Austmont

CATERING EQUIPMENT PTY LTD

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CONSTRUCTION AND FITOUT OF FOOD PREMISES - INSTALLATION CERTIFICATE & LETTER OF COMPLIANCE

Accredited Certifier

Re: Kitchen Consultant Statement

Subject Premises: Gunyama Park Aquatic and Recreation Centre

I hereby certify that the planned fitout of equipment and refrigeration in the above location complies with the National Food Code current at that time. This code is designed to comply with requirements of the NSW Pure Foods Act and Regulations and is adopted by Sydney and Metropolitan Council's -
A: Food Act 2003 and Regulations
B: FSANZ Food Standards Code
C: AS4674 – 2004 Design Construction and Fitout of Food Premises
D: The Protection of the Environment Operations Act 1997
E: Water Efficiency Labelling and Standards Act 2005 (WELS Act)

I am an appropriately qualified and competent person in this area and as such can certify that the design and performance of the design systems comply with the above and which are detailed on the attached drawings.

The kitchen layout is designed to maintain view lines throughout the food preparation area.

The cooking area with exhaust above faces back to back with the food preparation bench and has direct access to cool room and dry store.

A kiosk counter faces the wet lounge area of the outdoor pool concourse and the adjacent sliding door provides access to the pool concourse.

The servery with coffee station, Point of Sale and food display wraps around the centrally located food preparation area and faces foyer and seating area.

Wash up and wet area bench with pass through dishwasher and exhaust above are placed to provide easy access for incoming used dishes.

A separate temporary waste storage is provided with capacity to hold at least one day's of waste including cleaner's sink.

Hand-wash sinks are located near cooking and food preparation area and pigeon holes provide clean and dedicated storage for staff belongings.

An office nook is located between kiosk counter and servery.

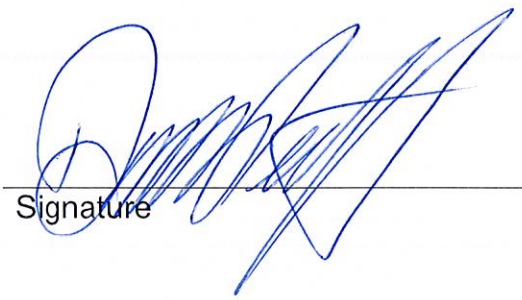
Finishes and detailed design are to meet the most recent issue of the relevant Australian Standards, Food Act and Food Safety Standard

Crèche Kitchenette
The Crèche Kitchenette is within the main crèche area. No food preparation is to be done within the crèche, there will be pre-prepared food serviced and re-heating facilities (microwave). Crèche is run by pool operators.
The crèche kitchenette provides a dishwasher and a designated hand wash sink to allow staff to serve food parents bring to the crèche.
Please refer to DA plans and attached briefing diagram for the extent of kitchenette area. The cleaners sink and extent of Kitchenette area to meet AS4674.

Mechanical exhaust is designed to reach the following flow rates:

- Mechanical Exhaust Café flow rate:
  - Exhaust: 2000 L/S
  - Point of release: Above green roof over café
- Mechanical Exhaust Creche Kitchenette
  - Exhaust 230 L/S
  - Point of release: roof above gym

Name of Designer:	Don Petroff
Qualifications:	Industry operator for 27 years
Company:	Austmont Catering Equipment P/L
Address:	21 Amax Avenue Girraween NSW 2145
Phone Number:	02 9896 3050
Fax Number:	02 9896 3059



Signature 2/6/16 Date

NORTH

GRAPHICAL SCALE

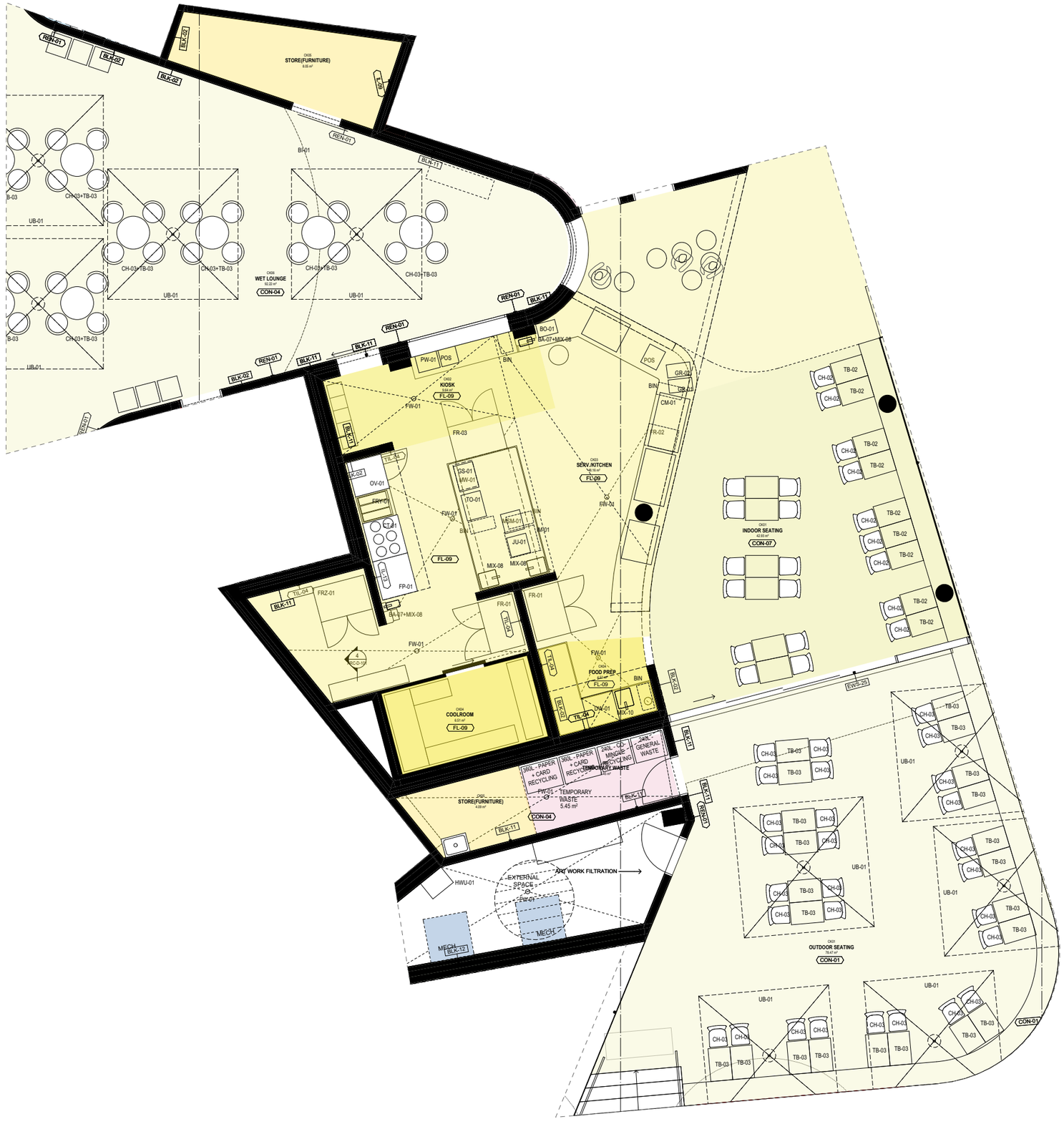
0 0.25 0.5 1 1.5 2 2.5m

GENERAL NOTES

ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED ON SITE BY THE CONTRACTOR BEFORE PROCEEDING WITH THE WORK.

DO NOT SCALE DRAWINGS. USE FIGURED DIMENSIONS ONLY

ALL LEVELS RELATIVE TO 'AUSTRALIAN HEIGHT DATUM'



EQUIPMENT SCHEDULE COMMERCIAL KITCHEN

BO-01	BOILING WATER UNIT
CM-01	COFFEE MACHINE
CT-01	COOK TOP
DW-01	DISHWASHER
FP-01	FLAT PLATE
FR-01	FULL HEIGHT FRIDGE
FR-02	UNDERBENCH MILK FRIDGE
FR-03	FULL HEIGHT DRINK FRIDGE
FRY-01	FRYER
GR-01	GRINDER
GR-02	GRINDER
GS-01	GRAVITY SLICER
HWU-01	HOT WATER UNIT
IM-01	ICE MACHINE
JU-01	JUICER
MW-01	MICROWAVE
MSM-01	MILK SHAKE MIXER
OV-01	OVEN
PW-01	PIE WARMER
TO-01	TOASTER

FINISHES SCHEDULE COMMERCIAL KITCHEN

FL-09	POLYVINYL FLOORING, WELDED SEAM (COMMERCIAL KITCHEN GRADE) SLIP RESISTANCE AND COVING TO AS4674
IL-13	FULL HEIGHT STAINLESS STEEL WALL PANELLING
TIL-04	CERAMIC WALL TILES - TYPE 4 WITH EPOXY GROUT KITCHEN WALLS

ALL KITCHEN WALLS TO BE OF SOLID CONSTRUCTION

CEILING FINISH TO BE SEALED IMPERVIOUS PAINTED PLASTERBOARD

3000L IN-GROUND GREASE ARRESTOR LOCATED WITHIN FOOTPATH - REFER TO ARC-DA-102 AND HYDRAULIC ENGINEER'S DETAILS

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

ARC-DA-RBD
CAFE AND KIOSK

DRAWN:	IA/MD
CHECKED:	NR
SCALE:	1:100 @ A3
FIRST ISSUE:	

DRAWING NO — REV

ARC-DA-RBD-01 A

DEVELOPMENT APPLICATION

NORTH

GRAPHICAL SCALE

0 0.25 0.5 1 1.5 2 2.5m

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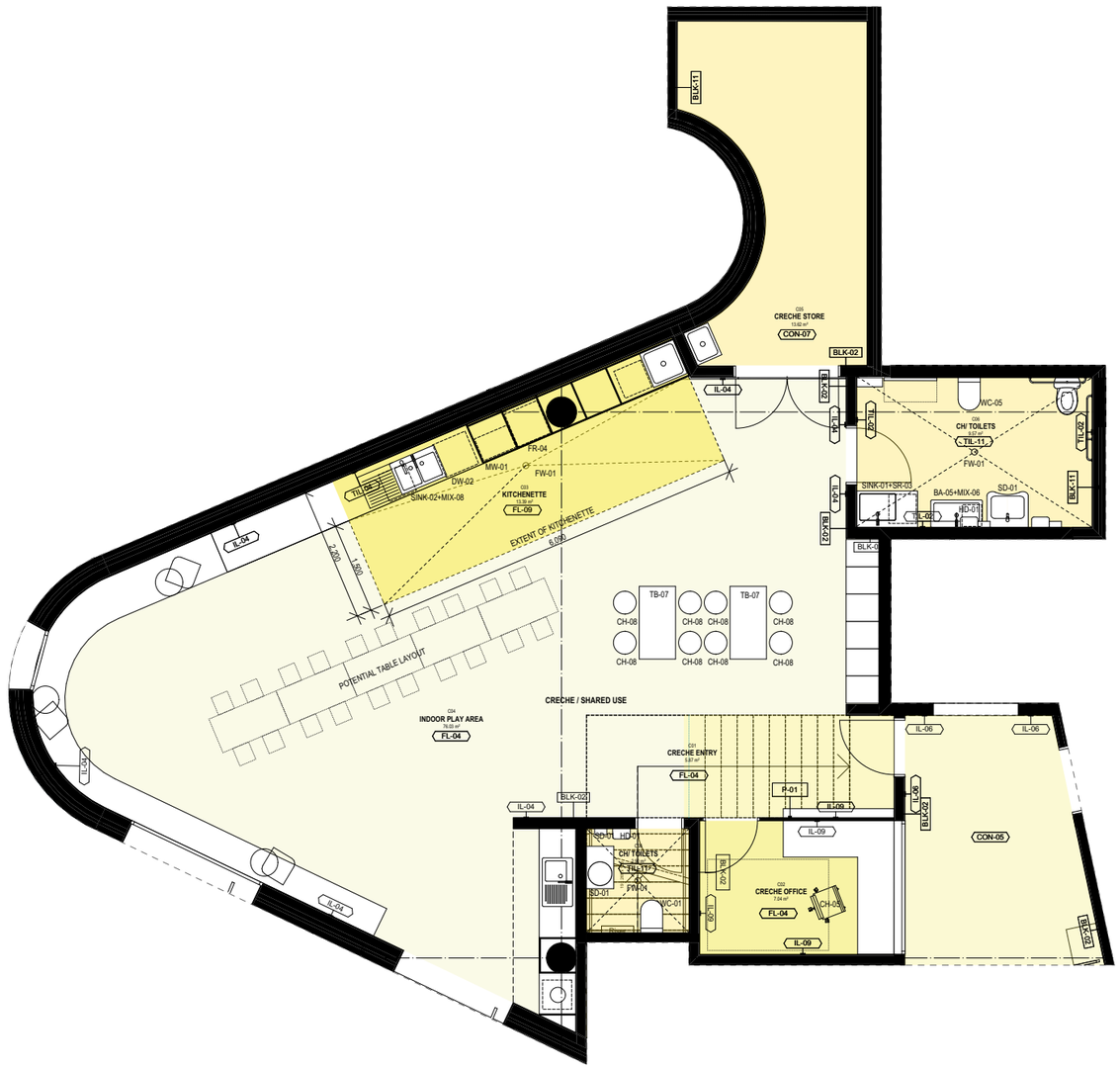

FINISHES SCHEDULE - CRECHE KITCHENETTE

FL-09	POLYVINYL FLOORING, WELDED SEAM (COMMERCIAL KITCHEN GRADE) SLIP RESISTANCE AND COVING TO AS4674
IL-13	FULL HEIGHT STAINLESS STEEL WALL PANELLING
TIL-04	CERAMIC WALL TILES - TYPE 4 WITH EPOXY GROUT KITCHEN WALLS
FW-01	FLOOR WASTE (COMMERCIAL KITCHEN GRADE)

ALL KITCHEN WALLS TO BE OF SOLID CONSTRUCTION

CEILING FINISH TO BE OF SEALED IMPERVIOUS PAINTED PLASTERBOARD

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Zetland NSW 2017
Australia

TITLE

ARC-DA-RBD
CRECHE / SHARED USE

DRAWN: IA/MD
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FIRST ISSUE:

DRAWING NO: ARC-DA-RBD-02
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31 May 2016

Vertical Transportation Development Application Statement – Gunyama Park Aquatic and Recreation Centre

We are writing with reference to the vertical transportation design for the development at Gunyama Park Aquatic and Recreation Centre, Green Square, NSW which consists of:

1 x 1800kg / 24 passengers lift serving the concourse level and gym primarily for special use DDA access.

We hereby certify that the above vertical transportation system has been designed in accordance with acceptable industry engineering and design practices. The elevator system will incorporate facilities for persons with disabilities and stretcher access requirements.

It is the intent of the Vertical Transportation specification that the equipment and installation shall conform to the requirements of all relevant codes and standards issued by recognised Codes, Standards and Legislative bodies applicable including but not limited to:

- AS 1735 – Lifts, Escalators and Moving Walks
- AS 1735.1 – General Requirements
- AS 1735.2 – Passenger and goods lift – Electric (For reference in the event of silence or ambiguity within AS1735.1 and code referenced within)
- AS 1735.11 – Fire-rated landing doors
- AS 1735.12 – Facilities for persons with disabilities
- AS 4431 – Guidelines for Safe Working on New Lift Installations in New Constructions
- Building Code of Australia 2016

- AS 1428.2 – Design for Access and Mobility; Part Two: Enhanced and Additional Requirements – Buildings and Facilities
- AS1428.4 – Design for access and mobility - Means to assist the orientation of people with vision impairment - Tactile ground surface indicators
- EN10088.2 – Stainless Steel Finishes
- EN50214 – Flexible Cables for Lifts
- AS1530 – Methods for fire tests on building materials, components and structures AS1657 – Fixed platforms, walkways, stairways and ladders - Design, construction and installation
- AS1670.4 – Fire detection, warning, control and intercom systems - System design, installation and commissioning - Sound systems and intercom systems for emergency purposes
- AS1100 – Technical Drawings
- AS 2118.1 – Automatic Fire Sprinkler Systems
- AS/NZ 3000: Electrical Installations (known as the Australian/New Zealand Wiring Rules). Wiring requirements for lift installations
- AS/NZ 3008 – Electrical Installations – Selection of Cables – Cable sizes for lift installations
- ISO 7465 – Passenger lifts and service lifts -- Guide rails for lift cars and counterweights
- ISO 9001 – Quality Systems

We confirm the vertical transport solution developed is adequate for the proposed development and is in line with industry design criteria and standards.

We trust the information meets with your requirements however should you have any questions or would like to discuss further any aspect of the above please feel free to contact me.

Yours sincerely

Paul Sullivan
Engineer - Vertical Transportation

About this document

This document is the Design Statement for the Gunyama Park Aquatic and Recreation Centre prepared for the City of Sydney on behalf of ABA Grimshaw Architects.

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1. Context

There are multiple methods to measure and model the population of activity areas within GPARC. For the benefits of Council and the design team @leisure have produced estimated annual visitor numbers for each of the key activity areas.

These numbers can guide key design issues and support the work of other consortia that have produced details on BCA regulations, peak bather loads and maximum daily bather loads.

The annual visitor numbers will represent the 'average' occupancy for each area. The 'maximum' will be based on BCA regulations and the 'minimum' for each is zero.

Appendix 1 shows the various sources and assumptions that support the data.

Base Data

A 2km catchment from the centre was used as the base figures for this study. An additional 5% of the population living between 2km and 5km was also added.

As the GPARC will have multiple offerings, including a 50m pool, the catchment was extended further. However it should be acknowledged there are also multiple competing venues within a 10km radius of the site.

Forecasted population figures for 2021 and 20131 were used, provided from the Bureau of Transport Statistics for NSW. 2021 was used in agreement with Council, as it was the closest year to the proposed 2019 opening date for GPARC.

There is likely to be significant demand from local workers who do not live in the immediate vicinity. This has been addressed by adding 20% of the total workers within a 2km catchment. This allows for the multiple employment categories in the source data and typical consumer habits.

Table 1 shows a summary of the population base data.

Table 1: Population base data

Base Data	2021 Population Projection	2031 Projected Population
2km catchment from GPARC	94,797	116,672
5% of the 5km catchment from GPARC	19,089	21,444
20% of 2km worker catchment from GPARC	11,955	13,479
Total population for study calculations	125,841	151,595

Activity Areas

Visits to each of the GPARC's various activity areas were estimated for 2021 and 2031. These were calculated using data from Australian Bureau of Statistics (ABS) and Exercise Recreation and Sports Statistics (ERASS) [2 & 3 – See References section]. The following sections provide a summary for each main area. Appendix 1 shows the various sources and assumptions that support the data further.

2. Estimated Visitation

Outdoor Activity Areas

The following table shows the estimated users per annum for the key visitable outdoor facilities that will be provided at GPARC in 2021 and 2031.

Table 2: Outdoor activity area visitations

Outdoor Activity Area	Estimated Visits 2019	Estimated Visits 2031
Multipurpose Synthetic Field	184,548	203,002
Perimeter Circuit Path	435,330	535,796
Fitness Stations	43,966	53,222
Barbeque Facilities	17,724	24,360
Total Outdoor use	**681,568**	**816,380**

The Park User Study details how a well-programed synthetic field will show high utilisation for a range of sporting activities (it should be noted the visitor number is reduced due to the dimension of the proposed synthetic surface). The expected increase in the local population by 2031 is likely to result in more casual/ social use of the synthetic field without programed hours.

Walking and jogging have some of the highest exercise participation rates in NSW with 33.5% and 8.8% respectively. If there is a dedicated internal circuit path of 475lm and an external park perimeter path of 730lm it is likely to attract significant use.

If the fitness station areas are well equipped and positioned, they are likely to receive considerable use.

Should two BBQ stations be provided in sheltered, visually appealing and well lit/safe locations throughout the site they are likely to attract high usage from the local residents, business community and sporting groups.

Swimming Activity Areas

The following table shows the estimated users per annum for each of the swimming activity areas. The sources and further assumptions are outlined in Appendix 1.

Table 3: Swimming activity area visitations

Swimming Activity Area	Estimated User Visits in 2021	Estimated User Visits in 2031
Indoor leisure water	93,212	112,264
Outdoor leisure water	39,948	48,113
Indoor 25m program pool	106,899	137,445
Outdoor 50m pool	167,543	202,798
Hydrotherapy pool	33,120	39,330
Total Swimming User Visits	440,722	539,949

Although many users may visit several activity areas on each visit these numbers have attempted to reflect their main purpose for attending the centre (e.g. exercise, social/casual play, swimming lesson etc.).

Indoor Physical Activity Areas

Table 4 shows the estimated users per annum for the main indoor physical activity areas. These are based on participation rates and local catchment where possible. A probable program for the Spin was considered to estimate visitation in this area.

With an estimated 22.4% of adults taking part in fitness or aerobics activities on average 1.5 times per week, these facilities are likely to be in high demand.

It should be noted that this is a highly competitive market, with numerous competing providers and although the increase in local population will increase visitor numbers it will not be linear as the fitness rooms are likely to reach capacity at peak times.

Table 4: Health & fitness visitations

Health & Fitness Area	Estimated User Visits in 2021	Estimated User Visits in 2031
Gym, cardio room, dry fitness studio	288,015	347,202
Spin room	14,560	17,472
Weights room	27,638	33,317
Total Health and Fitness Visits	330,213	397,992

Total Centre Visits

Based on the above the total number of visits per year for indoor and outdoor aquatics and fitness (no outdoor activity areas) is shown below.

Table 5: Project Centre visits

	2021	2031
Total estimated from sources for GPARC	770,935	937,941

Peak Attendance

Based on other CoS Aquatic Centres (Cook and Phillip Park Aquatic Centre, Ian Thorpe Aquatic Centre and Victoria Park Pool), there is a relatively flat overall attendance throughout the year. Therefore the monthly average of visits is estimated to be approximately 64,250 in 2021.

There is potential to have peaks at different activity centres e.g. increased outdoor swimming use in summer, however depending on geographical considerations this may not always be the case e.g. more people may choose to go to the beach etc.

Based on previous projects and @leisure staff experience we have assumed that the maximum attendance at swimming activity centres in a 1-month period will be between 14.5% to 16.66% of the annual attendance (approximately 80% to 100% additional loading versus the average), and 9% to 12.5% for health and fitness activity centres (35% to 50% additional loading versus the average).

The lower limit being for areas that are likely to reach maximum capacity during peak periods of the day.

These figures can be used as a guide, but should be updated as the design and management model develops.

It should be noted the busiest month for each activity area is likely to differ.

The peak week was calculated based on being a maximum of 30% of a peak month.

Saturday is likely to be the busiest day at each activity centre (based on benchmarking and @leisure staff experience). We have assumed that the maximum 1-day attendance at any swimming activity centre will be between 1% and 1.16% of the annual attendance and between 0.75% and 0.87% for health & fitness areas (both approximately 25% to 30% of a peak week).

The following tables shows the estimated peak monthly, weekly and daily visits at indoor activity centres:

Table 6: Monthly peak visitations

Activity Area	Estimated Peak Visits 2021	Estimated Peak Visits 2031
Indoor leisure water	15,529	18,703
Outdoor leisure water	6,655	8,016
Indoor 25m program pool	17,809	22,898
Outdoor 50m pool	24,294	29,406
Hydrotherapy pool	5,518	6,552
Gym, cardio room, dry fitness studio	25,921	31,248
Spin room	1,820	2,184
Weights room	3,455	4,165

Table 7: Weekly peak visitations

Activity Area	Estimated Peak Visits 2021	Estimated Peak Visits 2031
Indoor leisure water	4,659	5,611
Outdoor leisure water	1,997	2,405
Indoor 25m program pool	5,343	6,870
Outdoor 50m pool	7,288	8,822
Hydrotherapy pool	1,655	1,966
Gym, cardio room, dry fitness studio	7,776	9,374
Spin room	546	655
Weights room	1,036	1,249

Table 8: Daily peak visitations

Activity Area	Estimated Peak Visits 2021	Estimated Peak Visits 2031
Indoor leisure water	1,081	1,302
Outdoor leisure water	463	558
Indoor 25m program pool	1,240	1,594
Outdoor 50m pool	1,675	2,028
Hydrotherapy pool	384	456
Gym, cardio room, dry fitness studio	2,160	2,604
Spin room	127	152
Weights room	282	337

Conclusion

The actual number of GPARC users will be determined by a number of factors including management model, programing, marketing, and promotional activities, competing facilities and the GPARC design features.

What can be determined by this study is that there is a large potential market and the centre is likely to be in high demand based on likely catchment and state exercise participation statistics.

3. Multipurpose playing field

The provision of a multiuse synthetic turf playing field is recommended. This is due to the likely profile of the population and associated demand for social sports. Where there is limited availability and high demand for social and club competition sport, limited space can be dealt with by the construction of a synthetic playing field.

There are a number of field setup arrangements options. The sports identified as being able to be accommodated and most compatible are generally: social, junior or modified forms of Rugby league, Soccer-football, and AFL:

A) 1 Large footprint field (90m * 65m + over runs) with halfway line orientated north south:

- Soccer football (C or D grade)
- Touch rugby/League Tag/ Mod League
- Australian Rules football (5yrs. Mini-kick and Aus-Kick)
- Rugby Union – minis and junior
- Hockey – minis and junior

B) 2 Small footprint fields (50m x35 m + over runs orientated east west:

- Oz/League Tag League
- 7 aside Soccer---football
- Multiple Small Sided Football games.

Support facilities

To support the use of an artificial sport field by community, school, clubs and corporate sports providers, some basic support facilities are provided pitch side. These include:

- Referee/program table
- Storage
- Accessible first aid facilities (could be located within the leisure centre)
- Undercover area
- Accessible toilet
- Toilet and change rooms
- Lighting (that meets sport code specifications).

These amenities are well grouped into one central amenity block conveniently located adjacent to the playing field

Based on the types and program of use for the park, we the estimate a mean average of up to 90 users in the park at one time. Three female toilets and one male toilet with an additional 2 urinals, and a unisex accessible toilet and change are therefore appropriate. In accordance with the Access to Premises Standards an ambulant accessible toilet cubicle in each male and female toilet block is also provided.

Two small team change rooms (unisex) are provided that can be used as a home and away team change for example, when the pitch is being used by single gender players, or as one male and one female change otherwise. We assume that the bulk of field users will be male, and a higher proportion of park users will be female (fitness and families with children), hence a 50% /50% apportionment of space is reasonable.

The support facility provides a table which can be set up with views over the pitch for (management/ programming), a central shelter for field users, and drinking and wash station (outside change rooms).

Fencing and field netting

In accordance with feedback received from Key Park User Groups through consultation, a permanent fence/ back net (25m in width, 7m in height) is provided along the north and south of the synthetic multipurpose sports field.
It is not proposed to provide one set of permanent goals posts in the surface, due to the need to run at least two games east west in peak times, and to accommodate multiple sports codes with different fields dimensions. Temporary goals are stored beneath the timber terrace and seating edge at the north and south end of the sports field, with access through hatches.

Perimeter path circuit

A perimeter circuit path around the park and green space, with trees or vegetation on each side, provides a trail-for running, skating and children's small-wheeled toys. Residents, employees, personal trainers, sports clubs, as well as events, will use this track for fitness and training. This facility could generate more than 3,000 visits per week, almost as many users as the sports field.

In addition, the boardwalk terrace and seat edge has considerable merit as a place to sit, relax, and watch activity around the field and for general circulation.

Fitness station

A fitness station with combination exercise equipment is provided at the north end of the park adjacent Zetland Avenue, acting as a destination in its own right, without necessarily forming part of the path network. The fitness station will have the capacity to allow use by personal trainers and use from multiple people at the one time (subject to the City's appointed Operators lease and license arrangements with regards to commercial personal trainers).

References

1. Southern Area Wet & Dry Leisure Centre Business Feasibility Study – SGL Group 2007

2. Australian Bureau of Statistics (ABS) 2012

- 4177 - Participation in Sport and Physical Recreation New South Wales 2011-12
- 4901 - Children's Participation in Cultural and Leisure Time Activities

3. Australian Sports Commission 2010 - Exercise Recreation and Sports Statistics (ERASS)

- Frequency of participation in physical activities
- Frequency of participation in non-organised physical activity
- Frequency of participation in organised physical activity

4. Bureau of Transport Statistics for NSW

- Population Forecasts
- Employment Forecasts

Appendix 1: Sources and Assumptions

Population Projections

Population Forecasts

Forecasted population figures for 2021 and 2031 were used, provided from the Bureau of Transport Statistics for NSW, September 2014 release. In both years the age range was from 0 to 85, inline with likely participation limits.

The Bureau of Transport Statistics for NSW Workforce forecasts, September 2014 release, was used as a base for employee numbers in the GPARC catchment. 20% of this total number was used in calculations to allow for those who are residents already captured in population forecasts, the reduced parking and to allow for consumer habits e.g. employees who will be members of a gym close to their home etc.

Catchments

A 2km catchment from the centre was used. Several industry indicators recognise that a large percentage of an aquatics users will be from within this catchment. As the GPARC will have multiple offerings, including a 50m pool, the catchment was extended further to include 5% of the population from 2km to 5km. There are several competing facilities within this catchment and parking availability at GPARC may be limited at peak times, making the centre less attractive for families or visitors who can not easily access the Centre by public transport, therefore it was assumed 5% is a fair estimate.

A catchment of 2km was allowed for the workforce as it is assumed users are unlikely to travel further than this.

Outdoor Activity Area	Sources and Assumptions
Multipurpose Synthetic Field	Figure based on Park User Study, Estimated Program – Option 1B. Additional 10% allowance in 2031 for increased usage through local population increase.
Perimeter Paths for Running & Walking	2km population catchment of 15 to 85 year olds X participation rates for walking. 2km population catchment of 19 to 54 year olds X participation rates for running/jogging. To allow for high use of alternate local routes ABS Frequency reduced to an average of once per week and 25% of full potential local participation in 2021 and 2031.
Fitness Stations	Allowance for 9.5 visits to fitness stations per hour x average 13 hours per day (11.5 visits in 2031).
Barbeque Facilities	Based on 3 BBQ facilities being utilized 22 times per week each during a 32 week 'peak' and 7 times a week during 20 weeks off-peak. Average of 7 users per visit. Increased to 28/week peak and 9/week off-peak in 2031.

Swimming Activity Area	Sources and Assumptions
Indoor leisure water	• Total catchment x state swimming participation rates • ABS frequency allowance of 0.6 visits per week (supposed by the Southern Area Wet & Dry Leisure Centre Business Feasibility Study) • Private use & competing facility reduction factor (30%) • Estimated ratio of indoor to outdoor casual use 70:30 • 35% of pool users will use leisure pool for social activities/play (based on Southern Area Wet & Dry Leisure Centre Business Feasibility Study)
Outdoor leisure water	• Local catchment x state swimming participation rates • ABS frequency allowance of 0.6 visits per week (supported by the Southern Area Wet & Dry Leisure Centre Business Feasibility Study) • Private use & competing facility reduction factor (30%) • Estimated ratio of outdoor to indoor casual use 30:70 • 35% of pool users will use leisure pool for social activities/play (based on Southern Area Wet & Dry Leisure Centre Business Feasibility Study)
Indoor Program 25m pool	• Total catchment x state swimming participation rates • ABS frequency allowance of 0.6 visits per week (supported by the Southern Area Wet & Dry Leisure Centre Business Feasibility Study) • Private use & competing facility reduction factor (30%) • 65% of pool users are likely to swim for exercise/learn to swim so likely to use lap pools - Southern Area Wet & Dry Leisure Centre Business Feasibility Study. • Estimated 65% will use outdoor facilities due to 50m length - 35% indoor 25m • Additional school use based on 200 school visits per week over 32 weeks (50% in 25m pool). • Learn to swim program - 20,000 conservative annual visits based on benchmarking (allowing for other visits to be captured in participation rates). 30,000 in 2031 due to increase in local catchment of young children.
Outdoor 50m pool	• Total catchment x state swimming participation rates • ABS frequency allowance of 0.6 visits per week (supported by the Southern Area Wet & Dry Leisure Centre Business Feasibility Study)

Swimming Activity Area	**Sources and Assumptions**
	• Private use & competing facility reduction factor (30%) • 65% of pool users are likely to swim for exercise/learn to swim so likely to use lap pools - Southern Area Wet & Dry Leisure Centre Business Feasibility Study. • Estimated 65% will use outdoor facilities due to 50m length - 35% indoor 25m • Additional school use based on 200 school visits per week over 32 weeks (50% in 50m pool) • Club users of 75 per week for 48 weeks (125 per week allowance in 2031)
Hydrotherapy pool	Based on average of 8 users per hour, with 12 hours a day use by 345 days per annum. This assumes the facility can be used for paid clinical clients attending with a physiotherapist and it is also open for public use.

Indoor Physical Activity Areas	**Sources and Assumptions**
Gym, cardio room, dry fitness studio	Local catchment x ERASS participation rates. Frequency of 1 visit per week assumed on average. Due to the nature of the gym and fitness industry a 75% reduction for competing facilities was allowed in both 2021 and 2031. A further reduction of 2.5% assumed due to lack of parking at peak times.
Spin room	4 classes per day x 10 participants per class. Increased to 12 participants per class in 2031.
Weights room	Local catchment x ERASS Weightlifting Participation. Average use once per week. Due to the nature of the gym industry a 75% reduction for competing facilities was allowed inn both 2021 and 2031.

Peak Attendance Calculations

Overall attendance at the centre is likely to be relatively flat if criteria like price, design, quality of service etc. meet customer demands. A flat attendance rate would be 8.33% of the total visitations. Based on previous projects and @leisure staff experience we have assumed that the maximum attendance at the swimming activity centres in a 1-month period will be 16.66% of the annual attendance (100% additional loading versus the average). We reduced this for the outdoor 50m pool to 14.5% to allow for reduced use at peak times each day e.g. lap lanes likely to reach capacity.

This method allows for the potential significant variation in the indoor versus outdoor use during seasonal weather changes. It should be noted that it is unlikely that the indoor and outdoor pools would be at peak attendance at the same point.

Health and fitness activities are less effected by weather or seasonal variation, however there is potential for peaks e.g. during promotions, New Year resolutions etc.

The peak week was calculated by allowing 30% of a peak month.

Saturday is generally the busiest day across the industry and we have assumed that a 25% to 30% loading of a peak week would form a peak day.

City Of Sydney

Gunyama Park Aquatic and Recreation Centre

Structural Statement

006 STR REPT

Issue 5 | 27 May 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 240516-10

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ARUP

Document Verification

ARUP

Job title		Gunyama Park Aquatic and Recreation Centre		**Job number** 240516-10
Document title		Structural Statement		**File reference**
Document ref		006 STR REPT		
Revision	**Date**	**Filename**	0006 STR design brief.docx	
Issue 1	18 Dec 2015	**Description**	First Issue – issued with 50% DD	
			Prepared by	Checked by	Approved by
		Name	Jane Nixon	Jane Nixon	
		Signature			
Issue 2	4 Mar 2016	**Filename**	0006 STR rev 1 design brief.docx	
		Description	Updated following further design development and comments from City of Sydney	
			Prepared by	Checked by	Approved by
		Name	Jane Nixon/ Marouf Raza	Jane Nixon	
		Signature			
Issue 3	1 Apr 2016	**Filename**	0006 STR rev 1 design brief 100per DD.docx	
		Description	Updated for 100% DD	
			Prepared by	Checked by	Approved by
		Name	Jane Nixon/ Marouf Raza	Jane Nixon	
		Signature			
Issue 4	13 May 2016	**Filename**	0006 STR rev 1 design brief DA.docx	
		Description	Development Application	
			Prepared by	Checked by	Approved by
		Name	Jane Nixon/ Marouf Raza	Jane Nixon	
		Signature			
			Issue Document Verification with Document		✓

Document Verification

Job title		Gunyama Park Aquatic and Recreation Centre			**Job number** 240516-10
Document title		Structural Statement			**File reference**
Document ref		006 STR REPT			
Revision	**Date**	**Filename**	0006 STR rev 1 design brief DA 160526.docx		
Issue 5	27 May 2016	**Description**	Development Application with CoS comments incorporated		
			Prepared by	Checked by	Approved by
		Name	Jane Nixon/ Marouf Raza	Jane Nixon	
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
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		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ✓

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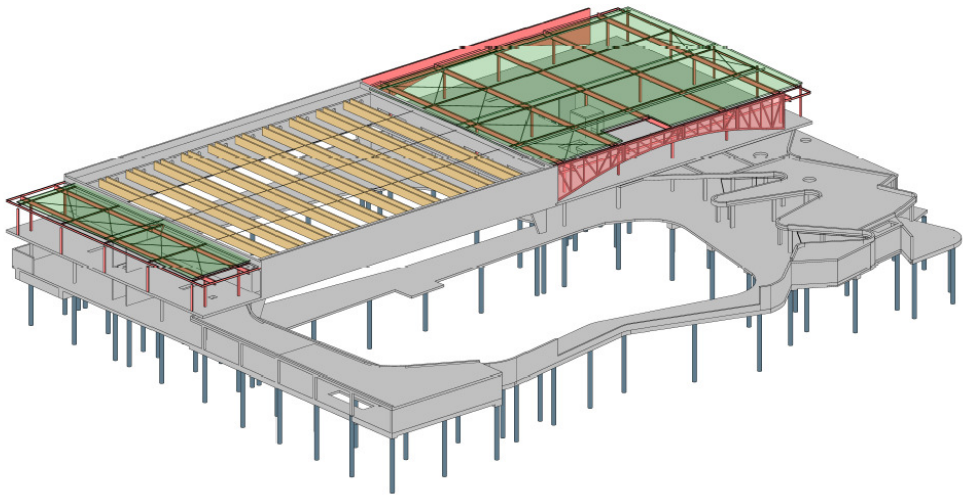
4.1 Codes and Standards 5

1 Introduction

This report describes the structure and systems used to form the Building Structure for Gunyama Park Aquatic and Recreation Centre.

Design of the pool and tanks structure is by the Aquatics Engineer.



3D view of building structure

2 Ground Conditions

The site consists of a 1.2m to 4.5m of uncontrolled fill with natural soils encounter at RL of 14-16m for a depth of 12.5 to 16m. Natural soils are loose to very dense sand plus layers of interbedded Sand and Clay layers. Low to medium strength sandstone is then not encountered till approx. an RL of 2.4m.

The water table measured at about 2m below existing ground level, with advised design water table at about existing ground level, RL 18m.

A geotechnical report has been carried out by Douglas Partners “Report on Additional Geotechnical Investigation Green Square Heath and Recreation Centre”, project 73743.02, dated March 2016.

3 Structural system

The building structure is a reinforced concrete frame, stabilised by shear wall and frame action.

General building data;

Concourses:	Suspended structure surrounding pools, 110m x75m
Low rise Mounds	reinforced concrete, 3.6m tall, 35m x35m

Aquatics Building and Gym	Concrete frame with post-tensioned floors
	Single level with no basement
	Generally 9.6x9m grid
	Overall 110m long x41m wide, with 10.3m height
	Structure set out to provide 47m x36m column free space over indoor pools

3.1 Concourse and foundations

Due to poor soil conditions on site and possible future settlement if prepared subgrade is provided, the concourse level has been designed as a suspended reinforced concrete slab supported on piles.

Based on current geotechnical information piles will need to be socketed into class II/III rock and will approximately be 18-20m from existing ground level.

Pile set out to support the ground floor has been set out on an approx. 9x9.6m grid to align with the grid of columns supporting gym floor. This is then carried out over the concourse and external areas considering column layout in these areas.

The concourse structure will be reinforced concrete consisting of band beams spanning in the north south direction supporting a one way slab spanning in the east west direction.

Retaining walls on the perimeter of the pool complex retain soil where the level has been raised above ground level.

3.2 Junction with Pool Structure

Overall the intent is to have the concourse/building structure structurally independent to the pool structure. The pool structure will have strict requirements on differential movements and shrinkage so intent is to keep structures separated.

3.3 Buildings over café area and plant room

The buildings at either end of the 50m pool are formed by a reinforced concrete slab supported on a series reinforced concrete piers on 7to 9m grid (approx.) within the architectural walls/set out.

Depth of soil over these areas is to be limited to 300-400mm to minimise loading on structural slab, and detailed to ensure adequate drainage and avoid water build up within the planter box.

3.4 Level 1 gym structure

The gym floor consists of a post tension flat plate slab. Slab and column thickness is determined to achieve the required dynamic performance and maximise flexibility of use of areas within the gym.

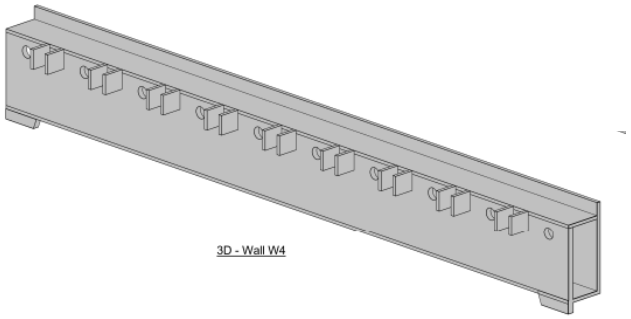
The design has been carried out in accordance with "AISC; Design Guide 11 – Floor Vibrations Due to Human Activity". Design is based on the assumption that the main activity in the gym area is aerobic loading and space is not used for group dancing or concerts.

3.5 Structural Blade walls

The roof and level 1 service walkways is supported by a pair of concrete blade walls running the full length of the building in the north south direction. These blade walls are designed and optimised to achieve long span architectural intent adjacent to the indoor 25m pool.

Both the inner and outer blade wall are structural and tied together to form a box section and stabilise the walls across the span. The walls have been designed as story high beams with post tensioning used to control deflection.

This box is supported by eccentric blade walls aligned with the inner blade wall. Eccentricity and twist in the system is then taken out by transverse walls at either end of the opening over the pool.



Inner and outer wall form box section to efficiently span 47m.

Walkway slab and gutter slab tie walls together for form box and stabilise walls across spans.

3.6 Fire stairs

Fire stairs will be of reinforced concrete with appropriate fire separation from the occupied spaces

3.7 Roof structure

Roof rafters across the pool hall are formed by timber rafters/beams, spanning 36m across the pool hall and supported by the concrete structural blade walls.

Timber makes an ideal material for the corrosive pool environment and performs well in a controlled relatively moist environment that is created in the indoor pool hall.

Currently design is based on Glulam engineered timber rafters - Glulam GL13 Radiata pine. Timber will need to be coated to protect timber from exposure during construction as well as for the long term pool and interior environments.

Roof structure over gym and southern plant area will be light weight steel framing.

3.8 Lateral stability

Overall lateral stability is provided by 200mm thick reinforced concrete shear walls between concourse and gym level both with in the northern front of house area and the southern back of house area. The lift shaft will also assist in stability.

Cross bracing is provided in the roof under areas of metal roofing to stabilise the roof and rafters back to the north/south blades. East/west lateral loading will be transferred to the Gym level through portal action of the blade walls and roof.

3.8.1 Seismic design

The structure has been designed as an Importance Level 2 structure under earthquake loading. Therefore, the following parameters have been used:

- Annual probability of exceedance (BCA Table B1.2b) - 1:500
- Site sub soil class - Ce
- Site Hazard Factor - 0.08
- Earthquake design category - II

3.9 Park amenities building

This is a single story building with a light weight steel roof supported by columns or blockwork blade walls. A retaining wall is provided along one side to support landscaping adjacent to the building. The foundation of the building consists of screw piles into sand.

4 Design codes and References

The design and documentation of the building and associated works shall comply with all relevant Australian Standards and the Building Code of Australia (BCA).

Standard Specifications or Codes of the British Standards Institute (BS) or the American Society for Testing and Materials (ASTM) or other are referenced only when a relevant Standards Australia publication does not exist.

Current editions of all codes and standards shall apply.

4.1 Codes and Standards

The following codes and standards will form basis of structural design

AS/NZS 1170.0	Structural design actions – general principles
AS/NZS 1170.1 actions	Structural design actions – Permanent, imposed, and other
AS/NZS 1170.2	Structural design actions - Wind actions
AS 1170.4	Structural design actions – Earthquake actions in Australia
AS 1720.1	Timber Structures Code - Design Methods
AS 2121	Cold Formed Steel Structures Code
AS 2159	Piling code
AS/NZS 2312	Guide to the protection of structural steel against atmospheric corrosion
AS 3600	Concrete Structures Code
AS 3700	Masonry Code
AS 3735	Concrete Structures for Retaining Liquids
AS 4100	Steel Structures Code
AS 5100	Bridge design
BS 5950-8	Structural use of steelwork in building – Code of practice for fire resistant design
Eurocode 4	Design of composite steel and concrete structures
BCA	Building Code of Australia

AISC; Design Guide 11 – Floor Vibrations Due to Human Activity

Your ref
Our ref 230735/JNN
File ref 007 Str letter

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City of Sydney
C/o Grimshaw
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Millers Point, NSW 2000

27 May 2016

Dear Sir

C16116 Gunyama Park Aquatic and Recreation Centre
Structural Design Certificate

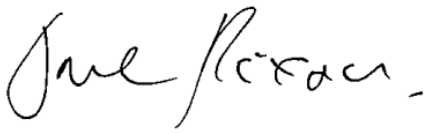
We (Arup) are providing structural engineering services to City of Sydney in relation to the Gunyama Park Aquatic and Recreation Centre development. Notwithstanding anything to the contrary contained in this certificate we are obliged to exercise reasonable skill and care in the performance of our Services under the Appointment and we shall not be liable except to the extent that we have failed to exercise reasonable skill and care and this certificate shall be read and construed accordingly, and in particular shall be subject to the terms and conditions of the Appointment.

We certify that we have prepared plans, specifications and other drawings (refer to the attached list) for the Project and the same have been prepared in accordance with the relevant Australian Standards and Codes of Practice, The Building Code of Australia, and the relevant Australian Standards listed below;

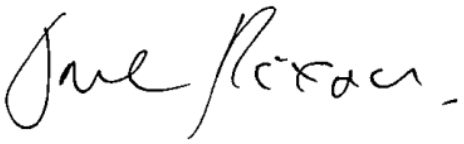
AS1170
AS2159
AS3600
AS3700
AS4100

I am an appropriately qualified and competent person in this area being listed in the National Professional Engineers Register (NPER) and as such can certify that the design and performance of the design systems comply with the above and which are detailed on the following drawings:

See attached drawing register dated 01/04/2016

Full Name of Designer:	Jane Nixon
Qualifications.:	MIEAust CPEng NPER (no 2319664)
Address of Designer:	Level 10, 201 Kent Street, Sydney NSW 2000
Contact Details:	Tel: 9320 9320 Fax: 9320 9321 Email: jane.nixon@arup.com
Name of Employer:	Arup Pty Ltd
Signature:	

Yours sincerely



Jane Nixon

TRANSMITTAL

ARUP

Project	Project No	Sht
Gunyama Park Aquatic and Recreation Centre	240516	1

Structures

Send by: Email and Newforma

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Company	Attention	No. of copies
ABA	Gero Heimann	1
Grimshaw	Nard Buijs	1

Structures

DAY	01
MONTH	04
YEAR	16

ID	Title	Revision
ST-0000	Cover Sheet	03
ST-0001	Drawing Notes - Sheet 1 of 2	03
ST-0002	Drawing Notes - Sheet 2 of 2	03
ST-0005	Costing Notes	03
ST-0010	Loading Plan - Ground Floor Level	03
ST-0011	Loading Plan - Lower Roof Level	03
ST-0012	Loading Plan - Level 1	03
ST-0013	Loading Plan - Roof Level	03
ST-0020	Reinforcement Lap Table	03
ST-0030	Typical Suspended Slab Details	03
ST-0040	Typical RC Wall Details sheet 1	03
ST-0041	Typical RC Wall Details sheet 2	03
ST-0050	Typical Blockwork Details - Sheet 1	03
ST-0051	Typical Blockwork Details - Sheet 2	01
ST-0060	Typical Post Tension Details Sheet 1	03
ST-0061	Typical Post Tension Details sheet 2	03
ST-0062	Typical Post Tension Details sheet 3	03
ST-0070	Typical Stair Details	03
ST-1010	General Arrangement - Piling / Foundations	03
ST-1020	General Arrangement - Ground Floor Level	03
ST-1021	Typical Ground Floor Details- sheet 1	02
ST-1022	Typical Ground Floor Details- sheet 2	02
ST-1025	Proposed Ground Slab Construction Sequence	01
ST-1030	General Arrangement - Lower Roof Level	03
ST-1031	Level 1 General details	02
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Issue authorised by:	J N N

Purpose of Issue:	A = Approval P = Preliminary T = Tender I = Information C = Construction	P

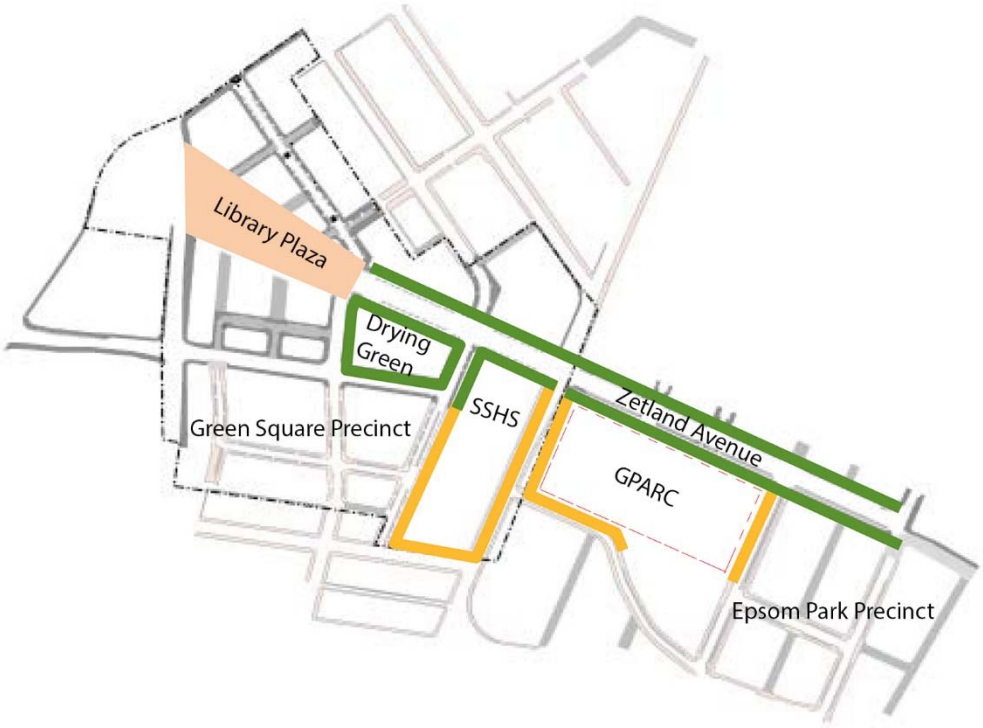
PAVING APPROACH TO STREETS SURROUNDING THE GPARC SITE

Background

Gunyama Park Aquatic and Recreation Centre (GPARC) sits within the Epsom Park Precinct and is bound by streets on three sides and in part on the fourth. The GPARC project will be responsible for delivering a portion of Rose Valley Way (north side only). All other roads surrounding the site will be delivered and paid for by others. An overview of the streets and delivery responsibilities are outlined below:

- Zetland Avenue (new) to the north, to be delivered by the City of Sydney's Green Square Infrastructure team.
- Joynton Avenue (rebuild) to the west, to be delivered by the City of Sydney's Green Square Infrastructure team.
- George Julius Avenue (new) to the east, to be delivered through `Works in Kind' by future developer(s).
- Rose Valley Way (new) to the south, to be delivered by GPARC (north side of street only). The remainder will be delivered as `Works in kind' by future developer(s).

The current concept design for the Epsom Park Precinct paving palette proposes two different treatments to footpaths, kerbs, and parking bays in the streets surrounding the GPARC site, as indicatively shown in the diagrams below.

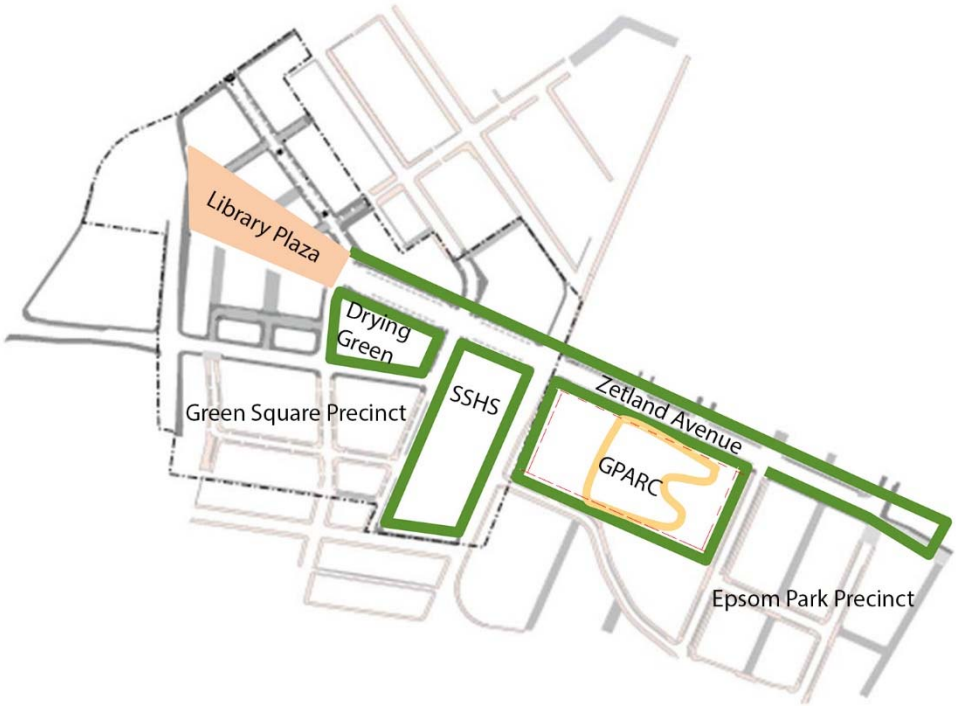


Current paving palette – Green Square and Epsom Park Precinct public domain footpaths. Source: City of Sydney



Current paving palette – GPARC site and surrounding streets.
Source: TCL (extract from presentation to the Design Advisory Panel 15 September 2015)

Proposed approach for consistent paving treatment
To unify the key community spaces along Zetland Avenue, a consistent high quality paving palette is proposed to the perimeter of each site, including the Drying Green, South Sydney Hospital Site (SSHS) and GPARC. This paving approach spans two precincts (Green Square and Epsom Park) and will require localised modifications to the material palette in each as shown in the diagram below.



Proposed paving palette – Green Square and Epsom Park Precinct public domain footpaths.
Source: City of Sydney



Proposed paving palette – GPARC site and surrounding streets.
Source: TCL (extract from presentation to the Design Advisory Panel 15 September 2015)

A consistent paving treatment to the footpaths surrounding the GPARC site will:

- Unify the site
- Acknowledge the importance of the community facilities and civic nature of the site
- Make the GPARC public domain consistent with other projects in the precinct (Zetland Avenue, the Drying Green, and the former South Sydney Hospital site community campus)

The proposed approach for a consistent paving treatment around the GPARC site was endorsed by the Design Advisory Panel on 15 September 2015. Minutes from this meeting are included in the DA package (Advice Sheet 38/ 2015 of Design Advisory Panel meeting 15 September 2015).

The developer of the site on 84-92 Epsom Rd has also accepted this approach and adopted the proposed paving for their forecourt pavement interface with the GPARC site, ensuring a full loop around the site.

Proposed departures from the Epsom Park Precinct Public Domain Concept Design

The full material palette for footpaths, car parking bays, road kerbs, and gutters in the current Epsom Park Precinct concept design and the proposed departures from these are listed in the tables below.

<u>Rose Valley Way, northern side of street, within GPARC boundary, between corner of Joynton Avenue and 84-92 Epsom Rd</u>

	ROSE VALLEY WAY	
	CONCEPT DESIGN - ISSUE D Epsom Park Precinct	**PROPOSD APPROACH** **Green Square Infrastructure Team**
FOOTPATH	Insitu concrete 'Green' - PV2	**Concrete unit paving - PV1**
PARKING BAY	Trihex Charcoal - PV5	*No change*
KERB	Concrete Kerb - KB2	*No change **
GUTTER	Concrete gutter - G1	*No change*

Joynton Avenue – eastern side of street, between corners of Zetland Avenue and Rose Valley Way

	JOYNTON AVENUE - CORNER OF ROSE VALLEY WAY		JOYNTON AVENUE - CORNER OF ZETLAND AVENUE	
	CONCEPT DESIGN - ISSUE D Epsom Park Precinct	**PROPOSD APPROACH** **Green Square Infrastructure Team**	CONCEPT DESIGN - ISSUE D Epsom Park Precinct	**PROPOSD APPROACH** **Green Square Infrastructure Team**
FOOTPATH	Concrete unit paving - PV1	*No change*	Concrete unit paving - PV1	*No change*
PARKING BAY	*N/A*	*N/A*	*N/A*	*N/A*
KERB	Concrete Kerb - KB2	**Blue Stone Kerb - KB1 ***	Blue Stone Kerb - KB1	*No change*
GUTTER	Concrete gutter - G1	*No change*	Concrete gutter - G1	*No change*

Zetland Avenue – southern side of street, between corners of Joynton Avenue and George Julius Avenue

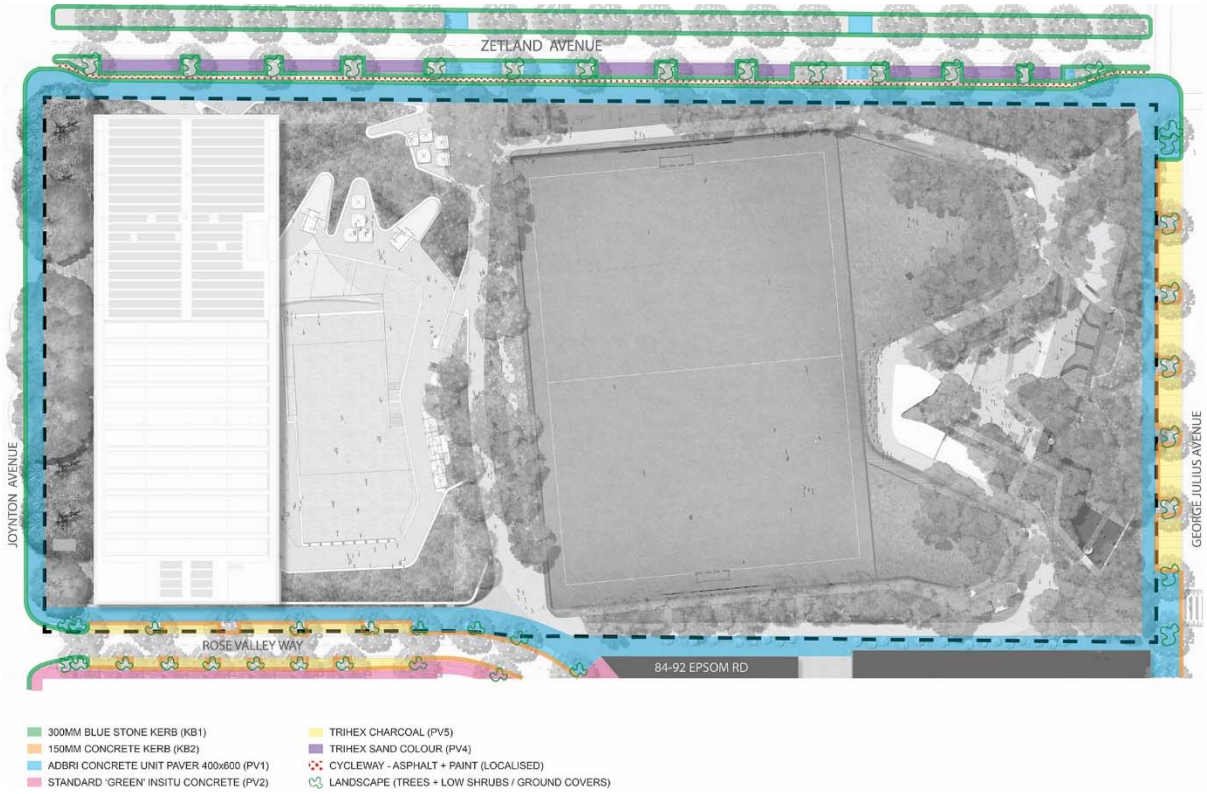
	ZETLAND AVENUE	
	CONCEPT DESIGN - ISSUE D Epsom Park Precinct	**PROPOSD APPROACH** **Green Square Infrastructure Team**
FOOTPATH	Concrete unit paving - PV1	*No change*
PARKING BAY	Trihex Sand colour - PV4	*No change*
KERB	Blue Stone Kerb - KB1	*No change*
GUTTER	Concrete gutter - G1	*No change*

George Julius Avenue – western side of street, between corners of Zetland Avenue and 94-104 Epsom Rd

	GEORGE JULIUS AVENUE	
	CONCEPT DESIGN - ISSUE D Epsom Park Precinct	**PROPOSD APPROACH** **Green Square Infrastructure Team**
FOOTPATH	Concrete unit paving - PV1	*No change*
PARKING BAY	Trihex Sand colour - PV4	*No change*
KERB	Concrete Kerb - KB2	*No change **
GUTTER	Concrete gutter - G1	*No change*

* Kerb transition approach

The current concept design for Epsom Park Precinct public domain shows a 300mm blue stone kerb along Zetland Avenue and returning into the northern corner of Joynton Avenue. A 150mm concrete kerb is shown for Rose Valley and returning into the southern corner of Joynton Avenue. It is proposed that the blue stone kerb is applied throughout Joynton Avenue and returns into Rose Valley Way where it transitions to a 150mm concrete kerb at the parking bays as shown on the plan below.
The Epsom Park Precinct public domain concept design also shows a 150mm concrete kerb on George Julius Avenue. It is proposed that the 300mm blue stone kerb on Zetland Avenue returns into George Julius Avenue and then transitions to a 150mm concrete kerb at the parking bays as shown on the plan below.



Detailed paving palette and kerb transitions proposed for streets surrounding the GPARC site
Source: ABA graphic on background site plan by TCL



Gunyama Park Aquatic and Recreation Centre

Statement of Environmental Effects

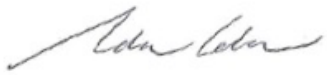
June 2016

mecone

Project Director

Adam Coburn

Signed*



……..

Date: 9 June 2016

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* This document is for discussion purposes only unless signed and dated by the persons identified. This document has been reviewed by the Project Director.

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Executive Summary

Overview

This Statement of Environmental Effects (SEE) report supports a development application to City of Sydney Council for the proposed Gunyama Park Aquatic and Recreation Centre development located at 132-140 Joynton Avenue, Zetland (the site). The preparation of the SEE and lodgment of the development application has been undertaken for Andrew Burges Architects (ABA) and Grimshaw Architects, on behalf of City of Sydney as the landowners.

This statement describes the proposed development of the site and surrounding area in the context of relevant planning controls and policies applicable to the form of the development proposed. In addition, the statement provides an assessment of those relevant heads of consideration pursuant to section 79C of the *Environmental Planning and Assessment Act 1979* (EPAA).

The SEE is also supported by a number of professional consultant reports, drawings, and management plans, as outlined in the Appendices list.

Proposed Development

This application seeks approval for the development of an indoor and outdoor aquatic and recreation centre and park. Gunyama Park Aquatic and Recreation Centre will service the growing Green Square community and will include:

- Clearing of site and removal/demolition of structures;
- Site earthworks;
- Construction of the an Aquatic and Recreation Centre, which will contain
    - A 50m heated outdoor pool;
    - A 25m indoor program pool;
    - A heated outdoor leisure pool;
    - An indoor leisure pool;
    - An indoor hydrotherapy pool;
    - An indoor crèche;
    - A licensed café;
    - An indoor health and fitness centre and outdoor balcony;
- Construction of Gunyama Park including
    - An outdoor playground;
    - An outdoor synthetic sports field;
    - An outdoor skate bowl and skate moments;
    - An outdoor fitness station;
    - Park amenity buildings
    - BBQ areas; and
    - Native landscaping.

The estimated cost of development for the proposal is approximately $79,268,535 excluding GST.

The summary of the proposal is provided in Table 1 below.

Table 1. Summary of Proposed Development	
Item	Total
Gross Floor Area	5,545m^2
Site Area	28,693sqm
FSR	0.19:1
Height	RL 30.4

Environmental Assessment

An environmental assessment has been undertaken in Section 4 of this report, supported by additional consultant studies as per the requirements of Council. Refer to Section 4 for the full Environmental Assessment.

The environmental assessment found that the associated impacts of the proposal are considered to be minimal and manageable. Hence, the proposal:

- Is a suitable development for the subject site;
- Responds to the future street alignment and the desired built form;
- Will include the Aquatic and Recreation Centre which will be developed to meet the standards of 5 Star Green Star development;
- Includes ESD measures to reduce water and energy consumption;
- Improves the public domain;
- Provides native landscaping to improve the natural environment; and
- Provides increased recreational areas for the Green Square and surrounding community.

In accordance with Section 79C of the Act, the assessment of the proposal is found:

- To be wholly suitable for the site;
- In the public interest; and
- To be consistent with the provisions of the relevant LEP and DCP.

Therefore, based on the above outcomes and a high quality outcome for the site and the Sydney City Council area, we recommend that the proposed development be approved by Council.

1 Introduction

This Statement of Environmental Effects (SEE) report has been prepared for Andrew Burges Architects (ABA) and Grimshaw Architects on behalf of City Property to support a Development Application (DA) to Sydney City Council (Council) for an aquatic and recreation centre and park on the site located at 132 – 140 Joynton Avenue, Zetland (the site).

The SEE includes an assessment of the proposed works in terms of the matters for consideration as listed under Section 79C of the *Environmental Planning and Assessment Act 1979* (EPAA) and should be read in conjunction with information annexed to this report as outlined in the Table of Contents.

Specifically, the SEE includes the following information:

- Description of the site in its local and regional context;
- Identifies the proposed works;
- Identifies and addresses all relevant Council controls and policies;
- Identifies the potential environmental impacts of the proposal; and
- Provides measures for minimising or managing the potential environmental impacts.

The DA seeks approval for the construction of Gunyama Park Aquatic and Recreation Centre. The proposed development will generally include the following works:

- Clearing of site and removal/demolition of structures;
- Site earthworks;
- Construction of the an Aquatic and Recreation Centre, which will contain
    - A 50m heated outdoor pool;
    - A 25m indoor program pool;
    - A heated outdoor leisure pool;
    - An indoor leisure pool;
    - An indoor hydrotherapy pool;
    - An indoor crèche;
    - A licensed café;
    - An indoor health and fitness centre and outdoor balcony;
- Construction of Gunyama Park including
    - An outdoor playground;
    - An outdoor synthetic sports field;
    - An outdoor skate bowl and skate moments;
    - An outdoor fitness station;
    - Park amenity buildings
    - BBQ areas; and
    - Native landscaping.

Turner and Townsend on behalf of the client has calculated the cost of development for the proposal to be $79,268,535. An environmental assessment of the proposal is provided in Section 5 of this report.

1.1 Proponent and Project Team

The Development Application and SEE Report have been prepared on behalf of the applicant, the City of Sydney. The project team is shown in Table 2 below.

Table 2. Project Team

Item	Consultant
Architect & Head Design Consultant	ABA & Grimshaw Architects
Urban Planning	Mecone
Traffic	GTA Consultants
Landscape Architect	TCL
Quantity Surveyor	Turner and Townsend
Stormwater Management and WSUD	CJ Arms & Associates
Flooding	HydroStorm Consulting
Flora & Fauna	Ecological Consultants Australia
Energy Efficiency/Environmental Management	Surface Design
Arborist	Earthscape Horticultural Services
Geotechnical	Douglas Partners
Contamination	AECOM
BCA	BCA Logic
Accessibility	BCA Logic
Waste Management Plan	ARUP
Waste Management Plan	ARUP
Reflectivity	Surface Design
Plan of Management	City Greening and Leisure/City Operations
Heritage	John Oultram Heritage and Design
Security Management	City Security

Table 2. Project Team	
Item	Consultant
PV and Cogeneration	City Green Infrastructure
Lighting	ARUP
Signage	Extrablack
Public Art	Jonathan Jones
Erosion & Sediment Control	CJ Arms & Associates
Construction Management Plan	Grimshaw Architects

1.2 Background

This DA has been prepared following a design competition, which was held by Council. This was a two stage competition in which Stage 1 was an open and anonymous design competition with all entries assessed by a jury. Five finalist entries were invited to participate in Stage 2 of the Design Competition, all lodging their Stage 2 schemes on 26 August 2014. The jury reviewed each proposal between 8-9 September 2014, and the scheme proposed by ABA was unanimously chosen as the winning design. The concept was to translate the ocean pools of Sydney into an inner city suburb, and the Jury was impressed with how this had been successfully implemented.

2 The Site

2.1 Site Location

The site is located at Joynton Avenue, Zetland bounded by Joynton Avenue to the west, the future Rose Valley Way to the south, the future Zetland Avenue to the north, and the future George Julius Avenue to the east. The future address will be to Zetland Avenue, following new road construction and lot orientations. The subject site is inclusive of a number of properties legally known as Lot 1 DP 850686, Lot 2 DP 850686, Lot 100 DP 1200645, Lot 101 DP 1200645, and Lot 1 DP 830870. However, the development will not utilise the entirety of all these lots, as seen in Figure 1 below. The site has a total area of 28,693sqm. The development will be delivered in stages relative to lot ownership, as shown on the staging plan located within the architectural set at Appendix 1.



Figure 1 – Property boundaries and development area
Source: Google Maps modified by Mecone

The site is located approximately 4km south of the Sydney CBD and 4km north of Sydney Airport. The subject site is located within the Sydney Central Subregion, as identified under the NSW Department of Planning & Environment's *A Plan for Growing Sydney* (see Figure 2). This Plan outlines how Sydney will grow into the future, where growth corridors and transport upgrades will be delivered, and how the environment can be protected. Green Square is identified as a strategic centre in the Central Subregion. The Green Square Town Centre is earmarked for 4000 new dwellings and 90,000sqm of commercial and retail floor space, whilst the entire suburb's population is expected to reach 61,000 by 2030. The site is located within the Global Economic Corridor, which extends from Macquarie Park through the Sydney CBD and to the Airport and Port Botany. The Global Economic Corridor generates over 41% of the NSW Gross State Product and contains a heavy concentration of knowledge jobs in sectors of education, communications and emerging industries such as biotechnology.

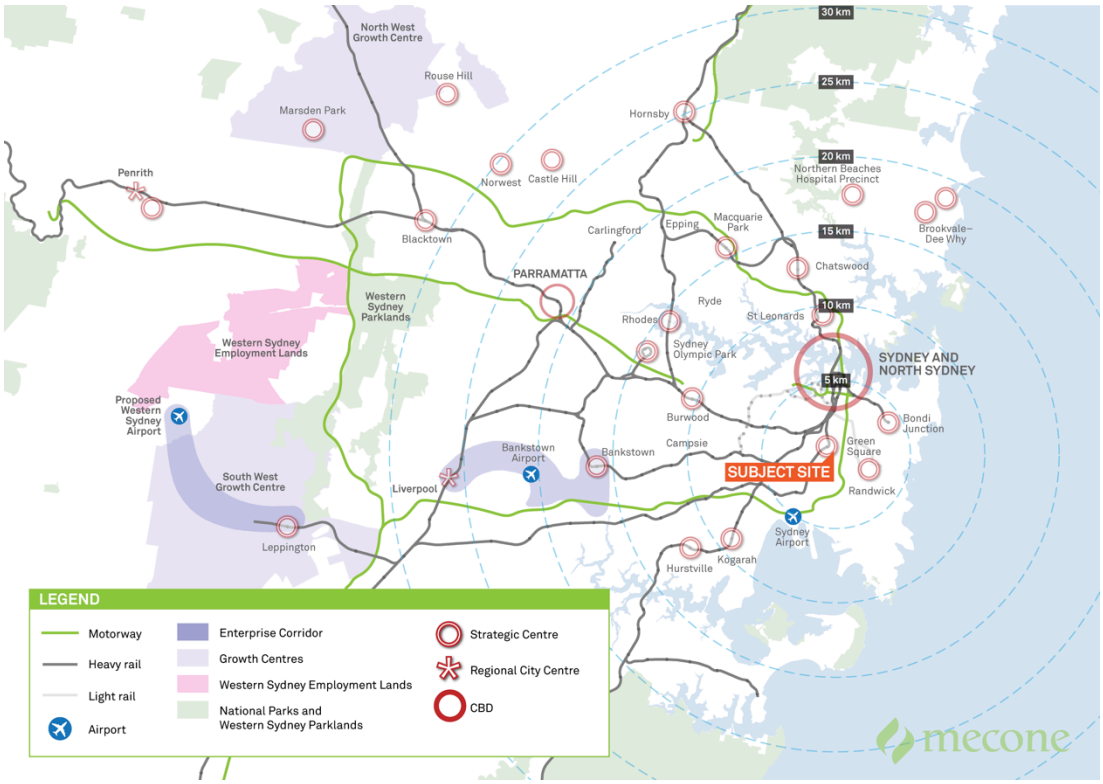


Figure 2 – Regional Context Diagram
Source: Mecone

In a local context, the site is located within the Green Square Urban Renewal Precinct, which includes the suburbs of Beaconsfield and Zetland, and parts of Rosebery, Alexandria and Waterloo. This precinct is primarily industrial in nature but is in transition, with major residential and commercial development projects having recently been completed or currently taking place. The site of the future Gunyama Park Aquatic and Recreation Centre will be located directly southeast of the future Green Square Town Centre, 500m from the Green Square railway station. The Green Square local area is growing significantly in population due to ongoing development, and there is likely to be an additional 5,000 residents living in the area by the time the Gunyama Park Aquatic and Recreation Centre opens.

The site is also within 2km of important nearby establishments such as the University of New South Wales, Royal Randwick Racecourse, Sydney Park, and East Village shopping centre. Figure 3 below shows the local context of the site.



Figure 3 – Local context diagram
Source: Google Maps modified by Mecone

2.2 Site Description

Table 3 provides the legal description, and a brief summary of the site and surrounding context. In addition, a survey plan of the site is provided within the architectural set at Appendix 1.

Table 3. Site Description

Item	Description
Legal Description	Land owned by the City of Sydney Lot 2 DP 850686 (132 – 138 Joynton Avenue, Zetland) Lot 100 DP 1200645 (140 Joynton Avenue, Zetland) Lot 101 DP 1200645 (94 – 104 Epsom Road, Zetland) Land owned by Others Lot 1 DP 850686 (130 Joynton Avenue, Zetland) Lot 1 DP 830870 (106 – 116 Epsom Road, Zetland)
Total Area	28,693sqm
Location	Joynton Avenue, Zetland
Street Frontage	Future frontage of 155m metres to Zetland Avenue

Table 3. Site Description	
Item	**Description**
Site Description	The site is formerly industrial in nature, though structures have been largely demolished. The Joynton Avenue frontage features some significant planting however otherwise the entire site has been concreted or built over, with only scattered vegetation. Uses include storage, warehouses and car parking.
Previous uses	The site has been predominantly used for industrial purposes.
Surrounding Context	Surrounding buildings are mixed, including industrial buildings, residential and commercial uses. These uses are slowly changing to medium density residential as part of the ongoing development of Green Square.
Public Transport	530m to Green Square railway station (T2 Airport, Inner West and South Line) 15-100m to Bus Stops ▪ 301 Sydney – Eastgardens ▪ 343 Daceyville – Sydney – Chatswood ▪ 348 Wolli Creek – Bondi Junction ▪ 370 Leichardt - Coogee ▪ M20 Artarmon – Botany Future light rail link proposed from Green Square to surrounding suburbs and CBD.

Site analysis images are provided at Appendix 1, within the architectural design plans.

Pictures of the site and the surrounding development context is presented in the following figures.



Figure 4 – Area of site used as car storage
Source: Mecone



Figure 5 – Opposite site to west (Joynton Avenue)
Source: Mecone



Figure 6 – Adjoining site to north
Source: Mecone



Figure 7 – Joynton Avenue Streetscape View
Source: Mecone

3 The Proposal

3.1 Development Summary

ABA have provided the design for the proposed development. The proposed development will generally include the works identified in the table below.

Table 4. Summary of Proposed Development

Item	Total
Gross Floor Area	5,545m^2
Site Area	28,693sqm
FSR	0.19:1
Height	RL 30.4

Refer to Appendix 1 for detailed architectural plans of the proposed development. Figure 8 and Figure 9 provide elevations and a photomontage of the proposal, which are also found within the architectural plans.

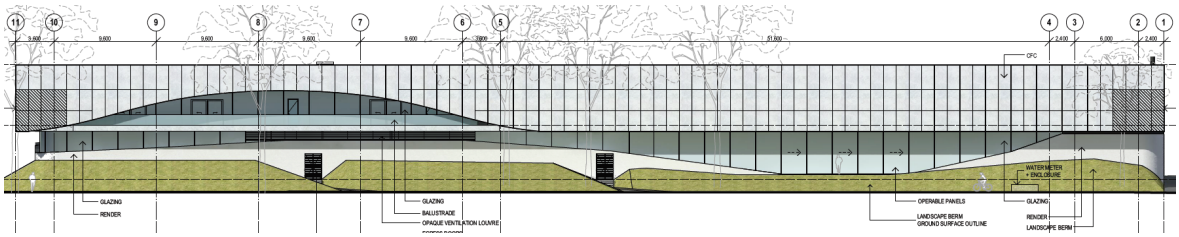


Figure 8 – Elevation (West)
Source: ABA



Figure 9 – Internal Photomontage of pool hall
Source: ABA with Doug & Wolf

3.2 Proposed Use and Details of Operation

Management plans have been provided by the City of Sydney for both Gunyama Park and the Aquatic and Recreation Centre (see Appendix 24 and Appendix 25). These provide further information relating to the proposed uses and operational details. Key items relating to uses and operation, as detailed within the Plan of Management, are discussed in the sections below.

3.2.1 Aquatic and Recreation Centre

The Building Management Plan for the Aquatic and Recreation Centre outlines how the centre is to be managed and operated safely, and addresses:

- Permitted uses;
- Occupancy numbers;
- Hours of operation;
- Safety and security;
- Noise;
- Responsible service of alcohol;
- Waste management; and
- Access and movement.

There are three modes in which people will engage in activities at the Aquatic and Recreation Centre; drop in/casual, where individuals and families decide to visit on a case by case basis; Program, where users pre-commit through a registration process to a series of uses involving some instruction and at a predetermined time; and Rental/Hire, where a group rent a space and controls the users and use. Included as part of the centre will also be a licensed food and drink premises (café), which will serve snacks, refreshments, light meals and beverages.

The Aquatic and Recreation Centre will operate 7 days a week, except for on Good Friday and Christmas Day, with potential early closures or later openings over the Christmas and New Year periods and Anzac Day. The proposed hours are:

Aquatic and Recreation Centre (including fitness area) – indoor and outdoor

<u>Staff setting up and closing:</u>	
Monday to Friday	5.00am – 11.30pm
Saturday, Sunday and Public Holidays	5.30am – 9.30pm
<u>Customers using the building:</u>	
Monday to Friday (indoor)	5.30am – 11.00pm
Monday to Friday (outdoor)	5.30am – 10.00pm
Saturday, Sunday and Public Holidays	6.00am – 9.00pm

Café – indoor and kiosk

<u>Staff setting up and closing:</u>	
Monday to Friday	6.00am – 11.30pm *
Saturday, Sunday and Public Holidays	6.30am – 9.30pm *

*subject to external operator or centre management

Customers using the building:

Monday to Friday	6.30am – 10.00pm
Saturday, Sunday and Public Holidays	7.00am – 8.00pm

It is noted that the Building Management Plan places restrictions on noise-generating equipment, game control devices or activities in the outdoor. These restrictions will be in place before 7:00am and after 9:00pm on weekdays (non-daylight savings), before 8:00am and after 8:000pm on weekends and public holidays (non-daylight savings), before 7:00am and after 10:00pm on weekdays (during daylight savings), and before 8:00am and after 9:00pm on weekends and public holidays (during daylight savings).

The Centre will be managed during all operating hours by skilled staff, qualified in facility management, maintenance, and programming and community development. The Building Management Plan states that on average there will be between 25-35 staff in the building at one time.

The final Building Management Plan will confirm the maximum number of people permitted within the Centre at any one time.

3.2.2 Gunyama Park

The Gunyama Park Management Plan provides management and maintenance objectives to be undertaken by the City of Sydney, as well as operational information. Key operational policies include:

- The need for formal bookings through the Council's Operator for organized use of the sports field;
- Availability for bookings of the sports field from 8am to 10pm Monday to Sunday, including public holidays;
- Electric barbecues which will be available for use without a booking, and will cease operation at 10pm;
- Public toilets and changerooms to be managed through a contracted service provider, opened at dawn and closed around sunset daily. Toilets/changerooms will be cleaned daily, and twice per day on weekends and school holidays;
- Safety features incorporated into the design such as illumination of the park perimeter and entrances after dark, park lighting along main pedestrian thoroughfares, regular monitoring of vegetation to ensure good sightlines, incorporation of CPTED principles into the design, routine inspections and more.

3.3 Built Form

Aquatic and Recreation Centre

The proposed built form of the centre will comprise various indoor and outdoor components, designed as beach pools inspired by the many beachside pools of Sydney.

The Aquatic and Recreation Centre is located at the western edge of the site, towards Joynton Avenue, and is setback 10m from Joynton Avenue in accordance with the required landscape setback. The centre will be 2 storeys in height, extending in a generally north-south orientation (lengthwise), and will comprise 'arching' of the façade to provide views outwards across the external swimming area and towards Gunyama Park through the eastern façade, and views to the tree canopies in the Joynton Avenue landscape setback from the west façade.

The interior of the centre will feature one 25m program pool, a health and fitness centre, one leisure water area, and one hydrotherapy pool. Internally, the centre will also feature a crèche, a café, staff offices and meeting rooms, storage and service rooms, as well as bathroom facilities, change rooms, and back of house/plant areas at ground floor levels.

The centre will be constructed with a flat roof, to be topped with solar panel systems and skylights providing natural light.

Directly adjoining the indoor centre to the east is the proposed outdoor swimming area at ground floor level. A 50m lap pool will be flanked by a smaller leisure pool to its northeast. The outdoor area will also feature change room facilities, spectator seating, offices, kiosk and service areas.

Entrance to the facility will be provided via two pedestrian forecourts, accessed from Zetland Avenue or Gunyama Park.

The built form is demonstrated in the photomontage at Figure 10 below.



Figure 10 – Proposed Aquatic and Recreation Centre built form
Source: ABA with Doug and Wolf

Gunyama Park

Gunyama Park has been designed to contain a synthetic sports field of 65m x 90m plus ball overruns (7,219m^2 in total), adjoined by natural grass areas, a playground, skate facilities, a fitness station, BBQ facilities, and park amenities and change rooms directly to the east of the Aquatic and Recreation Centre. A perimeter pathway encircles the park.

A planting strategy has been created with the objectives of maintaining clear sightlines, considering options for habitat, considering an indigenous planting palette, and considering aesthetics and maintenance. The planting strategy has adopted these objectives, and identified specific sub areas within the park and Aquatic and Recreation Centre which require specific planting approaches.

The park amenity buildings, proposed towards the eastern side of the park, will contain field change rooms, public toilets and a wash basin area, as well as storage for a BBQ, and tables and chairs.

Refer to Figure 11 for a photomontage of the proposed built form of the park.



Figure 11 – Proposed Gunyama Park outlook
Source: ABA with Doug & Wolf

3.4 Landscaping

The proposal results in positive landscaping outcomes for the site, such as increased permeable area, integrated WSUD, and planting of native vegetation. A number of shade tolerant species will be planted under the roofline of the Aquatic and Recreation Centre, contrasting the species chosen around the pool environment and rooftop. Separate species have also been chosen to surround the park and playground, as well as adjacent to the playspace. The Landscape Site Plan is shown below in Figure 12.



Figure 12 – Landscape Site Plan
Source: TCL

3.5 Access and Parking Provisions

The site is bounded by Joynton Avenue to the west, the future Rose Valley Way to the south, the future Zetland Avenue to the north and the future George Julius Avenue to the east. Whilst no car parking will be provided directly on site, the parking strategy for the site includes the provision of 30 x 90° angled spaces along the future George Julius Avenue directly adjoining the site, and on street car parking spaces (including one loading space) along the future Rose Valley Way. Loading areas, accessible parking bays, and bus drop-off/pick-up bays will be provided adjacent the site on the future Zetland Avenue.

Accessibility is also provided via the site's proximity to the Green Square railway station, and as the surrounding area redevelops new streets will improve permeability for local pedestrians and cyclists.

4 Planning Assessment

Mecone has undertaken an assessment of the proposal against the relevant planning and environmental legislation and guidelines to identify potential environmental impacts and mitigation measures, discussed within the following two sections of this SEE.

4.1 Integrated Development

The development is "Integrated Development" pursuant to Section 90 of the EP&A Act 1979, requiring concurrence from the Office of Water, as an activity approval is required under Section 91 of the Water Management Act 2000.

4.2 Environmental Planning Instruments (EPIs)

4.2.1 Sydney Local Environmental Plan 2012

The Sydney Local Environmental Plan (SLEP) 2012 is the primary local planning instrument applying to the site. The table below provides a summary of the key development standards that apply to the site under the SLEP 2012.

Figure 13 indicates the land use zone as per the relevant map in the SLEP 2012. An assessment of the relevant matters under SLEP 2012 is discussed in Table 5.

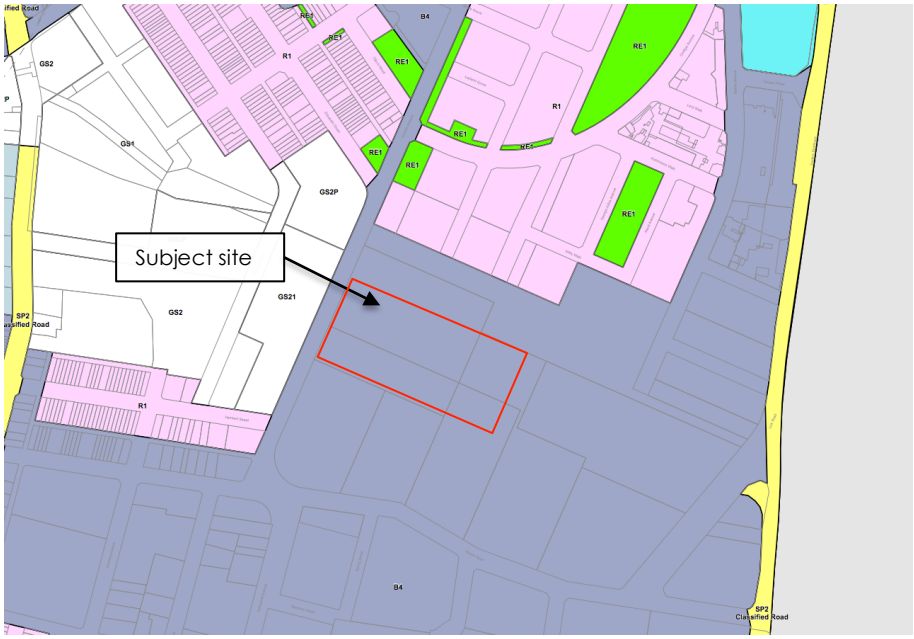


Figure 13 – Land use map
Source: NSW Legislation

Table 5. Summary of the key controls within the SLEP 2012		
Item	Provision	Compliance
Land use zoning (B4)	***1 Objectives of zone*** • *To provide a mixture of compatible land uses.* • *To integrate suitable business, office, residential, retail and other development in accessible locations so as to maximise public transport patronage and encourage walking and cycling.* • *To ensure uses support the viability of centres.* ***2 Permitted without consent*** *Home occupations* ***3 Permitted with consent*** *Boarding houses; Child care centres; Commercial premises; Community facilities; Educational establishments; Entertainment facilities; Function centres; Hotel or motel accommodation; Information and education facilities; Medical centres; Passenger transport facilities; Recreation facilities (indoor); Registered clubs; Respite day care centres; Restricted premises; Roads; Seniors housing; Shop top housing; Any other development not specified in item 2 or 4* ***4 Prohibited*** *Extractive industries; Heavy industrial storage establishments; Heavy industries*	**Complies.** The proposed development is consistent with the objectives of the zone which are: • *To provide a mixture of compatible land uses;* • *To integrate suitable business, office, residential, retail and other development in accessible locations so as to maximise public transport patronage and encourage walking and cycling;* • *To ensure uses support the viability of centres.* The development is defined as a *'recreation area'* and a *'recreation facility (indoor)'*. Both uses are permissible in the B4 Zone.
4.3 Height of Buildings	The maximum building height control varies for the site and includes 27m (T2) for the Aquatic and Recreation Centre and 3m (A) for the remainder of the site which includes Gunyama Park. 	**Does not comply.** The proposed Aquatic and Recreation Centre does not exceed 27m, however certain structures within Gunyama Park exceed 3m. As discussed below, a request for variation to this standard has been prepared under Clause 4.6 of the SLEP 2012.

Table 5. Summary of the key controls within the SLEP 2012

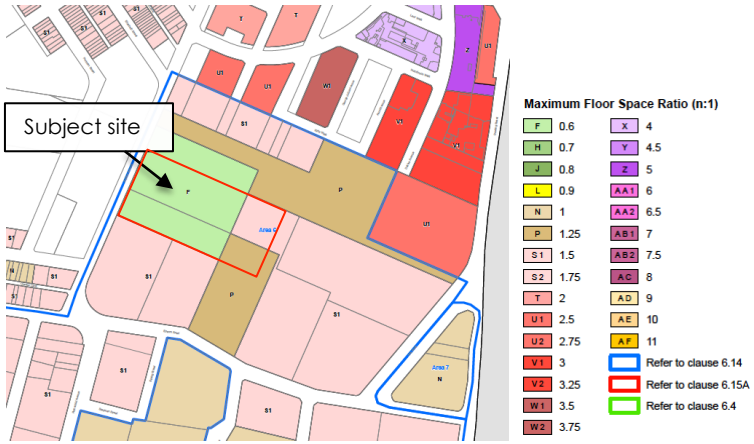
Item	Provision	Compliance
4.4 Floor space ratio	The following figure illustrates the Floor Space Ratio (FSR) applicable to the site. The FSR varies for the site which includes 0.6:1(F), 1.25:1 (P) and 1.5:1 (S1). The site also falls within 'Area 6' and therefore the site is eligible for an additional 0.5:1 (under Clause 6.14) if it includes development for the purposes of recreation areas, recreation facilities (indoor), recreation facilities (outdoor), public roads, drainage or flood mitigation works. The Aquatic and Recreation Centre itself is wholly located on land with an FSR of 0.6:1 (F). With the additional community infrastructure allowance of 0.6:1, the permissible FSR for the Aquatic and Recreation Centre is **1.1:1.** The park and associated structures resultantly have FSRs, when combined with the additional allowances under Clause 6.14, of **1.1:1**, **1.75:1**, and **2.0:1**. 	**Complies.** The calculated GFA of the development inclusive of the main building and park amenities is 5,545m^2. The site has an area of 28,693m^2 and the development therefore has an FSR of **0.19:1.** This is well below the lowest FSR control applicable to the site of 1.1:1.
4.6 Exceptions to development standards	Clause 4.6 provides flexibility in applying certain development standards to particular development. Development consent must not be granted for development that contravenes a development standard unless the consent authority has considered a written request from the applicant that seeks to justify the contravention of the development standard by demonstrating: (a) that compliance with the development standard is unreasonable or unnecessary in the circumstances of the case, and (b) that there are sufficient environmental planning grounds to justify contravening the development standard.	A request for a variation to a development standard is applied for, with respect to the height of building control of 3m. See Clause 4.2.2 of this SEE.

Table 5. Summary of the key controls within the SLEP 2012		
Item	Provision	Compliance
5.10 Heritage Conservation	(4) Effect of proposed development on heritage significance The consent authority must, before granting consent under this clause in respect of a heritage item or heritage conservation area, consider the effect of the proposed development on the heritage significance of the item or area concerned. This subclause applies regardless of whether a heritage management document is prepared under subclause (5) or a heritage conservation management plan is submitted under subclause (6). (5) Heritage assessment The consent authority may, before granting consent to any development: (a) on land on which a heritage item is located, or (b) on land that is within a heritage conservation area, or (c) on land that is within the vicinity of land referred to in paragraph (a) or (b), require a heritage management document to be prepared that assesses the extent to which the carrying out of the proposed development would affect the heritage significance of the heritage item or heritage conservation area concerned.	**Complies.** A comprehensive Heritage Impact Statement accompanies the DA at Appendix 16, prepared by John Oultram Heritage & Design, which should be read in conjunction with this SEE. No heritage issues that would preclude development on the site have been identified.
6.14 Community infrastructure	Additional floor space of 0.5:1 is permissible on sites within "Area 6" which provide community infrastructure, only if the development includes development for the purposes of recreation areas, recreation facilities (outdoor), recreation facilities (indoor), public roads, drainage or flood mitigation works.	**Complies.** Additional FSR allowances have been applied, as discussed under 4.4 – Floor Space Ratio.

Table 5. Summary of the key controls within the SLEP 2012		
Item	Provision	Compliance
6.21 Design Excellence	(4) In considering whether development to which this clause applies exhibits design excellence, the consent authority must have regard to the following matters: (a) whether a high standard of architectural design, materials and detailing appropriate to the building type and location will be achieved, (b) whether the form and external appearance of the proposed development will improve the quality and amenity of the public domain, © whether the proposed development detrimentally impacts on view corridors, (d) how the proposed development addresses the following matters: (i) the suitability of the land for development, (ii) the existing and proposed uses and use mix, (iii) any heritage issues and streetscape constraints, (iv) the location of any tower proposed, having regard to the need to achieve an acceptable relationship with other towers (existing or proposed) on the same site or on neighbouring sites in terms of separation, setbacks, amenity and urban form, (v) the bulk, massing and modulation of buildings, (vi) street frontage heights, (vii) environmental impacts, such as sustainable design, overshadowing and solar access, visual and acoustic privacy, noise, wind and reflectivity, (viii) the achievement of the principles of ecologically sustainable development, (ix) pedestrian, cycle, vehicular and service access and circulation requirements, including the permeability of any pedestrian network, (x) the impact on, and any proposed improvements to, the public domain, (xi) the impact on any special character area, (xii) achieving appropriate interfaces at ground level between the building and the public domain, (xiii) excellence and integration of landscape design.	**Complies.** The development is considered to display 'design excellence'. The proposal has been subject to the process of a design competition in accordance with subclause 5. The design development has also been reviewed at presentations to Council's Design Advisory Panel and Public Art Advisory Panel (refer to meeting minutes at Appendix 34).
7.14 Acid Sulfate Soils	The site is identified as containing 'Class 5' acid sulfate soils as indicated on the acid sulfate soils map. For Class 5 soils, development consent must not be granted for works within 500m of an adjacent Class 1, 2, 3 or 4 land that is below 5 metres AHD and by which the watertable is likely to be lowered below 1m AHD on adjacent Class 1, 2, 3 or 4 land, unless an acid sulfate soils management plan has been carried prepared.	**Complies**. The proposal is not within 500m of sites with Class 1-4 acid sulfate soils and will not lower the water table level below 1m AHD.

Table 5. Summary of the key controls within the SLEP 2012		
Item	Provision	Compliance
7.15 Flood planning	(2) This clause applies to land at or below the flood planning level. (3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development: (a) is compatible with the flood hazard of the land, and (b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and (c) incorporates appropriate measures to manage risk to life from flood, and (d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and (e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.	**Complies.** Flood modeling has been undertaken for the development and is discussed further within Section 5.3 of this SEE.
7.20 Development requiring preparation of a development control plan.	Clause 7.20(2)(b) of SLEP 2012 provides that development consent must not be granted to development on land greater than 5,000m2 unless a development control plan (DCP) has been prepared specifically for the land. Notwithstanding this, subclause 3 states: *(3) A development control plan is not required to be prepared if the consent authority is satisfied that such a plan would be unreasonable or unnecessary in the circumstances…"*	No DCP/Stage 1 DA has been undertaken. Discussed in further detail under Section 4.2.2 of this SEE.

4.2.2 Key SLEP 2012 Issues

Height of Buildings – Clause 4.3

The subject site is bound by two predominant height of buildings (HOB) controls, 27m for the Aquatic and Recreation Centre, and 3m for the area containing Gunyama Park.

A request for a variation to this development standard has been prepared accompanying this application, in accordance with the provisions of Clause 4.6 of the SLEP 2012, as structures within Gunyama Park will exceed 3m when measured from existing ground level.

The written request for an exception to the height standard under Clause 4.6 is considered to demonstrate that in the circumstances of the case:

- Compliance with the height standard is unreasonable and unnecessary;
- There are sufficient environmental planning grounds for the contravention;
- The development is in the public interest, being consistent with the objectives of the height standard and zone;
- The design has been subject to an intensive design excellence process; and
- There are no matters of State or regional planning significance and no public benefits in maintaining the height standard.

Clause 7.20 – Development requiring…a development control plan

Clause 7.20(2)(b) of SLEP 2012 provides that development consent must not be granted to development on land greater than 5,000m^2 unless a development control plan (DCP) has been prepared specifically for the land. Notwithstanding this, subclause 3 states:

> *(3) A development control plan is not required to be prepared if the consent authority is satisfied that such a plan would be unreasonable or unnecessary in the circumstances…"*

It is noted that pursuant to Section 83(C) of the EP&A Act 1979, the obligation to prepare a development control plan under any environmental planning instrument may be satisfied by the making and approval of a staged development application.

The application has not been lodged as a staged development application and does not follow the preparation of a site-specific DCP. Nevertheless, it is considered appropriate in this circumstance to progress directly to a development application, when considering:

- The international design competition that has been undertaken for the development, which considered macro and micro scale impacts in the built form considerations;
- The existing precinct-specific Sydney DCP 2012 Part 5.3 Green Square – Epsom Park ('the Epsom Park DCP'), which has given thorough consideration of land uses, setbacks, heights, pedestrian accessibility, landscaping, staging and local infrastructure both upon the site and across the broader precinct. The Epsom Park DCP envisages an Aquatic and Recreation Centre and park for this site, and the proposed development is in accordance with the DCP's key provisions as discussed in Section 4.3 of this SEE;

- The purpose of Clause 7.20, which is considered to be to guide large scale developments where multiple land uses and design options may be possible, requiring greater consideration of the various environmental impacts. Although the site is considerably large, the built form and scale of the development is at a human scale and has been considered in the creation of the Epsom Park DCP.

Given the above, we consider it unreasonable and unnecessary to require the preparation of a site specific DCP or the making and approval of a staged development, and request Council allow the application to progress in its current form.

4.2.3 State Environmental Planning Policy No. 55

Clause 7 of State Environmental Planning Policy No. 55 – Remediation of Land ('SEPP 55'), requires that a consent authority must not consent to the carrying out of development on land unless:

"*(a) it has considered whether the land is contaminated, and*

(b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and

(c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose."

A Remedial Action Plan (RAP) has been prepared by AECOM and accompanies this DA at Appendix 35. The objectives of the RAP include summarizing the findings of the three stages of environment site investigations at the site, and presenting a plan of the anticipated remediation that will allow the development to proceed in a manner that protects human health and the environment, and to make the site suitable for the proposed uses.

Interim Audit Advice has been prepared by Ramboll Environ as an independent review of the suitability of appropriateness of AECOM's RAP (see Appendix 36). The Auditor considers that if the remedial works proposed by AECOM are implemented alongside the consideration of comments provided within the Interim Audit Advice, the proposed remedial and additional investigation works should confirm that the site is suitable for the proposed use.

4.3 Development Control Plans (DCPs)

The *Sydney Development Control Plan 2012 (Green Square – Epsom Park Precinct)* (SDCP 2012) is the primary Development Control Plan that applies to the site and sets out the core controls for the site.

A full assessment of the proposal against the DCP controls that apply to the site has been provided at Appendix 3.

Urban Strategy

Control 5.3.1 of SDCP 2012 outlines the urban strategy for the Epsom Park precinct of Green Square (see Figure 14 below). The proposed development is compliant with the layout demonstrated in the Urban Strategy, and has been provided with a 10m landscaped setback to Joynton Avenue and pedestrian links across the site.



Figure 14 – Epsom Park Urban Strategy
Source: Sydney DCP 2012

4.4 Other Planning Matters

4.4.1 Security Management

A Security Management Plan has been prepared by City Operations to accompany the application (see Appendix 20). This outlines the security features that will be a part of the development and includes:

- Fitting of the facility with electronic access control and a security alarm system;
- Primary access into the building controlled by a swipe card reader;
- Staff being responsible for arming and disarming alarm systems on a daily basis;
- The installation of CCTV cameras at point of sale positions, vending machines, cash handling areas, locker facilities and public entry points;
- Perimeter fences fitted with microphonic perimeter sensor cable type alarms to detect attempted intrusions; and
- External and selective internal doors to be fitted with master keyed locks.

5 Environmental Assessment

5.1 Traffic and Transport

Traffic Impact Assessment

A Transport Impact Assessment has been prepared by GTA Consultants and accompanies this application at Appendix 28**Error! Reference source not found.**. The purpose of this report is to set out an assessment of the anticipated transport implications of the proposal, giving consideration to:

- Existing pedestrian and bicycle facilities within the vicinity of the subject site;
- Existing public transport facilities and services within the vicinity of the subject site;
- Existing on-street parking conditions;
- Existing traffic conditions surrounding the site (referencing previous traffic modeling studies);
- Pedestrian and bicycle requirements;
- Suitability of pedestrian and cyclist facilities;
- Suitability of the proposed site access arrangements;
- Suitability of the proposed parking arrangements;
- Service vehicle requirements; and
- The transport impact of the proposal on the surrounding road network (referencing previous studies).

Journey to Work Data

Journey to Work (JTW) data analysed by GTA Consultants indicates that of 1,832 people living in Green Square in 2011, 54% commuted to work by car (as a driver or passenger), and 37% commuted via bus or train. The most common work places for residents includes Sydney Inner City (57%) and Botany (8%).

Existing and Future Road Network

GTA Consultants have outlined the existing road network as comprising:

- Joynton Avenue, a collector road that has historically functioned as the main north-south link through the area, and carries approximately 24,000 vehicles per day in the vicinity of the site;
- Epsom Road, a collector road aligned east-west to the south of the site, which carries approximately 12,000 vehicles per day in the vicinity of the site; and
- Hansard Street, a local road travelling west from Joynton Avenue to the south of the site, connecting with Botany Road.

The existing road network is unrepresentative of future conditions given the planned modifications to the Green Square development area. The future key precinct intersections will include:

- Joynton Avenue/ Zetland Avenue (signalised);
- Zetland Avenue/ George Julius Avenue (signalised);
- Joynton Avenue/ Rose Valley Way (priority controlled);
- George Julius Avenue/ Rose Valley Way (priority controlled);

- Epsom Road/ George Julius Avenue (signalised); and
- Epsom Road/ Joynton Avenue.

Car Parking Assessment

GTA has adopted a 39% car driver and passenger mode split for assessing the potential parking demand at GPARC, noting that initial parking demand may be higher but offset by lower short-term patronage and alternative transport mode access.

In terms of the adequacy of car parking supply, there will be between 150 and 175 on-street spaces within a 200m walk of GPARC that would be available for visitor parking, increasing to between 215 – 240 within a 225m walk. No car parking will be provided on site, though 30 parking spaces for 90 degree parking will be provided adjacent to the site on George Julius Avenue. In addition, a "park and swim" system will be put in place for on-street parking in the vicinity of the centre. GTA have noted that a range of incentive programs and a detailed implementation strategy are key to the functionality of GPARC and the precinct in general. In part, this is discussed within the "Green Travel Plan".

It is noted that the lower provision of parking is consistent with the objectives of Division 1 – Car parking ancillary to other development under SLEP 2012, namely Clause 7.1(1) which states:

> *(1) The objectives of this Division are:*
>
> *(a) to identify the maximum number of car parking spaces that may be provided to service particular uses of land, and*
>
> *(b) to minimise the amount of vehicular traffic generated because of proposed development.*

Traffic Impact

GTA have identified a PM peak parking demand of just over 100 spaces, with a peak hour traffic generation of 100 – 200 vehicle trips when assuming a turnover of 1-2 vehicle movements per space. This is considered reflective of opening conditions in which the GPARC catchment will be large, prior to firmly establishing the associated transport improvements. These requirements can be met by the on-street parking that will be associated with GPARC. Vehicle trips are anticipated to decrease over time as the surrounding residential areas develop further and a significant proportion of users arrive from the local area.

Given there is no off-street parking proposed, all site-specific traffic will be associated with the on-street car parking spaces. By 2031 the future Joynton Avenue/ Zetland Avenue intersection will operate close to capacity in peak periods, however this is with the realisation of other traffic generating uses within the Epsom Park Precinct, and will not be solely due to the contribution of the GPARC site. The GPARC development will in fact lessen in traffic impact by 2031 due to anticipated travel mode shift.

Green Travel Plan

The purpose of the travel plan is to advise the wider travel choices to visitors and staff, to help visitors and staff identify healthier transport means, to provide equal opportunities for residents without access to a car, to reduce congestion, and to enable deliveries and essential journeys to move more freely.

GPARC mode share targets for 2020 travel are as follows:

- Car (Driver) 30%
- Bus/Light Rail 25%
- Train 10%
- Vehicle Passenger 5%
- Walk Only 20%
- Other (eg. Cycling) 10%

Travel plan recommendations are included in Section 7 of GTA's Green Travel Plan, including a number of incentive measures, educational initiatives and other recommendations as a way of promoting and encouraging sustainable transport use. These are aimed at achieving the mode share targets outlined above.

5.2 Ecologically Sustainable Development

The proposed development has been designed to achieve a certified 5 star Design and As Built Green Star rating from the Green Building Council of Australia. The sustainable design specifications have been outlined in an Energy Efficiency Report, prepared by Surface Design (See Appendix 14).

An Environmental Management Plan (EMP) also prepared for the development by Surface Design outlines design and construction planning environmental measures which are to be implemented (See Appendix 15). This will act as a guide for the project stages following development approval on items of:

- Construction site management;
- Materials management and use;
- Energy and water use;
- Reporting; and
- Standards and codes that apply.

This report outlines the ways in which the project responds to the City of Sydney 2030 objectives. The EMP sets guidelines for the development, assesses the site environmental risks specific to the GPARC project, and describes how these will be managed.

5.3 Stormwater Management Provisions

CJ Arms and Associates have prepared a report on the stormwater drainage management proposed for the park (See Appendix 6). The scope includes:

- Stormwater drainage strategy;
    - 3 month, 20 year and 100 year flow rates
    - Discharge limits (Sydney Water)
- Onsite stormwater management;
    - No increase in stormwater overflows to adjacent properties
    - Detention requirements
    - Retention requirements
- Stormwater treatment requirements; and

- Irrigation requirements as outlined in the Irrigation Consultant Strategy prepared by Hydroplan (held within the supplementary appendices).

The proposal is to contain the entire 100-year flow from the sports field and adjacent areas within proposed underground tanks. 100-year flows traversing the site will do so across the surface 'overland flow path', with finishes, materials, and landscaped elements designed to accommodate the anticipated level and velocity. To avoid damage to the pitch, there will be no external flows from adjacent catchments traversing the playing field. Similarly, no external overland flows from adjacent water catchments will traverse habitable areas of the buildings.

5.4 Water Sensitive Urban Design

The DA is supported by a Water Sensitive Urban Design (WSUD) Strategy prepared by CJ Arms & Associates, which demonstrates how urban runoff has been considered in the stormwater infrastructure and landscaping design (Refer to Appendix 7).

The site is divided into 13 individual catchments, in a total area of 28,693m^2. In line with the key water management objectives outlined by the City of Sydney, the overall objectives for managing stormwater quality of these catchments are to:

- Apply an integrated approach to water management through the use of WSUD principles;
- Encourage sustainable water use practices; and
- Assist in the management of stormwater to minimise flooding and reduce the effects of stormwater pollution on receiving waterways.

Accordingly, the stormwater quality improvement targets are to achieve annual pollutant load reductions of 90% for gross pollutants, 85% for total suspended solids, 65% for total phosphorous, and 45% for total nitrogen.

Competing demands for space at the site have required a creative use of WSUD solutions to be integrated within the landscape design, such as promotion of water harvesting and reuse, and incorporating filtration elements such as raingardens into outdoor landscaping. Two forms of rainwater harvesting are proposed within the GPARC hydraulic design. Roofwater harvesting will collect rainwater from the Aquatic and Recreation Centre roof in a 100kL rainwater tank, and make this water available for toilet flushing, green roof irrigation, and swimming pool makeup. This will meet 12.5% of the annual toilet flushing and swimming pool water demands, whilst annually 75% of the roof runoff will be captured and prevented from discharging further downstream. The second harvesting technique is stormwater harvesting, which will involve the installation of a 50kL in-ground storage tank below the landscaped area in the northeastern part of the site. It will collect and store filtered water to be made available for non-potable irrigation of turfed areas. A 385kL on-site detention (OSD) tank is also to be provided under the sports field to the western part of the park.

5.5 Geotechnical Investigation

Numerous geotechnical investigations have been undertaken upon the site. The latest geotechnical report prepared by Douglas Partners (April 2016) is attached as Appendix 23 to this SEE, which supersedes previous investigations and provides comment on geotechnical issues relevant to the proposed development including excavation and site preparation, excavation support, groundwater, foundations and pavements.

5.6 BCA Requirements

BCA Logic have prepared a BCA Assessment Report, attached to this SEE at Appendix 12. The purpose of the report is to ensure that the current design proposal meets the Deemed-to-Satisfy Provisions of the BCA 2016. Items have been raised within BCA Logic's report where further consideration against the BCA may be required, or may require assessment as Performance Based (Fire Engineered) Alternative Solutions. These matters are to be addressed for the Construction Certificate stage of the development.

5.7 Accessibility

Accessibility has been considered by BCA Logic in an Access Assessment Report (see Appendix 13). This report includes an assessment of the proposal against the relevant provisions of the BCA, the Disability Discrimination Act 1992 (DDA), and the Disability (Access to Premises – Buildings) Standards 2010 (the Premises Standard). BCA Logic have determined in their review of the DA documentation that the design complies with or is capable of complying with these codes. Additional recommendations and operational strategies have been provided.

5.8 Acoustics

An Acoustic Design Report prepared by Arup accompanies the application at Appendix 17, providing advice on:

- Setting of acoustic criteria based on local and national guidance and best international practice;
- Results from an environmental noise survey to develop current criteria and inform the development of criteria for future developments;
- A precedent study of two existing Sydney swimming pool facilities, the Cook and Phillip Park Aquatic and Fitness Centre, and Ian Thorpe Aquatic and Fitness Centre;
- Identification of acoustic challenges throughout the proposed GPARC development, and
- Proposed solutions to acoustic challenges in accordance with the current design.

Key acoustic issues outlined within Arup's report centre on internal noise levels, room acoustics and internal finishes, sound insulation, environmental noise emissions, emergency equipment, and construction noise and vibration. Recommendations and mitigation methods have been provided by Arup to respond to these matters.

Arup's report includes a Noise Impact Assessment for the development, looking at sound receivers south across the future Rose Valley Way, and north across the future Zetland Avenue West. School carnivals, sporting events, and the licensed café have been considered in the modeling and have been shown to be acceptable with respect to noise impact.

5.9 Waste Management Provisions

A Waste Management Plan (WMP) has been prepared by Arup which addresses the relevant requirements for waste management, identifying waste sources and proposing mitigation measures (see Appendix 8).

With the proposed development targeting a 5 Star Green Star rating, there are a number of waste management objectives which must be met. These include:

- Reduce waste sent to landfill during demolition and construction by achieving a construction waste to landfill rate of 10kg/m^2 total GFA or less, or achieving an overall 90% diversion rate from landfill for demolition and construction waste; and
- Reduce operational waste sent to landfill.

Arup have calculated the total waste generation estimation at 24,202L/week, comprising:

- 11,229 L/week to landfill waste;
- 3,860 L/week to co-mingle recycling; and
- 9,113 L/week to paper and card recycling.

Four waste storage facilities are to be provided; one central landfill waste storage room, one central recycling waste storage room, one hard rubbish and bulky item storage room, and one temporary waste storage area. Waste management is to be undertaken by various responsible agents including building management, commercial tenants, various private contractors, and the City of Sydney.

Following approval of the project, the WMP will inform the development of a detailed Waste Policy Design Compliance Certificate for the Construction Certificate application, inform a future Green Star submission, ensure that detailed design and fit out of the building is consistent with best practice standards, and inform all plans and procedures for all operational waste management.

Green waste is to be stored and managed offsite by a dedicated contractor, and public waste in Gunyama Park is to be collected directly from source by Council. As such, these waste streams are separate from estimates associated with the operation of the Aquatic and Recreation Centre.

5.10 Flora and Fauna Significance

This application is supported by an Arboricultural Report, prepared by Earthscape Horticultural Services (see Appendix 9) and a Flora & Fauna Assessment and Test of Significance prepared by Ecological Consultants Australia (Appendix 10). A Tree Protection Plan is also held at Appendix 33.

A total of more than 160 trees were identified on site, of varying species, height and retention value. Of these, only 16 were considered to be of high retention value, generally relating to the lemon-scented gums fronting Joynton Avenue.

Recommendations of the Tree Assessment Report include:

- Careful consideration of the retention of 'High" retention value trees and retention of "Moderate" retention value trees where possible;
- Replacement planting within appropriate areas of the site to compensate for the loss of amenity resulting from the removal of trees; and
- The provision of replacement trees to preferably include locally indigenous species.

The recommendations of the Flora & Fauna Assessment includes:

- Replacement of *Corymbia citriodora* trees with *Corymbia maculata* trees along Joynton Avenue if removed, with hollows removed by arborists at the time of felling;

- Planting of replacement grey-headed flying-fox feeding habitat, equal to the number of trees proposed to be removed that act as feeding sources;
- Establishment of an ecologist or wildlife carer to be on site when possum-habitats (Ivy) are removed.

Further, Ecological Consultants Australia have prepared a Critical Species Habitat Impact Statement which accompanies the application at Appendix 11 and confirms the development will not significantly impact on any critical species habitat.

6 Section 79C Assessment

In summary, the below Table 6 provides an assessment of the development against the provisions of Section 79C of the EP&A Act 1979.

Table 6. Section 79C Assessment Summary

Clause No.	Clause	Assessment
(1)	Matters for consideration—general	
(a)(i)	The provision of: Any environmental planning instrument, and	The development is consistent with the provisions of SLEP 2012, being permissible in the zone and in accordance with the relevant development standards.
(ii)	Any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Director-General has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and	Not applicable.
(iii)	Any development control plan, and	The development is subject to the controls of SDCP 2012. An assessment of the proposal against the controls of this DCP has been provided within this SEE and Appendix 3 which has shown the development to be consistent.
(iiia)	Any planning agreement that has been entered into under Section 93F, or any draft planning agreement that a developer has offered to enter into under Section 93F, and	No planning agreement has been entered into under Section 93F of the Act.
(iv)	The regulations (to the extent that they prescribe matters for the purposes of this paragraph), and	Not applicable.
(v)	Any coastal zone management plan (within the meaning of the Coastal Protection Act 1979), that apply to the land to which the development application relates,	Not applicable.
(b)	The likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,	The likely environmental, social and economic impacts have been considered within the course of this SEE and have shown to be manageable.
(c)	The suitability of the site for the development,	The site is considered suitable for the proposed development. It has been identified within the SDCP as the preferred site for an Aquatic and Recreation Centre and open space area.

Table 6. Section 79C Assessment Summary		
Clause No.	Clause	Assessment
(d)	Any submissions made in accordance with this Act or the regulations,	To be considered by Council.
(e)	The public interest.	The proposal is considered to be in the public interest, and will cater for the recreational needs of the growing community.

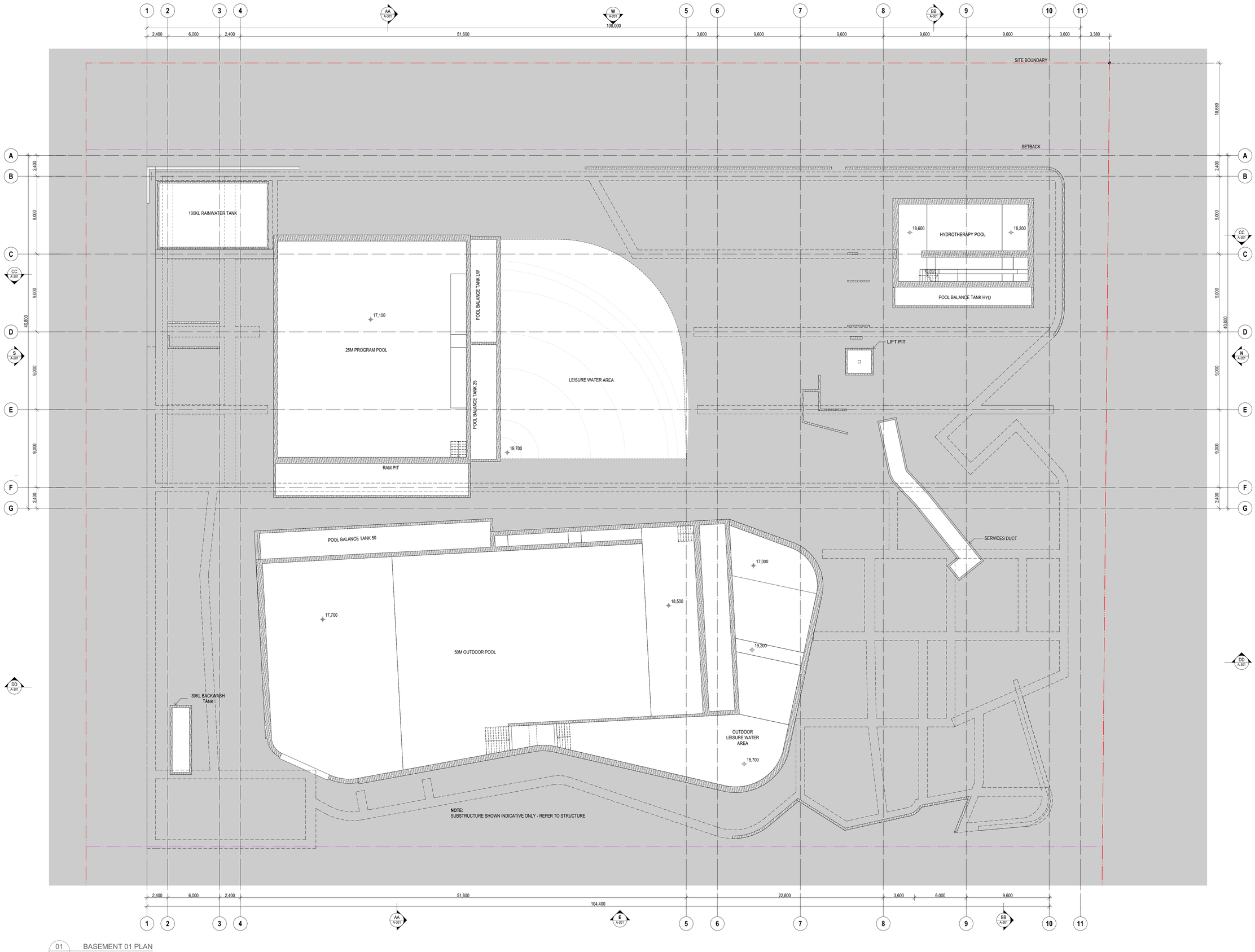
7 Conclusion

This SEE has been prepared on behalf of City Property to support a development application to City of Sydney Council for the proposed Gunyama Park Aquatic and Recreation Centre development on the site valued at $79,268,535. The proposed development is considered to be a positive outcome for the City of Sydney Council and the current and future residents of Green Square.

An environmental assessment has been undertaken in Section 4 of this report, supported by additional consultant studies as per the requirements of Council. The environmental assessment found the associated impacts of the proposal are considered to be minimal and manageable. This SEE has also demonstrated that the proposed works are largely compliant with the SLEP 2012 and SDCP 2012 and that environmental impacts have been considered. In summary, the proposal:

- Will provide high-quality community infrastructure in both Gunyama Park and the Aquatic and Recreation Centre, resulting in major positive social impacts for the growing Green Square population. The development will also cater for a range of users and ensure accessibility;
- Demonstrates 'design excellence', having been subject to a design competition in which the scheme was unanimously selected as the winner;
- Incorporates ESD principles to ensure environmental impacts are minimised, such as the inclusion of solar-panels, sustainable water use practices, and the implementation of a Green Travel Plan;
- Is consistent with the objectives for development in the B4 Zone;
- Is compliant with the key development standards applicable under SLEP 2012, as well as other applicable State planning instruments;
- Is consistent with the provisions, objectives and guidelines of the "Epsom Park" section of SDCP 2012;
- Is a suitable development for the site and is considered to be in the public interest.

Therefore, we request that Council recommend that the proposed development be granted development approval.



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INTELLECTUAL PROPERTY

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NORTH

GRAPHICAL SCALE
0 1 2 4 6 8 10m

GROSS FLOOR AREA (GFA)	
GROUND FLOOR	
MAIN BUILDING	3,904 m²
PARK AMENITIES	91 m²
LEVEL 01	
MAIN BUILDING	1,550 m²
TOTAL	**5,545 m²**
FLOOR SPACE RATIO (FSR)	
GROSS FLOOR AREA	5,545m²
SITE AREA	28,693 m²
RATIO	**0.19:1**

REV	DATE	ISSUE
A	31/05/16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

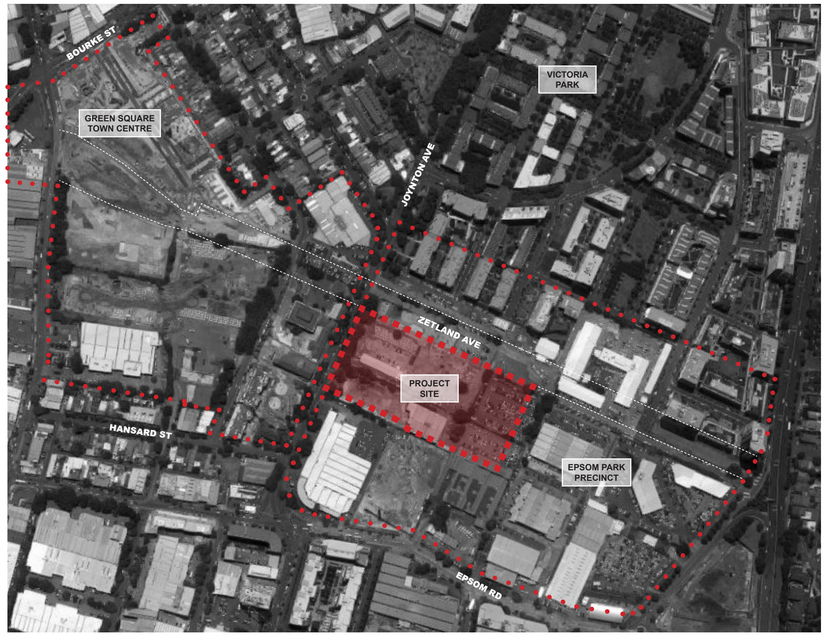
BASEMENT PLAN

DRAWN:	CM
CHECKED:	NB
SCALE:	1:200 @ A1
FIRST ISSUE:	31/05/15
DRAWING NO	REV

ARC-DA-101 A

DEVELOPMENT APPLICATION

DRAWING NO.	DRAWING NAME	Scale
ARCHITECTURE		
ARC-DA-001	COVER SHEET	NTS
ARC-DA-002	SITE ANALYSIS DIAGRAMS	1:1500 @ A1
ARC-DA-011	SITE PLAN	1:500 @ A1
ARC-DA-012	SITE PLAN INTERIM STAGE SURROUNDING PUBLIC DOMAIN	1:500 @ A1
ARC-DA-101	BASEMENT PLAN	1:200 @ A1
ARC-DA-102	GROUND FLOOR PLAN	1:200 @ A1
ARC-DA-104	FIRST FLOOR PLAN	1:200 @ A1
ARC-DA-105	MAIN ROOF PLAN	1:200 @ A1
ARC-DA-201	ELEVATIONS OVERALL	1:200 @ A1
ARC-DA-301	SECTIONS OVERALL	1:200 @ A1
ARC-DA-401	PARK AMENITIES BUILDING	1:100 @ A1
APPENDICES		
ARC-DA-501	MATERIALS BOARD 01	NTS
ARC-DA-502	MATERIALS BOARD 02	NTS
ARC-DA-511	PHOTOMONTAGES	NTS
ARC-DA-521	SHADOW DIAGRAMS	1:2000 @ A1
117244002	PLAN SHOWING SERVICES LOCATIONS - REV 04 - 1/5	1:1000 @ B1
117244002	PLAN SHOWING SERVICES LOCATIONS - REV 04 - 2/5	1:200 @ B1
117244002	PLAN SHOWING SERVICES LOCATIONS - REV 04 - 3/5	1:200 @ B1
117244002	PLAN SHOWING SERVICES LOCATIONS - REV 04 - 4/5	1:200 @ B1
117244002	PLAN SHOWING SERVICES LOCATIONS - REV 04 - 5/5	1:200 @ B1
117244500	PLAN SHOWING ALIGNMENT ID AND SITE AREAS - REV 05	1:1000 @ A1
LANDSCAPE		
ARC-T-DA-001	DRAWING LIST & SITE CONTEXT PLAN	1:750 @ A1
ARC-T-DA-002	LANDSCAPE LEGEND & MATERIALS	NTS
ARC-T-DA-003	TREE PROTECTION & REMOVAL PLAN	1:350 @ A1
ARC-T-DA-004	GENERAL ARRANGEMENT PLAN	1:350 @ A1
ARC-T-DA-005	FURNITURE & FIXTURES PLAN	1:350 @ A1
ARC-T-DA-006	GRADING PLAN	1:350 @ A1
ARC-T-DA-007	PLANTING PLAN	1:350 @ A1
ARC-T-DA-008	LONG SECTIONS & ELEVATION	VARIES @ A1
ARC-T-DA-009	SECTIONS	1:50 @ A1
ARC-T-DA-010	DETAILED PLAYGROUND PLAN	1:100 @ A1
ARC-T-DA-011	DETAILED PLAYGROUND	1:50 @ A1
ARC-T-DA-012	DETAILED PLAYGROUND	NTS



SITE LOCATION + AERIAL PHOTO

BACKGROUND DRAWINGS

SURVEY
Merged Design Drawings Ver2.zip *(Background info (A) (2.18))*
Drawing Number/ Title/ revision/ date

JOYNTON AVENUE AND ZETLAND AVENUE STREETSCAPE DESIGN (ULTIMATE):
GSTC EIPD P4 80% Levels Design CAD and 12D 160401

JOYNTON AVENUE AND ZETLAND AVENUE STREETSCAPE DESIGN (INTERIM):
GSTC EIPD P4 80% Levels Design CAD and 12D 160401

MERITON DEVELOPMENT, 84-92 EPSOM RD
14-209_Private Domain_CC_03_24Feb16

ROAD AND DRAINAGE LAYOUT EPSOM PARK
151201_Epsom Park 100% concept

TRUNK DRAIN SEPARABLE PORTION 1 (ROSE VALLEY WAY)
Trunk Drain R.V.Way_19Feb16

TRUNK DRAIN SEPARABLE PORTION 2 (ZETLAND AVE - AQUATIC CENTRE)
Trunk Drain - SP2 ISSUED FOR CONSTRUCTION DRAWINGS_22Dec15.zip

WATER MAIN
Trunk Drain 840mm WMain_25Nov15

JOYNTON AVENUE AND ZETLAND AVENUE INTERIM LEVEL DESIGN:
60300384-ref-c-02-4A-DES_CONT_PLAN_3D.DWG
GSTC EIPD Package 4 80% Interim Levels Package 160404 - flattened.pdf
60300384-REF-C-02-4A-DES_CONT_PLAN_3D.DWG
Street_Park Grading Interface_260416.pdf

INTERIM FLOOD MODELLING
L-R1037-0416-01_GPARC Flood Modelling_Det Basin & Temp Drainage_28Apr16

FLOOD MODELLING
Ultimate Dev_Design_Flood_Levels_Flow_Path_8Dec15Plan.pdf

Used for information only
JOYNTON AVENUE LANDSCAPE SETBACK:
60300384-REF-C-02-4A-XSEC-TYP1
60300384-REF-C-02-4A-XSEC-TYP2
60300384-REF-C-02-4A-XSEC-TYP3
60300384-REF-C-02-4A-XSEC-TYP-PLAN

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GROSS FLOOR AREA (GFA)		
GROUND FLOOR		
	MAIN BUILDING	3,904 m²
	PARK AMENITIES	91 m²
LEVEL 01		
	MAIN BUILDING	1,550 m²
	TOTAL	**5,545 m²**
FLOOR SPACE RATIO (FSR)		
GROSS FLOOR AREA		5,545m²
SITE AREA		28,693 m²
	RATIO	**0.19:1**

PROJECT NAME: GUNYAMA PARK AQUATIC AND RECREATION CENTRE (GPARC)
PROJECT NUMBER: C16113

DEVELOPMENT APPLICATION



REV	DATE	ISSUE
A	31/05/16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

COVER SHEET

DRAWN:	CM
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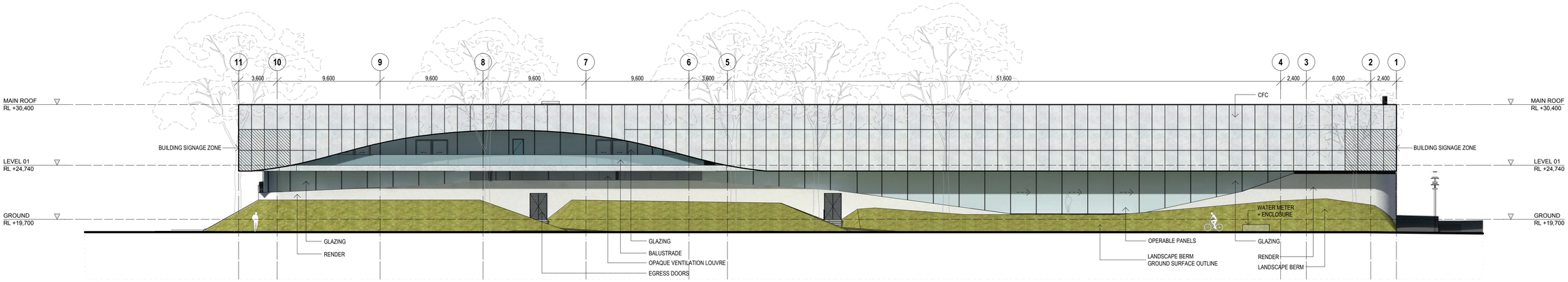
SCALE:	NTS
FIRST ISSUE:	31/05/16

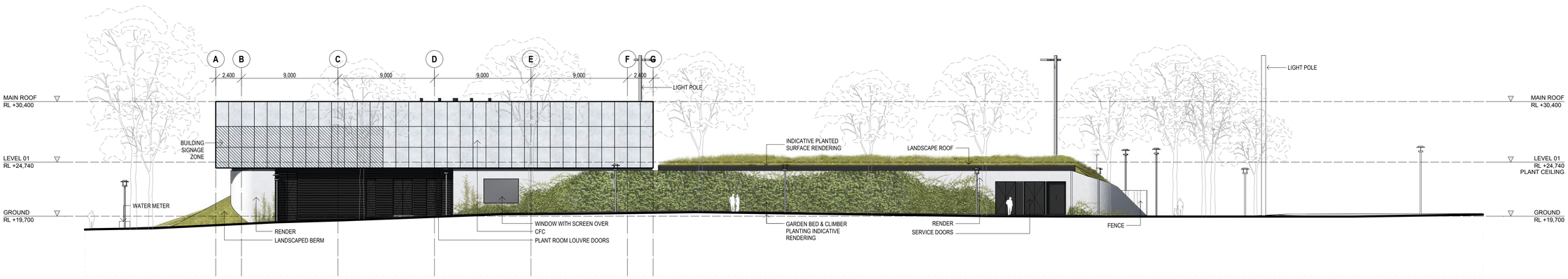
DRAWING NO — REV

ARC-DA-001 A

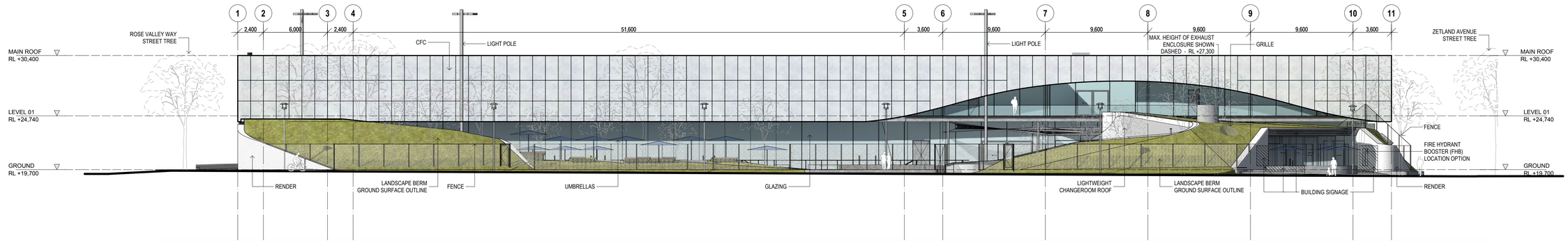
DEVELOPMENT APPLICATION



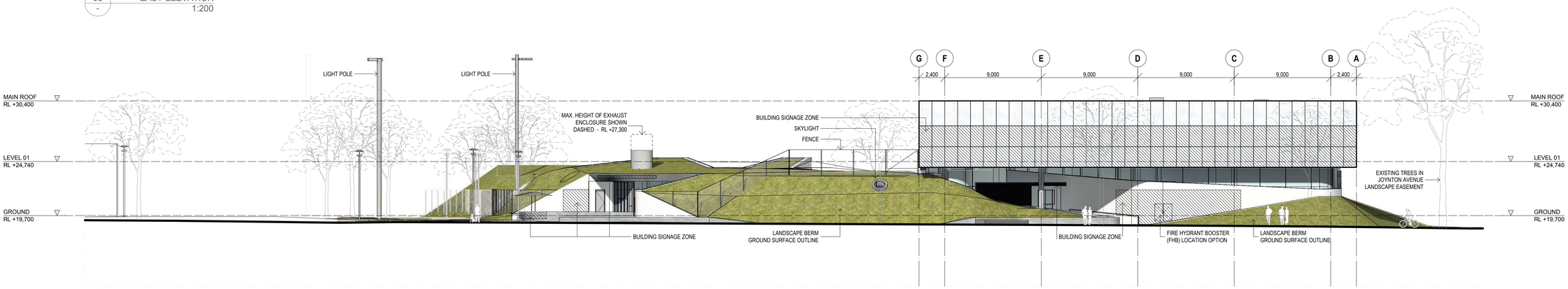
01 - WEST ELEVATION
1:200



02 - SOUTH ELEVATION
1:200



03 - EAST ELEVATION
1:200



04 - NORTH ELEVATION
1:200

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NORTH

GRAPHICAL SCALE
0 1 2 4 6 8 10m

NOTE:
REFER ALSO TO MATERIALS BOARD SHEET
ARC-DA-501

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Gunyama Park Aquatic and Recreation Centre (GPARC)

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TITLE
ELEVATIONS OVERALL

DRAWN:	CM
CHECKED:	NB
SCALE:	1:200 @ A1
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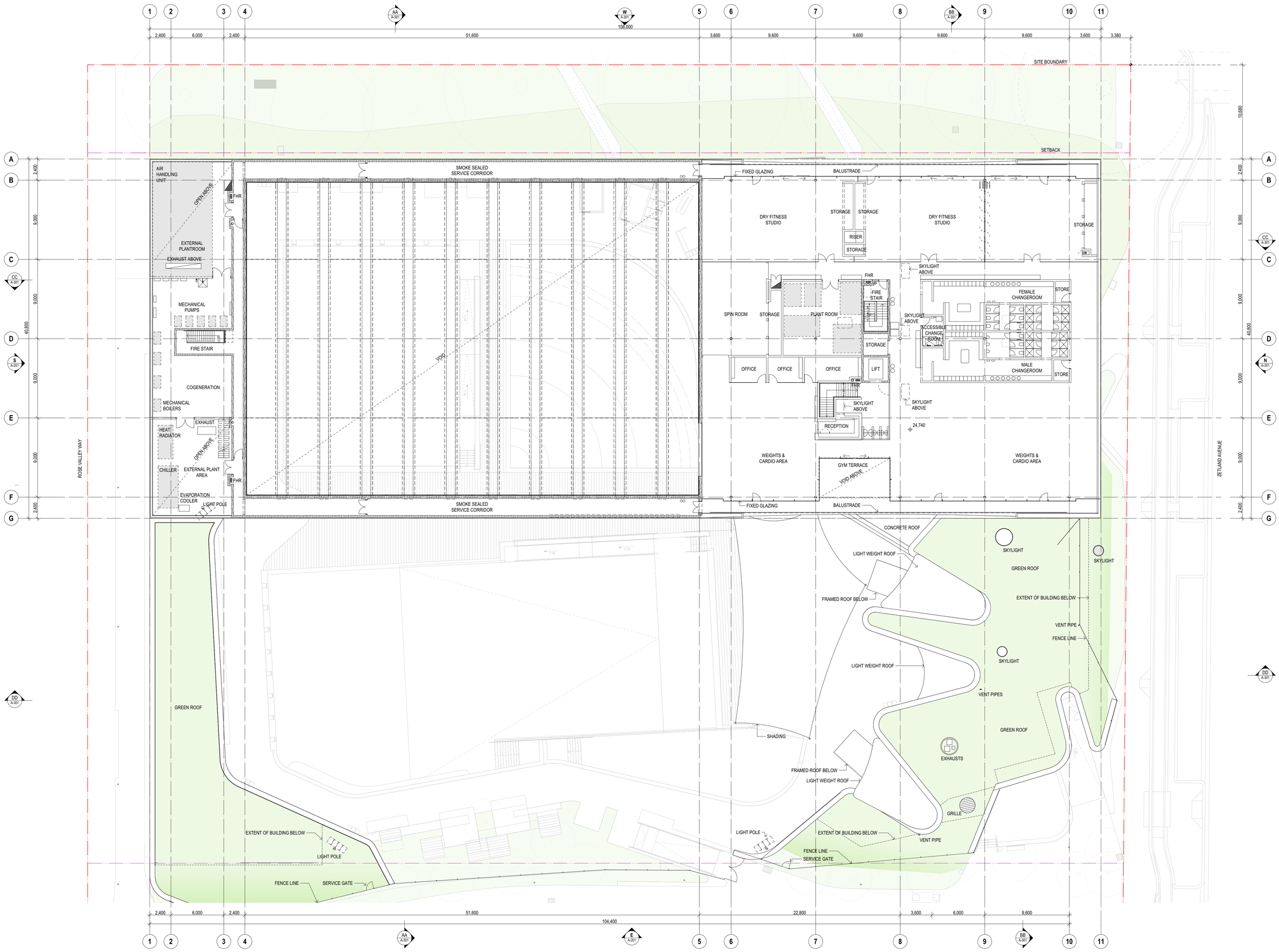
DRAWING NO	REV

ARC-DA-201 A

DEVELOPMENT APPLICATION



01 - LEVEL 01 PLAN
1:200

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NORTH

GRAPHICAL SCALE
0 1 2 4 6 8 10m

GROSS FLOOR AREA (GFA)	
GROUND FLOOR	
MAIN BUILDING	3,904 m²
PARK AMENITIES	91 m²
LEVEL 01	
MAIN BUILDING	1,550 m²
TOTAL	**5,545 m²**
FLOOR SPACE RATIO (FSR)	
GROSS FLOOR AREA	5,545m²
SITE AREA	28,693 m²
RATIO	**0.19:1**

A 31/05/16 DEVELOPMENT APPLICATION
REV DATE ISSUE

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

FIRST FLOOR PLAN

DRAWN: IA
CHECKED: NB
SCALE: 1:200 @ A1
FIRST ISSUE: 31/05/15
DRAWING NO: ARC-DA-104
REV: A

DEVELOPMENT APPLICATION



01 GROUND FLOOR PLAN
- 1:200

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NORTH

GRAPHICAL SCALE
0 1 2 4 6 8 10m

GROSS FLOOR AREA (GFA)	
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A	31/05/16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

GROUND FLOOR PLAN

DRAWN:	IA
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SCALE:	1:200 @ A1
FIRST ISSUE:	31/05/15
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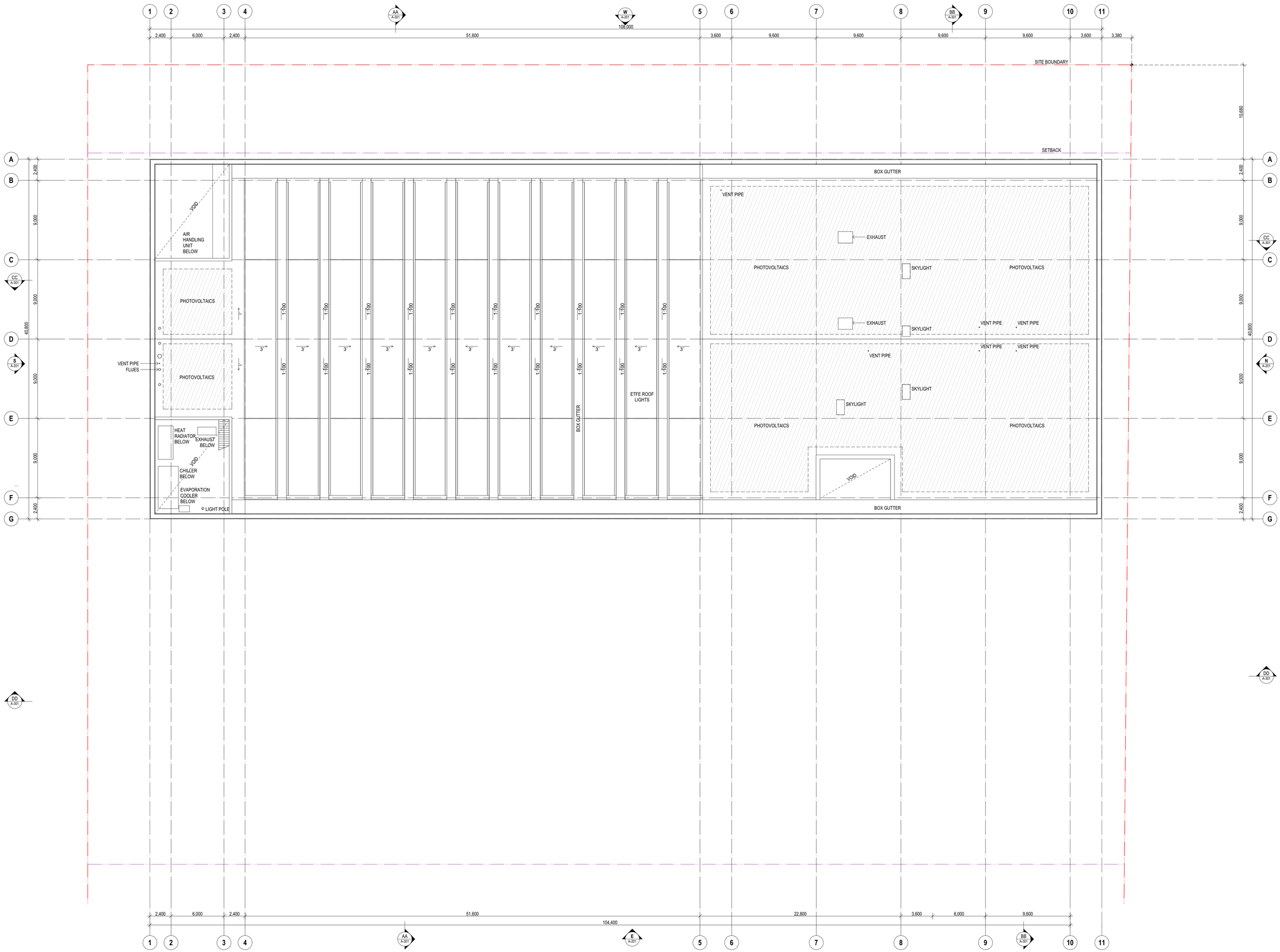
ARC-DA-102 A

DEVELOPMENT APPLICATION



01 - MAIN ROOF PLAN
1:200

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NORTH

GRAPHICAL SCALE

0 1 2 4 6 8 10m

GROSS FLOOR AREA (GFA)	
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Gunyama Park Aquatic and Recreation Centre (GPARC)

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TITLE

MAIN ROOF PLAN

DRAWN:	IA
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SCALE:	1:200 @ A1
FIRST ISSUE:	31/05/16
DRAWING NO	REV

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DEVELOPMENT APPLICATION

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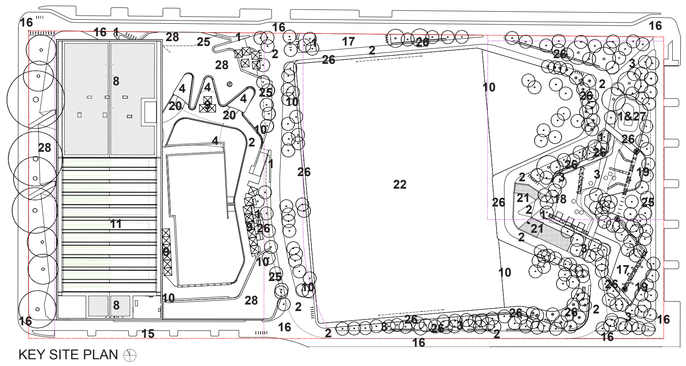
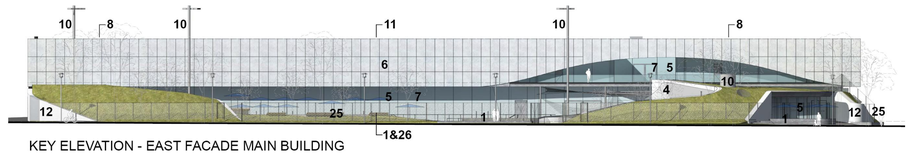
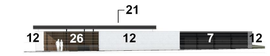


KEY SITE PLAN



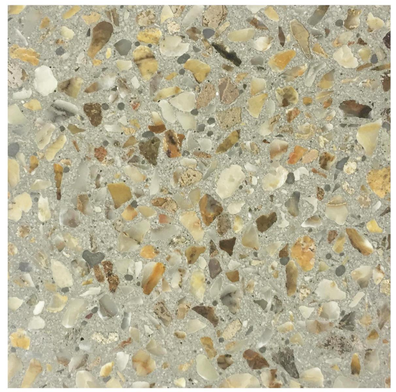
KEY ELEVATION - EAST FACADE MAIN BUILDING



KEY ELEVATION - SOUTHWEST FACADE AMENITIES & STORAGE



1. **SEATING:** CONCRETE, SMOOTH FINISH, LIGHT GREY



2. **PAVING:** CONCRETE, EXPOSED AGGREGATE, GREY & NEUTRAL STONES

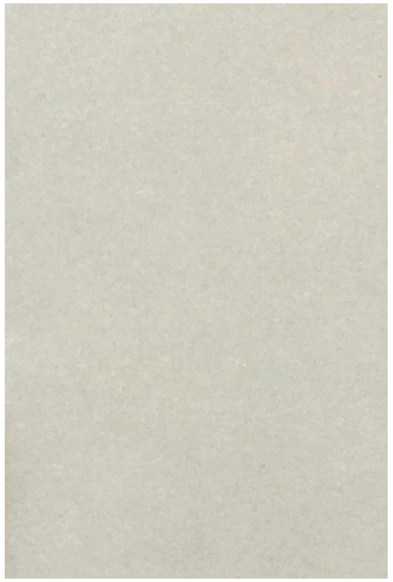


3. **PAVING:** CONCRETE, EXPOSED AGGREGATE, SANDSTONE & NEUTRAL STONES



4. **ROOFING & SHADE:** FABRIC MEMBRANE, WHITE

5. **FACADE GLAZING:** CLEAR



6. **WALL CLADDING:** COMPRESSED FIBRE CEMENT (CFC), SMOOTH FINISH, LIGHT GREY



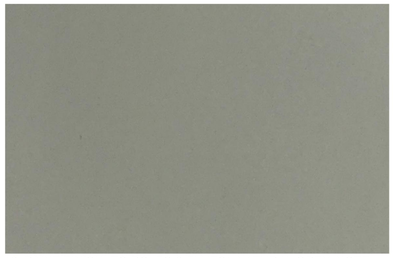
7. **GLAZING FRAMES & AIR LOUVRES:** ALUMINIUM, ANODISED BLACK



9. **UMBRELLA FABRIC:** BLUE



8. **ROOFING & GUTTERS:** SLIMLINE ROOFING SYSTEM, GREY
NOTE: PHOTOVOLTAIC COLLECTORS INSTALLED ON ROOF



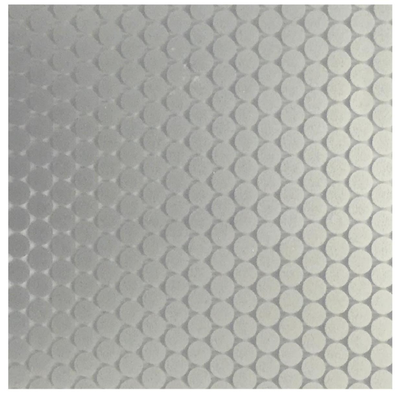
10. **PAINT FINISH** (TO POLES & FLUES): NATURAL GREY. **NOTE:** LARGEST FLOOD-LIGHTS ONLY ARE INDICATED ON KEY PLANS



12. **WALLS:** RENDERED, TEXTURE FINISH, WARM WHITE



13. **PAINT FINISH** (TO TIMBER CLADDING): VARIED GREENS, BLUES, PINKS



11. **GLAZING** (POOL HALL SKYLIGHT): POLYMER CUSHION, 70% FILM

14. **PAINT FINISH** (TO RENDERED WALLS): WHITE

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GUNYAMA PARK AQUATIC AND RECREATION CENTRE · GPARC · MATERIAL SAMPLE BOARD 1 OF 2 · FOR DEVELOPMENT APPLICATION · 31.05.2016

ANDREW BURGES ARCHITECTS + GRIMSHAW + TCL

REV	DATE	ISSUE
A	31/05/16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

MATERIALS BOARD 01

DRAWN:	MD
CHECKED:	NB
SCALE:	NTS
FIRST ISSUE:	31/05/16

DRAWING NO: ARC-DA-501 REV: A

DEVELOPMENT APPLICATION

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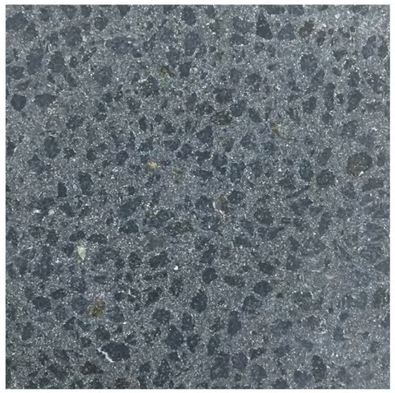
28. **BERM PLANTING & GREEN ROOF:** BOTANY SCRUB



27. **PAVING** (SKATE BOWL PERIMETER): GRANITE, GREY



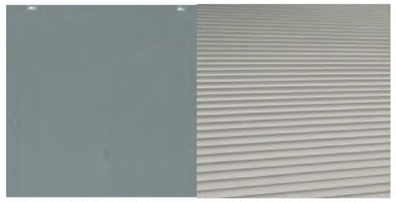
16. **PAVING** (STREETS): CONCRETE, EXPOSED AGGREGATE, GREY



17. **GROUND FINISH:** SOFT-FALL RUBBER, GREY



18. **SHADE CANOPY:** CAMOUFLAGE NETTING, DESERT COLOUR



21. **ROOF & GUTTERS** (PARK AMENITIES): METAL DECK, GREY

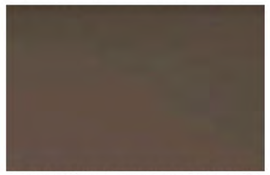




19. **LANDSCAPE WALL & SEAT:** SANDSTONE, DRY STONE WALL. **NOTE:** SAMPLE NOT TO SCALE

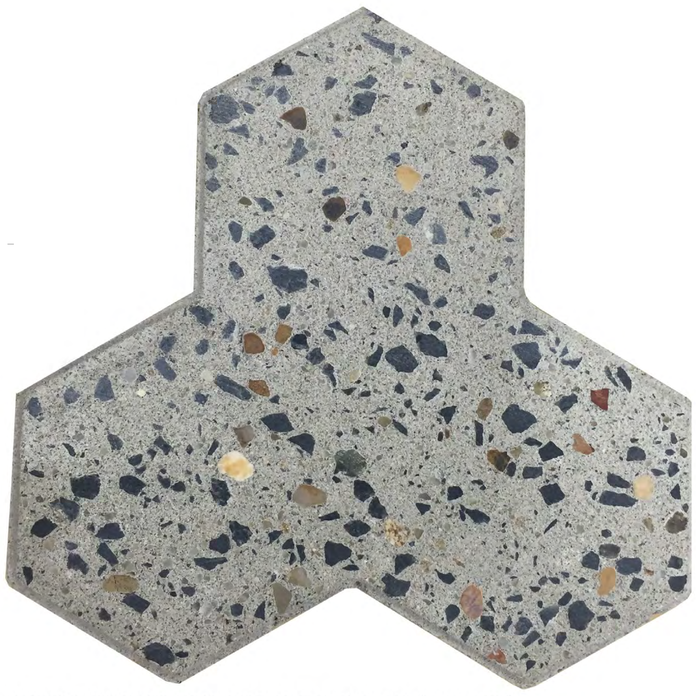


22. **TURF:** SYNTHETIC, GREEN





24. **PAINT FINISHES** (TO METAL LANDSCAPE FURNITURE & EQUIPMENT): BRONZE & BLACK. **NOTE:** THIS ITEM IS NOT INDICATED ON THE KEY PLANS



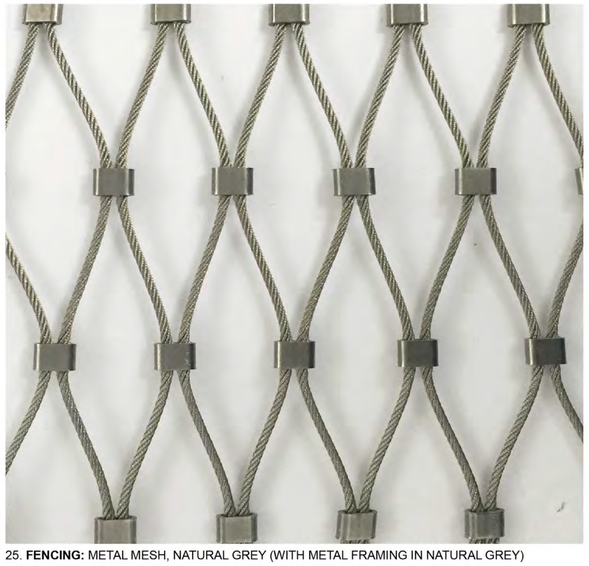
15. **PAVING** (PARKING BAYS): EXPOSED AGGREGATE, GREY & BLUE & NEUTRAL STONES



20. **CLADDING:** TIMBER BOARDS, PAINTED



23. **DRAINAGE GRATE:** STAINLESS STEEL. **NOTE:** THIS ITEM IS NOT INDICATED ON THE KEY PLANS



25. **FENCING:** METAL MESH, NATURAL GREY (WITH METAL FRAMING IN NATURAL GREY)



26. **DECKING & CLADDING:** HARDWOOD, NATURAL SEAL FINISH

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GUNYAMA PARK AQUATIC AND RECREATION CENTRE · GPARC · MATERIAL SAMPLE BOARD 2 OF 2 · FOR DEVELOPMENT APPLICATION · 31.05.2016

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A	31/05/16	DEVELOPMENT APPLICATION

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Australia

TITLE

MATERIALS BOARD 02

DRAWN:	MD
CHECKED:	NB
SCALE:	NTS
FIRST ISSUE:	31/05/16

DRAWING NO — REV

ARC-DA-502 A

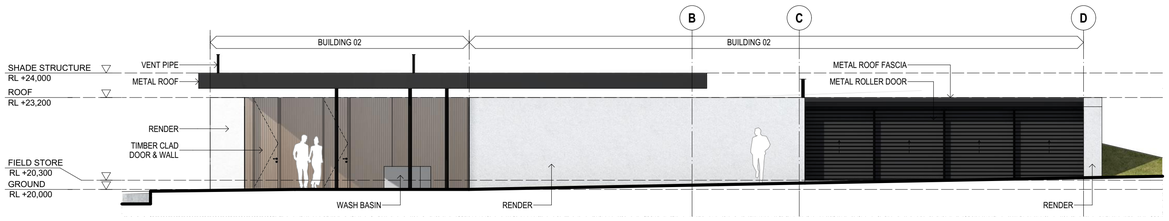
DEVELOPMENT APPLICATION



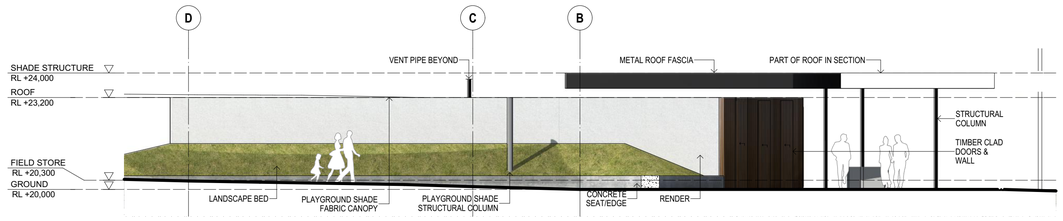
01 GROUND FLOOR PLAN
1:100



02 ROOF PLAN
1:100



03 BUILDING 01 - SW ELEVATION
1:100



04 BUILDING 01 - NE ELEVATION
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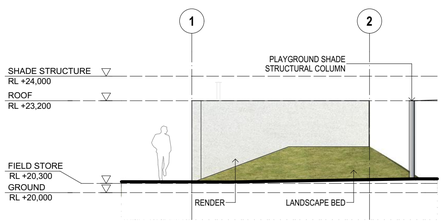

05 BUILDING 01 - SE ELEVATION
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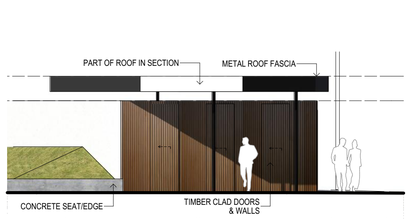

06 BUILDING 01 - NW ELEVATION
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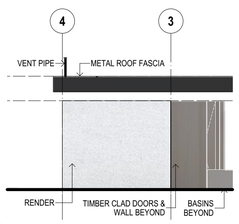

07 BUILDING 02 - NW ELEVATION
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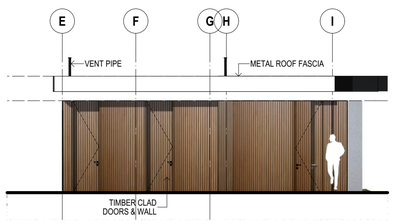

08 BUILDING 02 - SW ELEVATION
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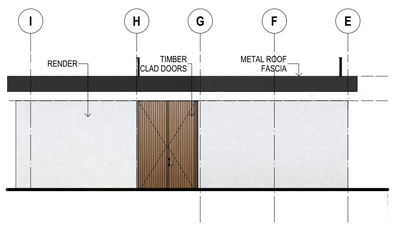

09 BUILDING 02 - NE UNWRAPPED ELEVATION
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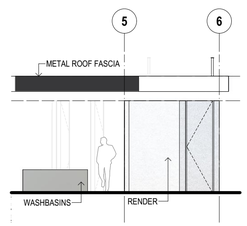

10 BUILDING 02 - SE ELEVATION
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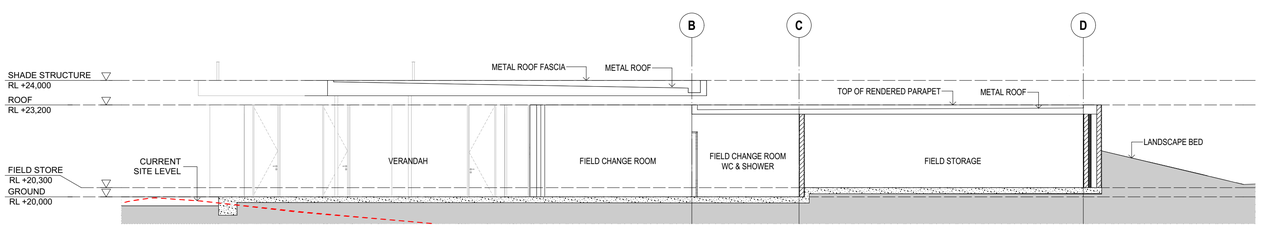

11 SECTION AA
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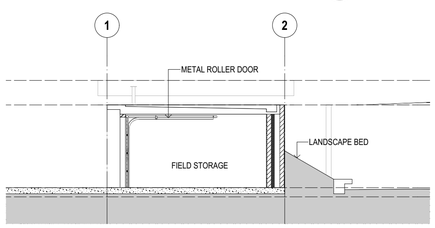

12 SECTION BB
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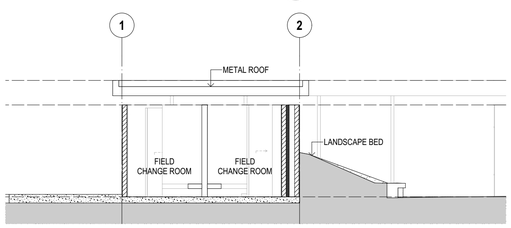

13 SECTION CC
1:100

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NORTH

GRAPHICAL SCALE
0 0.5 1 2 3 4 5m

GROSS FLOOR AREA (GFA)	
GROUND FLOOR	
MAIN BUILDING	3,904 m²
PARK AMENITIES	91 m²
LEVEL 01	
MAIN BUILDING	1,550 m²
TOTAL	**5,545 m²**
FLOOR SPACE RATIO (FSR)	
GROSS FLOOR AREA	5,545m²
SITE AREA	28,693 m²
RATIO	**0.19:1**

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A	31/05/16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

PARK AMENITIES BUILDING

DRAWN:	MD
CHECKED:	NB
SCALE:	1:100 @ A1
FIRST ISSUE:	31/05/16
DRAWING NO	REV

ARC-DA-401 A

PRELIMINARY



01 - PHOTOMONTAGE 1/3



02 - PHOTOMONTAGE 2/3



03 - PHOTOMONTAGE 3/3

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TITLE

PHOTOMONTAGES

DRAWN:	CM
CHECKED:	NB
SCALE:	NTS
FIRST ISSUE:	27/05/16

DRAWING NO — REV

ARC-DA-511 A

DEVELOPMENT APPLICATION

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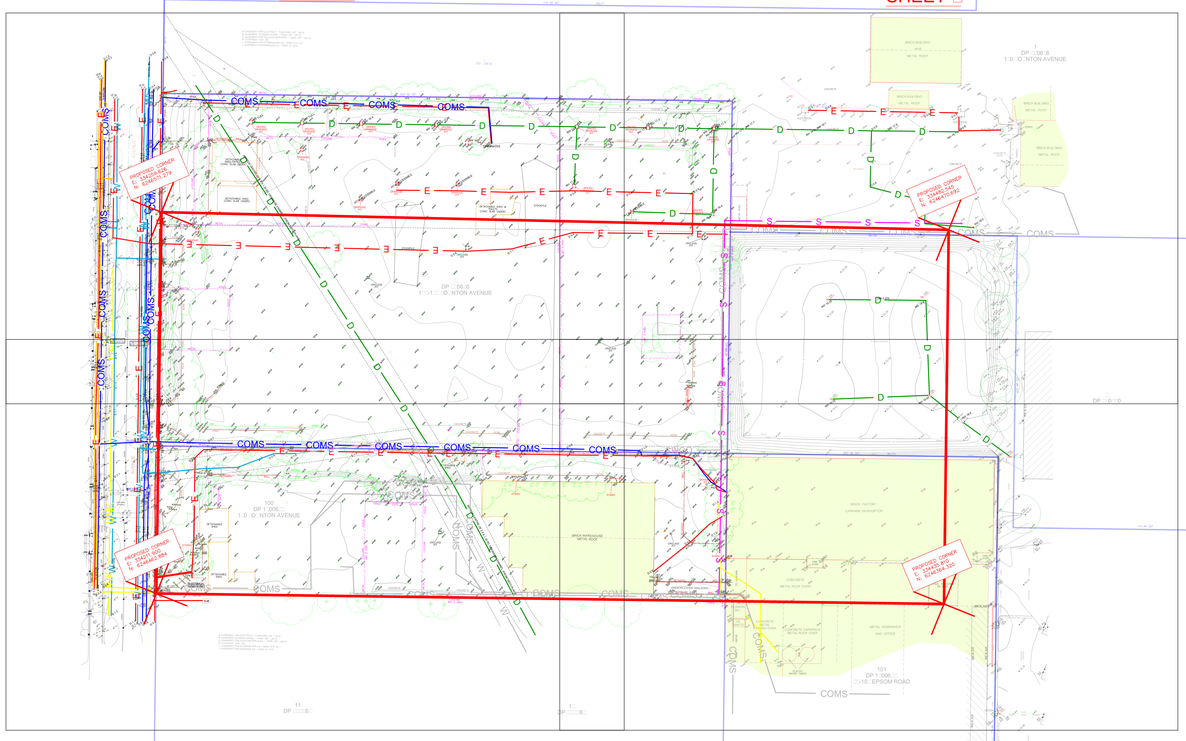

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SERVICES LOCATION NOTES

1□ SERVICES SHOWN HEREON ARE INDICATIVE ONL□□CURRENC□□COMPLETENESS AND ACCURAC□ ARE NOT TO BE PRESUMED□

□□ A CURRENT SERVICES SEARCH□INCLUDING ALL DIAL BEFORE □OU DIG□SERVICES PLANS□AND SITE CHECKING OF ALL E□ISITNG SERVICES WILL BE NECESSAR□ PRIOR TO COMMENCING AN□ WORK□

□□ THESE PLANS HAVE BEEN PREPARED AS A GUIDE FOR KNOWN SERVICES WITHIN THE SITE□ALL INFORMATION HAS BEEN OBTAINED B□ REFERENCING AVAILABLE PLANS AND B□ APPL□ING ELECTRONIC DETECTION METHODS□AS A RESULT THIS INFORMATION SHOULD BE USED AS A GUIDE ONL□□PRIOR TO COMMENCEMENT OF AN□ CONSTRUCTION WORK□INCLUDING E□CAVATION AND DEMOLITION□IT IS IMPORTANT THAT SERVICES BE VISUALL□ VERIFIED AND CAUTION BE APPLIED WHEN E□CAVATING IN AREAS WHERE SERVICES ARE NOT SHOWN TO E□IST AS UNKNOWN□REDUNDANT AND NON-TRACEABLE UTILITIES MA□BE PRESENT□

□□ THE INFORMATION SHOWN HEREON MA□ VAR□ DUE TO SITE CONDITIONS ENCOUNTERED DURING THE COURSE OF THE SERVICE LOCATION□

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1□□ "HAND DIG UNTIL THE EXACT LOCATION OF THE CABLE HAS BEEN ESTABLISHED" - AUSGRID

1□□ THE ABOVE NOTES ARE AN INTEGRAL PART OF THE PLAN

HP	DENOTES HIGH PRESSURE
PE	DENOTES POL□ETH□LENE PIPE
CICL	DENOTES CAST IRON CEMENT LINED PIPE
SCL	DENOTES STEEL CEMENT LINED PIPE
IBL	DENOTES INTERNAL BITUMEN LINED PIPE

D 1□ - DENOTES APPRO□ 1□ METRE DEPTH OF SERVICE

S	SEWER
COMS	COMMUNICATIONS
COMS	UNDETECTED COMMUNICATIONS □B□ DB□D□
E	ELECTRICIT□
G	GAS
D	DRAINAGE
D	UNDETECTED DRAINAGE □B□ DB□D□
W	WATER SUPPL□
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NOTES□
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LEGEND□

SEWER MANHOLE	SIGN	STATE SURVEY MARK	UNCLASS WATER
UNCLASS SEWER	TRAFFIC JUNCTION BOX	SURVEY MARK	WATER METER
SEWER VENT	TRAFFIC SIGNAL PIT	UNCLASS ELECTRICITY	STOP VALVE
SEWER LAMP HOLE	GAS PIT	POWER POLE	TAP
TELSTRA PIT 1.0x1.0	GAS MARKER POST	LIGHT POLE	HYDRANT
UNCLASS TELSTRA	UNCLASS GAS	ELECTRICITY PIT	GULLY PIT
TWIN TELSTRA PIT	TRAFFIC CONTROL SIGNAL	UNCLASS SERVICE	JUNCTION BOX
TELSTRA PIT		CCTV CAMERA	GRATED PIT
		BIN	DRAINAGE MANHOLE

REVISION	DATE	DESCRIPTION	CCAD REF	APPROVED
0□	□□-0□-□016	LOT AND DP NUMBERS ADDED	11□□□□AL	PC
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0□	0□-06-□01□	CONFINED SPACE UPDATED TO SERVICING PIT	11□□□□AL	PC
01	□1-01-□01□	SUBSTATION □ TELSTRA DB□D ADDED	11□□□□AL	PC
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PRO□ECT□ GUN□AMA PARK □ GREEN S□UARE AC□UATIC CENTRE

PLAN SHOWING SERVICES LOCATIONS EPSOM PARK PRECINCT □ETLAND

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SERVICES LOCATION NOTES

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D 1□ - DENOTES APPRO□ 1□ METRE DEPTH OF SERVICE

S	SEWER
COMS	COMMUNICATIONS
COMS	UNDETECTED COMMUNICATIONS □B□ DB□D□
E	ELECTRICIT□
G	GAS
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LEGEND□

SEWER MANHOLE	SIGN
UNCLASS SEWER	TRAFFIC JUNCTION BOX
SEWER VENT	TRAFFIC SIGNAL PIT
SEWER LAMP HOLE	GAS PIT
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D 1.1 - DENOTES APPRO□ 1.1 METRE DEPTH OF SERVICE

S	SEWER
COMS	COMMUNICATIONS
COMS	UNDETECTED COMMUNICATIONS □B□ DB□D□
E	ELECTRICIT□
G	GAS
D	DRAINAGE
D	UNDETECTED DRAINAGE □B□ DB□D□
W	WATER SUPPL□
UNK	UNKNOWN SERVICE

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DETACHABLE SHED

ELECTRICAL SUBSTATION

BRICK WAREHOUSE METAL ROOF

APPROX CENTRE OF 2.5 X 1.35 RC DRAINAGE CHANNEL (FROM DBYD PLANS)

PROPOSED CORNER KERB RAMP TO SYDNEY WATER STANDARD

'A'□EASEMENT FOR ELECTRICIT□ PURPOSES □DP □□06□6□
'B'□EASEMENT TO DRAIN WATER □ WIDE□□DP □□06□6□
'C'□EASEMENT FOR TELECOM SERVICES □□WIDE□□DP □□06□6□
R□COVENANT G10□□06□
□□EASEMENT FOR STORMWATER 6.0□□ WIDE □H□6.□□0□□
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LEGEND□

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PLAN SHOWING SERVICES LOCATIONS EPSOM PARK PRECINCT □ETLAND

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SERVICES LOCATION NOTES

1□ SERVICES SHOWN HEREON ARE INDICATIVE ONL□□ CURRENC□□COMPLETENESS AND ACCURAC□ ARE NOT TO BE PRESUMED□

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□□ THE INFORMATION SHOWN HEREON MA□ VAR□ DUE TO SITE CONDITIONS ENCOUNTERED DURING THE COURSE OF THE SERVICE LOCATION□

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□□ PRIOR TO AN□ DESIGN OR CONSTRUCTION WITHIN THE VICINIT□ OF THESE SERVICE LINES□IT IS IMPORTANT THAT THESE SERVICES BE VISUALL□ VERIFIED AND THEIR POSITION UPDATED ON THIS PLAN□

□□ "POTHOLE TO ESTABLISH THE EXACT LOCATION OF ALL UNDERGROUND ASSETS USING A HAND SHOVEL□BEFORE USING HEAVY MACHINERY" - DIAL BEFORE YOU DIG

□□ "TO DETERMINE THEIR PRECISE LOCATION, SYDNEY WATER□S PIPELINES MUST FIRST BE E□POSED B□ POTHOLING USING HAND HELD TOOLS OR VACUUM TECHNI□UES I E□BEFORE AN□ MECHANICAL MEANS OF EXCAVATION ARE EMPLOYED" - SYDNEY WATER

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11□ "IF YOU ARE GOING TO EXCAVATE/BORE WITHIN 0.4m OF THE GAS MAIN LOCATION AS INDICATED ON THE MAP □OU MUST E□CAVATE CAREFULL□ B□ HAND□IF □OU CAN□T LOCATE THE GAS MAIN, CONTACT THE LOCAL DEPOT" - □EMENA

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1□□ THE ABOVE NOTES ARE AN INTEGRAL PART OF THE PLAN

HP DENOTES HIGH PRESSURE
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SCL DENOTES STEEL CEMENT LINED PIPE
IBL DENOTES INTERNAL BITUMEN LINED PIPE

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LEGEND□

SEWER MANHOLE	SIGN	STATE SURVEY MARK	UNCLASS WATER
UNCLASS SEWER	TRAFFIC JUNCTION BOX	SURVEY MARK	WATER METER
SEWER VENT	TRAFFIC SIGNAL PIT	UNCLASS ELECTRICITY	STOP VALVE
SEWER LAMP HOLE	GAS PIT	POWER POLE	TAP
TELSTRA PIT 1.0x1.0	GAS MARKER POST	LIGHT POLE	HYDRANT
UNCLASS TELSTRA	UNCLASS GAS	ELECTRICITY PIT	GULLY PIT
TWIN TELSTRA PIT	TRAFFIC CONTROL SIGNAL	UNCLASS SERVICE	JUNCTION BOX
TELSTRA PIT		CCTV CAMERA	GRATED PIT
		BIN	DRAINAGE MANHOLE

REVISION	DATE	DESCRIPTION	CCAD REF	APPROVED
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PLAN SHOWING SERVICES LOCATIONS
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PE	DENOTES POL□ETH□LENE PIPE
CICL	DENOTES CAST IRON CEMENT LINED PIPE
SCL	DENOTES STEEL CEMENT LINED PIPE
IBL	DENOTES INTERNAL BITUMEN LINED PIPE

D 1□1 - DENOTES APPRO□ 1□1 METRE DEPTH OF SERVICE

NOTES□
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IMPORTANT NOTE□
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SEWER MANHOLE	SIGN
UNCLASS SEWER	TRAFFIC JUNCTION BOX
SEWER VENT	TRAFFIC SIGNAL PIT
SEWER LAMP HOLE	GAS PIT
TELSTRA PIT 1.0x1.0	GAS MARKER POST
UNCLASS TELSTRA	UNCLASS GAS
TWIN TELSTRA PIT	TRAFFIC CONTROL SIGNAL
TELSTRA PIT	

STATE SURVEY MARK	UNCLASS WATER
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PLAN SHOWING SERVICES LOCATIONS EPSOM PARK PRECINCT □ETLAND

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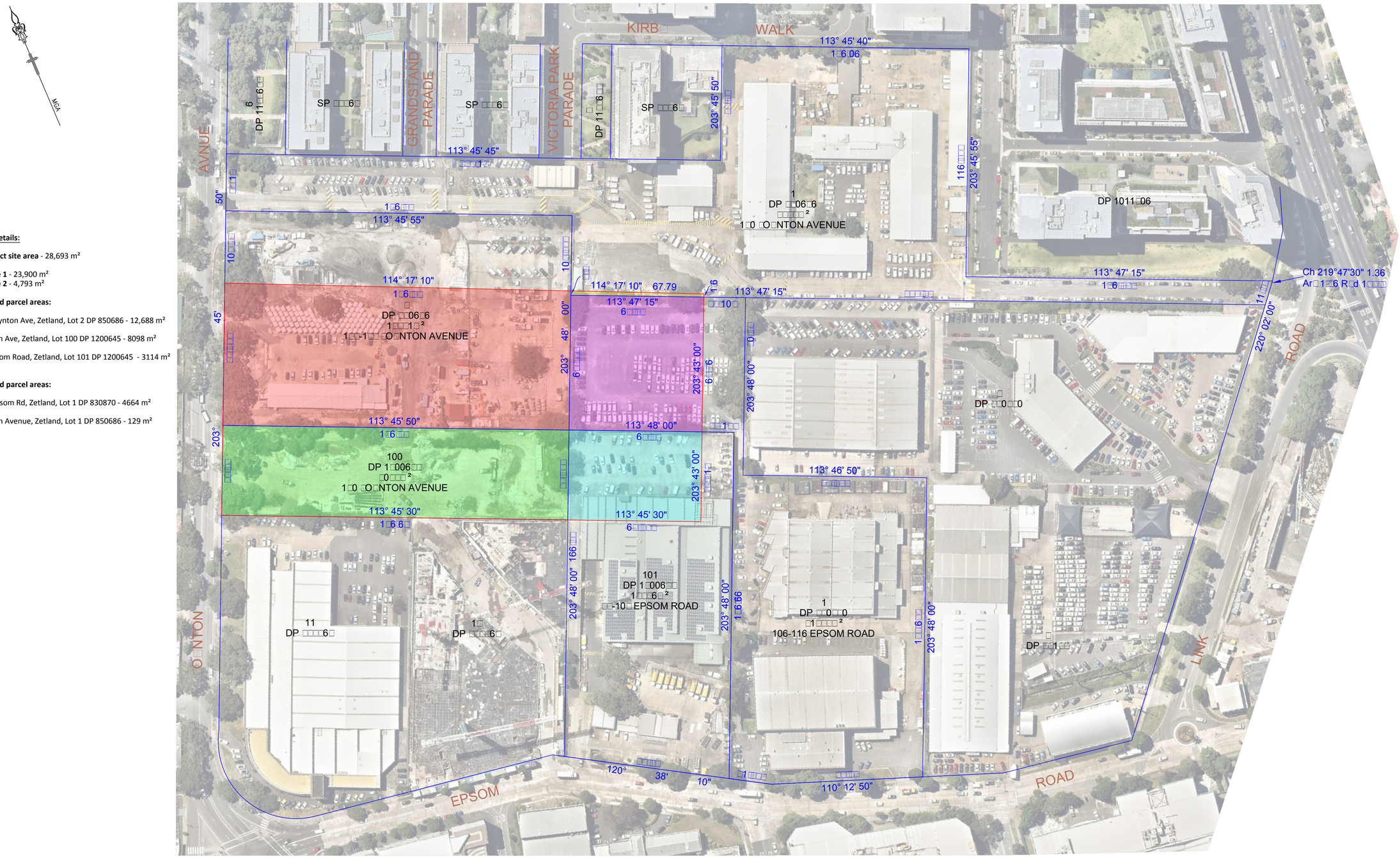

Site area details:

Total project site area - 28,693 m²

Total Stage 1 - 23,900 m²
Total Stage 2 - 4,793 m²

Stage 1 land parcel areas:

- 132-138 Joynton Ave, Zetland, Lot 2 DP 850686 - 12,688 m²
- 140 Joynton Ave, Zetland, Lot 100 DP 1200645 - 8098 m²
- 94-104 Epsom Road, Zetland, Lot 101 DP 1200645 - 3114 m²

Stage 2 land parcel areas:

- 106-116 Epsom Rd, Zetland, Lot 1 DP 830870 - 4664 m²
- 130 Joynton Avenue, Zetland, Lot 1 DP 850686 - 129 m²

IMPORTANT NOTE□
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PRO□ECT□ GUNYAMA PARK AND GREEN SQUARE AQUATIC CENTRE

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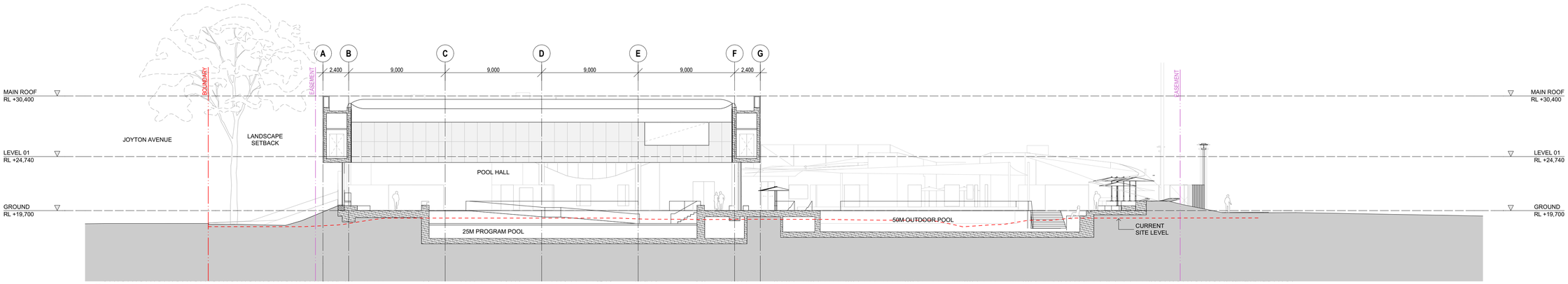
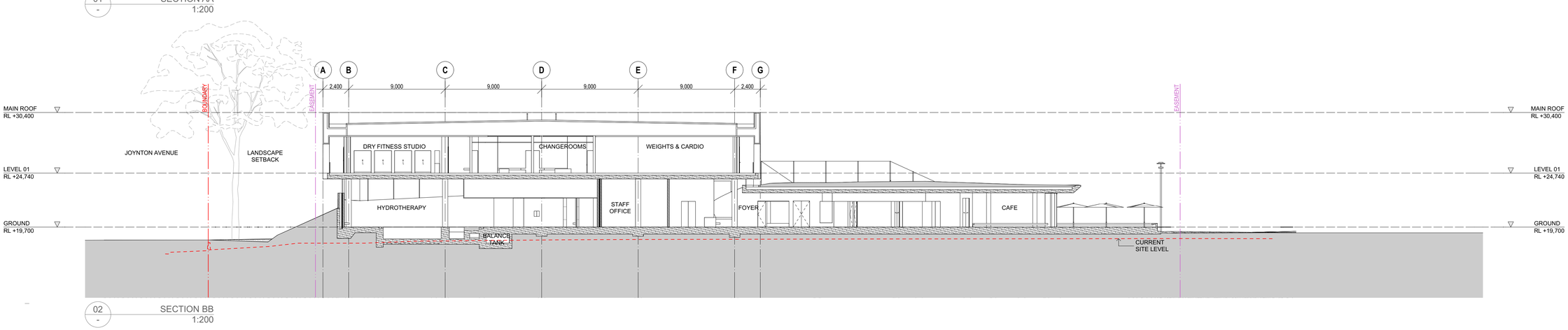
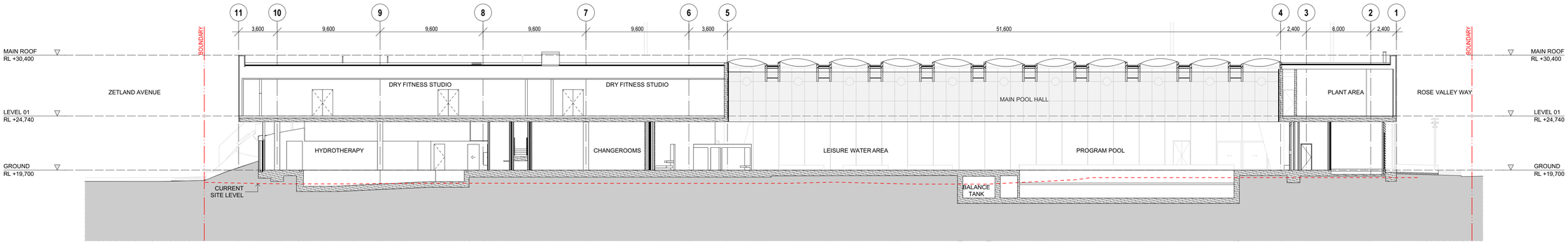


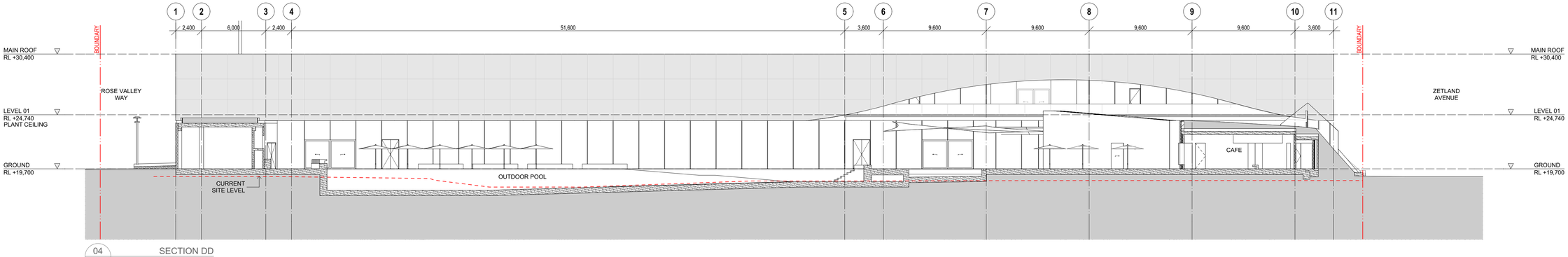
01 - SECTION AA 1:200



02 - SECTION BB 1:200



03 - SECTION CC 1:200



04 - SECTION DD 1:200

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NORTH

GRAPHICAL SCALE

0 1 2 4 6 8 10m

REV	DATE	ISSUE
A	31/05/16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

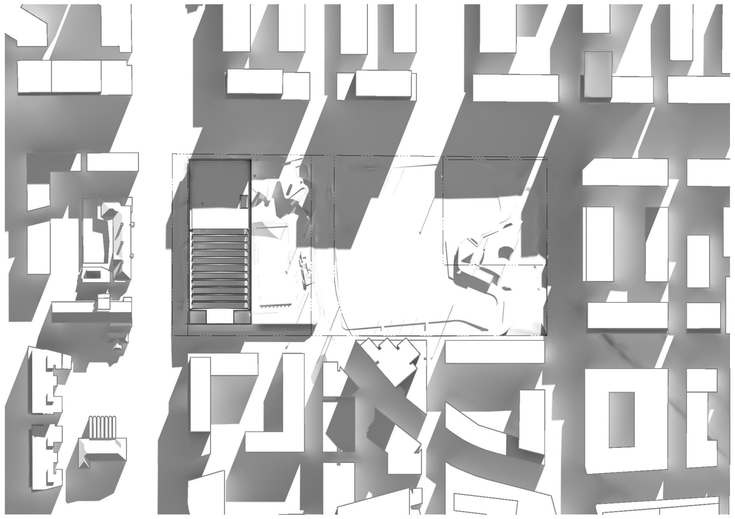
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

SECTIONS OVERALL

DRAWN: CM
CHECKED: NB
SCALE: 1:200 @ A1
FIRST ISSUE: 31/05/16
DRAWING NO: ARC-DA-301
REV: A

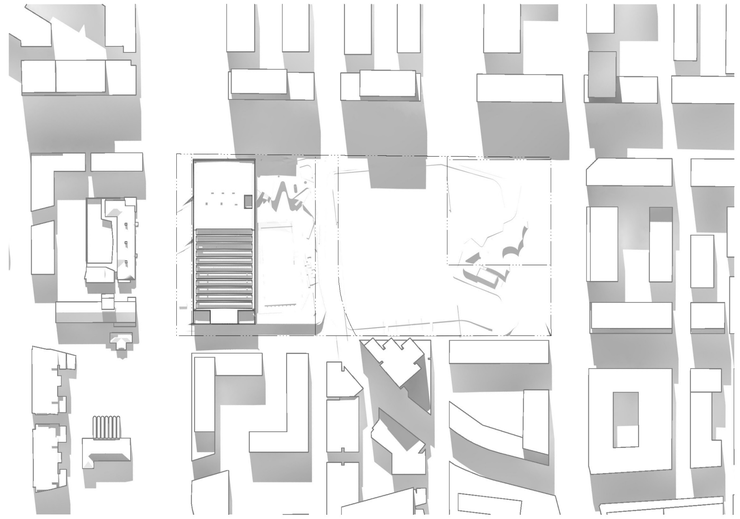
DEVELOPMENT APPLICATION



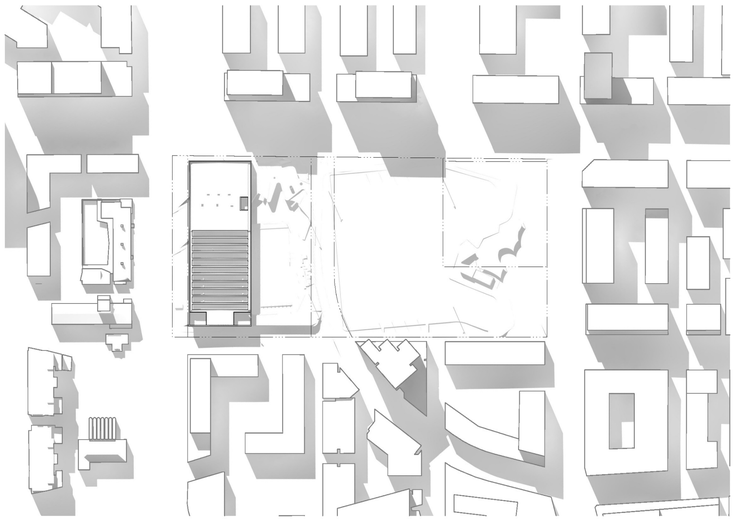
01 - 9 AM - MIDWINTER - JUNE 21 1:2000



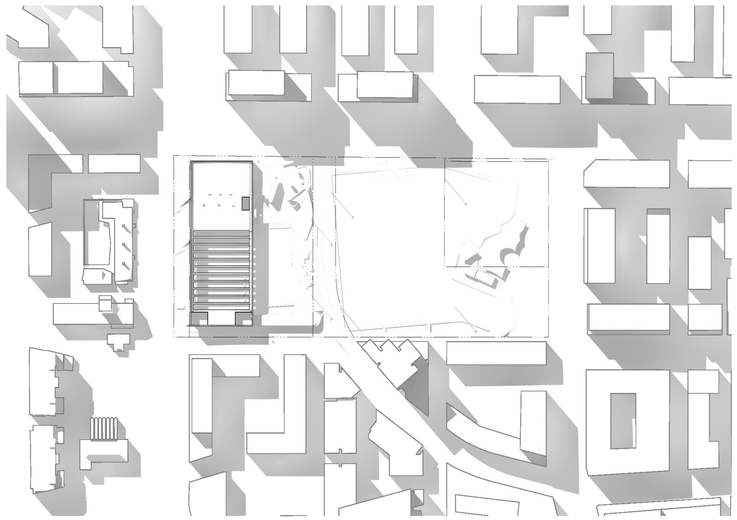
02 - 10 AM - MIDWINTER - JUNE 21 1:2000



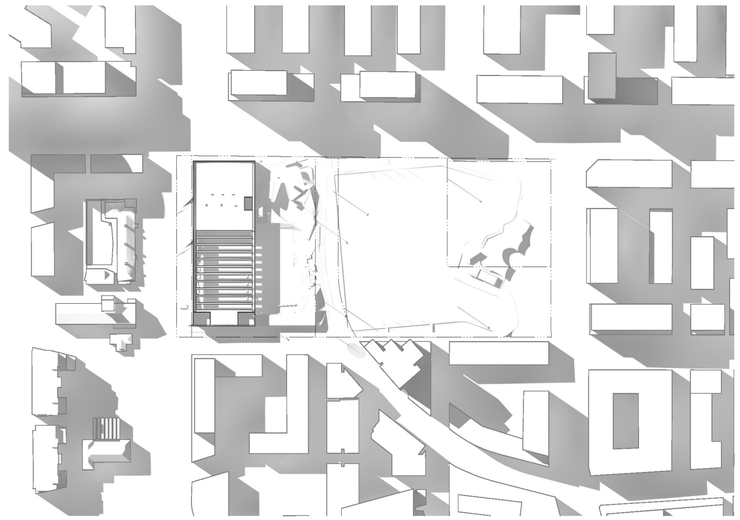
03 - 11 AM - MIDWINTER - JUNE 21 1:2000



04 - 12 PM - MIDWINTER - JUNE 21 1:2000



05 - 1 PM - MIDWINTER - JUNE 21 1:2000



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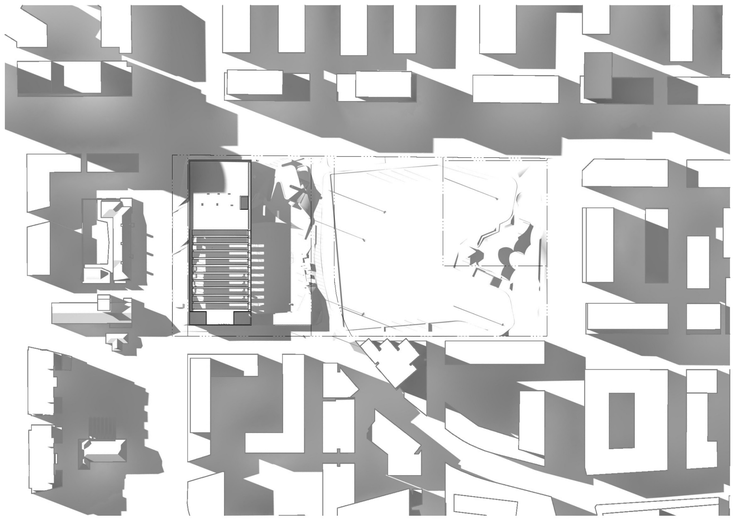

07 - 3 PM - MIDWINTER - JUNE 21 1:2000

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NORTH

GRAPHICAL SCALE

0 10 20 40 60 80 100m

GENERAL NOTES

ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED ON SITE BY THE CONTRACTOR BEFORE PROCEEDING WITH THE WORK

DO NOT SCALE DRAWINGS. USE FIGURED DIMENSIONS ONLY

ALL LEVELS RELATIVE TO 'AUSTRALIAN HEIGHT DATUM'

REV	DATE	ISSUE
A	27/05/16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

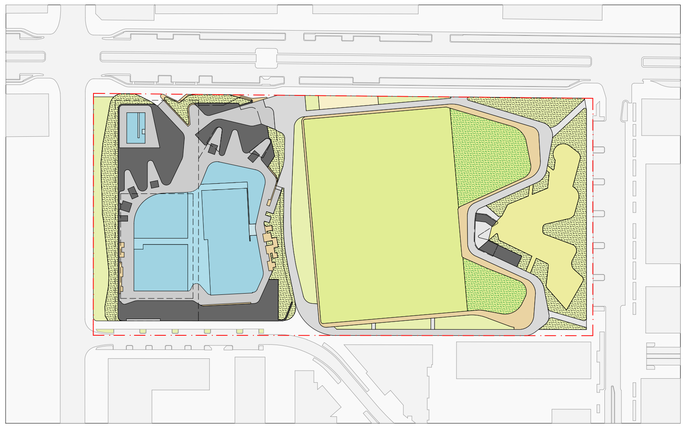
TITLE

SHADOW DIAGRAMS

DRAWN: CM
CHECKED: NB
SCALE: 1:2000 @ A1
FIRST ISSUE: 27/05/16

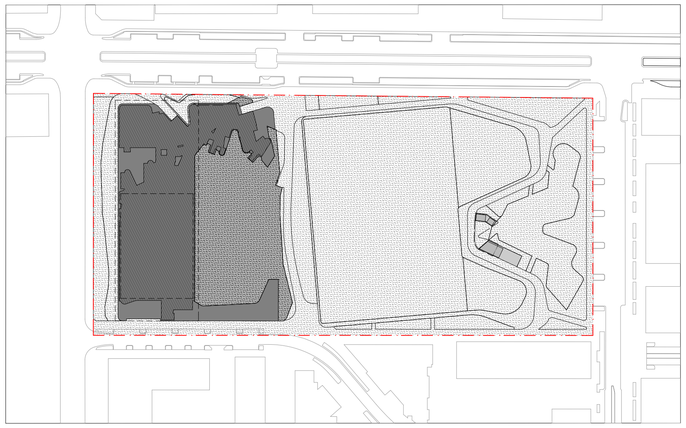
DRAWING NO: ARC-DA-521
REV: A

DEVELOPMENT APPLICATION



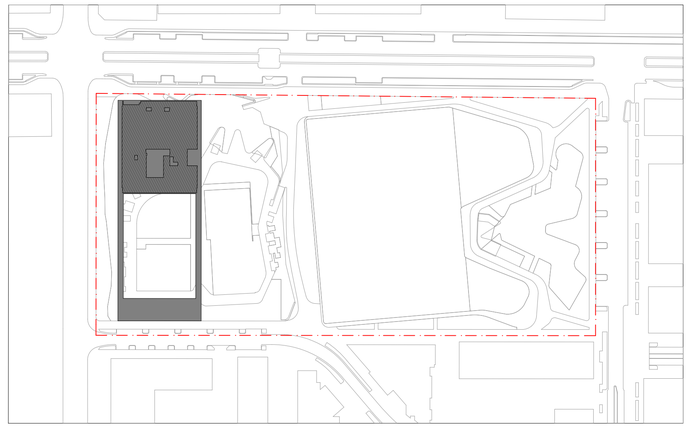
DA SITE BOUNDARY
POOLS
BUILDING
CONCOURSE
CIRCUIT PATH
SECONDARY PATH
SEATING EDGE
SPORTS FIELD
LAWN AREA
LANDSCAPE
LANDSCAPED BERMS
PLAYGROUND
FITNESS STATION

01 - SITE PROGRAMMING 1:1500



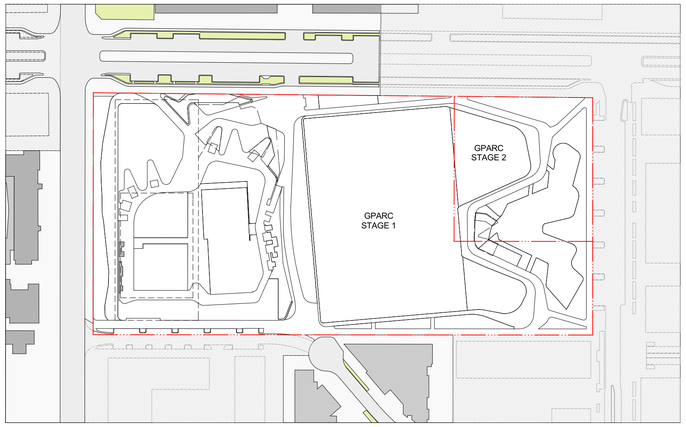
GROUND FLOOR GFA 3904m2
GROUND FLOOR TOTAL BUILDING AREA 5130m2
EXTERNAL AREAS WITHIN ENCLOSURE 3229m2
EXTERNAL AREAS OUTSIDE ENCLOSURE 20,190m2
PARK AMENITIES GFA 91m2
PARK AMENITIES TOTAL BUILDING AREA 169m2
DA SITE BOUNDARY 28,693m2

02 - GROUND FLOOR BUILDING AREAS 1:1500



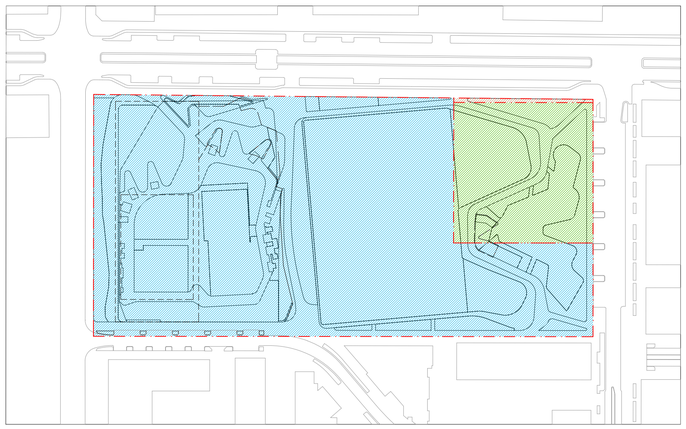
FIRST FLOOR GFA 1550m2
FIRST FLOOR TOTAL AREA 2587m2
DA SITE BOUNDARY

03 - FIRST FLOOR BUILDING AREAS 1:1500



PLANNED ROADS TO BE COMPLETED BEFORE COMMENCEMENT OF GPARC CONSTRUCTION
PLANNED BUILDINGS TO BE COMPLETED BEFORE COMMENCEMENT OF GPARC CONSTRUCTION
EXISTING BUILDINGS
SURROUNDING SITE TO BE DELIVERED AFTER GPARC COMPLETION
DA SITE BOUNDARY

04 - INTERIM STAGE SURROUNDING PUBLIC DOMAIN 1:1500



OWNED BY CITY OF SYDNEY
OWNED BY OTHERS
OWNED BY OTHERS
DA SITE BOUNDARY 28,693m2

05 - LAND OWNERSHIP 1:1500

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NORTH

GRAPHICAL SCALE
0 10 20 40 80m

NOTE

THIS PROJECT WILL BE DELIVERED IN STAGES

GROSS FLOOR AREA (GFA)	
GROUND FLOOR	
MAIN BUILDING	3,904 m²
PARK AMENITIES	91 m²
LEVEL 01	
MAIN BUILDING	1,550 m²
TOTAL	**5,545 m²**
FLOOR SPACE RATIO (FSR)	
GROSS FLOOR AREA	5,545m²
SITE AREA	28,693 m²
RATIO	**0.19:1**

REV	DATE	ISSUE
A	31/05/16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

SITE ANALYSIS DIAGRAMS

DRAWN: CM
CHECKED: NB
SCALE: 1:1500 @ A1
FIRST ISSUE: 31/05/16

DRAWING NO: ARC-DA-002
REV: A

DEVELOPMENT APPLICATION

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NORTH

GRAPHICAL SCALE

0 2.5 5 10 15 20 25m

NOTE

THIS PROJECT WILL BE DELIVERED IN STAGES

GROSS FLOOR AREA (GFA)	
GROUND FLOOR	
MAIN BUILDING	3,904 m²
PARK AMENITIES	91 m²
LEVEL 01	
MAIN BUILDING	1,550 m²
TOTAL	5,545 m²
FLOOR SPACE RATIO (FSR)	
GROSS FLOOR AREA	5,545m²
SITE AREA	28,893 m²
RATIO	0.19:1

SOUTH SYDNEY HOSPITAL SITE

G.I.C. PRIVATE BUILDING

ZETLAND AVENUE

FIRE HYDRANT BOOSTER (FHB) LOCATION OPTION

ACCESSIBLE PARKING AND DROP OFF/ PICK UP ZONE SHOWN HATCHED

IN LANE BUS STOP

LOADING ZONE

OPEN CHANNEL TO COLLECT OVERLAND FLOW IN INTERIM SCHEME

INTERIM SCHEME ZETLAND AVENUE ROAD & PATH CONSTRUCTION: CUL DE SAC TO BE COMPLETED TO THIS EXTENT OF THE LENGTH OF ZETLAND AVENUE. INTERIM LEVELS REQUIRE GRADING THAT DIFFERS FROM THE ULTIMATE GRADING SCHEME

LAND OWNED BY OTHERS

LAND OWNED BY OTHERS

LAND OWNED BY CITY OF SYDNEY

EXTENT SHOWN IS INDICATIVE ONLY. INTERIM SCHEME BATTER / RETAINING WALL FINISHED TO PARK LEVELS

EXTENT SHOWN IS INDICATIVE ONLY. INTERIM SCHEME BATTER REQUIRED TO RETAIN ADJACENT LAND, WHEN INTERIM SCHEME RETAINING WALLS ARE NOT INSTALLED

EXTENT SHOWN IS INDICATIVE ONLY. INTERIM SCHEME BATTER / RETAINING WALL FINISHED TO PARK LEVELS

JOYNTON AVENUE

GEORGE JULIUS AVENUE

TREE TO BE REMOVED BY OTHERS

NEW TREES

LANDSCAPED BERM

EXISTING TREES TO BE RETAINED

GYM BALCONY UNDER

EGRESS PATH

ENTRY OFF ZETLAND AVE/ STREET ENTRY

BIKE PARKING (8)

BIKE PARKING (20)

BIKE PARKING (10)

LANDSCAPED BERM

LINE OF FENCE

SKYLIGHT

GREEN ROOF

SKY GUTTER

BOX GUTTER

ROOF OVER EXTERNAL CHANGE ROOMS

EXHAUST VENT

GRILLE

AIR EXHAUST

PHOTOVOLTAIC CELLS

SUNSHADING

ROOF OVER POOL HALL

CUTDOOR POOL 50m

T54 RL18.27

T55 RL18.43

T57 RL18.46

T61 RL18.60

NEW TREES

ALIGNMENT OF EASEMENT (LANDSCAPE SETBACK)

WATER METER

INTERIM SCHEME LOADING ACCESS

SITE BOUNDARY

OPEN PLANT AREA BELOW

GAS METER ROOM BELOW

TEMPORARY KERB RAMP FINISHED TO NEW FOOTPATH LEVELS

PARKING BAYS

FLOOD-LIGHT POLE

GREEN ROOF

STAFF BIKE PARKING (8)

BIKE PARKING (6)

BIKE PARKING (8)

ENTRY OFF ZETLAND AVE/ PARK ENTRY

PARK LIGHT POLE

BIKE PARKING (10)

FITNESS STATION

CIRCUIT PATH

FIELD NET

DECK SEAT EDGE

GREASE TRAP ACCESS

FLOOD-LIGHT POLE

ALIGNMENT OF EASEMENT (OVERLAND FLOW AND TRUNK DRAINAGE)

SERVICE GATE

RAIN GARDEN & PUBLIC ARTWORK

SKATEABLE MOMENT

INSITU CONCRETE PAVED

SPORTSFIELD (SYNTHETIC) 90m x 45m + PERIMETER

UMBRELLAS

PLATFORM SEATING

GPT ACCESS POINTS

GPT

WASTE LOADING BAY

BIKE PARKING (2)

DRUIT PATH & RAMP INTEGRATES WITH ADJACENT MERITON DEVELOPMENT

MERITON DEVELOPMENT

INTERIM SCHEME EXTENT OF ROSE VALLEY WAY

EXTENT SHOWN IS INDICATIVE ONLY. INTERIM SCHEME RETAINING WALL / BATTERING REQUIRED TO RETAIN LAND TO NEW FOOTPATH LEVELS & DIRECT STORMWATER TO OVERLAND FLOW

FLOOD-LIGHT POLE

PARK LIGHT POLE

CIRCUIT PATH

FIELD NET

DECK SEAT EDGE

FLOOD-LIGHT POLE

GRASS LAWN

BIKE PARKING (10)

AREA WITH BBQ SEATING & SHADE UMBRELLAS

SKATE BOWL

SKATEABLE MOMENT

PLAYGROUND SUNSHADING

PLAYGROUND

BIKE PARKING (14)

AMENITIES BUILDING, FIELD CHANGE ROOMS & STORAGE

PARK BENCH & TABLE

AREA WITH BBQ SEATING & SHADE UMBRELLAS

PARK SEATING

BIKE PARKING (10)

FENCE

FENCE TO BE ERECTED AROUND ENTIRE DEPOT SITE (TEMPORARY WATER STORAGE BASIN).

DEPOT SITE:
EXTENT SHOWN IS INDICATIVE ONLY.
CLEAR SITE & UTILISE AS TEMPORARY WATER HOLDING BASIN DURING INTERIM SCHEME WORKS.

REFER TO CJ ARMS DOCUMENTATION FOR DEMOLITION

01 - SITE PLAN INTERIM SCHEME 1:500

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A	31/05/16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

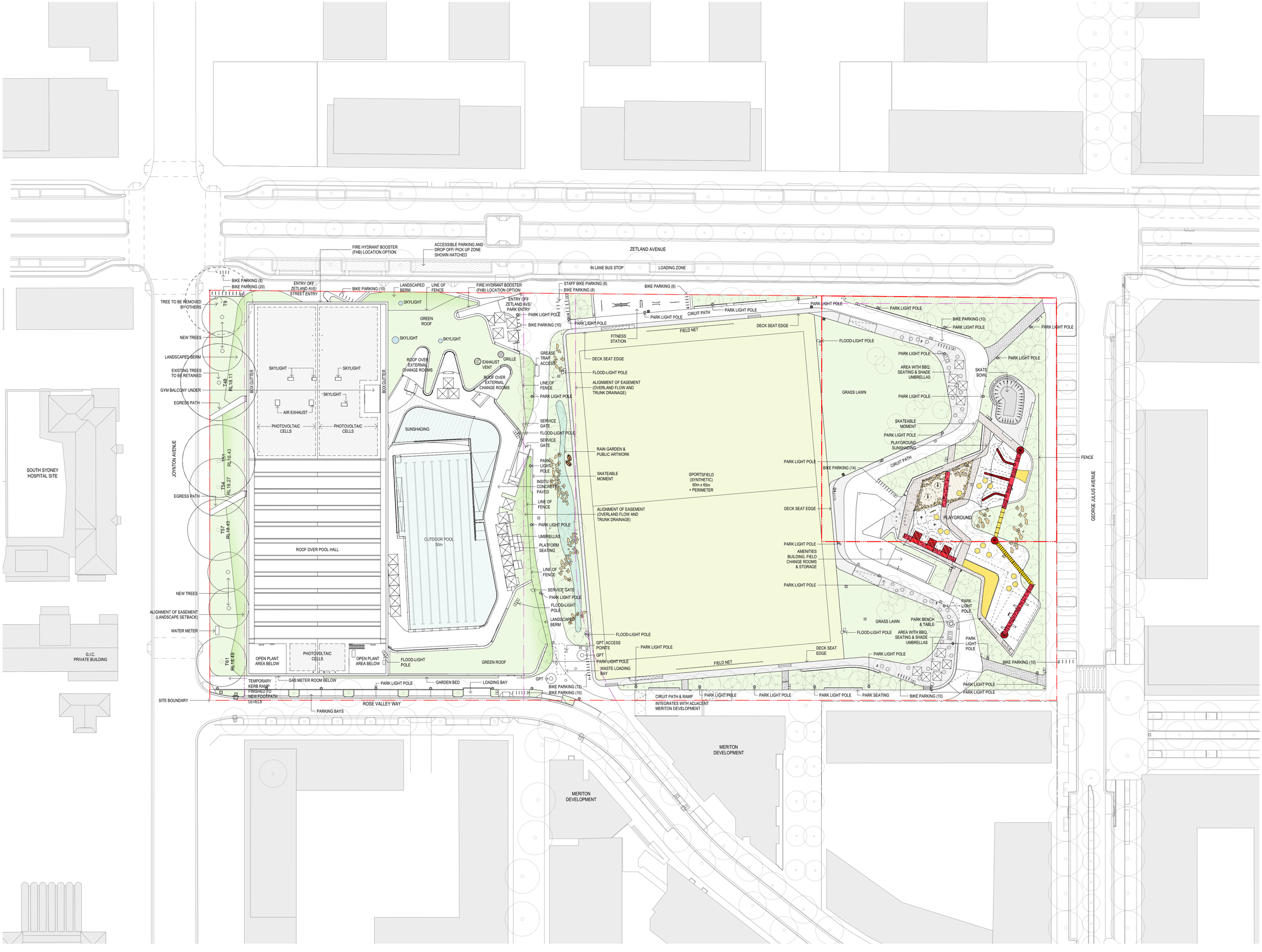
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

SITE PLAN INTERIM STAGE SURROUNDING PUBLIC DOMAIN

DRAWN: MD
CHECKED: NB
SCALE: 1:500 @ A1
FIRST ISSUE: 31/05/16
DRAWING NO: ARC-DA-012
REV: A

DEVELOPMENT APPLICATION



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NORTH

GRAPHICAL SCALE

0 2.5 5 10 15 20 25m

NOTE

THIS PROJECT WILL BE DELIVERED IN STAGES

GROSS FLOOR AREA (GFA)	
GROUND FLOOR	
MAIN BUILDING	3,904 m²
PARK AMENITIES	91 m²
LEVEL 01	
MAIN BUILDING	1,550 m²
TOTAL	**5,545 m²**
FLOOR SPACE RATIO (FSR)	
GROSS FLOOR AREA	5,545m²
SITE AREA	28,693 m²
RATIO	**0.19:1**

REV	DATE	ISSUE
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Sydney NSW 2000 Australia

PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

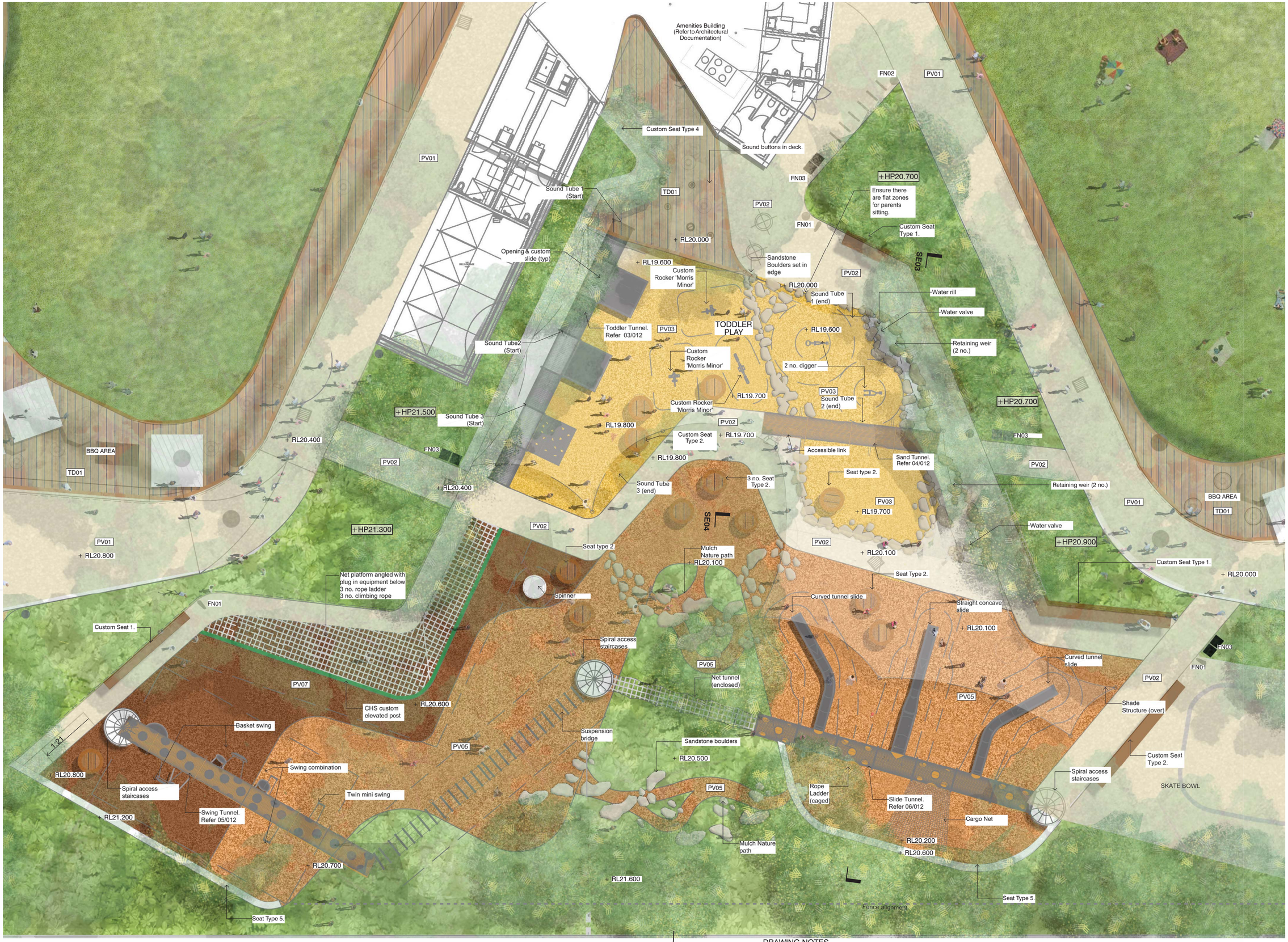
TITLE

SITE PLAN

DRAWN: MD
CHECKED: NB
SCALE: 1:500 @ A1
FIRST ISSUE: 31/05/16

DRAWING NO: ARC-DA-011
REV: A

DEVELOPMENT APPLICATION



DRAWING NOTES
TREES LIGHTENED FOR CLARITY.
REFER LANDSCAPE LEGEND & MATERIALS (ARC-T-DA-002).
REFER ARCHITECTURAL DOCUMENTATION FOR DETAIL ON AMENITIES BULDING

0 5 10m

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PROJECT

Gunyama Park Aquatic and Recreation Centre
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

Detailed Playground Plan

DRAWN: AL
CHECKED: SA
SCALE: 1:100@A1
FIRST ISSUE: 13/05/16

DRAWING NO: ARC-T-DA-010
REV: A

DEVELOPMENT APPLICATION

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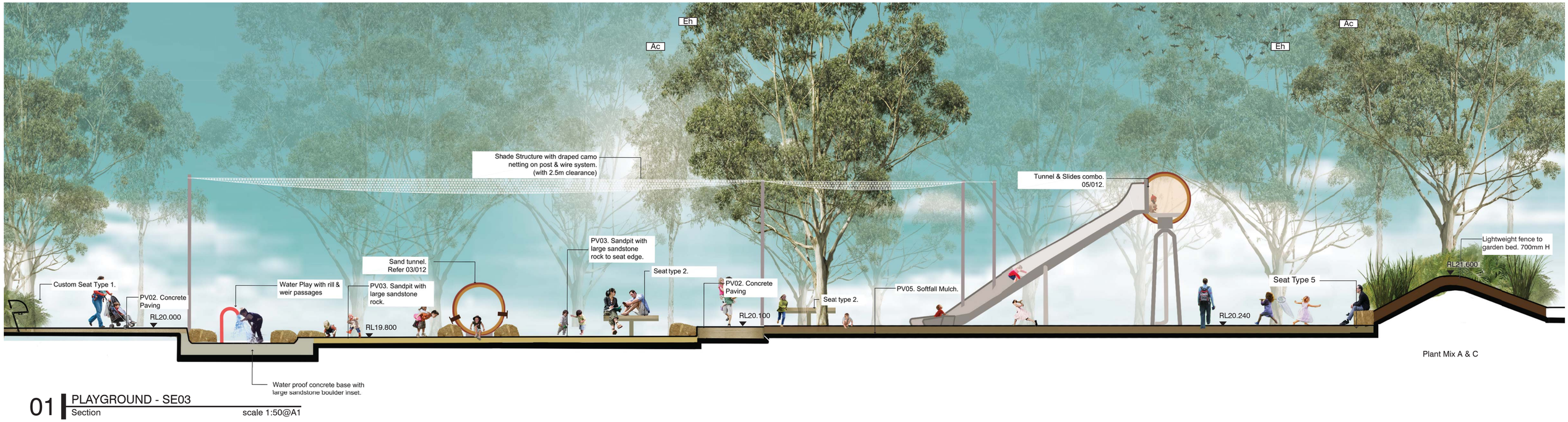

01 PLAYGROUND - SE03
Section scale 1:50@A1



Nature Play with PV05 & sandstone stepping stone amongst planting

02 PLAYGROUND - SE04
Section scale 1:50@A1

DRAWING NOTES
REFER ARCHITECTURE PLANS FOR FULL DETAILS ON AQUATIC & RECREATION CENTRE
REFER LANDSCAPE LEGEND & MATERIALS (ARC-T-DA-002)

A 27.05.16 DEVELOPMENT APPLICATION
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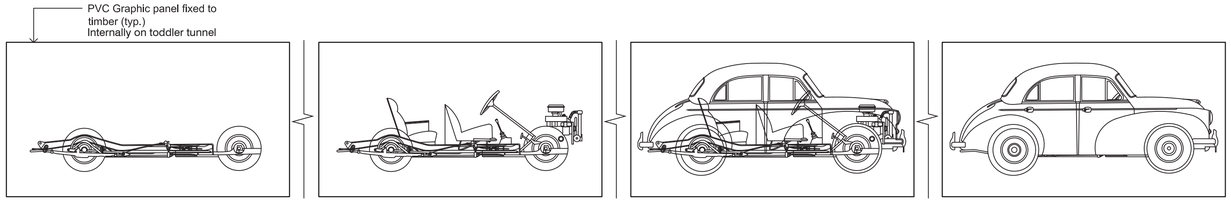
PROJECT
Gunyama Park Aquatic and Recreation Centre
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE
Detailed Playground

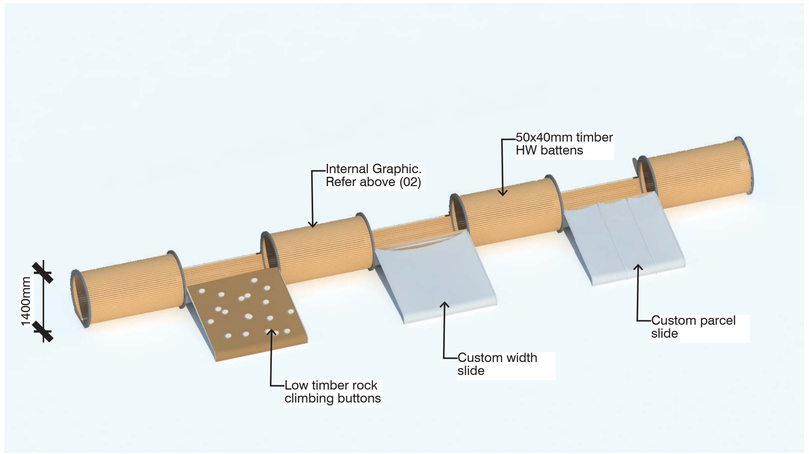
DRAWN: AL
CHECKED: SA
SCALE: 1:50 @A1
FIRST ISSUE: 13/05/16
DRAWING NO: ARC-T-DA-011
REV: A

DEVELOPMENT APPLICATION



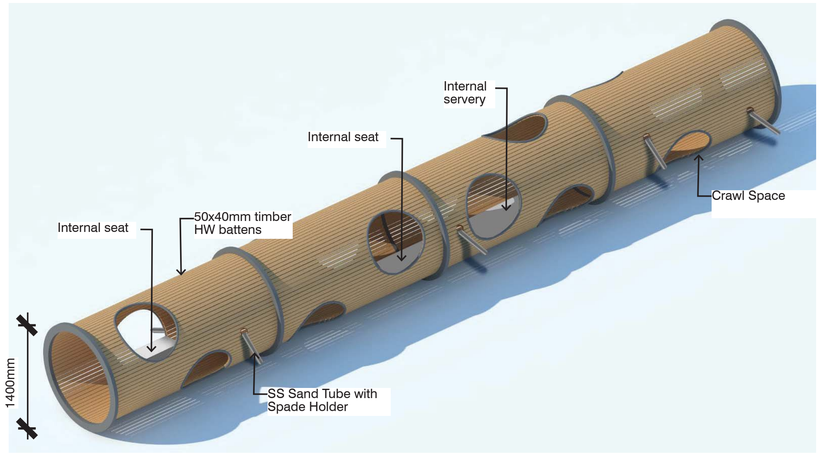
02 INTERPRETATION - MORIS MINOR PRODUCTION LINE

Diagram scale 1:50@A1



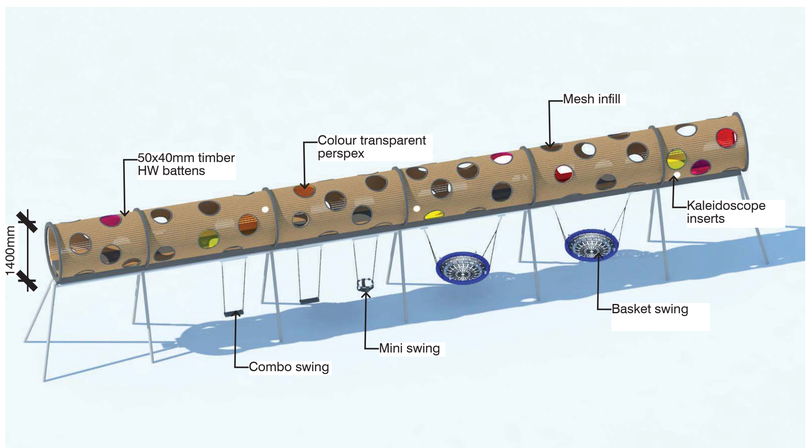
03 TODDLER TUNNEL

Axo scale NTS



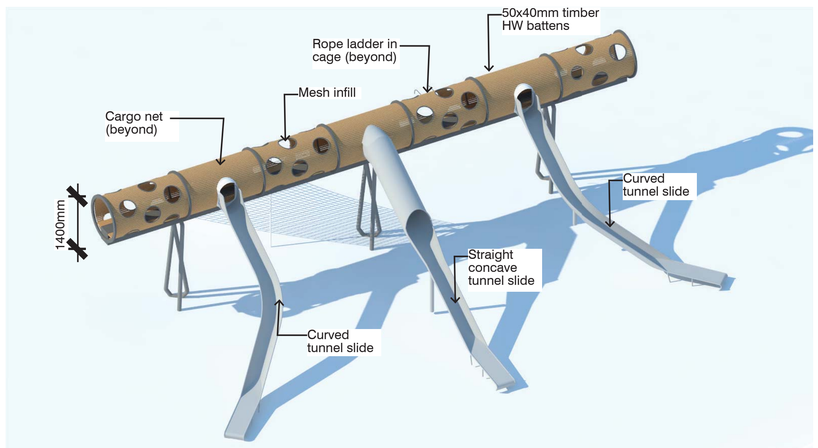
04 SAND TUNNEL

Axo scale NTS



05 SWING TUNNEL

Axo scale NTS



06 SLIDE TUNNEL

Axo scale NTS

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PROJECT

Gunyama Park Aquatic and Recreation Centre

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

Detailed Playground

DRAWN: AL
CHECKED: SA
SCALE: NTS
FIRST ISSUE: 13/05/16

DRAWING NO	REV
ARC-T-DA-012	A

DEVELOPMENT APPLICATION

GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LANDSCAPE WORKS

132 - 140 Joynton Avenue, Zetland NSW 2017

Drawing Number	Drawing Title	Scale
ARC-T-DA-001	DRAWING LIST & SITE CONTEXT PLAN	1:750@A1
ARC-T-DA-002	LANDSCAPE LEGEND & MATERIALS	NTS
ARC-T-DA-003	TREE PROTECTION & REMOVAL PLAN	1:350@A1
ARC-T-DA-004	GENERAL ARRANGEMENT PLAN	1:350@A1
ARC-T-DA-005	FURNITURE & FIXTURES PLAN	1:350@A1
ARC-T-DA-006	GRADING PLAN	1:350@A1
ARC-T-DA-007	PLANTING STRATEGY	1:350@A1
ARC-T-DA-008	LONG SECTIONS & ELEVATION	As shown
ARC-T-DA-009	SECTIONS	1:50@A1
ARC-T-DA-010	DETAILED PLAYGROUND PLAN	1:100@A1
ARC-T-DA-011	DETAILED PLAYGROUND	1:50@A1
ARC-T-DA-012	DETAILED PLAYGROUND	NTS

DRAWING NOTES
THIS SITE WILL BE DELIVERED IN STAGES ACCORDING TO LAND OWNERSHIP

STAGE 1: LAND OWNED BY CITY OF SYDNEY
STAGE 2: LAND OWNED BY OTHERS.



01 SITE CONTEXT
Plan scale 1:750@A1

0 10 20m 30m 40m

DRAWING NOTES
DEVELOPMENT OUTSIDE OF SITE BOUNDARY IS SHOWN FOR INFORMATION ONLY

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LEGEND

Site Boundary

Stages Boundary

A 27.05.16 DEVELOPMENT APPLICATION
REV DATE ISSUE

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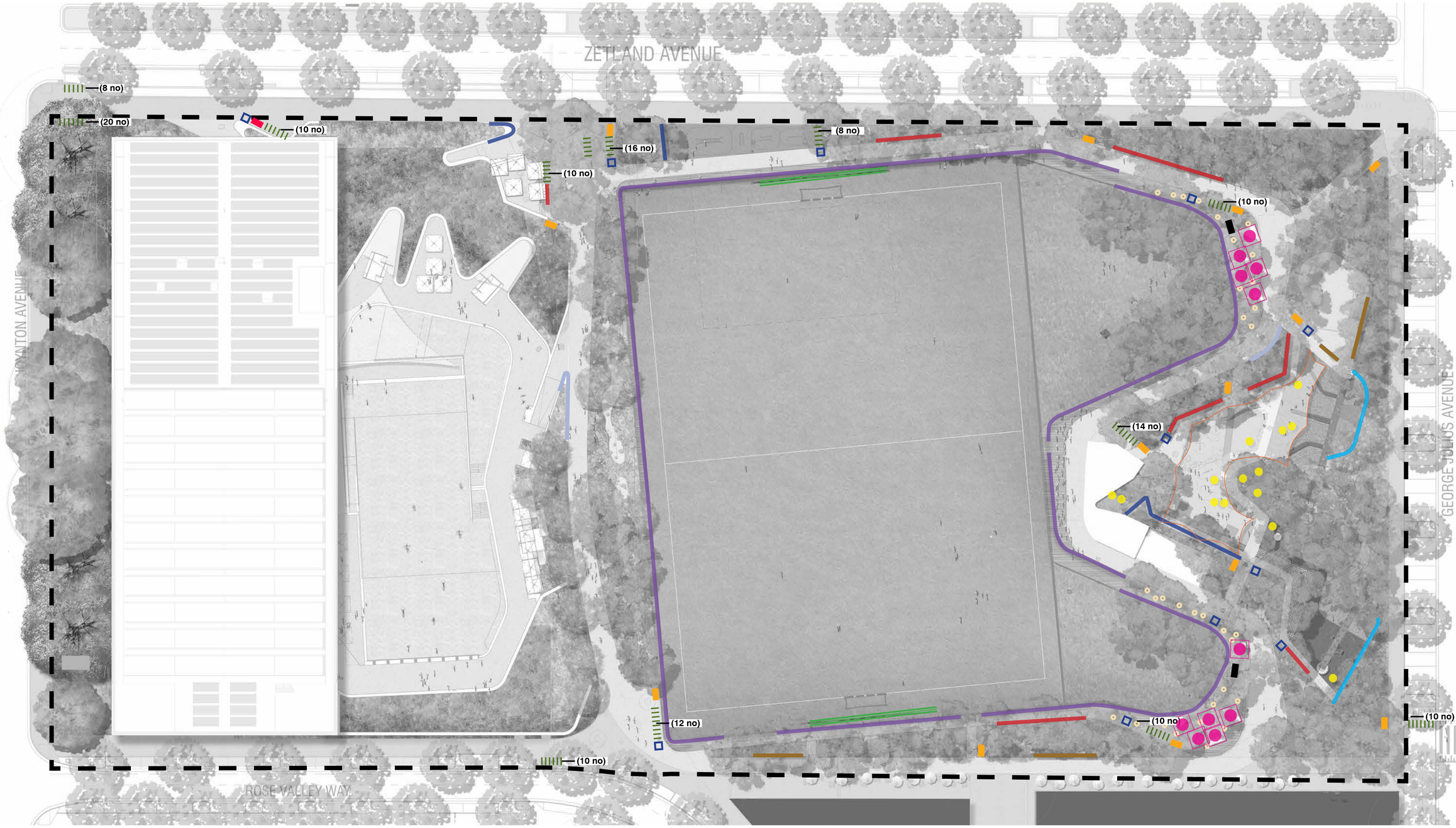
PROJECT
Gunyama Park Aquatic and Recreation Centre
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE
Drawing List & Site Context Plan

DRAWN: AL
CHECKED: SA
SCALE: 1:750
FIRST ISSUE: 13/05/16
DRAWING NO: ARC-T-DA-001
REV: A

DEVELOPMENT APPLICATION



SCALE 1:350@A1

0 5 10 15 20m

DRAWING NOTES

REFER LIGHTING STRATEGY FOR PARK LIGHTING.
REFER LANDSCAPE LEGEND & MATERIALS (ARC-T-DA-002).
THIS PROJECT WILL BE DELIVERED IN STAGES, REFER TO ARC-T-DA-004.

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LEGEND

- Site Boundary
- FN01- Drinking Fountain. Refer Furniture & Fixtures Schedule
- FN02 - Bicycle Hoop Refer Furniture & Fixtures Schedule
- FN03 - Recycle Bin & Refuse Refer Furniture & Fixtures Schedule
- FN04 - Shade Umbrellas Refer Furniture & Fixtures Schedule
- FN05 - Shade Netting Refer Furniture & Fixtures Schedule
- FX04 - BBQ Refer Furniture & Fixtures Schedule
- FX05 - Tree Grate Refer Furniture & Fixtures Schedule
- Seat Type 1 - Timber with backrest Refer Furniture & Fixtures Schedule
- Seat Type 2 - Circular Seat Refer Furniture & Fixtures Schedule
- Seat Type 3 - Timber seat Refer Furniture & Fixtures Schedule
- Seat Type 4 - Concrete Plinth Refer Furniture & Fixtures Schedule
- Seat Type 5 - Drystone Plinth Refer Furniture & Fixtures Schedule
- Picnic Table - Round table & chair Refer Furniture & Fixtures Schedule
- Timber Terrace Seating Edge
- Skateable Moment
- Sports Field Netting

REV	DATE	ISSUE
A	02.06.16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

Furniture & FixturesPlan

DRAWN: AL
CHECKED: SA
SCALE: 1:350 @A1
FIRST ISSUE: 13/05/16

DRAWING NO: ARC-T-DA-005
REV: A

DEVELOPMENT APPLICATION



SCALE 1:350@A1

0 5 10 15 20m

DRAWING NOTES

REFER ARCHITECTURE PLANS FOR FULL DETAILS ON AQUATIC & RECREATION CENTRE.
REFER LANDSCAPE LEGEND & MATERIALS (ARC-T-DA-002).
THIS SITE WILL BE DELIVERED IN STAGES ACCORDING TO LAND OWNERSHIP
STAGE 1: LAND OWNED BY CITY OF SYDNEY
STAGE 2: LAND OWNED BY OTHERS.
REFER LIGHTING STRATEGY FOR PARK LIGHTING.

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NOTES

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LEGEND

- Site Boundary
- Stages Boundary
- Existing Trees to be protected
- Proposed Street trees
- Proposed tree & tall shrub planting
- Proposed lower shrubs & groundcover
- Green Roof

1 Aquatic & Recreation Centre
2 Park Entry
3 Café
4 Circuit Path
5 Overland Flow & Trunk drain (below)
6 Bike Parking
7 Rain Garden
8 Artwork
9 Mounded garden beds
10 Amenities Buildings, with canopy over
11 Exercise Station
12 Sports Field
13 Terrace & Seating Edge
14 BBQ Facilities
15 Lawn
16 Play Space
17 Skate Bowl
18 GPT locations in paving
19 Park Entry plaza
20 Skateable Moment
21 Landscape Setback
22 Sports Field Netting
23 Acoustic Centre Entry
24 Green Roof

PV01 Concrete Type 1
PV02 Concrete Type 2
PV03 Softfall Sand
PV05 Softfall Mulch
PV06 Concrete Pavers
PV07 Rubaroc
PV08 Trihex Concrete Paving
TD01 Timber Decking
SL01 Natural Instant Turf
SL02 Synthetic Turf
SL03 Organic Mulch
SL04 Sandstone Mulch

REV	DATE	ISSUE
A	02.06.16	DEVELOPMENT APPLICATION

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PROJECT
Gunyama Park Aquatic and Recreation Centre
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE
General Arrangment Plan

DRAWN: AL
CHECKED: SA
SCALE: 1:350 @A1
FIRST ISSUE: 13/05/16
DRAWING NO: ARC-T-DA-004
REV: A

DEVELOPMENT APPLICATION

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SCALE 1:350@A1

0 5 10 15 20m

LEGEND

- Site Boundary
- +RLXX.XX Proposed level
- +EXXX.XX Existing level
- +HPXX.XX High point
- 400 Wall / edge height
- 100mm contours
- Fall

DRAWING NOTES

THIS PROJECT WILL BE DELIVERED IN STAGES, REFER TO ARC-T-DA-004.

REV	DATE	ISSUE
A	27.05.16	DEVELOPMENT APPLICATION

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PROJECT

Gunyama Park Aquatic and Recreation Centre

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

Grading Plan

DRAWN: AL
CHECKED: SA
SCALE: 1:350 @A1
FIRST ISSUE: 13/05/16

DRAWING NO: ARC-T-DA-006
REV: A

DEVELOPMENT APPLICATION

LANDSCAPE TYPES SCHEDULE



PV01
Location: Circuit Path

Concrete - Trafficable
Special Class Mix A in situ concrete. - Type 1



PV02
Location: Secondary path network

Concrete - Trafficable
Special Class Mix A in situ concrete. - Type 2



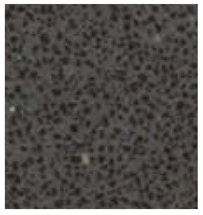
PV03
Location: Playground

Soft fall sand
(To meet AS4422 & AS 4685: 2014)



PV05
Location: Playground

Soft fall mulch
(To meet AS4422 &
AS 4685: 2014)



PV06
Location: Streetscape

Adbri 600 x400mm Sydney City Charcoal - EDR1093
(Type 1) (orientated perpendicular to kerb)



PV07
Location: Playground

Softfall - Rubaroc
Colour: 'Slate'



PV08
Location: Streetscape Parking

Trihex Concrete Paving
Colour: Silver Grey



TD01
Location: Circuit path & turf interface

Timber Decking, 30x40mm
Kiln Dried Black Butt, Class 1



SL01
Location: Turf

Natural Instant Turf
Buffalo 'Sapphire'



SL02
Location: Sports field

Synthetic Turf,
Specified by City of Sydney



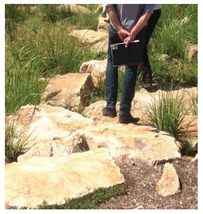
SL03
Location: Garden Bed Berms

Organic Mulch
'Eucy mulch or approved equivalent



SL04
Location: Garden Bed

Sandstone Mulch, size 20-40mm

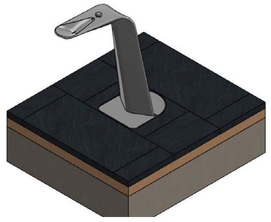


Stepping Stones
Location: Garden Bed, Playground

Sandstone rock, size 300-600mm

FURNITURE & FIXTURES SCHEDULE

PROPRIETARY FURNITURE



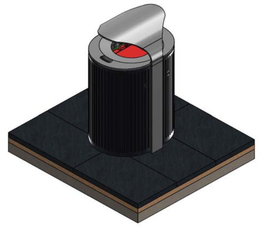
FN01
Location: Refer Furniture & Fixtures Plan

Ambulant Access Bubbler for CoS Standard Standard, with dog bowl



FN02
Location: Refer Furniture & Fixtures Plan

Bicycle Hoop
SS Bike Rail



FN03
Location: Refer Furniture & Fixtures Plan

CoS Standard Recycle Bin & Refuse



FN04
Location: Refer Furniture & Fixtures Plan

Shade Umbrella
Heavy Duty Commercial Grade Square Umbrella with waterproof 100% acrylic canvas.



FX04
Location: Refer Furniture & Fixtures Plan

BBQ's brushed stainless steel



FX05
Location: Refer Furniture & Fixtures Plan

Tree Grate, Stainless steel top with galv. frame



FN05
Location: Playground, refer Furniture & Fixtures Plan

Multiple layering of draped camo netting
Colour of posts: Natural grey, micaceous oxide.
Wire and fittings: Stainless steel



Sport Field Netting & Post
Location: Sportsfield
Proprietary Post & net
25m W x 7m H
Colour of netting: Black Colour of posts: Natural grey, micaceous oxide

CUSTOM FURNITURE



Seat Type 1
Location: Circuit Path
CoS Standard seat with timber seat & backrest
- customised length
- Bronze finish (Green Square Material Palette)
- with locations for wheelchair access



Seat Type 2
Location: Playground
Circular / Deck seat, 3000m D



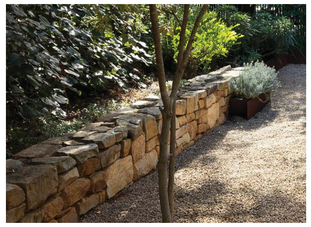
Picnic Table
Location: BBQ Areas
Brushed stainless steel round table & bench with allowance for wheelchair & central fixing umbrella



Seat Type 3
Location: Circuit Path
CoS Standard picnic seat (only) with timber.
- customised length
- Bonze finish (Green Square Material Palette)



Seat Type 4
Location: Refer Furniture & Fixtures Plan
Concrete Plinth, finish to match adjacent concrete paving PV01 or PV02.



Seat Type 5
Location: Playground, Refer Furniture & Fixtures Plan
Sandstone Drystone wall. 400mm H

DRAWING NOTES
REFER LIGHTING STRATEGY FOR PARK LIGHTING

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NOTES

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A 27.05.16 DEVELOPMENT APPLICATION

REV DATE ISSUE

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456 Kent St, Town Hall House
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PROJECT

Gunyama Park Aquatic and Recreation Centre

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

Landscape Legend & Materials

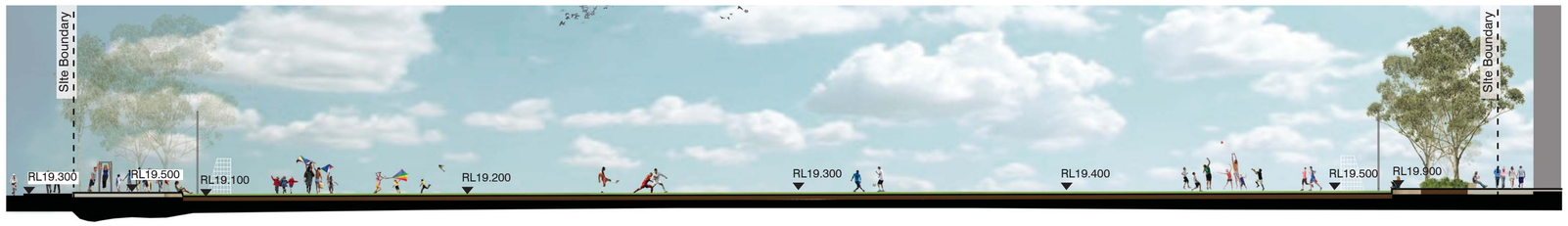
DRAWN: AL
CHECKED: SA
SCALE: NTS
FIRST ISSUE: 13/05/16

DRAWING NO ARC-T-DA-002 REV A

DEVELOPMENT APPLICATION



01 SE01 E/W SITE SECTION
Long Section scale 1:350@A1



02 SE02 N/S SITE SECTION
Long Section scale 1:250@A1



03 E01 JOYNTON AVENUE ELEVATION
Elevation scale 1:200@A1

DRAWING NOTES
REFER ARCHITECTURE PLANS FOR FULL DETAILS ON AQUATIC & RECREATION CENTRE
REFER LANDSCAPE LEGEND & MATERIALS (ARC-T-DA-002)
REFER TO ARBORIST REPORT

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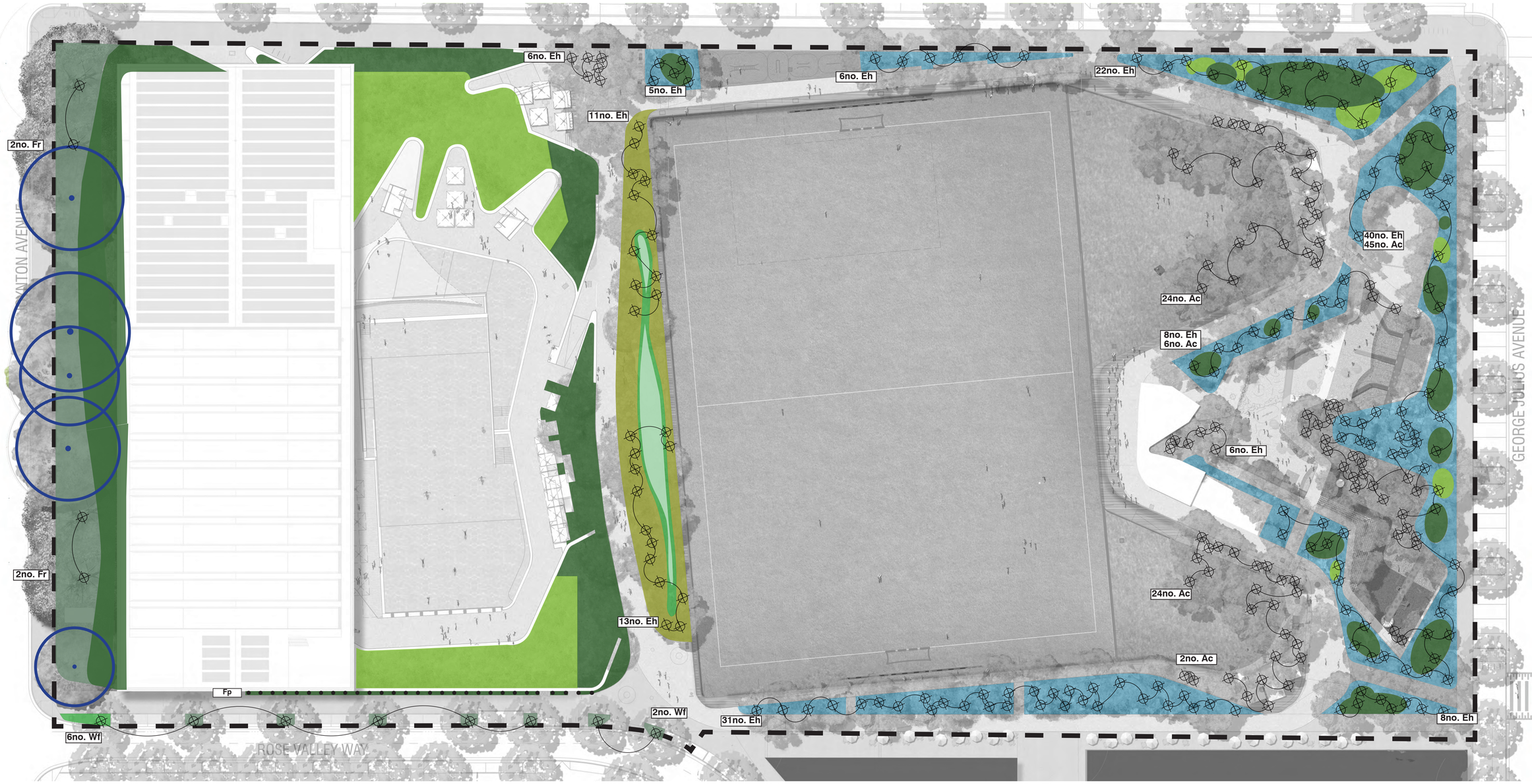
PROJECT
Gunyama Park Aquatic and Recreation Centre
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE
Long Sections & Elevation

DRAWN: AL
CHECKED: SA
SCALE: As Shown @A1
FIRST ISSUE: 13/05/16

DRAWING NO REV
ARC-T-DA-008 A

DEVELOPMENT APPLICATION



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NOTES

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LEGEND

- Site Boundary
- Existing Trees to be protected
- Proposed Trees

SCALE 1:350@A1

0 5 10 15 20m

PLANTING SCHEDULE

	Species	Common Name	Qty	Size
Fr	Ficus rubiginosa	Port Jackson fig	4	700L
Wf	Waterhousea floribunda	Weeping Lily Pilyt	8	100-700L (Range)
Ac	Angophora costata	Smooth-barked Apple	101	100-700L (Range)
Eh	Eucalyptus haemastoma	Broad-leaved Scribbly Gum	156	100-700L (Range)

PLANT MIX A - SHRUBS

Species	Common Name	Cts	Size (Pots/mm)
Acacia suaveolens	Sweet Wattle	1000	200
Actinotus helianthi	Flannel Flower	500	200
Banksia aemula	Wallum banksia	1000	200
Banksia ericifolia (s)	Old Man Bansia	1000	200
Bauera rubioides (s)	Dog rose	500	200
Boronia pinnata	Variable Bossiaea	500	200
Callistemon citrinus (s)	Crimson Bottlebrush	1000	200
Correa alba	White Correa	500	200
Correa reflexa	Native Fuchsia	500	200
Cryptandra amara	Pretty pearlflower	500	200
Darwinia fascicularis	Sydney Wattle	1000	200
Epacris longiflora	The Fuchsia Heath	500	200
Eriostemon australasius	Pink Wax Flower	500	200
Eriostemon buxifolius	Box-leaf waxflower	500	200
Goodenia ovata	hop goodenia	500	200
Grevillea speciosa	Red Spider Flower	800	200
Grevillea mucronulata	Green Spider Flower	500	200
Hakea dactyloides	Finger Hakea	800	200
Hakea teretifolia (s)	Dagger Hakea	800	200
Hardenbergia violacea	Happy Wanderer	500	200
Hibbertia scandens	Snake Vine	500	200
Isopogon anemonifolius	Broad-leaved Drumsticks	500	200
Isopogon anethifolius	Narrow-leaved Drumstick	500	200
Kennedia rubicunda (herb)	Dusky Coral Pea	500	200
Kunzea ambigua	Tick Bush	800	200
Lasiopetalum ferrugineum	Rusty Velvet Bush	500	200
Leptospermum laevigatum	Coastal Tee Tree	1000	200
Melaleuca squamea (s)	Swamp Honey Myrtle	500	200
Melaleuca thymifolia	Thyme Honey-myrtle	500	200
Persoonia lanceolata	the lance-leaf geebung	1000	200
Persoonia levis	Broad-leaved geebung	800	200
Platysace lanceolata	Shrubby Platysace	500	200
Rhagodia candolleana	Seaberry Saltbush	500	200
Stylidium graminifolium (herb)	The grass triggerplant	500	200
Viminaria juncea (s)	Golden Spray	500	200
Westringia fruticosa	Coastal Rosemary	500	200
Zieria pilosa	Pilose-leafed Zieria, Hairy Zieria	500	200
Pteridium esculentum	Austral Bracken	500	200
Ficus pumila	Creeping Fig	1000	200

Fp

PLANT MIX B - GRASSES

Species	Common Name	Cts	Size (Pots/mm)
Austrostipa pubescens		300	200
Dichelachne crinita	Lnghair Plme Grass	300	200
Lomandra longifolia	spiny-headed mat-rush	300	200

PLANT MIX C - GROUNDCOVERS

Species	Common Name	Cts	Size (Pots/mm)
Actinotus helianthi	Flannel Flower	300	200
Dampiera stricta		300	200
Dianella revoluta	Flax-lily	300	200
Pandorea pandorana	wonga wonga vine	300	200
Patersonia glabrata	Leafy Purple-flag	300	200
Gahnia sieberiana (s)	Red-fruit saw-sedge	300	200
Lepidosperma laterale	Sharp Sword-sedge	300	200
Leptocarpus tenax (s)	Slender Twine Rush	300	200
Lepyrodia scariosa	Scale Rush	300	200
Lomandra glauca	Aussie Blue Grass	300	200
Lomandra longifolia	Spiky-head mat-rush	300	200
Billardiera scandens		300	200
Hardenbergia violacea	False Sarsaparilla	300	200
Hibbertia scandens	Guinea Flower	300	200
Pteridium esculentum	Austral Bracken	300	200

PLANT MIX D - WETLAND - MARSH

Species	Common Name	Cts	Size (Pots/mm)
Baloskion tetraphyllum	Plume Rush	300	200
Baumea articulata	Jointed Twig-rush	300	200
Baumea juncea	Bare Twigrush	300	200
Bolboschoenus caldwelli	Marsh Club-rush	300	200
Bolboschoenus fluviatilis		300	200
Eleocharis acuta		300	200
Schoeneplectus mucronatus	Rough-seed Bulrush	300	200
Schoeneplectus validus	Softstem Bulrush	300	200
Triglochin procera	Water Ribbons	300	200

PLANT MIX E - WETLAND - EPHEMERAL

Species	Common Name	Cts	Size (Pots/mm)
Carex appressa	Tall sedge	300	200
Dianella revoluta	Blue Flax-lily	300	200
Ficina nodosa	Knobby Club-rush	300	200
Gahnia siberiana	Red-fruit saw-sedge	300	200
Juncus usitatus		300	200
Lomandra longifolia	Spin-head mat-rush	300	200
Melaleuca thymifolia	Thyme Honey-myrtle	300	200
Themeda australis	Kangaroo Grass	300	200

PLANT MIX F - WETLAND - FORAGING ZONE

Species	Common Name	Cts	Size (Pots/mm)
Baumea juncea	Bare Twigrush	300	200
Carex appressa	Tall sedge	300	200
Correa alba	Native Fuchsia	300	200
Dianella caerulea 'King Alfred'		300	200
Doryanthes excels	Spear Lily	300	200
Isolepsis nodosa	Knobby Club-rush	300	200
Juncus continuus	Pithy rush	300	200
Lomandra hystrix	Creek Matrush	300	200
Lomandra longifolia	Spiny-head Mat-rush	300	200
Westringia fruticosa	Native Rosemary	300	200

PLANT MIX G - VERGE ZONE

Species	Common Name	Cts	Size (Pots/mm)
Banksia spinulosa 'Birthday Candles'		500	200
Ficinia nodosa	'Knobby Club Rush'	500	200
Lomandra 'Tanika'		300	200
Xanthorrhoea australis	Grass Tree	500	200
Macrozamia communis	Burrawang	500	200
Clivia belgium	Orang/Kaffir Lily	500	200
Hedera canariensis	Canarian Ivy	500	200
Rhaphiolepis indica 'Oriental Pea	Oriental Pearl Indian Hawthorne	500	200

DRAWING NOTES

THIS PROJECT WILL BE DELIVERED IN STAGES, REFER TO ARC-T-DA-004

A 27.05.16 DEVELOPMENT APPLICATION

REV DATE ISSUE

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PROJECT

Gunyama Park Aquatic and Recreation Centre

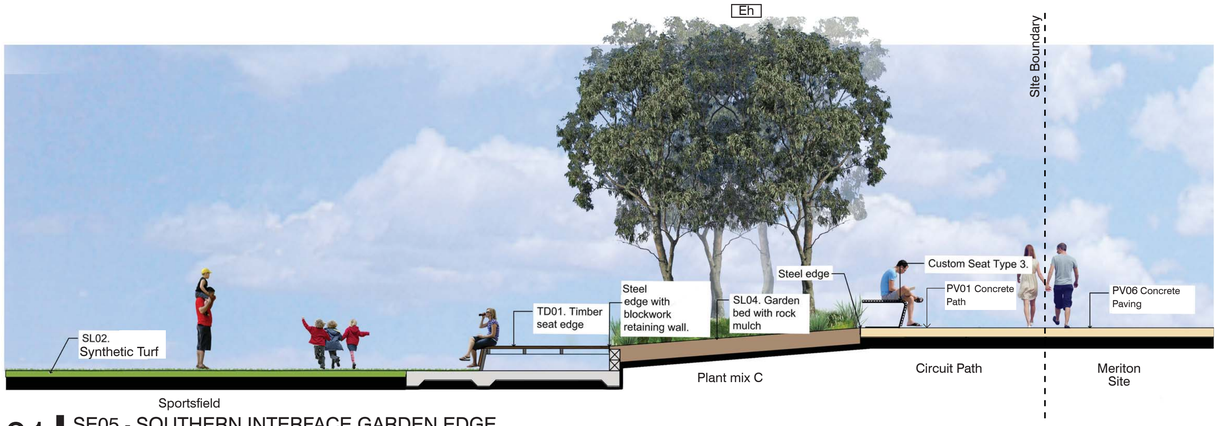
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

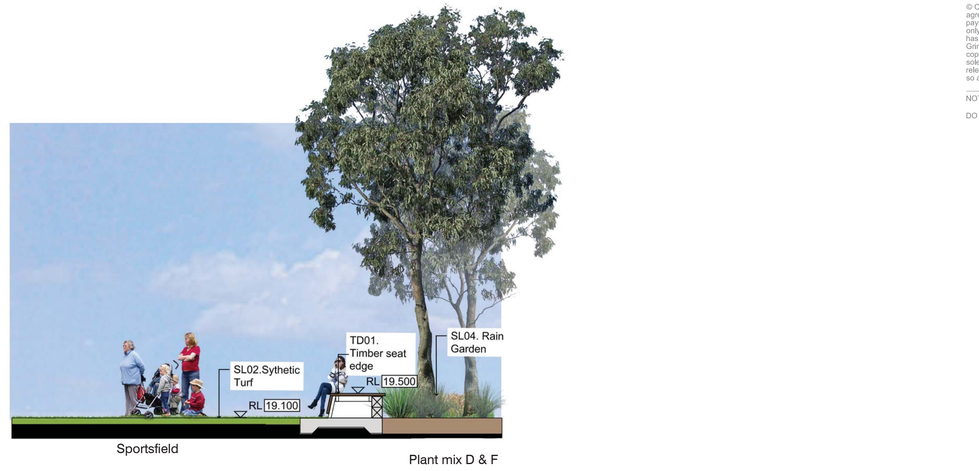
Planting Strategy

DRAWN: AL
CHECKED: SA
SCALE: 1:350 @A1
FIRST ISSUED: 13/05/16
DRAWING NO: ARC-T-DA-007
REV: A

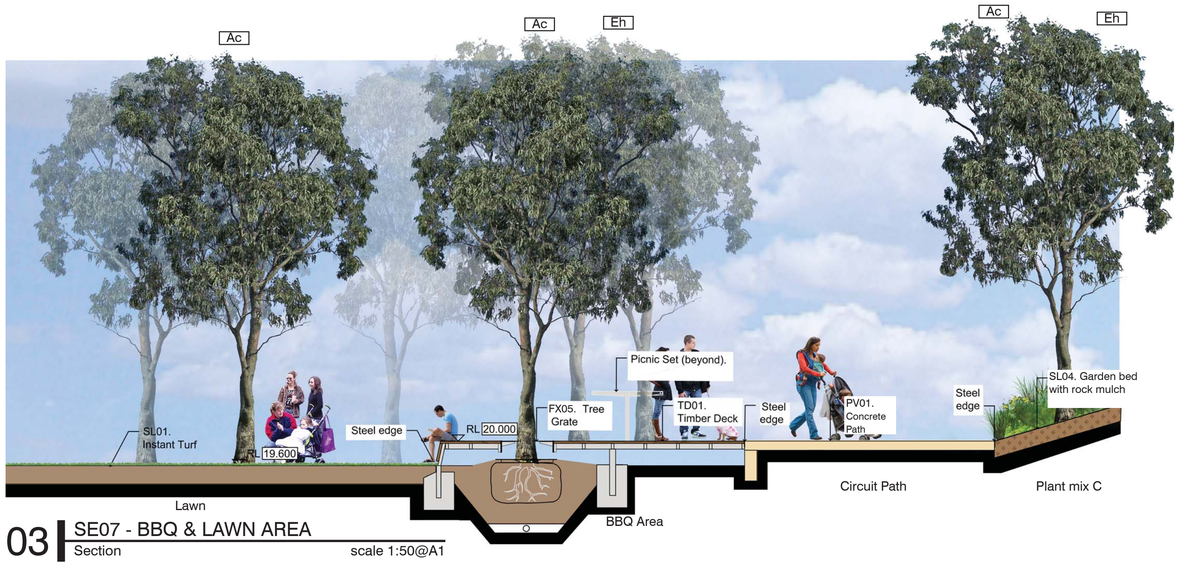
DEVELOPMENT APPLICATION



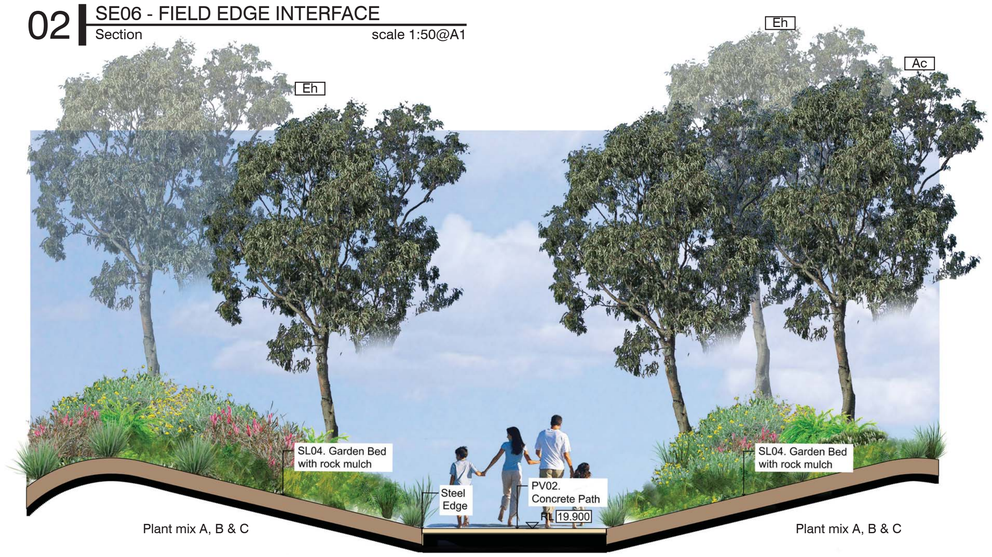
01 SE05 - SOUTHERN INTERFACE GARDEN EDGE
Section scale 1:50@A1



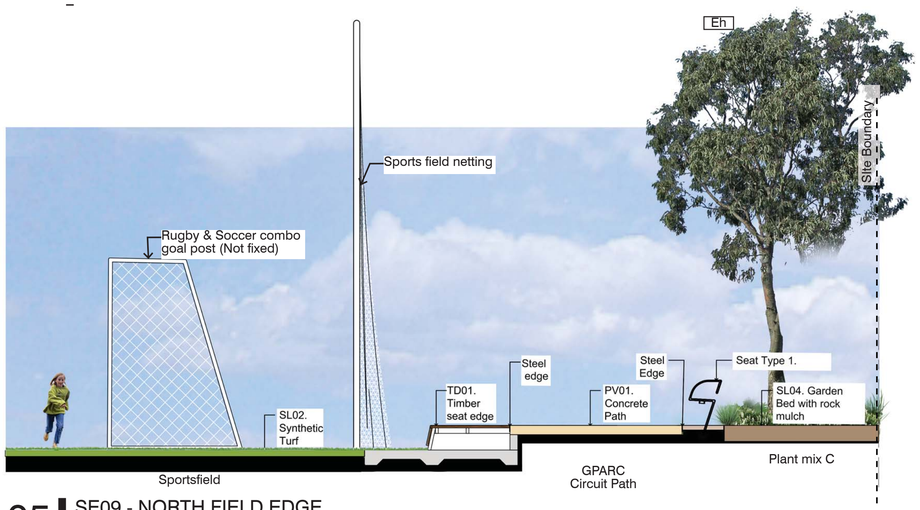
02 SE06 - FIELD EDGE INTERFACE
Section scale 1:50@A1



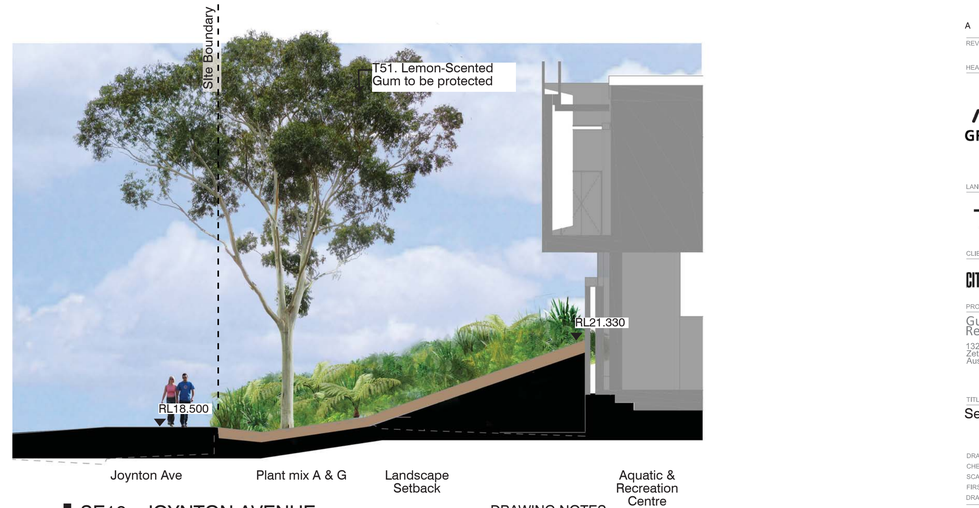
03 SE07 - BBQ & LAWN AREA
Section scale 1:50@A1



04 SE08 - ZETLAND & GEORGE JULIUS AVENUE ENTRANCE
Section scale 1:50@A1



05 SE09 - NORTH FIELD EDGE
Section scale 1:50@A1



06 SE10 - JOYNTON AVENUE
Section scale 1:100@A1

DRAWING NOTES
REFER ARCHITECTURE PLANS FOR FULL DETAILS ON AQUATIC & RECREATION CENTRE
REFER LANDSCAPE LEGEND & MATERIALS (ARC-T-DA-002)
REFER TO ARBORIST REPORT

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A	27.05.16	DEVELOPMENT APPLICATION

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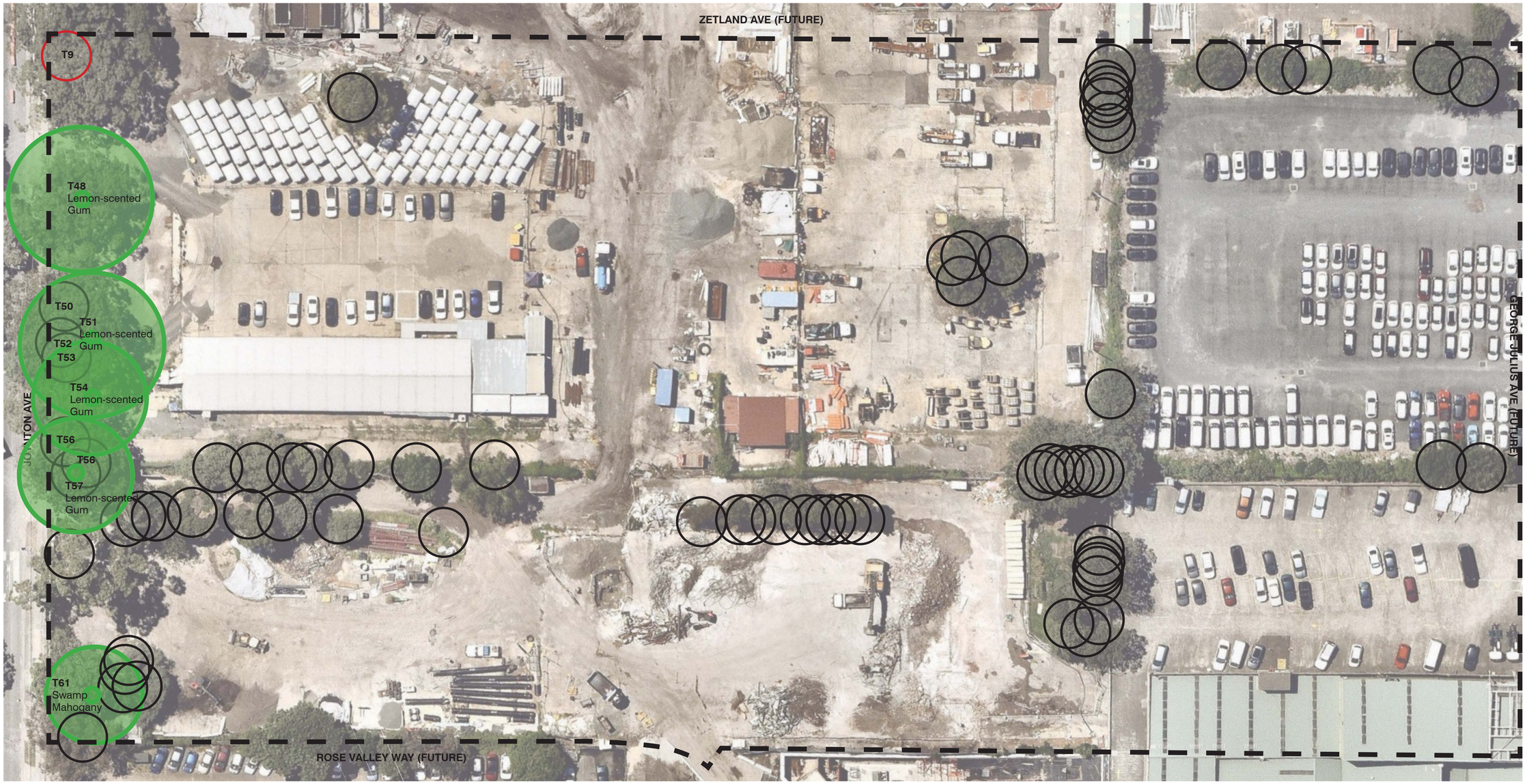
PROJECT
Gunyama Park Aquatic and Recreation Centre
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE
Sections

DRAWN: AL
CHECKED: SA
SCALE: As Shown @A1
FIRST ISSUE: 13/05/16
DRAWING NO: ARC-T-DA-009
REV: A

DEVELOPMENT APPLICATION



SCALE 1:350@A1

0 5 10 15 20m

DRAWING NOTES

REFER TO TREE ASSESSMENT REPORT & TREE PROTECTION PLAN BY ARBORIST.
REFER TO DEMOLITION PLAN (CIVIL ENGINEERING) FOR ALL HARDSCAPE ELEMENTS
THIS PROJECT WILL BE DELIVERED IN STAGES, REFER TO ARC-T-DA-004

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NOTES

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LEGEND

- Site Boundary
- Existing Trees to be retained & protected
  Tree protection fencing to be installed prior to the commencement of works. Refer Tree Assesment Report & Tree Protection Plan by Arborist.
- Existing Trees to be removed
- Existing Tree to be removed early (By others) as part of Zetland Avenue Road Works (mid 2017 - late 2018)

REV	DATE	ISSUE
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PROJECT

Gunyama Park Aquatic and Recreation Centre

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

Tree Protection & Removal Plan

DRAWN: AL
CHECKED: SA
SCALE: 1:350
FIRST ISSUE: 13/05/16

DRAWING NO: ARC-T-DA-003
REV: A

DEVELOPMENT APPLICATION

Table 1. Summary of key controls within the SDCP 2012		
Item	Provision	Compliance
Section 3 General Provisions		
3.11.3 Bicycle parking	The SDCP 2012 requires the minimum number of bicycle parking spaces to be provided for swimming pools which are as follows: - 1 space per 10 staff; and - 2 spaces per 20m^2 of pool area for customers/visitors. Where on-site bike parking rates are not provided in the SDCP, an applicant is to provide bike facilities to accommodate Council's mode share target for trips by bike as described in the Cycle Strategy and Action Plan 2007-2017. The City of Sydney Cycle Strategy and Action Plan 2007-2017 states: "Increase the number of bicycle trips made in the City of Sydney, as a percentage of total trips to 10% by 2016".	**Complies.** A large number of bicycle parking spaces are to be provided to meet the DCP requirements. Refer to the accompanying Traffic Impact Assessment and Green Travel Plan for further discussion.
3.11.4 Vehicle parking	It is noted that: *Where the development comprises of a land use not specified in the SLEP 2012, the proposed rate of car parking provision is to be justified via a Parking and Access Report.*	**Complies.** It is noted that a recreation area (indoor) is not a land use outlined within SLEP 2012. Parking is discussed in further detail within the accompanying Traffic Impact Assessment.
3.11.6 Service vehicle parking	(1) Separate parking spaces for service vehicles are to be provided in accordance with Schedule 7 Transport, parking and access, and are not to be shared with parking provided for any other purpose. Service vehicle parking spaces, including spaces for bike couriers are to be: (a) located near vehicle entry points and near lifts; (b) clearly designated and signposted for service vehicles only; (c) screened from the street where possible; and (d) located completely within the boundary of the site, clear of parked vehicles; and clear of through traffi c. (2) Parking spaces for service vehicles are not to be used for other purposes such as storage of goods and equipment.	**Generally complies.** Loading bays are proposed along Zetland Avenue and Rose Valle Way.

Table 1. Summary of key controls within the SDCP 2012		
Item	Provision	Compliance
3.11.7 Motorcycle parking	In all buildings that provide onsite parking, 1 motorcycle parking space for every 12 car parking spaces is to be provided as separate parking for motorcycles. Each motorcycle parking space is to be designated and located so that parked motorcycles are not vulnerable to being struck by a maneuvering vehicle.	**Not applicable.** No vehicular parking is proposed and therefore no motorcycle parking is required.
3.11.10 Vehicle access for developments greater than 1000sqm GFA	(1) For developments equal to or greater than 1,000sqm GFA, vehicle access to a site is to be located so the safety of those using the access and the street is not likely to be compromised. Vehicle access is not to be located in the following locations: (a) within 10m of an uncontrolled intersection, including intersections with laneways; (b) within 25m of the property boundary adjacent to a signalised intersection; (c) within 60m of the approach side of an intersection on a state road and within 30m on its departure side; (d) within 12m of a 'stop' or 'give way' sign or hold line at intersections; (e) opposite a busy side road for a distance of 6m beyond the alignment of the property boundaries adjacent to that side road; (f) opposite a busy driveway for a distance of 6m beyond the alignment of the driveway edges; (g) within 15m of the alignment of an intersection where the proposed vehicle access is to be used by service vehicles; (h) within 30m of the alignment of an intersection where the proposed vehicle access is used by service vehicles to access 3 or more loading spaces; (i) where there is insufficient 'weaving' distance to or from a nearby road that could be used by traffic generated by the development; (j) within 2m of other access driveways or within 1m of any common boundary, except where access is off a laneway; and (k) within 20m of the approach to, and 10m of the departure from an existing or proposed pedestrian crossing.	**Not applicable.** No vehicular access is provided into the site itself.
3.12.1 Accessible Design	(1) All development must comply with the following: all Australian Standards relevant to accessibility; the Building Code of Australia access requirements; and Disability Discrimination Act 1992. Complex developments where compliance is proposed through alternative solutions must be accompanied by an Access report prepared by a suitably qualified access professional.	**Complies.** Refer to the Access Report accompanying this Development Application.

Table 1. Summary of key controls within the SDCP 2012		
Item	Provision	Compliance
3.14.1 Waste management plans	(1) A waste management plan is to be submitted with the Development Application and will be used to assess and monitor the waste management process within a development. The waste management plan is to be consistent with the City of Sydney Policy for Waste Minimisation in New Developments 2005.	**Complies.** Waste management provisions required under the DCP are discussed in greater detail within the Waste Management Plan accompanying this application.
3.14.2 Construction and demolition waste	(1) The waste management plan is to address construction and demolition waste and include: (a) details regarding how waste is to be minimised within a development; (b) estimations of quantities and types of materials to be re-used or left over for removal from the site; (c) details regarding the types of waste and likely quantities of waste to be produced; (d) a site plan showing storage areas away from public access for reusable materials and recyclables during demolition and construction and the vehicle access to these areas; (e) details of reusing or recycling methods for waste either on-site or off-site; (f) targets for recycling and reuse; (g) nomination of the person responsible for ensuring targets are met and the person responsible for retaining waste dockets from facilities appropriately licensed to receive the development's construction and demolition waste; (h) confirmation that all waste going to landfi ll is not recyclable or hazardous; and (i) measures to reuse or recycle at least 80% of construction and demolition waste, either on site or diverted for reuse and recycling with receipts suffi cient to demonstrate the target will be achieved.	

Table 1.	Summary of key controls within the SDCP 2012	
Item	**Provision**	**Compliance**
Section 5 – Specific Areas		
5.3.1 Urban Strategy		**Complies.** As illustrated the subject site is to incorporate the following: • A 10m deep soil setback along Joynton Avenue; • An active edge along the northern and eastern edges of the Aquatic Centre; and • A pedestrian/cycle link is to be incorporated through the centre of the site connecting Zetland Avenue and Rose Valley Way. The proposal is considered to provided an active frontage to Zetland Avenue by providing pedestrian oriented ground floors, building entries, and minimising blank walls. A pedestrian/cycle path has been identified as crossing Gunyama Park directly to the east of the aquatic centre.

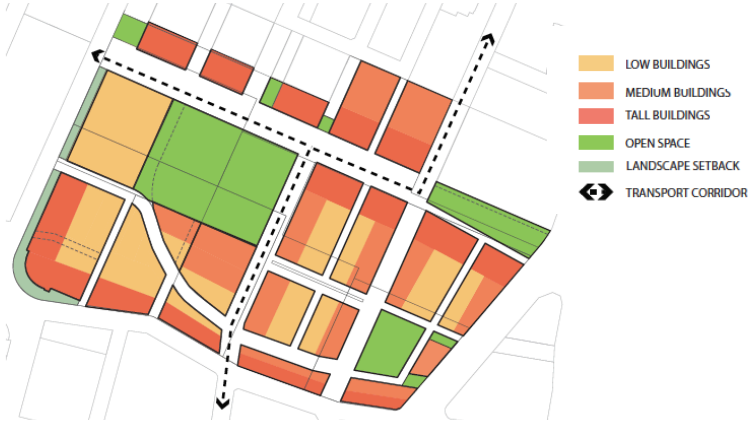
Table 1. Summary of key controls within the SDCP 2012		
Item	Provision	Compliance
5.3.2 Urban Design Principles		
Principle 1: Transition of Building Heights		**Complies.** The aquatic centre is a low building height (2 storeys) and is provided with a landscaped setback to Joynton Avenue.
Principle 2: Land Uses		**Complies.** Land uses are consistent with those outlined in the "Land Uses" image, with open space, active edges, and landscaped setbacks provided.

Table 1. Summary of key controls within the SDCP 2012

Item	Provision	Compliance
Principle 3: Public Domain		**Complies.** The following provisions apply to the site: • *Provide one main park of approximately 15,500 square metres for active and passive recreation.* • *Landscaped setbacks are provided to reduce the perception of scale of buildings at the street level.* *Use landscaping to assist in managing stormwater.* These provisions have been met. The site has been landscaped to assist in managing stormwater (refer to associated reports).
5.3.3 Local Infrastructure and public domain		
5.3.3.1 Public Open space	(1) Where required by Council, public open space is to be dedicated to Council in the locations identified on Figure 5.45 Epsom Park Dedications and Easements and in accordance with the standards set out in Table 5.6 Provision for public open space in Epsom Park. (2) The landscaping and materials used for open spaces is to respond to the neighbourhood's character and to relate to the history of the Epsom Park precinct. **Type** / **Requirements** / **Guidelines** A District Park — One park of approximately 15,500sqm at the centre of the neighbourhood (Gunyama Park). — The park is to: (a) provide for deep soil planting; (b) be used for active and passive recreation; (c) provide a flexible active sports pitch; (d) provide passive spaces; and (e) provide a clear link to the Green Square Aquatic Centre to complement the active sports facilities.	**Complies.** The proposed development is consistent with Figure 5.45 of the DCP. Gunyama Park meets the guidelines for development of Park A.

Table 1. Summary of key controls within the SDCP 2012		
Item	Provision	Compliance
5.3.3.2 Street network		**Able to comply.** Not strictly applicable to this application as street construction is not proposed, however the application does not prevent the street network being constructed as outlined.
5.3.3.3 Movement and Connectivity	(1) Major access and egress points are to be consistent with Figure 5.65 Epsom Park Circulation and Access. (2) Circulation is to be consistent with Figure 5.65 Epsom Park Circulation and Access. (3) Introduce traffic signals at the junction of Epsom Road and George Julius Avenue and Joynton Avenue and Zetland Avenue in accordance with Figure 5.47 Epsom Park Street Hierarchy. (4) Bollards or other measures in accordance with Council requirements to restrict vehicle access whilst allowing pedestrian and cycle access are to be installed in the following locations: (a) Fuse Street (b) Rose Valley Way east, end (c) Pony Race Street (5) Driveways and car park entries are to be in accordance with Figure 5.65 Epsom Park Circulation and Access.	**Generally complies.** The proposal is generally consistent with the circulation and access requirements outlined in Figure 5.65 of the DCP.

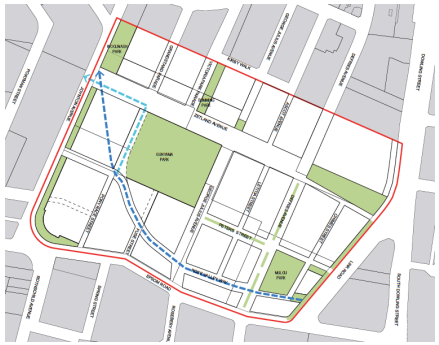
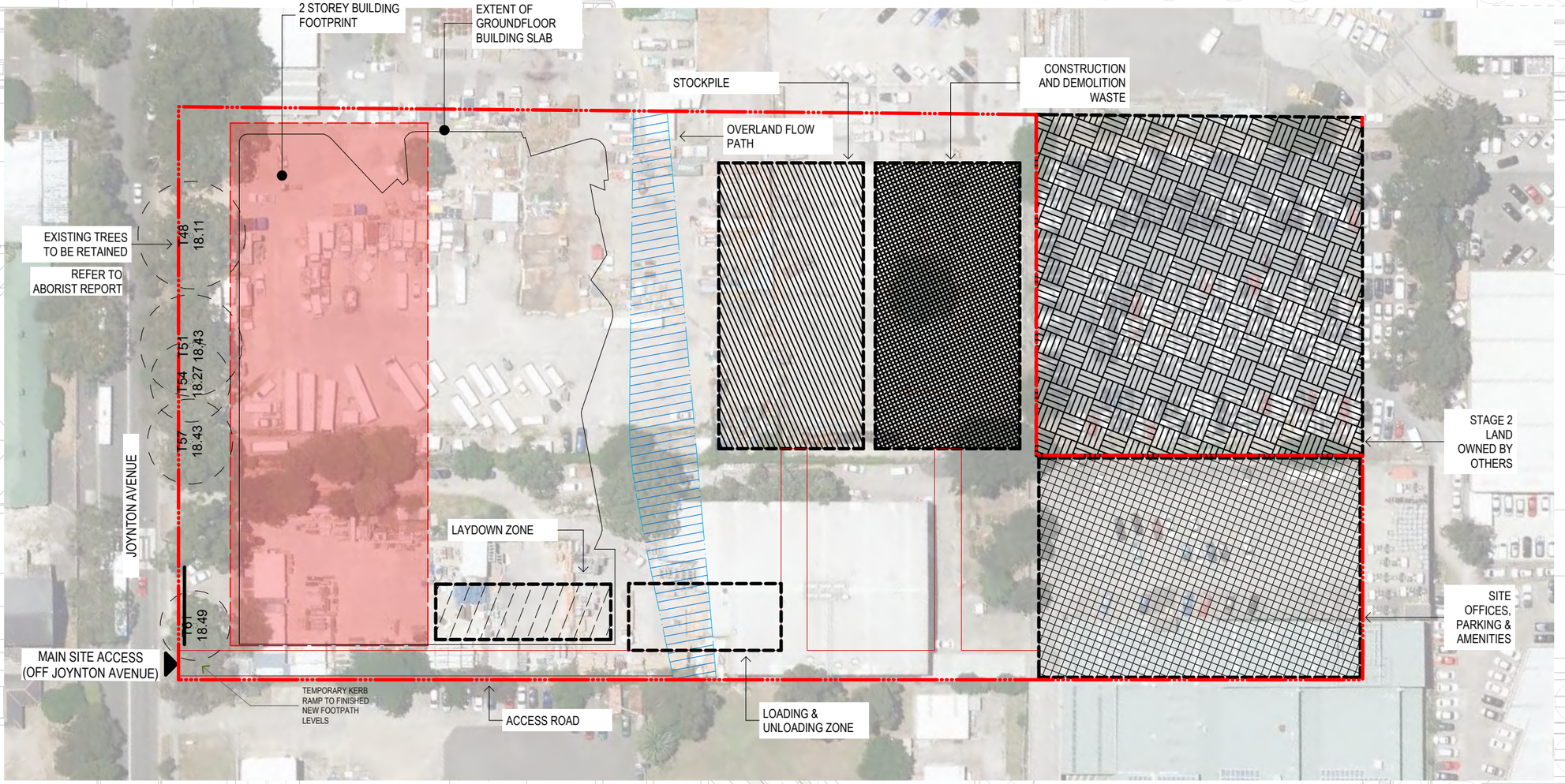
Table 1. Summary of key controls within the SDCP 2012		
Item	**Provision**	**Compliance**
	(6) Underground car parking entries are to be set back from the building line to reduce their visual dominance in the streetscape.	
5.3.3.4 Stormwater management and waterways	Provision (1) Realign the existing stormwater culvert as detailed in Figure 5.67 Epsom Park Stormwater Management. (2) If identifi ed, bio-swales are to be designed and constructed to allow for pedestrian crossings. 	**Complies.** The existing stormwater easement is to be realigned by Sydney Water. Refer to accompanying stormwater reports for greater discussion.
5.3.4 Building Form and Design		
General	(1) Development must not exceed the maximum number of storeys as shown on the Building height in storeys map and Figure 5.68 Epsom Park Building Height in Storeys. (2) The street frontage height of a building must not exceed the maximum street frontage height shown on Figure 5.69 Epsom Park Street Frontage Height.. (3) Dwelling types are to comply with Figure 5.70 Epsom Park Building Types.	**Complies.** The site is shown as being subject to a maximum height of 2 storeys. The development does not exceed this height. The building is a community facility in line with the Building Types figure.

Table 1. Summary of key controls within the SDCP 2012		
Item	Provision	Compliance
5.3.4.1 Building setbacks	(1) Setbacks are to be provided in accordance with the Public domain setbacks map and the Building Setback and Alignment map. (A 10m landscaped setback is required to Joynton Avenue.)	**Generally complies**. The DCP requires the provision of a landscaped setback to the south (Rose Valley Way). No vehicular access is being provided to the site however a small landscaped area is provided. Setback is also provided to Gunyama Park as required. A 10m setback is provided to Joynton Avenue.
5.3.4.4 Other developmen t	(1) Active uses are to be provided in the locations identified in Figure 5.74 Epsom Park Active Frontages. (An active edge is shown against the aquatic centre to Zetland Avenue and Joynton Avenue)	**Complies.** A 10m landscaped setback has been provided.
5.3.5 Staging and implementation		
General Provisions	(1) A staging plan is required to be submitted to Council with each development application. (2) The staging plan must: (a) Where relevant address how either the extension of Rosebery Avenue (George Julius Avenue) or Defries Avenue, between Epsom Road and Zetland Avenue are to be used as the route for the Eastern Transit Corridor, until the preferred route is established; and (b) Where relevant address how the proposed main park is to be constructed and dedicated to Council prior to the occupation of the Green Square Aquatic Centre. (3) George Julius Avenue and Defries Avenue are to be confi gured to allow for short-term operation as bus routes, and longer term operation as light rail corridors. (4) Pony Race Street and Fuse Street are to be provided as pedestrian/cycle ways only, however in the short term traffi c will be permitted to respond to development staging.	**Complies.** A Staging Plan accompanies the architectural set at Appendix 1.



PROJECT SITE BOUNDARY
HOARDING
OVERLAND FLOW
STAGE 2 AREA
SITE OFFICE
TREES TO BE RETAINED
STOCKPILE
WASTE
LAYDOWN ZONE

INTELLECTUAL PROPERTY

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PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

CONSTRUCTION MANAGEMENT PLAN

DRAWN:
CHECKED: NB
SCALE: 1:1000 @ A3
FIRST ISSUE: 14/06/16

DRAWING NO: ARC-R-301
REV: A

City of Sydney



Gunyama Park Aquatic and Recreation Centre
Hydrological Assessment and Flood Analysis

REPORT

HydroStorm Consulting

Gunyama Park Aquatic and Recreation Centre Hydrological Assessment and Flood Analysis

This report has been prepared by HydroStorm Consulting for the City of Sydney**.** The information, data and analysis presented in this report has been based on the data provided by the City of Sydney and its agents, consultants and other government agencies. The material presented in this report should not be used for any other purpose than specified in this report. Use by third party is prohibited without the express permission of HydroStorm Consulting.

Client:	City of Sydney Level 3, 456 Kent Street SYDNEY NSW 2000
Contact:	Sophie Spinks
Report Version:	V5 – FINAL
Dated:	3 June, 2016

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Appendices

Appendix A: Interim Development Stage – Temporary Drainage Details

1 Introduction

The City of Sydney (The City) is currently preparing development plans for the proposed Gunyama Park Aquatic and Recreation Centre (GPARC) in the Epsom Park Precinct of Green Square. The proposed development lies in the Sheas Creek floodplain and requires appropriate controls to manage the flood risk.

The City commissioned HydroStorm Consulting to undertake a Hydrological Assessment and Flood Analysis for the proposed development of GPARC. This study provides the necessary flood data to assist the design consultant at the various design stages. The study report has been prepared to support the application for the proposed development.

2 Background

The proposed development lies in the floodplain of Sheas Creek catchment and requires appropriate controls to manage the flood risk. This study provides the necessary flood data to inform the planning process and ultimately support the development application for the proposed development.

The proposed GPARC is located within the Epsom Park Precinct where a staged development is planned. Only a few land parcels within the precinct will have been developed before the construction of the proposed GPARC starts. Therefore, the assessment for the development has been undertaken for an interim development stage of the Epsom Park Precinct (along with some other developments in the catchment) as well as the ultimate development of the Epsom Park Precinct and the wider catchment.

Hydraulic modelling has been undertaken for both development stages to manage the flood risk associated with the proposed development at those two stages.

3 Gunyama Park Aquatic and Recreation Centre Development Plans

The proposed GPARC development is located in the Epsom Park Precinct. The location of the development is shown in Figure 1 and the development plans are presented in Figures 2 to 4.

The Aquatic Centre and Gunyama Park are separated by a pedestrian path, which also acts as an overland flow path for events greater than the 20 Year ARI flood event. The overland flow on Rose Valley Way is conveyed to this overland flow path from the upstream catchment.

4 Development Stages

4.1 Interim Development Stage

As discussed above, the Epsom Park Precinct development would be at an interim stage when the proposed GPARC development would be completed. The City provided the details of the interim development stage of the Epsom Park Precinct, which is shown in Figure 5. The interim development stage includes:

- GPARC
- Meriton Development
- Part of Rose Valley Way completed

- Part of Zetland Avenue completed
- Raised Joynton Avenue
- Council Depot removed and land regraded
- Sydney Water Trunk Drain completed

An important aspect of the interim development stage is that the Sydney Water Trunk Drain would be completed before the GPARC development. This trunk drain plays a major role in managing the flood risk in the Epsom Park Precinct. The nominal capacity of the trunk drain is to convey the 20 year ARI flood event.

4.2 Ultimate Development Stage

The proposed development of GPARC would ultimately be part of the wider development in the Epsom Park Precinct and surrounding areas. Modelling of the proposed development in the ultimate development scenario is required to ensure that flood risk is managed over the long term.

The modelled ultimate development scenario includes the following future developments:

- Epsom Park Precinct
- Green Square Town Centre Precinct
- Lachlan Precinct
- Raised Joynton Avenue
- Sydney Water Trunk Drain

The above development scenario has been used in previous hydraulic assessments carried out for the various stages of Green Square Town Centre.

4.3 Connection of Local Drainage with Sydney Water Trunk Drain

The local drainage from the GPARC project would be connected to the Sydney Water Trunk Drain near the southern end of the overland flow path between the Gunyama Park and Aquatic and Recreation Centre, close to the Rose Valley Way. An indicative location of this connection is shown in Figure 5.

5 Hydraulic Modelling

The SOBEK hydraulic model developed for the draft Alexandra Canal Catchment Flood Study has been adopted for the assessment of the proposed GPARC. This model is based on a 4 m grid and utilises the direct rainfall method for hydrological modelling. The model grid is derived from the Lidar data, which was acquired by the City in 2009.

The proposed terrain for the Gunyama Park and the pedestrian path (overland flow path) was provided by CJ Arms and Associates (GPARC Hydraulic Engineers). The terrain data was processed to develop a 4m grid for the site. There was no terrain model available for the Aquatic Centre, which was raised in the developed grid so that it blocked the flow from entering the Aquatic Centre.

5.1 Interim Development Stage Model

The grid for the GPARC was incorporated into the existing model such that it replaced the existing features within the development site boundary. The grid for the proposed development was simply stamped on to the Alexandra Canal Catchment Flood Study grid. No refinement at the boundary of the two grids was undertaken since no data was available to rectify any discrepancies at the boundary of the two grids.

The model grid for the interim development stage is shown in Figure 6.

5.2 Ultimate Development Stage Model

The grid for the proposed development was incorporated into the model representing the ultimate development stage as discussed above.

The model grid for the ultimate development stage, including the GPARC is shown in Figure 7.

5.3 Design Flood Modelling

Modelling was undertaken for the interim and ultimate development stages for the 100 year ARI event together with the Probable Maximum Flood (PMF). A one-hour duration was adopted for the 100 year flood events and 45 minutes for the PMF.

A two-hour duration for the 100 year event is generally considered to be critical for the Alexandra canal catchment. However, due to the location of the Epsom Park Precinct in the upper reaches of the catchment, the one-hour duration was found to be critical (higher flood levels).

The PMF duration of 45 minutes is generally considered to be critical for the Alexandra Canal Catchment.

6 Impact Assessment and Management

The initial modelling of the interim development stage showed impact (increase in 100 year design flood levels). The impact was on the existing properties to the east of Council depot and within the Honda Site. A concept design for interim drainage was prepared to remove this impact. Details of the proposed drainage concept are provided in Appendix A (Interim Development Stage – Temporary Drainage Details). These details were provided to CJ Arms and Associates (GPARC Hydraulic Engineers) for design of the local drainage system.

Modelling for the proposed drainage was undertaken for the 100 year flood event. Figure 8 shows the impact of the drainage. This figure demonstrates that the proposed drainage successfully removes the impact due to GPARC. A small impact shown on the Epsom Road to the south of Meriton Site is due to the development on that site. It is assumed that the detailed drainage design of Meriton Site would have addressed this impact.

7 Design Flood Levels

The design flood levels along the flow path between Gunyama Park and the Aquatic Centre are provided in Figure 9. Both 100 year ARI and the Probable Maximum Flood (PMF) levels are provided. The Flood Planning Level (FPL) for the proposed development should be derived by applying appropriate freeboard to the 100 year ARI flood level.

7.1 Flow Velocity

The flow velocity varies along the overland flow path between Gunyama Park and the Aquatic and Recreation Centre. The 100 year velocity is generally 0.4 m/s with a maximum velocity close to 0.7 m/s. At the southern and northern ends of the flow path, the maximum velocity reaches 0.8 m/s.

7.2 Provisional Flood Hazard

The 100 year provisional flood hazard for the interim development stage is low on the streets surrounding the GPARC, including the Council depot site. However, under PMF, the provisional hazard becomes high at these afore mentioned locations. Figure 10 shows the PMF hazard for the interim development stage.

For ultimate development stage, the 100 year provisional flood hazard is low on the streets surrounding the GPARC, including the overland flow path, except for a small localized patches. These patches represent a few grid cells (4m x 4m) and the high hazard in these areas is insignificant.

The PMF provisional hazard for the ultimate development stage is shown in Figure 11.

7.3 Flood Emergency Response Planning

A Flood Emergency Response Plan (FERP) is required to manage the threat to life and property in an extreme flooding situation. The provisional flood hazard for the PMF event has been provided to facilitate the preparation of FERP for the proposed development. This plan is required before the Occupation Certificate is issued for the development.

8 Council Depot Site

The council depot site is proposed to be converted to a temporary flood detention basin under the interim development stage. The 100 year flood level in the basin is 18.7 m AHD. This corresponds to a maximum flooding depth of 0.8 m in the 100 year flood event. Temporary fencing would be required to prevent access to the flood detention basin.

The proposed design of the detention assumes a gradually sloping terrain from the existing ground levels towards the retaining wall for the Gunyama Park. The footprint of the detention basin can be reduced by providing a deeper basin over a smaller area, to free up the area for other beneficial use during the interim development stage.

9 Conclusions

The hydraulic impact of the proposed GPARC has been assessed utilising the available hydraulic model from the Alexandra Canal Floodplain Risk Management Study. This assessment confirms that the proposed development does not have an adverse impact on the surrounding properties during the interim development stage.

The impact on Epsom Road is minor and is likely due to the development on the Meriton Site. It has been assumed that the detailed drainage design of the Meriton Site would rectify this impact.

The impact of the ultimate development stage has been assessed previously by the City at the concept design stage of the Epsom Park Precinct along with the other developments in the larger catchment.

The 100 year flood levels for the ultimate development stage along the flow path between Gunyama Park and Aquatic and Recreation Centre are higher than the interim development stage. The 100 year flood levels for the ultimate development stage are provided in Figure 9. These flood levels should be used for flood planning purposes.

The 100 year provisional flood hazard is low for both the ultimate and interim development stages in the streets surrounding the development. However, the PMF provisional hazard is high for the both development stages. A prominent change in the PMF hazard from the interim to the ultimate development stage is the emergence of high hazard in the Gunyama Park.

The provisional flood hazard definition provided in this report can be used in the flood planning process for the proposed development.

10 Qualifications

The modelling results for the proposed GPARC development is based on the April 2015 design of the Sydney Water Trunk Drain. Any modifications to this design is likely to change the outcome of this study. Further modelling may be required for the assessment of the proposed development.

HydroStorm Consulting



Habib Rehman
Principal Water Consultant
B.Sc. Eng (Hons) M.Sc. Eng

FIGURES



Figure 1. Location of Gunyama Park Aquatic and Recreation Centre

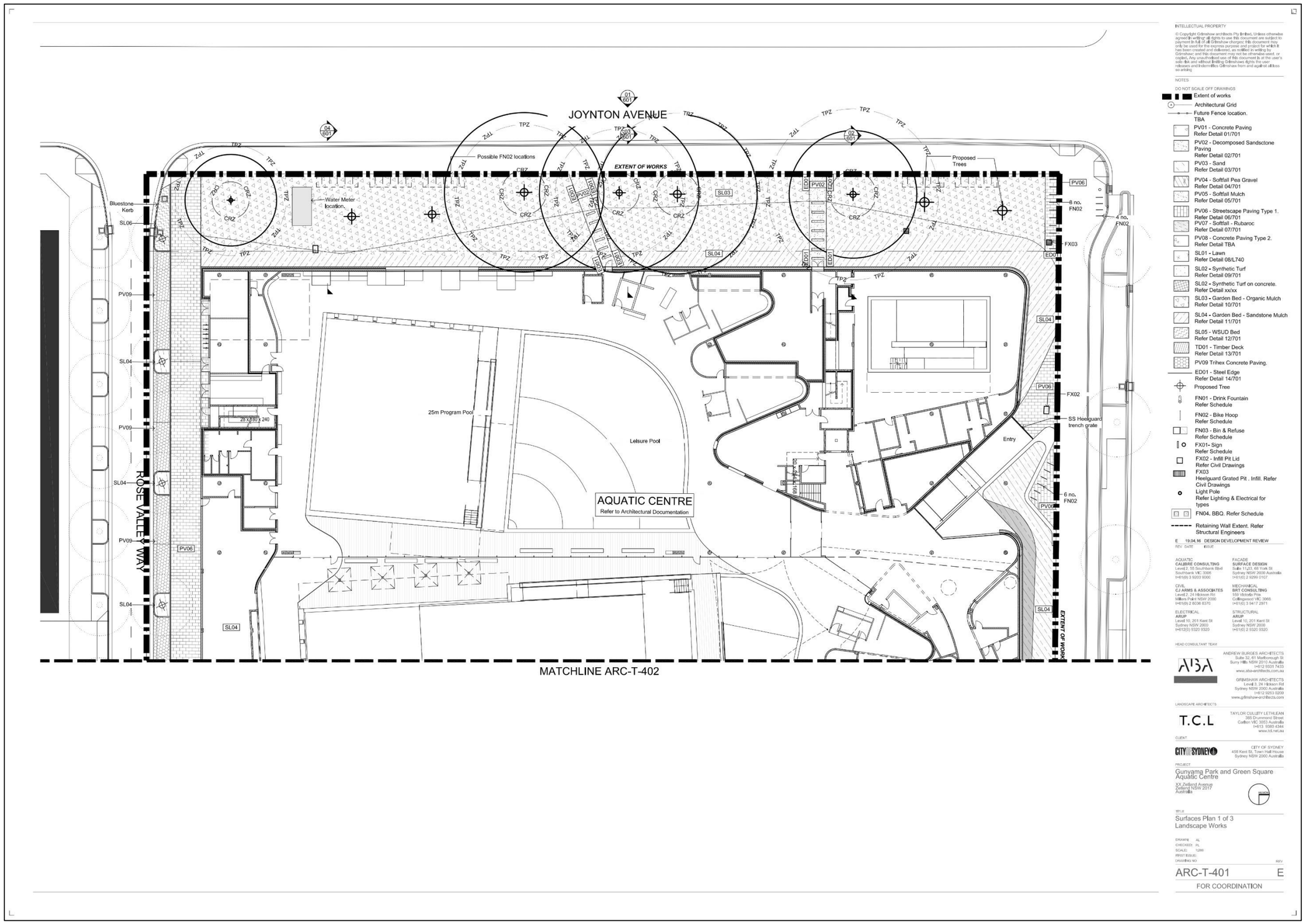
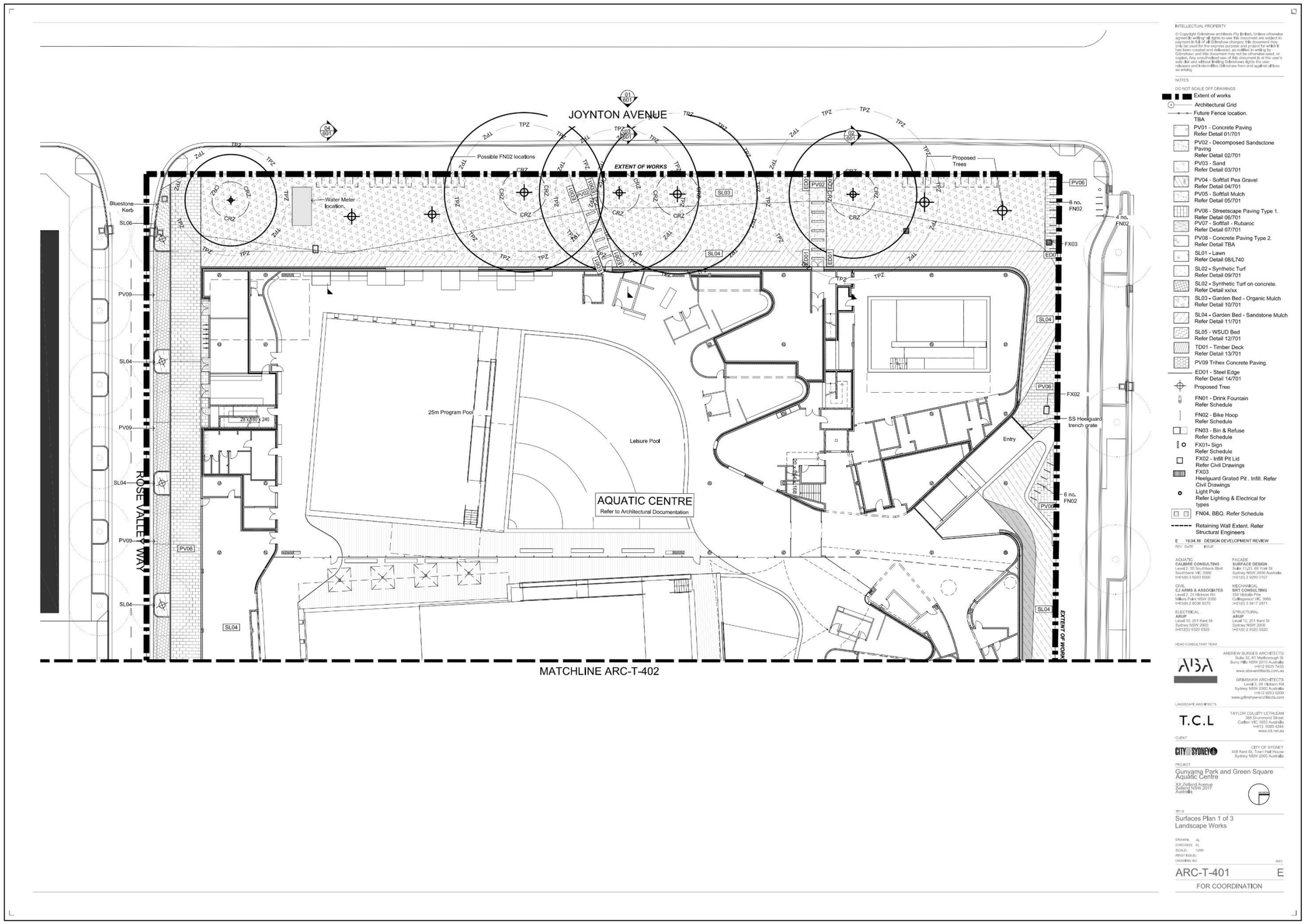


Figure 2. Gunyama Park Aquatic and Recreation Centre – Proposed Development Plans – A



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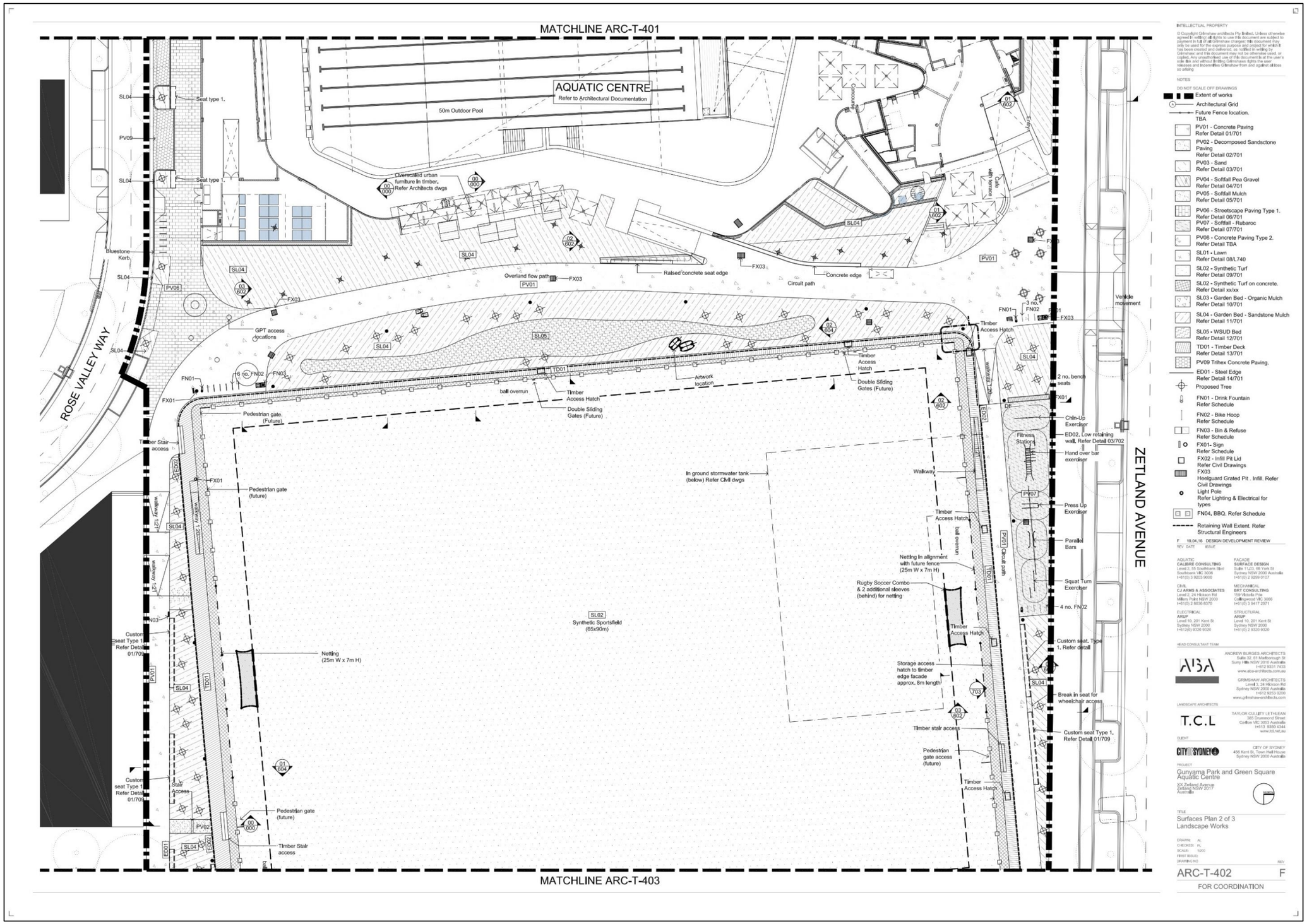

Figure 3. Gunyama Park Aquatic and Recreation Centre – Proposed Development Plans – B

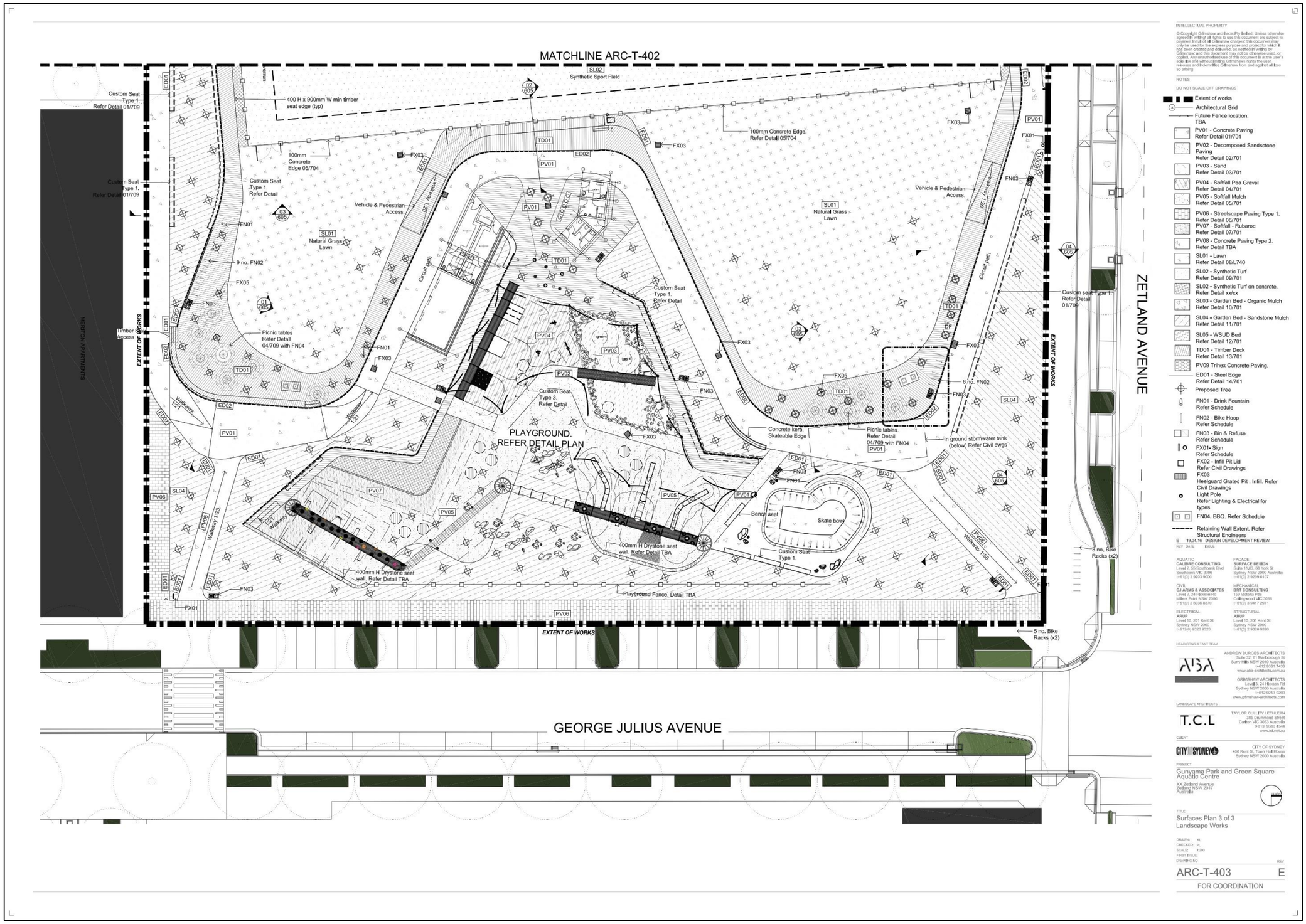

Figure 4. Gunyama Park Aquatic and Recreation Centre – Proposed Development Plans – C

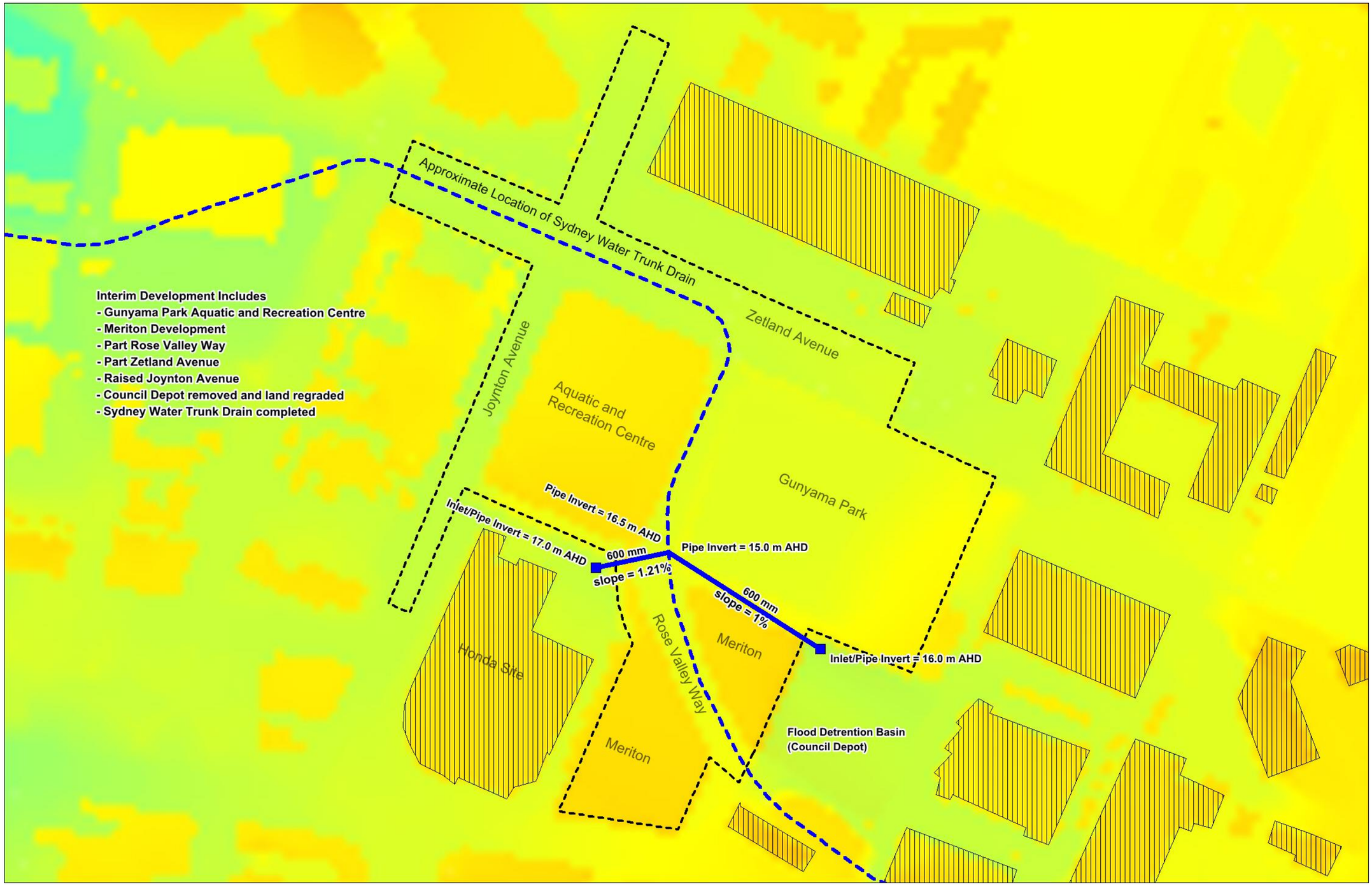

Figure 5. Interim Development Stage Details

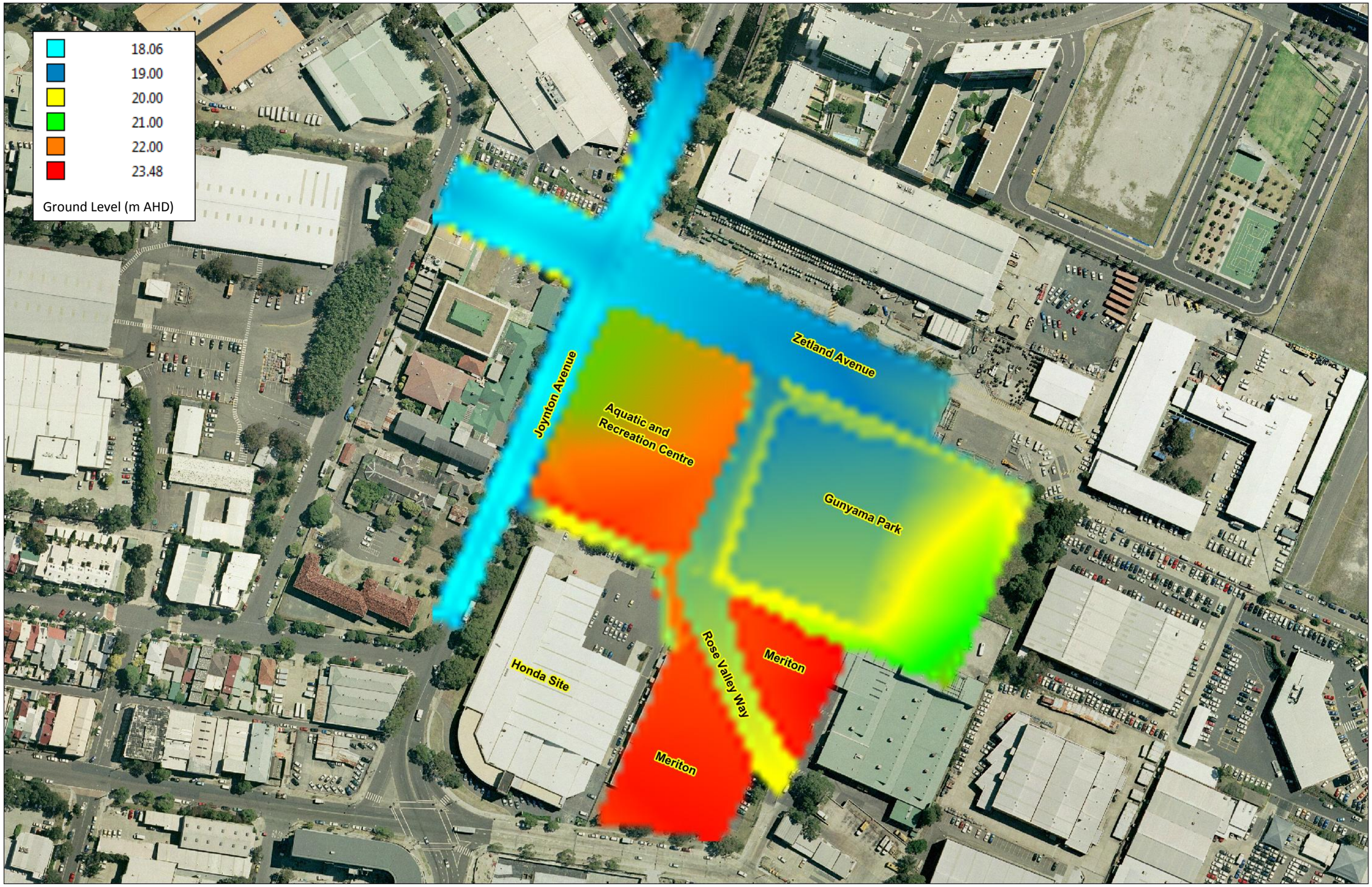

Figure 6. Interim Development Stage Terrain

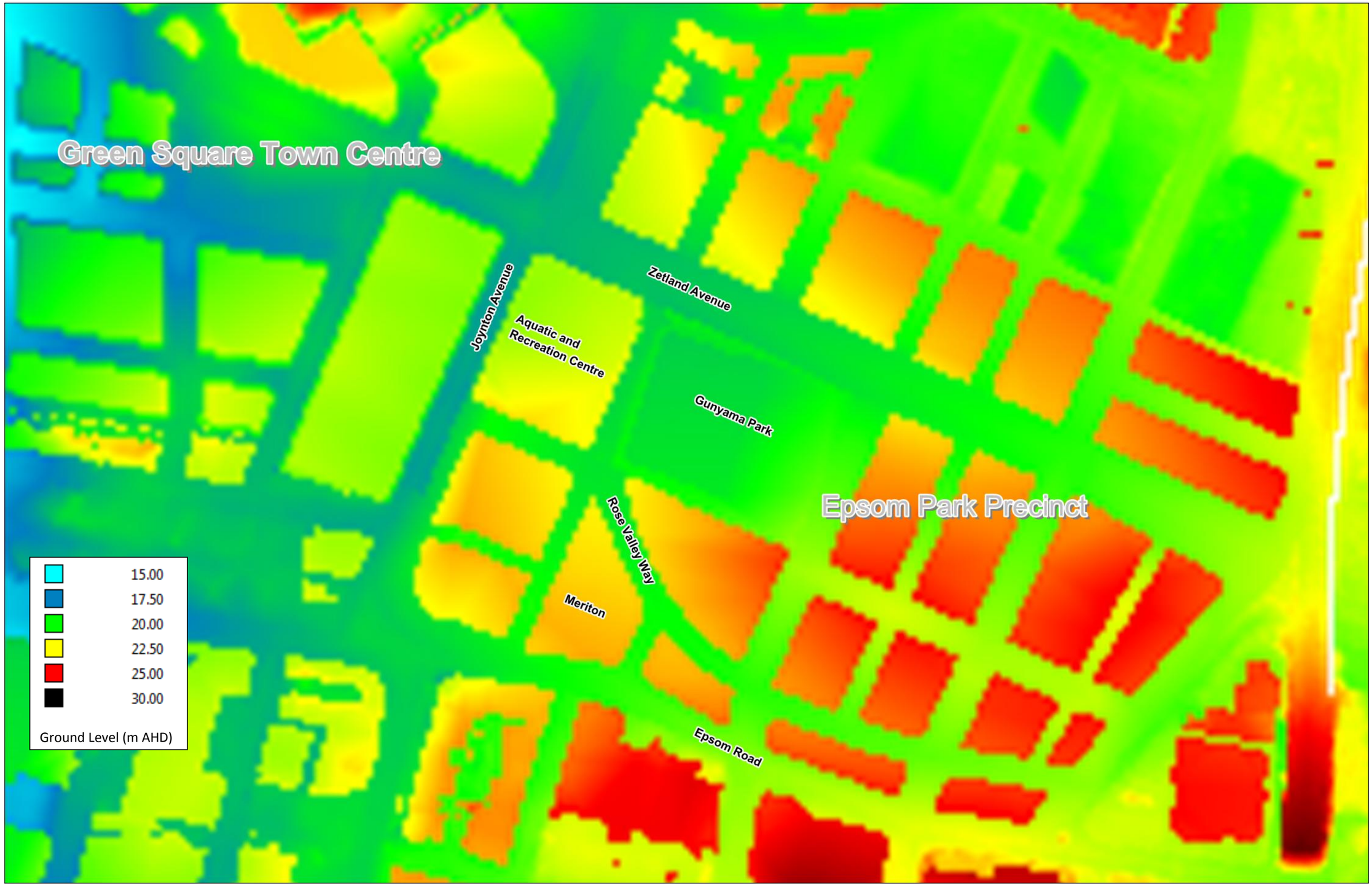

Figure 7. Ultimate Development Stage Terrain

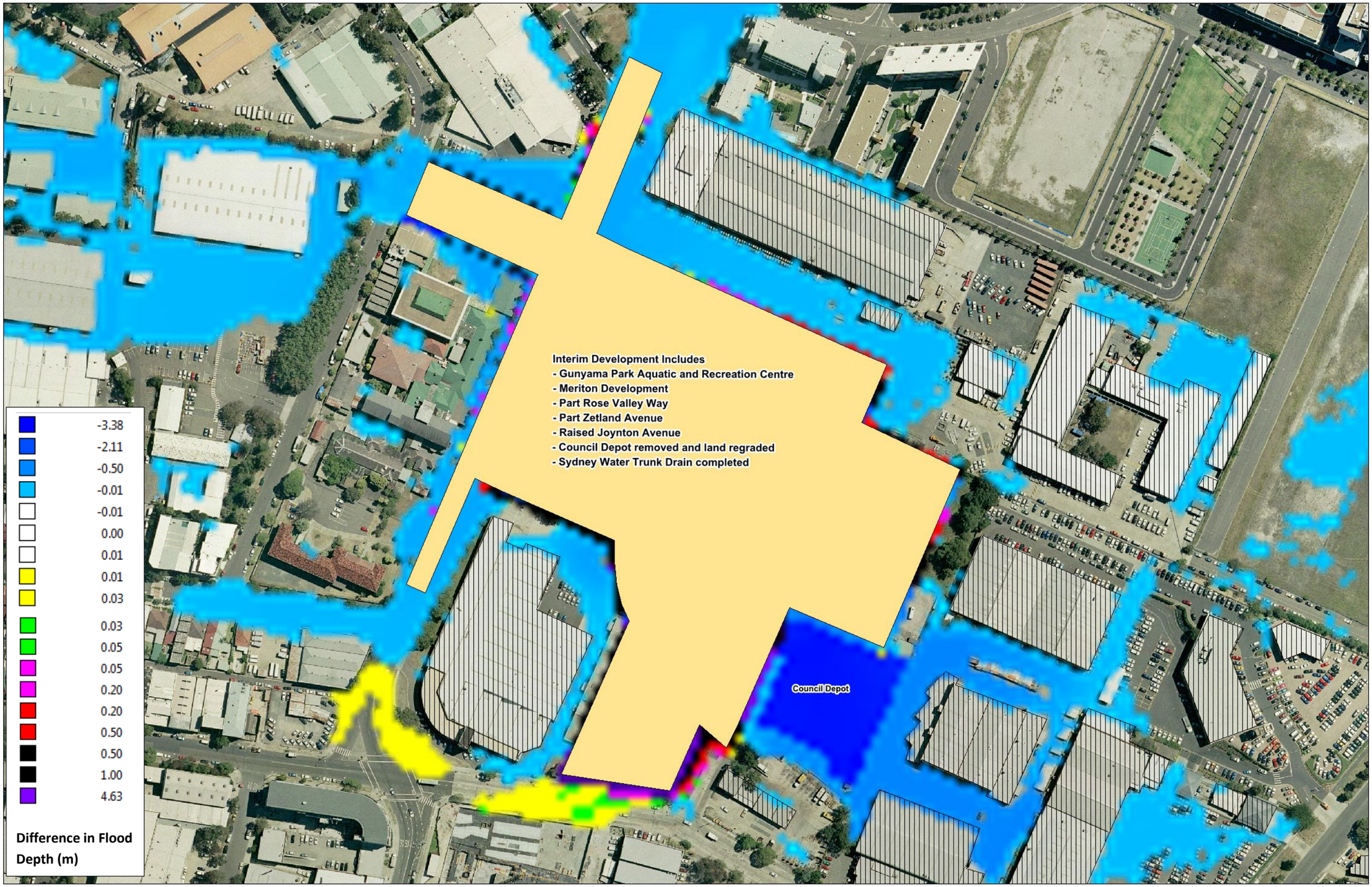

Figure 8. 100 year Flood Impact Interim Development Conditions – Difference in Flood Levels (Interim Development minus Existing)

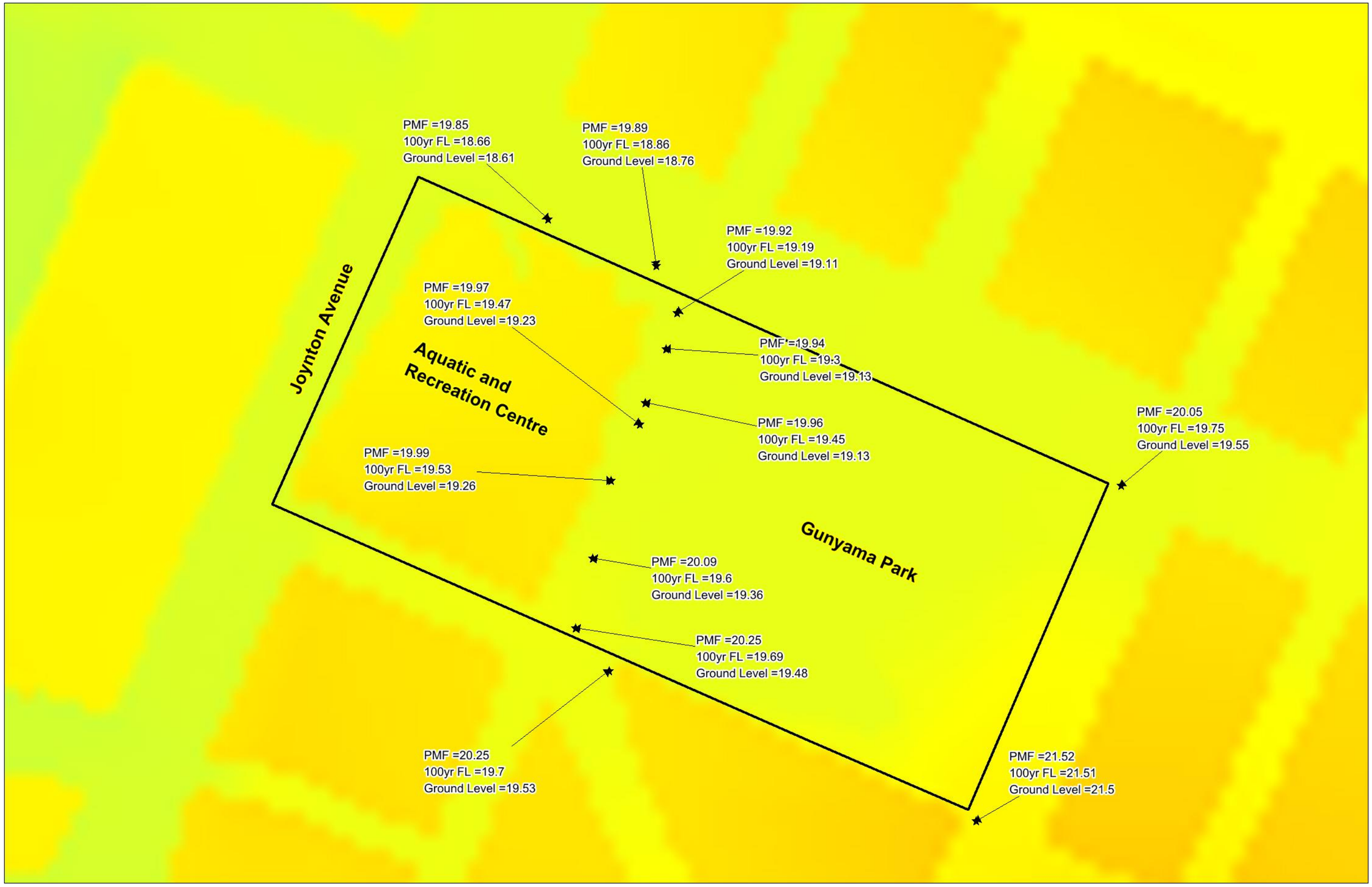

Figure 9. Design Flood Levels (100 year and PMF) – Ultimate Development Stage

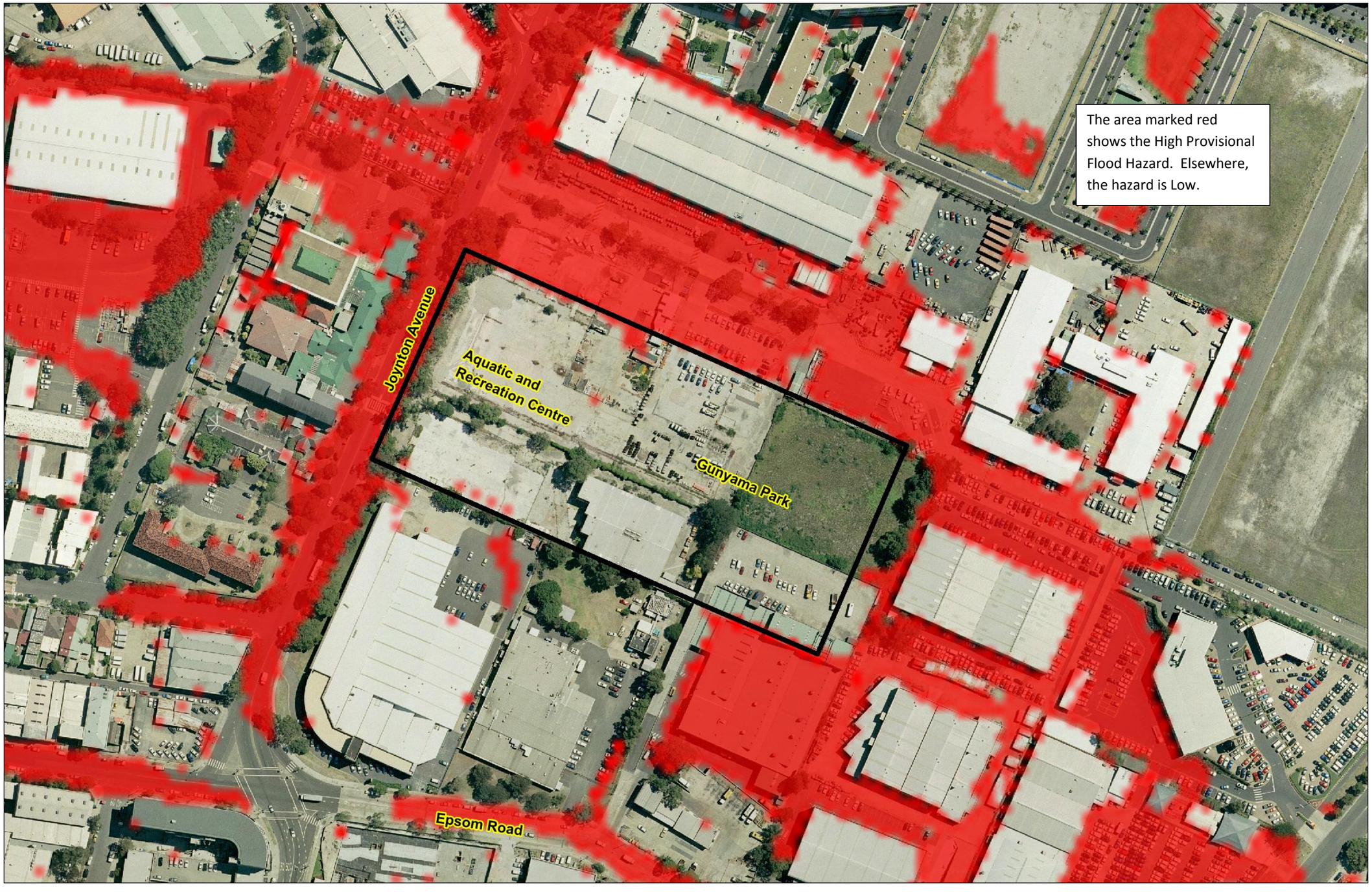

Figure 10. Provisional Flood Hazard – PMF – Interim Development Stage



Figure 11. Provisional Flood Hazard – PMF – Ultimate Development Stage

APPENDIX A

INTERIM DEVELOPMENT STAGE

TEMPORARY DRAINAGE DETAILS

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25 May 2016

Ref: L-R1037-0416-02

City of Sydney
456 Kent Street
SYDNEY NSW 2000

Attn: Sophie Spinks

Gunyama Park Aquatic and Recreation Centre Flood Investigations
Interim Development Scenario
Council Depot Flood Detention Basin and Temporary Drainage Details

Dear Sophie

During the meeting held at City of Sydney on 20 April 2016, CJ Arms and Associates requested details of the concept design of the temporary drainage proposed for the interim development conditions in the Epsom Park Precinct.

The following details are provided for your consideration:

Proposed Flood Detention Basin at the Council Depot Site

The proposed development of Gunyama Park Aquatic and Recreation Centre (GPARC) is located in the Epsom Park Precinct. A temporary flood detention basin is proposed at the Council Depot site to manage the flood impacts of GPARC under the interim development scenario for the Epsom Park Precinct.

Figure 1 shows the proposed terrain of the detention basin along with the contours. The spot levels shown in this figure are the existing ground levels, which have been derived from the flood model grid. The model grid has been developed from the ground Lidar data provided by the Council circa 2010. The spot levels should be cross checked with the available ground survey of the Council Depot.

Figure 2 shows the cross-sections for the proposed detention basin. Location of these cross-sections is shown in Figure 1. The height of the retaining wall along Gunyama Park shown in these cross-sections is approximate and should be corrected to the proposed design levels.

Flood modelling shows that the flood level in the detention basin would rise to 18.64 m AHD in a 100 yr ARI flood event. With a free-board of 0.5 m, the flood planning level related to the detention basin is 19.14 m AHD. The minimum level of the top of the retaining wall should therefore be 19.14 m AHD. It should be noted that this level would also apply to the retaining wall along the Meriton site.

Temporary Drainage from Council Depot and Honda Site

Temporary drainage has been provided to drain the flood detention basin. A 600 mm diameter pipe is proposed to carry the floodwaters from the detention basin to the Sydney Water Trunk Drain. Figure 3 shows

the layout of this pipe. Modelling shows that this pipe would carry a peak discharge of 0.85 m^3/s in a 100 year ARI flood event and drain the detention basin in approximately 3.5 hours after the start of design rainfall event.

Another temporary drainage pipe is required from the Honda site. The required pipe size is 600 mm. Modelling shows that this pipe would carry a peak discharge of 0.7 m^3/s in a 100 year ARI flood event. The ponding in the north-eastern corner of the Honda site (near Rose Valley Way) would be drained in approximately 2 hours after the start of design rainfall event.

The inlet capacity at the two locations would need to be designed to carry the peak discharges provided above.

The required invert levels of the pipes and slopes are also shown in Figure 3.

The location of the temporary drainage shown in the Figure 3 is approximate and would need to be finalized in the detailed design.

Discharge Time Series

Figure 4 shows the discharge time series for Sydney Water Trunk Drain where it passes under the flow path between Aquatic Centre and Gunyama Park. The Trunk Drain consists of twin 1650 mm pipes and each pipe carries the discharge shown in Figure 4.

Assumptions/Qualifications

The following assumptions/qualification apply to the data presented in this report:

- The details provided in this letter report are based on the concept design undertaken using the flood modelling of the Sheas Creek catchment, which includes the Epsom Park Precinct. The flood model is based on a 4m grid and this needs to be considered in adopting the proposed levels for various drainage elements. If the detailed design levels vary significantly from those presented in this report, additional flood investigations may be required.
- The existing ground levels around the periphery of the flood detention basin presented in this report should be cross checked with the ground survey data
- The required height of the retaining wall along the Gunyama Park boundary of the detention basin should be confirmed from the detailed design drawings for the Gunyama Park Aquatic and Recreation Centre project
- The location of temporary drainage shown in Figure 3 is approximate

HydroStorm Consulting



Habib Rehman
Principal Consultant
B.Sc. Eng (Hons) M.Sc. Eng

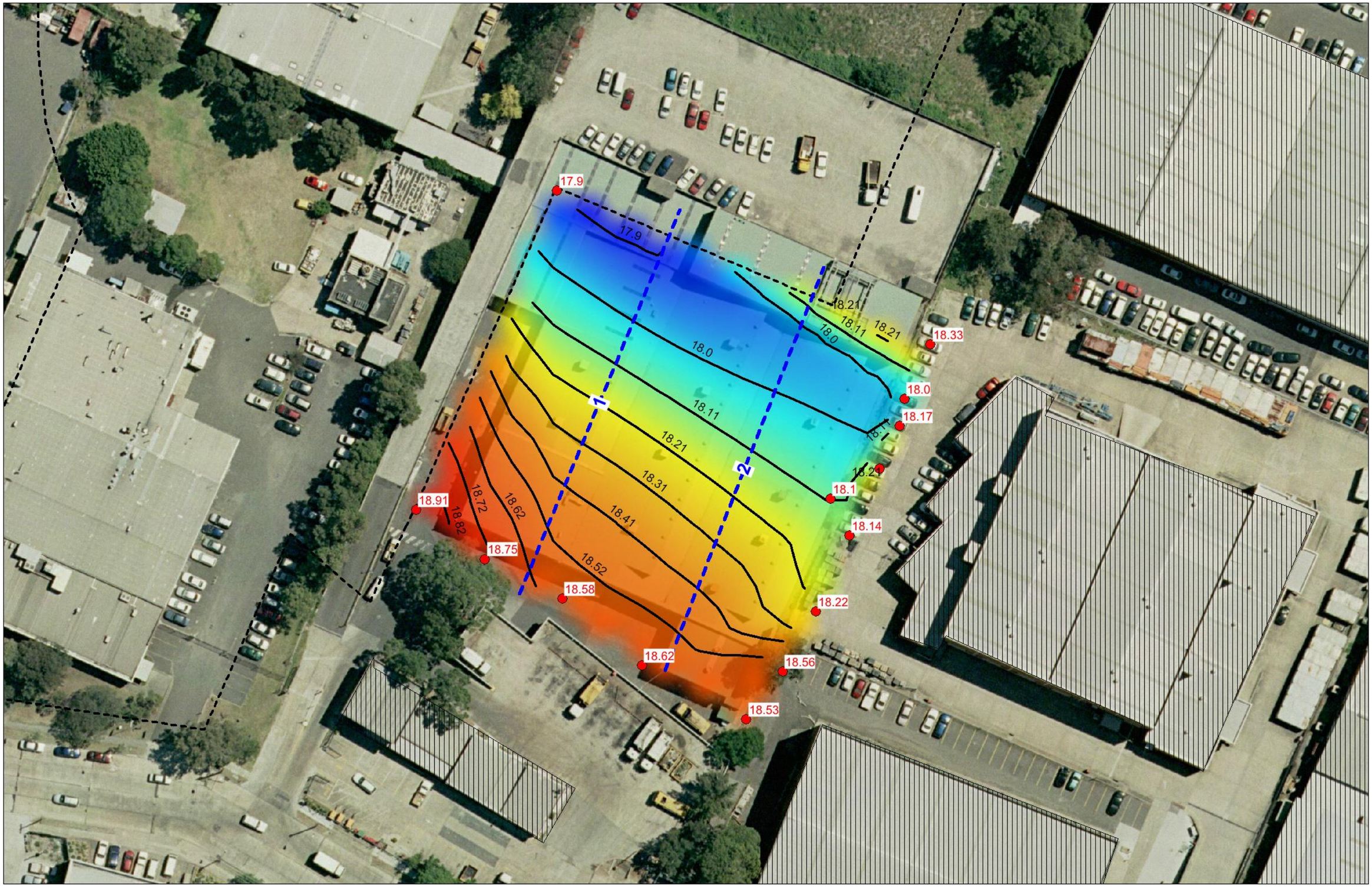
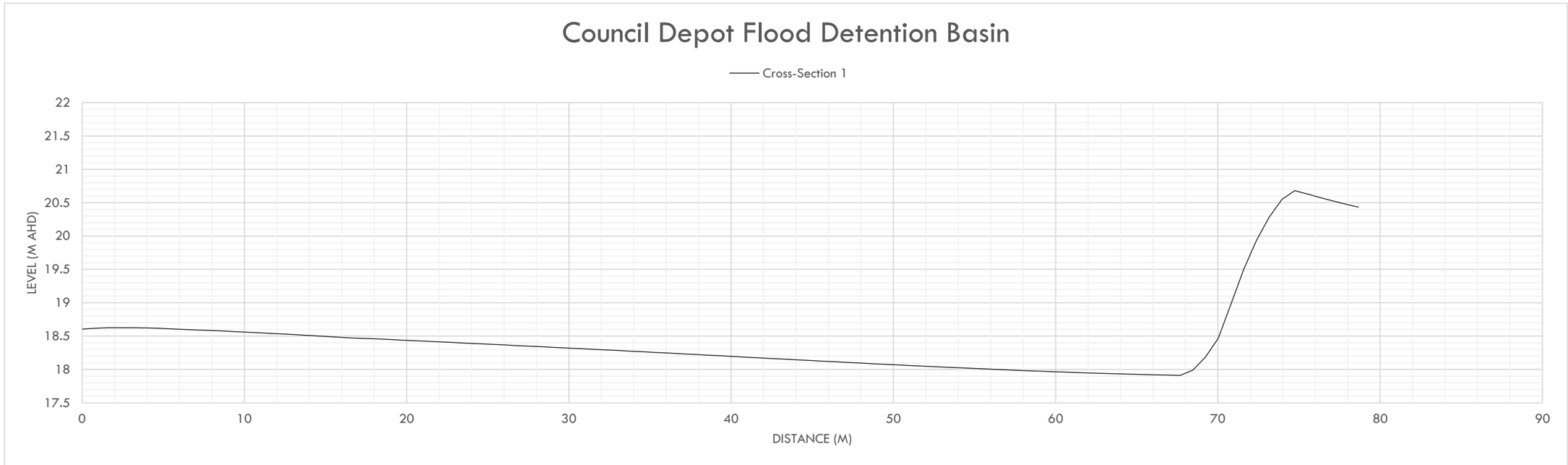


Figure 1. Proposed Flood Detention Basin at Council Depot Site – Proposed Basin Levels (m AHD)



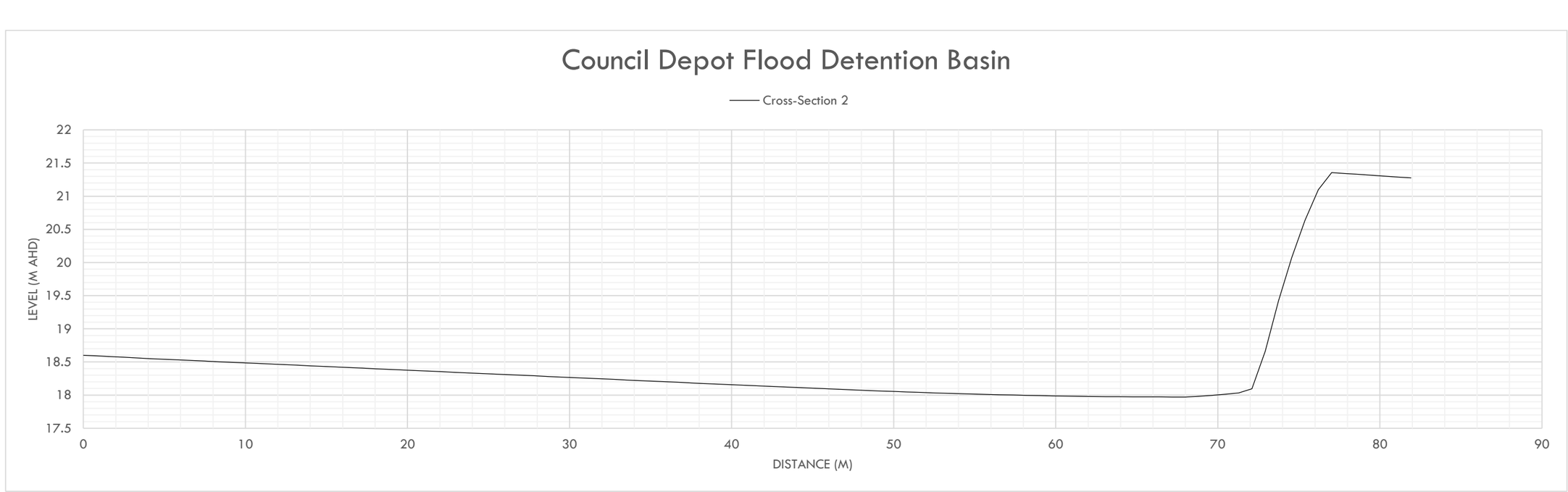


Figure 2. Proposed Flood Detention Basin – Cross-Sections

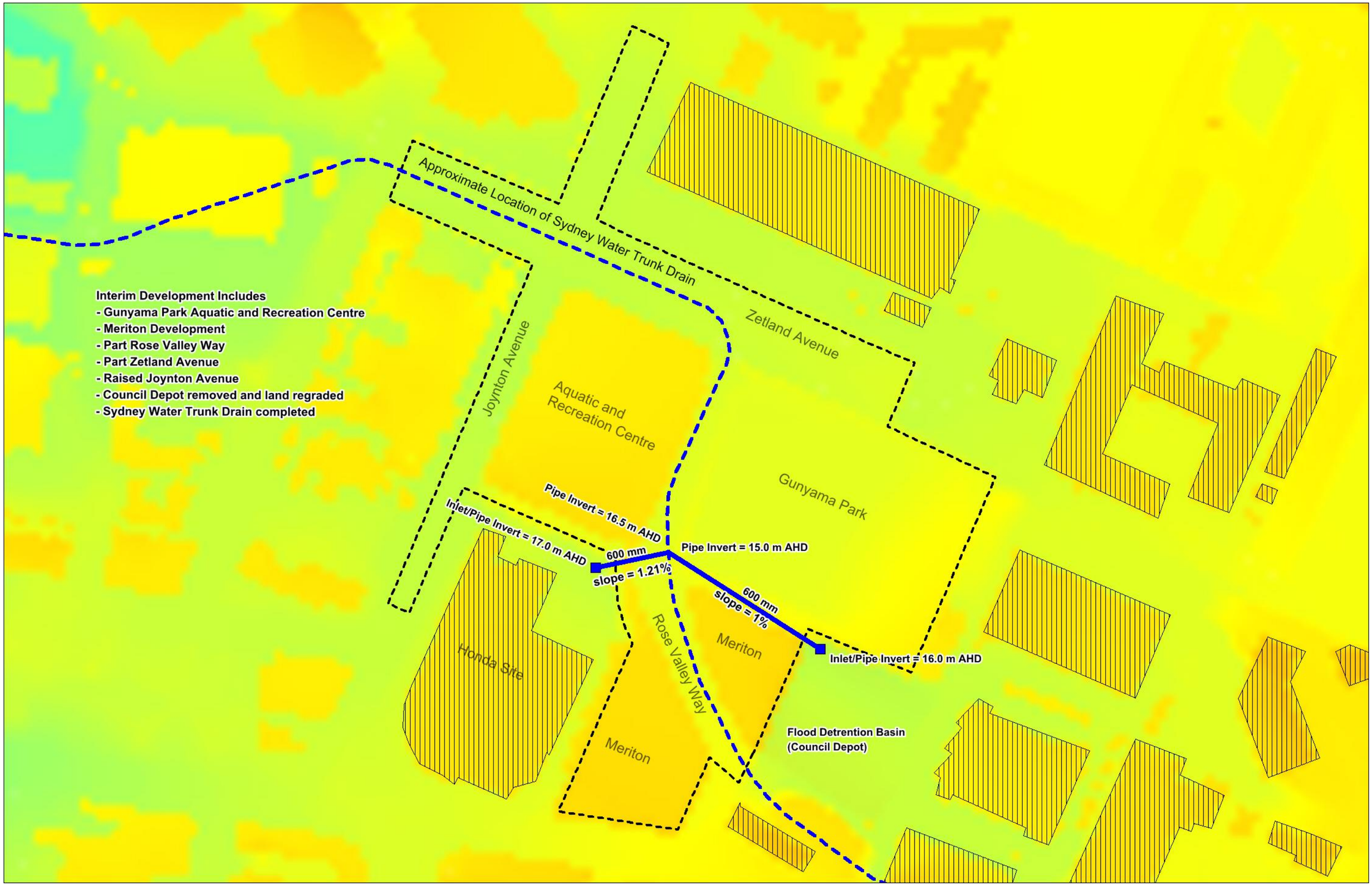


Figure 3. Interim Development Scenario – Temporary Drainage Details

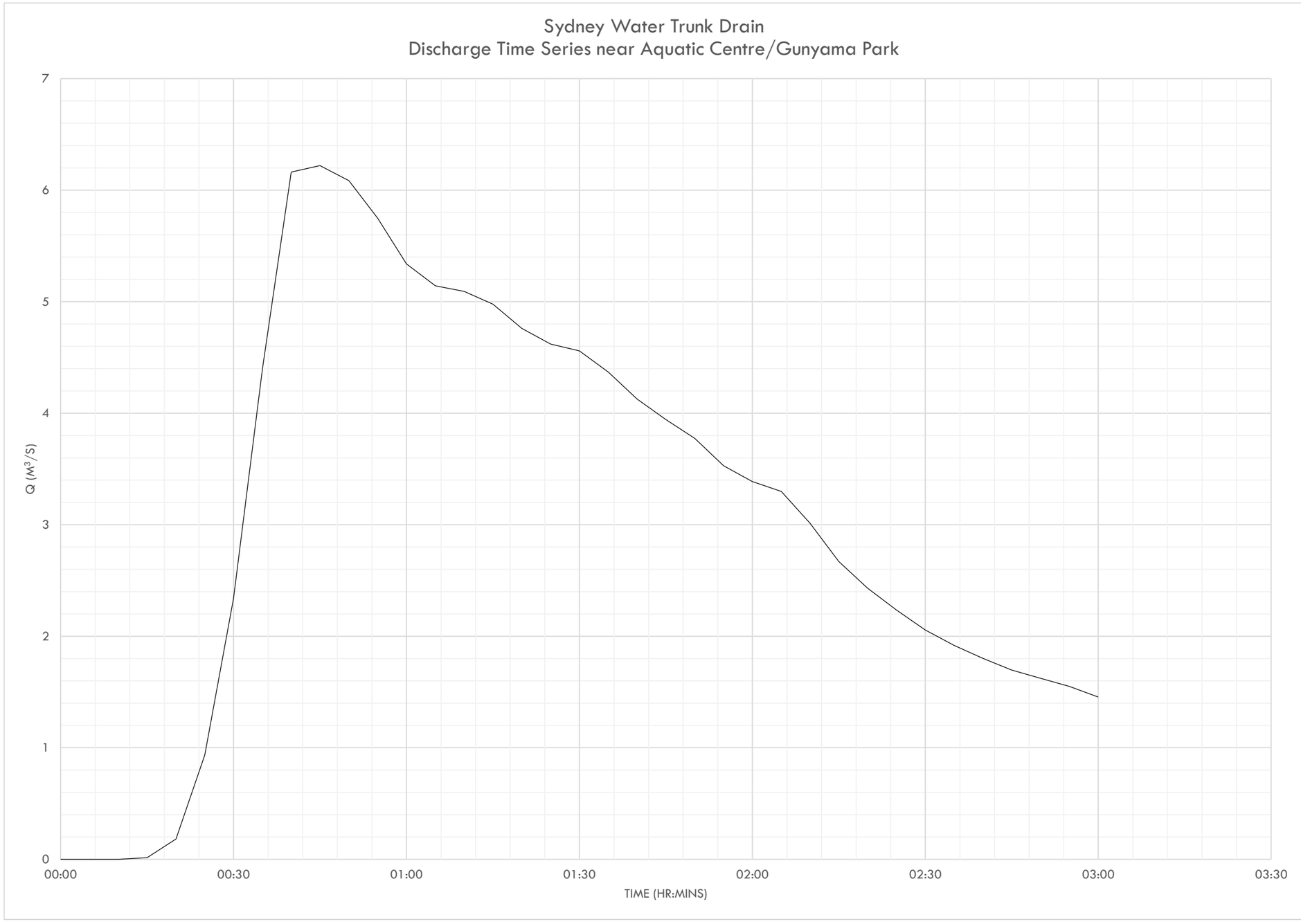
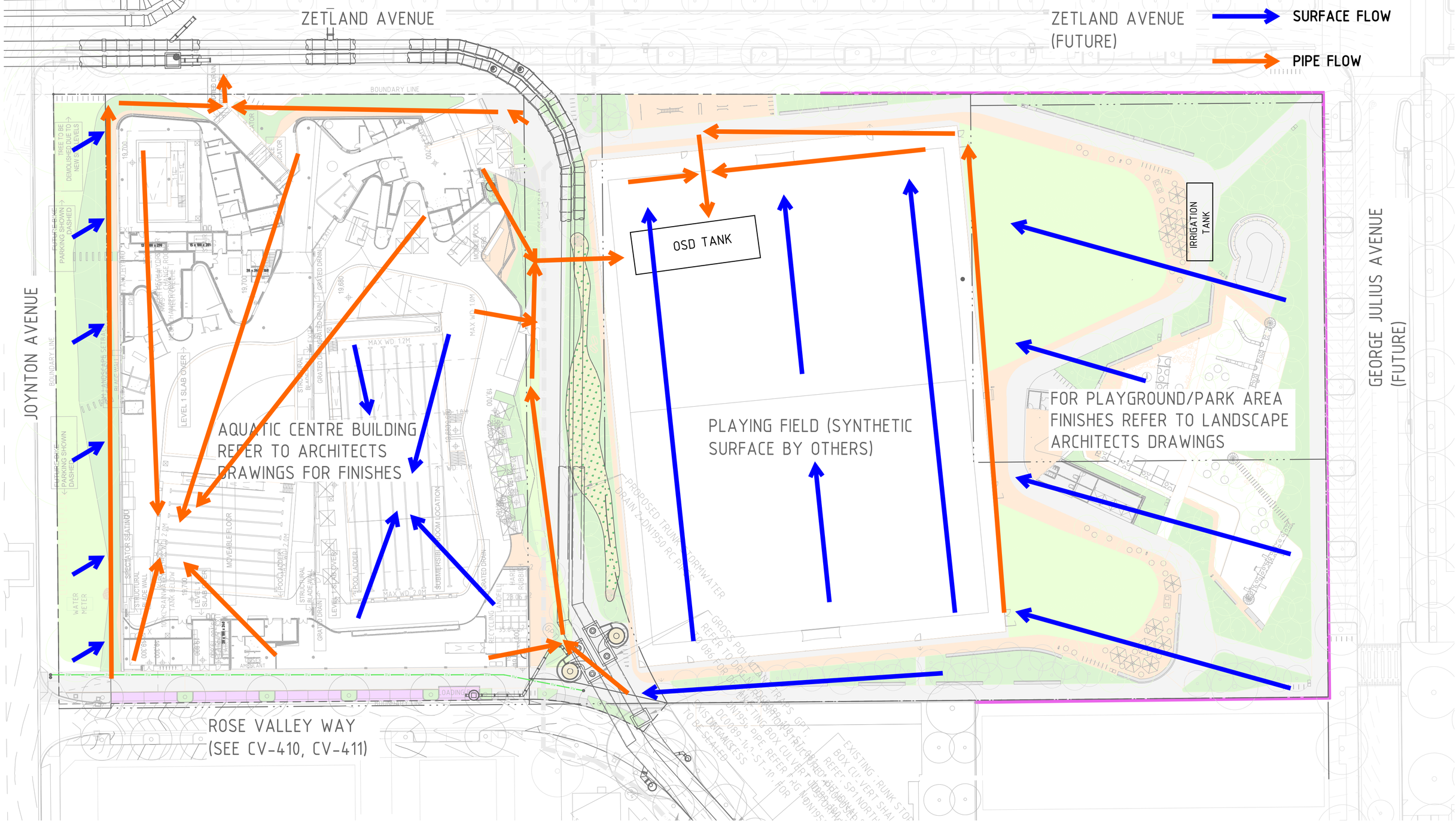


Figure 4. Discharge Time Series in Sydney Water Trunk Drain at Aquatic Centre/Gunyama Park



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PROJECT **GPARC**
GUNYAMA PARK AQUATIC AND RECREATION CENTRE

DRAWING STATUS PRELIMINARY
PROJECT STATUS CONCEPTUAL

DRAWING STORMWATER MANAGEMENT 3 MONTH FLOW PATH CONCEPTUAL PLAN

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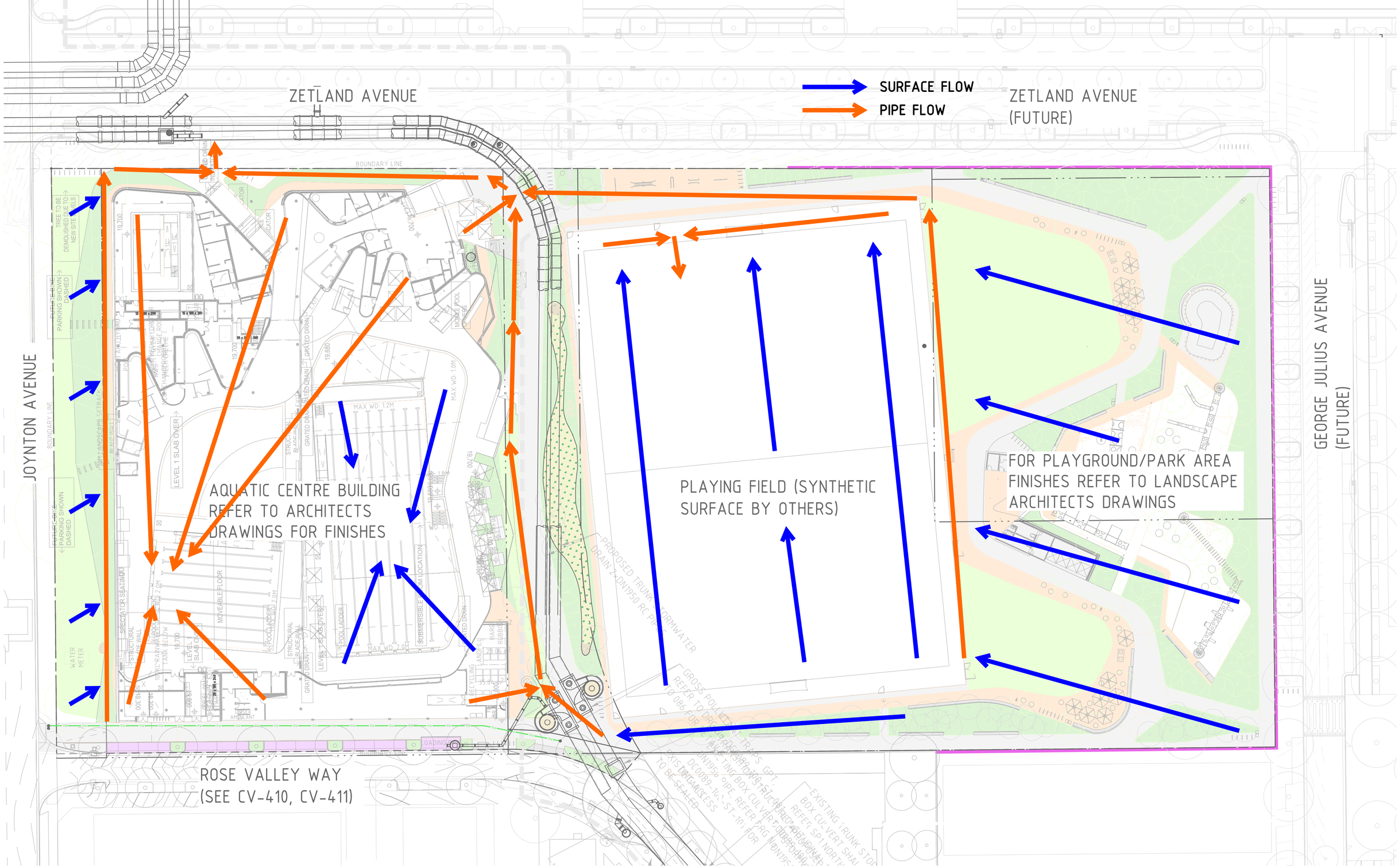

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GUNYAMA PARK AQUATIC AND RECREATION CENTRE

DRAWING STORMWATER MANAGEMENT 20 YEAR FLOW PATH CONCEPTUAL PLAN

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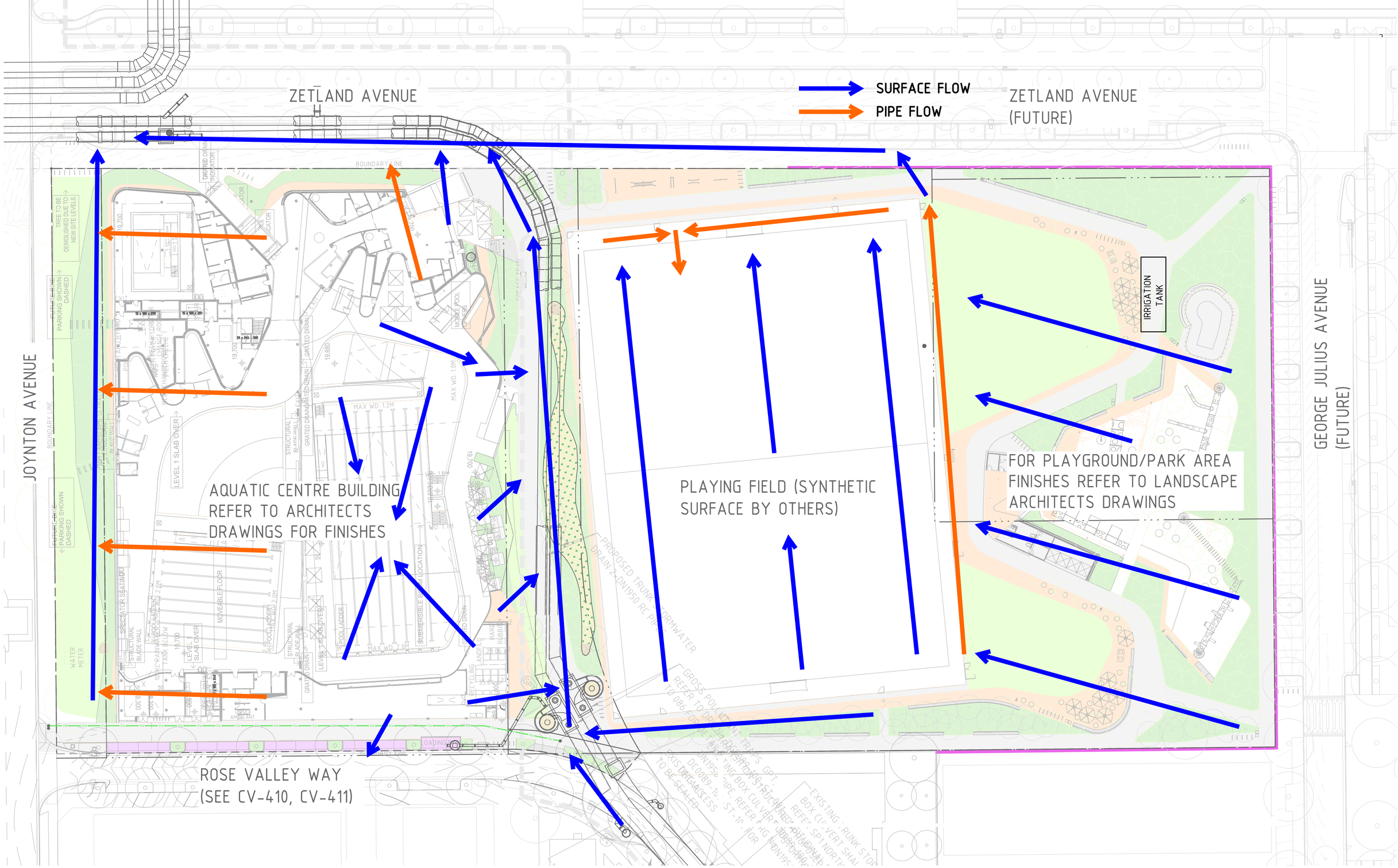

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PROJECT **GPARC**

GUNYAMA PARK AQUATIC AND RECREATION CENTRE

DRAWING STATUS PRELIMINARY

PROJECT STATUS CONCEPTUAL

DRAWING STORMWATER MANAGEMENT 100 YEAR FLOW PATH CONCEPTUAL PLAN

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DEVELOPMENT APPLICATION SUBMISSION

Gunyama Park Aquatic and Recreation Centre (GPARC).

STORMWATER MANAGEMENT REPORT

CIVIL ENGINEERING REPORT

PREPARED FOR:

CITY OF SYDNEY

Project Number: C16113

REVISION: P9

DATE: 06/06/2016

DOCUMENT HISTORY

Revision	Prepared By	Verified By	Date
P1	BW/WB/RO	PP/CA	30/07/2015
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P3	BW/WB/RO	DJ	15/10/2015
P4	BW/WB/RO	DJ	18/12/2015
P5	BW/WB/RO	DJ	21/04/2016
P6	BW/WB/RO	VR	17/05/16
P7	BW/WB/RO	VR	19/05/16
P8	BW/WB/RO	VR	31/05/16
P9 Final	VR	VR	06/06/16

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APPENDED DRAWINGS

Stormwater Management Catchment Area Assessment Conceptual Plan SK-C1000
Stormwater Management 3 month Flow Path Conceptual Plan SK-C1003
Stormwater Management 2 year month Flow Path Conceptual Plan SK-C1020
Stormwater Management 100 year Flow Path Conceptual Plan SK-C1100

1. BACKGROUND

1.1 PURPOSE

CJ Arms & Associates have been engaged by City of Sydney through Andrew Burges Architects and Grimshaw Architects to undertake the hydraulic engineering, fire services engineering, civil engineering and WSUD (stormwater management) design.

The focus of this report is the stormwater drainage management and provision of storage for proposed irrigation.

This report considers the ultimate development requirements and not the interim stormwater management of the Council depot site.

1.2 SCOPE

The scope of this report is to provide advice on the following items:

- Stormwater drainage strategy
  - 3 month, 20 year and 100 year flow rates
  - discharge limits (Sydney Water)
- Onsite stormwater management
  - no increase in stormwater overflows to adjacent properties
  - detention requirements
  - retention requirements
- Stormwater treatment requirements
- Irrigation requirements (as outlined in Irrigation Consultant's DA Statement.)

1.3 SITE OF PROPOSED DEVELOPMENT

The proposed site is located at Joynton Avenue within the Epsom Park Precinct adjacent to the Green Square Town Centre. The existing site consists of old buildings, carparks and concrete slabs of varying age and quality.

Once fully developed the project will include a new Aquatic Centre, with indoor and outdoor swimming pools and gym, an outdoor synthetic soccer field, landscaping, playgrounds and areas for spectators, barbeques, and exercising, as shown below in figure 1.

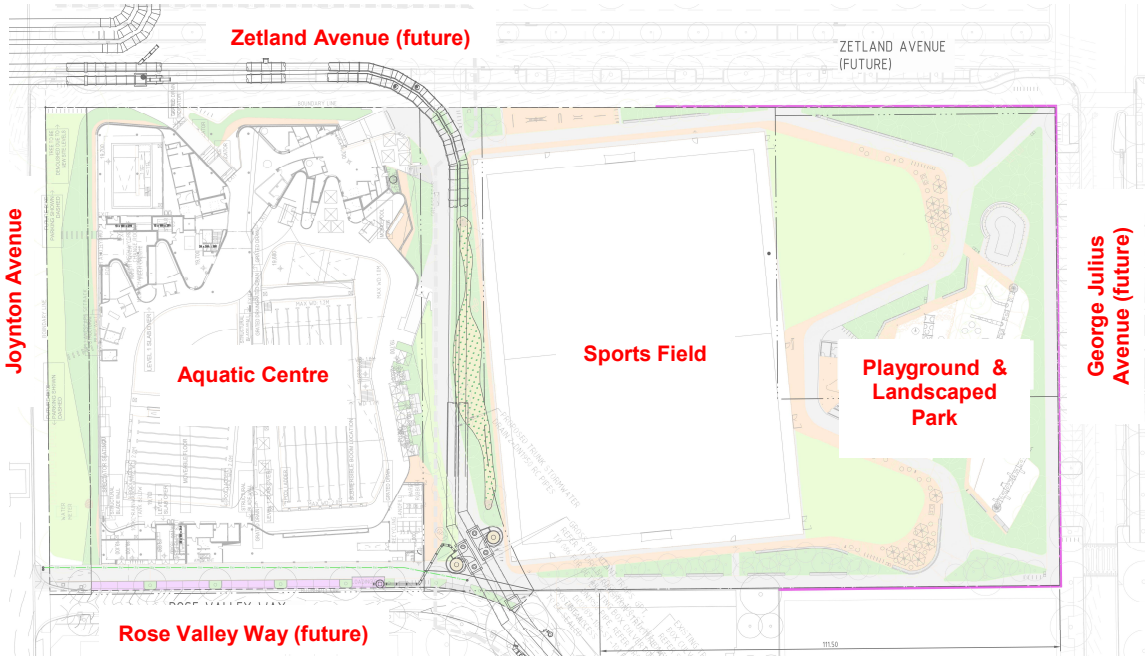


Figure 1 – Location of proposed development

1.4 PROPOSED DEVELOPMENT

It is planned to redevelop the site in three main aspects. Firstly, the aquatic centre on the west comprising new swimming pools, gymnasiums and amenities. Secondly in the centre of the site a new synthetic sports field, a regional playground and landscaped park precinct on the remainder of the east of the site.

The site is also encumbered by extensive existing stormwater culverts and water mains that require diversion to accommodate the aquatic centre building. These diversions are being designed, managed and constructed by others and they do not form part of this scope. They do however impact our development and need careful consideration in our design scope.

Hydrostorm Consulting in their final report issued 3 June 2016, confirmed that the proposed Sydney Water trunk drainage work would be completed before the GPARC site is developed and that the capacity of the truck drain is to convey the 20 year ARI flood event. The balance of stormwater will be conveyed overland through the GPARC site. This overland flow has significant impact on the proposed geometry of our site but has been accommodated.

The stormwater from the GPARC site will be allowed to discharge into the truck drain via the provided connection point in Zetland Ave; the discharge will be restricted to 1.032 m^3/s and this will be achieved by provided an onsite retention tank.

The report confirms that the 1 in 100-year flood levels across the site will vary from RL 19.70 at Rose Valley Way to RL 18.86 at Zetland Avenue in the ultimate development stage. It further recommends that these levels should be used for flood planning purposes.

The pitch area will be protected from the floodwaters by a 400mm high perimeter bund/seat structure preventing floodwaters from crossing the pitch; meaning there should be no ponding on the pitch at all in the 100 year flood event. Futhermore the entire pitch drains into the onsite detention tank.

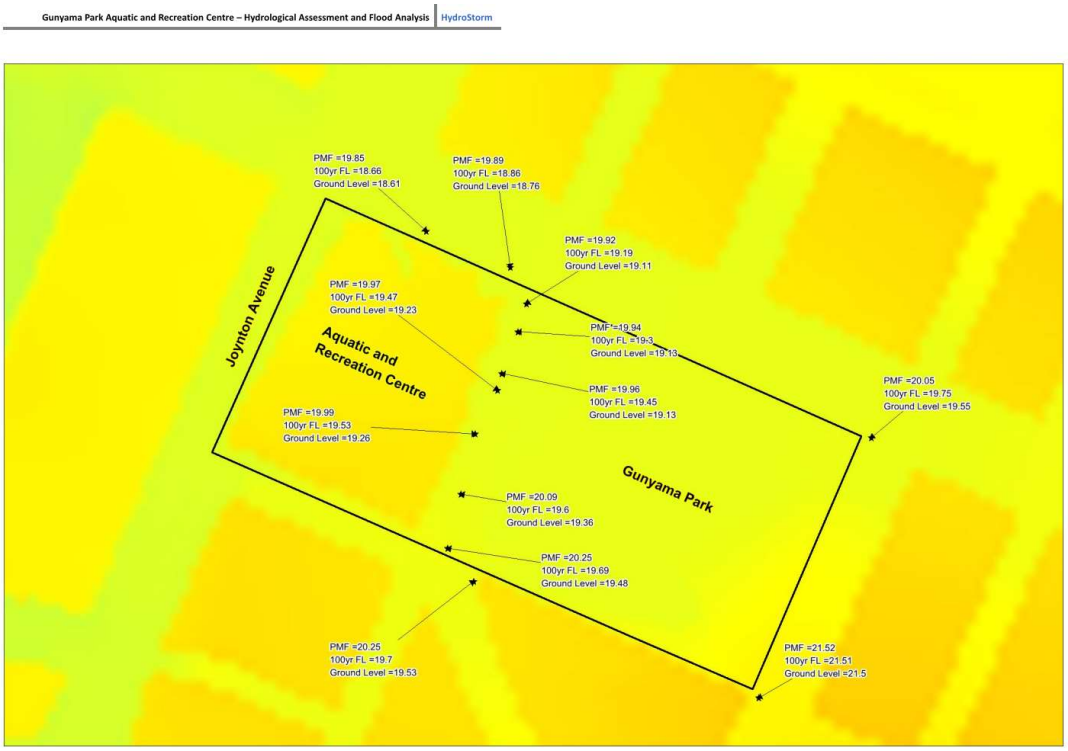


Figure 9. Design Flood Levels (100 year and PMF) – Ultimate Development Stage

Figure 1 – 1 in 100 flood level advice from HydroStorm Consulting

1.5 INTERIM DRAINAGE REQUIREMENTS

The interim drainage requirements refer to the conditions that will apply until the surrounding site is fully developed. HydroStorm Consulting have modelled this condition and have made the following recommendations: -

1. The need for the creation of a temporary flood storage basin at the Council Depot Site. In this situation, the flood modelling requires a detention basin with a top water level of RL 18.64 AHD in the 1 in 100-year event. With a 500 mm freeboard, the flood planning floor levels surrounding the basin should be at 19.14 AHD. The basin will be constructed to protect the GPARC and the Meriton Site.

2. Provision for temporary drainage from the Council Depot Site. A 600 diameter drain will be constructed from the retention basin into the Sydney Water trunk drain.

3. Provision for temporary drainage from the Honda Site. A 600 diameter drain will be required form the low point in Rose Valley Way to the Sydney Water trunk drain.

4. The inlet capacity at these two locations would need to be designed to carry the peak discharges of 0.85 m^3/ s for the Council depot drain and 0.7 m^2/s for the Honda site drain respectively.

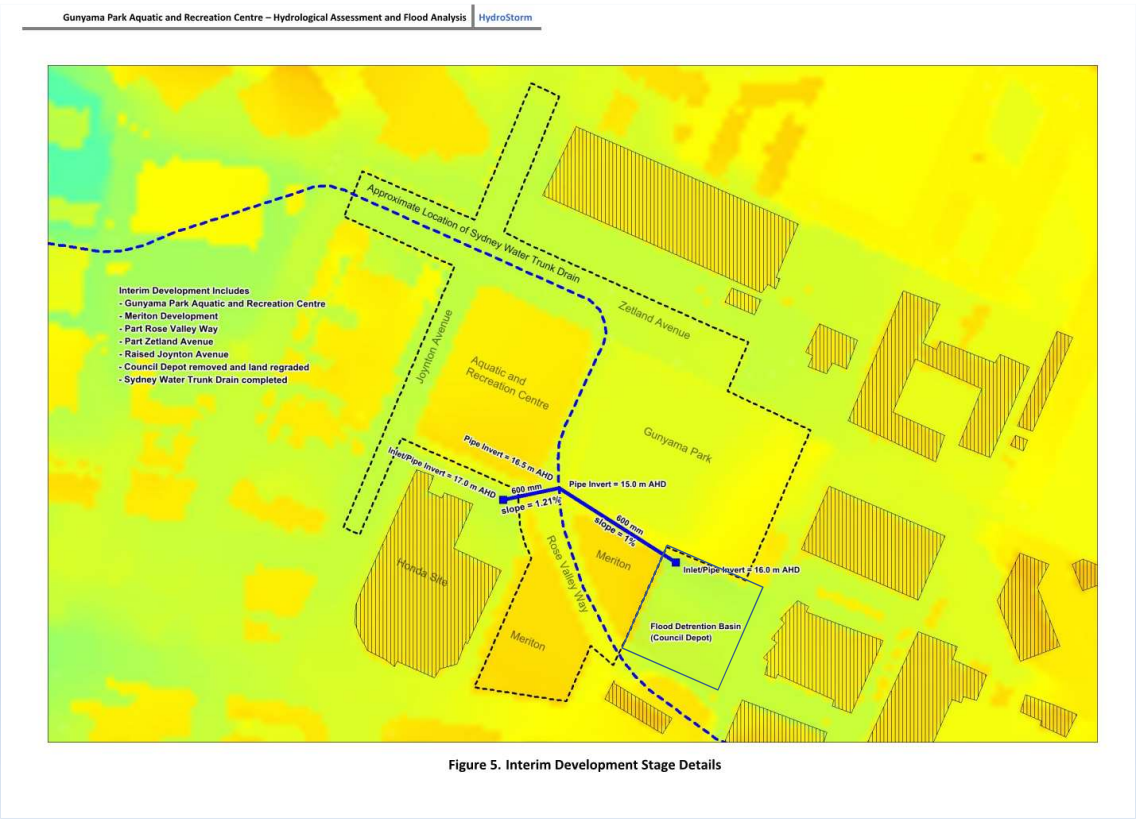


Figure 5. Interim Development Stage Details

Figure 3 – 1 in 100 Interim Drainage advice from HydroStorm Consulting

On this basis we believe that the currently proposed geometry of the site deals with the major flood path traversing the site, no additional measures are required to manage external floodwaters.

1.6 ASSOCIATED DRAWINGS

The following drawings are to be read in conjunction with this report.

CV-001	Title & Notes
CV-005	Demolition Plan
CV- 007	Bulk Earthworks Plan
CV-010	Site Plan
CV-100	West Zone (Building)
CV-101	Central Zone (Field)
CV-102	East Zone (Park)
CV-300	Site Sections Sheet 1
CV-301	Site Sections Sheet 2
CV-400	Site Details Sheet 1
CV-410	Rose Valley Way Layout Plan
CV-411	Rose Valley Way Paving & Details
CV-500	Catchment Analysis
CV-600	Pavement Plan & Details
CV-700	Pit Schedule
SK-C1003	3 month flow path
SK-C1020	20 year flow path
SK-C1100	100 year flow path

1.7 INFORMATION OBTAINED & LIMITATIONS

Our reports and associated drawings and documents have been prepared utilising the following information sources.

1. Sydney Water overland flow through site (south to north) 1.33m^3/sec
2. Flood modellers (Hydrostorm Consulting) dated 3.06.16 is included in this report.
3. Sydney Water permissible site discharge of 1,032L/s
4. Sydney Water onsite detention requirement of 384,000L
5. Design rainfall intensities:

   100 YR ARI = 274mm/hr, 20 YR ARI = 211mm/hr, 3 MTH ARI = 50mm/hr
6. DCP Stormwater treatment requirements (GP 90% >5mm, SS 85%, TP 65%, TN 45%)
7. Project Site Survey (3D), prepared by Cardno Hard & Forester, updated 04/06/2015
8. Rose Valley Way Level Design, prepared by City of Sydney, issue date 21/09/2015
9. Rose Valley Way Drainage Design, prepared by City of Sydney, issue date 21/09/2015
10. George Julius Ave Level Design, prepared by City of Sydney, issue date 21/09/2015
11. Zetland Ave Level Design, prepared by City of Sydney, updated 16/02/2016
12. Stormwater Culvert Upgrade Design, prepared by DG Alliance, issue date 22/12/2015
13. Water Main Diversion Design, prepared by DG Alliance, issue date 25/11/2015
14. Meriton Site Level Design, prepared by at&l, updated 24/02/2016
15. Douglas Partners Geotechnical Assessment (updated 11/04/16)
16. AECOM Remedial Action Plan (updated 13/04/2016)
17. Landscape drawings provided by TCL in March 2016
18. Aquatic centre drawings updated by ABA on 6 /05 /16

2. EXISTING STORMWATER INFRASTRUCTURE

2.1 SYDNEY WATER DRAINS

Documents provided by DG Alliance (32 pages referred to as “GA-06-SP2” dated 26/05/2015) provide guidance as to the future alignment of the Sheas Creek main drain being upgraded by Sydney Water.

The entire precinct is undergoing major drainage upgrades and development works and subsequently most of the existing stormwater infrastructure surrounding our site is redundant.

We have overlaid the information provided to us as a basis for our design and intend to use this information to inform the stormwater design for our site unless advised otherwise.

2.2 LEGAL POINT OF CONNECTION

Describe the legal point of connection from the site (include the pipe system and the overland flow system).

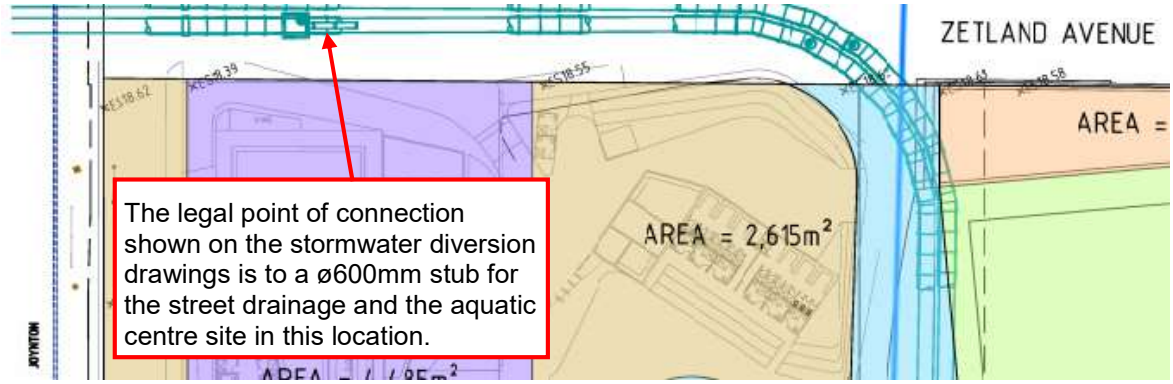


Figure 4 – Legal Point of Connection

The site discharge will be limited to 1.032 m^3/s. To achieve this a site stormwater detention tank will be used to moderate the flows.

3. SITE CATCHMENT ANALYSIS

The following diagram and table explain the breakup of the site catchments and their properties for the purposes of design. Sub-catchments are numbered on the drawing for ease of reference. For further information please refer to appended sub-catchment drawings.



Figure 5 – Site Catchment Diagram

#	Catchment Name	Surface Finish	Area (m^2)	Runoff Coeff
1.	WEST BOUNDARY	Garden bed	1,135	0.5
2.	ROSE VALLEY WAY PARKING	Asphalt/concrete	455	0.9
3.	MAIN ROOF	Metal roof	4,485	1
4.	POOL TERRACE	Timber/paving	990	0.9
5.	GREEN ROOFS	Grass or shrubs /ground covers	2,715	0.7
6.	OPEN POOL	Pool	1,725	0
7.	OVERLAND FLOW PATH	Timber/paving	1,530	0.9
8.	ZETLAND AVE DECK	Timber/paving	620	0.9
9.	PLAYING FIELD	Synthetic (semi permeable)	7,000	0.7
10.	ROSE VALLEY WAY DECK	Timber/paving	720	0.9
11.	PARK INFILL STRIP	Grass/paving/garden	220	0.7
12.	SE PARK	Grass/paving/garden	3,325	0.5
13.	NE PARK	Grass/paving/garden	4,800	0.5
	TOTAL		**29,720**	**0.671**

Figure 6 – Site Catchment Analysis

3.1.1 Flow Analysis

Based on the catchment analysis described earlier we can determine the following flow rates for water within our site.

#	Catchment Name	3 month flow (L/s)	20 year flow (L/s)	100 year flow (L/s)
1.	WEST BOUNDARY	7.9	33.3	42.6
2.	ROSE VALLEY WAY PARKING	5.7	24.0	30.7
3.	MAIN ROOF	62.3	262.9	336.4
4.	POOL TERRACE	12.4	52.2	66.8
5.	GREEN ROOFS	26.4	111.4	142.5
6.	OPEN POOL	0.0	0.0	0.0
7.	OVERLAND FLOW PATH	19.1	80.7	103.3
8.	ZETLAND AVE DECK	7.8	32.7	41.9
9.	PLAYING FIELD	68.1	287.2	367.5
10.	ROSE VALLEY WAY DECK	9.0	38.0	48.6
11.	PARK INFILL STRIP	2.1	9.0	11.6
12.	SE PARK	23.1	97.4	124.7
13.	NE PARK	33.3	140.7	180.0
	TOTAL	**277**	**1,170**	**1,497**

Figure 7 – Site Catchment Flows

3.1.2 Flow Conveyances

Stormwater flows up to the 20 year ARI will be contained within a traditional pit and pipe network. The 3-month flow rate for catchments 3 -13 will be diverted into the stormwater harvesting system for treatment to meet the DCP requirements (refer WSUD Strategy Report).

Flows from catchments 3 -13 that exceed the 3-month flow but less than the 20-year flow will be piped to the legal point of connection (in Zetland Avenue). Flows from these catchments in excess of the 20-year storm will flow across the surface and discharge into the surrounding streets or the onsite detention system.

Flows from the main roof (up to the 100-year flow) are directed to the building rainwater tanks for re-use back into the building. The roofwater tank is 100,000 L. Water collected in this tank will be available for nonpotable reuse in the Aquatic Centre (toilet flushing, irrigation, swimming pool makeup). Our water balance modelling indicates that the roofwater tank will meet 12.5% of the annual toilet flushing and swimming pool water demands. Water modelling also shows that 75% of runoff from the roof will be captured and prevented from discharging offsite.

3.2 ONSITE STORMWATER FLOW MANAGEMENT

Current site discharge limits:

- 1,032 L/s discharge limit
- 384,000 L detention requirement

These restrictions do not consider the upgrades to the existing culverts that Sydney Water are constructing – Sydney Water cannot confirm the new limits considering the upgrades and have told us to talk to the DG alliance to get this information. We understand that the City of Sydney are trying to procure this information for us.

In order to meet these requirements we propose to contain the entire 100-year flow from the playing field and adjacent areas within the tanks. e.g.: 100-year total site discharge = 1,497L/s subtract 100-year flow from catchments 8, 9, 10 & 11 = 1,497 – 41.9 – 367.5 – 48.6 – 11.6 = 1,027 L/s. As this is less than the discharge limit we comply with the requirements.

We are investigating options for the construction of the detention tank. The options being explored are:

1. Concrete tanks
2. Invisible Structures (egg crate) style tanks (these are proprietary)

The adopted solution will consider the requirements of the playing field, the condition of the subgrade soil layers and the chosen subgrade improvement methods, the access requirements for cleaning and maintenance and how the tanks are integrated and linked to the stormwater treatment systems to be provided.

Details will be provided once a direction has been determined by our project team.

3.3 OVERLAND FLOWS

As previously noted, the 100-year flows that traverse the site will do so across the surface. The ‘overland flow path’ will be constructed will finishes, materials and landscaped elements that will be designed to accommodate the level and velocity anticipated from this event.

HydroStorm Consulting have completed their modelling and have confirmed that the development will have no adverse impact on the surrounding developments.

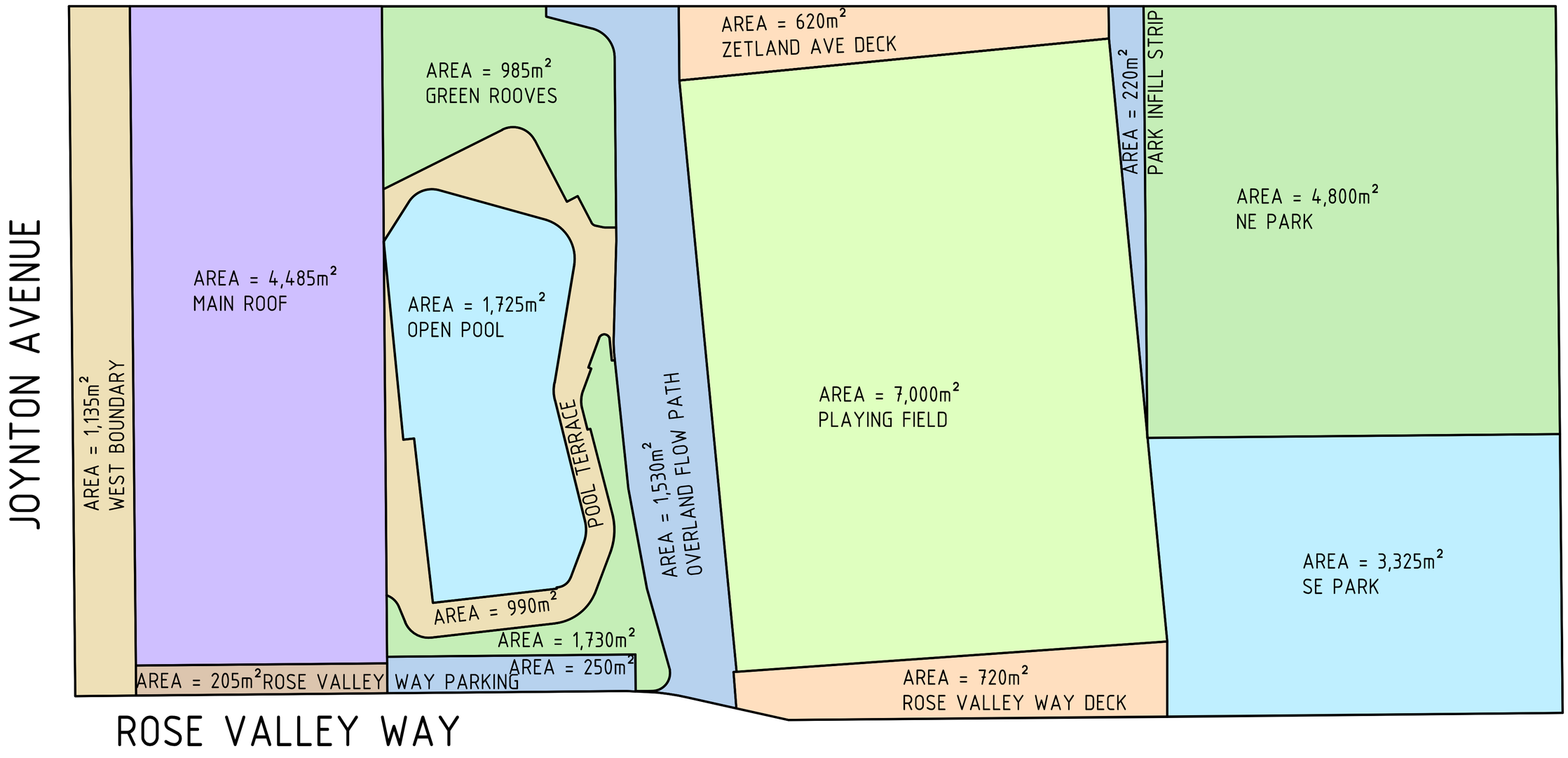
The floodwater depths in a 1 in 100-year event vary between 40 mm and 270 mm and the associated velocities vary between 0.4 m/s to a max of 0.8 m/s. In this event, we believe that the overland flow velocities do not present a safety concern.

There will be no external overland flows from adjacent catchments traversing the playing field to prevent any damage to the pitch.

Similarly, there will be no external overland flows from adjacent catchments traversing habitable areas of the buildings.

The Hydrostorm Consulting report also recommends that a flood emergency response plan will be required (catering for extreme flooding events) prior to the occupancy certificate can be issued.

Appended drawings



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Gunyama Park Aquatic and Recreation Centre (GPARC)

Water Sensitive Urban Design (WSUD) Strategy

PREPARED FOR:

CITY OF SYDNEY

Project Number: C16113

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REFERENCE DRAWINGS

Stormwater Management Catchment Area Assessment Conceptual Plan SK-C1000		*appended*
Stormwater Management 3 month Flow Path Conceptual Plan SK-C1003		*appended*
Stormwater Management 2 year month Flow Path Conceptual Plan SK-C1020		*appended*
Stormwater Management 100 year Flow Path Conceptual Plan SK-C1100		*appended*
CV-001	Title & Notes	
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1. BACKGROUND

1.1 REPORT OBJECTIVES

This WSUD report has been prepared by CJ Arms & Associates on behalf of Andrew Burges Architects and Grimshaw Architects to satisfy the City of Sydney's information needs and to be used as a decision support tool in ongoing design development.

The key objective of this report is to demonstrate how urban runoff is considered in the design of stormwater infrastructure and landscaping of the Gunyama Park Aquatic and Recreation Centre (GPARC) project. The report's focus is the integration of Water Sensitive Urban Design (WSUD) elements and the treatment and detention of rainfall runoff from the site.

This WSUD report is designed to be read in conjunction with *Gunyama Park Aquatic and Recreation Centre Hydraulic Study Civil Engineering Report* (CJ Arms & Associates), which describes site stormwater management and projected irrigation demands.

1.2 SITE DESCRIPTION

The GPARC development site is located at Joynton Avenue within the Epsom Park Precinct adjacent to the Green Square Town Centre. The existing site consists of old buildings, carparks and concrete slabs of varying age and quality.

Once fully developed the project will include a new Aquatic Centre, with indoor and outdoor swimming pools and gym, an outdoor synthetic soccer field, landscaping, playgrounds and areas for spectators, barbeques, and exercising (Figure 1).

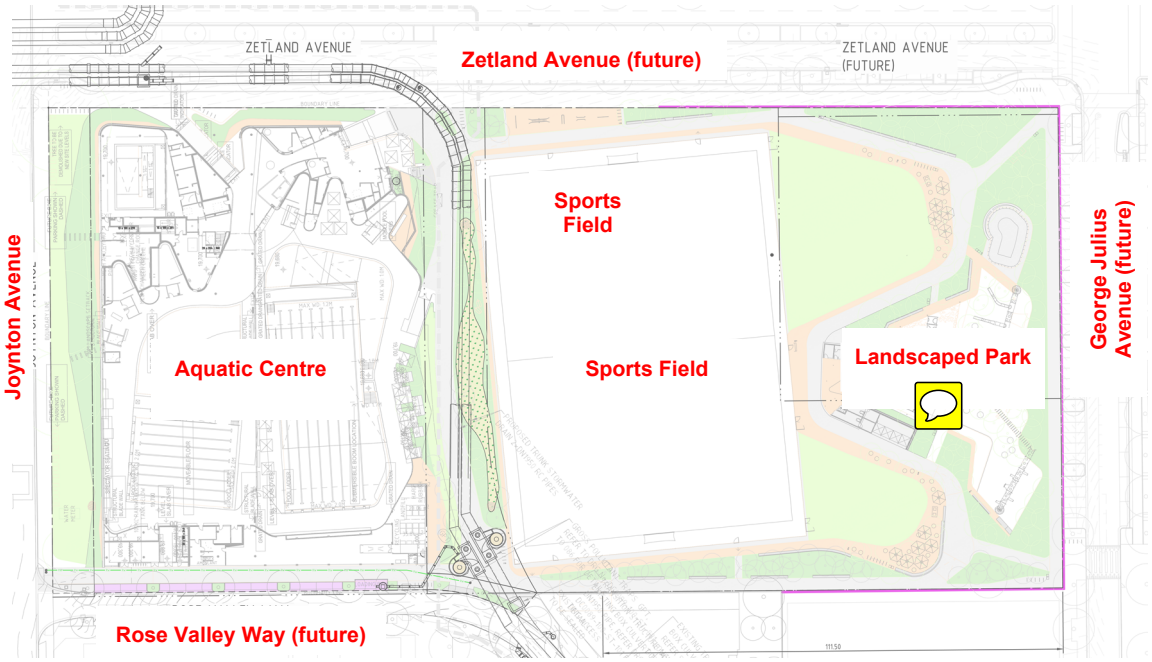

Figure 1 – Location of proposed development

1.3 SITE CATCHMENT ANALYSIS

The following diagram and table explain the breakup of the site catchments and their properties for the purposes of design. Sub-catchments are numbered on the drawing for ease of reference. For further information please refer to appended sub-catchment drawings.



Figure 2 – Site Catchment Diagram

#	Catchment Name	Surface Finish	Area (m²)	Runoff Coeff
1.	WE OUNDARY	Garden bed	1,135	0.5
2.	ROSE VALLEY WAY PARKING	Asphalt/concrete	455	0.9
3.	MAIN ROOF	Metal roof	4,485	1
4.	POOL TERRACE	Timber/paving	990	0.9
5.	GREEN ROOFS	Grass or (garden /shrubs)	2,715	0.7
6.	OPEN POOL	Pool	1,725	0
7.	OVERLAND FLOW PATH	Timber/paving	1,530	0.9
8.	ZETLAND AVE DECK	Timber/paving	620	0.9
9.	PLAYING FIELD	Synthetic (semi permeable)	7,000	0.7
10.	ROSE VALLEY WAY DECK	Timber/paving	720	0.9
11.	PARK INFILL STRIP	Grass/paving/garden	220	0.7
12.	SE PARK	Grass/paving/garden	3,325	0.5
13.	NE PARK	Grass/paving/garden	4,800	0.5
	TOTAL		**29,720**	**0.671**

Table 1 – Site Catchment Analysis

2. STORMWATER QUALITY TREATMENT

Sustainable stormwater management is critical to the overall integrated water cycle management plan for the project. In line with key water management objectives outlined in City of Sydney (2012) the overall objectives for managing stormwater quality at GPARC are to:

- Apply an integrated approach to water management through the use of water sensitive urban design principles.
- Encourage sustainable water use practices.
- Assist in the management of stormwater to minimise flooding and reduce the effects of stormwater pollution on receiving waterways.

2.1 TREATMENT TARGET REQUIREMENTS

Stormwater quality improvement for the GPARC project aims to meet the standards required by the City of Sydney. These are shown in Table 1.

Table 1 –Stormwater quality pollutant load reduction targets — DCP (City of Sydney, 2012).

	Annual pollutant load reduction
Gross pollutants (>5 mm)	90%
Total Suspended Solids (TSS)	85%
Total Phosphorous (TP)	65%
Total Nitrogen (TN)	45%

The requirement for a designated component of the site to achieve Green Star certification has also been taken into consideration. Managing stormwater in line with the DCP targets shown in Table 1 will contribute to this certification. However, as the Green Star pollutant load reduction targets differ from the DCP targets (refer Table 2). The project area is considered separately in this regard and the award of Green Star credits for sustainable stormwater management is discussed in a separate report.

Table 2 – Stormwater quality pollutant load reduction targets — Green Star.

	Annual pollutant load reduction		
	A	**B**	**C**
Gross pollutants (>5 mm)	85%	90%	90%
Total Suspended Solids (TSS)	80%	80%	90%
Total Phosphorous (TP)	30%	60%	70%
Total Nitrogen (TN)	30%	45%	60%

Categories A, B or C as per the Green Star targets.

The Green Star project area is essentially the Aquatic Centre with Gunyama Park excluded, as indicated in Figure 3. Although slightly different treatment targets may be applicable for the designated Green Star area, the DCP pollutant load reduction targets remain the ultimate aspirations for the entire GPARC site.

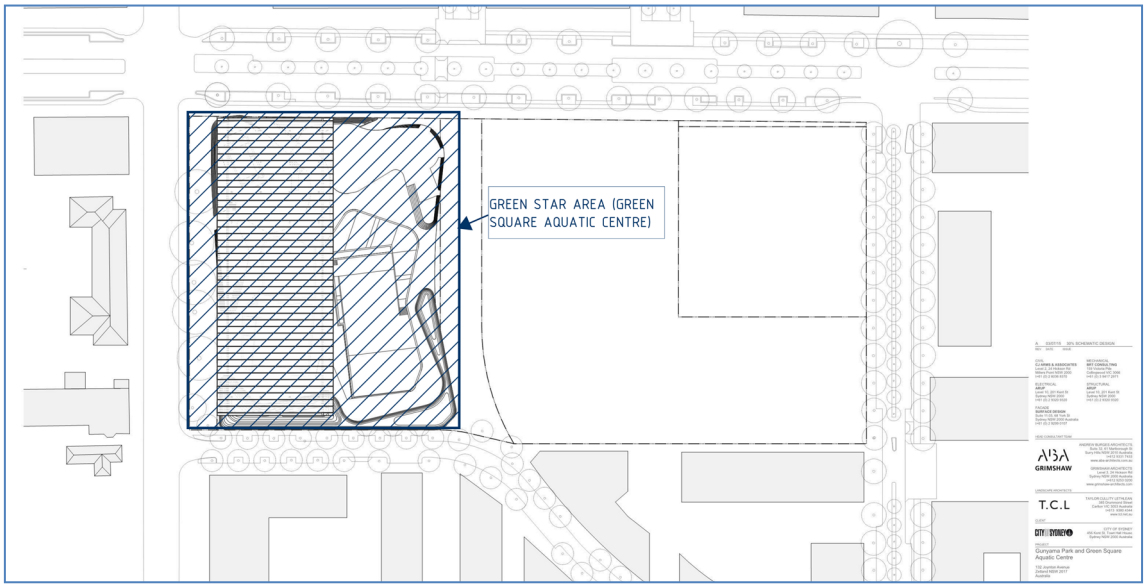

Figure 3 – Designated Green Star area.

2.2 TREATMENT TRAIN DESIGN STRATEGY

Water sensitive urban design principles form the basis for the sustainable stormwater management strategies utilised to manage runoff from the GPARC project. Examples of feasible strategies include:

- Installation of bioretention and biofiltration modules such as raingardens and bioswales;
- Gross pollutant traps or similar mechanical filtration devices;
- Onsite detention (tanks); and
- Harvesting, treatment, and reuse of rainwater.

Rainfall runoff from each sub-catchment at GPARC will contribute to the total volume of site stormwater requiring treatment. The total area, perviousness, and designated use of each subcatchment are all factors in determining the volume and quality of the stormwater. For example, both the aquatic centre roof and Rose Valley Way parking bays are highly impervious so almost all of the rainfall will emanate as runoff. However, roofwater is relatively clean while runoff from ground level hardstands carries more contamination, not only because of its contact with the surface of the carpark where wear and tear of tyres, and oil and grease accumulate but also because stormwater drains to the lowest point, which is where dust and litter settle.

The designated sub-catchments at GPARC are discussed in Section 1.3 of this report. Characteristics of each subcatchment, including perviousness (rainfall runoff coefficient), are compiled in **Error! Reference source not found.**.

When developing the stormwater management plan for GPARC one of the primary contributing factors for consideration has been passively draining runoff towards a suitable location for treatment. The competing demands for space within the GPARC project have required creative WSUD solutions that can be integrated within the landscape to achieve a double use of space. Examples of WSUD solutions integrated in the GPARC design that provide multiple benefits are:

- *Promoting water sustainability through water harvesting and reuse*. Rainwater reuse not only provides an alternative water source to reduce the project's overall mains water demand, but is also a valid means by which stormwater can be sustainably managed.
- Incorporating infiltration elements (bioswales and raingardens) into outdoor landscaping. Raingardens and bioswales can be seamlessly planted out with hardy indigenous species that may also be used in standard garden beds. The media used to construct the treatment elements would differ from standard landscaping soil (nutrient load, organic matter, infiltration properties), but this is not noticeable from above the ground.

The annual pollutant load reduction targets shown in Table 1 are stringent in comparison with stormwater treatment targets applicable to many other development projects. Meeting these targets is likely to require the inclusion of relatively significant stormwater treatment infrastructure, most often with a relatively large footprint. In developing a WSUD strategy to meet the high aspirations of the DCP targets, it has been necessary to formulate the design around the constraints imposed by Sydney's high rainfall climate and the availability of space within the development.

An effective strategy in meeting the treatment targets within the constraints of this site has been the use of passive, biologically mediated treatment techniques with the added benefit of advanced technology that reduces the overall footprint of the treatment train. This is aimed at enhancing the efficiency of the various individual treatment elements by incorporating each element in an engineered treatment train to maximise contaminant removal at each stage.

A stormwater treatment train strategy has been developed for the GPARC project and is presented in this report. This design has been modelled in MUSIC to assess its overall ability to manage stormwater-borne contamination. Results show that this strategy meets the DCP treatment targets for the removal of stormwater pollutants.

An alternative treatment strategy has been developed and is also presented in this report. The two treatment train options are presented as two separated options (Option 1 and Option 2). Option 1 temporarily detains rainfall runoff in an inground tank beneath the sports field. Retained water is pumped onto a series of biofiltration elements installed along the length of the overland flow path. By transferring the water by pumping, these elements can be dosed incrementally. This means that the total area of biofiltration modules can be reduced compared with a standard passive dosing system.

Option 2 operates in a similar manner as Option 1. It is a proprietary system that is based on the use of vegetated biofiltration modules (Biofilta™).

A main design premise for the WSUD strategy for GPARC is capturing and treating the more frequent low flow events (0.25 ARI design flow). Installing treatment measures offline, incorporating a high flow bypass into the design, or manually transferring the water to be treated provides protection from large flood flows that could damage the device, flatten reeds and grasses, or scour and transport previously collected pollutants downstream.

The maximum flow rate at which a treatment measure is designed to operate effectively is termed the 'design flow'. Setting a maximum design flow is aimed at maximising pollutant removal efficiency while managing cost and space requirements. In general, the optimum operating range falls within a design flow rate of around 0.25 ARI (3 month recurrence interval storm). It has been shown that the incremental benefit of increasing the treated volume of runoff diminishes beyond this design flow (Melbourne Water, 2010).

The stormwater management strategy designed for the GPARC project incorporates several different treatment measures in series and offers a number of advantages. These include:

1. Rainwater collection and reuse from the large aquatic centre roof will increase water security and lead to a significant reduction in total water use across the site. Rainwater will be made available for non-potable end uses, which include toilet flushing, irrigation, and swimming pool make up.
2. Stormwater collection, treatment, and reuse from ground level hardstands and pavements will further offset the project's reliance on Sydney Water's potable water supply. Harvested stormwater is to be made available for irrigation from turfed areas, including lawns and also from the green roof.
3. The use of sustainable stormwater treatment technologies meets a need for self-watered gardens within the site, i.e. passively irrigated landscaped zones. Designing pavements so that they drain towards garden beds has a double use of space advantage in that the landscaped zones serve to infiltrate runoff and provide stormwater treatment, with the additional benefits of enhanced aesthetics and low maintenance.
4. In terms of Green Star credits, rainwater collection and reuse will serve to maximise the number of points awarded under *Potable Water Credit 18.A*, which targets substantial reductions in overall potable water consumption.

2.2.1 Water Reuse Strategy

Harvested rainwater can provide a cost-effective alternative source of water. It provides an offset in potable water demand and so will contribute to onsite water sustainability, including achieving points under the Green Star credit *18.A: Potable Water*.

By installing appropriately sized rainwater tanks and suitable reuse infrastructure, a proportion of runoff from the site can be captured and reused. This reduces the overall volume of site stormwater that would otherwise require treatment prior to discharge. In this way, rainwater reuse is a valid means by which site stormwater can be sustainably managed.

Rainwater is considered to be a source of nonpotable water. Nonpotable water demands at GPARC include toilet flushing, irrigation, and swimming pool makeup. The appropriate end use depends on the surface from which the water is collected, the means of collection and storage, and the level of treatment applied.

A water balance model has been developed which identifies water use data for each end use, both potable and nonpotable. Information used in developing the water balance model include population estimates, an understanding of the types of water fixtures and fittings that will be installed and the likely frequency of use, predicted pool water demands and knowledge of likely irrigation needs (based on Hydroplan report Ref 13299-251-04). Table 3 presents a summary of water use data for nonpotable end uses based on water modelling results.

Table 3 – Nonpotable Water Demands GPARC.

Enduse	Daily Demand (L/d)	Avg. Monthly Demand (kL/mo)	Annual Demand (kL PA)
Toilet flushing	5,420	210	1,980
Pool makeup	68,560	2,087	25,020
Irrigation[1]	980 – 12,560 L/d (seasonally dependent)	13 – 179 (seasonally dependent)	1,129
TOTAL	**76,870**		**28,129**

[1] Irrigation demands do not include washing down of synthetic playing field surface.

Two streams of rainwater harvesting are incorporated into the GPARC hydraulic design:

1. **Roofwater harvesting**. Water collected from Aquatic Centre roof (4,480 m^2) in a 100kL rainwater tank, and made available for toilet flushing, green roof irrigation, and swimming pool makeup. Eco Harvest's in-house rainwater modelling tool has been used to determine the most efficient rainwater tank size.
   Rainwater will meet 12.5% of the annual nonpotable demands of the Aquatic Centre. Annually, 75% of runoff from the roof will be captured and prevented from discharging downstream or requiring further treatment
2. **Stormwater harvesting**. A 50 kL inground storage tank will be installed within the landscaped area of the park. This comprises the central detention and treatment system. It will collect and store filtered water which will be available for nonpotable irrigation of turfed areas, including the grassed areas to the west and Aquatic Centre green roofs as required.
   This strategy has been coordinated with Hydroplan (project irrigation consultants) to meet the required irrigation demand.

2.2.2 Treatment Train Design Option 1 — Passive Biofiltration System

Table 4 – Summary of Treatment Measures in Option 1 Design Strategy.

Subcatchment	Treatment Measure
Aquatic Centre roof (4,485 m^2)	Storage tank (100 kL) Reuse (pool water makeup, toilet flushing, and irrigation refer Section 2.2.1) Tank overflow to western landscaped edge
Western landscaped edge (1,135 m^2), includes: • Pavement, street trees and landscaping • Overflow from Aquatic Centre rainwater tank	Biofiltration / Raingarden (integrated into landscape garden beds) Allow 30 m^2 treatment area (plus edge treatment and batters)
Sports field Synthetic turf (7,000 m^2)	Detention, treatment, and irrigation • Gross Pollutant Trap • 385 kL (in ground) detention tank • Planted biofiltration/bioswale (260 m2) • 50 kL (in ground) stormwater reuse tank for irrigation of turfed areas (refer Section 2.2.1)
Unroofed aquatic centre • Outdoor pools and decks • Entrance, café, and ticketing (green roof) • Vegetated mounds (green roof) • Landscaping	
Playground, mounds and turfed area)	
Overland flow channel (1,530 m^2)	
Rose Valley Way parking bays	Biofiltration (to be completed post road works) Allow 10 m^2 treatment area (plus edge treatment and batters)

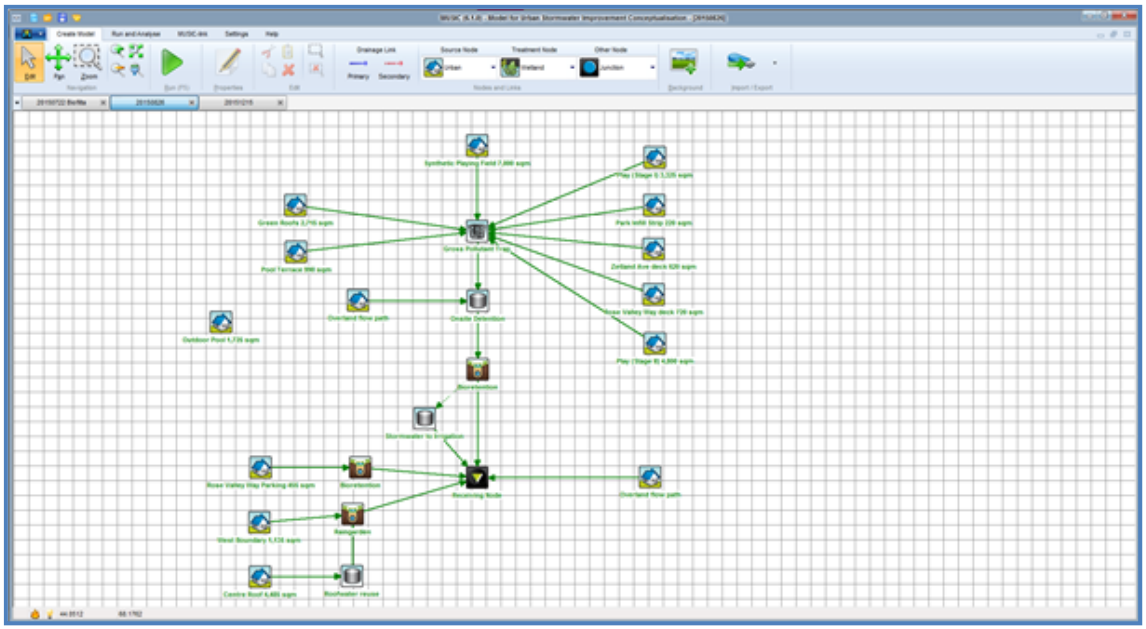

Figure 4 – Screenshot of MUSIC model—Treatment Train Option 1.

Table 5 – Design Option 1: MUSIC modelling results and treatment performance data.

			Annual pollutant load reduction (%)	
Parameter	**Source**	**Residual load**	**% removed**	**DCP target**
GPs	763 kg/y	15.6 kg/y	98%	90%
TSS	5,890 kg/y	892 kg/y	85%	85%
TP	12.1 kg/y	2.8 kg/y	75%	65%
TN	85.5 kg/y	34.8 kg/y	59%	45%

2.2.3 Design Option 2 — Intensified Biofiltration System

Table 6 – Summary of Treatment Measures in Option 2 Design Strategy.

Subcatchment	Treatment Measure
Aquatic Centre roof (4,485 m^2)	Storage tank (100 kL) Reuse (pool water makeup and toilet flushing, refer Section 2.2.1) Tank overflow to western landscaped edge
Western landscaped edge (1,135 m^2), includes: • Pavement, street trees and landscaping • Overflow from Aquatic Centre rainwater tank	Biofiltration / Raingarden Allow 30 m^2 treatment area (plus edge treatment and batters)
Sports field Synthetic turf	Biofita™ proprietary product. Includes: • Gross Pollutant Trap • Sediment chambers (x2) • In ground storage / detention tank (primary tank 385 kL) • Biofiltration (180 m^2) • Treated water to irrigation (50 kL in ground storage tank)
Unroofed aquatic centre • Outdoor pools and decks • Entrance, café, and ticketing (green roof) • Mounds (green roof) • Landscaping	
Playground, mounds and turfed area	
Pavement and landscaping (1,340 m^2)	*Untreated*

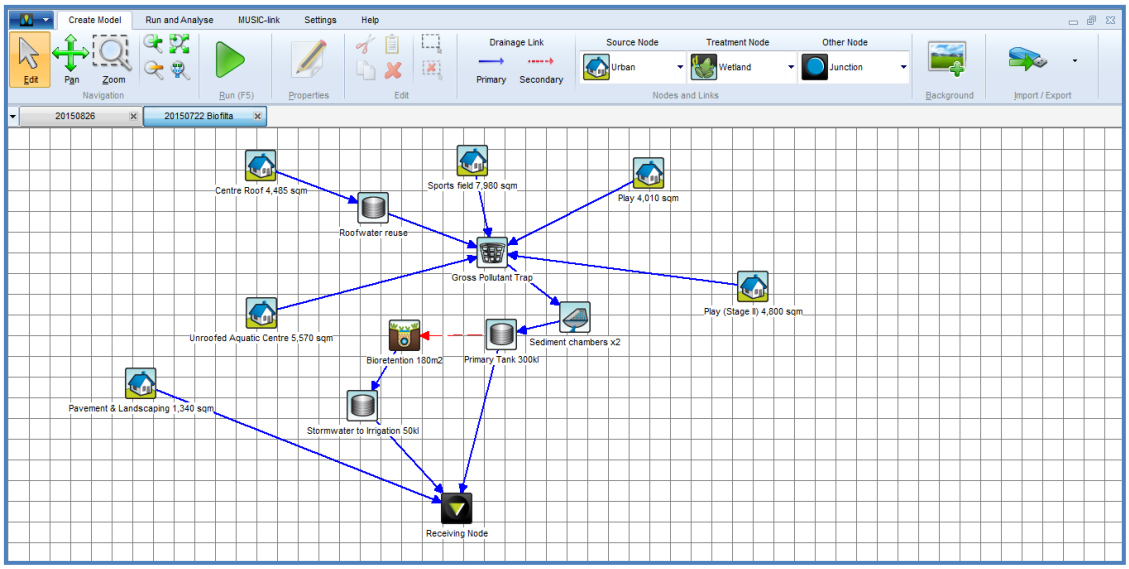

Figure 5 – Screenshot of MUSIC model—Treatment Train Option 2.

Table 7 – Design Option 2: MUSIC modelling results and treatment performance data.

Parameter	Input (kg)	Output (kg)	% removed	Removed PA (kg)
GP	749	0	100%	90%
TSS	5,710	716	87%	85%
TP	11.4	1.79	84%	65%
TN	83.1	22.6	73%	45%

3. SUMMARY AND CONCLUSIONS

By assessing the GPARC site on a subcatchment basis it has been possible to formulate a feasible stormwater management plan that meets the essential project criteria of:

- Employing low energy, ecological water management strategies to filter, detain and reuse stormwater before off site discharge (i.e. WSUD).
- Meeting the DCP pollutant removal standards.

The WSUD elements employed are integrated into the available space and provide the added benefits of enhanced aesthetics and multiple use of space.

4. REFERENCES

City of Sydney (2012). Sydney Development Control Plan. Section 3: General Provisions. December 2013. http://www.cityofsydney.nsw.gov.au/development/planning-controls/development-control-plans.

Melbourne Water. (2010). Constructed Wetlands Guidelines. Melbourne: Melbourne Water Corporation. April 05, 2010

5. APPENDED DRAWINGS



City of Sydney

C16113: Gunyama Park Aquatic and Recreation Centre

Waste Management Plan

Project # C16113

Issue 8 | 2 June 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Appendices

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Building plans

Appendix B
Details of waste management forms

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Site visit notes

1 Introduction

This Waste Management Plan (WMP) has been prepared by Arup on behalf of the City of Sydney to accompany a Development Application for Gunyama Park Aquatic and Recreation Centre (GPARC) in Green Square, Sydney.

Located to the south of the city centre, Green Square is set to deliver 20,000 new homes, 40,000 new residents and 22,000 new jobs by 2030. The 14-hectare Green Square Town Centre will be at this heart of the growing community and is to be developed in four stages over the next few decades. GPARC will provide important community infrastructure for the initial stage of development.

GPARC will consist of the following features:

- Aquatic centre including leisure water, program pool, 50m outdoor pool, hydrotherapy pool and associated visitor facilities,
- Health and fitness centre (gym) and associated visitor facilities,
- Café and kiosk,
- Crèche,
- Administration areas, and
- Gunyama Park: sports fields, play space, seating, Skate Park, open woodland and associated visitor facilities.

1.1 Project context

As shown in Figure 1 below, the proposed GPARC development is in the new Epsom Park Precinct, east of Green Square Town Centre. Zetland Avenue and Rose Valley Way will border GPARC.

Within the next 5-10 years, Epsom Park will undergo significant urban renewal to accommodate high density residential uses, including retail and community uses and open space.

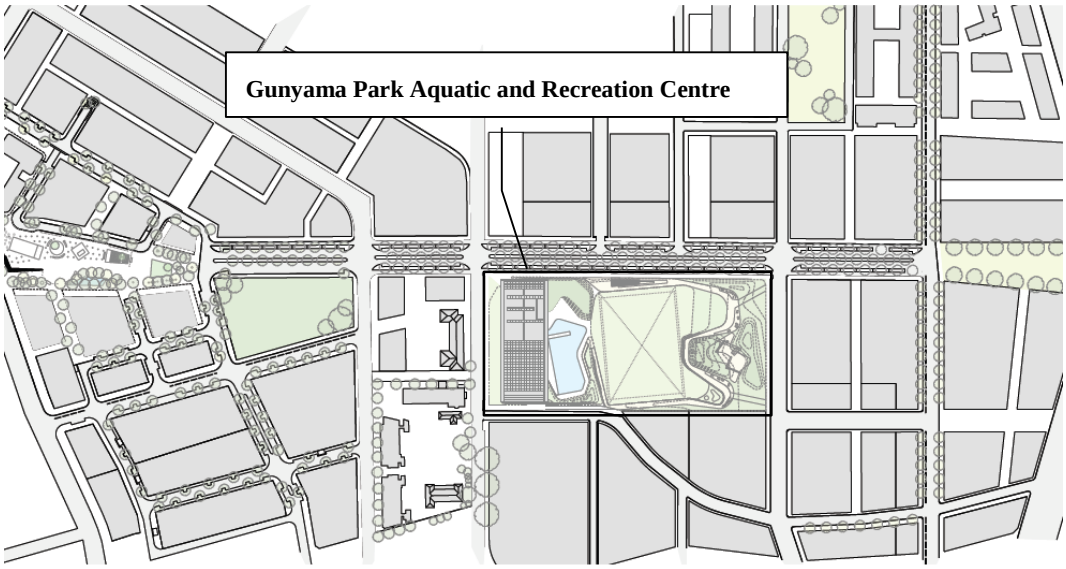


Figure 1: Site context plan – Gunyama Park Aquatic and Recreation Centre

1.2 Purpose of Waste Management Plan

This document addresses aspects of waste management relating to the requirements of Development Applications under the *NSW Environmental Planning and Assessment Act 1979* ((EP&A Act), the Department of Planning and Environment Secretary's Environmental Assessment Requirements (SEARS), and) and Council of the City of Sydney Guidelines for Waste Management in New Developments (2014) ('CoS Waste Guidelines').

This WMP identifies waste sources and proposes management measures for the project design, construction and operation. The format of this document can assist with the completion of a Construction Waste Management Plan (CWMP), which the Contractor will be required to prepare prior to the construction of the development. It may also assist with the development of documentation as part of a Green Star submission.

The key purposes of the WMP are to:

- Address the waste management requirements for the proposal to a standard suitable for planning approval under the EP&A Act;
- Provide guidance for the project in waste minimisation from construction activities;
- Increase economic feasibility of the project through effective waste separation, recycling and re-use measures; and
- Identify waste management requirements for operation.

2 Legislative requirements

2.1 NSW state legislation

2.1.1 The Protection of the Environment Operations Act, 1997

The Protection of the Environment Operations Act 1997 covers the requirements for waste generators in terms of storage, classification and correct disposal of waste. The Act establishes the waste generator as having responsibility for the correct management of waste, including final disposal.

2.1.2 Waste Avoidance and Resource Recovery Act 2001

Due to concerns about waste management practices and increasing volumes of waste, the NSW government introduced the *Waste Avoidance and Resource Recovery Act 2001* ('the Act'), superseding the *Waste Minimisation and Management Act 1995* following its five year review.

The objective of the Act is to encourage the most efficient use of resources, to reduce environmental harm, and to provide for the continual reduction in waste generation in line with the principles of ecologically sustainable development (ESD).

The WMP is a requirement for a new development in NSW and is written with reference to the *NSW Waste Avoidance and Resource Recovery Strategy* 2014-21, made under the Act.

2.1.3 The NSW Waste Reduction and Purchasing Policy 2007 (WRAPP)

The NSW Waste Reduction and Purchasing Policy (WRAPP) requires all state government agencies and state owned corporations to develop and implement a WRAPP plan to reduce waste in four scheduled waste sources:

- Paper products;
- Office equipment and components;
- Vegetation material; and
- Construction and demolition materials.

WRAPP is not directly applicable to the project, but has been used as a guiding document for waste initiatives.

2.2 Council of the City of Sydney *Guideline for Waste Management in New Developments*

The Council of the City of Sydney *Guideline for Waste Management in New Developments* ('CoS Waste Guidelines') was developed in 2014 in accordance with NSW Waste Avoidance and Resource Recovery Strategy (2003 version, now superceded). The *guideline for waste management planning in new developments*

describes and provides advice on achieving best practice waste management for all new and 'change of use' developments requiring consent in the City of Sydney.

All new developments that generate demolition, construction and ongoing waste require a waste management plan and the guideline addresses the considerations needed to prepare a Waste management plan.

The guidelines include the minimum requirements for waste storage and collection areas, waste handling provisions and waste service access needs. The guidelines set out provisions for solid waste only; liquid waste management should be designed in accordance with relevant NSW government legislation.

The guideline describes the waste management criteria needed to be considered in the development assessment process and is divided into sections based on development type.

The specific sections which pertain to the proposed development include:

- Section A – General Requirements: All developments;
- Section F- Construction and demolition waste provisions

Key requirements of the CoS Waste Guideline include:

- All commercial premises must have a dedicated and enclosed waste and recycling storage area which has adequate storage to meet generation rates,
- All businesses must have written evidence, held on site, of a valid and current contract with a licensed collector for waste and recycling collection and disposal, and,
- All businesses are encouraged to include provisions within waste contracts that allow for the collection and recycling of significant waste streams.

Numerous other requirements are specified within the Waste Guideline. These have been addressed throughout this WMP where required.

2.3 Green Star

A Green Star assessment is being sought for this development under the Green Building Council of Australia (GBCA) Green Star Design and As Built v1.1 rating tool, under a requirement to achieve a 5 Star rating. A number of the Green Star goals for this project relate to waste management in the areas of design, demolition/construction, and operation. These objectives are summarised below in Table 1.

Key objectives outlined within this WMP include:

- Reduce waste sent to landfill during demolition and construction by achieving a construction waste to landfill rate of 10 kg/m^2 total GFA or less, or achieving an overall 90% diversion rate from landfill for demolition and construction waste,
- Reduce operational waste sent to landfill by specialist operational waste management plan or meeting the prescriptive operational waste management requirements.

This WMP has not been developed for use as the specialist operational waste management report required as part of Green Star Credit 8.1A for future Green Star submission, but will inform the development of such a report. This WMP will also inform the development of a Building User Guide (Credit 4.2) and a Construction Waste Management Plan (CWMP).

Table 1: Green Star objectives for waste management

Relevant Green Star Credit	Initiative	Target	Environmental Benefit	Requirements
Design and As-Built V1- **Credit 4.2 (Management)** **Building Information**	Building User's information ***Up to 1 point***	To recognise the development and provision of building information that facilitates operator and user understanding of a buildings systems, their operation and maintenance requirements and their environmental targets, to enable optimised performance	Reduces waste sent to landfill; responds to resource depletion.	Development of a Building User's guide, relevant for building management and residents, including operational waste requirements: • What waste streams can and cannot be recycled;
Design and As-Built V1- **Credit 22.1 (Materials)** **Construction and Demolition Waste**	22.1 A - Reduction of Construction and Demolition Waste (fixed benchmark) ***Up to 1 point***	To reward projects that reduce construction waste going to landfill by reusing or recycling building materials	Reduces waste sent to landfill; responds to resource depletion.	One point is available where the construction going to landfill meets a fixed benchmark defined as kg/m² of total GFA; • 0.5 points for 12.5% • 1 point for 10%
	22.1 B - Reduction of Construction and Demolition Waste (percentage benchmark) ***Up to 1 point***			One point is awarded where project teams can demonstrate that 90% of waste generated during construction and demolition has been diverted from landfill, defined as kg/m² of total GFA
Design and As-Built V1- **Credit 8.1 (Management)** **Operational Waste**	8.1A Operational Waste Management Plan ***Up to 1 point for 8.1***	To recognise projects that implement waste management plans that facilitate the re-use, upcycling, or conversion of waste into energy and stewardship of items to reduce the quantity of outgoing waste.	Reduces waste sent to landfill; responds to resource depletion.	One point is awarded when a waste management plan for building operations is prepared by a waste professional or specialist from project team, including identification of landfill targets and monitoring procedures by weight, and ongoing review processes.
	8.1B Prescriptive Operational Waste Management ***Up to 1 point for 8.1***			One point is awarded when waste management practice are implemented meet the following prescriptive requirements; • Provision for separation of specific waste streams (general waste, paper and cardboard, glass, plastic and at least one other stream) • A dedicated sufficiently sized area for the storage and collection of the applicable waste streams • Access requirements for waste collection areas must adhere to third party best practice guidelines

3 Waste management approach

3.1 Method for estimation of waste generation volume

Weekly waste volumes for the proposed development will be estimated in order to determine waste storage and collection requirements. Weekly waste volumes are based on a 7 day operation assumption.

Given the unique nature of operational waste generation in a large scale sports facility and the lack of directly applicable waste generation rates in the CoS Waste Guidelines, an 'all of facility approach' has been taken to estimate waste generation on a per visitor basis using waste data from similar facilities. Where certain operational areas were not present at comparable facilities, CoS Waste Guidelines generation rates, based on total gross floor area (GFA) have been used in addition to the 'all of facility approach.'

Figure 2 illustrates the methodology for calculating weekly waste and recycling volumes.

Figure 2: Weekly waste generation methodology

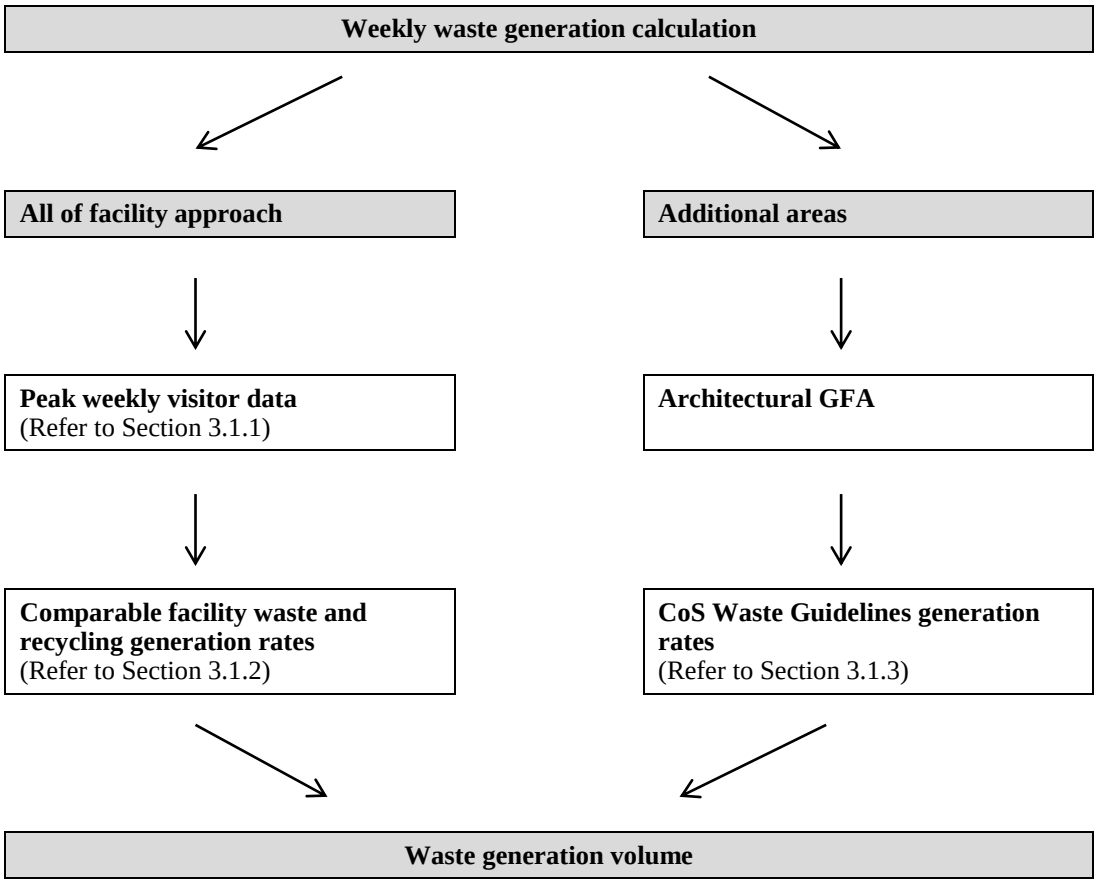


Table 2 outlines the waste generation methodology assumed for each operational area of the GPARC development.

Table 3 Waste generation methodology per operational area

Operational Area	Methodology
Aquatic Centre; Indoor & Outdoor facilities	All of facility approach
Health and Fitness Centre	All of facility approach
Café and Kiosk	All of facility approach
Administration areas	All of facility approach
Creche	Additional areas
Gunyama Park[1]	Not applicable

Where appropriate, the relevant CoS Waste Guidelines generation rates have been used to cross check the 'all of facility approach' per visitor waste estimates.

3.1.1 Estimate weekly visitor numbers

Estimated weekly numbers are based on the Population study draft report provided by @leisure.[2] Table 3 depicts the peak weekly visitor numbers by operational area, estimated for 2021 and 2031.

Table 3 @leisure Peak weekly visitor numbers

Operational Area	2021 @leisure Estimation	2031 @leisure Estimation
Indoor leisure water	4,659	5,611
Outdoor leisure water	1,997	2,405
Indoor 25m program pool	5,343	6,870
Outdoor 50m pool	7,288	8,822
Hydrotherapy pool	1,655	1,966
Gym, cardio room, dry fitness studio	7,776	9,374
Spin Room	546	655
Weights Room	1,036	1,246
Total	**30,300**	**36,949**

Anticipated 22% increase in total weekly visitor numbers between 2021 and 2031

[1] Note that landscaping waste is to be stored and managed offsite by a dedicated contractor, and public waste in Gunyama Park is to be collected directly from source by Council. As such, these waste streams are separate from estimates for waste generation associated with operation of the Aquatic Centre itself.
[2] Report to be provided by @leisure, "*GPGSAC@leisure Input to Population study*", "*GPGSAC_@leisure Population study supporting Document*"

This WMP has based calculations on 2021 peak weekly visitor numbers at the request of CoS[3]. It is assumed that CoS will increase its weekly collection frequency to meet the demands of increasing visitor numbers.

Table 4 nominates the weekly visitor numbers applicable to the waste generation calculation in this WMP. A 0.70 reduction factor has been applied to the @leisure Population study draft report 2021 peak weekly number[4].

Table 4 Applicable weekly visitor numbers

Operational Area	Applicable visitor number
Indoor leisure water	3,261
Outdoor leisure water	1,398
Indoor 25m program pool	3,740
Outdoor 50m pool	5,102
Hydrotherapy pool	1,159
Gym, cardio room, dry fitness studio	5,443
Spin Room	382
Weights Room	725
Total	**21,210**

3.1.2 Waste generation rates from comparable facilities

The table below summarises the estimated waste generation rates from comparable Aquatic Centres audits. These facilities were visited by the Design Team for the purpose of understanding storage requirements and operational management procedures associated with waste management at similar sites.

Estimated waste volumes are shown below as litres of waste per visitor (peak). Peak waste is used as the basis for the model, where it is assumed that as per the audits of similar facilities (refer to Appendix C) frequency of collection will be decreased as required if a low season is observed during building operation.

[3] Email communication 15/02/16 'C16113-GPARC-Waste Collection Area'

[4] Peak weekly visitor rate applied to waste generation rates is a conservative approach, with the best method for calculation to use a weekly visitor rate that occurs 90% of the time. Waste generation rates can be refined at a later stage using the weekly average for both 2021 and 2031 and the % occurrence over the year, if provided.

Table 5 Aquatic centre waste audits[5]

Facility	Peak visitors (visitor/week)	Landfill waste (Peak L/visitor)	Co-mingle recycling (Peak L/visitor)	Paper/ card recycling (Peak L/visitor)
Ian Thorpe Aquatic Centre (Indoor)	**12,355**	**0.44[6]**	**N/A**	**0.39**
Prince Alfred Park Pool (Outdoor)	**6,355**	**0.65**	**0.18**	**0.51**

In addition to use of these rates, a 'sense check' of bin numbers according to facility size and visitor numbers was performed. The comparison indicates that the approach of estimating waste according to visitor numbers from comparable facilities is robust.

Table 6 outlines the waste generation rates assumed for the 'all of facility approach.'

Where visitor numbers for GPARC development were provided separately for indoor and outdoor facilities, the generation rates illustrated below were applied in the waste model.

Table 6 Applicable waste and recycling generation rates

GPARC Facility	Landfill waste (Peak L/ visitor)	Co-mingle recycling (Peak L / visitor)	Paper/ card recycling (Peak L/week)
Outdoor facility	**0.65**	**0.18**	**0.51**
Indoor facility	**0.44**	**0.18**	**0.39**

3.1.3 City of Sydney waste generation rates

The waste generation rates from the CoS Guidelines for Waste Management in New Developments, which are applicable to this development, are shown below in Table 7 and Table 8.

Table 7 identifies areas within GPARC, which are considered 'additional' to those identified in the audit of comparable facilities.

None of the comparable facilities visited hosted a crèche of similar size or operating hours as that included in GPARC, therefore an appropriate waste generation rate from the CoS Waste Guidelines had been considered in addition to the 'all of facility approach' rates. It is unlikely that the rates from audits of similar facilities recognised crèche aged children and associated generation rates, hence included as an addition.

[5] Refer to Appendix C: Site visit notes
[6] Note: the landfill waste stream at Ian Thorpe Aquatic Centre includes co-mingle waste, which is not segregated. It is also likely to be lower than other facilities due to a lack of outdoor recreation spaces.

Table 7 Applicable waste and recycling generation rates

Building space use	Applicable waste generation type	Landfill waste rate (L/100 m^2/day)	Recycling rate (L/100 m^2/day)
Crèche[7]	Services	55	10[8]

Table 8 outlines the CoS Waste Guidelines generation rates that have been used to cross-check the waste audit estimates from similar facilities. The generation rates for food generation and administration areas have been included, in order to ensure front of house waste is accounted for and an appropriately sized temporary storage facility is provided.

Table 8 Applicable waste and recycling generation rates

Building space use	Applicable waste generation type	Landfill waste rate (L/100 m^2/day)	Recycling rate (L/100 m^2/day)
Café[9]	Cafes	175	685[10]
Kiosk[11]	Takeaway	50	25[12]
Administration areas	Office	6	12

3.2 Method for estimation of waste storage and management requirements

Waste storage area requirements, specifically central waste storage facilities for nominated streams, are calculated from the total weekly waste generation volume.

Waste storage area requirements are based upon nominated collection frequencies (Section 9) and bin sizes within the CoS Waste Guidelines Reference A (Table 9).

Waste storage requirements and management practices for common waste storage areas are in accordance with Section A ‘General requirements’ (for all developments) and Section E ‘Commercial Developments: Specific provisions’ of the CoS Waste Guidelines.

[7] Onsite review of the functional operation and waste generated in aquatic centre crèche facilities (Ian Thorpe Aquatic Centre) indicates that ‘retail’ is the most appropriate waste generation rate for a crèche facility
[8] 11% of total recycling rate is assumed co-mingle and 89% of total recycling rate is assumed paper and cardboard based on Encycle (2013)
[9] Onsite food preparation in café and kiosk facilities will be minimal. As such, a ‘cafe’ rate has been applied for waste generation in the nominated café areas.
[10] As per Footnote 8.
[11] Onsite food preparation in café and kiosk facilities will be minimal. However, as a kiosk facility generates high packaging volumes a ‘takeaway’ rate has been applied for waste generation in the nominated kiosk areas.
[12] As per Footnote 8.

Table 9: CoS Guidelines Reference A – Mobile Garbage bins Australian Standard Sizes

Bin Capacity (L)	Bin floor dimensions (m)	Bin GFA (m^2)
120	0.56 x 0.49	0.27
240	0.74 x 0.58	0.43
360	0.85 x 0.63	0.54
660	1.37 x 0.85	1.19
1100L	1.36 x 1.25	1.75

3.3 Assumptions and limitations

The waste modelling undertaken in this WMP is limited to operational waste associated with management of the Aquatic Centre. In addition, the following waste streams are to be managed separately from operational waste as outlined in Section 8.2.

- Green waste from site landscaping – this will be stored and managed offsite by a landscaping contractor, and
- All waste and recycling from Gunyama Park – this is to be collected directly from bins by Council and will be stored and managed offsite.

4 Demolition and Construction waste

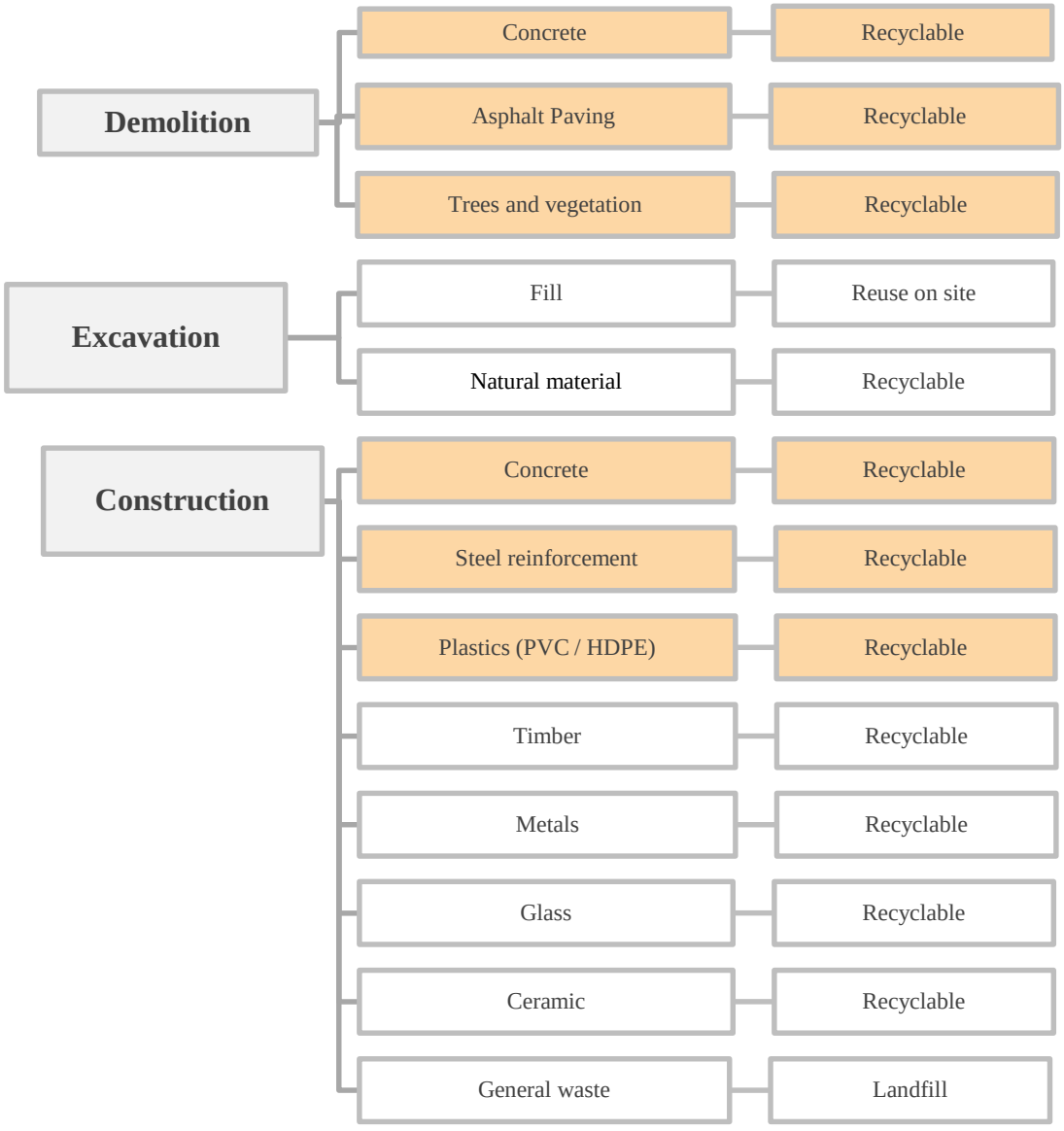
4.1 Demolition and Construction waste streams

Demolition and construction works for this development are to take place with consideration of the project Green Star objectives, particularly in regards to the minimisation of construction waste sent to landfill.

An overview of the major waste streams resulting from construction is provided below in Figure 3. Waste streams that have the potential to generate the greatest volume are highlighted in orange.

If contaminated fill or materials are identified prior to or during the demolition or excavation phases, these are to be dealt with by specialists in accordance with all relevant legislation.

Figure 3: Excavation and construction waste streams



4.2 Construction waste management

Waste generation and management during excavation and construction phases is the responsibility of the Head Contractor and is to be handled in accordance with the approved Construction Waste Management Plan as it relates to materials procurement, handling, storage and use. Waste generated during construction will be reused and recycled as a priority, or disposed to landfill only where unavoidable.

During construction, suitable areas on site (or off site, if necessary), will be allocated which provide adequate space and access for:

- Storage of building materials,
- Storage of construction waste,
- Sorting of construction waste, and
- Removal of construction waste for recycling, re-use or landfill.
- Interim storage of fill materials as required

Construction waste management will be performed to meet the specific goals of the project Green Star requirements. Within the Management category of Green Star, credit 22.1 addresses demolition construction waste management and is worth a maximum of 2 points, as outlined below.

Credit 22.1A:

- One point is available where the construction going to landfill meets a fixed benchmark defined as kg/m² of total GFA;
    - 0.5 points for 12.5%
    - 1 point for 10%

Credit 22.1B:

- One point is awarded where project teams can demonstrate that 90% of waste generated during construction and demolition has been diverted from landfill, defined as kg/m² of total GFA.

Prior to commencing construction, the construction contractor will develop a detailed Construction Waste Management Plan (CWMP) in order to ensure that construction waste is minimised and diverted from landfill where ever possible. Credit 22.1 is the only directly applicable Green Star credit to be influenced by the CWMP. The CWMP will outline the waste management strategy for demolition and construction including site storage points and site access points for removal of construction waste during each phase of construction. All construction vehicles will access the site from the south west corner from Joynton Avenue

Demolition and construction waste tracking sheets are to be completed by the contractors, as provided in the CoS Waste Guidelines. Example sheets are attached in Appendix B.

5 Operational waste estimate

5.1 Area schedule

The Table below provides an overview of gross floor areas (GFA) and occupancy for space uses within the proposed development that contribute to operational waste generation. All areas that contribute to waste generation in this development are located on the Ground Floor and the Health and Fitness Centre on Level 1.

In addition, a full area schedule for the development will be provided in Appendix A.

Table 10: Waste generation GFA per operational area[13]

Operational Area	GFA (m^2)
Aquatic Centre; Indoor facilities	4,053
Aquatic Centre; Outdoor facilities	2,517
Health and Fitness Centre	1,636
Café and Kiosk	336
Administration areas	199
Creche	147
Entry/Lobby	772
Total	**9,660**

5.2 Operational waste streams

The waste streams, which will be generated during operation of the proposed development, are identified below in Table 11.

Table 11: Waste generation GFA per operational area

Operational Area	Waste Streams
Aquatic Centre; Indoor & Outdoor facilities	Landfill waste (mixed general waste)
	Co-mingle recycling
	Paper and cardboard recycling
	Hard rubbish or bulky items
	Sanitary Waste
Health and Fitness Centre	Landfill waste (mixed general waste)
	Co-mingle recycling
	Paper and cardboard recycling
	Hard rubbish or bulky items
	Sanitary Waste
Café and Kiosk	Landfill waste (mixed general waste)

[13] GFA areas based on Accommodation schedules with a 10% factor for GFA. Refer to Appendix A

	Co-mingle recycling
	Paper and cardboard recycling
	Cooking Oil
	Organic waste[14]
Administration areas (including entry lobby)	Landfill waste (mixed general waste)
	Co-mingle recycling
	Paper and cardboard recycling
	Hard rubbish or bulky items
	Electronic waste
Crèche	Landfill waste (mixed general waste)
	Co-mingle recycling
	Paper and cardboard recycling
	Sanitary and nappy waste

5.3 Waste generation estimations

Estimates of weekly waste generation for each operational section of the development are summarised below in Table12.

Table 12: Waste generation estimation

Operational Area	Landfill waste volume (L/week)	Paper & card recycling volume (L/week)	Co-mingle recycling volume (L/week)	Total volume (L/week)
Indoor leisure water	9,632	5,677	3,457	18,766
Outdoor leisure water				
Indoor 25m program pool				
Outdoor 50m pool				
Hydrotherapy pool				
Gym, cardio room, dry fitness studio				
Spin room				
Weights room				
Café/kiosk	1,128	3,311	403	4,842
Creche	469	125	-	594
Total volume (L/week)	**11,229**	**9,113**	**3,860**	**24,202**

[14] TBC by Café Operator

6 Waste storage areas

Dedicated waste storage rooms and facilities for GPARC are outlined below in Table 13, and described in further detail in sections 6.1 - 6.4.

Note that waste storage areas are not provided for landscaping and public waste associated with Gunyama Park. This waste will be removed directly by Council or landscaping contractors and will not be stored onsite.

Table 13 Waste storage facilities

Component	No.	Description
Central landfill waste storage room	**1**	This room will provide central storage for landfill waste and prior to its collection. If organic waste is to be collected from food preparation areas, this may also be stored within the central landfill waste storage room. This room will also host a vessel for waste cooking oil.
Central recycling waste storage room	**1**	This room will provide central storage for co-mingle and paper card recycling prior to its collection. The room will provide adequate storage for sorting of recycling. This will be a partitioned section of the central landfill waste storage room.
Hard rubbish and bulky item storage room	**1**	This room will provide oversized items of waste prior to its collection. This room will be a partition within the central landfill storage room.
Temporary waste storage area (café/ kiosk)	**1**	A temporary waste storage area is to be provided within or adjacent to the café/ kiosk area, sized adequately to host a minimum of one full day's waste prior to its transfer to the central storage area.

6.1 Central landfill waste storage room

This room is located on the ground floor of the Aquatic Centre, adjacent to the off-street loading dock. Refer to Appendix A1 for floor plan nominating storage area and required bins.

This room will receive waste from the Aquatic Centre and associated facilities. It will host:

- **General waste**: 6 x 1100L MGBs
- **General waste**: 4 x 240L MGBs
- **Waste cooking oil:** 1x waste cooking oil vat or 2x20L drum[15]

Minimum GFA: **23 m^2**

The café/kiosk facilities which are the source of the majority of food waste generated onsite are unlikely to host significant onsite food preparation. As such, opportunities for organic waste segregation onsite are minimal. If the selected café

[15] TBC by café operator

operator chooses to separate organic waste during its limited food preparation activities, this will also be stored within the central waste storage room prior to collection for organic recycling.

It is noted that unless servery products are biodegradable, the risk of organic waste contamination is high. If organic waste separation is desired across the GPARC precinct substantial management change will be required, such as mandating compostable food packaging.[16]

6.2 Recycling – central storage

This room is located on the ground floor of the Aquatic Centre, adjacent to the off-street loading bay. Refer to Appendix A1 for floor plan nominating storage area and required bins.

This room will receive co-mingle and paper/card recycling from the Aquatic Centre and associated facilities. It will provide adequate space for sorting of recyclables.

It will host:

- **Co-mingle recycling**: 3 x 660L MGBs
- **Co-mingle recycling:** 2 x 240L MGBs
- **Paper and card recycling:** 4 x 1100L MGBs
- **Paper and card recycling:** 8 x 360L MGBs
- **Small e-waste recycling:** small receptacle [17]

Minimum GFA: **32 m^2**

6.3 Hard rubbish & bulky items– central storage

This room is located on the ground floor of the Aquatic Centre, adjacent to the off-street loading bay. Refer to Appendix A1 for Floor plan nominating storage area and required bins.

A dedicated room will be provided to store hard rubbish, bulky items and oversized waste temporarily, prior to its collection by a suitable contractor (on-call, as needed).

Minimum GFA: **8 - 12 m^2**

6.4 Café/ kiosk – temporary storage

The central waste storage area is located on the southern end of the Aquatic Centre and access from the Café/Kiosk is across the pool deck. A temporary storage room will be required to host a minimum of one days waste from the café

[16] If organic stream is nominated, provision for an organic bin is required.
[17] Alternatively, a bin for small e-waste may be hosted within the main administrative area of the building

and kiosk facilities. Refer to Appendix A1 for Floor plan nominating storage area and required bins.

- **General waste**: 1 x 240L MGBs
- **Co-mingle recycling**: 1 x 240L MGBs
- **Paper and card recycling:** 1 x 360L MGBs

Estimated GFA: **3 m^2**

7 Waste storage design

7.1 Signage

Recyclables and general waste will be stored in colour coded, AS4213 compliant bins to ensure waste streams are not inadvertently mixed. All waste storage areas and bins will be provided with clear labels and directions for use in order to maximise appropriate separation of waste streams.

7.2 General waste facilities design

All waste storage rooms will be designed according to the provisions stipulated by the CoS Waste Guidelines (Section A, General and Reference B: Bin Bay/Bin Room Construction). Provisions for this development are outlined in Table 13.

The central waste storage rooms must be located in a position that is convenient for both users and waste contractors. The access pathway for wheeling bins between a central waste storage point and a collection point must be free of steps or kerbs. The distance between the central waste storage rooms and their respective collection points will not exceed 20 m and must not exceed grade of 1 in 12.

The table below provides a summary of design requirements relating to the waste storage facilities.

Table 14: Waste storage design

Design aspect	Design provision
Floor	The floors of the waste storage rooms will be constructed of concrete of at least 75mm thickness and graded and drained to the sewerage system as approved by Sydney Water Corporation. The floors will be finished to a smooth, even surface, and coved at their intersection with walls and plinths. The walls will be resistant to water and moisture penetration. A ramp to the doorway will be provided if necessary.
Structure	The walls, ceilings and floors of the storage rooms will be finished with a light colour. The walls of the waste storage rooms will be constructed of approved solid impervious material and will be cement rendered internally[18] to a smooth even surface coved at all intersections. The storage area will be constructed and finished to prevent absorption of liquids and odours, and will be easily cleanable.
Doors	The waste storage rooms will be fitted with close fitting and self-closing doors which may be readily opened from within the room. A sign will be erected in a prominent position clearly stating that the doors must be kept closed at all times when not in use.
Water	Hot and cold water will be provided to the waste storage rooms. Water will be mixed through a centralised mixing valve with hose cock.[19]

[18] Use of other equivalent surfacing such as off form concrete to be confirmed with Council during consultation

[19] It is expected that separate hot and cold water controls will be required. Detail to be developed with selected cleaning method and system.

Design aspect	Design provision
Lighting	Adequate lighting will be provided for all rooms, controllable from a switch located both outside and inside the room. Lighting will ensure safe access to the area at night.
Pest control	The waste storage rooms, areas and containers will be constructed in a manner as to prevent the entry of vermin. Automatic closing mechanisms can minimise access for vermin.
Ventilation	The waste storage rooms will be supplied with an approved system of mechanical exhaust ventilation.
Safety	Smoke detectors will be fitted in accordance with AS1670 Automatic Fire Detection and Alarm Systems and connected to the fire prevention system of the building. All equipment will be protected from theft and vandalism.
Signage	Signs will be provided to demonstrate how to use the waste management system (including segregation of wastes for recycling, use of waste compactor), as well as appropriate safety signage. The different recycling and waste bins will be clearly identified and signed appropriately.
General	All waste management facilities will be compliant with the Building Code of Australia (BCA) and all relevant Australian Standards. The waste management system and storage areas will not be visible from the exterior of the building.

8 Waste management

8.1 Waste management responsibilities

The major responsibilities associated with waste management are outlined below in Table 15. These responsibilities are separate for the Aquatic Centre facilities and Gunyama Park.

All contracts with building managers, commercial tenants and cleaners will clearly outline the waste management and collection system, and will clearly allocate waste management responsibilities.

Table 15: Waste management responsibilities

	Task	Responsibility
WASTE STORAGE AREAS	Bin cleaning, cleaning of temporary and central waste storage areas, transfer corridors and collection areas.	Building management
	Removal of waste from bins within the Aquatic Centre (including pool decks) to the central waste storage area.	Building management
	Removal of waste from any commercially tenanted areas (café/ kiosk) to central waste storage areas. Bins will be presented in central waste storage areas and switched for empty bins. No man handling of MGB's.	Commercial tenants
	Removal of sanitary waste and nappies from specialist bins	Private contractor
SIGNAGE	Provision of signage in all communal waste collection and storage areas to demonstrate how to use the waste management system, and what materials are acceptable in recycling bins and chutes.	Building management
	Provision of prominently displayed signage identifying: • Waste and recycling storage areas; • Waste and recycling compartments	Building management
	If a cardboard baler is to be provided in future design iterations, clear warning/ safety signage for cardboard baler equipment is required	Building management
	Provision of clear labels on all waste and recycling receptacles to identify which materials may be placed in which bin.	Building management
WASTE COLLECTION	Transfer of bins between the central waste storage areas and loading bay/ vehicle.	Waste collection contractor
	Collection of public waste from Gunyama Park	City of Sydney
	Removal of green waste associated with landscaping facilities (no onsite storage)	Private contractor

	Return of waste bins to their appropriate storage areas after emptying into waste collection truck in the loading dock.	Waste collection contractor

8.2 Logistical considerations

Particular considerations for management of different waste streams are summarised below in Table 16.

Table 16: Waste stream management considerations

Waste Stream	Management considerations
General waste and recycling	Landfill waste and recycling will be transferred from the Aquatic Centre (including from pool deck areas) to the central storage room by building management and/or cleaners as necessary, typically 1 per day and up to 3 times a day in peak periods.
Organic waste[20]	Organic waste treatment or collection may be provided for cafe/ kiosk tenants if a large amount of food preparation is to take place onsite. This is unlikely to be the case. If so, this will be transferred to the central waste storage room by commercial tenants prior to collection or onsite treatment.
Sanitary waste	Crèche facilities and female change rooms will provide dedicated receptacles for nappies and sanitary waste. These will be managed and collected directly from their source by specialist private contractors.
Small electronic waste	Small electronic waste (such as print cartridges) from administrative areas will be stored in a dedicated receptacle – located either in the administrative area or the central recycling storage area.
Hard rubbish and large electronic waste	Hard rubbish is to be moved by building management or commercial tenants to the designated hard rubbish storage area. Building management will then schedule collection as necessary.
Broken gym equipment	This will be collected directly from its position in the gym by the equipment owner or manufacturer.

[20] Organic waste stream to be confirmed

9 Waste collection

9.1 Waste collection frequency

This section will provide a summary of the weekly collection frequency[21] for each of the waste streams associated with the development.

Waste collection services for each waste stream will be provided by appropriate licenced contractors. Written evidence will be provided and held on site at all times of a valid and current contractor with a licenced collector for waste and recycling collection and disposal.

Collection frequency for landfill waste, co-mingle recycling and paper and card recycling may be reduced during the 'low season' to one collection per week. The need to reduced collection frequency during low visitor periods will be assessed in an ongoing basis during operation.[22]

The waste generation volumes are based on projected 2021 visitor numbers and the need to increase collection frequency as local population growth increases will also be assessed in an ongoing basis during operation.[23]

Table 17: Waste collection summary

Waste Stream	Collection Frequency	Licenced Collector
Landfill waste	2 x per week	Private contractor
Co-mingle recycling	2 x per week	Private contractor
Paper and card recycling	2 x per week	Private contractor
Nappies waste bins	1 – 2 x per week	Private contractor
Sanitary waste bins	1 – 2 x per week	Private contractor
Electronic waste	As necessary	Private contractor
Hard rubbish	As necessary	Private contractor
Waste cooking oil	1x per week	Private contractor
Gunyama park public waste	Park bins to be emptied daily	Council
Landscaping waste	According to contractor schedule	Private contractor

9.2 Waste collection arrangements

Waste bins will be transferred from the central storage areas to the loading bay by waste contractors upon collection. Empty bins will be transferred from the loading dock back to central storage by the waste contractor.

[21] Weekly collection frequency is based on a 7 day operation assumption.
[22] As per Appendix C Aquatic Centres often reduce collection frequency during months where visitor numbers decrease, particularly over winter. However, similar facilities which provide indoor pool facilities (such as the Ian Thorpe Aquatic Centre) do not experience a 'low season' and do not reduce collection frequency during winter months. As GPARC provides both indoor and outdoor facilities, the need to reduced collection frequency during a 'low season' will need to be reviewed and assessed during operation.
[23] CoS has agreed to increase collection frequency from 2x week to 3x week as visitor numbers rise.

The waste loading bay is located off Rose Valley Way at the east end of the path between Gunyama Park and Gunyama Park Aquatic and Recreation Centre. External access to the central waste and recycling room is via Rose valley way. Bins will be wheeled approximately 10m to the external entrance.

For the loading bay location and access to central storage refer to Appendix A2.

9.3 Waste contractor vehicle access

The route for the waste contractor access to the waste loading bay is via Rose Valley way. Access will at no time cause the flow of traffic on surrounding public streets to be blocked.

Vehicle access to the loading bay is to be designed according to a waste collection vehicle with specifications summarised in Table18 below. Truck turning circle studies demonstrate access can be achieved. Please Refer to Appendix A2.

During Interim Stage works access to Rose Valley Way is limited. Temporary access to the loading bay during Interim Stage will be from Joynton avenue to the loading bay, then out via the flood path onto Zetland Ave.

For the proposed and temporary access path locations, including truck turning circle studies refer to Appendix A2.

Table 18: Rear loading collection vehicle for MGBs

Vehicle Specification	Measurement
Length overall	9.54 m
Width overall	2.6 m
Operational height	4 m
Travel height	3.8 m
Weight (payload)	26 tonnes

9.4 Amenity

The management systems and constructed elements for waste within this development will be designed and installed so as to enhance outcomes for building amenity. Any potential for noise and odour to arise will be minimised. Specifically:

- **Visual aspects:** The waste management facilities and central storage areas will not be visible from the exterior or interior of the building.
- **Noise:** significant noise-generating waste management equipment will not be utilised in this development. Production of ‘offensive noise,’ as defined under the *Protection of the Environment Operations Act 1997*, will be avoided.
- **Odour**: Any putrescible waste awaiting collection will be stored in a Council approved container with permanently tight fitting lids and smooth, washable internal surfaces.

  All waste storage areas will be fitted with mechanical vertical ventilation systems.

Adequate mechanical ventilation and regular collection of waste will eliminate the risk of odour to building inhabitants and neighbours.

10 Next steps

This WMP forms a framework to implement best practice for waste management across all design and planning stages. The waste management approach supports the Green Star requirement for the project to enhance outcomes for waste minimisation, reuse and recycling.

When planning approval is granted for the proposed development, this WMP will:

1. Inform the development of a detailed Waste Policy Design Compliance Certificate for the Construction Certificate application, which is to include details regarding disposal and recycling of different materials expected from demolition, construction, and the transport and destinations of these materials;
2. Inform a future Green Star submission associated with credit 8.1 of Green Star Design and As Built;
3. Ensure that detailed design and fit-out of the building is consistent with best practice standards and plans for waste management, and
4. Inform all plans and procedures for operational waste management

Appendix A

Building plans

A1 Building plans with mark up of waste facilities



WASTE STRATEGY - KEY

POOL CONCOURSE AND ENTRY(FOYER) AREA

- FIXED BINS
- COLLECTION FREQUENCY: ONCE/DAY

3 BIN SYSTEM (3x 68L AT 15 LOCATIONS)
2X GENERAL WASTE
1X CO-MINGLE RECYCLING

TEMPORARY WASTE STORAGE

- ROTATION SYSTEM
- COLLECTION FREQUENCY: ONCE/DAY

2X PAPER AND CARD RECYCLING (360L MGB)
1X CO-MINGLE RECYCLING (240L MGB)
1X GENERAL WASTE BIN (240L MGB)

CENTRAL WASTE STORAGE

- CAFE/ KIOSK GENERATION (ROTATION)
  4x 240L LANDFILL
  2x 360L CO-MINGLE RECYCLING
  8x 360L PAPER/CARDBOARD RECYCLING

- AQUATIC CENTRE GENERATION
  6x 1100L LANDFILL
  3x 660L CO-MINGLE RECYCLING
  4x 1100L PAPER/CARDBOARD RECYCLING

- COLLECTION FREQUENCY: TWICE/WEEK

3 GROUND FLOOR PLAN 1:200

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

CITY OF SYDNEY

AIBA GRIMSHAW

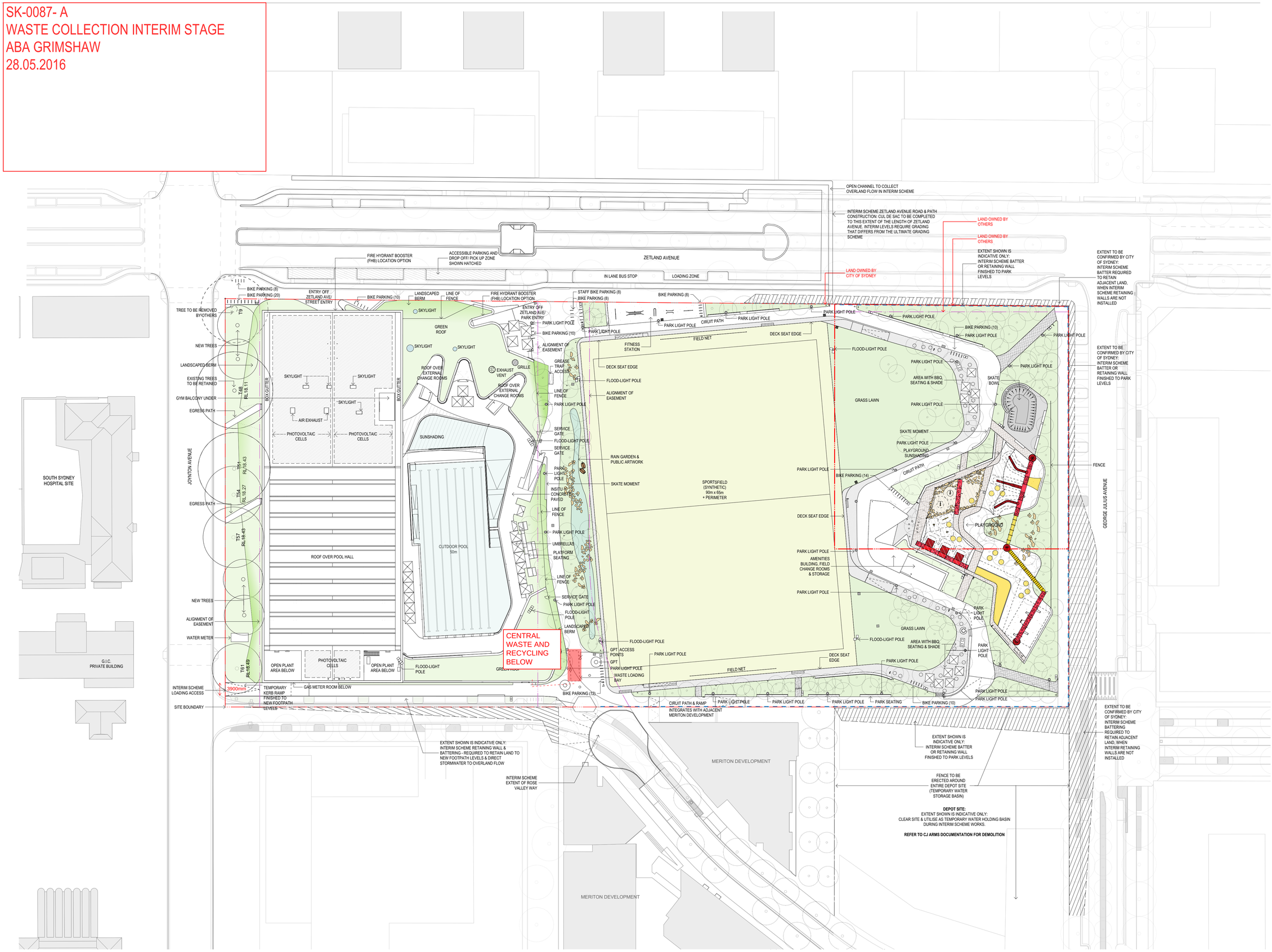
T.C.L

DATE REVISION

SK 0068-F
WASTE STRATEGY POOL CONCOURSE, ENTRY AREA AND CAFE

A2 Gunyama Park layout

SK-0087- A
WASTE COLLECTION INTERIM STAGE
ABA GRIMSHAW
28.05.2016



01 SITE PLAN INTERIM SCHEME
- 1:500

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NORTH

GRAPHICAL SCALE
0 2.5 5 10 15 20 25m

NOTE
THIS PROJECT WILL BE DELIVERED IN STAGES

GROSS FLOOR AREA (GFA)	
GROUND FLOOR	
MAIN BUILDING	3,904 m²
PARK AMENITIES	66 m²
LEVEL 01	
MAIN BUILDING	1,438 m²
TOTAL	5,408 m²
FLOOR SPACE RATIO (FSR)	
GROSS FLOOR AREA	5,408 m²
SITE AREA	28,693 m²
RATIO	0.19:1

REV	DATE	ISSUE
A	31/05/16	DEVELOPMENT APPLICATION

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STRUCTURAL
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456 Kent St, Town Hall House
Sydney NSW 2000 Australia

PROJECT
Gunyama Park Aquatic and Recreation Centre (GPARC)

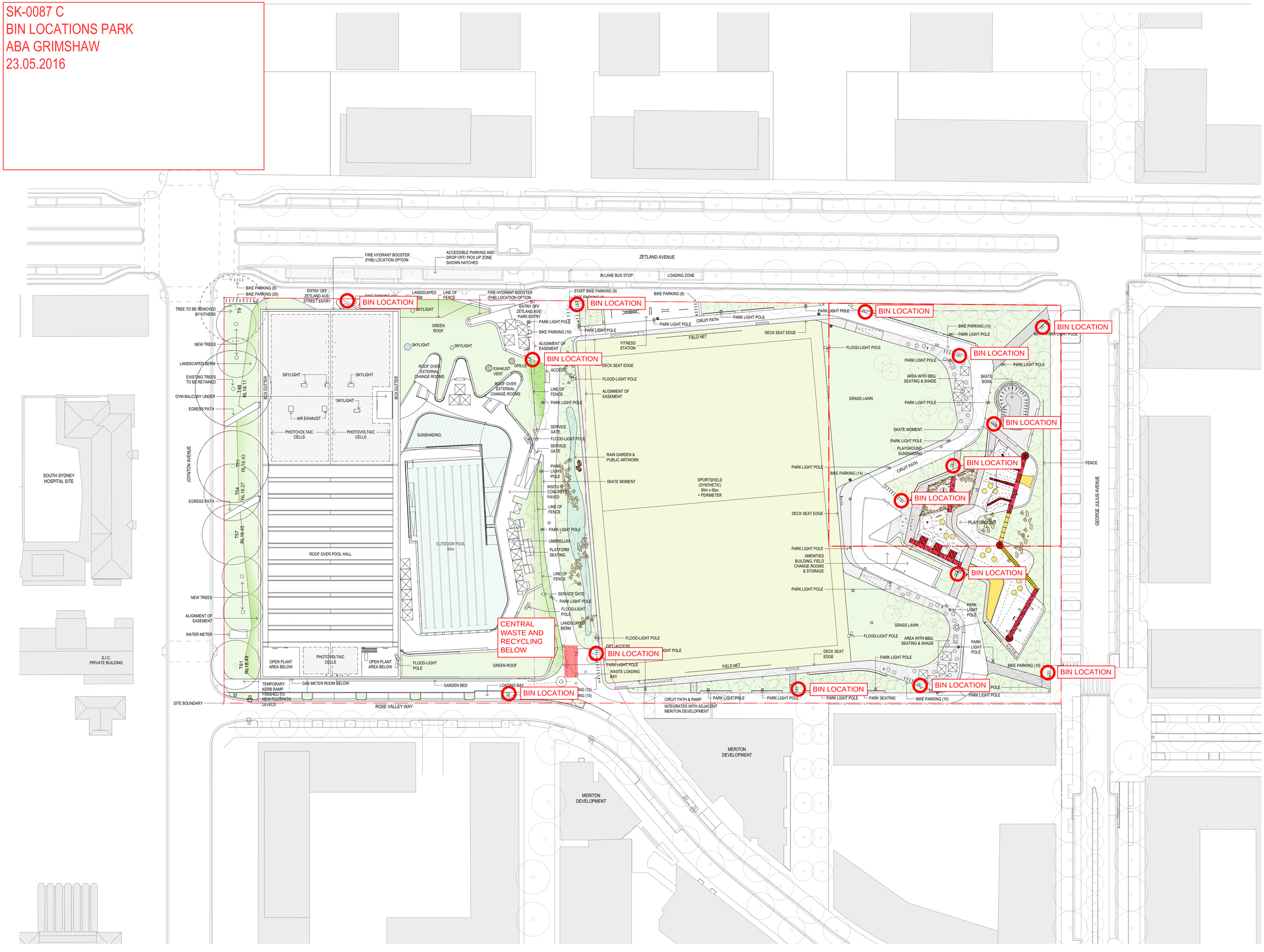
132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE
SITE PLAN INTERIM STAGE SURROUNDING PUBLIC DOMAIN

DRAWN: MD
CHECKED: NB
SCALE: 1:500 @ A1
FIRST ISSUE: 31/05/16
DRAWING NO: ARC-DA-012
REV: A

DEVELOPMENT APPLICATION

SK-0087 C
BIN LOCATIONS PARK
ABA GRIMSHAW
23.05.2016



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NORTH

GRAPHICAL SCALE

0 2.5 5 10 15 20 25m

NOTE

THIS PROJECT WILL BE DELIVERED IN STAGES

GROSS FLOOR AREA (GFA)	
GROUND FLOOR	
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LEVEL 01	
MAIN BUILDING	1,438 m²
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GROSS FLOOR AREA	5,408 m²
SITE AREA	28,693 m²
RATIO	**0.19:1**

REV	DATE	ISSUE
A	31/05/16	DEVELOPMENT APPLICATION

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Sydney NSW 2000 Australia
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CITY OF SYDNEY
456 Kent St, Town Hall House
Sydney NSW 2000 Australia

PROJECT

Gunyama Park Aquatic and Recreation Centre (GPARC)

132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

SITE PLAN

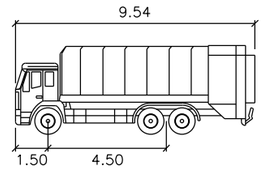
DRAWN:	MD
CHECKED:	NB
SCALE:	1:500 @ A1
FIRST ISSUE:	31/05/16
DRAWING NO	REV
ARC-DA-011	A

DEVELOPMENT APPLICATION

SWEPT PATH KEY

- VEHICLE CENTRE LINE
- VEHICLE TYRE PATH
- VEHICLE BODY PATH
- 600mm CLEARANCE FROM VEHICLE BODY

ASSUMED SPEED 5km/h



9.5m Garbage meters CoS

Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 33.7

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Melbourne 03 9851 9600
Sydney 02 8448 1800
Brisbane 07 3113 5000
Canberra 02 6243 9400
Adelaide 08 8334 3600
Gold Coast 07 5510 4814
Townsville 07 4722 2765
Perth 08 6316 4634

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PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY
SUBJECT TO CHANGE WITHOUT NOTIFICATION

GREEN SQUARE AQUATIC CENTRE
FINAL LAYOUT DESIGN
9.5m WASTE VEHICLE SWEPT PATH ASSESSMENT

DATE: 3/06/2016
SCALE: 1:750@A3
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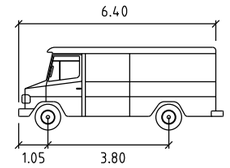
APPROVED: RMH
DRAWING NO. 16S1006100-03-01-P6
SHEET: 01 OF 10

SWEPT PATH KEY

- VEHICLE CENTRE LINE
- VEHICLE TYRE PATH
- VEHICLE BODY PATH
- 300mm CLEARANCE FROM VEHICLE BODY

ASSUMED SPEED 5km/h



SRV

	metres
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Lock to Lock Time	: 6.0
Steering Angle	: 38.0

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Melbourne 03 9851 9600
Sydney 02 8448 1800
Brisbane 07 3113 5000
Canberra 02 6243 9400
Adelaide 08 8334 3600
Gold Coast 07 5510 4814
Townsville 07 4722 2765
Perth 08 6316 4634

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PRELIMINARY PLAN
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SUBJECT TO CHANGE WITHOUT NOTIFICATION

GREEN SQUARE AQUATIC CENTRE
FINAL LAYOUT DESIGN
6.4m SRV SWEPT PATH ASSESSMENT

DATE: 3/06/2016
SCALE: 1:750@A3
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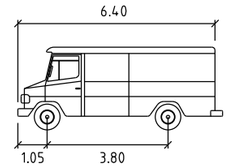
APPROVED: RMH
DRAWING NO. 16S1006100-03-02-P6
SHEET: 02 OF 10

SWEPT PATH KEY

- VEHICLE CENTRE LINE
- VEHICLE TYRE PATH
- VEHICLE BODY PATH
- 300mm CLEARANCE FROM VEHICLE BODY

ASSUMED SPEED 5km/h



SRV — metres

Width	: 2.30
Track	: 2.30
Lock to Lock Time	: 6.0
Steering Angle	: 38.0

Melbourne 03 9851 9600
Sydney 02 8448 1800
Brisbane 07 3113 5000
Canberra 02 6243 9400
Adelaide 08 8334 3600
Gold Coast 07 5510 4814
Townsville 07 4722 2765
Perth 08 6316 4634

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PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY
SUBJECT TO CHANGE WITHOUT NOTIFICATION

GREEN SQUARE AQUATIC CENTRE
INTERIM STAGE
6.4m SRV SWEPT PATH ASSESSMENT

DATE: 3/06/2016
SCALE: 1:500@A3
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APPROVED: RMH
DRAWING NO. 16S1006100-03-10-P6
SHEET: 10 OF 10

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A3 Area schedule

ARC-Z-051 **ACCOMMODATION SCHEDULE - SUMMARY**

PROJECT NAME	C16113 - GPGSAC - GUNYAMA PARK AND GREEN SQUARE AQUATIC CENTRE
PROJECT ADDRESS	XX ZETLAND AVENUE, NSW, 2017
REVISION	J
ISSUE DESCRIPTION	100% DA - UPDATE 01
ISSUE DATE:	13/05/2016

ACTIVITY AREA	CATEGORY CODE	CATEGORY NAME	BRIEFED AREA	COMP. AREA STAGE 2B (25.08.2014)	MEASURED AREA 100% DD (01.04.16)	**MEASURED AREA 100% DA (12.05.16)**	DIFFERENCE BRIEFED AREA/MEASURED AREA	% DIFFERENCE	ADDITIONAL NOTES
01 FRONT OF HOUSE									
	01.01.01-FOH-E	Forecourt (ext)	100	260	163.02	157.84	57.84	58%	Area increase as forecourt is integrated into street edge.
	01.01.02-FOH-E	Entry	245	231	420.74	428.61	183.61	75%	Generous Entry foyer as developed with input at design meetings. Development of Double entry
	01.02-FOH-CK	Cafe/ Kiosk	295	171	301.18	305.76	10.76	4%	
	01.03.01-FOH-CK	Creche/ Shared Use	135	147	129.40	134.01	-0.99	-1%	
	~~01.03.02-FOH-CK~~	~~Creche Outdoor Play Area (opt, ext)~~							Optional - Not currently in design
	01.04-FOH-CC	Circulation Core	40	69	117.52	115.55	75.55	189%	
		INTERNAL SUBTOTAL	**715**	**618**	**968.84**	**983.93**	**268.93**	38%	
		EXTERNAL SUBTOTAL	**100**	**260**	**163.02**	**157.84**	**57.84**	58%	
02 ADMINISTRATION	115.5499878	115.5499878				115.5499878			
	02.01-ADM-M	Management Offices	115	135	80.81	79.97	-35.03	-30%	
	02.02-ADM-MR	Meeting Rooms	40	23	49.07	40.66	0.66	2%	
	02.03.01-ADM-SA	Staff Amenities	60	54	51.06	53.92	-6.08	-10%	
	02.03.02-ADM-SA	Staff Bicycle Parking (ext)	15	20	9.19	6.18	-8.82	-59%	
		INTERNAL SUBTOTAL	**215**	**212**	**180.94**	**174.55**	**-40.45**	-19%	
		EXTERNAL SUBTOTAL	**15**	**20**	**9.19**	**6.18**	**-8.82**	-59%	
03 AQUATIC CENTRE	6.17999649	6.17999649				6.17999649			
	03.01-AQC-PH	Pool and Leisure Hall	1985	2146	2260.59	2153.87	168.87	9%	
	03.02-AQC-OP	Outdoor Pool (ext)	1710	2,613	2237.19	2288.28	578.28	34%	Includes Beach Entry
	03.03-AQC-W	Wet Changerooms and Lockers	375	359	440.41	436.9	61.90	17%	
	03.04.01-AQC-F	First Aid	10	13	9.97	10.26	0.26	3%	
	~~03.04.02-AQC-F~~	~~First Aid Toilet (opt)~~							Optional - Not currently in design
	03.05-AQC-H	Hydrotherapy	430	423	503.49	497.86	67.86	16%	
	03.06-AQC-PS	Plant and Store	570	562	608.42	585.35	15.35	3%	Based on schematic pool plant design
		INTERNAL SUBTOTAL	**3370**	**3503**	**3822.88**	**3684.24**	**314.24**	9%	
		EXTERNAL SUBTOTAL	**1710**	**2,613**	**2237.19**	**2288.28**	**578.28**	34%	
04 HEALTH & FITNESS CENTRE	585.3496094	585.3496094				585.3496094	585.35		
	04.01-HFC-HF	Health and Fitness Offices	40	43	39.75	39.75	-0.25	-1%	
	04.02-HFC-G	Gym	830	850	743.51	743.07	-86.93	-10%	
	04.03-HFC-FS	Dry Fitness Studios	455	430	428.45	427.58	-27.42	-6%	
	04.04-HFC-D	Dry Changerooms and Lockers	230	210	176.09	176.09	-53.91	-23%	
	04.05-HFC-CI	Circulation	85	61	100.71	100.47	15.47	18%	
		INTERNAL SUBTOTAL	**1640**	**1594**	**1488.51**	**1486.96**	**-153.04**	-9%	
05 BACK OF HOUSE	100.4699707	100.4699707				100.4699707			
	05.01-BOH-G	Garbage Room	30	33	127.93	140.25	110.25	368%	
	05.02-BOH-P	Plant	220	220	416.54	423.7	203.70	93%	
	05.03-BOH-P	Cogeneration/ Trigeneration Plant	330	325	100.14	100.14	-229.86	-70%	
		INTERNAL SUBTOTAL	**580**	**578**	**644.61**	**664.09**	**84.09**	14%	
TOTAL (EXCL. OTHER) - INTERNAL AREA									
		Internal Sub Total Excl. Other	6520	6505	7105.78	6993.77	473.77	7%	
		Gross Floor Area Allowance, 10%	655	650.5	710.578	699.377	44.38	7%	
			7175	**7155.5**	**7816.358**	**7693.147**	**518.15**	7%	
TOTAL (EXCL. OTHER) - EXTERNAL AREA		External Sub Total Excl. Other	1825	2,893	2,409	2452.3	627.3	34%	
		Gross Floor Area Allowance							
			1825	**2,893**	**2,409**	**2452.3**	**627.30**	**34%**	

06 OTHER						100.1399536			
	~~06.01-OTR-CP~~	~~Carpark~~				100.1399536	100.14		Not currently located in plans
	06.03-OTR-CR	Cogeneration/ Trigeneration Related Plant	25	28	102.33	102.33	77.33	309%	Placeholder
	102.3299561	102.3299561	115			102.3299561	-12.67	-11%	
		SUBTOTAL	**140**	**28**	**102**	**304.7999097**	**164.80**	118%	

Appendix B

Details of waste management forms

B1 Details of waste management form - construction phase

Details of waste management – construction phase

MATERIALS ON-SITE			DESTINATION		
			REUSE AND RECYCLING		DISPOSAL
Type of materials	**Est. Vol. (m^3)**	**Est. Wt. (t)**	**ON-SITE** **- specify proposed reuse or on-site recycling methods**	**OFF-SITE** **- specify contractor and recycling outlet**	**- specify contractor and landfill site**
Excavated Materials					
Garden Organics					
Bricks					
Tiles					
Concrete					
Timber – please specify					
Plasterboard					
Metals					
Other waste eg. ceramic tiles, paints, PVC tubing, cardboard, fittings					

B2 Details of waste management form - demolition phase

Details of waste management – demolition phase

MATERIALS ON-SITE			DESTINATION		
			REUSE AND RECYCLING		DISPOSAL
Type of materials	**Est. Vol. (m^3)**	**Est. Wt. (t)**	**ON-SITE** **- specify proposed reuse or on-site recycling methods**	**OFF-SITE** **- specify contractor and recycling outlet**	**- specify contractor and landfill site**
Excavated Materials					
Garden Organics					
Bricks					
Tiles					
Concrete					
Timber – please specify					
Plasterboard					
Metals					
Asbestos					
Other waste eg. ceramic tiles, paints, PVC tubing, cardboard, fittings					

Appendix C

Site visit notes

C1 Aquatic centre site visit notes

Site Visit Notes

ARUP

Level 10, 201 Kent St
Sydney 2000

Project title	Gunyama Park Green Square Aquatic Centre	Job number 240516-00
cc	Arup – Belinda Hewitt, Jane Nixon, Laura Craft, Javier Valderama Grimshaw Architects – Martin Langham ABA Architects – Louise Lovmand City of Sydney – Nicole Robinson	File reference \\global.arup.com\australasia\SYD\Projects\240000\240516-00 Green Square Aquatic\Work\Internal\Design\Waste\Site Inspections
Prepared by	Belinda Hewitt, Laura Craft	Date 18 March 2015
Subject	Site Inspection Notes – Ian Thorpe Aquatic Centre, Victoria Park Pool, Prince Albert Park Pool	

Arup undertook three site inspections for Council aquatic facilities to assist in preparing waste design advice for the Gunyama Park Green Square (GPGS) Aquatic Centre. The following inspections were attended by Belinda Hewitt (Arup), Laura Craft (Arup), Jane Nixon (Arup, Prince Alfred Park Pool visit only), Martin Langham (Grimshaw Architects) and Nicole Robinson (City of Sydney).

- Ian Thorpe Aquatic Centre: 9am, Tuesday March 17
- Victoria Park Pool: 10.30am, Tuesday March 17
- Prince Alfred Park Pool, 3.30pm, Wednesday March 18

This document outlines the key findings and observations from the site visits relating to design advice and waste management strategy development for GPGS Aquatic Centre.

1 Ian Thorpe Aquatic Centre

Background

Building commenced operation circa 2007. Visitor numbers circa 560,000 per annum.

Waste streams and sources

Waste sources: Small café (minimal onsite food prep – limited to sandwiches, hot chips etc.), pool, gym, change rooms, administration areas.

Waste streams:

- Paper/ card (primarily from café, largely made up of boxes used for delivery)
- Wet waste (all other sources – largest source is café/ aquatic centre, second largest is change rooms due to use of hand towels, smallest is the gym)
- Nappies and sanitary waste – change rooms
- Waste cooking oil – from café

Note: no co-mingle / plastic waste stream. Not enough space to host co-mingle MGBs in central storage, no co-mingle collection bins across the centre (building may have achieved DA prior to 2005 Waste Policy?).

File Note

240516-00 18 March 2015

Waste storage facilities and collection

Central storage

Landfill: 2x 1100L MGBs – these regularly overflow. Lids must be left open at all times to receive chute discharge. Causes some problems with odour, mess/ overflow, flies and vermin. Cleaners do not check for overflow due to the chute system.

Cardboard and paper recycling: 2x 1100L MGBs

Waste cooking oil: 2x small drums - oil recycler will not provide vat for free due to low volume generated. Will be arranging with Veolia to lease a vat.

Hard rubbish storage

Other hard rubbish is stored in a 'storage room' on the ground floor, more than 2x the size of the central waste storage room. Dedicated e-waste storage is also provided.

Broken gym equipment is never stored on site. Leased, so owners will come and dismantle/ collect directly from gym if required.

Onsite waste bins

- 7x bins in the pool area
- 4x bins in the gym (2x in hall, 2x in gym) – changed approx. 3x per day
- Additional bins + nappi/ sanitary bins in change rooms

Waste collection

Collection frequency

- Paper/ card – 2x per week (Monday, Friday)
- Wet waste – 2x per week (Monday, Friday)
- Nappis and sanitary waste – collected by contractor approx. 1x per week (Enviroservices)
- Waste cooking oil – monthly

Current bin provision is not enough, wet waste regularly overflows – partly due to chute discharge configuration, but also due to lack of storage capacity. At time of site visit was significantly overflowing/ near capacity and still 4 days from next collection. Site manager says they 'could easily fill 3 1100L MGBs.' There is a regular need to pay overflow collection charges.

Friday is the more sizable collection. If there is a major event or significant peak period, additional collections may be arranged.

Collection frequency does not vary seasonally. Due to indoor location of facilities, patronage does not vary hugely over the year and waste generation is near constant.

Logistical considerations

Transfer of waste

Wet waste transferred to central storage room via waste chute (entry is via a storage room on ground floor).

Cleaning staff collect waste bags from bins and transfer these to the chute using a trolley.

No goods lift, general lift or stairs are used for transfer of other items.

Note cardboard is stored informally in a storage room during the day prior to transfer to central storage room by cleaners at night – indicates temporary storage provision is needed if central storage room is not on the ground floor or not easily accessible by staff.

Collection of waste

No access to car park outside of operational hours for security reasons – could not provide waste contractors with access. Must therefore come between 6am – 9am. Enter via exit side of boom gate due to ceiling restrictions. Must stop short of the room itself due to ceiling services restricting height.

It was difficult to find a contractor who would agree with this arrangement.

Other notes

Installing hand dryers instead of towels would significantly reduce waste and associated costs.

Pest control and grease trap collection occur quarterly.

2 Victoria Park Pool

Background

Building commenced operation circa 1954. Visitor numbers TBC by Samuel Hutchinson.

Waste streams and sources

Waste sources: Small café (minimal onsite food prep – limited to sandwiches, hot chips etc.), pool, gym, change rooms, crèche, administration areas.

Waste streams:

- Paper/ card (primarily from café, largely made up of boxes used for delivery, administration printing)
- Organic Waste (minimal waste from food preparation)
- Wet waste (all other sources – high percentages from café due to food packaging, change rooms due to use of paper hand towels. Gym waste reduced due to wipe-down towels)
- Nappies and sanitary waste – change rooms and crèche

Note: no co-mingle / plastic waste stream. Building operation prior to 2005 Waste Policy, no intentions to convert streams.

Waste storage facilities and collection

Central storage

Landfill: 2x660L MGBs – Generally no overflow, except for peak times i.e. Christmas. Problem with odour, flies and vermin due resolved by sealing window to ladies change room and cleaning central storage quarterly.

Cardboard and paper recycling: 2x 1100L MGBs.

Note: Issues with drainage in central storage area during wet periods as park run-off clogs the system.

Hard rubbish storage

Hard rubbish and e-rubbish is stored in a room downstairs, until a skip can be provided upstairs in delivery bay area.

Broken gym equipment is not stored on site. As it is leased, owners will come and dismantle/ collect directly from gym if required.

Onsite waste bins

- 5x bins in the pool area – chanced 1-2x per day by supervising lifeguards
- 1x bin in the gym – changed approx. 3x per day
- 1-2x bins in each office
- Additional bins + nappy / sanitary bins in change rooms

Waste collection

Collection frequency

- Paper/ card – 2x per week (reduced to 1x per week in winter)
- Wet waste – 2x per week (reduced to 1x per week in winter)
- Sanitary waste – 1x per month
- Nappy waste – 1x per week

Current bin configuration is sufficient for general waste, while paper and cardboard, particularly during peak occupancy periods, susceptible to overflow. Overflow collection charges are paid (albeit rarely), or an additional collection is scheduled.

Collection frequency varies significantly due to weather and season, due to outdoor facility.

Logistical considerations

Transfer of waste

Wet waste collected from pool decks by lifeguards and manually carried to central storage room (access via internal gate).

Cleaning staff collect waste bags from change room, gym and office bins and transfer to central storage room (access via internal gate).

Café staff collect daily waste and transfer to central storage room (access via internal gate).

Goods lift used to transfer hard waste and e-waste to below ground temporary storage.

Collection of waste

Waste is collected at 5:30am from central storage room. Waste contractors enter Victoria Park through the carpark entrance (City Rd) and drive to the central storage room. Access is via the external gate and waste

contractors provided with a key. The system provides a smooth waste collection with waste contractor and management happy.

Other notes

Crèche hosts up to 8 kids at a time 2 days per week. Not highly utilised, planning to move up to 5 days per week.

3 Prince Alfred Park Pool

Background

Building commenced operation May 2013. Visitor numbers around 170,000 per annum.

Waste streams and sources

Waste sources: Small café serving pool and public park (minimum onsite food prep), pool, change rooms, administration areas.

Waste streams:

- Paper/ card recycling (primarily from café)
- Comingle recycling (café waste only)
- Organic Waste (minimal waste from food preparation)
- Wet waste (primarily pool deck – high percentages from café packaging)
- Nappies and sanitary waste – change rooms

Note: Original design for co-mingle on pool deck however risk of cross contamination high. Reduced wet waste in change room through provision of hand dryers.

Waste storage facilities and collection

Central storage:

Landfill: 8x240L MGBs –

Cardboard and paper recycling: 6x240L MGBs –

Co-mingle: 6x240L MGBs –

Waste cooking oil: Approx. 5-6 drums per month

Central Storage room insufficient for waste storage. Smaller MGB's required to fit through door width and transferred to waste collection point once full. All available bins do not fit in provided floor space (issue with blocking fire escape). Strongly recommend using larger (1100L bins).

Central Storage room washed down 1x per week.

AC is provided to address odour problem (issue during summer with organic waste and increased temperature and public holidays with increased occupancy and reduced collections).

Due to close proximity to city there is persistent problem with rats.

Hard rubbish storage

Hard rubbish and e-rubbish is stored in plant room (lower level) and central storage room (where possible)

Chlorine buckets (hazardous material) stored in plant room (8-9 required for hot summer days)

Onsite waste bins

- 8x bins in the pool area – changed approx. 2x per day by supervising lifeguards
- Approx. 2x bins in each change room
- 2x bins provided in café area outside pool (park bins)
- Bins and needle collection provided in public toilet outside pool (services café and park)

Note: Significant issues with waste management servicing outside café/park area; dogs tied to bin poles, waste dumping in public toilets including needles. Public toilets are required to be locked during the night due to location.

Waste collection

Collection frequency

- Paper/ card (blue)– 2x per week; Mon, Weds (reduced to 1x per week in winter)
- Wet waste (red) – 3x per week; Mon, Weds, Fri (reduced to 2x per week in winter)
- Comingle (yellow) – 2x per week; Weds, Fri (reduced to 1x per week in winter)
- Needle bins (outside area) – 1x per week

Collection frequency varies significantly due to weather and season, due to outdoor facility.

Logistical considerations

Transfer of waste

Wet waste collected from pool decks by lifeguards and manually carried to central storage room.

Cleaning staff collect waste from change room and transfer to central storage room.

Café staff collect daily waste and transfer to central storage room (by wheeling 240L bins across pool deck).

Note: Potential risk when wheeling bins across pool deck for waste overflow to enter pool. Recommend avoiding this kind of logistical arrangement.

Collection of waste

Waste is collected at 5:00am from park location between pool and Chalmers St. Waste contractors (Sita) do not have private access to pool. Pool staff are required to wheel bins to park location and waste contractor drives truck into park. Bins are locked (particularly when wheeled in advance due to storage room shortage) to avoid cross contamination and occasionally bins are vandalised or stolen.

Chlorine buckets are stored in the plant rooms and transferred to tip by either staff (remuneration incentive) or management (hire cars).

File Note

240516-00 18 March 2015

Note: Waste Contractors max. pick up 3x per week (no scope for additional collection if required). Hazardous Materials are not in scope of waste management plan.

Other notes

Active strategies to reduce waste are not considered as main source of waste is café, and this is the main source of revenue. Also, pool users are encouraged to bring in own food and beverages. Associated waste generation is dependent on occupancy and difficult to predict.

DOCUMENT CHECKING (not mandatory for File Note)

	Prepared by	Checked by	Approved by
Name	Belinda Hewitt, Laura Craft	Laura Craft	Jane Dixon
Signature			

C2 Site visit data received

			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL MEAN	MAX PEAK FROM MEAN	PEAK WASTE GEN L/VISITOR	Notes
	Visitors		44476	47781	53833	39008	45864	40098	51091	48987	51919	52338	51480	37116	46999.25	15%		November 2013 - October 2014. Indoor pool, minor peak
		Landfill																Landfill and co-mingle not segregated
		Co-mingle																Landfill and co-mingle not segregated
		Comb. Landfill + comingle	1.8	1.92	2.16	1.68	2.16	2.04	1.92	1.92	2.16	2.16	2.16	1.92	2.00	8%		Veolia audit data Nov 2013 - Oct 2014
	Waste by weight (T/ month)	**Paper and card**	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.45	0.45	0.45	0.45	0.35	0.41	9%		Veolia audit data Nov 2013 - Oct 2014
		Landfill	24	24	24	24	24	24	24	24	24	24	24	24			0.444	Estimate based on bin numbers
		Co-mingle																No co-mingle waste
Ian Thorpe Aquatic Centre	**Waste by volume (m3 / month)**	**Comb. Landfill + comingle**																
		Paper and card	19	19	19	19	19	19	19	19	19	19	19	19			0.388	Estimate based on bin numbers
	Visitors		23749	13326	24268	12223	11570	9184	8723	8257	11790	15016	16866	18075	14420.583	68%		Data not yet provided
		Landfill																TBC once visitor nos provided
Victoria Park Pool	**Waste by volume (m3 / month)**	**Co-mingle**																TBC once visitor nos provided
		Paper and card																TBC once visitor nos provided
	Visitors		27691	19051	16,051	8,529	4451	7353	7521	7463	12411	18496	24442	15195	14054.5	97%		March 2014 - Feb 2015. Outdoor pool, large peak
		Landfill																Data not available
		Co-mingle																Data not available
	Waste by weight (T/ month)	**Comb. Landfill + comingle**																
		Paper and card																Data not available
		Landfill	18	16.08	11.52	7.92	7.92	8.4	6	6.96	9.12	12.96	12.72	12.96	10.88	65%	0.650	March 2014 - Feb 2015. Outdoor pool, large peak
		Co-mingle	5.04	4.08	3.36	2.4	3.6	2.64	2.88	1.92	2.88	5.04	3.6	4.08	3.46	46%	0.182	March 2014 - Feb 2015. Outdoor pool, large peak
		Comb. Landfill + comingle	23.04	20.16	14.88	10.32	11.52	11.04	8.88	8.88	12	18	16.32	17.04	14.34	61%	0.832	Note outdoor setting and inc. café size = higher waste streams
Prince Alfred Park Pool	**Waste by volume (m3 / month)**	**Paper and card**	3.6	4.8	6.48	4.08	4.56	4.08	4.56	3.36	6.96	4.56	6.24	7.68	5.08	51%	0.505	March 2014 - Feb 2015. Outdoor pool, large peak

EARTHSCAPE HORTICULTURAL SERVICES
Arboricultural, Horticultural and Landscape Consultants

ABN 36 082 126 027

ARBORICULTURAL IMPACT ASSESSMENT REPORT

PROPOSED NEW PARK AND AQUATIC CENTRE

132-140 JOYNTON AVENUE, ZETLAND

May 2016

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EXECUTIVE SUMMARY

This report examines the potential impact of the construction of a new Aquatic Centre and Park [known as Gunyama Park Aquatic and Recreation Centre (GPARC)] located at 132-140 Joynton Avenue, Zetland on existing trees in the vicinity of the site. The majority of the site is former industrial land containing dilapidated buildings and hardstand areas. There are approximately ninety-one (91) trees within the site and in close proximity to the site boundaries on adjoining land. This includes eighty-one (81) trees within the GPARC site boundary and ten (10) trees on adjoining land.

The proposed development will necessitate the removal of forty-seven (47) trees of low and very low retention value, nineteen (19) of moderate retention value and two (2) trees of high retention value. A further seven (7) trees on adjoining properties to the east owned by Ausgrid and Lincon (forming part of the GPARC site) are also proposed to be removed as part of the development. An arboricultural assessment of these trees has not yet been undertaken pending transfer of ownership of this land to the City of Sydney. Three (3) trees on the nature strip adjacent the GPARC site and one (1) tree within the GPARC site (T9) are to be removed by others as part of the proposed roadworks in Joynton Avenue and Zetland Avenue.

Given the extent of the development proposed and new ground levels required across the site for flood mitigation purposes, there are no feasible options that can be recommended that would permit the retention of any of these trees of moderate or high retention value in this instance. However, replacement planting is proposed as part of the overall site landscape treatment within the site and in surrounding streetscape areas to compensate for loss of amenity.

Four (4) large Lemon-scented Gums and one (1) Swamp Mahogany of high retention value along the Joynton Avenue frontage are proposed to be retained as part of the proposed development. These trees will not be adversely affected by the proposed works, provided that they are adequately protected during construction in accordance with the recommended tree protection plan and specifications

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1 INTRODUCTION

1.1.1 This report was commissioned by the Council of the City of Sydney to assess the health and condition of approximately ninety-one (91) trees located within or immediately adjacent to 132-140 Joynton Avenue and 94-104 Epsom Road, Zetland. The report has been prepared to aid in the assessment of a Development Application (DA) for the construction of a new Aquatic Centre and Park, known as Gunyama Park Aquatic and Recreation Centre (GPARC), forming part of the Green Square Town Centre development.

1.1.2 The purpose of this report is to assess the potential impact of the proposed development on the subject trees, together with recommendations for amendments to the design or construction methodology where necessary to minimise any adverse impact. The report also provides recommended tree protection measures to ensure the long-term preservation of the trees to be retained where appropriate.

1.1.3 This report has been prepared in accordance with the Scope of Work outlined in Section 4.4.1-4.4.3 of the City of Sydney's Consultant Arboricultural Services Contract [No. 1352] and Sections 2.3.2-2.3.5 of the Australian Standard for *Protection of Trees on Development Sites* (AS 4970:2009).

2 THE SITE

2.1.1 The subject property is an area of former industrial land known as Lot 2 in DP 850686 and Lot 100 in DP 1200645, being 132-140 Joynton Avenue, Zetland, Lot 101 in DP 1200645, being 94-104 Epsom Road, Zetland, Lot 1 in DP 850686, being 130 Joynton Avenue, Zetland and Lot 1 in DP 830870, being 106-116 Epsom Road, Zetland. For the purposes of this report, the subject allotments will be referred to as "the Site". The total area of the site is 41,881 m² (4.18 hectares). The site is zoned Infrastructure [SP2] (Community Facility) under the *Sydney Local Environmental Plan* (SLEP) 2012. The site is relatively flat with large areas covered with concrete and asphalt pavements. 132-140 Joynton Avenue has been recently vacated by a number of leaseholders and major trunk drainage works have recently commenced. 94-104 Epsom Road is presently used by the City of Sydney as a maintenance and operations depot (maintenance, cleaning, waste and fleet management). The site contains a number of demountable buildings used as temporary offices and amenities. 140 Epsom Road contains a three storey brick warehouse building. 94-104 Epsom Road contains a number of buildings comprising the City of Sydney maintenance facility. The site contains a number of trees located mainly around the periphery of the site and allotment boundaries. These include a variety of exotic (introduced) and non-local native species with some locally-indigenous trees. A row of large *Corymbia citriodora* (Lemon-scented Gums) stands along the western boundary of 132-140 Joynton Avenue.

2.1.2 The landscape and soils of this area have been extensively disturbed and modified for urban development. Remnant soils of this area are typical of the Tuggerah Soil Landscape Group (as classified in the Soil Landscapes of the Sydney 1:100,000 Sheet), consisting of "deep (greater than 2000mm) *Podzols* on dunes and *Podzol/Humus Podzol* intergrades on swales." The landscape of the area was formerly gently undulating to rolling coastal dune fields with slope gradients of between 1 and 10%.[1]

2.1.3 Most of the locally-indigenous vegetation formerly occurring in this area has been cleared for residential and industrial development. The original vegetation community of this area consisted of low swamp woodland & Eastern Suburbs Banksia Scrub, with dominant locally-indigenous tree species including *Angophora costata* (Sydney Red Gum), *Corymbia gummifera* (Red Bloodwood), and *Banksia aemula* (Wallum Banksia) on elevated areas, with *Eucalyptus botryoides* (Bangalay), *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquenervia* (Broadleaved Paperbark) occurring in low lying areas.[2]

3 SUBJECT TREES

3.1.1 The subject trees were inspected by Earthscape Horticultural Services (EHS) on the 16th October 2014. A further inspection of trees proposed to be retained as part of the proposal was conducted on 5th May 2016. Each tree has been provided with an identification number for reference purposes denoted on the attached Tree Location Plan (**Appendix 5**), based on the survey drawings prepared by Cardno Hard & Forester, Dwg. Ref No. 116783500, Rev 01 dated 05/03/2014 (132-140 Joynton Avenue) and the Public Works and Services Department of the Council of the City of South Sydney, Dwg No. S5-587/200 (undated). The numbers used on this plan correlate with the Tree Assessment Schedule (**Appendix 3**). Tree No.s T61a, T62a, T62b, T62c, T62d, T62e, T67a, T69a, T74a, T76a, T77a, T78a, T96a, T104a, T104b, T104c, T104d, T106-T122, T125-T134 and T140-T152 were not shown on the original survey and have been plotted on the drawing in their approximate positions.

3.1.2 Note that Tree No.s T153-T159 located in the north–eastern portion of the GPARC have not been included in this assessment (refer **Appendix 6**). These trees stand within the properties of 130 Joynton Avenue, Zetland (Lot 1 in DP 850686) presently owned by Ausgrid and 106-116 Epsom Road, Zetland (Lot 1 in DP 830870) presently owned by Lincon. These properties were not accessible at the time of the initial assessment. These trees will be assessed once ownership of these lands is transferred to the City of Sydney.

4 HEALTH AND CONDITION ASSESSMENT

4.1 Methodology

4.1.1 An assessment of each tree was made using the Visual Tree Assessment (VTA) procedure.[3] All of the trees were assessed in view from the ground. No aerial inspection or diagnostic testing has been undertaken as part of this assessment.

4.1.2 The following information was collected for each tree:-

- Tree Species (Botanical & Common Name);
- Approximate height;
- Canopy spread; measured using a metric tape and an average taken.
- Trunk diameter (measured at 1.4 metres from ground level);
- Live Crown Size; (measured by subtracting the total height of the tree from the lowest point of the crown and multiplying by the average crown spread to give a value in square metres).
- Health & vigour; using foliage size, colour, extension growth, presence of disease or pest infestation, canopy density, presence of deadwood, dieback and epicormic growth as indicators,
- Condition; using visible evidence of structural defects, instability, evidence of previous pruning and physical damage as indicators.
- Suitability of the tree to the site and its existing location; in consideration of damage or potential damage to services or structures, available space for future development and nuisance issues.

4.1.3 This information is presented in a tabulated form in **Appendix 3**.

4.2 Safe Useful Life Expectancy (SULE)

4.2.1 The remaining Safe Useful Life Expectancy (SULE)[4] of the tree is an estimate of the sustainability of the tree in the landscape. This calculation is based on an estimate of the average age of the species in an urban area, less its estimated current age. The life expectancy of the tree has been further modified where necessary in consideration of its current health and vigour, condition and suitability to the site. The estimated SULE of each tree is shown in **Appendix 3.**

4.2.2 The following ranges have been allocated to each tree:-

- Greater than 40 years (Long)
- Between 15 and 40 years (Medium)
- Between 5 and 15 years (Short)
- Less than 5 years (Transient)
- Dead or immediately hazardous (defective or unstable)

5 LANDSCAPE SIGNIFICANCE

5.1 Methodology for Determining Landscape Significance

5.1.1 The significance of a tree in the landscape is a combination of its environmental, heritage and amenity values. Whilst these values may be fairly subjective and difficult to assess consistently, some measure is necessary to assist in determining the retention value of each tree. To ensure a consistent approach, the assessment criterion shown in **Appendix 1** have been used in this assessment.

5.1.2 A rating has been applied to each tree to give an understanding of the relative significance of each tree in the landscape and to assist in determining priorities for retention, in accordance with the following categories:-

1. **Significant**
2. **Very High**
3. **High**
4. **Moderate**
5. **Low**
6. **Very Low**
7. **Insignificant**

5.2 Environmental Significance

5.2.1 Tree Management Controls

Prescribed Trees within the City of Sydney Local Government Area (LGA) are protected under Section 3.5.3 of the *Sydney Development Control Plan* (SDCP) 2012, made pursuant to Clause 5.9 (2) of the *Sydney Local Environmental Plan* (SLEP) 2012. The SDCP generally protects all trees of a height of five (5) metres or greater or with a canopy spread of five (5) metres or greater, or trunk diameter of 300mm or greater (measured at ground level) or any tree listed on Council's Significant Tree Register. Some exemptions apply. The following trees are exempt (not protected) under the provisions of the SDCP 2012:-

Tree No.	Species	Exemption
T67a, T140-T148#	*Celtis sinensis* (Chinese Nettle Tree)	Environmental Weed Species
T71 & T104	*Lagunaria patersonia* (Norfolk Island Hibiscus)	Environmental Weed Species
T56, T62a# & T76	*Melia azedarach* (White Cedar)	Environmental Weed Species
T74a	*Olea europaea var. africana* (African Olive)	Environmental Weed Species
T63, T65, T66	*Syagrus romanzoffianum* (Cocos Palm)	Nuisance Species
T1	Unidentified Species	Dead tree

[#] Note that these trees are located within adjoining properties.

The remainder of the trees are protected under the SDCP 2012.

5.2.2 Wildlife Habitat

Melaleuca quinquenervia (Broad-leaved Paperbark) [T104c & T104d], *Acacia binervia* (Coastal Myall) [T119], *Allocasuarina littoralis* (Black She-oak) [T62c, T62d, T62e], *Banksia integrifolia* (Coast Banksia) [T81-T87], *Cupaniopsis anarcardioides* (Tuckeroo) [T62b], *Eucalyptus botryoides* (Bangalay) [T60] and *Eucalyptus robusta* (Swamp Mahogany) [T61, T88] are all locally-indigenous species, representative of the original vegetation of the area and would be of benefit to native wildlife. However, none of the trees contain cavities suitable as nesting hollows for arboreal mammals or birds or other visible signs of wildlife habitation. All of these trees appear to have been planted within the site. None are remnant of the original vegetation community.

5.2.3 Noxious Plants & Environmental Weeds

None of the trees assessed are scheduled as Noxious Weeds under the meaning of *Noxious Weeds Act* (NSW) 1993.

Celtis sinensis (Chinese Nettle Tree) [T67 & T96a] is considered to be an Environmental Weed Species in some Local Government Areas (LGAs) within the Sydney Metropolitan Area. This species is not protected within the Sydney LGA where less than ten (10) metres in height. Note that T67 & T96a are greater than 10 metres in height and therefore protected under the SDCP 2012.

Acacia saligna (Golden Wreath Wattle) [T62, T64, T72, T73 & T75], whilst protected under the SDCP 2012, is considered to be an Environmental Weed Species in some Local Government Areas within the Sydney Metropolitan Area.

5.2.4 Threatened Species & Ecological Communities

Eucalyptus nicolii (New England Peppermint) [T61a] is listed as Vulnerable Species in Schedule 2 of the *Threatened Species Conservation Act* 1995 (NSW) and listed as a Vulnerable Species under the *Environmental Protection and Biodiversity Conservation Act* 1999. Note that whilst this species is listed as vulnerable, it is not endemic to this area and is a commonly planted ornamental tree in parks, gardens and streetscapes. As such, this tree is *not* considered to have any ecological significance in the context of this site.

None of the other trees included in this assessment are listed as Threatened or Vulnerable Species or form part of Endangered Ecological Communities (EECs) under the provisions of the *Threatened Species Conservation Act* 1995 (NSW) or the *Environmental Protection and Biodiversity Conservation Act* 1999.

5.3 Heritage Significance

5.3.1 Heritage Items

The subject property is *not* listed as an item of Environmental Heritage under Schedule 5, Part 1 of the Sydney Local Environmental Plan (LEP) 2012.

5.3.2 Heritage Conservation Area

The site is *not* located within a Heritage Conservation Area under Schedule 5, Part 2 of the Sydney LEP 2012.

5.3.3 Significant Tree Register

None of the subject trees are listed in of Council's Register of Significant Trees Volume 2 (Significant Street Trees)[5] or Volume 3 (Significant Trees: Other Government Authorities, Institutional, Religious and Non-government Organisations)[6] or Volume 4 (Significant Trees under Private Ownership).[7]

The row of *Corymbia citriodora* (Lemon-scented Gums) [T9, T48, T51, T54 & T57] along the western boundary of 132-140 Joynton Avenue make a significant contribution to the amenity of the streetscape. These trees were probably planted c.1970-1980 being fairly typical of this area and having dimensions consistent with planting about this time. They have been planted in concert with alternate plantings of *Callistemon viminalis* (Weeping Bottlebrush).

5.4 Amenity Value

5.4.1 Criteria for the assessment of amenity values are incorporated into **Appendix 1**. The amenity value of a tree is a measure of its live crown size, visual appearance (form, habit, crown density), visibility and position in the landscape and contribution to the visual character of an area. Generally the larger and more prominently located the tree, and the better its form and habit, the higher its amenity value.

6 TREE RETENTION VALUES

6.1.1 The Retention Values shown in **Appendix 3** and **Appendix 5** have been determined on the basis of the estimated longevity of the trees and their landscape significance rating, in accordance with **Table One**. Together with guidelines contained in **Section 7** (Tree Protection Zones) this information should be used to determine the most appropriate position of building footprints and other infrastructure within the site, with due consideration to other site constraints, to minimise the impact on trees considered worthy of preservation.

TABLE 1 – TREE RETENTION VALUES – ASSESSMENT METHODOLOGY

	Landscape Significance Rating						
Estimated Life Expectancy	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Long - Greater than 40 Years	High Retention Value						
Medium- 15 to 40 Years			Moderate Retention Value				
Short - 5 to 15 years				Low Ret. Value			
Transient - Less than 5 Years				Very Low Retention Value			
Dead or Potentially Hazardous							

7 TREE PROTECTION ZONES

7.1.1 The Tree Protection Zone (TPZ) is a radial distance measured from the centre of the trunk of the tree as specified in **Appendix 4**. These have been calculated in accordance with AS 4970-2009 (Protection of Trees on Development Sites).[8]

7.1.2 The intention of the TPZ is to ensure protection of the root system and canopy from the potential damage from construction works and ensure the long-term health and stability of each tree to be retained. Incursions to the root zone may occur due to excavations, changes in ground levels, (either lowering or raising the grade), trenching or other forms or soil disturbance such as ripping, grading or inverting the soil profile. Such works may cause damage or loss of part of the root system, leading to an adverse impact on the tree.

7.2 Structural Root Zone (SRZ)

7.2.1 The Structural Root Zone (SRZ) provides the bulk of mechanical support and anchorage for a tree. This is also a radial distance measured from the centre of the trunk as specified in **Appendix 4**. The SRZ has been calculated in accordance with AS 4970-2009 (Protection of Trees on Development Sites).

7.2.2 Incursions within the SRZ are not recommended as they are likely to result in the severance of woody roots which may compromise the stability of the tree or lead to its decline and demise.

7.3 Acceptable Encroachments to the Tree Protection Zone.

7.3.1 Where encroachment to the TPZ is unavoidable, an incursion to the TPZ of not exceeding 10% of the area of the TPZ and outside the SRZ may be acceptable. Examples of acceptable incursions are shown in **Appendix 2**. Greater incursions to the TPZ may result in an adverse impact on the tree.

7.3.2 Where incursions greater than 10% of the TPZ are unavoidable, exploratory excavation using non-destructive methods may be required to evaluate the extent of the root system affected and determine whether or not the tree can remain viable

7.4 Acceptable Encroachments to the Canopy

7.4.1 The removal of a small portion of the crown (foliage and branches) is generally tolerable provided that the extent of pruning required is less than 10% of the total foliage volume of the tree and the removal of branches does not create large wounds or disfigure the natural form and habit of the tree. All pruning cuts must be undertaken in accordance with AS 4373:2007. This generally involves reduction of the affected branches back to the nearest branch collar at the junction with the parent branch, rather than at an intermediate point. The latter is referred to as “lopping” and is no longer an acceptable arboricultural practice. Generally speaking, the minimum pruning as required to accommodate any proposed works is desirable. Extensive pruning can result in a detrimental impact on tree health and may lead to exposure of remaining branches to wind forces that they were previously sheltered from, leading to a greater risk of branch failure.

7.4.2 Clearance to between the building line and canopy should take into account any projecting structures, such as balconies, awnings and the roofline and any requirement for temporary scaffolding to be erected during construction (typically 1-1.5 metres wide). High structures should preferably be located outside the canopy dripline (as shown indicatively on the attached plans) in order to avoid or minimise canopy pruning.

8 PROPOSED DEVELOPMENT

8.1.1 The proposed development includes the remediation of selected areas of the site and construction of a new Park and Aquatic Centre within the property known as Gunyama Park Aquatic and Recreation Centre (GPARC).

9 IMPACT ASSESSMENT

9.1.1 The intention of this assessment is to determine the incursions to the root zones and canopies created by the proposed development and evaluate the likely impact of the proposed works on the subject trees. Details shown on the following plans were used in this assessment:-

Title	Author	Dwg No.	Date
Site Plan	ABA Grimshaw	ARC-DA-011 Rev A	22/04/2016
Long Sections	ABA Grimshaw	SK0077 Rev B	05/05/2016
Cross Sections	ABA Grimshaw	SK0078 Rev B	05/05/2016
Plan	ABA Grimshaw	SK0079 Rev B	05/05/2016
Sketch Perspective	ABA Grimshaw	SK0080 Rev B	05/05/2016
Remedial Action Plan	AECOM	60314745-RPT02	22/04/2016

9.1.2 A summary of the impact of the proposed development on each tree within the site is shown in **Appendix 5**. The following criteria have been examined as part of this assessment:-

- Existing Relative Levels (R.L.);
- Tree Protection Zone (TPZ);
- Structural Root Zone (SRZ);
- Footprint and envelope of the proposed development and temporary structures (scaffolding, hoardings etc);
- Incursions to the TPZ & SRZ, including estimated cut & fill beyond the building footprint;
- Incursions to the tree canopy from the building envelope and temporary structures; and
- Assessment of the likely impact of the works on existing trees.

9.1.3 The proposed development will necessitate the removal of forty-seven (47) trees of low and very low retention value. These include Tree No.s T62, T64, T72, T73 & T75 (Golden Wreath Wattle), T81, T82 & T85 (Coast Banksia), T52, T53, T59, T69, T76a, T79 & T80 (Weeping Bottlebrush), T92, T93, T94, T98, T101 & T149 (River Oak), T67, T67a, T96a, T140, T141, T142, T143, T144, T145, T146, T147 & T148 (Chinese Hackberry), T60 (Bangalay), T61a (New England Peppermint), T88 (Swamp Mahogany), T103 (Silky Oak), T71 & T104 (Norfolk Island Hibiscus), T56, T76 (White Cedar), T89 (Murraya), T74a (African Olive), T74 (Avocado Pear tree) and T63, T65 & T66 (Cocos Palm). None of these trees are considered significant or worthy of special measures to ensure their preservation. It should be noted that Trees T56, T63, T65, T66, T67, T67a, T71, T74a, T76, T77a, T96a, T104, T141, T142, T143, T144, T145, T146, T147 & T148 are exempt from the SDCP 2012.

9.1.4 The proposed development will also necessitate the removal of nineteen (19) trees of moderate retention value. These include Tree No.s T83, T84, T86 & T87 (Coast Banksia), T50 & T58 (Weeping Bottlebrush), T90, T91, T95, T96, T97, T99, T100, T102, T150, T151 & T152 (river Oak), T70 (Blackbutt), T47 (Sydney Blue Gum). These trees are not considered significant, but are in good health and condition and make a fair contribution to the amenity of the site and surrounding properties. In order to compensate for loss of amenity resulting from the removal of these trees to accommodate the proposed development, consideration should be given to replacement planting within the site in accordance with Section 11.

9.1.5 Tree No.s T62a (White Cedar), T62b (Tuckeroo), T62c, T62d & T62e (Black She-Oak), and T104c & T104d (Broad-leaved Paperbarks) are located within the adjoining property to the south. All of these trees are proposed to be retained at this stage. However, in the future these trees will

be removed by others to facilitate the construction of a new roadway (Rose Valley Way) adjacent to the site.

9.1.6 Tree No.s T55 (Brushbox) and T10 & T49 (Broadleaved Paperbark) are located on the nature strip in Joynton Avenue (adjacent to the GPARC) and T9 (Lemon-scented Gum) is located within GPARC. These trees are also proposed to be removed by others to accommodate new road works in Joynton Avenue prior to commencement of works within the GPARC.

9.1.7 It should be noted that Tree No.s T104a & T104b (Broadleaved Paperbarks on the adjoining site to the south) have already been removed to facilitate the construction of an approved residential development (Meriton Apartments) adjoining the site. Tree No.s T77a, (Chinese Hackberry), T77 (Weeping Bottlebrush) T78a (Coast Banksia) and T78 (Grey Ironbark) located within the site have also been removed as part of approved trunk drainage works.

9.1.8 The proposed development will also necessitate the removal of two (2) trees of high retention value. These include Tree No.s T68 (NZ Christmas Bush or Pohutukawa) and T69a (Sydney Blue Gum). These trees do not have any special ecological or heritage significance, but are all in good health and condition and make a positive contribution to the amenity of the site, streetscape and surrounding properties. Given the extent of the development proposed and new ground levels required across the site for flood mitigation purposes, there are no feasible options that can be recommended that would permit the retention of these trees in this instance. In order to compensate for loss of amenity resulting from the removal of these trees to accommodate the proposed development, consideration should be given to replacement planting within the site in accordance with Section 11.

9.1.9 The existing masonry retaining wall along the western site boundary is proposed to be demolished within the TPZs of T48, T51, T54 & T57 (Lemon-scented Gums) and T61 (Swamp Mahogany) and the road and footpath levels in Joynton Avenue raised by approximately one (1) metre for flood mitigation purposes. The demolition of the existing wall will not result in any adverse impact on the subject trees, provided that all demolition works within the TPZ are undertaken in accordance with Section 10.5. As the existing wall and footing would form a barrier to root growth from these trees to the west, the placement of engineered fill for the roadway and footpath will not result in any actual incursion to the root zones and therefore will not result in any adverse impact on these trees. A small amount of non-engineered fill will be required over the embankment between the western boundary and the subject trees to provide a transition to the new street level. The finished level of the street is approximately the same level at the base of the trees. Provided that the fill material in this area is supplied and placed within the TPZs in accordance with Section 10.9, the proposed works will not result in any adverse impact on these trees.

9.1.10 The existing concrete paved areas to the east of Trees T48, T51, T54 & T57 (Lemon-scented Gums) and T61 (Swamp Mahogany) is proposed to be demolished within the TPZs and new earth landscape berms to be constructed within a similar position. The demolition of the existing concrete pavements and kerb will not result in any adverse impact on the subject trees, provided that all demolition works within the TPZ are undertaken in accordance with Section 10.5. Placement of the new berms will not result in a significantly greater encroachment to the root zones than presently exists with the pavement. Given that the pavements will be removed and the new berms will be constructed using a non-engineered material, permeability to any root zone currently beneath the pavement will actually be improved. The toe of the berm finishes clear of the trunk and then transitions to street level, such that there will be very little fill placed within the SRZs. This work should not result in any adverse impact on the subject trees, provided that the fill material for the landscape berms is supplied and placed in accordance with Section 10.9.

9.1.11 The proposed Aquatic Centre building is located within the TPZs of Trees T48, T51, T54 & T57 (Lemon-scented Gums) and T61 (Swamp Mahogany). Engineered fill for the building platform

will extend slightly within the TPZs of these trees. However, in all instances the encroachment to the root zone is less than 10% of the TPZs, which is within acceptable limits under AS 4970:2009. It should be noted that the building platform is also located within the footprint of an existing concrete paved area. As such, the proposed works will not result in any adverse impact on these trees. The upper floor of the Aquatic Centre extends into the canopy projection of T48 to about 12 metres from ground level. As such, some canopy pruning of this tree may be required to clear the building envelope. However, it should be feasible to reduce any tertiary branches projecting through temporary scaffolding to suitable junctions without necessitating the removal of any large secondary branches (refer to **Plate 1**). The remaining trees, whilst clear of the building, may require minor canopy pruning to clear any temporary scaffolding. This will not result in any adverse impact on the subject trees provided that all temporary scaffolding within the TPZs is erected in accordance with 10.13 and any required canopy pruning (that essential to clear the building envelope and temporary scaffolding) is undertaken in accordance with Section 10.10.



Plate 1 – View of T48 (Lemon scented Gum) showing approximate alignment of temporary scaffold. It should be feasible to reduce most of the tertiary branches projecting within the scaffold zone without removing any larger secondary branches.

9.1.12 Proposed new pedestrian pathways are located within the TPZs of Trees T48, T54 & T57 (Lemon-scented Gums) and T61 (Swamp Mahogany). These have been located outside SRZs and will result in minimal encroachments to TPZs. In all instances the paths are located above existing grade and within the footprint of existing pavements to be demolished. As such, the proposed pathways will not result in any adverse impact on these trees.

9.1.13 The general approach to site remediation will be to retain contaminated materials either in-situ or cap and retain excavated material within the site. Where levels are raised with new (imported) soil material or validated clean fill, a marker material shall be placed at the interface of the original surface level and the new fill in new open space and landscape areas. The marker material will be a light coloured knitted HDPE geotextile. Along the western boundary in the vicinity of Trees T48, T51, T54 & T57 (Lemon-scented Gums) and T61 (Swamp Mahogany) where existing ground levels are proposed to be retained, the marker material is proposed to be installed beneath a thick

(200mm) layer of mulch, and elsewhere beneath the fill layers. This approach should not result in any adverse impact on these trees, provided that the marker material is an open weave permeable material that allows moisture penetration and oxygenation to the root zone.

9.1.14 No other trees will be adversely affected by the proposed development.

10 RECOMMENDED TREE PROTECTION MEASURES

10.1 Tree Protection Plan

10.1.1 The following Tree Protection Measures should be read in accordance with the Tree Protection Plan (**Appendix 6**). The Tree Protection Plan (TPP) indicates the position of tree protection devices and other recommended measures to ensure the protection of trees within the site to be retained as part of the proposed development.

10.2 Prohibited Activities

10.2.1 The following activities should be avoided within specified Tree Protection Zones (refer **Appendix 4 & 6** for extent of the TPZ for each tree):-

- Excavations and trenching (with exception of the approved remediation works, underground services, building foundations or pavement sub-grade);
- Soil disturbance, surface grading, compaction, tyning, ripping or cultivation of soil;
- Mechanical removal of vegetation, including extraction of tree stumps;
- Soil level changes including the placement of fill material (excluding imported validated fill for remediation works or placement of fill for approved works)
- Movement and storage of plant, equipment & vehicles (except within defined temporary haul roads, where ground protection has been installed, or within the footprint of existing floor slabs or paved areas);
- Erection of site sheds (except where approved by the site arborist);
- Affixing of signage, barricades or hoardings to trees;
- Storage of building materials, waste and waste receptacles;
- Stockpiling of spoil or fill;
- Stockpiling of bulk materials, such as soil, sand, gravel, roadbase or the like;
- Stockpiling of demolition waste;
- Disposal of waste materials and chemicals including paint, solvents, cement slurry, fuel, oil and other toxic liquids;
- Other physical damage to the trunk or root system; and
- Any other activity likely to cause damage to the tree.

10.3 Tree Protection Fencing

10.3.1 All trees within the site to be retained shall be protected prior to and during construction from all activities that may result in detrimental impact by erecting a suitable protective fence beneath the canopy to the full extent of the Tree Protection Zone, excluding the footprint of the proposed works and areas within adjoining properties, as indicated on the Tree Protection Plan. As a minimum, the fence should consist of temporary chain wire panels of 1.8 metres in height, supported by steel stakes as required and fastened together and supported to prevent sideways movement using corner braces where required. The fence shall be erected prior to the commencement of any work on-site. The fence may be removed prior to commencement of filling for the construction of the new berms and associated landscape works, but trunk protection must remain in place until completion of landscape works. Where tree protection zones merge together a single fence encompassing the area is deemed to be adequate as indicated on the Tree Protection Plan (Appendix 6). Existing site boundary fences may form part of the enclosure.

10.3.2 Appropriate signage shall be installed on the fencing to prevent unauthorised movement of plant and equipment or entry to the Tree Protection Zone.

10.3.3 A 100mm layer of woodchip mulch shall be installed to the full extent of the fenced area of all trees to be retained. Mulch shall be installed and spread by hand to avoid soil disturbance and compaction within the root zone.

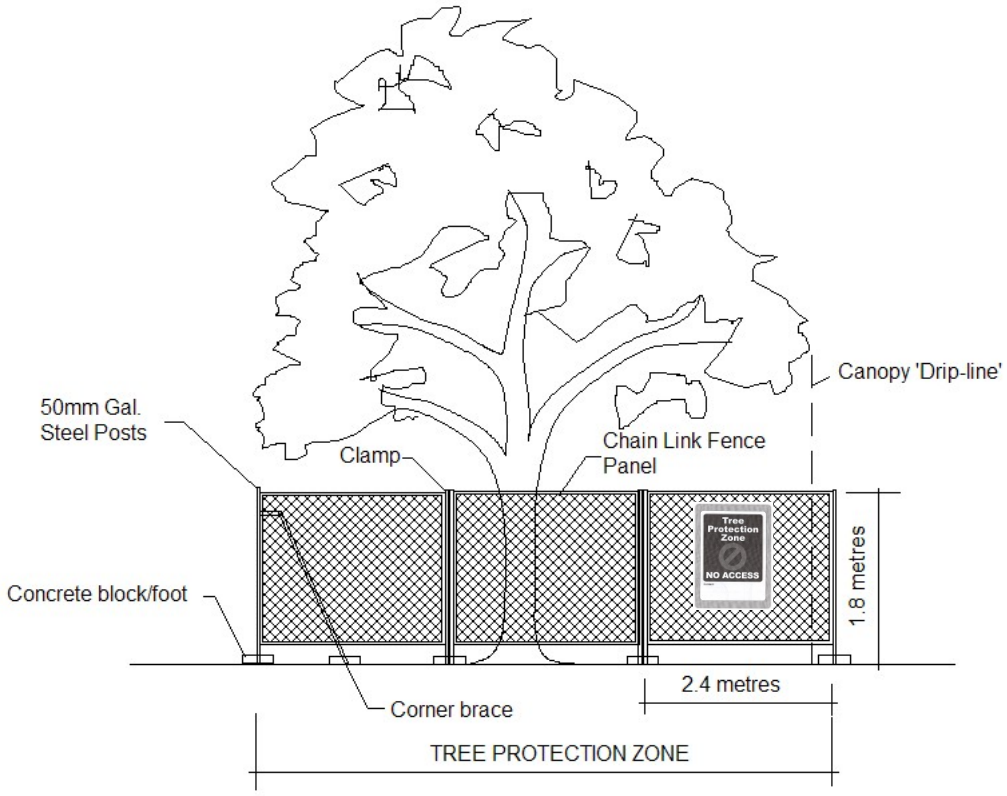


Figure 1 – Detail of Tree Protection Fence

10.3.4 Signs shall be installed on the Tree Protection Fence to prevent unauthorised movement of plant and equipment or entry to the Tree Protection Zone. The signs shall be securely attached to the fence using cable ties or equivalent. Signs shall be placed at minimum 10 metre intervals. The wording and layout of the sign shall comply with AS 4970-2009 as shown in **Figure 2**.

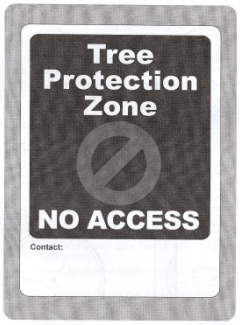


Figure 2 – Detail of Tree Protection Sign

10.4 Trunk Protection

10.4.1 Trunk Protection boarding shall be erected around nominated trees to avoid accidental damage, as indicated on the Tree Protection Plan (**Appendix 6**). The Trunk Protection shall consist of a layer of carpet underfelt (or similar) wrapped around the trunk, followed by 1.8 metre lengths of softwood timbers (90 x 45mm in section) aligned vertically and spaced evenly around the trunk at 150mm centres (i.e. with a 50mm gap) and secured together with 2mm galvanised wire or galvanised hoop strap as shown in **Figure 3**. Recycled timber (such as demolition waste) may be suitable for this purpose, subject to the approval of the Project Arborist. The timbers shall be

wrapped around the trunk (over the carpet underfelt), but not fixed to the tree to avoid mechanical injury or damage to the trunk. Trunk protection should be installed prior to any site works and maintained in good condition for the duration of the construction period. Carpet underfelt (alone) is sufficient for trees with a trunk diameter of less than 200mm.



Figure 3 – Detail of Trunk Protection

10.5 Demolition Works within Tree Protection Zones

10.5.1 Demolition of paved areas within the Tree Protection Zones of trees to be retained shall be undertaken under the supervision of the Site Arborist. The pavement surface and sub-base within the TPZ shall be gradually removed in layers of no greater than 50mm thick using a small rubber tracked excavator or alternative approved method to avoid damage to underlying roots and minimise disturbance and compaction of the underlying soil profile. The machine shall work within the footprint of the existing paved surfaces to avoid compaction of the underlying soil. The final layer of sub-base material shall be removed using hand tools were required to avoid compaction of the underlying soil profile and damage to woody roots.

10.5.2 Following removal of the pavement surface and sub-base, clean, friable topsoil shall be used to fill in the excavated area and bring flush with surrounding levels within new landscape areas. Soil shall only be imported and spread when the underlying soil conditions are dry to avoid compaction of the soil profile. Where there is insufficient recovered site topsoil for this purpose, any imported material shall be free of rocks, vegetation, heavy clay or other extraneous matter. Any imported soil material should be similar in texture to the existing site topsoil.

10.5.3 Demolition of existing walls, kerbs and other structures within the Tree Protection Zone of trees to be retained shall be undertaken under the supervision of the Site Arborist. The structures shall be demolished using equipment on stationed outside the TPZ where possible or within the footprint of existing hardstand areas. Care shall be taken to avoid the root systems, trunks and lower branches of trees in the vicinity of the structures during demolition works, with special attention required during demolition of the footings and other sub-surface members to avoid damage to woody roots.

10.6 Excavations within Tree Protection Zones

10.6.1 Prior to any mechanical excavations for building foundations or pavement sub-grade within the Tree Protection Zone of all trees nominated for retention, exploratory excavation using non-

destructive techniques shall be taken along the perimeter of the structure or pavement within the TPZ. Non-destructive excavation techniques may include the use of hand-held implements, air pressure (using an Air-spade® device) or water pressure. The exploratory excavation shall be undertaken along the perimeter of the foundation or pavement (within the TPZ) to the depth of the foundation or to a maximum of 800mm from surface levels, to locate and expose any woody roots prior to any mechanical excavation. All care shall be undertaken to preserve woody roots intact and undamaged during exploratory excavation. Any roots encountered of less than 50mm in diameter may be cleanly severed with clean sharp pruning implements at the face of the excavation. The root zone in the vicinity of the excavation shall be kept moist following excavation for the duration of construction to minimise moisture stress on the tree.

10.6.2 Where large woody roots (greater than 50mm diameter) are encountered during exploratory excavations, further advice from a qualified arborist shall be sought prior to severance. Where necessary, (to avoid severing large woody roots) consideration should be given to the installation of an elevated structure (e.g. pier and beam footing, suspended slab or floor supported on piers, cantilevered slab, up-turned edge beam etc) in preference to structures requiring a deep edge beam or continuous perimeter strip footing. The beam section of any pier and beam footing should be placed **above** grade to avoid excavation within the SRZ. Pier footings intersecting large woody roots should be slightly offset where necessary to avoid root severance.

10.6.3 For masonry walls or fences it may be acceptable to delete continuous concrete strip footings and replace with suspended in-fill panels (eg steel or timber pickets, lattice etc) fixed to pillars. For paved areas, consideration should be given to raising the proposed pavement level and using a porous fill material in preference to excavation where large woody roots are found within the sub-base.

10.6.4 The Marker Geofabric used for remediation purposes should be placed above existing ground levels (without excavating below grade). Any leaf litter or other debris may be removed prior to installation of the Marker. The marker fabric may be placed below any proposed fill layer where required.

10.7 Underground Services

10.7.1 All proposed stormwater lines and other underground services should be located outside TPZs of trees proposed to be retained wherever possible or installed by alternative measures. Alternative measures include suspending pipelines beneath the floor of a building or structure (to avoid excavation with the TPZ), non-destructive excavation methods or Horizontal Directional Drilling (HDD). Where the installation of service lines within TPZs is unavoidable, the pipelines or conduits should be installed as follows.

10.7.2 Where the extent of the incursion to the root zone is less than 10% of the TPZ including any excavations for benching and shoring the trench, the pipeline or conduit may be installed by open trenching using standard construction methods (excavator or trenching machine). 10% of the TPZ is equivalent to one-third of the TPZ radius on one side (refer to **Appendix 2**). Refer to **Appendix 4** for radial distances of TPZs for each tree.

10.7.3 Where the extent of the incursion to the root zone exceeds 10% of the TPZ, but is outside the SRZ, non-destructive excavation methods must be adopted in accordance with **Section 10.6**. Where large woody roots are encountered during excavation or trenching (root diameter greater than 50mm), these shall be retained intact wherever possible (e.g. by tunnelling beneath roots and inserting the pipeline or conduit beneath or re-routing the service etc). Where this is not practical and root pruning is the only alternative, proposed root pruning should be assessed by a qualified arborist [AQF 5] to evaluate the potential impact on the health and stability of the subject tree.

10.7.4 Excavations required for underground services within the Structural Root Zone of any tree to be retained should only be undertaken by sub-surface boring (Horizontal Directional Drilling). The Invert Level of the pipe, plus the pipe diameter, must be lower than the estimated root zone depth as specified. At this site a minimum depth of 1 metre to the invert level of the pipe is specified.

10.8 Pavements

10.8.1 Proposed paved areas within the Tree Protection Zone of trees to be retained should be placed above grade to minimise excavations within the root zone and avoid root severance and damage. Pavement sub-base material should be as per **Section 10.9**.

10.9 Fill Material

10.9.1 Fill material placed within the Tree Protection Zone of trees to be retained (including fill for landscape berms) should be a well-drained friable material, equivalent in texture to the existing site topsoil material. The fill material should be free from rocks, vegetation and other extraneous material complying with AS 4419:2003 (*Soils for Landscaping and Garden Use*). The fill may be consolidated but should not be compacted to engineering standards. No fill material should be placed in direct contact with the trunk of any tree. Where necessary, local soil levels should be adjusted to finish not higher than the existing soil level at the interface with the trunk. Plant and equipment used to place and spread fill material should be stationed outside the TPZ or on existing hardstand areas where possible. Where not possible, suitable ground protection should be installed in accordance with **Section 10.14**.

10.9.2 Where placement of fill is required for pavement sub-grade is required within TPZs of trees to be retained, a coarse, gap-graded material such as 20 – 50mm crushed basalt (Blue Metal) or equivalent shall be used to provide some aeration to the root zone. Note that road base or crushed sandstone or other similar material containing a high percentage of fines is unacceptable for this purpose. The fill material should be consolidated with a non-vibrating roller to minimise compaction of the underlying soil. A permeable geotextile may be used beneath the sub-base to prevent migration of the stone into the sub-grade.

10.10 Canopy & Root Pruning

10.10.1 All canopy pruning work required shall be carried out in accordance with Australian Standard 4373-2007 – Pruning of Amenity Trees. Written approval from Council may be required under the Tree Preservation Order prior to undertaking this work. All pruning work shall be carried out by a qualified and experienced arborist or tree surgeon [Australian Qualification Framework Level 3] in accordance with the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998). No branches of greater than 100mm in diameter should be removed or pruned without further advice from a Consulting Arborist [Australian Qualification Framework Level 5].

10.10.2 Where root pruning is required, roots shall be severed with clean, sharp pruning implements and retained in a moist condition during the construction phase using Hessian material or mulch where practical. Severed roots shall be treated with a suitable root growth hormone containing the active constituents Indol-3-yl-Butric Acid (IBA) and 1-Naphthylacetic Acid (NAA) to stimulate rapid regeneration of the root system.

10.11 Tree Damage

10.11.1 Care shall be taken when operating cranes, drilling rigs and similar equipment near trees to avoid damage to tree canopies (foliage and branches). Under no circumstances shall branches be torn-off by construction equipment. Where there is potential conflict between tree canopy and construction activities, the advice of the Site Arborist must be sought.

10.11.2 In the event of any tree becoming damaged for any reason during the construction period a consulting arborist [Australian Qualification Framework Level 5] shall be engaged to inspect and provide advice on any remedial action to minimise any adverse impact. Such remedial action shall be implemented as soon as practicable and certified by the arborist.

10.12 Tree Removal

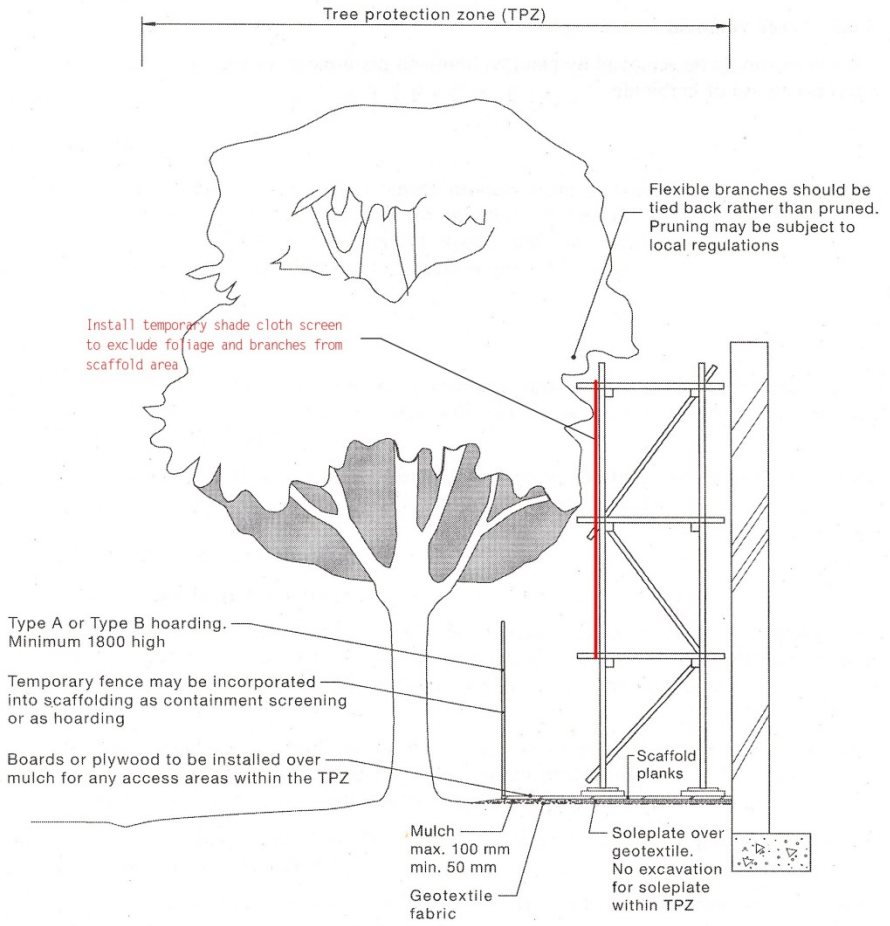
10.12.1 The approval of the City of Sydney Council shall be obtained prior to the removal or pruning of any tree protected under the SDCP 2012.

10.12.2 Tree removal work shall be carried out by an experienced tree surgeon in accordance with the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998). Care shall be taken to avoid damage to other trees during the felling operation.

10.12.3 Stumps located within the TPZs of trees to be retained shall be grubbed-out where required using a mechanical stump grinder (or by hand where less than 150mm in diameter) without damage to the root system of other trees. Where trees to be removed are within the SRZ of any trees to be retained, consideration should be given to cutting the stump close to ground level and retaining the root crown intact. Stumps within the Tree Protection Zone of other trees to be retained shall **not** be pulled out using excavation equipment or similar.

10.13 Temporary Scaffolding

10.13.1 Where temporary scaffolding must be erected within the TPZ of trees to be retained (as indicated in **Appendix 6**), the scaffold shall be erected in accordance with **Figure 5**. Where foliage or branches project through the scaffold and create a safety hazard, this foliage and branches shall be temporarily excluded from the inner part of the scaffold by affixing a shade cloth screen on the outside of the scaffold **(**refer to **Figure 5)**, or alternatively temporarily tying back branches where required. The pruning or removal of branches to accommodate the scaffold should be avoided wherever possible. Suitable ground protection shall be installed beneath the scaffold as shown in **Figure 5** to prevent contamination, disturbance and compaction of the soil profile within the scaffold zone during construction.



NOTE: Excavation required for the insertion of support posts for tree protection fencing should not involve the severance of any roots greater than 20 mm in diameter, without the prior approval of the project arborist.

Figure 5 - Detail of Temporary scaffolding within a Tree Protection Zone

10.13.2 Where pruning or removal of branches to accommodate temporary scaffolding is unavoidable, all such pruning work shall be undertaken in accordance with **Section 10.8**.

10.14 Ground Protection

10.14.1 A 100mm layer of woodchip mulch shall be installed within designated areas of the Tree Protection Zone of nominated trees as indicated on the Tree Protection Plan (**Appendix 7**) to minimise compaction of the underlying soil profile during construction activity and haulage. A Geotextile fabric, such as Geotex® 'ST' Series manufactured by Synthetic Industries or an equivalent product, shall be installed beneath the mulch layer to minimise compaction to the underlying soil profile and limit migration of mulch into the underlying soil profile. Mulch shall be installed and spread by hand to avoid soil disturbance and compaction within the root zone. Ground protection shall be installed prior to any site works and maintained in good condition for the duration of the construction period. On completion of the works, ground protection shall be removed without damage or disturbance to the underlying soil profile.

11 REPLACEMENT PLANTING

11.1 Replacement Planting

11.1.1 In order to compensate for loss of amenity resulting from the removal of trees to accommodate the proposed development, consideration should be given to replacement planting within appropriate areas of the site in accordance with the SDCP 2012.

11.1.2 Replacement trees should preferably include some locally indigenous species. These will be most appropriate to the site conditions and be most valuable in terms of preserving the landscape character and wildlife habitat of the area. The following species are appropriate to the site conditions and could be considered for replacement planting:-

- *Syncarpia glomulifera* (Turpentine)
- *Angophora costata* (Sydney Red Gum)
- *Eucalyptus racemosa* (Scribbly Gum)
- *Glochidion ferdinandi* (Cheese Tree)
- *Cupaniopsis anarcardiodes* (Tuckeroo)
- *Banksia integrifolia* (Coast Banksia)
- *Syzygium paniculatum* (Magenta Cherry)
- *Acmena smithii* (Lillypilly)
- *Melaleuca styphelioides* (Prickly Paperbark)
- *Ficus coronata* (Sandpaper Fig)
- *Ficus rubiginosa* (Port Jackson Fig)
- *Tristaniopsis laurina* (Water Gum)
- *Acacia glaucescens* (Coastal Myall)
- *Corymbia gummifera* (Red Bloodwood)
- *Corymbia eximia* (Yellow Bloodwood)
- *Corymbia ciriodora* (Lemon-scented Gum)
- *Eucalyptus robusta* (Swamp Mahogany)
- *Lophostemon confertus* (Brushbox)
- *Hibiscus tiliaceus* ‘Rubra’ (Bronze Cottonwood)
- *Metrosideros excelsa* (Pohutukawa)



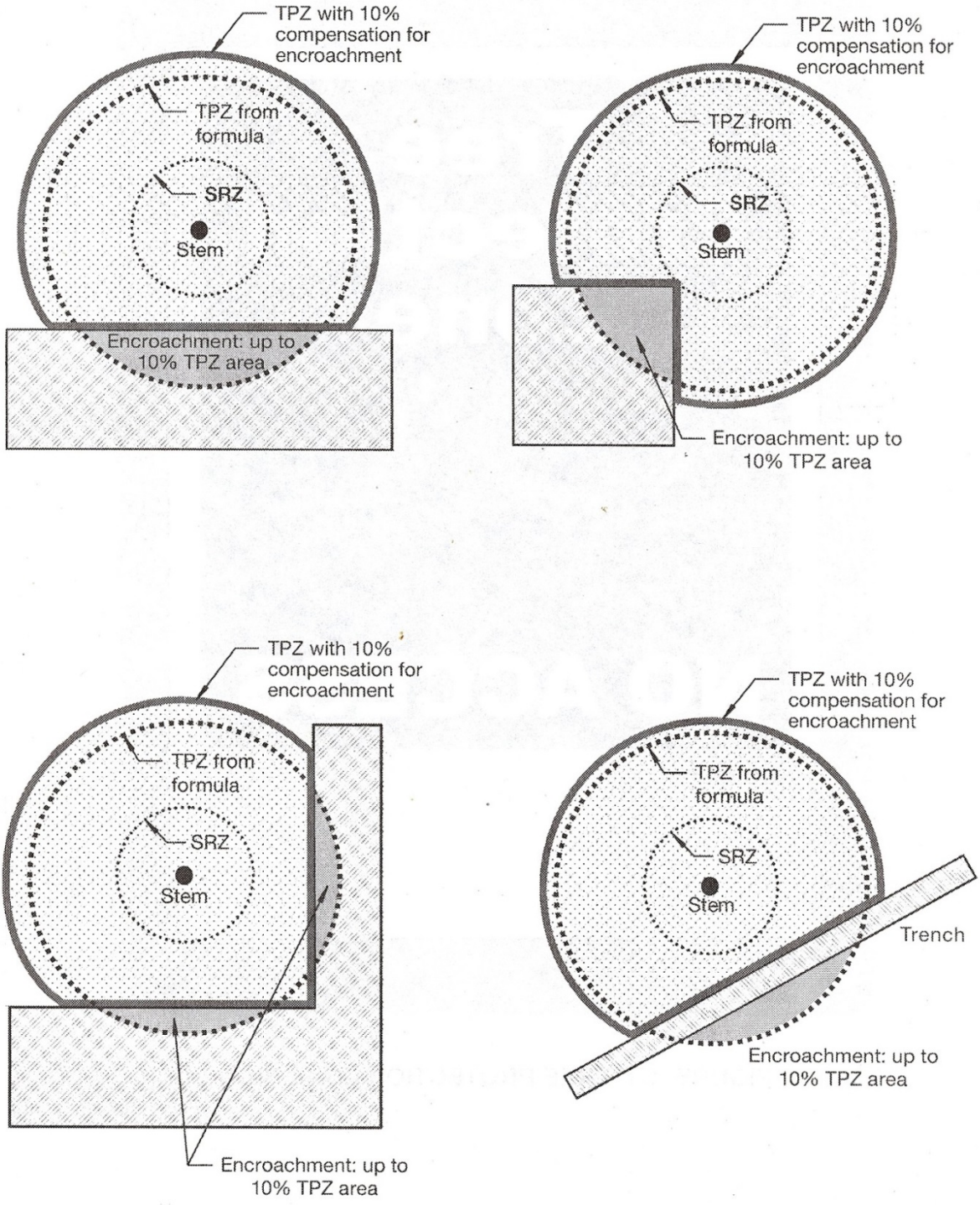
Andrew Morton
EARTHSCAPE HORTICULTURAL SERVICES
23rd May 2016

APPENDIX 1 - CRITERIA FOR ASSESSMENT OF LANDSCAPE SIGNIFICANCE

RATING	HERITAGE VALUE	ECOLOGICAL VALUE	AMENITY VALUE
1. SIGNIFICANT	The subject tree is listed as a Heritage Item under the Local Environment Plan (LEP) with a local, state or national level of significance or is listed on Council's Significant Tree Register	The subject tree is scheduled as a Threatened Species as defined under the Threatened Species Conservation Act 1995 (NSW) or the Environmental Protection and Biodiversity Conservation Act 1999	The subject tree has a very large live crown size exceeding 300m² with normal to dense foliage cover, is located in a visually prominent position in the landscape, exhibits very good form and habit typical of the species
	The subject tree forms part of the curtilage of a Heritage Item (building /structure /artefact as defined under the LEP) and has a known or documented association with that item	The tree is a locally indigenous species, representative of the original vegetation of the area and is known as an important food, shelter or nesting tree for endangered or threatened fauna species	The subject tree makes a significant contribution to the amenity and visual character of the area by creating a sense of place or creating a sense of identity
	The subject tree is a Commemorative Planting having been planted by an important historical person (s) or to commemorate an important historical event	The subject tree is a Remnant Tree, being a tree in existence prior to development of the area	The tree is visually prominent in view from surrounding areas, being a landmark or visible from a considerable distance.
2. VERY HIGH	The tree has a strong historical association with a heritage item (building/structure/artefact/garden etc) within or adjacent the property and/or exemplifies a particular era or style of landscape design associated with the original development of the site.	The tree is a locally-indigenous species, representative of the original vegetation of the area and is a dominant or associated canopy species of an Endangered Ecological Community (EEC) formerly occurring in the area occupied by the site.	The subject tree has a very large live crown size exceeding 200m²; a crown density exceeding 70% (normal-dense), is a very good representative of the species in terms of its form and branching habit or is aesthetically distinctive and makes a positive contribution to the visual character and the amenity of the area
3. HIGH	The tree has a suspected historical association with a heritage item or landscape supported by anecdotal or visual evidence	The tree is a locally-indigenous species and representative of the original vegetation of the area and the tree is located within a defined Vegetation Link / Wildlife Corridor or has known wildlife habitat value	The subject tree has a large live crown size exceeding 100m²; The tree is a good representative of the species in terms of its form and branching habit with minor deviations from normal (e.g. crown distortion/suppression) with a crown density of at least 70% (normal); The subject tree is visible from the street and surrounding properties and makes a positive contribution to the visual character and the amenity of the area
4. MODERATE	The tree has no known or suspected historical association, but does not detract or diminish the value of the item and is sympathetic to the original era of planting.	The subject tree is a non-local native or exotic species that is protected under the provisions of this DCP.	The subject tree has a medium live crown size exceeding 40m²;The tree is a fair representative of the species, exhibiting moderate deviations from typical form (distortion/suppression etc) with a crown density of more than 50% (thinning to normal); and
			The tree is visible from surrounding properties, but is not visually prominent – view may be partially obscured by other vegetation or built forms. The tree makes a fair contribution to the visual character and amenity of the area.
5. LOW	The subject tree detracts from heritage values or diminishes the value of a heritage item	The subject tree is scheduled as exempt (not protected) under the provisions of this DCP due to its species, nuisance or position relative to buildings or other structures.	The subject tree has a small live crown size of less than 40m² and can be replaced within the short term (5-10 years) with new tree planting
6. VERY LOW	The subject tree is causing significant damage to a heritage Item.	The subject tree is listed as an Environment Weed Species in the relevant Local Government Area, being invasive, or is a known nuisance species.	The subject tree is not visible from surrounding properties (visibility obscured) and makes a negligible contribution or has a negative impact on the amenity and visual character of the area. The tree is a poor representative of the species, showing significant deviations from the typical form and branching habit with a crown density of less than 50% (sparse).
7. INSIGNIFICANT	The tree is completely dead and has no visible habitat value	The tree is a declared Noxious Weed under the Noxious Weeds Act (NSW) 1993 within the relevant Local Government Area.	The tree is completely dead and represents a potential hazard.

Ref:- Morton, A (2006) **Determining the Retention Value of Trees on Development Sites**
TreeNet - Proceedings of the 7th National Street Tree Symposium 2006 Government of South Australia Department for Transport, Energy and Infrastructure

APPENDIX 2 – ACCEPTABLE INCURSIONS TO THE TREE PROTECTION ZONE (TPZ)



NOTE: Less than 10% TPZ area and outside SRZ. Any loss of TPZ compensated for elsewhere.

REF:- Council of Standards Australia (August 2009)
AS 4970 – 2009 – Protection of Trees on Development Sites
Standards Australia, Sydney

REFERENCES:-

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[2] Benson, Doug & Howell, Jocelyn (1990)
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[4] Barrell, Jeremy (1996)
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International Society of arboriculture, Illinois, USA

[5] Ruting, Noel (November 2005)
Register of Significant Trees – Part 2 of 4; Significant Street Trees (City of Sydney)
Landarc Pty Ltd & the Council of the City of Sydney, Sydney NSW

[6] Ruting, Noel (November 2005)
Register of Significant Trees – Part 3 of 4; Significant Trees on land under the care control and management of Other Government Authorities, Institutional, Religious and Non-Government Organisations (City of Sydney)
Landarc Pty Ltd & the Council of the City of Sydney, Sydney NSW

[7] Ruting, Noel (November 2005)
Register of Significant Trees – Part 4 of 4; Significant Trees under Private Ownership (City of Sydney)
Landarc Pty Ltd & the Council of the City of Sydney, Sydney NSW

[8] Council of Standards Australia (August 2009)
AS 4970 – 2009 – Protection of Trees on Development Sites
Standards Australia, Sydney

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
9	***Corymbia citriodora*** (Lemon-scented Gum)	22	24	815	456	M	Appears stable with sound branching structure. Suspected fracture near junction with main trunk - lower primary limb SE side.	No Evidence	Very Good	No Evidence	Long - more than 40 years	2	**High**	On-site
10	***Melaleuca quinquenervia*** (Broad-leaved Paperbark)	6	13	500	52	M	Appears stable with fair branching structure. Multiple primary limbs at 2 metres.	Previously topped and lopped (gully-cut) at 4 metres to clear powerlines.	Good	No Evidence	Long - more than 40 years	4	**Moderate**	Nature strip (Joynton Avenue)
47	***Eucalyptus saligna*** (Sydney Blue Gum)	15	10	500	110	M	Appears stable with sound branching structure. Exhibits multiple small wounds due to branch loss (mechanical injury). Ground disturbance and compaction around root plate.	No Evidence	Good	No Evidence	Medium 15-40 Years	3	**Moderate**	On-site
48	***Corymbia citriodora*** (Lemon-scented Gum)	18	22	742	330	M	Appears stable with sound branching structure.	No Evidence	Good	No Evidence	Long - more than 40 years	2	**High**	On-site
49	***Melaleuca quinquenervia*** (Broad-leaved Paperbark)	10	12	519	96	M	Appears stable with sound branching structure.	Selectively pruned to clear overhead powerlines (gully-cut)	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	Nature strip (Joynton Avenue)
50	***Callistemon viminalis*** (Weeping Bottlebrush)	7	10	250 + 220 + 200x2	50	M	Appears stable with fair branching structure. Exhibits multiple high bark inclusions at 1-2 metres. Small wound due to branch loss	No Evidence	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
51	***Corymbia citriodora*** (Lemon-scented Gum)	22	18	700	324	M	Appears stable with sound branching structure. Fill berm close to trunk on east side.	No Evidence	Very Good	No Evidence	Long - more than 40 years	3	**High**	On-site
52	***Callistemon viminalis*** (Weeping Bottlebrush)	5	7	120x4	28	M	Appears stable with sound branching structure.	No Evidence	Good	High vine infestation (Balloon Vine)	Short 5-15 Years	5	**Low**	On-site
53	***Callistemon viminalis*** (Weeping Bottlebrush)	5	5	80x2	20	SM	Appears stable with sound branching structure.	No Evidence	Good	High vine infestation (Balloon Vine)	Short 5-15 Years	5	**Low**	On-site
54	***Corymbia citriodora*** (Lemon-scented Gum)	18	17	554	221	M	Appears stable with sound branching structure. Crown suppressed on the north side due to crowding.	No Evidence	Good	No Evidence	Long - more than 40 years	3	**High**	On-site

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
55	***Lophostemon confertus*** (Brushbox)	9	9	389	54	SM	Appears stable with fair branching structure.	Selectively pruned to clear overhead powerlines (gully-cut)	Very Good	No Evidence	Long - more than 40 years	4	**Moderate**	Nature strip (Joynton Avenue)
56	***Melia azedarach*** (White Cedar)	6	6	90	30	I	Appears stable with fair branching structure.	No Evidence	Good	Moderate vine infestation (Balloon Vine)	Short 5-15 Years	6	**Very Low**	On-site
57	***Corymbia citriodora*** (Lemon-scented Gum)	17	16	729	192	M	Appears stable with sound branching structure.	No Evidence	Very Good	No Evidence	Long - more than 40 years	3	**High**	On-site
58	***Callistemon viminalis*** (Weeping Bottlebrush)	9	13	440	78	M	Appears stable with sound branching structure.	No Evidence	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
59	***Callistemon viminalis*** (Weeping Bottlebrush)	5	6	250 + 150	18	M	Appears stable with fair branching structure.	Crown lifted to 2 metres	Good	No Evidence	Short 5-15 Years	5	**Low**	On-site
60	***Eucalyptus botryoides*** (Bangalay)	25	17	812	289	M	Appears stable with fair branching structure. Exhibits multiple moderate wounds throughout crown due to previous branch loss. Extended lateral primary limbs with terminal loading. Poor form and habit.	Selectively pruned	Good	No Evidence	Short 5-15 Years	3	**Low**	On-site
61	***Eucalyptus robusta*** (Swamp Mahogany)	14	14	478	140	M	Appears stable with sound branching structure. 20% epicormic growth.	No Evidence	Very Good	No Evidence	Long - more than 40 years	3	**High**	On-site
61a	***Eucalyptus nicholii*** (New England Peppermint)	14	16	750	176	M	Appears stable with fair branching structure. Exhibits moderate dieback with 20% deadwood and 10% epicormic growth.	No Evidence	Fair with thinning crown	No Evidence	Short 5-15 Years	4	**Low**	On-site
62	***Acacia saligna*** (Golden Wreath Wattle)	7	7	150 + 180	28	SM	Appears stable with fair branching structure. Crown suppressed on west side due to previous pruning. High bark inclusion at 0.5 metres.	Selectively pruned. Primary limbs lopped at 2 metres	Good	No Evidence	Short 5-15 Years	5	**Low**	On-site
62a	***Melia azedarach*** (White Cedar)	12	16	500 + 400x2	160	M	Appears stable with fair branching structure. Exhibits multiple high bark inclusions at GL	No Evidence	Good	No Evidence	Medium 15-40 Years	6	**Very Low**	Adjoining property

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
62b	***Cupaniopsis anarcardioides*** (Tuckeroo)	7	6	160 + 200	30	M	Appears stable with fair branching structure. Exhibits a high bark inclusion at GL.	Crown lifted to 2 metres	Very Good	No Evidence	Medium 15-40 Years	5	Low	Adjoining property
62c	***Allocasuarina littoralis*** (Black She-oak)	10	7	250x2	56	M	Appears stable with poor branching structure. Exhibits multiple high bark inclusions at GL.	Crown lifted to 2 metres	Fair with thinning crown	No Evidence	Short 5-15 Years	4	Low	Adjoining property
62d	***Allocasuarina littoralis*** (Black She-oak)	9	6	170x2	42	M	Appears stable with poor branching structure. Exhibits multiple high bark inclusions at GL.	Crown lifted to 2 metres	Fair with thinning crown	No Evidence	Short 5-15 Years	4	Low	Adjoining property
62e	***Allocasuarina littoralis*** (Black She-oak)	6	5	150x2	20	M	Appears stable with poor branching structure. Exhibits multiple high bark inclusions at GL.	Crown lifted to 2 metres	Fair with thinning crown	No Evidence	Short 5-15 Years	4	Low	Adjoining property
63	***Syagrus romanzoffianum*** (Cocos Palm)	12	5	261	20	M	Appears stable with sound branching structure.	No Evidence	Good	No Evidence	Long - more than 40 years	6	Low	On-site
64	***Acacia saligna*** (Golden Wreath Wattle)	7	8	300	32	M	Appears stable with sound branching structure. Upper crown suppressed due to overshadowing with distorted main leader.	No Evidence	Good	No Evidence	Short 5-15 Years	5	Low	On-site
65	***Syagrus romanzoffianum*** (Cocos Palm)	12	5	341	20	M	Appears stable with fair branching structure. Exhibits a narrowing in the trunk at 1 metre	No Evidence	Good	No Evidence	Short 5-15 Years	6	Very Low	On-site
66	***Syagrus romanzoffianum*** (Cocos Palm)	14	6	303	42	M	Appears stable with sound branching structure.	No Evidence	Good	No Evidence	Long - more than 40 years	6	Low	On-site
67	***Celtis sinensis*** (Chinese Hackberry)	11	9	250	63	SM	Appears stable with fair branching structure. Growing through steel pallisade fence.	Secondary limbs lopped	Good	No Evidence	Short 5-15 Years	6	Very Low	On-site
67a	***Celtis sinensis*** (Chinese Hackberry)	8	8	200	40	SM	Appears stable with sound branching structure.	No Evidence	Good	No Evidence	Medium 15-40 Years	6	Low	On-site
68	***Metrosideros excelsa*** (NZ Christmas Bush)	10	12	600	102	M	Appears stable with sound branching structure. Exhibits a moderate wound at 2.5 metres due branch loss (secondary limb).	No Evidence	Good	No Evidence	Long - more than 40 years	3	High	On-site
69	***Callistemon viminalis*** (Weeping Bottlebrush)	8	10	500	80	M	Appears stable with fair branching structure.	No Evidence	Fair	Severe vine infestation (Balloon Vine)	Short 5-15 Years	5	Low	On-site

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
69a	***Eucalyptus saligna*** (Sydney Blue Gum)	14	9	350	99	SM	Appears stable with sound branching structure.	No Evidence	Very Good	Moderate English Ivy infestation	Long - more than 40 years	3	**High**	On-site
70	***Eucalyptus pilularis*** (Blackbutt)	13	6	240	66	I	Appears stable with sound branching structure. Two x basal epicormic sprouts	No Evidence	Good	Low foliar insect infestation (Psyllids)	Long - more than 40 years	4	**Moderate**	On-site
71	***Lagunaria patersonia*** (Norfolk Island Hibiscus)	11	8	450	72	M	Appears stable with fair branching structure. Exhibits multiple moderate bark inclusions at 4 metres.	Crown lifted to 4 metres	Good	No Evidence	Medium 15-40 Years	6	**Low**	On-site
72	***Acacia saligna*** (Golden Wreath Wattle)	5	6	170	24	SM	Appears stable with sound branching structure.	No Evidence	Very Good	No Evidence	Short 5-15 Years	5	**Low**	On-site
73	***Acacia saligna*** (Golden Wreath Wattle)	5	5	100x3	20	SM	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Short 5-15 Years	5	**Low**	On-site
74	***Persea americana*** (Avocado Pear)	8	10	400	70	M	Appears stable with fair branching structure. Exhibits a prominent lean to the NW.	No Evidence	Good	High English Ivy infestation	Medium 15-40 Years	5	**Low**	On-site
74a	***Olea europaea var. africana*** (African Olive)	8	10	300x3 + 200	80	M	Appears stable with fair branching structure. Exhibits multiple high bark inclusions at GL.	No Evidence	Good	High English Ivy infestation	Short 5-15 Years	6	**Very Low**	On-site
75	***Acacia saligna*** (Golden Wreath Wattle)	7	9	400x2	27	OM	Stability suspect with poor branching structure. Extended lateral branching habit with terminal loading. Crown suppressed on west side due to previous branch loss. Multiple moderate wounds due to previous branch loss with decay evident. 50% deadwood.	No Evidence	Poor with sparse crown	No Evidence	Transient (less than 5 years)	5	**Very Low**	On-site
76	***Melia azedarach*** (White Cedar)	6	7	300	31.5	SM	Appears stable with sound branching structure.	No Evidence	Good	No Evidence	Long - more than 40 years	6	**Low**	On-site
76a	***Callistemon viminalis*** (Weeping Bottlebrush)	9	12	500	84	M	Appears stable with fair branching structure. Exhibits a prominent lean to the west.	No Evidence	Good	Severe English Ivy infestation	Short 5-15 Years	4	**Low**	On-site

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
79	***Callistemon viminalis*** (Weeping Bottlebrush)	8	4	150	24	SM	Appears stable with fair branching structure. Crown suppressed on east side due to crowding.	Crown lifted to 3 metres	Fair	No Evidence	Short 5-15 Years	5	**Low**	On-site
80	***Callistemon viminalis*** (Weeping Bottlebrush)	8	6	217	42	SM	Appears stable with fair branching structure. Exhibits a prominent lean to the north. Crown suppressed on the south side due to building.	Crown lifted to 4 metres	Good	No Evidence	Short 5-15 Years	5	**Low**	On-site
81	***Banksia integrifolia*** (Coast Banksia)	8	6	331	30	SM	Appears stable with sound branching structure. Exhibits a very prominent lean to the north (self corrected). Crown suppressed on south side due to building.	Crown lifted to 4 metres	Good	No Evidence	Medium 15-40 Years	5	**Low**	On-site
82	***Banksia integrifolia*** (Coast Banksia)	9	4	220	20	SM	Appears stable with fair branching structure. Exhibits a prominent lean to the west (self corrected). Crown suppressed on south side due to building.	Crown lifted to 4 metres	Good	No Evidence	Medium 15-40 Years	5	**Low**	On-site
83	***Banksia integrifolia*** (Coast Banksia)	8	7	300	42	M	Appears stable with fair branching structure. Exhibits a very prominent lean to the north. Crown suppressed on the south side due to building.	Crown lifted to 4 metres	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
84	***Banksia integrifolia*** (Coast Banksia)	11	8	320	64	M	Appears stable with sound branching structure. Slight lean to the north. Crown suppressed on the south side due to building.	Selectively pruned	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
85	***Banksia integrifolia*** (Coast Banksia)	8	4	200	24	SM	Appears stable with poor branching structure. Exhibits a very prominent lean to the west (self corrected). Poor form and habit. 20% epicormic growth.	Crown lifted to 4 metres	Good	No Evidence	Short 5-15 Years	5	**Low**	On-site
86	***Banksia integrifolia*** (Coast Banksia)	12	7	436	56	M	Appears stable with fair branching structure. Exhibits a very prominent lean to the NW. Crown suppressed on the SE side due to building.	Crown lifted to 5 metres	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
87	***Banksia integrifolia*** (Coast Banksia)	7	5	258	25	SM	Appears stable with fair branching structure. Exhibits a prominent lean to the NW. Crown suppressed on south side due to building. Located in close proximity to existing building.	Crown lifted to 4 metres	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
88	***Eucalyptus robusta*** (Swamp Mahogany)	12	9	380	45	SM	Appears stable with sound branching structure. Slight lean to the north. Crown suppressed on the south side due to building. Multiple small wounds in upper crown due previous branch loss (storm damage). Some broken hanging branches with 15% deadwood.	Crown lifted to 4 metres	Fair with thinning crown	No Evidence	Short 5-15 Years	4	**Low**	On-site
89	***Murraya paniculata*** (Murraya)	6	6	150x2 + 100	36	M	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Medium 15-40 Years	5	**Low**	On-site
90	***Casuarina cunninghamiana*** (River Oak)	20	11	450	176	M	Appears stable with sound branching structure. Minor dieback with 5% deadwood.	Crown lifted to 4 metres	Fair with slightly thinning crown	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
91	***Casuarina cunninghamiana*** (River Oak)	22	15	700	255	M	Appears stable with sound branching structure.	Lower limbs selectively pruned	Good	No Evidence	Medium 15-40 Years	3	**Moderate**	On-site
92	***Casuarina cunninghamiana*** (River Oak)	16	4	268	44	SM	Appears stable with fair branching structure. Upper crown suppressed due to overshadowing.	Crown lifted to 4 metres	Fair with thinning crown	No Evidence	Short 5-15 Years	5	**Low**	On-site
93	***Casuarina cunninghamiana*** (River Oak)	18	12	350	192	M	Appears stable with poor branching structure. Crown suppressed on east and west sides due to crowding. Poor form and habit.	Lower secondary limbs lopped	Fair	High English Ivy infestation	Short 5-15 Years	4	**Low**	On-site
94	***Casuarina cunninghamiana*** (River Oak)	20	8	369	96	M	Appears stable with poor branching structure. Crown suppressed on east and west sides due to crowding. Poor form and habit. Leader distorted at 14 metres. Moderate axial wound on lower trunk due to suspected canker.	Crown lifted to 6 metres	Fair	No Evidence	Short 5-15 Years	4	**Low**	On-site
95	***Casuarina cunninghamiana*** (River Oak)	20	10	440	160	M	Appears stable with sound branching structure. Crown suppressed on east and west sides due to crowding.	Selectively pruned	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
96	***Casuarina cunninghamiana*** (River Oak)	22	12	450	180	M	Appears stable with sound branching structure. Crown suppressed on the west side due to crowding.	Crown lifted to 5 metres	Good	No Evidence	Medium 15-40 Years	3	**Moderate**	On-site

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
96a	***Celtis sinensis*** (Chinese Hackberry)	11	11	160 + 220x2	99	SM	Appears stable with poor branching structure. Exhibits a large axial wound on lower primary limb with very prominent lean to the north.	Selectively pruned on west side.	Good	High vine infestation (Balloon Vine)	Short 5-15 Years	6	**Very Low**	On-site
97	***Casuarina cunninghamiana*** (River Oak)	20	12	519	192	M	Appears stable with sound branching structure. Located in close proximity to existing building.	No Evidence	Good	No Evidence	Medium 15-40 Years	3	**Moderate**	On-site
98	***Casuarina cunninghamiana*** (River Oak)	15	5	197	60	I	Appears stable with sound branching structure. Located in close proximity to existing building.	Crown lifted to 3 metres	Fair	No Evidence	Short 5-15 Years	5	**Low**	On-site
99	***Casuarina cunninghamiana*** (River Oak)	20	8	379	120	M	Appears stable with sound branching structure. Crown suppressed on east side due to crowding. Located in close proximity to existing building.	No Evidence	Fair	No Evidence	Medium 15-40 Years	3	**Moderate**	On-site
100	***Casuarina cunninghamiana*** (River Oak)	17	7	306	63	SM	Appears stable with sound branching structure. Crown suppressed on west side due to crowding. Located in close proximity to existing building.	No Evidence	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
101	***Casuarina cunninghamiana*** (River Oak)	14	8	287	80	SM	Appears stable with fair branching structure. Located in close proximity to existing building. Prominent lean to the west. Crown suppressed on east side due to crowding. Poor form and habit.	No Evidence	Fair	No Evidence	Medium 15-40 Years	5	**Low**	On-site
102	***Casuarina cunninghamiana*** (River Oak)	15	9	392	90	M	Appears stable with sound branching structure. Crown supressed on north side. Located in close proximity to existing building.	No Evidence	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
103	***Grevillea robusta*** (Silky Oak)	9	3	134	22.5	I	Appears stable with sound branching structure.	No Evidence	Good	No Evidence	Medium 15-40 Years	5	**Low**	On-site
104	***Lagunaria patersonia*** (Norfolk Island Hibiscus)	13	8	200 + 350	96	M	Appears stable with fair branching structure. Exhibits a high bark inclusion at 0.5 metres.	Crown lifted to 2 metres	Very Good	No Evidence	Long - more than 40 years	6	**Low**	On-site

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
104c	***Melaleuca quinquenervia*** (Broad-leaved Paperbark)	12	12	900	120	M	Appears stable with fair branching structure. Exhibits multiple moderate bark inclusions at 1-2 metres.	No Evidence	Good	No Evidence	Medium 15-40 Years	3	**Moderate**	Adjoining property
104d	***Melaleuca quinquenervia*** (Broad-leaved Paperbark)	8	11	900	66	M	Appears stable with fair branching structure. Exhibits multiple moderate bark inclusions at 1-2 metres.	No Evidence	Good	No Evidence	Medium 15-40 Years	3	**Moderate**	Adjoining property
140	***Celtis sinensis*** (Chinese Hackberry)	8	7	200x3	49	SM	Appears stable with poor branching structure. Exhibits multiple severe bark inclusions at 0.5 metres.	No Evidence	Very Good	No Evidence	Medium 15-40 Years	6	**Very Low**	On-site
141	***Celtis sinensis*** (Chinese Hackberry)	7	6	180	36	SM	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Medium 15-40 Years	6	**Low**	On-site
142	***Celtis sinensis*** (Chinese Hackberry)	8	6	170	42	SM	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Short 5-15 Years	6	**Low**	On-site
143	***Celtis sinensis*** (Chinese Hackberry)	6	6	130	30	SM	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Short 5-15 Years	6	**Low**	On-site
144	***Celtis sinensis*** (Chinese Hackberry)	8	6	160	42	SM	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Short 5-15 Years	6	**Low**	On-site
145	***Celtis sinensis*** (Chinese Hackberry)	6	6	150	30	SM	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Short 5-15 Years	6	**Low**	On-site
146	***Celtis sinensis*** (Chinese Hackberry)	7	6	150	36	SM	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Short 5-15 Years	6	**Low**	On-site
147	***Celtis sinensis*** (Chinese Hackberry)	7	6	150	36	SM	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Short 5-15 Years	6	**Low**	On-site
148	***Celtis sinensis*** (Chinese Hackberry)	7	6	170	36	SM	Appears stable with fair branching structure.	No Evidence	Very Good	No Evidence	Short 5-15 Years	6	**Low**	On-site

APPENDIX 3 - TREE HEALTH AND CONDITION ASSESSMENT SCHEDULE

Tree Identification No.	Species	Height (m)	Spread (m)	Trunk Diameter (mm)	Live Crown Size (m^2)	Maturity Class	Condition	Previous Pruning	Health		Remaining Safe Useful Life Expectancy (SULE)	Landscape Significance Rating	Retention Value	Location
									Vigour	Pest & Disease				
149	***Casuarina cunninghamiana*** (River Oak)	7	8	350	56	SM	Appears stable with fair branching structure. Some dieback in upper crown with 5% deadwood.	No Evidence	Fair with thinning crown	Low vine infestation (Balloon Vine)	Short 5-15 Years	4	**Low**	On-site
150	***Casuarina cunninghamiana*** (River Oak)	9	8	350	64	SM	Appears stable with sound branching structure.	No Evidence	Good	No Evidence	Medium 15-40 Years	4	**Moderate**	On-site
151	***Casuarina cunninghamiana*** (River Oak)	9	8	300	64	SM	Appears stable with poor branching structure. Exhibits a severe bark inclusion at 3 metres.	No Evidence	Good	No Evidence	Long - more than 40 years	4	**Moderate**	On-site
152	***Casuarina cunninghamiana*** (River Oak)	8	7	200	56	I	Appears stable with sound branching structure.	No Evidence	Very Good	No Evidence	Long - more than 40 years	4	**Moderate**	On-site

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
9	***Corymbia citriodora*** (Lemon-scented Gum)	P	12.2	3.0	469.6	Existing masonry retaining wall offset 2.3 metres west to be demolished within TPZ/SRZ. Existing kerb and gutter and concrete pavement offset 1.2 metres south to be demolished within TPZ. Proposed new roadway and footpath offset 2.6 metres west to be raised to RL 18.40 (700 mm above existing RL at base of tree) for flood mitigation purposes. Engineered fill within TPZ (beyond existing masonry wall). No actual incursion to root zone due to barrier created by existing wall. Proposed building (Aquatic Centre) offset 7.9 metres east at RL 19.70 (1.5 metres above grade). Engneered fill for building platform within TPZ (over footprint of existing concrete pavement). Encroachment to TPZ = 6%. Building envelope to RL 30.40 (12 metres above grade). Some canopy pruning will be required to clear building envelope and any temporary scaffolding. Proposed pedestrian pavement and bike parking area and associated retaining wall offset 1.2 metres north at RL18.40. Engineered fill for pavement sub-base within TPZ/SRZ or excavations for retaining wall foundations within SRZ. Encroachment to TPZ = 26%. Proposed fire hydrant booster pump offset 1.3 metres NW. Excavations for foundation slab and underground services within SRZ. Proposed non-engineered fill for landscape berm offset 5.5 metres east to toe of berm (within footprint of existing concrete pavement - less than present encroachment).	Extent of encroachment to TPZ exceeds acceptable limits under AS 4970:2009. The proposed works are likely to result in a significant adverse impact on this tree. There are no feasible alternatives that can be recommended that would permit retention of this tree given the level at the base of the tree and the street levels proposed. The proposed works will therefore necessiate the removal of this tree (high retention value). Note that this tree is proposed to be removed as part of the Joynton Avenue & Zetland Avenue road works as part of a separate DA.	Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
10	***Melaleuca quinquenervia*** (Broad-leaved Paperbark)	M	6.5	2.5	132.7	Located within footprint of proposed new footpath at approx RL 18.40 (1.1 metres above grade). Road level in Joynton Avenue raised for flood mitigation purposes.	Proposed works will necessitate removal	This tree to be removed by others as part of the Zetland Avenue/Joynton Avenue road works. Note that these works do not form part of the GPARC.
47	***Eucalyptus saligna*** (Sydney Blue Gum)	P	6.0	2.5	113.0	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
48	***Corymbia citriodora*** (Lemon-scented Gum)	P	11.1	2.9	389.0	Existing masonry retaining wall offset 2.4 metres west to be demolished within TPZ/SRZ. Existing kerb and gutter and concrete pavement offset 4.2 metres north and 3.9 metres east to be demolished within TPZ. Proposed new roadway and footpath offset 2.7 metres west to be raised to RL 18.40 (300 mm above existing RL at base of tree) for flood mitigation purposes. Engineered fill within TPZ (beyond existing masonry wall). No actual incursion to root zone due to barrier created by existing wall. Proposed building (Aquatic Centre) offset 9.3 metres east at RL19.70. Engneered fill for building platform within TPZ (over footprint of existing concrete pavement). Encroachment to TPZ = 8% (less than present situation). Upper floor offset 8 metres east to RL 30.40 (12 metres above grade). Some canopy pruning will be required to clear building envelope and any temporary scaffolding. Proposed pedestrian pathway offset 6.8 metres south at RL? Engineered fill for pavement sub-base within TPZ/SRZ (partially within footprint of existing concrete pavement). . Proposed non-engineered fill for landscape berm offset 2.2 metres east to toe of berm (mostly within footprint of existing concrete pavement).	No adverse impact provided that all works proposed within TPZ are undertaken as recommended.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3. Install Trunk Protection in accordance with Section 10.4. Demolish existing masonry wall and concrete pavement within TPZ in accordance with Section 10.5. Supply and place non-engineered fill for landscape berms within TPZs in accordance with Section 10.9. No fill shall be placed in direct contact with the trunk. Install any required temporary scaffolding in accordance with Section 10.13. Undertake any required canopy pruning (that essential to clear the building envelope and temporary scaffold) in accordance with Section 10.10
49	***Melaleuca quinquenervia*** (Broad-leaved Paperbark)	M	6.2	2.5	121.8	Located within footprint of proposed new footpath at approx RL 18.40 (1.0 metres above grade). Road level raised for flood mitigation purposes.	Proposed works will necessitate removal	This tree to be removed by others as part of the Zetland Avenue/Joynton Avenue road works. Note that these works do not form part of the GPARC.
50	***Callistemon viminalis*** (Weeping Bottlebrush)	M	5.4	2.4	91.6	Located within footprint of proposed new earthen mound (transition between Joynton Avenue and new Aquatic Centre)	Proposed to be removed to accommodate new landscape works.	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
51	***Corymbia citriodora*** (Lemon-scented Gum)	P	10.5	2.8	346.2	Existing masonry retaining wall offset 2.4 metres west to be demolished within TPZ/SRZ. Existing kerb and gutter and concrete pavement offset 4.1 metres east to be demolished within TPZ. Proposed new roadway and footpath offset 2.6 metres west to be raised to RL 18.40 (close to existing RL at base of tree) for flood mitigation purposes. Engineered fill within TPZ (beyond existing masonry wall). No actual incursion to root zone due to barrier created by existing wall. Proposed building (Aquatic Centre) offset 9.4 metres east at RL19.70 (1.5 metres above grade). Engineered fill for building platform within TPZ (over footprint of existing concrete pavement). Upper floor offset 8 metres east to RL 30.40 (12 metres above grade). Some canopy pruning will be required to clear building envelope and any temporary scaffolding. Proposed non-engineered fill for landscape berm offset 1.4 metres east to toe of berm (partly within footprint of existing concrete pavement).	No adverse impact provided that all works proposed within TPZ are undertaken as recommended.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3. Install Trunk Protection in accordance with Section 10.4. Demolish existing masonry wall and concrete pavement within TPZ in accordance with Section 10.5. Supply and place non-engineered fill for landscape berms within TPZs in accordance with Section 10.9. No fill shall be placed in direct contact with the trunk. Install any required temporary scaffolding in accordance with Section 10.13. Undertake any required canopy pruning (that essential to clear the building envelope and temporary scaffold) in accordance with Section 10.10
52	***Callistemon viminalis*** (Weeping Bottlebrush)	M	3.5	1.8	38.5	Located within footprint of proposed new earthen mound (transition between Joynton Avenue and new Aquatic Centre)	Proposed to be removed to accommodate new landscape works.	Remove tree.
53	***Callistemon viminalis*** (Weeping Bottlebrush)	M	2.5	1.4	19.6	Located within footprint of proposed new earthen mound (transition between Joynton Avenue and new Aquatic Centre)	Proposed to be removed to accommodate new landscape works.	Remove tree.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
54	***Corymbia citriodora*** (Lemon-scented Gum)	P	8.3	2.6	216.9	Existing masonry retaining wall offset 2.2 metres west to be demolished within TPZ/SRZ. Existing kerb and gutter and concrete pavement offset 2.1 metres south and 4.1 metres east to be demolished within TPZ/SRZ. Proposed new roadway and footpath offset 2.5 metres west to be raised to RL 18.40 (100mm above existing RL at base of tree) for flood mitigation purposes. Engineered fill within TPZ (beyond existing masonry wall). No actual incursion to root zone due to barrier created by existing wall. Proposed building (Aquatic Centre) offset 9.5 metres east at RL? Engneered fill for building platform within TPZ (over footprint of existing concrete pavement). Minor encroachment to TPZ (<5%) (less than present situation). Upper floor offset 8.2 metres east to RL 30.40 (12 metres above grade). Minor canopy pruning will be required to clear building envelope and any temporary scaffolding. Proposed pedestrian pathway offset 4.3 metres south at RL 18.40-19.70 (0.6-1.5 metres above grade). Engineered fill for pavement sub-base within TPZ/SRZ (within footprint of existing concrete pavement). Proposed non-engineered fill for landscape berm offset 1.8 metres east to toe of berm (mostly within footprint of existing concrete pavement).	No adverse impact provided that all works proposed within TPZ are undertaken as recommended.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3. Install Trunk Protection in accordance with Section 10.4. Demolish existing masonry wall and concrete pavement within TPZ in accordance with Section 10.5. Supply and place non-engineered fill for landscape berms within TPZs in accordance with Section 10.9. No fill shall be placed in direct contact with the trunk. Install any required temporary scaffolding in accordance with Section 10.13. Undertake any required canopy pruning (that essential to clear the building envelope and temporary scaffold) in accordance with Section 10.10
55	***Lophostemon confertus*** (Brushbox)	M	4.7	2.2	68.3	Located within footprint of proposed new footpath at approx RL 18.40 (0.9 metres above grade). Road level raised for flood mitigation purposes.	Proposed works will necessitate removal	This tree to be removed by others as part of the Zetland Avenue/Joynton Avenue road works. Note that these works do not form part of the GPARC.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
56	***Melia azedarach*** (White Cedar)	M	3.0	1.2	28.3	Located within footprint of proposed new earthen mound (transition between Joynton Avenue and new Aquatic Centre)	Proposed to be removed to accommodate new landscape works.	Remove tree.
57	***Corymbia citriodora*** (Lemon-scented Gum)	P	8.8	2.9	240.5	Existing masonry retaining wall offset 2.2 metres west to be demolished within TPZ/SRZ. Existing kerb and gutter and concrete pavement offset 2.8 metres NE to be demolished within TPZ/SRZ. Proposed new roadway and footpath offset 2.4 metres west to be raised to RL 18.40 (close to existing RL at base of tree) for flood mitigation purposes. Engineered fill within TPZ (beyond existing masonry wall). No actual incursion to root zone due to barrier created by existing wall. Proposed building (Aquatic Centre) offset 9.7 metres east at RL19.7 (1.5 metres above grade). Engineered fill for building platform within TPZ (over footprint of existing concrete pavement). Minor encroachment to TPZ (<5%) (less than present situation). Upper floor offset 8.2 metres east to RL 30.40 (12 metres above grade). Minor canopy pruning may be required to clear building envelope and any temporary scaffolding. Proposed pedestrian pathway offset 4.5 metres north at RL18.40-19.70 (0.6-1.5 metres above grade). Engineered fill for pavement sub-base within TPZ/SRZ (within footprint of existing concrete pavement). Proposed non-engineered fill for landscape berm offset 2.9 metres east to toe of berm (mostly within footprint of existing concrete pavement).	No adverse impact provided that all works proposed within TPZ are undertaken as recommended.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3. Install Trunk Protection in accordance with Section 10.4. Demolish existing masonry wall and concrete pavement within TPZ in accordance with Section 10.5. Supply and place non-engineered fill for landscape berms within TPZs in accordance with Section 10.9. No fill shall be placed in direct contact with the trunk. Install any required temporary scaffolding in accordance with Section 10.13. Undertake any required canopy pruning (that essential to clear the building envelope and temporary scaffold) in accordance with Section 10.10
58	***Callistemon viminalis*** (Weeping Bottlebrush)	M	5.3	2.3	87.5	Located within footprint of proposed new earthen mound (transition between Joynton Avenue and new Aquatic Centre)	Proposed to be removed to accommodate new landscape works.	Remove tree. Undertake replacement planting with a new tree elsewhere within the road reserve to compensate for loss of amenity in accordance with Section 11.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
59	***Callistemon viminalis*** (Weeping Bottlebrush)	M	3.0	1.8	28.3	Located within footprint of proposed new earthen mound (transition between Joynton Avenue and new Aquatic Centre)	Proposed to be removed to accommodate new landscape works.	Remove tree.
60	***Eucalyptus botryoides*** (Bangalay)	P	9.7	3.0	298.2	Located within footprint of proposed new earthen mound (transition between Joynton Avenue and new Aquatic Centre)	Proposed to be removed to accommodate new landscape works.	Remove tree.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
61	***Eucalyptus robusta*** (Swamp Mahogany)	P	7.2	2.4	161.2	Existing masonry retaining wall offset 3.1 metres west to be demolished within TPZ/SRZ. Existing kerb and gutter and concrete pavement offset 3.2 metres east, north & south to be demolished within TPZ/SRZ. Proposed new roadway and footpath offset 3.4 metres west to be raised to RL 18.40 (close to existing RL at base of tree) for flood mitigation purposes. Engineered fill within TPZ (beyond existing masonry wall). No actual incursion to root zone due to barrier created by existing wall. Proposed building (Aquatic Centre) offset 8.4 metres east at RL19.70 (1.2 metres above grade). Engineered fill for building platform within TPZ (over footprint of existing concrete pavement). Minor encroachment to TPZ (<5%) (less than present situation). Upper floor offset 7.2 metres east to RL 30.40 (12 metres above grade). Minor canopy pruning may be required to clear building envelope and any temporary scaffolding. Proposed pedestrian pathway offset 4.0 metres south at RL18.40 (3-400mm above grade). Engineered fill for pavement sub-base within TPZ/SRZ (within footprint of existing concrete pavement). Proposed non-engineered fill for landscape berm offset 2.9 metres east to toe of berm (mostly within footprint of existing concrete pavement).	No adverse impact provided that all works proposed within TPZ are undertaken as recommended.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3. Install Trunk Protection in accordance with Section 10.4. Demolish existing masonry wall and concrete pavement within TPZ in accordance with Section 10.5. Supply and place non-engineered fill for landscape berms within TPZs in accordance with Section 10.9. No fill shall be placed in direct contact with the trunk. Install any required temporary scaffolding in accordance with Section 10.13. Undertake any required canopy pruning (that essential to clear the building envelope and temporary scaffold) in accordance with Section 10.10
61a	***Eucalyptus nicholii*** (New England Peppermint)	P	9.0	2.9	254.3	Located within footprint of proposed new road way (Rose Valley Way) - future works not forming part of the GPARC project).	Proposed works will necessitate removal	Remove tree

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
62	***Acacia saligna*** (Golden Wreath Wattle)	M	3.5	1.8	38.5	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
62a	***Melia azedarach*** (White Cedar)	M	10.8	3.2	366.2	Located within footprint of proposed new road way (Rose Valley Way) - future works not forming part of the GPARC project.	Proposed to be removed in the future by others as part of the Rose Valley Way road works. Note that these works do not form part of the GPARC. This tree to be retained at this stage.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3.
62b	***Cupaniopsis anarcardioides*** (Tuckeroo)	M	3.4	1.9	35.4	Located within footprint of proposed new road way (Rose Valley Way) - future works not forming part of the GPARC project.	Proposed to be removed in the future by others as part of the Rose Valley Way road works. Note that these works do not form part of the GPARC. This tree to be retained at this stage.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3.
62c	***Allocasuarina littoralis*** (Black She-oak)	M	4.5	2.2	63.6	Located within footprint of proposed new road way (Rose Valley Way) - future works not forming part of the GPARC project.	Proposed to be removed in the future by others as part of the Rose Valley Way road works. Note that these works do not form part of the GPARC. This tree to be retained at this stage.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3.
62d	***Allocasuarina littoralis*** (Black She-oak)	M	3.2	1.9	33.0	Located within footprint of proposed new road way (Rose Valley Way) - future works not forming part of the GPARC project.	Proposed to be removed in the future by others as part of the Rose Valley Way road works. Note that these works do not form part of the GPARC. This tree to be retained at this stage.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3.
62e	***Allocasuarina littoralis*** (Black She-oak)	M	2.7	1.8	22.9	Located within footprint of proposed new road way (Rose Valley Way) - future works not forming part of the GPARC project.	Proposed to be removed in the future by others as part of the Rose Valley Way road works. Note that these works do not form part of the GPARC. This tree to be retained at this stage.	Retain in accordance with recommended Tree Protection Measures (Section 10). Install Tree Protection Fencing in accordance with Section 10.3.
63	***Syagrus romanzoffianum*** (Cocos Palm)	G	3.1	1.9	30.8	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
64	***Acacia saligna*** (Golden Wreath Wattle)	M	4.0	2.0	50.2	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
65	***Syagrus romanzoffianum*** (Cocos Palm)	G	4.1	2.1	52.5	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
66	***Syagrus romanzoffianum*** (Cocos Palm)	G	3.6	2.0	41.4	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
67	***Celtis sinensis*** (Chinese Hackberry)	M	4.5	1.8	63.6	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
67a	***Celtis sinensis*** (Chinese Hackberry)	M	4.0	1.7	50.2	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
68	***Metrosideros excelsa*** (NZ Christmas Bush)	M	7.2	2.7	162.8	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal (High Retention Value). There are no feasible options that can be recommended that would permit the retention of this tree.	Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
69	***Callistemon viminalis*** (Weeping Bottlebrush)	M	6.0	2.5	113.0	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
69a	***Eucalyptus saligna*** (Sydney Blue Gum)	P	4.5	2.1	63.6	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal (High Retention Value). There are no feasible options that can be recommended that would permit the retention of this tree.	Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
70	***Eucalyptus pilularis*** (Blackbutt)	P	3.0	1.8	28.3	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
71	***Lagunaria patersonia*** (Norfolk Island Hibiscus)	M	5.4	2.4	91.6	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
72	***Acacia saligna*** (Golden Wreath Wattle)	M	3.0	1.6	28.3	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
73	***Acacia saligna*** (Golden Wreath Wattle)	M	2.4	1.7	18.1	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
74	***Persea americana*** (Avocado Pear)	M	4.8	2.3	72.3	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
74a	***Olea europaea var. africana*** (African Olive)	M	6.0	2.5	113.0	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
75	***Acacia saligna*** (Golden Wreath Wattle)	M	7.2	2.7	162.8	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
76	***Melia azedarach*** (White Cedar)	M	3.6	2.0	40.7	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
76a	***Callistemon viminalis*** (Weeping Bottlebrush)	M	6.0	2.5	113.0	Located within footprint of proposed new Aquatic Centre.	Proposed works will necessitate removal	Remove tree.
77	***Callistemon viminalis*** (Weeping Bottlebrush)	M	2.0	1.4	12.6	Located within footprint of proposed pathway/roadway.	This tree has already been removed as part of the Green Square Trunk Drainage works. Note that these works do not form part of the GPARC.	Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
77a	***Celtis sinensis*** (Chinese Hackberry)	M	5.4	2.4	91.6	Located within footprint of proposed pathway/roadway.	This tree has already been removed as part of the Green Square Trunk Drainage works. Note that these works do not form part of the GPARC.	Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
78	***Eucalyptus paniculata*** (Grey Ironbark)	P	10.5	2.8	346.2	Located within footprint of proposed pathway/roadway.	This tree has already been removed as part of the Green Square Trunk Drainage works. Note that these works do not form part of the GPARC.	Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
78a	***Banksia integrifolia*** (Coast Banksia)	M	4.2	2.1	55.4	Located within footprint of proposed new Aquatic Centre.	This tree has already been removed as part of the Green Square Trunk Drainage works. Note that these works do not form part of the GPARC.	Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
79	***Callistemon viminalis*** (Weeping Bottlebrush)	M	2.0	1.5	12.6	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
80	***Callistemon viminalis*** (Weeping Bottlebrush)	M	3.0	1.7	28.3	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
81	***Banksia integrifolia*** (Coast Banksia)	M	4.0	2.1	49.6	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
82	***Banksia integrifolia*** (Coast Banksia)	M	2.6	1.8	21.9	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
83	***Banksia integrifolia*** (Coast Banksia)	M	3.6	2.0	40.7	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
84	***Banksia integrifolia*** (Coast Banksia)	M	4.0	2.1	50.2	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
85	***Banksia integrifolia*** (Coast Banksia)	M	2.4	1.7	18.1	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
86	***Banksia integrifolia*** (Coast Banksia)	M	5.2	2.3	86.1	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
87	***Banksia integrifolia*** (Coast Banksia)	M	3.1	1.9	30.1	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
88	***Eucalyptus robusta*** (Swamp Mahogany)	M	4.6	2.2	65.3	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
89	***Murraya paniculata*** (Murraya)	M	3.0	1.8	28.3	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
90	***Casuarina cunninghamiana*** (River Oak)	M	5.4	2.4	91.6	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
91	***Casuarina cunninghamiana*** (River Oak)	M	8.4	2.8	221.6	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
92	***Casuarina cunninghamiana*** (River Oak)	M	3.2	1.9	32.4	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
93	***Casuarina cunninghamiana*** (River Oak)	M	6.0	2.1	113.0	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
94	***Casuarina cunninghamiana*** (River Oak)	M	4.4	2.2	61.7	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
95	***Casuarina cunninghamiana*** (River Oak)	M	5.3	2.3	87.5	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

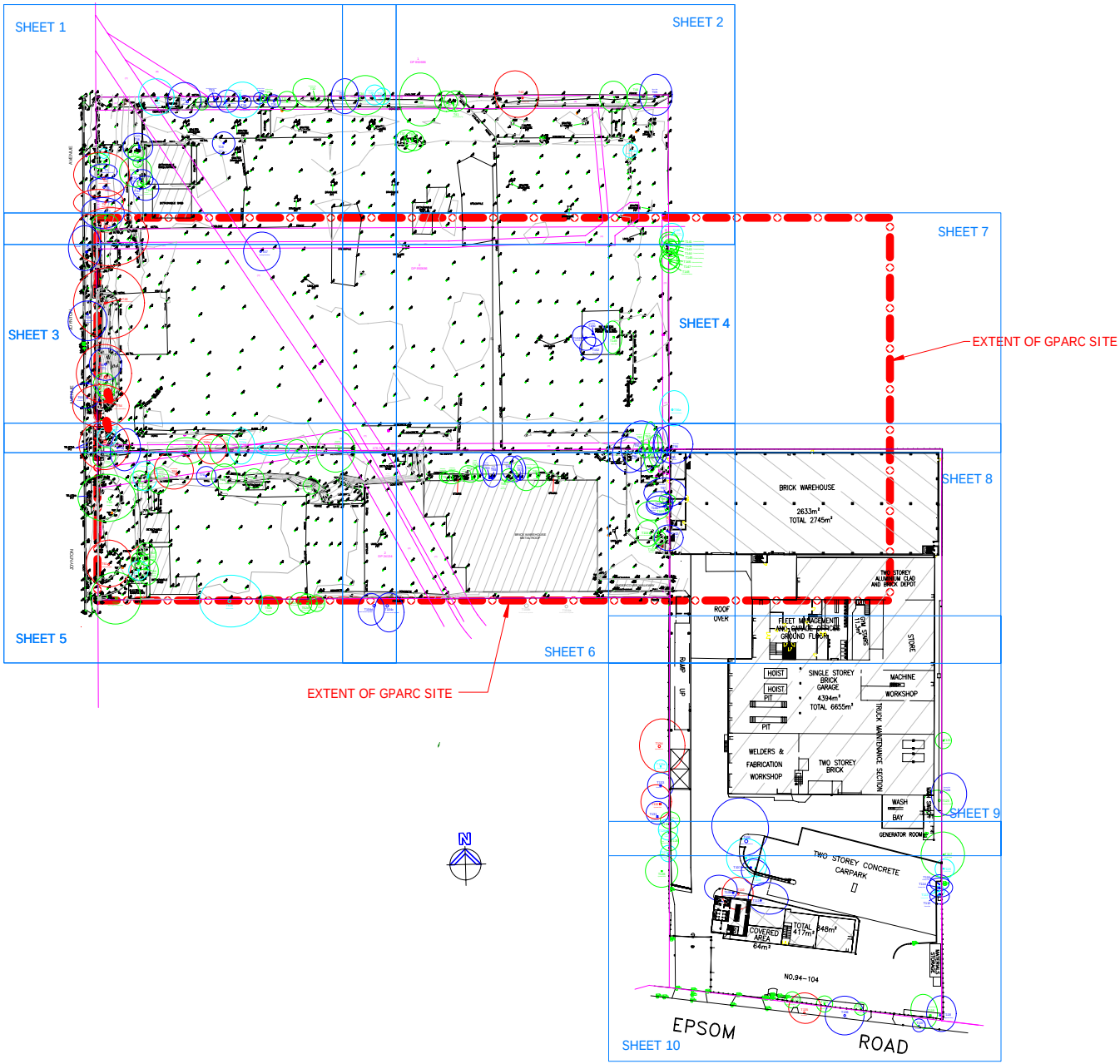
Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
96	***Casuarina cunninghamiana*** (River Oak)	M	6.0	2.4	113.0	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
96a	***Celtis sinensis*** (Chinese Hackberry)	M	5.5	2.3	95.0	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
97	***Casuarina cunninghamiana*** (River Oak)	M	6.2	2.5	121.8	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
98	***Casuarina cunninghamiana*** (River Oak)	M	2.4	1.7	17.6	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
99	***Casuarina cunninghamiana*** (River Oak)	M	4.5	2.2	64.9	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
100	***Casuarina cunninghamiana*** (River Oak)	M	3.7	2.0	42.3	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
101	***Casuarina cunninghamiana*** (River Oak)	M	4.0	2.0	50.2	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
102	***Casuarina cunninghamiana*** (River Oak)	M	4.7	2.2	69.4	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
103	***Grevillea robusta*** (Silky Oak)	M	1.6	1.4	8.1	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
104	***Lagunaria patersonia*** (Norfolk Island Hibiscus)	M	5.4	2.4	91.6	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
104c	***Melaleuca quinquenervia*** (Broad-leaved Paperbark)	M	9.0	3.2	254.3	Located within footprint of proposed new road way (Rose Valley Way) - future works not forming part of the GPARC project).	Proposed works will necessitate removal. To be retained at this stage.	This tree to be retained at this stage. Proposed to be removed by others as part of the Rose Valley Way road works. Note that these works do not form part of the GPARC.
104d	***Melaleuca quinquenervia*** (Broad-leaved Paperbark)	M	9.0	3.2	254.3	Located within footprint of proposed new road way (Rose Valley Way) - future works not forming part of the GPARC project).	Proposed works will necessitate removal. To be retained at this stage.	This tree to be retained at this stage. Proposed to be removed by others as part of the Rose Valley Way road works. Note that these works do not form part of the GPARC.
140	***Celtis sinensis*** (Chinese Hackberry)	M	4.8	2.3	72.3	Located within footprint of proposed new park (Gunyama Park).	Proposed works will necessitate removal	Remove tree.
141	***Celtis sinensis*** (Chinese Hackberry)	M	3.0	1.6	28.3	Located within footprint of proposed new park (Gunyama Park).	Proposed works will necessitate removal	Remove tree.
142	***Celtis sinensis*** (Chinese Hackberry)	M	3.0	1.6	28.3	Located within footprint of proposed new park (Gunyama Park).	Proposed works will necessitate removal	Remove tree.
143	***Celtis sinensis*** (Chinese Hackberry)	M	3.0	1.4	28.3	Located within footprint of proposed new park (Gunyama Park).	Proposed works will necessitate removal	Remove tree.
144	***Celtis sinensis*** (Chinese Hackberry)	M	3.0	1.5	28.3	Located within footprint of proposed new park (Gunyama Park).	Proposed works will necessitate removal	Remove tree.
145	***Celtis sinensis*** (Chinese Hackberry)	M	3.0	1.5	28.3	Located within footprint of proposed new park (Gunyama Park).	Proposed works will necessitate removal	Remove tree.
146	***Celtis sinensis*** (Chinese Hackberry)	M	3.0	1.5	28.3	Located within footprint of proposed new park (Gunyama Park).	Proposed works will necessitate removal	Remove tree.
147	***Celtis sinensis*** (Chinese Hackberry)	M	3.0	1.5	28.3	Located within footprint of proposed new park (Gunyama Park).	Proposed works will necessitate removal	Remove tree.

APPENDIX 4 - IMPACT ASSESSMENT SCHEDULE

Tree Identification No.	Species	Construction Tolerance	Tree Protection Zone (m R)	Structural Root Zone (m R)	TPZ (m^2)	Encroachments to Root Zone &/or Canopy	Likely Impact	Recommendation
148	***Celtis sinensis*** (Chinese Hackberry)	M	3.0	1.6	28.3	Located within footprint of proposed new park (Gunyama Park).	Proposed works will necessitate removal	Remove tree.
149	***Casuarina cunninghamiana*** (River Oak)	M	4.2	2.1	55.4	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree.
150	***Casuarina cunninghamiana*** (River Oak)	M	4.2	2.1	55.4	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
151	***Casuarina cunninghamiana*** (River Oak)	M	3.6	2.0	40.7	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.
152	***Casuarina cunninghamiana*** (River Oak)	M	3.5	1.7	38.5	Located within footprint of proposed new Synthetic Turf sports field	Proposed works will necessitate removal	Remove tree. Undertake replacement planting with a new tree elsewhere within the site to compensate for loss of amenity in accordance with Section 11.



LEGEND

- HIGH
- MODERATE
- LOW
- VERY LOW

APPENDIX 5
TREE LOCATION PLAN SHOWING
TREE RETENTION VALUES
132-140 Joynton Road and
94-104 Epsom Road, ZETLAND, NSW

Earthscape Horticultural Services
Arboricultural and Horticultural Consultants
PO Box 364
BEROWRA NSW 2081
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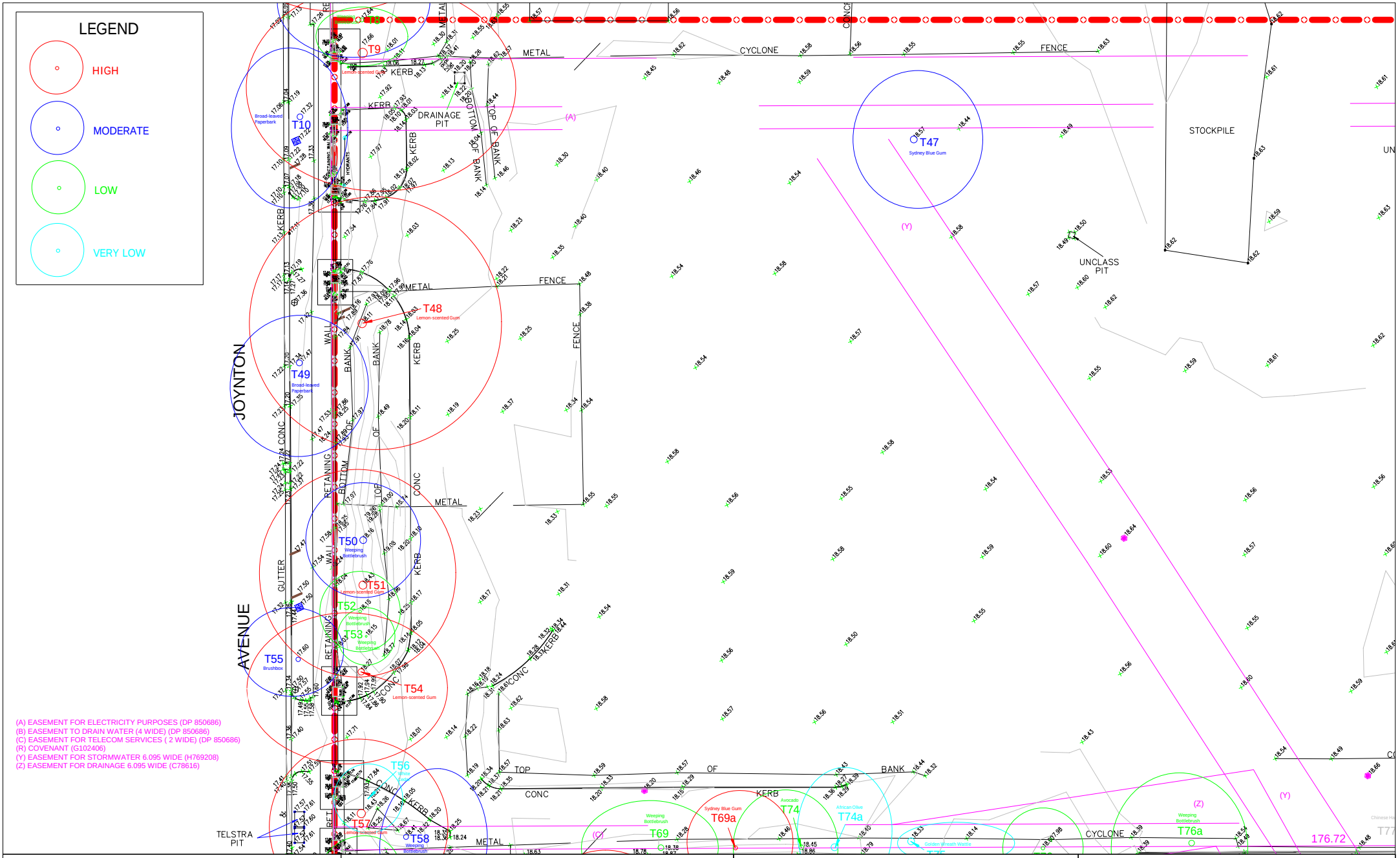
Based on the Survey Drawing
prepared by Cardno Hard & Forester
Dwg Ref No. 11678500
Dated 05/03/2014

DWG No. T14-102401

KEY PLAN

DATE: 23/05/2016



(A) EASEMENT FOR ELECTRICITY PURPOSES (DP 850686)
(B) EASEMENT TO DRAIN WATER (4 WIDE) (DP 850686)
(C) EASEMENT FOR TELECOM SERVICES (2 WIDE) (DP 850686)
(R) COVENANT (G102406)
(Y) EASEMENT FOR STORMWATER 6.095 WIDE (H769208)
(Z) EASEMENT FOR DRAINAGE 6.095 WIDE (C78616)

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SHEET 3
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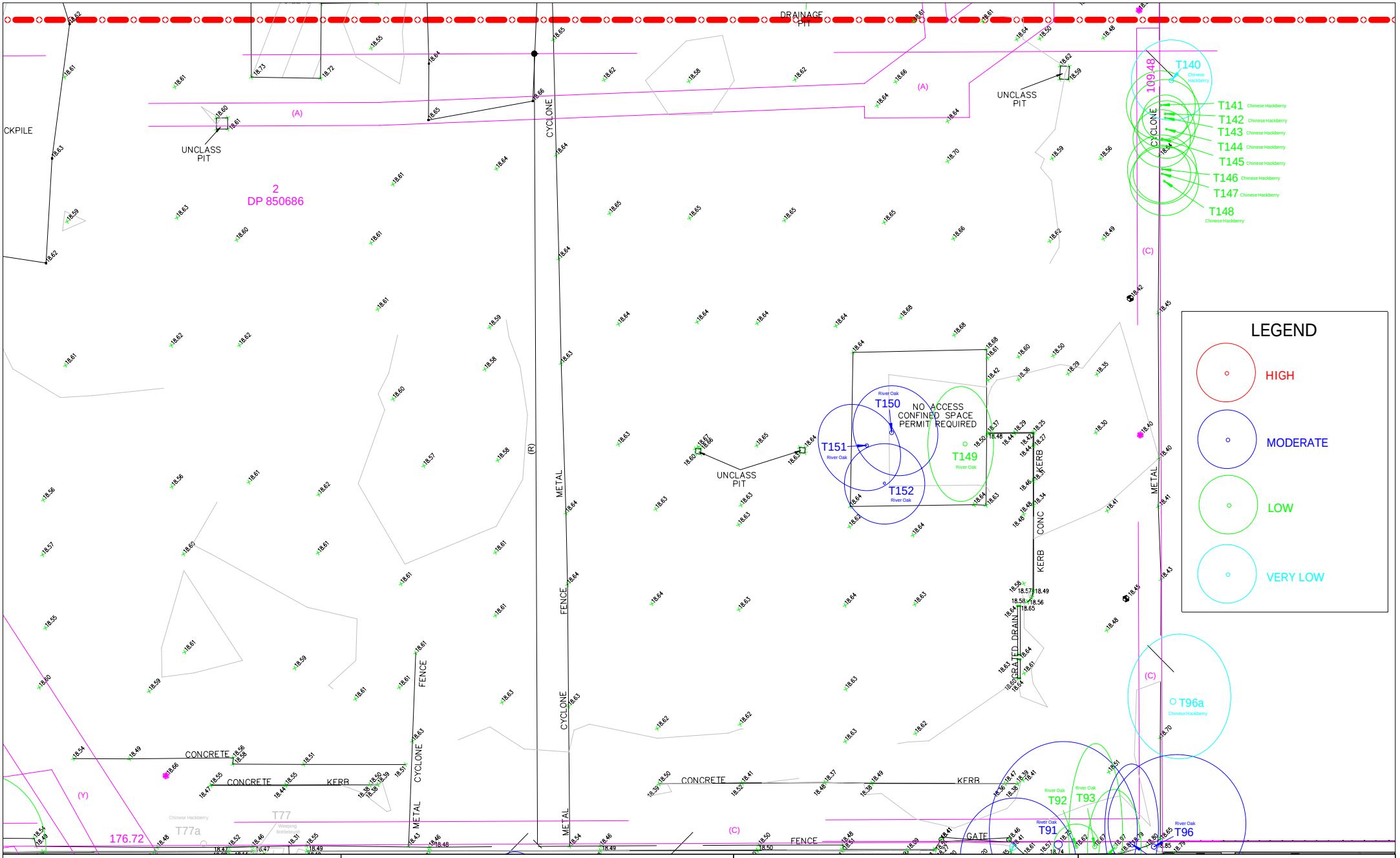

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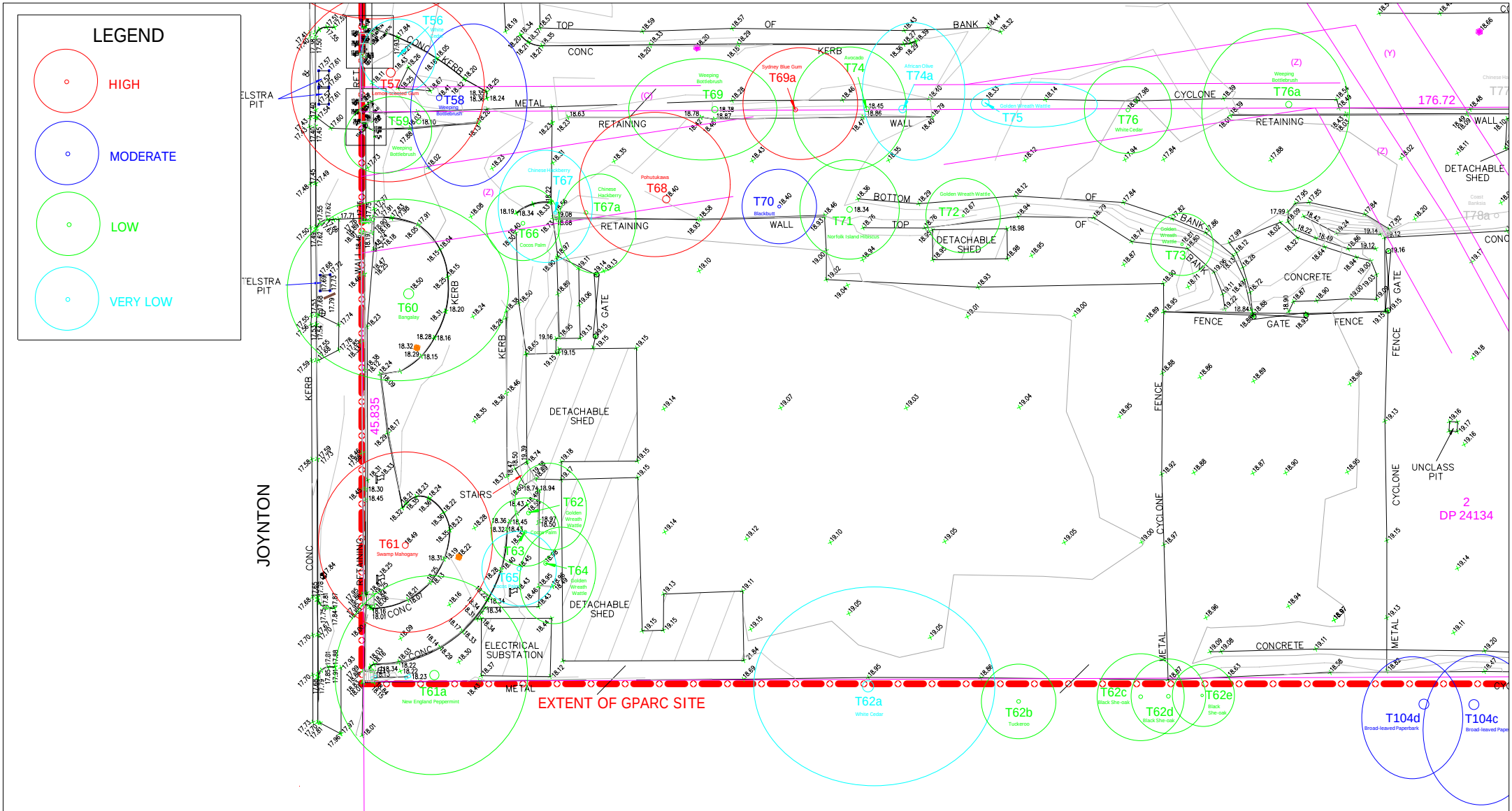

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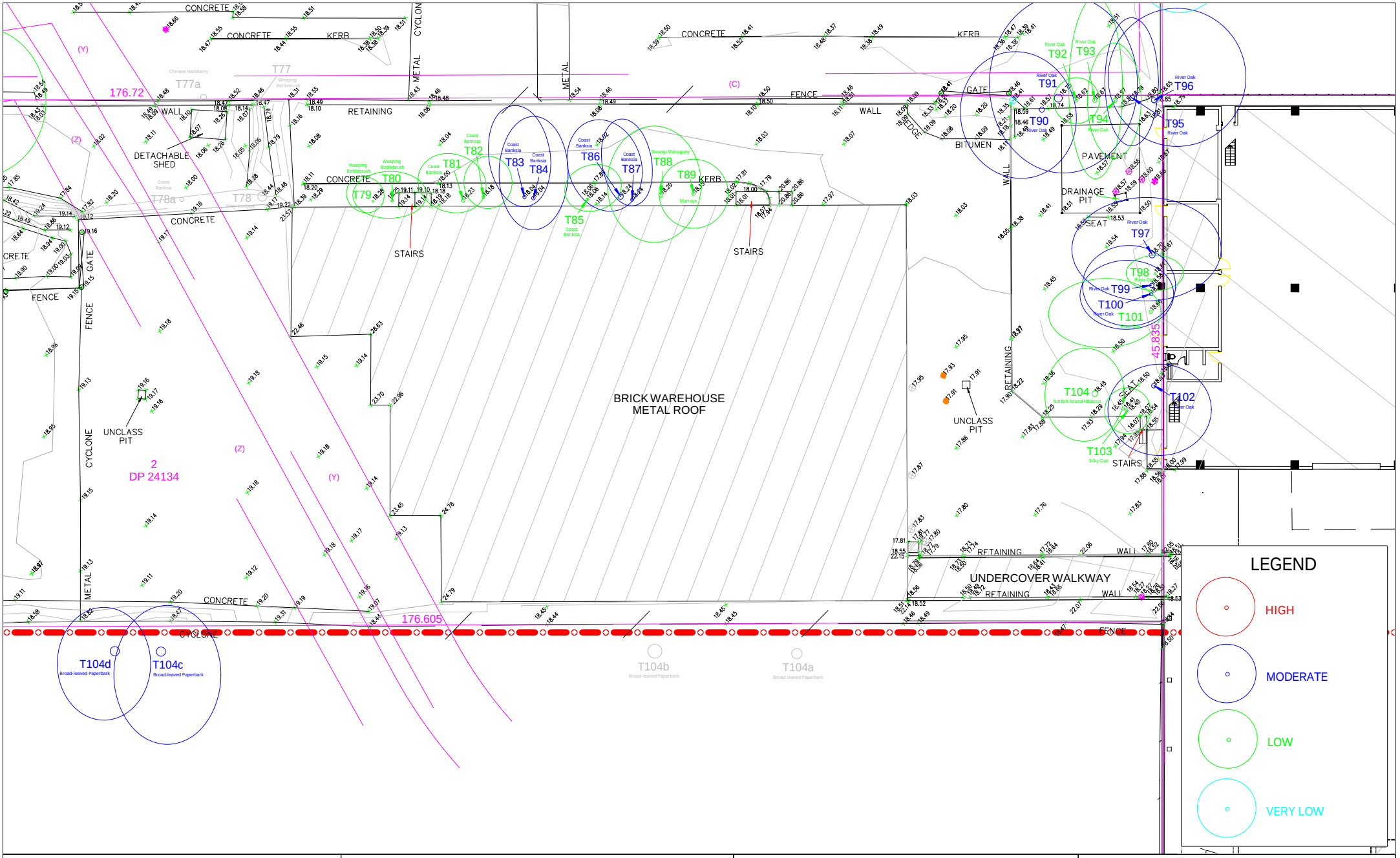

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SHEET 6
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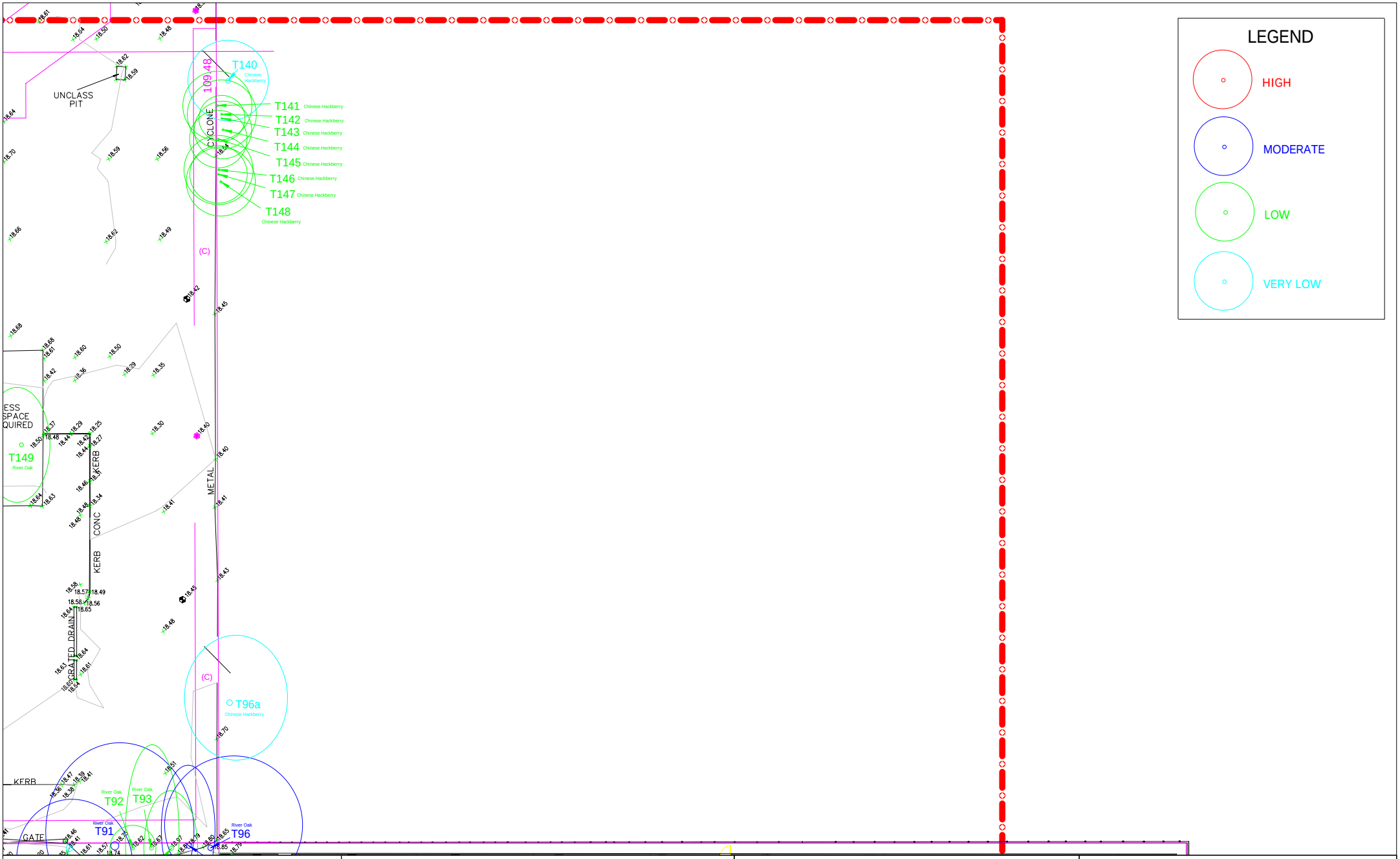

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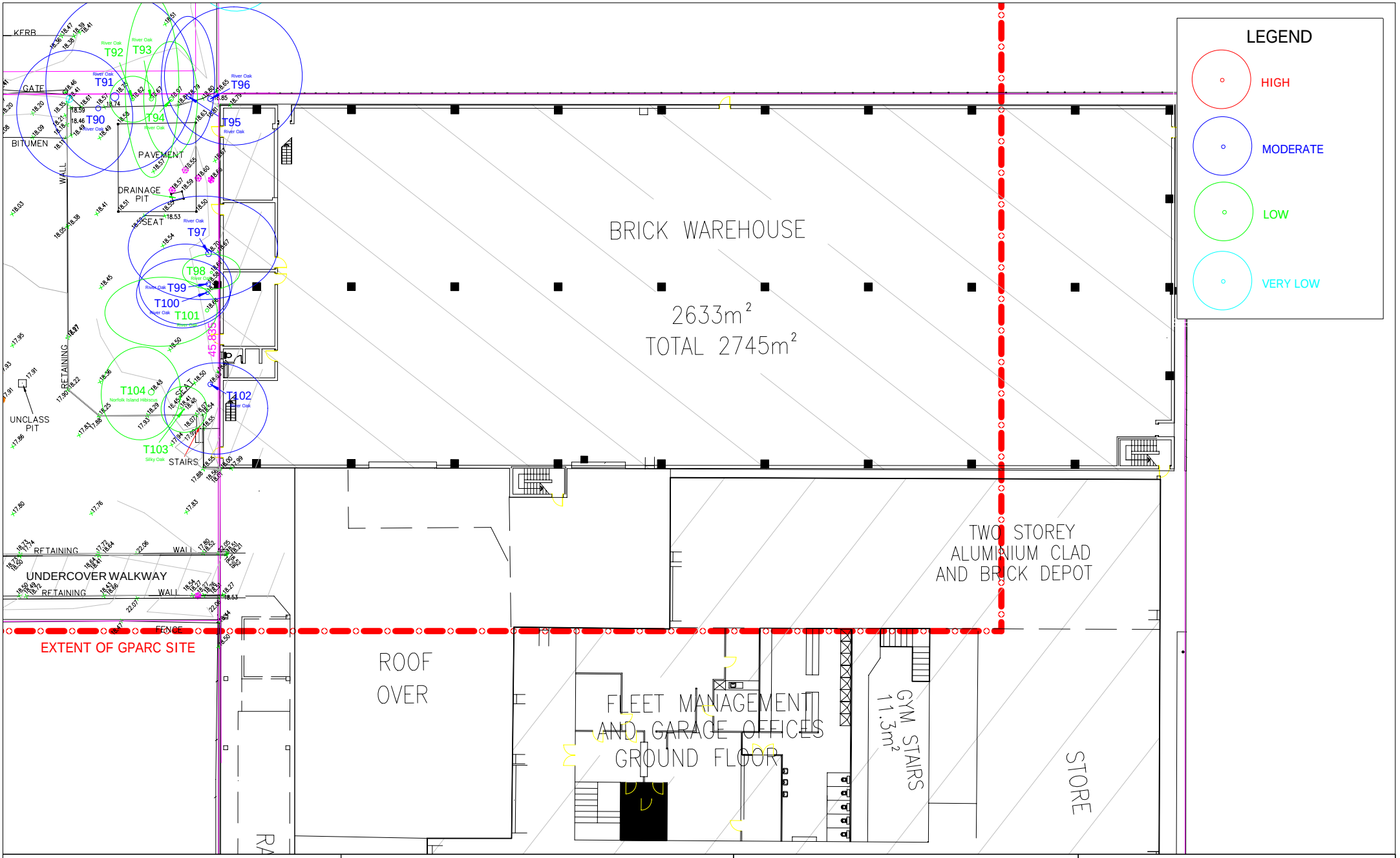
SHEET 7
DATE: 23/05/2016



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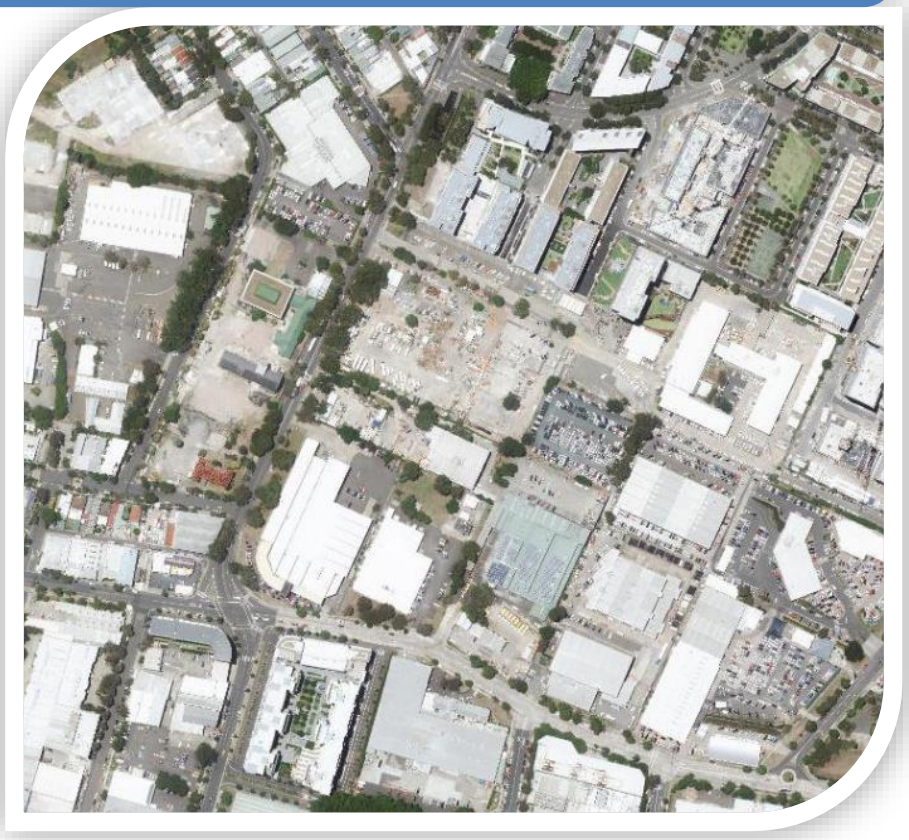
DWG No. T14-102401
SHEET 8
DATE: 23/05/2016

Flora and Fauna Assessment and Test of Significance
Future Gunyama Park and Green Square Aquatic Centre Site



For City of Sydney Council

By Ecological Consultants Australia

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Statement of Authorship

This study and report Flora and Fauna Assessment and 7-Part Test of Significance
Future Gunyama Park and Green Square Aquatic Centre Site *was undertaken by Dragonfly Environmental for the Client – City of Sydney Council. The principle author of the report is Geraldene Dalby-Ball whose qualifications are BSc. majoring in Ecology and Botany. Geraldene (Mia) has over 20 years experience in this field. Other authors are Robert McDougall.*

Limitations Statement

Information presented in this report is based on an objective study undertaken in response to the brief provided by the client. Any opinions expressed in this report are the professional, objective opinions of the authors and are not intended to advocate any particular proposal or pre-determined position.

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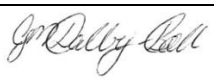
Signed:	
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PURPOSE OF THIS REPORT

Green Square is a 278Ha precinct in inner southern Sydney that is to be the site of a major urban renewal project. Taking in predominantly former industrial land in the City of Sydney Local Government Area the site is set to house up to 53,000 people when development is complete in 2030, along with containing a range of community facilities designed to meet the needs of this greatly expanded residential population.

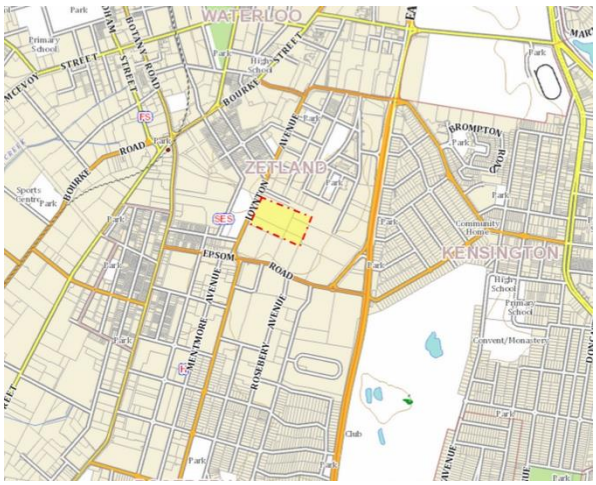
As part of the renewal of this area City of Sydney Council (the City) plan to build a new park – named Gunyama Park – and aquatic centre in an area bordering Joynton Ave and Epsom Rd, Zetland. The City requested Ecological Consultants Australia (ECA) to carry out a flora and fauna assessment and 7-Part-Test on the site to determine whether or not this work would have any significant environmental impacts and, if so, to provide recommendations on minimising these impacts. This report is provided as a response to that request.

SUMMARY

Findings of this flora and fauna report are:

- The site is a highly modified environment consisting primarily of paved areas and buildings.
- Vegetation present is either planted mature trees or weeds, the majority of which are of very limited conservation significance.
- Vertebrate fauna present is limited to bird and mammal species commonly found in suburban environments. Grey-Headed Flying-Foxes, which visit the site to feed on flowers and fruit of trees present, are the only fauna species observed of conservation significance.
- It is recommended that:
  - *Corymbia citriodora* trees be planted as replacement food trees for Grey-Headed Flying-Foxes on-site and elsewhere in the LGA.
  - Hollows be salvaged where possible and retained on-site. At least 4 nest boxes should be installed on-site (2 x micro-bat and 2 x medium size).
  - A qualified ecologist be present on site during removal of potential possum habitat and that at least 1 ring tail possum dray substitute be placed on side when landscape planting is dense enough to provide adequate habitat.

THE SITE



The site is at the location marked with a red outline in Plates 1, 2 and 3 and consists of land identified as Deposited Plan numbers 850686, 24143 and 235181 (with the latter lot being only partly included). The street frontages of these lots are 132-138 and 140 Joynton Ave and 94-104 Epsom Rd, Zetland, in the City of Sydney Local Government Area (LGA).

Prior to European invasion the site consisted of undulating coastal dune fields, with areas of wetland in the swales and valleys, forming what

Plate 1: Location of the site within the suburb of Zetland (Cadastral view)



Plate 2: Location of the site within Zetland (aerial view).

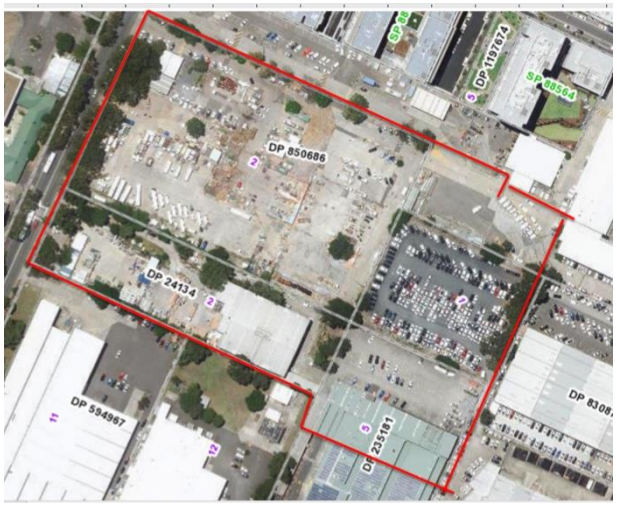


Plate 3: Outline of the site.

early Europeans named the Botany Swamp. Now the land has been levelled, drained and developed. A small constructed wetland is in Woolwash Park (108 Joynton Rd) this may have links to the former wetland.

The subject site itself is now entirely the product of human activity, being mostly paved with concrete and asphalt. The site is occupied by industrial land uses in the form of a council works depot (94-104 Epsom Rd), a scaffolding facility (140 Joynton Ave) and an industrial plant hire depot (132-138 Joynton Ave). The latter two users departed during the course of this study, leaving the sections of the site they previously occupied mostly empty.

The majority of land surrounding the site is also industrial, with notable flora and fauna habitat areas in the vicinity being Woolwash Park (60m from the site), The Australian Golf Course (~600m) Moore Park Golf Course (~800m), Centennial Park (~1.63km) and Sydney Park (~1.67km).

Background Documents

Documents reviewed as part of this study specifically relating to the proposed works are listed below and are included as attachments.

- Attachment I shows an artist impression of the proposed works (ABA and Grimshaw and TCL CompetitionA3 Panels).
- Attachment II Is the *Pre-Development Tree Assessment* by Earthscapes (November 2014). Attachment II includes the *Tree Health and Condition Assessment Schedule* (Appendix 3) and *Tree Protection Zone* (Appendix 4) and *Tree Location Plans Showing Tree Retention Values* (Appendix 5) NB this has 10 maps.

Proposal

The proposal is for the development of a park and aquatic centre on the site. The western section of the site is to host a large covered swimming pool, with surrounding landscaping designed to mimic the patterns of Sydney's beaches and headlands, the central section will host active outdoor recreation

facilities while the eastern section will contain an area of constructed wetland intended to reflect the original environment of the site. The most up to date plan at the time of writing is the winning entry submitted by Andrew Burges Architects as part of the design competition for the site and this has been used as a reference for the site's future development.

ENVIRONMENTAL SURVEY METHODS

Field

The flora and fauna assessment of the site took place via two diurnal and three nocturnal field assessments carried out between in November 2014 and January 2015 (only two nocturnal assessments were initially planned however windy weather during one assessment resulted in highly reduced fauna presence, so an additional survey was carried out). During each assessment ecologists systematically walked throughout the entirety of the site, noting all fauna seen and heard. Habitat features on the site were noted and searched for occupying fauna. Indirect signs of fauna such as scats and scratches on trees were also searched for.

A motion sensing infra-red and visible light camera (Little Acorn 5210A) was also placed on the site for a period of three days in January 2015, located on the fence between 132-138 and 140 Joynton Ave beneath the large English Ivy infestation, looking across 132-138. Bait in the form of tuna and oats/honey/peanut butter mixture was placed in front of the camera at the time of set up to attract any fauna that may be present.

In addition to these methods, the nocturnal surveys included the use of Anabat to detect the presence of microbats, spotlighting to locate fauna via reflected eye-shine and a call playback, where the sounds of seven owl species possibly able to occur in the area were played via a loudspeaker and responses listened for.

Desktop

Currently existing information on threatened fauna and flora of the locality, defined as a 5km radius around the site, was accessed from Bionet and the DPC Atlas of NSW Wildlife (January 2015).

Other literature detailing regionally and locally threatened and significant flora and fauna, as well as endangered populations and plant communities within a 5km radius, including NSW Scientific Committee Final Determinations (1996-2014) and the City's *Urban Ecology Strategic Action Plan* (Urban Ecology Plan) were accessed and reviewed.

Aerial photographs from 1943 were viewed (accessed from https://maps.six.nsw.gov.au/) to assist with ascertaining the presence of remnant vegetation. The Pre-development Tree Assessment (Morton, 2014) was also reviewed.

Limitations of the study

While opportunistic observations of identifiable species were recorded no specific invertebrate surveys were conducted.

Surveys at one time of the year cannot be expected to detect the presence of all species occurring, or likely to occur, in the study area. This is because some species may (a) occur seasonally, (b) utilise different areas periodically (as a component of a more extensive home range), or (c) become dormant during specific periods of the year. Rather, this survey provides the opportunity to sample the area, search specifically for species likely to be encountered within the available time frame, and assess the suitability of habitat for particular species.

Considering the site and habitat availability ECA are confident that this survey is representative of the likely species and vegetation community composition of the site and that future studies at other times

would not change the recommendations.

FINDINGS

VEGETATION AND HABITAT

The site is highly modified from the natural environments that once existed in this location. It consists mostly of flat areas paved with concrete or asphalt, with warehouse and office buildings and a multi-storey vehicle storage facility at 94-104 Epsom Rd. Most structures located at 132-140 Joynton Ave were temporary in nature (demountable buildings and containers) and were progressively moved off the site as tenants left over the course of the study period between November 2014 and January 2015.

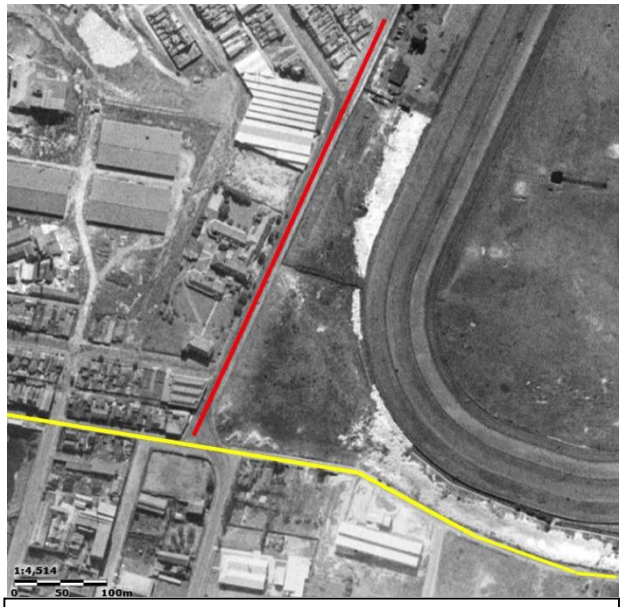


Plate 4 - The site, as shown in an aerial photograph from 1943, with little vegetation present. Joynton Ave is marked by the red line whilst Epsom Rd is marked by the yellow line. (source: https://maps.six.nsw.gov.au/)

Vegetation on the site is mostly one of two types; mature trees and weeds, with virtually no native mid or understorey vegetation. Morton (2014) identified 152 trees within the site - most are growing along the lot boundaries within the site and are not present in historical photos of the area (see plate 4) indicating that they have been planted since 1943 and are not remnants of a naturally occurring ecological community.

The proposed design for the future site is generally inconsistent with the retention of on-site trees. See the *Tree Assessment Appendix Plan* which locates the existing trees, particularly the trees recommended for retention.

Most of the trees growing on-site are of limited ecological value and are exotic species. A few exceptions to this exist on the site, and these are outlined below.

Lemon-scented Gum

Seven Lemon-scented Gum (*Corymbia citriodora)* trees fronting Joynton Ave - numbered in Morton (2014) as 4, 6, 9, 48, 51, 54 and 57 - have ecological value. Joynton Avenue is being raised in mid-2017 and raising the street levels may impact on the health and longevity of trees near the road hence it is likely these trees will be removed at the time of the development.

This species naturally occurred in the area prior to European invasion and serves as an important food tree for the vulnerable Grey-Headed Flying-Fox (the only threatened species recorded on the site – see fauna section below). In addition to the general values of this species of tree, the individual trees present are valuable in that they show the beginnings of hollow development, as shown in Plate 5.

The NSW Scientific Committee (2007) outlines the size and age at which >50% of trees of a given species have significant hollows and notes that *C. citriodora* generally develops these at a trunk diameter of 70cm and an age of 160 years. Whilst these trees are significantly younger than 160 years (Morton [2014] estimates their ages to be between 35 and 45 years) trees 4, 9, 48 and 51 already have trunks with a Diameter at Breast Height of 70cm or greater.



Plate 5 - One of the *Corymbia citriodora* trees fronting Joynton Ave, showing the early signs of hollow development.

Thus it is possible that some of these trees could have develop more significant hollows in coming decades, providing roosting and breeding habitat for wildlife and making a small contribution to reversing loss of hollows, which is declared as a Key Threatening Process in NSW (NSW Scientific Committee 2007).

Given the location of these trees on the edge of the site, where the proposal includes raising the height of the road the trees may not be retained. If the trees cannot be retained it is recommended that the hollows be removed from the trees by arborists at the time of tree felling. Hollows can be relocated on site on trees or structure over 4m in height. If existing hollows are not viable post tree felling (i.e. they are not well formed or break) then at least four nest boxes are recommended. Two for micro-bats and two for small birds.

Cocos Palms

Grey-Headed Flying Foxes were observed feeding on the three Cocos Palms (*Syagrus romanzoffianum*) located in 140 Joynton Ave (trees 63, 65 and 66 in Morton [2014]). While Morton (2014) lists these trees as being of low or very low retention value, and the species is an exotic one that can be invasive in parts of Australia, the depletion of feeding resources for the Grey-Headed Flying-Fox across their native range means that these trees should be left in place as long as possible and replaced with locally native species able to provide food for Grey-Headed Flying-Foxes after their removal.

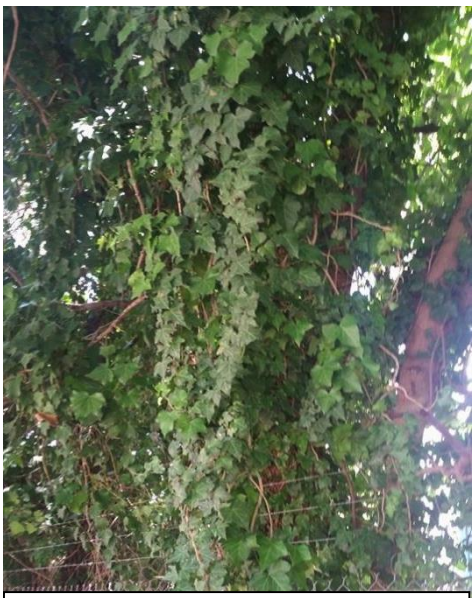


Plate 6 – A dense growth of English Ivy on the fence between properties 132-138 and 140 Joynton Ave.

Weeds

Other than planted trees, the main vegetation present on the site is weeds. Weeds are mostly present along the lot boundaries, particularly along the street frontage of 132-138 Joynton Ave and on the boundary between this property and 140 Joynton Ave.

Weeds present include Castor Oil Plant (*Ricinus communis*) and Pampas Grass (*Cortaderia* sp.), both of which are declared noxious weeds within the City of Sydney LGA, along with numerous environmental weeds such as Madera Vine (*Anredera cordifolia*), Cobblers peg (*Bidens pilosa*) and Asthma Weed (*Parietaria judaica*). Despite their weed status, many of these plants can provide potential fauna habitat.

Of particular note, in terms of habitat, is the patch of English Ivy (*Hedera helix*) growing on the fence and some of trees between 132-138 and 140 Joynton Ave (shown in Plate 6), which is one of the only patches of vegetation on the site dense enough to host Ring-tailed Possum drays. While no drays were observed during the survey period the lessee of 140 Joynton Ave reported regular sightings Ring-tailed Possums on that property and it is likely that those possums live in the dense ivy in this area. It is therefore recommended that, when this is removed, an ecologist or wildlife handler be present on site to relocate any possums that may be present.

Other Habitat Resources

A number of other resources that wildlife could use as feeding and roosting habitat exist on the site. Spaces under buildings in 94-104 Epsom Rd, and the drainage canal running under this property (which is open to the air at 106 Epsom Rd) could serve as roosting spaces for small ground mammals and birds and microbats respectively. These sites were examined in the course of the survey and other than pigeon droppings within the drainage canal no signs of wildlife were found within them.

The small vegetable garden in the rear of 94-104 Epsom Rd could provide food for wildlife including possums, birds and Grey-Headed Flying-Foxes. Value s relative minor and most of the plants growing there were not fruiting at the time of the study.

FAUNA

Fauna on the site was of low abundance and diversity and consisted entirely of species commonly found within urban environments and previously reported within the City of Sydney LGA. One reptile was seen, Common Garden Skink, searches were made for the Gully Skink as it has been recorded form within 2km of the site. None were seen and habitat is not optimal. No snakes were seen although some could live on-site in the piled materials (no threatened species). Vertebrate species found are shown on Table 1.

Table 1 – Fauna observed on site

Species	Abundance
Reptiles	
Common Garden Skink *Lampropholis gouchionti*	
Birds	
Australian Raven	+
Australian White Ibis	++
Common Myna*	++
Crested Pigeon	++
Eastern Koel^	+
Magpie Lark	+
Masked Lapwing	++
Noisy Miner	+++
Pied Currawong	++
Rainbow Lorikeet	++
Welcome Swallow#	+++
Mammals	
Common Brush-Tailed Possum	+
Cat*	+
Grey-Headed Flying Fox	+++

+ Single individual present

++ 2-5 individuals present

+++ more than 5 individuals present


White Ibis


Crested Pigeon

*Introduced species

^The call of an Eastern Koel was heard while on site but exact location could not be determined and no individuals were seen on the site.

#Welcome Swallows were seen flying around above the site, but were not observed to land within the site.

All species found are generally considered to be well-adapted to life in an urban environment.

While the physical nature of the site is generally inhospitable to most wildlife a number of the fauna species present may also play a role in keeping diversity low.

Noisy Miners, Rainbow Lorikeets and Pied Currawongs all exist at unnaturally high levels in urban environments as a result of an increased abundance of food plants grown as landscape features. Miners and Lorikeets are aggressively territorial and attack smaller birds whilst Currawongs prey on smaller bird species, which are often vulnerable without the shelter provided by more complex habitats found in natural environments.

Predation by cats is also a widespread problem in Australia that has been identified as a threat to the survival of 35 bird, 36 mammal, 7 reptile and 3 amphibian species (DoE, 2011). Of fauna likely to occur on the site a wide range of birds, along with ring-tailed possums, could all potentially fall prey to cats. Whilst only a single cat was observed during the survey period (with the same individual being observed on two separate nocturnal surveys – shown in Plate 7) it is likely that stray and/or feral cats have been present on the site for some time, as noted by the presence of signs in the Council depot reading 'do not feed the cats'.



Plate 7 – the cat on site, observed at night.

Other than Grey-Headed Flying-Foxes (discussed in the next section) none of the fauna on the site is of conservation significance. While steps should be taken to ensure no possums are harmed when removing trees or demolishing buildings, all other fauna are easily able to escape harm caused by demolition and construction work and other than those relating to Grey-Headed Flying-Foxes no changes to the proposal are recommended on the basis of the fauna present.

THREATENED SPECIES

Grey-Headed Flying-Fox

One threatened species, the Grey-Headed Flying-Fox, was observed on the site. This species is listed as Vulnerable under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* (1999) and the NSW *Threatened Species Conservation Act* 1995 and is considered a priority fauna species in the Urban Ecology Plan. Grey-Headed Flying-Foxes roam widely from large communal roosting areas called camps each night, feeding on a range of flowers and fruit from both native and exotic trees.

A major Grey-Headed Flying-Fox camp is located in Centennial Park, approximately 1.6km from the site, with another at Wolli Creek, approximately 3 km from the site. Individuals from these and other local camps visit the site to feed – they were observed feeding on fruit of introduced Cocos Palms and are also known to feed on the blossoms and fruit of a number of other tree species currently growing on the site. While trees on the site would make up only a very small proportion of the overall diet of local Grey-Headed Flying-Foxes, loss of foraging habitat is identified as one of the key threats to the survival of this species (DoE 2009).

As the *Corymbia citriodora* trees fronting Joynton Ave are proposed for removal it is recommend that City of Sydney include this species in plantings in other city parks and in the on-site landscaping. It has been noted to be an important part of the Grey-Headed Flying-Fox blossom diet (Eby and Law, 2008) and the size of the individual trees present means they produce a quantity of nectar that replacement plantings would not be able to replicate for several decades.

Cocos Palms and a number of other trees that will require removal to complete the proposal as planned also contribute to the diet of the Grey-Headed Flying-Fox and it is recommended that these be retained on site as long as possible and replaced with an equal or greater number of native food trees as part of the final development of the proposal – see recommendations section.

It is noted that the City's Street Tree Master Plan (2011) recommends Joynton Ave be planted with Spotted Gums (*Corymbia maculata)* this is supported. This species is one of the most important food trees for Grey-headed Flying-Foxes and as it flowers at different times of year to Lemon Myrtle the two complement each other well in helping contribute to a year round food supply.

Other Threatened Species

A search of the Bionet database (http://www.bionet.nsw.gov.au/) revealed that 70 threatened species and two endangered populations have been recorded within a 5km radius of the site. All species recorded are shown in Table 2.

Table 2 - Threatened species recorded within 5km of the site

Latin Name	Common Name
Crinia tinnula	Wallum Froglet
Pseudophryne australis	Red-crowned Toadlet
Litoria aurea	Green and Golden Bell Frog
Anseranas semipalmata	Magpie Goose
Stictonetta naevosa	Freckled Duck
Ptilinopus superbus	Superb Fruit-Dove
Hirundapus caudacutus	White-throated Needletail
Diomedea exulans	Wandering Albatross
Ardenna pacificus	Wedge-tailed Shearwater
Ardea ibis	Cattle Egret
Botaurus poiciloptilus	Australasian Bittern
Erythrotriorchis radiatus	Red Goshawk
Haliaeetus leucogaster	White-bellied Sea-Eagle
Hieraaetus morphnoides	Little Eagle
Burhinus grallarius	Bush Stone-curlew
Haematopus fuliginosus	Sooty Oystercatcher
Haematopus longirostris	Pied Oystercatcher
Charadrius leschenaultii	Greater Sand-plover
Charadrius mongolus	Lesser Sand-plover
Pluvialis fulva	Pacific Golden Plover
Actitis hypoleucos	Common Sandpiper
Calidris acuminata	Sharp-tailed Sandpiper
Calidris alba	Sanderling
Calidris canutus	Red Knot
Calidris ferruginea	Curlew Sandpiper
Calidris melanotos	Pectoral Sandpiper
Calidris ruficollis	Red-necked Stint
Calidris tenuirostris	Great Knot
Gallinago hardwickii	Latham's Snipe
Limicola falcinellus	Broad-billed Sandpiper

Latin Name	Common Name
Limosa lapponica	Bar-tailed Godwit
Limosa limosa	Black-tailed Godwit
Numenius madagascariensis	Eastern Curlew
Numenius minutus	Little Curlew
Tringa glareola	Wood Sandpiper
Tringa nebularia	Common Greenshank
Tringa stagnatilis	Marsh Sandpiper
Xenus cinereus	Terek Sandpiper
Stercorarius pomarinus	Pomarine Jaeger
Hydroprogne caspia	Caspian Tern
Sterna hirundo	Common Tern
Sternula albifrons	Little Tern
Lathamus discolor	Swift Parrot
Ninox strenua	Powerful Owl
Anthochaera phrygia	Regent Honeyeater
Epthianura albifrons	White-fronted Chat
Epthianura albifrons	White-fronted Chat population in the Sydney Metropolitan Catchment Management Area
Stagonopleura guttata	Diamond Firetail
Perameles nasuta	Long-nosed Bandicoot population in inner western Sydney
Pteropus poliocephalus	Grey-headed Flying-fox
Mormopterus norfolkensis	Eastern Freetail-bat
Miniopterus australis	Little Bentwing-bat
Miniopterus schreibersii	Eastern Bentwing-bat
Myotis macropus	Southern Myotis
Arctocephalus forsteri	New Zealand Fur-seal
Arctocephalus pusillus	Australian Fur-seal
Eubalaena australis	Southern Right Whale
Hibbertia puberula	
Tetratheca juncea	Black-eyed Susan
Amperea xiphoclada	
Acacia gordonii	
Acacia terminalis subsp.	Sunshine Wattle
Prostanthera marifolia	Seaforth Mintbush
Eucalyptus fracta	Broken Back Ironbark
Eucalyptus nicholii	Narrow-leaved Black Peppermint
Eucalyptus pulverulenta	Silver-leafed Gum
Eucalyptus scoparia	Wallangarra White Gum
Melaleuca deanei	Deane's Paperbark
Syzygium paniculatum	Magenta Lilly Pilly
Caladenia tessellata	Thick Lip Spider Orchid
Dichanthium setosum	Bluegrass
Persoonia hirsuta	Hairy Geebung

Aside from the Grey-Headed Flying-Foxes observed, the site is not considered to be suitable habitat for any of the species listed with the possible exception of the four listed microbat species (Eastern Freetail-bat, Little Bentwing-bat, Eastern Bentwing-bat, Southern Myotis) and three tree species (Narrow-leaved Black Peppermint, Wallangarra White Gum and Magenta Lilly Pilly).

Microbats mostly feed on insects and while, in their natural habitat, they roost in caves or under fissures in tree bark they have adapted to urban environments by roosting in cavities in buildings and in sub-terrain drainage lines.

An Anabat was used during the course of this survey to detect microbats via their ultra-sonic echolocation, however no such signals were picked up. It is considered highly unlikely that microbats will move into the site between the survey period and the demolition of buildings as the site does not host any habitat features that are not otherwise abundant in an urban environment, therefor it is not considered that any special action need be taken to protect microbats during demolition and construction works.

While Narrow-leaved Black Peppermint, Wallangarra White Gum and Magenta Lilly Pilly trees are all present on the site, they are all common as garden plants. Like all other trees present on the site, they have been planted and do not form part of a naturally occurring ecological community. They are also not native to the local area. Thus, it is not considered necessary for any specific course of action to be taken to conserve these trees.

7-PART TEST OF SIGNIFICANCE

The following outlines the impacts considered likely as a result of the proposal.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

While the loss of some foraging habitat will have a very minor impact on Grey-Headed Flying-Foxes, the action is not considered likely to place the species, or any specific populations of it, at further risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

No endangered populations present.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

> **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
> **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

No endangered or critically endangered ecological communities are present or likely to be affected by the proposal.

(d) in relation to the habitat of a threatened species, population or ecological community:

> **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
> **(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

(i) Foraging habitat for Grey-Headed Flying-Foxes will be reduced by a very minor amount.
(ii) The mobility of Grey-Headed Flying-Foxes means their habitat will not be markedly fragmented by any loss of trees associated with this proposal.
(iii) The trees to be lost are only a very minor part of the foraging habitat of the local population of Grey-Headed Flying-Foxes, with individuals moving about throughout a range that potentially covers hundreds of kilometres over the course of a year. As a result, any trees to be removed as part of this proposal are considered to be of limited importance.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No critical habitat present.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Draft National Recovery Plan for the Grey-Headed Flying-Fox (Eby et al 2009) lists the following as an action to assist in the recovery of this species:

> "Identify and protect foraging habitat critical to the survival of Grey-Headed Flying-Foxes across their range."

The site is not considered to contain habitat critical to the species and thus the proposal is not inconsistent with this, or any other, objectives of the recovery plan.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

Loss of hollow bearing trees is considered a key-threatening process under the NSW *Threatened Species Conservation Act* (1995). While none of the trees on site contain fully developed hollows, removing the trees along Joynton Ave that contain early stage hollows will slow down regeneration of hollows in the area. While there is no legislative requirement to protect these trees, beyond rules that protect all mature native trees, it is recommended any tree removal include the retention and relocation of viable hollows and or the installation of nest boxes (microbat and small bird).

Summary

The proposal is not considered likely to significantly impact on any threatened species. Whilst the loss of some food trees will have a very small impact on Grey-Headed Flying-Foxes, these impacts can be mitigated by planting appropriate food trees as part of the final site landscaping works (see *recommendations*).

RECOMMENDATIONS

REPLACEMENT OF *CORYMBIA CITRIODORA* TREES

As the *Corymbia citriodora* trees fronting Joynton Ave are proposed for removal – associated with road raising in 2017. It is suggested that the hollows be removed from the trees by arborists at the time of tree felling. Hollows can be relocated on site on trees or structures over 4m in height. If existing hollows are not viable post tree felling (i.e. they are not well formed or break) then at least four nest boxes are recommended. Two for micro-bats and two for small birds. More boxes would be beneficial.

In future if it is possible to retain any of these trees in-situ it will contribute to the Urban Ecology Plan goal of "protecting and expanding locally indigenous vegetation".

If removed the proposed planting of *Corymbia maculata* trees along Joynton Ave under the City's *Street Tree Master Plan* (2011), should be supplemented with *Corymbia citriodora* as they flower at different times thus contributing to Grey-Headed Flying-Fox feeding habitat by providing nectar rich flowers across more of the year than would be provided by a single species.

PLANTING OF REPLACEMENT GREY-HEADED FLYING-FOX FEEDING HABITAT

The majority of the trees across the site will have to be removed to facilitate the proposal in its current form. While most are generally of limited conservation value, one important ecological function that many have is as food trees for Grey-Headed Flying-Foxes. Eby and Law (2008) list native trees that provide important feeding resources to this threatened species, with 50 individual trees listed as key food trees currently growing on the site. The species and number of each tree is listed in Table 3.

Table 3: Key native Grey-Headed Flying-Fox food trees currently on site

Species	Number Present
Sydney Red Gum (*Angophora costata)*	1
Broad-leaved Paperbark *(Melealeuca quinquenervia*)	6
Blackbean (*Castanospermum austral*)	1
White Cedar (*Melia azedarach*)	6
Sydney Blue Gum (*Eucalyptus saligna)*	2
Brushbox *(Lophostemon confertus)*	5
Bangalay (*Eucalyptus botryoides*)	1
Swamp Mahogany (*Eucalyptus robusta)*	2
Grey Ironbark *(Eucalyptus paniculata)*	1
Port Jackson Fig *Ficus rubiginosa)*	2
Spotted Gum (*Corymbia maculata)*	5
Lemon Scented Gum (*Corymbia citriodora)*	18

In addition to these native species, Grey-Headed Flying-Foxes were observed feeding on the three exotic Cocos Palms (*Syagrus romanzoffianum*) on site and likely also eat the fruit of the three exotic Washington Palms (*Washingtonia robusta*). There are thus 56 individual trees on site that make a potential contribution to the survival of the Grey-Headed Flying-Fox. All of these trees, aside from some of the *Corymbia citriodora* trees discussed above, will likely require removal to facilitate the proposal as currently planned.

It is thus recommended that a number of Grey-Headed Flying-Fox food trees at least equal to the number removed be planted on the site as part of landscaping for the new development. New trees should be locally native (not all the trees in Table 3 naturally occur in the area), with exact number and species determined based on Eby and Law (2008). A diversity of species, rather than a monoculture, should be planted to ensure year-round food resources and a variety of habitat forms (e.g. rough bark and smooth bark).

This action would contribute to the Urban Ecology Plan goals to "Protect and enhance sites that provide habitat for priority fauna" and "Re-establish representative patches of the likely original vegetation communities".

ECOLOGICAL OBSERVATION OF IVY REMOVAL

Ring-Tailed Possums have been observed within 140 Joynton Ave and likely move across the entirety of the site. One area of high value habitat for this species is the dense ivy infestation growing on the trees and fence line separating 140 and 132-138 Joynton Ave.

Ring-Tailed Possums, particularly juveniles, can be injured or killed when their habitat is removed and it is therefore recommended that when this section of vegetation is removed, a qualified ecologist or wildlife carer be present on site to advise on possum-friendly removal techniques and capture and release, in an appropriate location, any individuals present. A substitute ring-tail possum dray is recommended for the site. This is made from 2 coir filled wire hanging baskets attached to each other to make a ball shape. This should be placed in any dense vegetation remaining on site on in dense vegetation in the planted sections once vegetation has established. Ring-tail possums can be released into the park (from local wildlife carers) once the habitat has established.

REFERENCES

BioNet Atlas of NSW Wildlife - http://www.bionet.nsw.gov.au/ (Office of Environment and Heritage)

City of Sydney 2011 – *Street Tree Master Plan*

City of Sydney 2014 – *Urban Ecology Strategic Action Plan*

Department of Environment 2011 – Feral Cats. http://www.environment.gov.au/biodiversity/invasive-species/feral-animals-australia/feral-cats

Department of Environment 2001 - Pteropus poliocephalus (Grey-headed Flying-fox). http://www.environment.gov.au/node/16466

Eby, P. 2009 - Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*.

Eby, P. and Law, B. 2008 - *Ranking the feeding habitats of Grey-headed flying foxes for conservation management*

Sixmaps – maps.six.nsw.gov.au (Land and Property Information NSW)

Morton, A. 2014 – *Pre-Development Tree Assessment Report, 132-140 Joynton Avenue and 94-104 Epsom Road, Zetland*

NSW Scientific Committee 2007 – Loss of Hollow Bearing Trees – Key Threatening Process Determination. http://www.environment.nsw.gov.au/determinations/lossofhollowtreesktp.htm

ATTACHMENTS

Attachment I shows an artist impression of the proposed works (ABA and Grimshaw and TCL CompetitionA3 Panels).

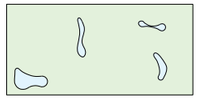
Attachment II Is the *Pre-Development Tree Assessment* by Earthscapes (November 2014). Attachment II includes the *Tree Health and Condition Assessment Schedule* (Appendix 3) and *Tree Protection Zone* (Appendix 4) and *Tree Location Plans Showing Tree Retention Values* (Appendix 5) NB this has 10 maps.



EAST SYDNEY BEACH POOLS COLLAGE

INDIGENOUS WETLAND

The site, immersed within the wetland landscapes of the Botany swamp.



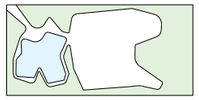
TOPOGRAPHIC INSERTION

A new geography constructed from the topographic insertion of key water and recreational programs into the site.



EMBEDDED RECREATIONAL LANDSCAPE

The newly constructed topography of headlands and valleys embeds a contemporary recreational landscape and pools within the indigenous banksia scrub and wetland landscape.



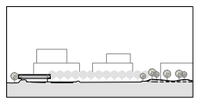
INDUSTRIAL SCALE URBAN TRELLIS

A remnant large span roof is elevated over the new landscape, providing an industrial scale urban trellis shading the forecourt and pool landscapes, and containing the large span dry programs of the gymnasium and fitness rooms.



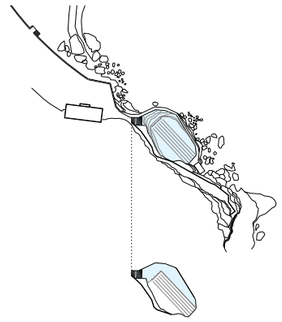
LANDSCAPE GROUND PLANE

With the wet program located in the introduced headlands and the dry program located in the industrial roofscape, a landscaped groundplane is free to extend across the full footprint of the site.



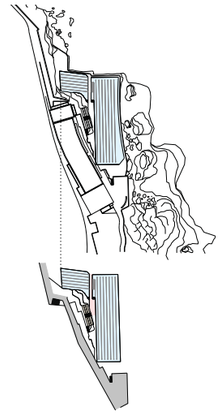
BEACH AND COASTAL POOL ANALYSIS

Very few indoor pools have been able to offer the PLEASURES OF SWIMMING that can match the primacy and hedonistic experience of swimming in Sydney's beach and harbour pools. Inspired by our collage of Sydney beach pools, our proposal establishes a playful interaction of natural and constructed landscapes that GRAFTS THE BEACH into the urban pool experience.



FREE POOL AREA - BRONTE COASTAL POOL

An area for laps is subtly demarcated within a free form oval shaped pool, creating a free pool area that expands the social possibilities and uses of the pool beyond lap swimming



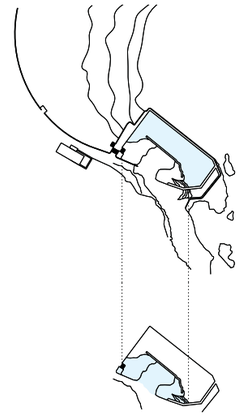
BLEACHER POOL EDGE, BOARDWALK POOL ENTRY, ELEVATED WALKWAY, OUTDOOR DECK – BONDI ICEBERGS

On the edge of the pool a landscape of bleachers creates a hedonistic social space for relaxing, reading and sun baking with friends. Two pools are separated by a boardwalk that provides a stair entry into the main pool. The social space of the pool is intensified by a public walkway and elevated deck overlooking the pool.



FREE EDGE, MALABAR POOL

A more conventional rectangular form is held on three sides of the pool, with the fourth a free form edge adjusted to the topographic edge and rock formations of the pool's site.



BEACH ENTRY, SOUTH CURL CURL

A conventional rectangular lap pool is entered through a substantial beach entry demarcated from the main pool by a low wall, creating a separate but connected gentle beach entry into the main body of water.



VIEW OVER 50M POOL AND BEACH ENTRY FROM TOP OF BLEACHERS



PRE-EUROPEAN WATERSCAPE - 1:100000

The location for Gunyama Park, fully immersed in the waterscape of the Botany Swamp. (Drawing taken from 1892 Tramway Map, Dept of Lands)



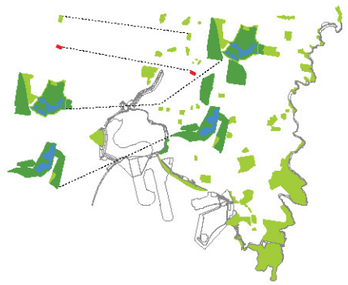
WETLAND LANDSCAPE - 1:100000

Map showing the extent of the botany swamp and banksia scrub landscape relative to the position of Gunyama Park (Drawing taken from Source: Benson & Howell, Taken for Granted 1990, p. 90, courtesy Doug Benson.)



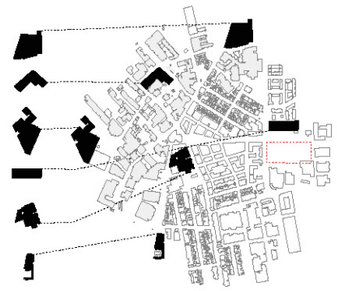
MARKET GARDEN PATCHWORK -1:100000

Map showing the extent of market gardening and intensified agricultural uses around Botany, to the south of the Gunyama site around 1850. (Drawing taken from Department of Lands, Water Reserve and the Country between Sydney and Botany, 1850)



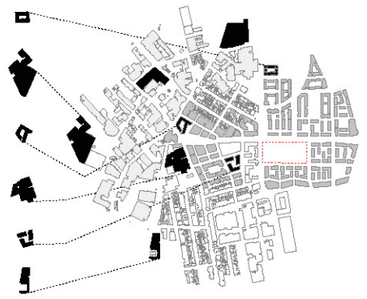
CONTEMPORARY PARK LANDSCAPE - 1:100000

Map showing the scale and location of Gunyama Park relative to all park landscapes within South Sydney. The map illustrates Gunyama park's equivalence in scale to a network of local recreational parks, as well as its close proximity to the restorative wetland landscapes of Centennial Park and Eastlakes.



20C INDUSTRIAL ROOF SPAN MAPPING – 1:12500

In the 20th Century South Sydney gained its distinctive constructed geography through the prevalence of large span industrial roof scapes gathered along the original water lines of the Botany Swamp. This mapping highlights both the scale and the idiosyncratic footprints of the large span industrial structures typical of the South Sydney Industrial areas.

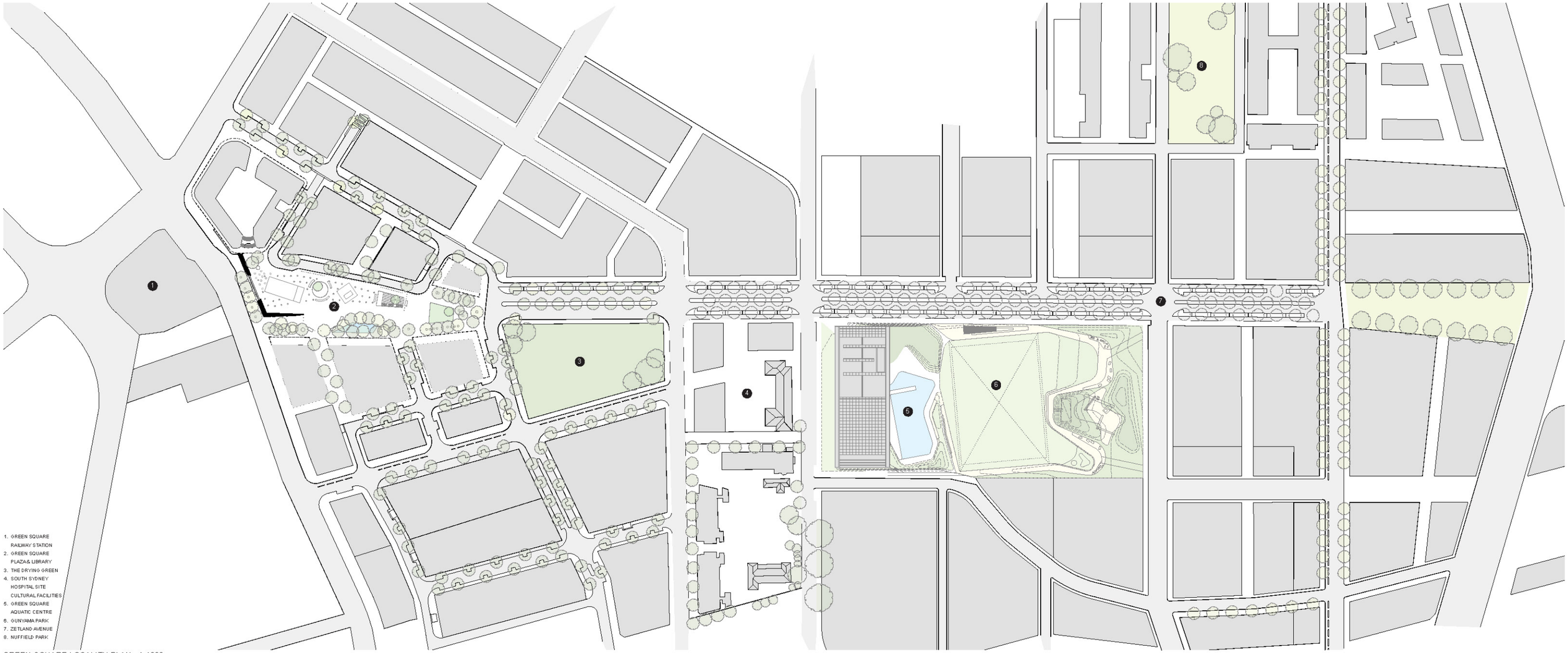


POST INDUSTRIAL PERIMETER BLOCK INSERTIONS – 1:12500

This idiosyncratic footprint of large span industrial roof scapes is slowly being erased in the post-industrial era by the consistent application of the perimeter block typology as infill for obsolete industrial sites. The perimeter block is applied in plan but not section – creating a perceptible diversity of heights and scale that operate in opposition to the apparent order of the plan. This mapping compares the typical industrial structure footprint in relation to the consistent perimeter block footprint.



GREEN SQUARE LOCALITY CROSS SECTION 1:1000



1. GREEN SQUARE RAILWAY STATION
2. GREEN SQUARE PLAZA& LIBRARY
3. THE DRYING GREEN
4. SOUTH SYDNEY HOSPITAL SITE CULTURAL FACILITIES
5. GREEN SQUARE AQUATIC CENTRE
6. GUNYAMA PARK
7. ZETLAND AVENUE
8. NUFFIELD PARK

GREEN SQUARE LOCALITY PLAN 1:1000



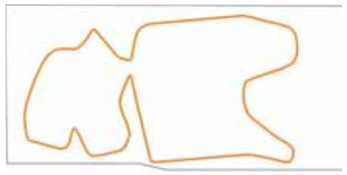
WITHIN A LANDSCAPE

The site is located on what was once a rich and diverse landscape of Botany Swamp. Its image and experience will be defined by the essential qualities of this landscape typology. An open woodland will envelop the site via a mix of iconic Angophora and Banksia trees with a uniting low understory of textured indigenous plants.



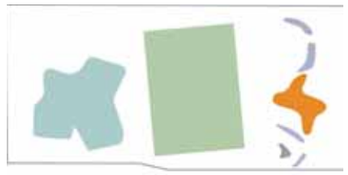
CREATING SPACE

The community is brought into this woodland setting via sculpted clearings activated by a sequence of destinations



CONNECTING THE SPACES

A line of travel that wraps around the pool and weaves its way through the park landscape. Promenade, recreation, fitness and social engagement are brought together via a single circulation and activity spine.



COMMUNITY PARTICIPATION

The park is animated by a range of leisure and recreational facilities. These overlapping activities bring the community of all ages together in a park environment that speaks of this place and its role in the greater Sydney context.



FORMING TOPOGRAPHY

A new topography is generated to define spaces and activities within the park. Playful landscapes, pool, architecture and social spaces are framed within this landform.



TOUCHING LIGHTLY

The last act is to gently rest a new built form that references the sites industrial past on this topography.



STAGING PLAN

Outline of functioning park in Stage 1 mode prior to the aquisition of the Stage 2 property.



1 AQUATIC CENTRE

2 VEGETATED MOUNDS
Earth forms covering building are planted with native vegetation.

3 KIOSK
Kiosk with street and sports field frontage.

4 BLEACHER SEAT ON TIMBER DECK
Timber deck incorporates a two tier of bleacher seating facing both street and park.

5 TIMBER PROMENADE
Raised above the adjacent sports field the timber promenade is both a connecting walkway and seating edge.

6 EXERCISE STATIONS
Located of the timber promenade exercise stations form part of a circuit.

7 SPORTS FIELD
Set below the level of the adjacent promenade is a multipurpose synthetic sports field.

8 TERRACED SEATING - EAST
A dual terrace of concrete seating overlooks the sports field, its form follows the promenade south and links with the skate space.

9 CHANGE ROOMS
The change facilities are covered by the parks topography and vegetation.

10 BBQ FACILITIES
BBQ's long tables and benches are located on elevated platforms along the promenade.

11 PLAY SPACE
Three industrial scale pipes (two bridging the hill tops and one on the ground in the valley) are the armature for a range of play elements and activities form the region scale play space.

12 OPEN WOODLAND
Angophoras and Banksia trees with an understory of textured native plants.

13 PARK AND POOL CONNECTION
The timber promenade connects the park to the pool allowing people to exit from the pool straight onto the timber promenade.

14 TERRACED SEATING - WEST
A dual terrace of timber bleacher seating overlooking the sports field.

15 LAWN
There are three areas of grass the flanking the synthetic field.

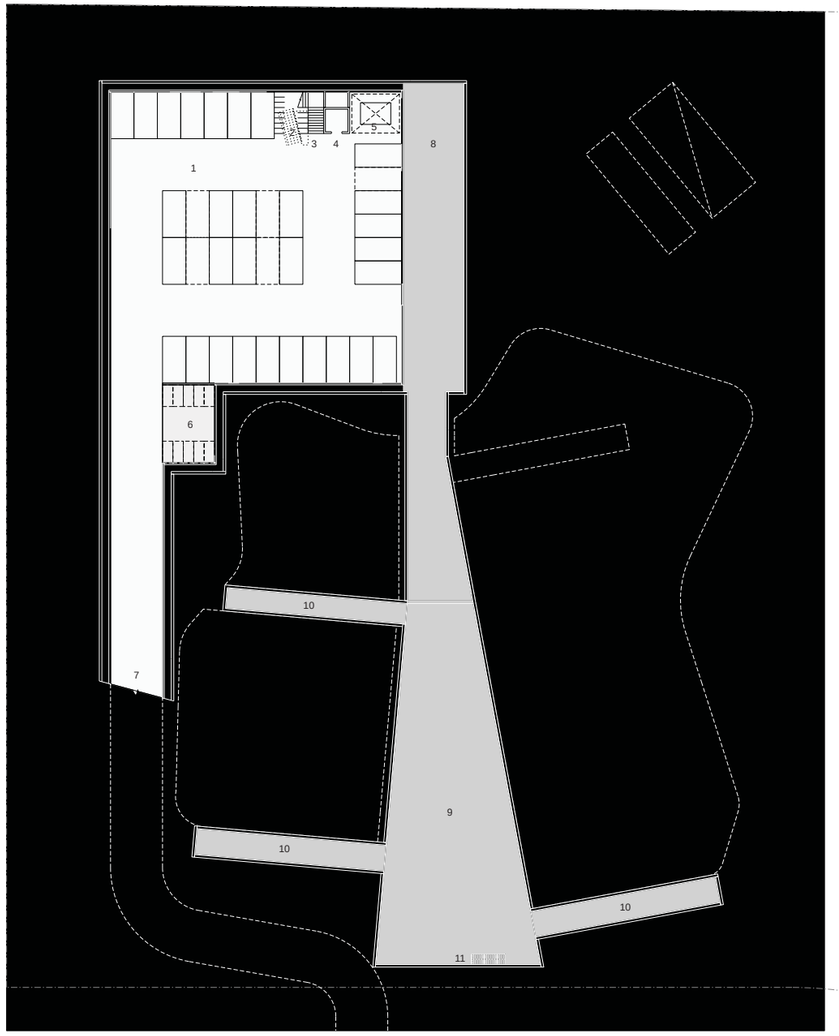
16 SKATE SPACE
The classic skate bowl with other elements for general riding play for people of all ages.

RENDERED LANDSCAPE SITE PLAN 1:250

VIEW OF PROMENADE AND CHILDRENS PLAY LOOKING TOWARDS AQUATIC CENTRE

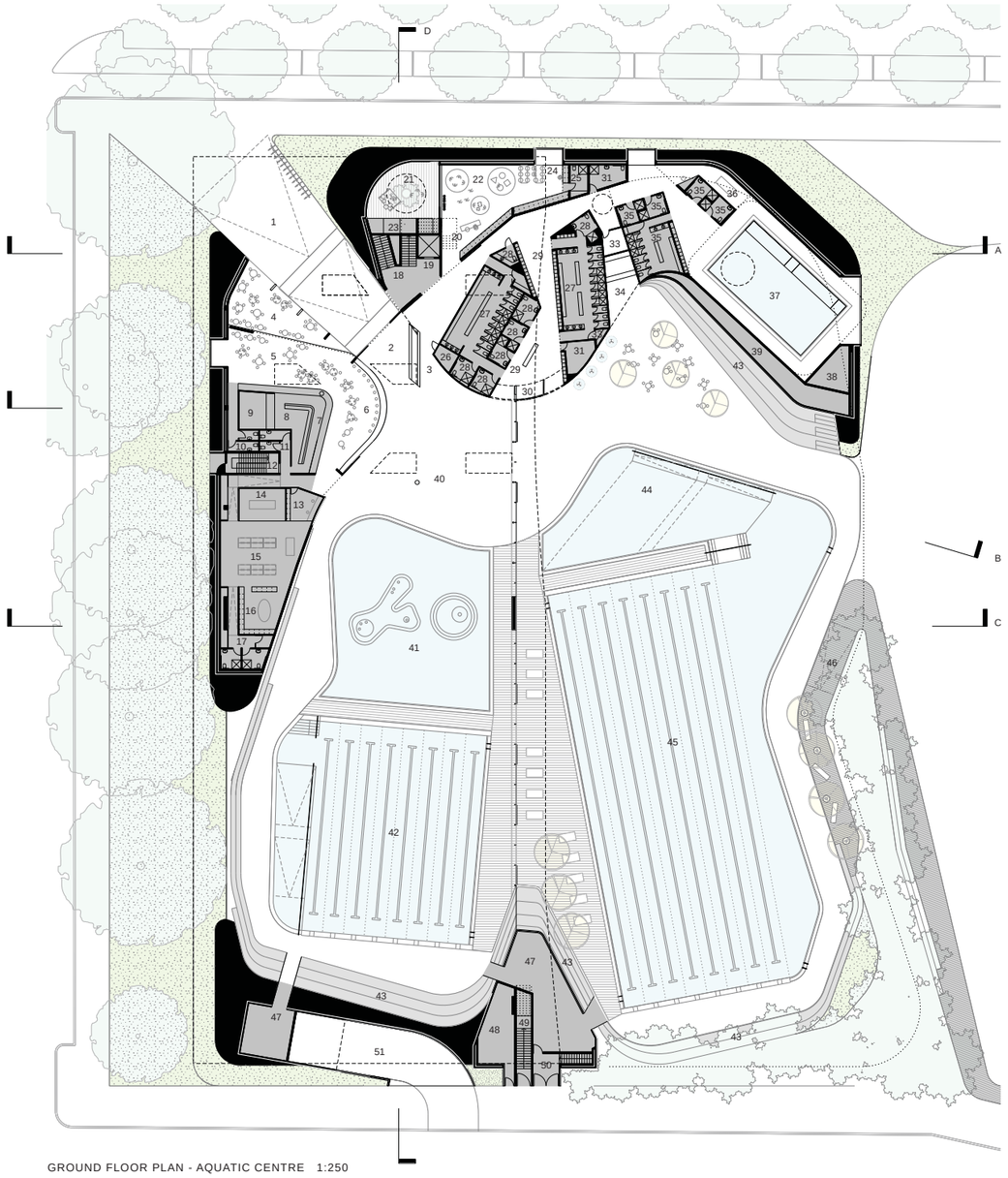


RENDERED SITE SECTION 1:250



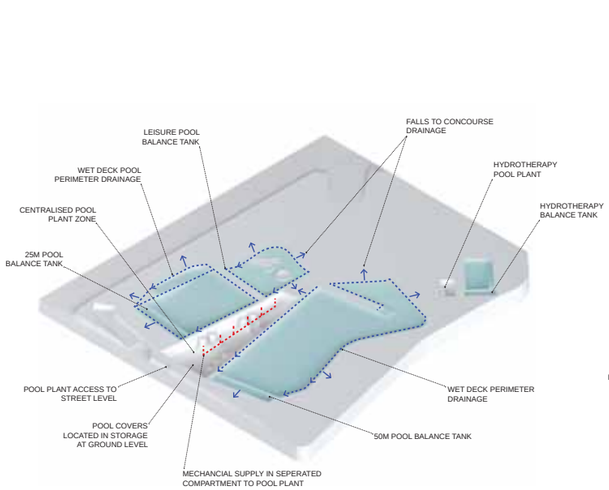
1 CARPARK
2 STAFF BICYCLE PARKING
3 STAIR
4 LIFT
5 SUBSTATION
6 MOTORCYCLE PARKING
7 DRIVEWAY TO STREET
8 GENERAL PLANT
9 POOL PLANT
10 BALANCE TANK
11 PLANT ACCESS TO STREET

BASEMENT FLOOR PLAN 1:250

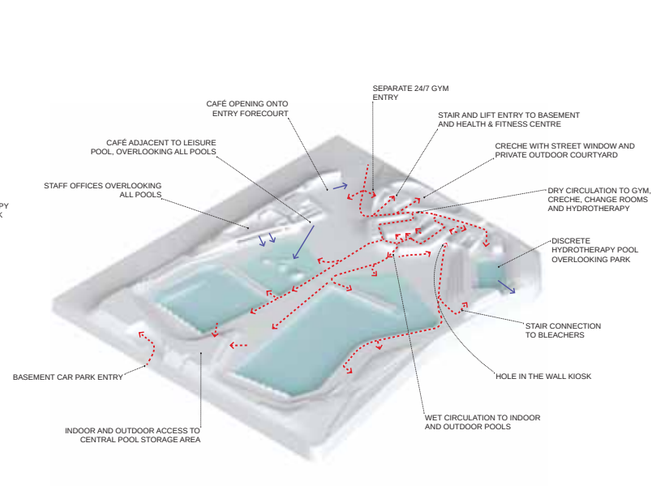


1 FORECOURT
2 FOYER
3 RECEPTION
4 CAFÉ TERRACE
5 CAFÉ – DRY LOUNGE
6 CAFÉ – WET LOUNGE
7 SERVERY / KITCHEN
8 FOOD PREPARATION
9 CAFÉ STORE
10 CAFÉ TOILETS
11 PUBLIC TOILETS
12 FIRESTAIR
13 POOL OPERATIONS OFFICE
14 MEETING ROOM
15 STAFF OFFICE
16 STAFF ROOM
17 STAFF TOILETS
18 STAIRS
19 LIFT
20 CRECHE ENTRY & OFFICE
21 OUTDOOR PLAY AREA
22 INDOOR PLAY AREA
23 CRECHE STORE
24 KITCHENETTE
25 CHILDREN'S TOILETS
26 CASH HANDLING ROOM
27 WET CHANGEROOMS
28 FAMILY/ACCESSIBLE CHANGEROOM
29 LOCKERS
30 PRAM STORAGE
31 FIRST AID
32 ASSISTED CHANGEROOM
33 CLEANER'S STORE
34 KIOSK
35 HYDROTHERAPY CHANGEROOM
36 HYDROTHERAPY SUPPORT/ASSESSMENT
37 HYDROTHERAPY POOL
38 HYDROTHERAPY STORE
39 HYDROTHERAPY POOL PLANT
40 POOL HALL
41 LEISURE WATER
42 PROGRAM POOL
43 SPECTATOR SEATING
44 BEACH POOL
45 MAIN POOL
46 BEACH DECK
47 POOL STORAGE
48 GARBAGE ROOM
49 STAIRS TO GYM LEVEL
50 ACCESS TO PLANT
51 CARPARK DRIVEWAY

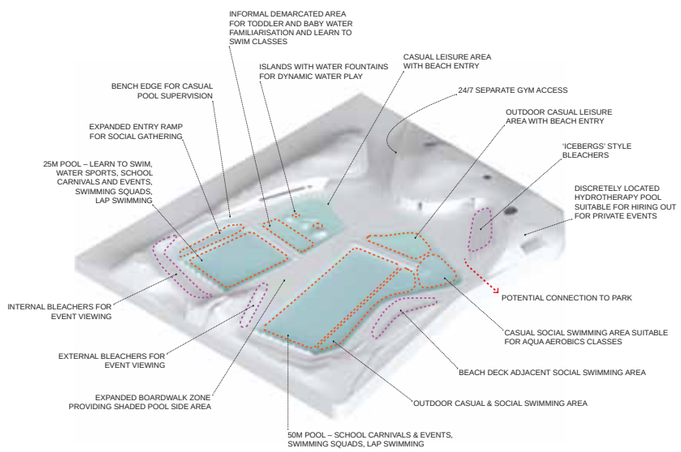
GROUND FLOOR PLAN - AQUATIC CENTRE 1:250



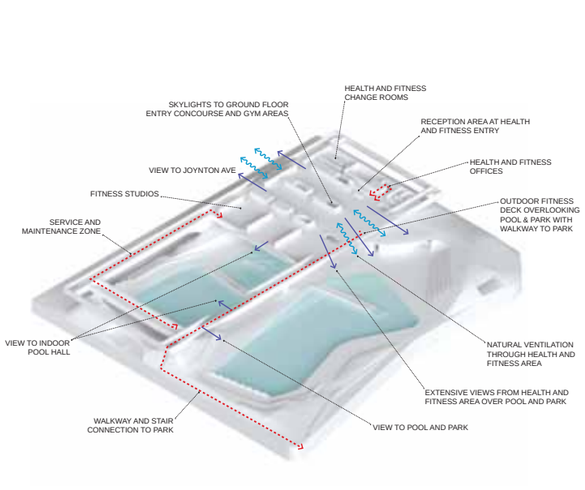
POOL PLANT DIAGRAM



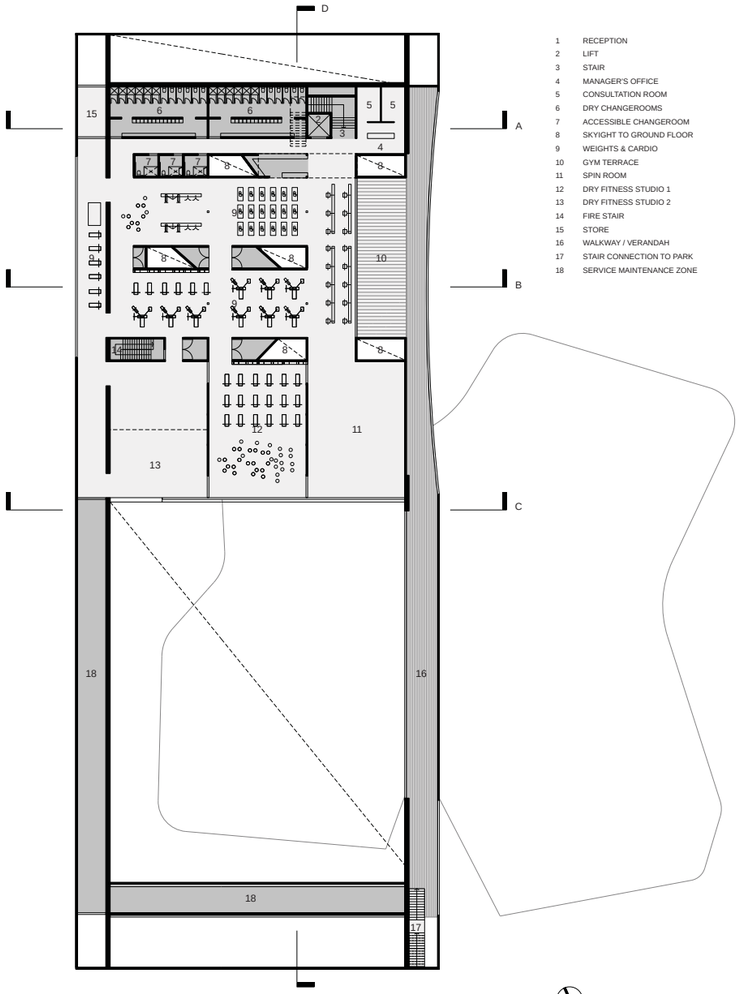
POOL CIRCULATION & VISUAL CONNECTIONS



AQUATIC CENTRE POOL PROGRAMMING

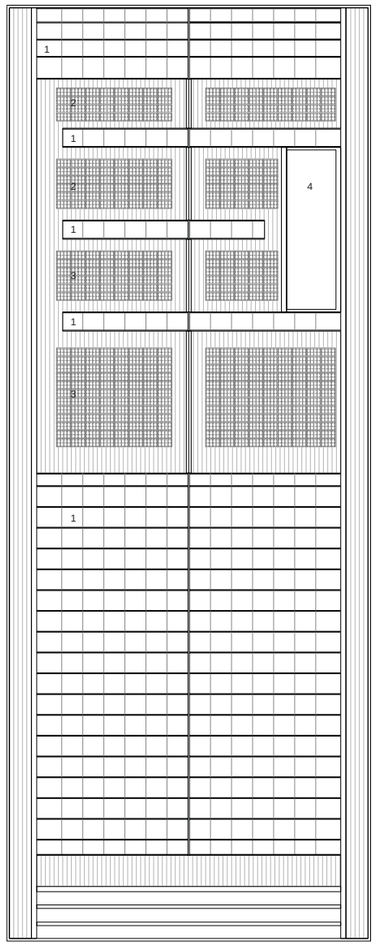


HEALTH AND FITNESS CENTRE CIRCULATION AND VISUAL CONNECTIONS



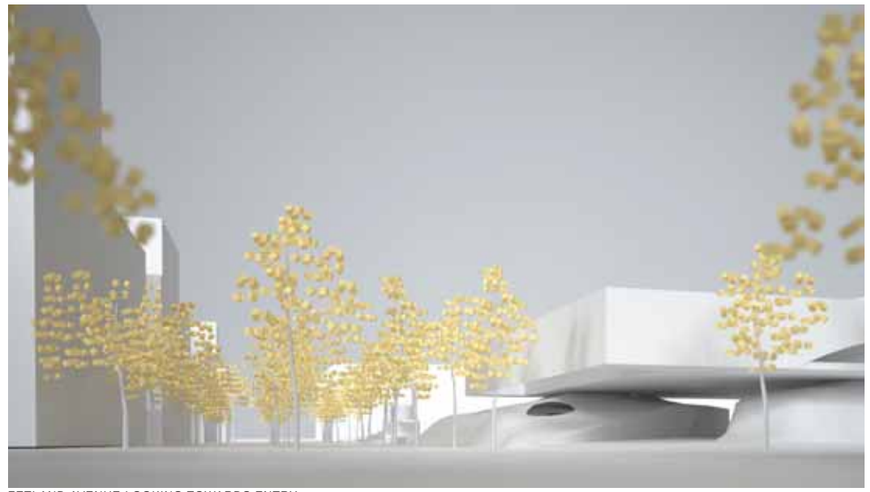
1 RECEPTION
2 LIFT
3 STAIR
4 MANAGER'S OFFICE
5 CONSULTATION ROOM
6 DRY CHANGEROOMS
7 ACCESSIBLE CHANGEROOM
8 SKYIGHT TO GROUND FLOOR
9 WEIGHTS & CARDIO
10 GYM TERRACE
11 SPIN ROOM
12 DRY FITNESS STUDIO 1
13 DRY FITNESS STUDIO 2
14 FIRE STAIR
15 STORE
16 WALKWAY / VERANDAH
17 STAIR CONNECTION TO PARK
18 SERVICE MAINTENANCE ZONE

LEVEL 1 FLOOR PLAN - HEALTH & FITNESS CENTRE 1:250



1 SKYLIGHT
2 SOLAR HOT WATER HEATING
3 PHOTOVOLTAIC PANELS
4 OPEN ROOF TO HEALTH & FITNESS TERRACE BELOW

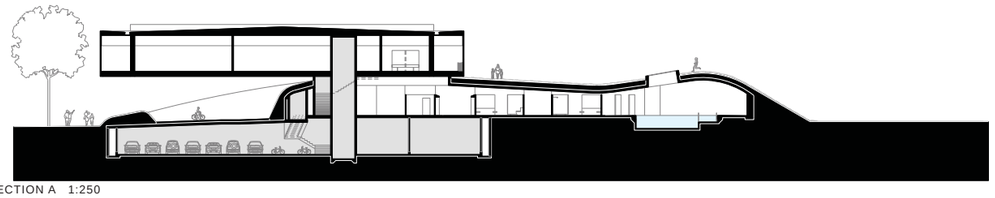
ROOF PLAN 1:250



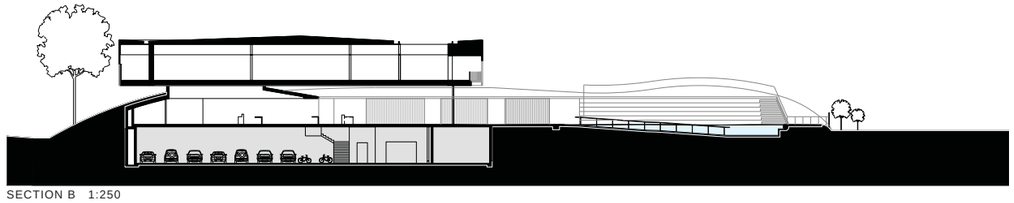
ZETLAND AVENUE LOOKING TOWARDS ENTRY



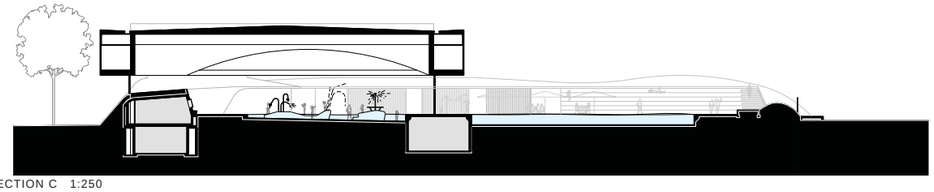
HYDROTHERAPY POOL LOOKING TOWARDS PARK



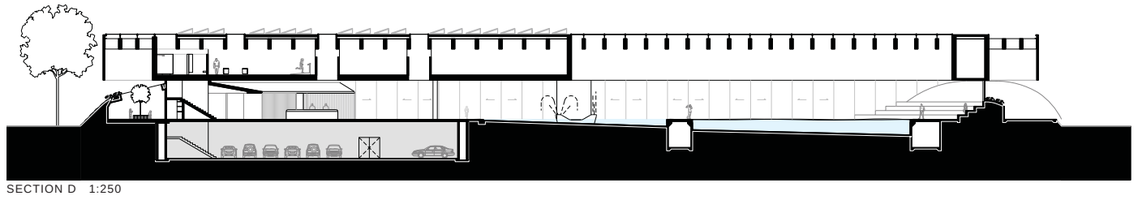
SECTION A 1:250



SECTION B 1:250



SECTION C 1:250



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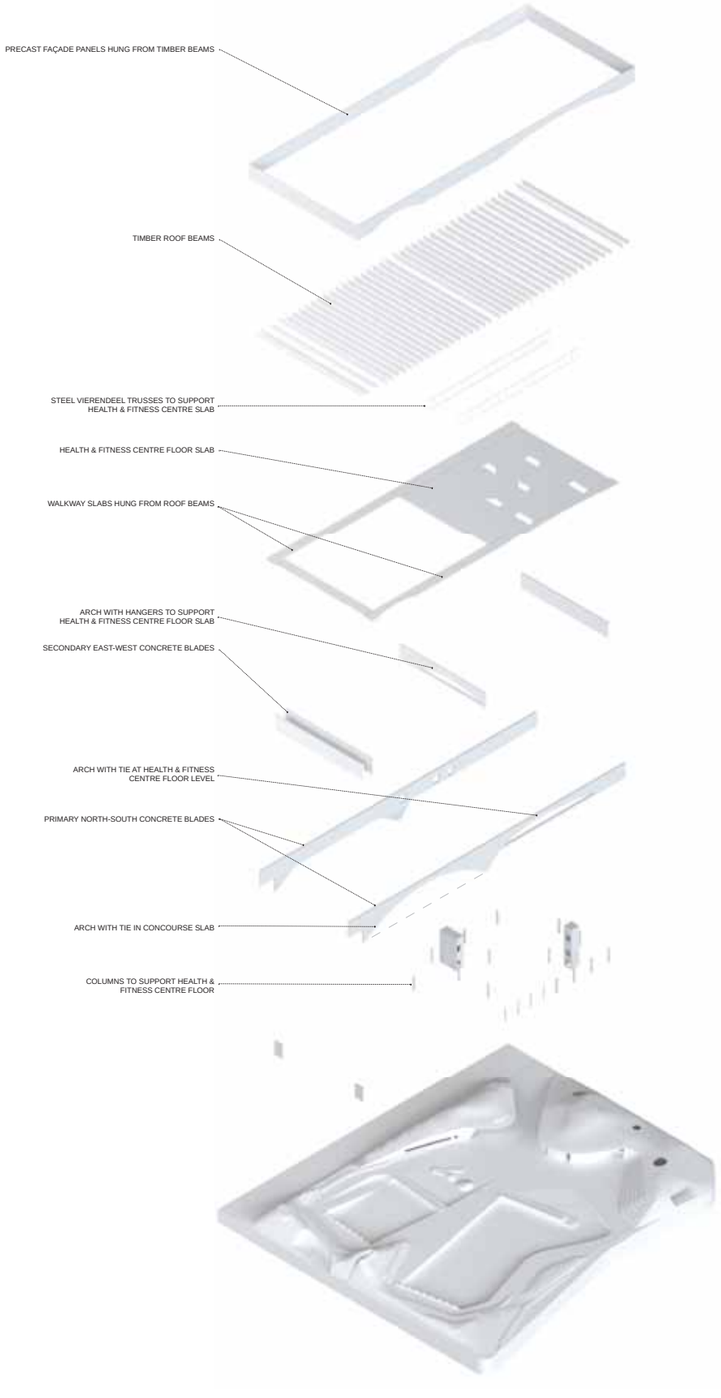
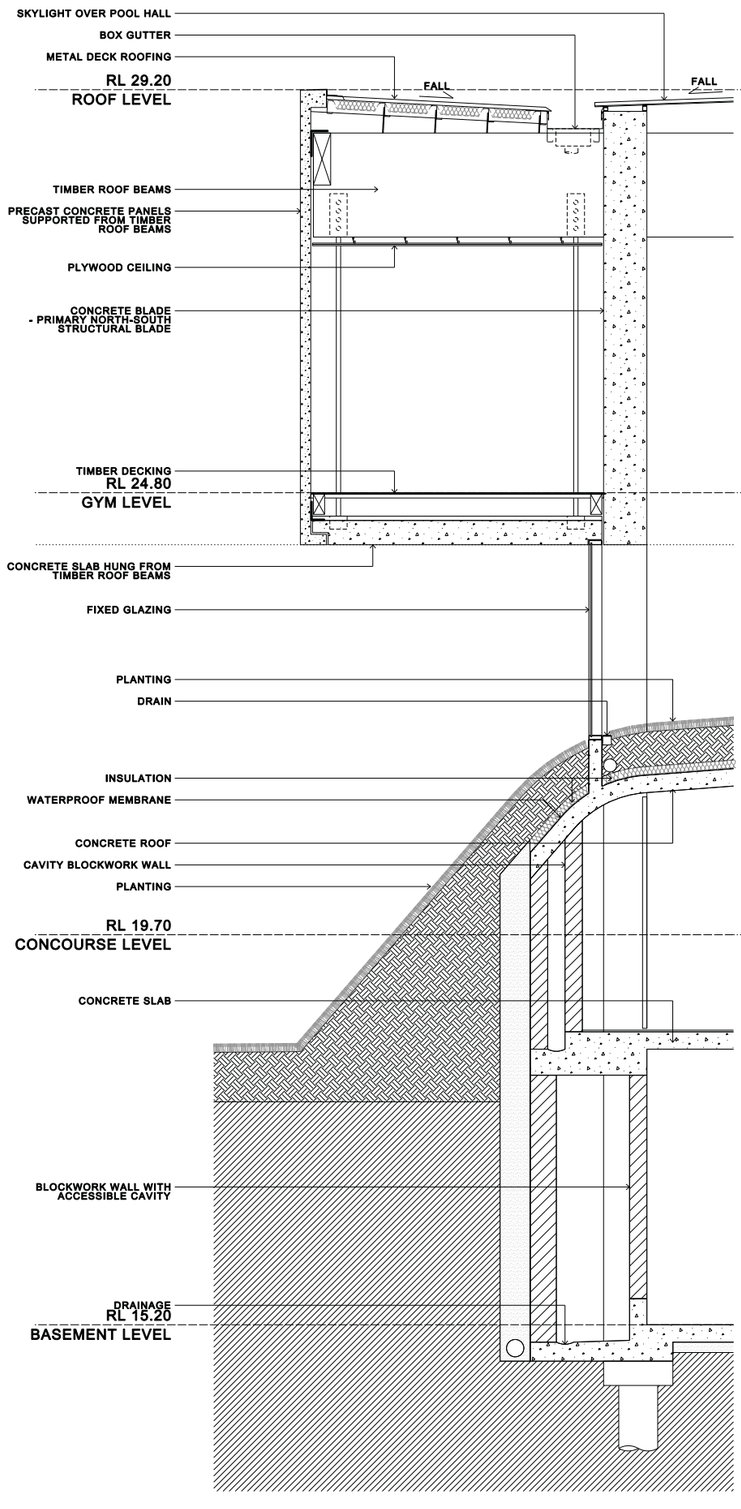
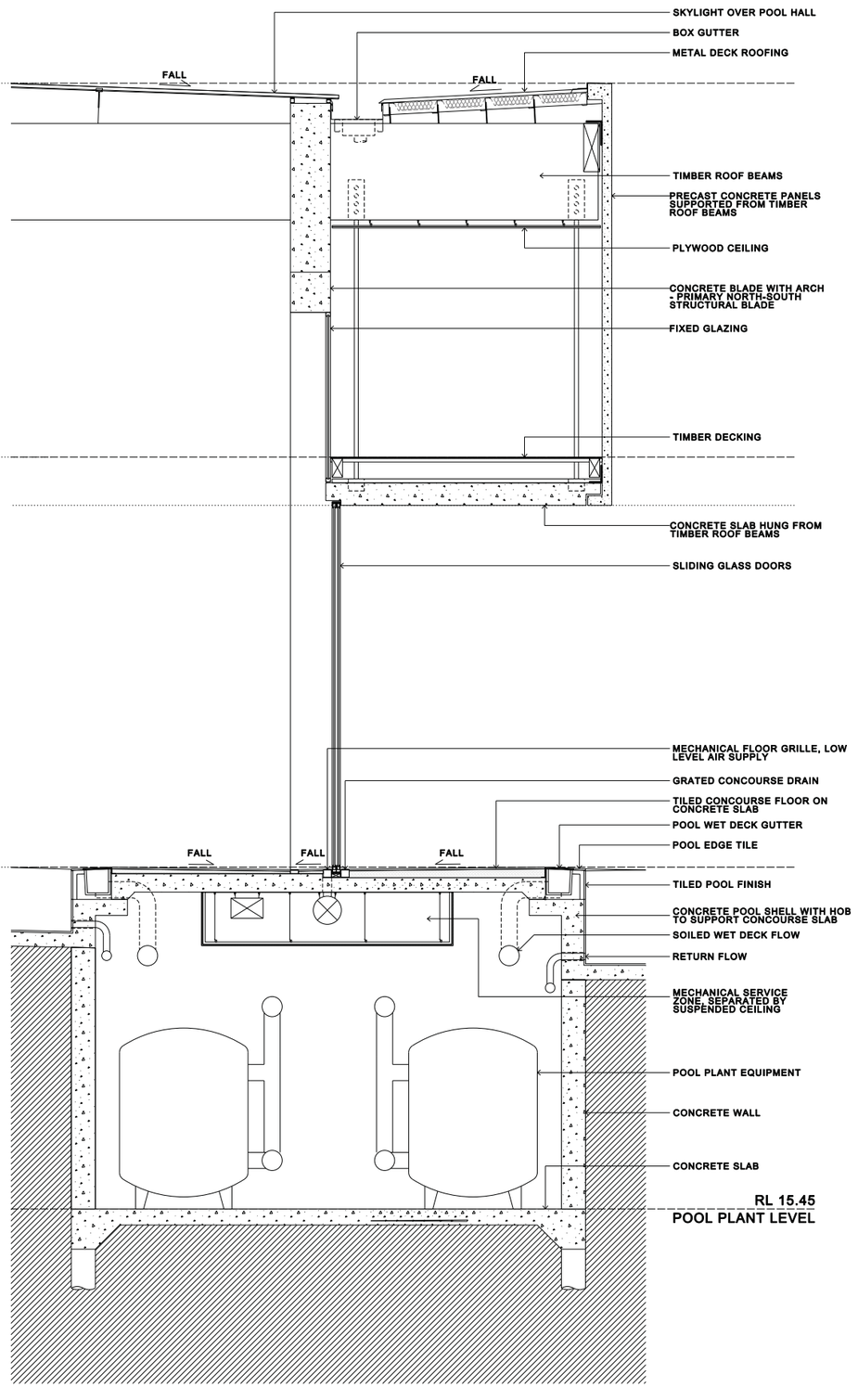


BUILDING STRUCTURE DIAGRAM





TECHNICAL SECTIONS 1:25



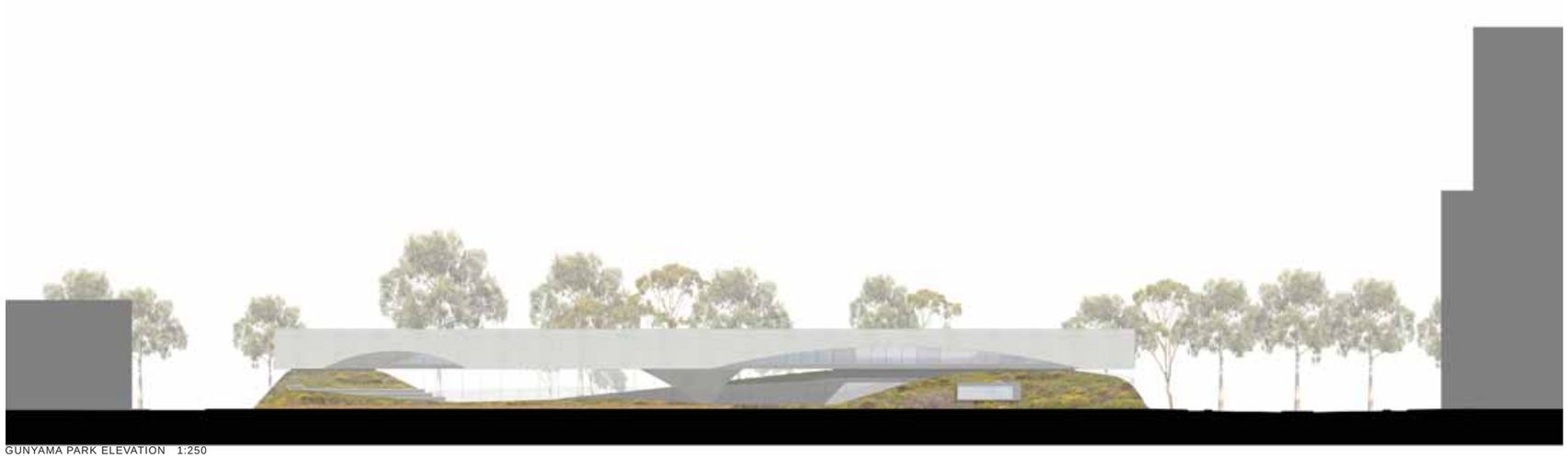
ZETLAND AVENUE ELEVATION 1:250



ROSE VALLEY WAY ELEVATION 1:250



JOYNTON AVENUE ELEVATION 1:250



GUNYAMA PARK ELEVATION 1:250



07:00 SPRING EQUINOX



07:00 SUMMER SOLSTICE



09:00 WINTER SOLSTICE



09:00 SPRING EQUINOX



09:00 SUMMER SOLSTICE



11:00 WINTER SOLSTICE



11:00 SPRING EQUINOX



11:00 SUMMER SOLSTICE



13:00 WINTER SOLSTICE



13:00 SPRING EQUINOX



13:00 SUMMER SOLSTICE



15:00 WINTER SOLSTICE



15:00 SPRING EQUINOX



15:00 SUMMER SOLSTICE

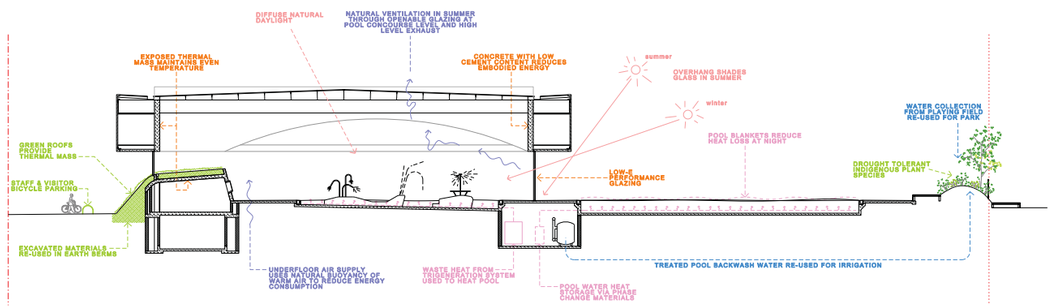


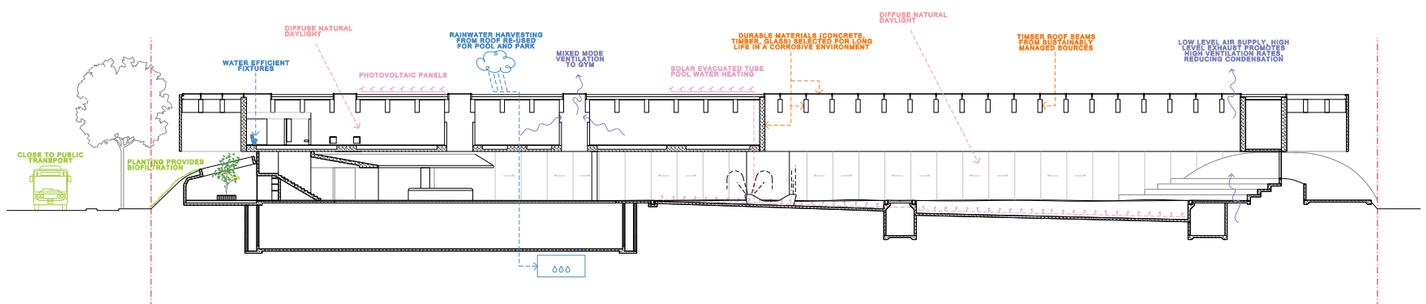
17:00 SPRING EQUINOX



17:00 SUMMER SOLSTICE

VIEW OF INDOOR 25M POOL LOOKING TOWARDS LEISURE POOL AND BUILDING ENTRY





ENVIRONMENTALLY SUSTAINABLE DESIGN CONCEPT SECTIONS 1:200



VIEW OF HEALTH AND FITNESS CENTRE OUTDOOR DECK AND WALKWAY OVERLOOKING POOL AND GUNYAMA PARK

Critical Habitat Impact Statement

31st May 2016

Attention: Sophie Spinks

There will be no impact on threatened species, communities, populations or critical habitats as a result of the proposed Gunyama Park Aquatic and Recreation Centre (GPARC) development.

Ecological Consultants Australia confirm that the proposal is not considered likely to significantly impact on any threatened species. Whilst the loss of some food trees will have a very small impact on Grey-Headed Flying-Foxes, these impacts can be mitigated by planting appropriate food trees as part of the final site landscaping works.

Project Site Before
The subject site is mostly paved with concrete and asphalt. The site has been occupied by industrial land uses in the form of an industrial plant hire depot (132-138 Joynton Avenue) with some trees fronting Joynton Avenue. The majority of land surrounding the site is also industrial. There is no known notable flora or fauna present on the site.

Proposed GPARC Site
The ecological values will be improved by providing additional native landscaping across the site which is greater than the pre-existing condition. Landscaping goes beyond best practice with specific species being chosen and located to provide habitat for native bees and butterflies as well as incorporating habitat features such as logs for reptiles and connecting shrub areas for Blue Wrens.

Mia Dalby-Ball

Director

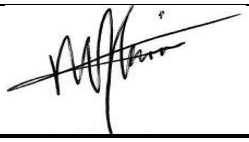
BCA LOGIC PTY LTD

Building Regulation, BCA,
Fire, Access and Energy Consultants



To:	Andrew Burges Architecture 32/61 Marlborough Street Surry Hills NSW 2010
Project:	GUNYAMA PARK AQUATIC AND RECREATION CENTRE (GPARC)
Report:	BCA Assessment Report – DA Stage
Reference No:	105468-BCA-r5
Date:	10 June 2016
Client Contact:	Nard Bujis
Email:	Nard.bujis@grimshaw-architects.com
From:	Matthew Harriman
Direct:	02 8484 4044
Email:	mharriman@bcalogic.com.au

DOCUMENT CONTROL

Revision	Date				
105468-BCA-r2	21 April 2016	**Description:**	**BCA Assessment Report – DA Stage**		
105468-BCA-r3	17 May 2016	**Description:**	**BCA Assessment Report – DA Stage**		
			Prepared By	Checked By	Approved By
		Name:	Matthew Harriman Building Regulations Consultant	Warwick Hunter Manager	Warwick Hunter Manager
		Signature:			
105468-BCA-r4	2 June 2016	Description:	**BCA Assessment Report – DA Stage**		
			Prepared by	Checked by	Approved by
		Name:	Matthew Harriman Building Regulations Consultant	Warwick Hunter Manager	Warwick Hunter Manager
		Signature:			
105468-BCA-r5	10 June 2016	Description:	**BCA Assessment Report – DA Stage (final update to populations)**		
			Prepared by	Checked by	Approved by
		Name:	Matthew Harriman Building Regulations Consultant	Warwick Hunter Manager	Warwick Hunter Manager
		Signature:			

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1 BASIS OF ASSESSMENT

1.1 Location and Description

The subject site is proposed to be developed into Gunyama Park Aquatic and Recreation Centre.

The proposal includes the development of an Aquatic Centre constructed in a two storey complex comprising a gym, amenities facilities, café, indoor pool, outdoor pool, recreation pools and a hydrotherapy pool. The building will to be constructed of various elements including load-bearing reinforced concrete columns and floors infilled with a combination of glass and masonry facades.

Further to the development of the Aquatic Centre complex, it is proposed to construct Gunyama Park and sports field which will adjoin/interconnect with the Aquatic centre. The park area will include children's play areas and a sports field bound by natural landscapes where seating and pathways will be located as well as various sanitary amenities.

It is proposed that the main access to the development will be obtained through various entrances surrounding the proposed complex of the aquatic centre and sports field where access to public transport, roads and pathways is obtained. Vehicular parking is proposed to be provided via on-street parking along the roadways bounding the development.

1.2 Purpose

The purpose of this report is to assess the current design proposal against the Deemed-to-Satisfy Provisions of BCA 2016, and to clearly outline those areas (if any) where compliance is not achieved, where areas may warrant redesign to achieve strict BCA compliance or where areas may be able to be assessed against the relevant performance criteria of BCA 2016. Such assessment against relevant performance criteria will need to be addressed by means of a separate Performance Based Fire Safety Engineered Assessment Report to be prepared under separate cover.

1.3 Building Code of Australia

This report is based on the Deemed-to-Satisfy Provisions of the National Construction Code Series Volume 1 – Building Code of Australia, 2016 Edition (BCA) incorporating the State variations where applicable. Please note that the version of the BCA applicable to new building works is the version applicable at the time of the lodgement of the Construction Certificate Application to the Accredited Certifying Authority. The BCA is updated generally on the 1st of May each year.

It is further noted that reference to the Deemed-to-Satisfy Provisions of the National Construction Code Series Volume 2 – Building Code of Australia, 2016 Edition (BCA) incorporating the State variations also forms a basis of this report for assessment of the Gunyama Park amenities facilities.

1.4 Limitations

This report does not include nor imply any detailed assessment for design, compliance or upgrading for:

(a) the structural adequacy or design of the building;

(b) the inherent derived fire-resistance ratings of any proposed structural elements of the building (unless specifically referred to); and

(c) the design basis and/or operating capabilities of any proposed electrical, mechanical or hydraulic fire protection services.

This report does not include, or imply compliance with:

(a) the National Construction Code – Plumbing Code of Australia Volume 3

(b) the Disability Discrimination Act 1992 including the Disability ((Access to Premises – Buildings) Standards 2010 – unless specifically referred to), (The provision of disabled access to the subject development has been assessed under separate cover by BCA Logic Pty Ltd);

(c) Demolition Standards not referred to by the BCA;

(d) Work Healthy and Safety Act 2011;

(e) Requirements of other Regulatory Authorities including, but not limited to, Telstra, Telecommunications Supply Authority, Water Supply Authority, Electricity Supply Authority, Work Cover, Roads and Maritime Services (RMS), Roads and Transport Authority, Local Council, ARTC, Department of Planning and the like; and

(f) Conditions of Development Consent issued by the Local Consent Authority.

1.5 Design Documentation

This report has been based on the Design plans and Specifications listed in Annexure A of this Report.

2 BUILDING DESCRIPTION

For the purposes of the Building Code of Australia (BCA) the development may be described as follows.

2.1 Rise in Storeys (Clause C1.2)

The building has a rise in storeys of two (2).

2.2 Classification (Clause A3.2)

The building has been classified as follows.

Class	Level	Description
6/9b	Café/Kitchen	Ground level Café accessed via the pool facility and off of Zetland Avenue.
5/9b	Hydro Pool	Ground Level Hydro therapy pool for rehabilitating persons.
9b	Gym, pool amenities	Ground level pool amenities for the public and a gym proposed on level 1.
10b	Swimming pools	Proposed swimming pools for use by the public.
10a	Park amenities and storage	Proposed park for use by the public with recreational sporting storage areas.
10b	Perimeter fencing	Perimeter fence being a structure.

It is noted that the proposed café occupies approximately 250m2 of floor area. In accordance with BCA Clause A2.3, this is less than 10% of the Class 9b portion. Therefore, the Café forms part of the aquatic centre and adopts the provisions of Class 9b for the purposes of the BCA.

2.3 Effective Height (clause A1.1)

The building has an effective height of less than 12 metres.

2.4 Type of Construction Required (Table C1.1)

The building is to be of Type B Construction.

2.5 Floor Area and Volume Limitations (Table C2.2)

The building is subject to maximum floor area and volume limits of:-

Class 6 and 7a	Maximum Floor Area	3,500m^2
	Maximum Volume	21,000m^3
Class 5 and 9b	Maximum Floor Area	5,500m^2
	Maximum Volume	33,000m^3
Class 10a	No maximum floor area and volume limits	
Class 10b	No maximum floor area and volume limits	

2.6 Fire Compartments

The following fire compartments have been assumed:

1. The hydro therapy pool is one compartment.
2. The Café is one compartment
3. The Pool hall, gym and offices are one fire compartment.
4. The services and plant areas form their own compartment.

2.7 Exits

The following points in the building has been considered as the exits: assumed:

a) The entry/exit door to Zetland Avenue from the pool entry foyer,

b) The entry/exit door to Zetland Avenue from the Café.

c) The first riser of the non-fire isolated stair at first floor level.

d) The doorways to the fire-isolated stairways (FIS) from ground floor level.

e) The doorways to the fire-isolated stairways (FIS) from first floor level.

f) The perimeter doorways to open space from within the pool hall.

g) The doorways from within the pool plant room areas.

2.8 Climate Zone (Clause A1.1)

The building is located within Climate Zone 5

3 ESSENTIAL FIRE SAFETY MEASURES

The following fire safety measures are required to be installed in the building, this table may be required to be updated as the design develops and options for compliance are confirmed.

Item	Proposed Essential Fire Safety Measure	Minimum Standard of Performance
1.	Automatic fire detection and alarm system installed as good practice to exceed the minimum requirements of the BCA. (TBC)	TBC – We recommend BCA2016 Clause E2.2a, Clause 4 of Specification E2.2a and AS1670.1-2004 as the minimum standard of performance.
2.	Automatic fire suppression system (sprinkler system) as good practice to exceed the minimum requirements of the BCA. (TBC)	TBC – We recommend BCA 2016 Clause E1.5, AS2118.1-2004 as the minimum standard of performance.
3.	Automatic fail safe devices	BCA2016 Clauses D2.21, AS1670.1-2004 and Manufacturer's Specification.
4.	Emergency lighting	BCA2016 Clauses E4.2 & E4.4, AS2293.1-2005
5.	Exit signs	BCA2016 Clauses E4.5, E4.6 & E4.8, AS2293.1-2005
6.	Fire hose reel system	BCA2016 Clause E1.4, AS2441-2005
7.	Fire hydrant system	BCA2016 Clause E1.3, AS2419.1-2005
8.	Fire seals protecting openings in fire resisting components of the building	BCA2016 Clause C3.15, AS1530.4-2005
9.	Lightweight Fire Rated Construction	BCA2016 Clause / Specification C1.8
10.	Mechanical air handling systems	BCA2016 Clause F4.5, F4.11, AS/NZS1668.2-2012
11.	Automatic Shutdown of Mechanical air handling systems	BCA2016 Clause E2.2b and Table E2.2b
12.	Paths of travel, stairways, passageways or ramps	BCA2016 Section D
13.	Portable fire extinguishers	BCA2016 Clause E1.6, AS2444-2001
14.	Required (automatic) exit doors	BCA2016 Clause D2.19, AS1670.1-2004
15.	Warning and operational signs	BCA2016 Clause D2.23, EP&A Reg. 2000 Clause 183

4 FIRE RESISTANCE LEVELS

The following fire resistance levels (FRL's) required for the various structural elements of the building, with a fire source feature being the far boundary of a road adjoining the allotment, a side or rear boundary or an external wall of another building on the allotment except a Class 10 structure.

Type B Construction

Item	Class 5 or 9b	Class 6
Loadbearing External Walls Less than 1.5m to a fire source feature 1.5 – 3m from fire source feature; 3 – 9m from a fire source feature 9 – 18m from a fire source feature More than 18m from a fire source feature	 120/120/120 120/90/60 120/30/30 120/30/- -/-/-	 180/180/180 180/120/90 180/90/60 180/60/- -/-/-
Non-Loadbearing External Walls Less than 1.5m to a fire source feature 1.5 – 3m from fire source feature; more than 3m from a fire source feature.	 -/120/120 -/90/60 -/-/-	 -/180/180 -/180/120 -/-/-
Loadbearing External Columns Less than 18m 18m or more	 120/-/- -/-/-	 180/-/- -/-/-
Non-Loadbearing External Columns	-/-/-	-/-/-
Fire Walls	120/120/120	180/180/180
Stair and Lift Shafts Loadbearing Stair shaft Non loadbearing	 120/120/120 -/120/120	 180-120-120 -/120/120
Internal walls bounding sole occupancy units Loadbearing Stair shaft Non loadbearing	 120/-/- -/-/-	 180/-/- -/-/-
Internal walls bounding public corridors, hallways and the like: Loadbearing Stair shaft Non loadbearing	 120/-/- -/-/-	 180/-/- -/-/-
Other loadbearing internal walls and columns	120/-/-	180/-/-
Roofs	-/-/-	-/-/-

5 STATEMENT OF COMPLIANCE

5.1 General

The architectural design documentation as referred to in this report has been assessed against the applicable provision of the Building Code of Australia, (BCA) and it is considered that such documentation complies or is capable of complying (as outlined in Annexure B) with that Code subject to the following areas where compliance with the BCA may require further consideration.

It is noted that where a non-compliance is identified (if any), further architectural design is required as client instruction requires the building to not have any Performance Solutions Implemented within the proposal.

Annexure B to this report provides a detailed assessment of the proposal against all relevant Deemed-to-Satisfy Provisions of the BCA.

Note: It is important that Annexure B is read in conjunction with the items below, as some matters may not have had sufficient information provided to allow a detailed assessment to be undertaken.

5.2 Dimensions and Tolerances

The BCA contains the minimum standards for building construction and safety, and therefore generally stipulates minimum dimensions which must be met. BCA Logic's assessment of the plans and specifications has been undertaken to ensure the minimal dimensions have been met.

The designer and builder should ensure that the minimum dimensions are met onsite and consideration needs to be given to construction tolerances for wall set outs, applied finished and skirtings to corridors and bathrooms for example, tiling bed thicknesses and the like which can adversely impact on critical maters such as access for people with disabilities, stair and corridor widths and balustrade heights.

5.3 Sprinklers

The building is not required to be sprinkler protected by the BCA. However, the client has advised that the building will be sprinkler protected as an asset protection method. The standard of performance and installation standard is unknown to our office. It is recommended that the sprinkler system be provided to comply with this BCA Clause E1.5 of the BCA.

This is to ensure that the sprinkler system is installed to current standards and to ensure ongoing maintenance and performance for the life of the building. This will further allow for the system to be listed as an essential fire safety measure and form part of minimum annual testing and certification in accordance with the EP&A act.

Furthermore, it is recommended that the proposed system is alarmed and monitored with the fire brigade. This is simply to ensure that the fire brigade is notified of the event of a fire and to further ensure that should a sprinkler head be activated, the fire brigade can attend site and turn off the system (24hours a day) If there is no fire to ensure that flooding and water damage to assets does not occur specifically when the building is not occupied. For example, if the system is not monitored or alarmed and a head activates at 1a.m., the system will continually allow water to flow until a person isolates the system at the commencement of the next business day.

5.4 Egress Width – Clause D1.6

Based upon an updated assessment of population and available egress width it has been calculated that the required egress width from the building is as follows:-

Ground Floor – The required aggregate egress width for a ground floor population of 1720 persons is 15.0 metres. This is able to be achieved by the proposed exit doorways. Once the door hardware has been selected then a detailed assessment of proposed exit doors and available egress width will need to be undertaken and current proposed doorways modified if necessary to ensure the required width is available.

First Floor – The required aggregate egress width for the first floor population of 380 persons is 3.5 metres.

This is able to be achieved by the proposed exit stairs and passageways to this level. However, detailed assessment of the widths will need to be undertaken once proposed handrail designs are detailed for assessment.

5.5 Maximum Populations – Clause D1.13

The calculation of populations in accordance with Clause D1.13 of the BCA allows different methods to be utilised and for a building of this nature the floor areas and m2/person is not always the most accurate method due to the actual usage being very different to the estimation methods of table D1.13 of the BCA.

It is understood that elements such as sanitary facilities and egress provisions are largely locked in and may not be able to be changed so the maximum populations will need to be assessed based upon available sanitary facilities and egress width as follows:-

Ground Floor Level

The population of the building at this level is limited by the proposed sanitary facilities. In accordance with Clause F2.3 of BCA the maximum population able to be served is 1680 patrons + 40 staff = 1720 persons.

Unless additional sanitary facilities are provided then 1720 is to be the maximum population and will need to be regulated/enforced.

Ground Floor Level Café

The maximum population to the ground floor level café has been calculated as 100 persons based upon the available sanitary facilities in this location.

First Floor Level

The population of the building at this level is limited by the available egress width (3.7m) in accordance with Clause D1.6 of the BCA which allows a maximum population 380 persons maximum.

This population is greater than that calculated in accordance with Clause/Table D1.13 of the BCA.

5.6 BCA Compliance Specification

The following BCA matters are to be addressed by specific BCA Design Certificate to be issued by the relevant architectural, services and engineering consultants at the Construction Certificate Stage. This schedule should be forwarded to all consultants to obtain verification that these items have and will be included in the design documentation / specifications:

Architectural Design Certification:

1. The FRL's of the structural elements for the proposed works have been designed in accordance with table 4 for a building of Type B Construction of Specification C1.1 of BCA2016.
2. Materials, floor and wall linings/coverings, surface finished and air-handling ductwork used in the works will comply with the fire hazard properties in accordance with Clause C1.10 and Specification C1.0 of BCA2016.
3. The building will be separated in accordance with Clause C2.5 of BCA2016
4. The building will be separated into separate fire compartments by a fire wall complaint with Clause C2.7 and Specification C1.1 of BCA2016.
5. The parts of different classifications located alongside one another in the same storey will be separated in accordance with Clause C2.9 and Specification C1.1 of BCA2016
6. The electricity substation, any main switch room sustaining emergency equipment required to operate in emergency mode, will be separated from the remaining building with construction having a FRL of 120-120-120 and provided with self-closing -/120/130 fire doors in accordance with Clause C2.13 of BCA2016.

7. Openings in the external walls that are required to have an FRL will be in located in accordance with Clause C3.2 and C3.3 of BCA2016 or protected in accordance with Clause C3.4 of BCA2016.
8. Doorways in any fire walls separating fire compartments will be protected in accordance with Clause C3.5 of BCA2016.
9. Sliding fire doors in a fire wall which is open when the building is use will be installed in accordance with Clause C3.6 of BCA2016.
10. Doorways in horizontal exits will be protected in accordance with Clause C3.7 of BCA2016.
11. Doors in a fire-isolated exit will be self-closing or automatic closing fire doors with a FRL of not less than -/60/30 in accordance with Clause C3.8 of BCA2016
12. Services penetrating elements required to possess a FRL including the floor slabs, walls, shafts, etc. will be protected in accordance with Clause C3.9, C3.12, C3.13 and C3.15 and Specification C3.15 of BCA2016.
13. The lift doors will be --/60/- fire doors complying with AS1735.11 in accordance Clause C3.10 of BCA2016.
14. Doorways and other opening in internal walls required to have an FRL will be protected in accordance with Clause C3.11 of BCA2016.
15. Columns protected by light weight construction will achieve an FRL not less than the FRL for the element it is penetrating, in accordance with Clause 3.17 of BCA2016.
16. A lintel must have the FRL required for the part of the building in which it is situated, unless it does not contribute to the support of a fire door, fire window or fire shutter, and it spans an opening in masonry which is not more than 150 mm thick and is not more than 3m wide if the masonry is non-loadbearing; or not more than 1.8m wide if the masonry is loadbearing and part of a solid wall or one of the leaves of a cavity wall, or it spans an opening in a non-loadbearing wall of the Class 2 or 3 building, in accordance with Specification C1.1 Clause 2.3 BCA2016.
17. All attachments to the external façade of the building will be of anon-combustible material, or a combustible material in accordance with Clause 2.4 of Specification C1.1 of BCA2016.
18. The top and bottom of the riser shafts will achieve an FRL not less than the FRL required for the walls of the shaft in accordance with Clause 2.7 of Specification C1.1 of BCA2016.
19. Fire doors will comply with AS1905.1 and Specification C3.4 of BCA2016.
20. Fire shutters and fire windows will be in accordance with Specification C3.4 of BCA2016.
21. The number of exits provided to the building will be in accordance with Clause D1.2 of BCA2016.
22. The required exits will be fire-isolated in accordance with Clause D1.3 of BCA2016.
23. Travels distances to exits will be in accordance with Clause D1.4 of BCA2016.
24. The alternative exits will be distributed uniformly around the storey and will not be less than 9m apart, and not more that 45m apart in the residential portion or patient care areas in the health-care building or 60m, in accordance with Clause D1.5 of BCA2016
25. The dimensions of exits and paths of travel to exits will be provided in accordance with Clause D1.6 of BCA2016.
26. The fire-isolated exits will be in accordance with Clause D1.7 of BCA2016.
27. The non-fire-isolated exits will be in accordance with Clause D1.9 of BCA2016.
28. The discharge points of exits will be in accordance with Clause D1.10 of BCA2016.
29. Horizontal exits will be in accordance with Clause D1.11 of BCA2016.
30. The non-required stairways, ramps and escalators will be in accordance with Clause D1.12 of BCA2016.
31. The ladder from the plant, lift machine rooms, and electricity network substation in lieu of a stairway will be in accordance with Clause D1.16 of BCA2016.
32. Access to the lift pit will be in accordance with Clause D1.17 of BCA2016.
33. The stairway or ramp within the fire-isolated shaft is to be non-combustible, and if there is a local failure not cause structural damage or impair the fire resistance of the shaft, in accordance with Clause D2.2 of BCA2016.

34. The non-fire isolated stairs will be constructed in accordance with Clause D2.3 of BCA2016.
35. The construction separating rising and descending stairs in the fire-isolated exit stairway will be non-combustible and smoke proof, in accordance with Clause D2.4 of BCA2016.
36. The smoke lobby to the fire-isolated exit will be constructed in accordance with Clause D2.6 of BCA2016.
37. The construction of EDB's will be in accordance with Clause D2.7 of BCA2016 with the enclosure bounded by a non-combustible or fire protective covering and smoke seals provided around the perimeter of the doors at each level.
38. The enclosing walls and ceiling under the non-fire-isolated stairway will achieve an FRL of 60/60/60, and a self-closing -/60/30 fire door, in accordance with Clause D2.8 of BCA2016.
39. New pedestrian ramps will comply with AS1428.1-2009, Clause D2.10 and Part D3 of BCA2016. The floor surface of a ramp must have a slip-resistance classification complying with Table D2.14 when tested in accordance with AS4586.
40. The fire-isolated passageway will be in accordance with Clause D2.11 of BCA2016.
41. Stair geometry to the new stairways will be in accordance with Clause D2.13 of BCA2016. Stair treads are to have a surface with a slip-resistance classification complying with Table D2.14 when tested in accordance with AS4586.
42. Landings and door thresholds throughout the development will be provided in accordance with Clause D2.14 and D2.15 of BCA2016. Landings to have either a surface with a slip-resistance classification complying with Table D2.14 when tested in accordance with AS4586 or a strip at the edge of the landing with a slip-resistance classification complying with Table D2.14 when tested in accordance with AS4586 where the edge ledge to a flight below.
43. The handrails and balustrades to all stairs and throughout the building will be in accordance with Clause D2.16, and D2.17 of BCA2016.
44. The fixed platform, walkway, stairway and ladder and any associated going and riser, landing handrail, balustrade, located within the machinery room, boiler house, lift-machine room, plant-room, or non-habitable attic/storeroom within the sole occupancy unit will comply with AS1657-2013 in lieu of Clause D2.12, D2.14, D2.16 and D2.17 of BCA2016.
45. The doorways and doors will be in accordance with Clause D2.19 and D2.20 of BCA2016.
46. The door latching mechanisms to the proposed required exit doors will be in accordance with Clause D2.21 of BCA2016.
47. Signage will be provided on fire and smoke doors in accordance with Clause D2.23 of BCA2016.
48. Fire precautions whilst the building is under construction fire precautions will be in accordance with Clause E1.9 of BCA2016.
49. Additional provisions will be made in accordance with Clause E1.10 of BCA2016, due to the special hazards associated with the building works or the location of the building works.
50. Non-illuminated exit signage will be installed in accordance with Clause E4.7, and of BCA2016.
51. External above ground waterproofing membranes must comply with AS 4654 Parts 1 and 2.
52. The new roof covering will be in accordance with Clause F1.5 of BCA2016.
53. Any sarking proposed will be installed in accordance with Clause F1.6 of BCA2016.
54. Waterproofing of all wet areas to the building will be carried out in accordance with Clause F1.7 of BCA2016 and AS3740.
55. Damp proofing of the proposed structure will be carried out in accordance with Clause F1.9 and F1.10 of BCA2016.
56. Sub-floor ventilation will be provided in accordance with Clause F1.12 of BCA2016.
57. All new glazing to be installed throughout the development will be in accordance with Clause F1.13 of BCA2016 and AS1288 / AS2047.
58. Sanitary facilities will be provided in the building in accordance with Clause F2.1, Table F2.1, Clause F2.3 and Table 52.3 of BCA2016.
59. The construction of the sanitary facilities will be in accordance with Clause F2.5 of BCA2016.
60. Ceiling heights to the new areas will be in accordance with Clause F3.1 of BCA2016.

61. Natural light will be provided in accordance with Clause F4.1, F4.2, and F4.3 of BCA2016.
62. Natural ventilation will be provided in accordance with Clause F4.5, F4.6 and F4.7 of BCA2016
63. Water closets and urinals will be located in accordance with Clause F4.8 of BCA2016.
64. The sanitary compartments will be either be provided with mechanical exhaust ventilation or an airlock in accordance with Clause F4.9 of BCA2016.
65. A means of cleaning of windows in accordance with the Construction Safety Act.
66. The swimming pool associated with the new building will comply with Clause G1.1 of the BCA2016 and The Swimming Pools Act 1992, Swimming Pools Regulation 2008, and AS1926 parts 1 and 2.
67. The refrigerated or cooling chamber, strongroom or vault will be in accordance with Clause G1.2
68. Essential fire or other safety measures must be maintained and certified on an ongoing basis, in accordance with the provisions of the Environmental Planning and Assessment Regulation, 2000.
69. Glazing will be in accordance with Part J2 of BCA2016.
70. Facilities for Energy Monitoring will be provided in accordance with Clause J8.3 of BCA2016.

Electrical Services Design Certification:

71. A smoke detection and alarm system will be installed throughout the building in accordance with Table E2.2a, and Specification E2.2a of BCA2016 subject to the client providing this as voluntary measure.
72. Emergency lighting will be installed throughout the development in accordance with Clause E4.2, E4.4 of BCA2016 and AS2293.1 – 2005
73. Exit signage will be installed in accordance with Clause E4.5, E4.7, and E4.8 of BCA2016 and AS2293.1.
74. Artificial lighting will be installed throughout the development in accordance Clause F4.4 of BCA2016 and AS/NZS 1680.0.
75. Lighting power and controls will be installed in accordance with Part J6 of BCA2016.

Hydraulic Services Design Certification:

76. Storm water drainage will be provided in accordance with Clause F1.1 of BCA2016 and AS3500.3
77. Fire hydrants will be installed in accordance with Clause E1.3 of BCA2016 and AS2419.1-2005 as required.
78. Fire hose reels will be installed in accordance with Clause E1.4 of BCA2016 and AS2441-2005.
79. A sprinkler system will be installed in accordance with Clause E1.5 of BCA2016, Specification E1.5 and AS2118 subject to the client providing this as voluntary measure.
80. Portable fire extinguishers will be installed in accordance with Clause E1.6 of BCA2016 and AS2444-2005.
81. The heated water supply systems will be designed and installed to NCC Volume 3 – Plumbing code and Clause J7.2 of BCA2016.

Mechanical Services Design Certification:

82. Where not naturally ventilated the building will be mechanically ventilated in accordance with Clause F4.5 of BCA2016 and AS1668.2-2012.
83. Any air conditioning to be provided with automatic shutdown in accordance with NSW Variation Table E2.2b where any air-handling system (other than non-ducted individual room units with a capacity not more than 1000 L/s and miscellaneous exhaust air systems installed in accordance with Sections 5 and 6 of AS/NZS 1668.1) which does not form part of the smoke hazard management system, on the activation of—

    (i) smoke detectors installed complying with Clause 5 of Specification E2.2a; and

(ii) any other installed fire detection and alarm system, including a sprinkler system complying with Specification E1.5.

84. The commercial kitchen will be provided with a kitchen exhaust hood in accordance with Clause F4.12 of BCA2016, and AS/NZS 1668.1 and AS1668.2.'

85. The air-conditioning and ventilations systems will be designed and installed in accordance with Part J5 of BCA2016.

Structural Engineers Design Certification:

86. The material and forms of construction for the proposed works will be in accordance with Clause B1.2, B1.4 and B1.6 of BCA2016 as follows:
    - Dead and Live Loads – AS1170.1
    - Wind Loads – AS1170.2
    - Masonry – AS3700
    - Concrete Construction – AS3600
    - Steel Construction AS4100
    - Aluminium Construction – AS/NZS1664.1 or 2
    - ABCB Standard for Construction of Buildings in Flood Hazard Areas.

87. The FRL's of the structural elements for the proposed works have been designed in accordance with table 4 for a building of Type B construction of Specifications C1.1 of BCA2016. Refer to Part 4 of this Report.

88. The lift shaft will have a FRL in accordance with Clause C2.10 and Specification C1.1 of BCA2016.

89. Lightweight construction used to achieve required fire resistance levels will comply with Specification C1.8 of BCA2016.

90. The construction joints to the structure will be in accordance with Clause C3.16 of BCA2016 to maintain the FRL integrity of the element concerned.

91. Upon completion of the works, a structural engineer will be able to certify that local failure will be in accordance with Clause D2.2 of BCA2016 for the fire isolated stairs.

Lift Services Design Certification:

92. Warning signage in accordance with Clause E3.3 of BCA2016 will be provided to the lifts to advise not to use the lifts in a fire.

93. A fire service recall control switch is to be installed on a landing at a location nominated by the appropriate authority in accordance with Clause E3.9.

94. A lift car fire service drive control switch is to be installed within the lift car in accordance with Clause E3.10.

95. Access and egress to the lift well landings will comply with the Deemed-to-Satisfy Provisions of D3 of the BCA2016, and will be suitable to accommodate disabled persons.

96. The type lifts will also be suitable to accommodate persons with a disability in accordance with Clause E3.6, Table E3.6a, and will have accessible features in accordance with table E3.6b of BCA2016.

97. The new lift will comply with AS1735.4 in accordance with Clause E3.3 of BCA2016.

NSW Specification Design Certificate:

98. The number of exits provided to the building will be in accordance with Clause D1.2 and NSW Clause D1.2 of BCA2016.

99. The discharge points of exits will be in accordance with Clause D1.10, and NSW Clause D1.10 of BCA2016.

100. The dimensions of exits and paths of travel to exits will be provided in accordance with Clause D1.6, and NSW Clause D1.6 of BCA2016.

101. The doorways and doors will be in accordance with Clause D2.19, NSW Clause D2.19 and D2.20 of BCA2016.

102. The door latching mechanisms to the proposed required exit doors will be in accordance with Clause D2.21 and NSW Clause D2.21 of BCA2016.

5.7 Gunyama Park Amenities- BCA Compliance Specification – Volume 2 of the BCA

The following BCA matters are to be addressed by specific BCA Design Certifications to be issued by the relevant architectural, services and engineering consultants prior to works commencing on-site. This schedule should be forwarded to all consultants to obtain verification that these items have and will be included in the design documentation / specifications:

Architectural Design Certification:

1. New pedestrian ramps and walkways will comply with Clause 6 and Clause 10 of AS1428.1-2009.

2. Landings and door thresholds throughout the development will be provided in accordance with Clause 7 and Clause 10 of AS1428.1-2009.

3. Braille and tactile signage will be in accordance with Clause 8 of AS1428.1-2009.

4. Tactile ground surface indicators will be provided in accordance with Clause 9 of AS1428.1-2009.

5. Accessible sanitary facilities will be designed and fitted out in accordance with Clause 15 and Clause 16 of AS1428.1-2009.

Hydraulic Services Design Certification:

6. Storm water drainage will be provided in accordance with Clause 3.1.2 of BCA 2016 and AS3500.3.

Structural Engineers Design Certification:

7. The material and forms of construction for the proposed works will be in accordance with Clause 3.11 of BCA2016 as follows:

    - Dead and Live Loads – AS1170.1
    - Wind Loads – AS1170.2
    - Masonry – AS3700
    - Concrete Construction – AS3600
    - Steel Construction – AS4100
    - Aluminium Construction – AS/NZS1664.1 or 2

8. The structural resistance of materials and forms of construction are to be determined using five percentile characteristic material properties with appropriate allowance for:

    1. Known construction activities;
    2. Type of materials;
    3. Characteristics of the site;
    4. The degree of accuracy inherent in the methods used to assess the structural behaviour; and
    5. Action affects arising from differential settlement of foundations and changes from temperature, moisture and similar effects.

ANNEXURE A - DESIGN DOCUMENTATION

This report has been based on the following design documentation.

Architectural Plans Prepared by ABA Grimshaw dated 22 April 2015			
DRAWING NO.	**REVISON**	**DRAWING TITLE**	**DATE**
ARCHITECTURE & LANDSCAPE - ABA / GRIMSHAW / TCL 01.ARCHITECTURE			
ARC-A-011	A	SITE PLAN	31/05/2016
ARC-A-101	A	BASEMENT PLAN	31/05/2016
ARC-A-102	A	GROUND FLOOR PLAN	31/05/2016
ARC-A-104	A	FIRST FLOOR PLAN	31/05/2016
ARC-A-105	A	MAIN ROOF PLAN	31/05/2016
ARC-A-201	A	ELEVATIONS OVERALL	31/05/2016
ARC-A-301	A	SECTIONS OVERALL	31/05/2016
ARC-A-401	A	PARK AMENITIES BUILDING	31/05/2016
02.LANDSCAPE			
ARC-T-DA-001	A	DRAWING LIST & SITE CONTEXT PLAN	27/05/2016
ARC-T-DA-002	A	LANDSCAPE LEGEND & MATERIALS	27/05/2016
ARC-T-DA-003	A	TREE PROTECTION & REMOVAL PLAN	27/05/2016
ARC-T-DA-004	A	GENERAL ARRANGEMENT PLAN	27/05/2016
ARC-T-DA-005	A	FURNITURE & FIXTURES PLAN	27/05/2016
ARC-T-DA-006	A	GRADING PLAN	27/05/2016
ARC-T-DA-007	A	PLANTING PLAN	27/05/2016
ARC-T-DA-008	A	LONG SECTIONS & ELEVATION	27/05/2016
ARC-T-DA-009	A	SECTIONS	27/05/2016
ARC-T-DA-010	A	DETAILED PLAYGROUND PLAN	27/05/2016
ARC-T-DA-011	A	DETAILED PLAYGROUND	27/05/2016
ARC-T-DA-012	A	DETAILED PLAYGROUND	27/05/2016
03.SIGNAGE			
	DA	SIGNAGE STRATEGY AND DRAWINGS	02/06/2016

ANNEXURE B

DETAILED ASSESSMENT OF THE DEEMED-TO-SATISFY PROVISIONS OF VOLUME 1 OF BCA2016

BUILDING ASSESSMENT

Outlined below is a detailed assessment of the Deemed-to-Satisfy Provisions of the Building Code of Australia (BCA) including the State variations where applicable.

All Deemed-to-Satisfy clauses that are applicable to the subject building have been referred to below, including a comment adjacent to each clause of the proposal's ability to satisfy each respective clause.

The abbreviations outlined below have been used in the following table.

N/A	Not Applicable. The Deemed-to-Satisfy clause have been satisfied by the proposed design.
Complies	The relevant provisions of the Deemed-to-Satisfy clause have been satisfied by the proposed design.
CRA	'COMPLIANCE READILY ACHIEVABLE'. It is considered that there was not enough information included in the documentation to accurately determine strict compliance with the individual clause requirements. However, subject to noting the requirements of each clause, compliance can be readily achieved. See Part 5 for Specification.
FI	Further Information is necessary to determine the compliance potential of the building design.
AS	Alternative Solution with respect to this Deemed-to-Satisfy Provision is necessary to satisfy the relevant Performance Requirements.
DNC	Does Not Comply.
Noted	BCA Clause simply provides a statement not requiring specific design comment or confirmation.

DEEMED TO SATISFY CLAUSE ASSESSMENT SUMMARY

Clause	Comment	Status
SECTION B: STRUCTURE		
PART B1 – STRUCTURAL PROVISIONS		
B1.0: Deemed-to-Satisfy Provisions	Noted	-
B1.1: Resistance to Actions	For Information Only – Structural Engineer to certify at CC stage.	CRA Refer Part 5.4 of Report
B1.2: Determination of Individual Actions	No details of loads imposed upon the building – Structural Engineer to certify at CC stage.	CRA Refer Part 5.3 of Report
B1.4: Determination of Structural Resistance of Materials and Forms of Construction	No details of materials and forms of construction – Structural Engineer, Architect and Manufacturers to certify at CC stage.	CRA Refer Part 5.3 of Report
B1.5 Structural Software	Structural software used in computer aided design of a building or structure within the geometrical limits of (b) of this Clause must comply with the ABCB Protocol for Structural Software. Structural Engineer to certify.	CRA Refer Part 5.3 of Report
B1.6 Construction of Buildings in Flood Hazard Areas	A Class 2 or 3 building, Class 9a health care building, Class 9c aged-care building or Class 4 part of a building must comply the ABCB Standard for Construction of Buildings in Flood Hazard Areas.	N/A
SECTION C: FIRE RESISTANCE		
PART C1 – STRUCTURAL PROVISIONS		
C1.0: Deemed-to-Satisfy Provisions	Noted	-
C1.1: Type of Construction Required	The building is to be of Type B Construction.	Noted
C1.2: Calculation of Rise in Storeys	The building has a rise in storeys of two (2).	Noted
C1.3: Buildings of Multiple Classification	The building will be of multiple classifications and is required to be of Type B construction.	Noted
C1.4: Mixed Types of Construction	Part Ground floor is of Class 9b/5 and part Ground Floor is Class 6. Level one is a Class 9b. Thus the entire building must be constructed out of Type B construction.	Noted
C1.7: Open Spectator Stands and Indoor Sports Stadium	The pool is not considered an indoor sports stadium.	N/A
C1.8: Lightweight Construction	Lightweight construction may be used to achieve required fire resistance levels. Should lightweight construction be proposed it is to comply with Specification C1.8.	CRA Refer Part 5.3 of Report
C1.10: Fire Hazard Properties	No details of the fire hazard properties of the materials and assemblies in the proposed building. Fire hazard indices to comply with Specification C1.10.	CRA Refer Part 5.3 of Report
C1.11: Performance of External Walls in Fire	For information only.	Noted
C1.12: Non-combustible Materials	For information only.	Noted
PART C2 – COMPARTMENT AND SEPARATION		
C2.0: Deemed-to-Satisfy Provisions	Noted	-
C2.1: Application of Part	Noted	-
C2.2: General Floor Area and Volume Limitations	In accordance with C1.1 the two storey building is required to be of Type B construction. The maximum compartment sizes stipulated by BCA Clause C2.2 achieve compliance with the BCA. The architect has calculated a volume of 31,257m^3 and a floor area of 5,053 m^2. In accordance with this clause, a maximum volume of 33,000m^3 and floor area of 5,500m^2 is permitted. It is	CRA Refer Part 5.3 of Report

SECTION C: FIRE RESISTANCE		
	noted that should the volume exceed the above requirements, the building can be assessed against the requirements of Type A construction. To be further assessed at CC stage as the design develops.	
C2.6: Vertical Separation of Openings in External Walls	Openings in the external wall within the building which are above another opening in the storey below are to be separated by a spandrel in accordance with this clause.	N/A
C2.7: Separation by Fire Walls	The following firewalls are proposed: - Between the southern end of the pool hall and plant equipment. - Between the Class 9b aquatic centre and hydro therapy pool. These firewalls are proposed to reduce compartment size and volume. Firewalls to be designed and constructed in accordance with this clause. It is noted that the proposed café occupies approximately 250m2 of floor area. In accordance with BCA Clause A2.3, this is less than 10% of the Class 9b portion. Therefore, the Café forms part of the aquatic centre and adopts the provisions of Class 9b for the purposes of the BCA. Therefore no firewall is required to separate these We note that further design input to the locations of the firewall is required as the design develops to ensure consistency BCA compliance. Refer to Appendix D of this report containing a full ground floor fire compartment mark-up.	CRA Refer Part 5.3 of Report
C2.8: Separation of Classifications in the Same Storey	Separation between the aquatic centre and southern plant rooms, hydro therapy pool is proposed by means of firewalls in accordance with this clause. The café is less than 10% of the floor area and therefore forms part of the Class 9b portion.	CRA Refer Part 5.3 of Report
C2.9: Separation of Classifications in Different Storeys	The gym portion forms part of the Class 9b pool hall.	N/A
C2.10: Separation of Lift Shafts	The lift shaft is are to have the FRL as required by Table 3 of Specification C1.1 of the BCA. See Part 4 of this report for further information.	CRA Refer Part 5.3 of Report
C2.11: Stairways and Lifts in One Shaft	As required, the lifts and the fire-isolated stairways are located within their own shafts.	CRA Refer Part 5.3 of Report
C2.12: Separation of Equipment	Equipment including lift motor rooms, emergency generators sustaining emergency equipment operating in emergency mode, central smoke control plant, boilers or battery areas with a voltage exceeding 24 volts and a capacity exceeding 10 ampere hours are required to be fire separated from the remainder of the building in accordance with this clause.	CRA Refer Part 5.3 of Report
C2.13: Electricity Supply System	In any switch room, if the main switch room sustains emergency equipment required to operate in emergency mode, is required to be separated from the building with construction having a FRL of 120/120/120, and doorways protected with self-closing -/120/30.	CRA Refer Part 5.3 of Report
PART C3 – PROTECTION OF OPENINGS		
C2.0: Deemed-to-Satisfy Provisions	Noted	-

SECTION C: FIRE RESISTANCE		
C3.1: Application of Part	Noted	-
C3.2: Protection of Openings in External Walls	Protection to be provided to any openings within 3m of a boundary in accordance with Clause C3.4. No openings require protection.	CRA Refer Part 5.3 of Report
C3.3: Separation of External Walls and Associated Openings in Different Fire Compartments	The buildings fire compartment are suitably separated with no specific openings in the external walls that require protection by this clause. All door openings will be required to comply with BCA Clause C3.4.	CRA Refer Part 5.3 of Report
C3.4: Acceptable Methods of Protection	Where protection is required, doorways, windows and other openings must be protected in accordance with this clause. Fire doors, fire windows and fire shutters must comply with Specification C3.4. Acceptable methods of doorway protection – a. Internal or external wall-wetting sprinklers used with doors that are self-closing or automatic closing; or b. -/60/30 fire doors that are self-closing or automatic closing. Acceptable methods of window protection: a. Internal wall wetting sprinklers where the windows are self-closing; or b. -/60/- fire windows that are automatic closing or permanently fixed in the closed position; or c. -/60/- automatic closing fire shutters.	Noted
C3.5: Doorways in Fire Walls	Doorways or fire shutters in fire walls are to have the same FRL as the fire wall except that each door/fire shutter can have an insulation level of 30.	CRA Refer Part 5.3 of Report
C3.6: Sliding Fire Doors	In addition to the provision of a fire door/shutter in a firewall, a sliding fire door is permitted to be provided in the held open position b fail safe devices in accordance with this clause. No Sliding fire doors proposed at this stage.	CRA Refer Part 5.3 of Report
C3.7: Protection of Doorways in Horizontal Exits	No horizontal exits proposed.	N/A
C3.8: Openings in Fire-isolated Exits	The doorways opening into the fire isolated exits are required to be protected by -/60/30 self-closing fire doors, except for the final exit doors.	CRA Refer Part 5.3 of Report
C3.9: Service Penetrations in Fire-isolated Exits	Fire stairs must not be penetrated by services other than electrical wiring under Clause D2.7, pressurisation ducting achieving an FRL of -/120/60 if it passes through another part of the building and does not open to any other part and water supply pipes for fire services.	CRA Refer Part 5.3 of Report
C3.10: Openings in Fire-isolated Lift Shafts	The lift doors are to have a FRL of no less than -/60/- and are to be in accordance with AS1735.11.	CRA Refer Part 5.3 of Report
C3.12: Openings in Floors and Ceilings for Services	No details provided. Services will need to be treated in accordance with this Clause where they penetrate fire resistant elements such as fire walls, floors and other fire resistant walls. Services to be within fire resistant shafts or treated in accordance with C3.15. To be assessed at CC stage.	CRA Refer Part 5.3 of Report
C3.13: Openings in Shafts	Access to any service shafts is to be through an access panel, or self-closing fire door, having a FRL of not less than -/60/30.	CRA Refer Part 5.3 of Report

SECTION C: FIRE RESISTANCE		
	Details of proposed service shafts to be assessed at CC stage.	
C3.15: Openings for Service Installations	Services will need to be treated in accordance with this Clause where they penetrate fire resistant elements such as fire walls, floors and other fire resistant walls. Services to be within fire resistant shafts or treated in accordance with C3.15. To be assessed at CC stage.	CRA Refer Part 5.3 of Report
C3.16: Construction Joints	Joints are to have the required FRL with respect to integrity and insulation relative to the building element they are joining. Structural Engineer to certify.	CRA Refer Part 5.3 of Report
C3.17: Columns Protected with Lightweight Construction to Achieve an FRL	It is considered that all columns will be of concrete construction and therefore will have sufficient fire resistance without the need for light weight construction to provide a FRL. Structural Engineer to certify.	CRA Refer Part 5.3 of Report
SPECIFICATION C.1.1 – FIRE-RESISTING CONSTRUCTION		
2.0: General Requirements	Noted	-
2.1: Exposure to Fire-Source Features	The building is not exposed to the property boundaries.	CRA Refer Part 5.3 of Report
2.2: Fire Protection for a Support of Another Part	Where a part of a building required to have an FRL depends upon direct vertical or lateral support from another part to maintain its FRL, that supporting part must have an FRL not less than that required by other provisions of this Specification; and if located within the same fire compartment as the part it supports have an FRL in respect of structural adequacy the greater of that required for the supporting part itself and for the part it supports.	Noted
2.3: Lintels	A lintel must have the FRL required for the part of the building in which it is situated, unless it does not contribute to the support of a fire door, fire window or fire shutter, and it spans an opening in masonry which is not more than 150 mm thick and is not more than 3m wide if the masonry is non- loadbearing; or not more than 1.8m wide if the masonry is loadbearing and part of a solid wall or one of the leaves of a cavity wall or is located in a non-loadbearing part of the Class 2 portion of the building.	CRA Refer Part 5.3 of Report
2.4: Attachments Not to Impair Fire-resistance	Any new attachments proposed to the external facade of the building are to be of non-combustible materials only. The combustibility of the proposed attachment is to have been tested to AS1530.1 and shown to be non-combustible. Care is to be taken with regards to any composite or sandwich panels as the entire panel is to be shown to be non-combustible. Details are to be provided. Any proposed linings are to be non-combustible and in compliance with this Clause. To be further assessed at CC stage once any external attachments have been defined.	CRA Refer Part 5.3 of Report
2.5: General Concessions	No Concessions applicable.	Noted
2.7: Enclosure of Shafts	Fire rated shafts are required to be enclosed, at the top and bottom, with construction having a FRL required for the walls of a non-load-bearing shaft in the same building, unless the shaft extends beyond the roof covering, with the exception of fire isolated stair and lift shafts that are to have lids with a FRL regardless.	CRA Refer Part 5.3 of Report
4.0: Type B Fire-resisting Construction	Noted	-

SECTION C: FIRE RESISTANCE		
4.1: Fire-resistance of Building Elements	The FRL's of all elements are to be in accordance with the FRL's detailed in the Table contained within Part 4.0 of this report The floor separating the ground floor and first floor Class 9b building is required to maintain an FRL of 30/30/30 in accordance with Clause 4.1 of Specification C1.1. The proposed external walls to the Class 9b portions are required to be constructed with a fire-resistance level (FRL) of up to 120/120/120 subject to the location of a fire source feature within 18m (loadbearing) or 3m (non-loadbearing). The firewall between the Hydro therapy pool and aquatic centre is to maintain an FRL of 120/120/120. Any proposed external columns within 18m to a fire source feature will be required to maintain an FRL of 120/-/-. Any proposed loadbearing internal columns will be required to maintain an FRL of 120/-/-. The roof over the Class 9b is not required to maintain an FRL.	CRA Refer Part 5.3 of Report

SECTION D: ACCESS AND EGRESS		
PART D1 – PROVISION FOR ESCAPE		
D1.0: Deemed-to-Satisfy Provisions	Noted	-
D1.1: Application of Part	Noted	-
D1.2: Number of Exits Required	The proposed Class 9b and Class 7a buildings are required to have direct access to not less than two exits from each storey in accordance with this Clause.	CRA Refer Part 5.3 of Report
D1.3: When Fire-Isolated Stairways and Ramps are Required	Every stairway serving as a required exit must be fire-isolated unless it connects or passes through no more than 2 consecutive storeys. Therefore, the exit stairs are permitted to be non-fire isolated.	CRA Refer Part 5.3 of Report
D1.4: Exit Travel Distances	Travel distances to an exit must not be more than 20 metres from any point on the floor. This can be increased to 40 metres from a point in choice where two or more exits are provided in different directions. The proposed architectural drawings have been scaled and measured and show that travel distances can comply. It is noted that travel distances for base building design to the first floor will maintain compliance. A further Assessment will be required at the fit out stage to ensure travel distances are maintained once equipment locations are identified. To be further assessed at CC stage. We have provided a mark-up of the first floor travel distances in Appendix F.	CRA Refer Part 5.3 of Report
D1.5: Distance Between Alternative Exits	Alternative exits within the basement are spaced more than 9m apart.	CRA Refer Part 5.3 of Report
D1.6: Dimensions of Exits and Paths of Travel to Exits	Exits or paths of travel to them are required to maintain clear and unobstructed width of 1 metre and 2 metres in height. Dimensions of exits and paths of travel to exits to be further assessed during development.	CRA Refer Part 5.3 of Report

SECTION D: ACCESS AND EGRESS		
	Ground Floor Based upon the D1.13 assessment, the following exit dimensions are noted for the ground floor: The population at this level is restricted to 1720 persons which requires an aggregate egress width of 15.0 metres. An assessment of the current proposed exit doorways has revealed that the available egress width is approximately 15.0 metres as required. However, the available clear egress width is affected by the proposed door hardware, door widths and hinge systems so a detailed assessment of egress width would be needed at CC stage once these items are selected to confirm compliance. NSW variation Clause to D1.6 requires all doorways to be provided with a panic bar system or the like and must not contain any operable door hardware in the direction of travel. Generally, a panic bar is 100mm wide per door leaf. The exit width is measured clear of panic bars. It is noted, that the egress width does not take in to consideration the requirement of panic bars to an exit door within a Class 9b. First Floor Based upon the D1.13 assessment, the following exit dimensions are noted for the first floor: As per recent advice the total estimated population for the first floor gym would ideally be at 500 persons which would be achievable based upon available sanitary facilities. However, a total exit width of 4.5m would be needed. Currently, the first floor is provided with approximately 3.7m of exit width by means of the fire isolated stairway and the non-fire isolated stairway. Again, it is noted that panic bars are required to serve the first floor exits. 200mm has been accommodated for panic bars, therefore, the required exit width of 3.5m can be achieved and this restricts the population to 380 persons in accordance with Clause D1.6(d((i). A number of doors throughout the building are required to be increased in size to at least 1m in width clear of panic bars. This is to ensure that the required exit width is maintained at all times. Please note that the exit width in this instance is measured by the width of the stairways. It is further noted, that a concession is applicable to all exit door leafs with a width reduction of 250mm for the required exit width at the door leaf only. i.e if a required exit width is 1m, then at the doorway, the width can be reduced to 850mm.	
D1.7: Travel via Fire-Isolated Exits	Each fire isolated stair serving the Class 9b building is required to discharge directly to a road or open space by way of its own shaft and/or passageway. Any fire-isolated stairwells will need to comply with Clause 11.1(f) and (g) of AS1428.1-2009 which requires each tread to have a luminance contract strip which can	CRA Refer Part 5.3 of Report

SECTION D: ACCESS AND EGRESS		
	be detailed on design documentation at the construction stage. Any fire-isolated stairwells are required to have a handrail that maintains a 270 degree clearance for a continuous hand hold in accordance with Clause 12 of AS1428.1-2009.	
D1.8: External Stairways or Ramps in Lieu of Fire-Isolated Exits	No external stairways or ramps in accordance with this clause.	N/A
D1.9: Travel by Non Fire-Isolated Stairways or Ramps	Stairways serving as a required exit are required to provide a continuous means of travel to a road or open space. A point on a floor to a point of egress to a road or open space must be no greater than 80m if travel is via a non-fire isolated stairway. In a class 9b building, the non-fire isolated stair must discharge 20m from a doorway providing egress to a road or open space and 40m where 2 exits in opposite directions are provided. It is noted that the non-fire isolated stair is provided with 20.5m to the final discharge door. However, travel in different directions is also provided.	CRA Refer Part 5.3 of Report
D1.10: Discharge from Exits	The discharge point of the required exits at ground floor level lead to open space. The discharge points for each exit must suitably be protected from being blocked by means of suitable barriers. Any pathway to the open space is to maintain an unobstructed width of 1 metre.	CRA Refer Part 5.3 of Report
D1.11: Horizontal Exits	No horizontal exits proposed.	CRA Refer Part 5.3 of Report
D1.12: Non-Required Stairways, Ramps or Escalators	There are no non required stairs proposed to the development.	N/A
D1.13: Number of Persons Accommodated	<u>Ground floor (BCA assessment):</u> Based upon the ratios provided in table D1.13 of the BCA the following populations could be accommodated:- Internal Seating: 98 Patrons Outdoor Seating: 95 Patrons 25m pool: 380 Patrons | 1 Lifeguard Indoor Leisure pool: 326 Patrons | 3 Lifeguards Hydro Therapy pool: 80 Patrons | 2 Lifeguards 50m pool: 765 Patrons | 3 Lifeguards Outdoor Leisure pool: 218 Patrons | 2 Lifeguards Creche: 25 Children | 2 employees All offices: 9 employees All meeting rooms: 8 Patrons Café | All employees: 10 employees Café | Indoor seating: 70 Patrons Café | Outdoor seating: 50 Patrons Total: 2,115 Patrons | 32 Employees This population calculation method is a conservative estimate and exceeds the maximum allowable population based upon the available sanitary facilities in accordance with Clause F2.3 of BCA which is 1640 patrons.	CRA Refer Part 5.3 of Report

SECTION D: ACCESS AND EGRESS		
	Based upon discussions with the architect and with respect to current sanitary facility counts then the populations are to be limited to the following:- <u>Ground Floor</u> CAFE/ KIOSK - 100 (general operation mode) and 200 (event mode) - with access to aquatic centre toilets for event mode as required Note: Due to restrictions with egress width and sanitary facility numbers then the 'event mode' shall be restricted to non-peak aquatic centre times IINDOOR/OUTDOOR POOL - 1,640 GYM - 380 (general operation mode) and 380 (event mode) - with access to aquatic centre toilets for event mode as required Note: Due to restrictions with egress width then an event mode of 500 is not possible at this level. Hence, 380 persons max at all times. CRECHE/ SHARED USE ROOM – 25 – This is based upon 50m2 useable floor area and 2m2/person based upon school classroom type use. But these populations are ancillary to the 1640 patrons to the outdoor pool. Not in addition. STAFF - 40 TOTAL = 100+1640+380+40 = 2160 (general operation mode & event mode) ---------- <u>First floor level</u> Table D1.13 of the BCA assessment enables estimated populations based upon likely use. Initial assessment calculated 320 patrons based upon 3m2 per person. However, should part of the fitness studios be used for activities such as 'Yoga' or similar, then the estimated patron population would increase to be approximately 380 patrons which is equivalent to the maximum available egress width to this level in accordance with Clause D1.6 of BCA. We recommend that populations are re-assessed at the CC stage as the design develops and potential fit-out options are considered.	
D1.14: Measurement of Distances	Information only.	Noted
D1.15: Method of Measurement	Information only.	Noted
D1.16: Plant Rooms, Lift Motor Rooms and electricity network substations: Concession	Plant room access will be directly via each storey: Concessions not applicable.	Noted
D1.17: Access to Lift Pits	Access to the lift pit is assumed to be through the bottom landing doors as the pit is assumed to be less than 3m deep.	CRA Refer Part 5.3 of Report
PART D2 – CONSTRUCTION OF EXITS		
D2.0: Deemed-to-Satisfy Provisions	Noted	-
D2.1: Application of Part	Noted	-
D2.2: Fire-Isolated Stairways and Ramps	It is assumed that the stairways will be constructed of reinforced concrete and therefore comply. The structural engineer is to certify that the shaft will withstand a local failure.	CRA Structural Engineer to certify

SECTION D: ACCESS AND EGRESS		
D2.3: Non-Fire-Isolated Stairways and Ramps	It is assumed that the stairways will be constructed of reinforced concrete and therefore comply. The structural engineer is to certify that the shaft will withstand a local failure.	CRA Structural Engineer to certify
D2.4: Separation of Rising and Descending Stair Flights	Each fire isolated stair is within its own shaft.	Complies
D2.5: Open Access Ramps and Balconies	No Smoke hazard management proposed.	N/A
D2.6: Smoke Lobbies	No Smoke lobbies proposed.	N/A
D2.7: Installations in Exits and Paths of Travel	Services or equipment comprising electricity meters, distribution boards or ducts or central telecommunications distribution boards or equipment or electrical motors or other motors serving equipment in the building installed within the corridors and hallways are to be enclosed by non-combustible construction or a fire-protective covering with doorways or openings suitably sealed against smoke spreading from the enclosure.	CRA Refer Part 5.3 of Report
D2.8: Enclosure of Space Under Stairs and Ramps	No enclosure is proposed beneath the fire isolated stair within the Creche area. Compliance is achievable. A WC is proposed beneath the non-fire isolated stair serving the gym. This is permitted subject to the WC enclosing walls maintain an FRL of 60/60/60 and a self-closing fire door maintaining -/60/30. Further information required at CC stage.	CRA Refer Part 5.3 of Report
D2.9: Width of Stairways and Ramps	The ramps throughout the discharge points are greater than 2m. it is recommended that the ramps are provided with a dividing handrail to comply with this clause.	CRA Refer Part 5.3 of Report
D2.10: Pedestrian Ramps	Ramps are to have suitable gradients for egress. The proposed ramps appear to maintain compliant gradients. The floor surface of a ramp must have a slip-resistance classification complying with Table D2.14 when tested in accordance with AS 4586.	CRA Refer Part 5.3 of Report
D2.11: Fire-Isolated Passageways	The fire-isolated passageways servicing the building are required to maintain the FRL of the fire isolated stair forming part of the passageway.	CRA Refer Part 5.3 of Report
D2.12: Roof as Open Space	There are no areas deemed as roof as open space.	N/A
D2.13: Goings and Risers	Stair geometry to comply with this clause. Stair treads are to have a surface with a slip-resistance classification complying with Table D2.14 when tested in accordance with AS 4586 or a nosing strip with a slip-resistance classification complying with Table D2.14 when tested in accordance with AS4586.	CRA Refer Part 5.3 of Report

<table>
<tr><th colspan="3">SECTION D: ACCESS AND EGRESS</th></tr>
<tr><td>D2.14: Landings</td><td>Landings to have either a surface with a slip-resistance classification complying with Table D2.14 when tested in accordance with AS4586 or a strip at the edge of the landing with a slip-resistance classification complying with Table D2.14 when tested in accordance with AS 4586 where the edge leads to a flight below.
<table>
<tr><th rowspan="2">Application</th><th colspan="2">Surface Condition</th></tr>
<tr><th>Dry</th><th>Wet</th></tr>
<tr><td>Ramp steeper than 1:14</td><td>P4 or R11</td><td>P5 or R12</td></tr>
<tr><td>Ramp steeper than 1:20 but not steeper than 1:14</td><td>P3 or R10</td><td>P4 or R11</td></tr>
<tr><td>Tread or landing surface</td><td>P3 or R10</td><td>P4 or R11</td></tr>
<tr><td>Nosing or landing edge strip</td><td>P3</td><td>P4</td></tr>
</table></td><td>CRA Refer Part 5.3 of Report</td></tr>
<tr><td>D2.15: Thresholds</td><td>Threshold ramps and step ramps in a building are required to be accessible in accordance with part D3.</td><td>CRA Refer Part 5.3 of Report</td></tr>
<tr><td>D2.16: Barriers to Prevent Falls</td><td>Barriers are required to be 1m above the floor of any balcony, path or the like. Details of the dimensions and configurations of the barriers to all levels to be nominated as being 1000mm in height.

FIS barriers are to be detailed as required with a bottom rail 150mm above the stair nosing’s, a mid-rail and a top rail 865mm above the stair nosing’s and 1.0m above the landings. Further specific details of barriers to be provided at CC Stage.</td><td>CRA Refer Part 5.3 of Report</td></tr>
<tr><td>D2.17: Handrails</td><td>A required exit (fire isolated or non-fire isolated) serving an area required to be accessible must be fitted with handrails in accordance with Clause 12 of AS1428.1 in which requires the handrail to be continuous and maintain a continuous hand hold.

Stair Treads are shown to be offset and therefore, handrail can achieve compliance.</td><td>CRA Refer Part 5.3 of Report</td></tr>
<tr><td>D2.18: Fixed Platforms, Walkways Stairways and Ladders</td><td>Access to all plant rooms is to either be direct from a floor level or stairs, ladders or the like are to be provided in accordance with AS1657.</td><td>CRA Refer Part 5.3 of Report</td></tr>
<tr><td>D2.19: Doorways and Doors</td><td>All required exit doors are required to be swinging in the direction of egress.</td><td>CRA Refer Part 5.3 of Report</td></tr>
<tr><td>D2.20: Swinging Doors</td><td>All required exit doors are shown to be swinging in the direction of egress. It will need to be ensured that the exit doors do not encroach at any part of its swing on the required stairway width by more than 500mm. In addition when fully open they must not encroach by more than 100mm on the required width. These measurements include door handles and other furniture.</td><td>CRA Refer Part 5.4 of Report</td></tr>
<tr><td>D2.21: Operation of Latch</td><td>Doors in a required exit, forming part of a required exit or in the path of travel to a required exit must be readily open able without a key from the side that faces a person seeking egress, by a single hand downward action or pushing action on a single device which is located between 900 mm and 1.1m from the floor.

There are a number of automatic sliding doors and turnstile/boom gate like electronic entry/exit points at both ground and first floor level. It is recommended that all</td><td>FI/CRA Refer Part 5.4 of Report</td></tr>
</table>

SECTION D: ACCESS AND EGRESS		
	these doors and electronic gates are fitted with fail safe devices as they form part of the path of travel to a required exit. However, there is no specific smoke detection or alarm system required by BCA Clause E2.2a and Table E2.2a and subsequently proposed in the building in which would activate any such devices. We do note that there is a requirement for a smoke detection system in accordance with Table E2.2b subject to confirmation from the mechanical engineer confirming the air conditioning system proposed within the building. Should a detection system be required, then the failsafe devices can be interconnected with this system. Subject to the mechanical engineers confirmation, we recommend that the building be provided with an automatic smoke detection and alarm system in accordance with BCA Clause E2.2a and Specification E2.2a. This will allow all automatic sliding doors and electronic gates to trip in the open position to allow safe egress through the building. This would also be good practice to alert the patrons and staff utilising the aquatic centre to allow for early evacuation in the event of a building alarm. Further input from the client is required. To be assessed at CC stage.	
D2.22: Re-entry from Fire-Isolated Exits	Re-entry not required.	N/A
D2.23: Signs on Doors	Required signage is to be located on all fire and smoke doors stating “Fire Safety Door, Do Not Obstruct, Do Not Keep Open” and the discharge door from the fire isolated stairways are to state “Fire Safety Door – Do Not Obstruct” in capital letters not less than 20mm in height.	CRA Refer Part 5.3 of Report
D2.24: Protection of Openable Windows	Protection not required.	N/A

SECTION E: SERVICES AND EQUIPMENT		
PART E1 – FIRE FIGHTING EQUIPMENT		
E1.0: Deemed-to-Satisfy Provisions	Noted	-
E1.3: Fire Hydrants	As the entire building is over 500 m^2, a fire hydrant system must be installed in accordance with Clause E1.3 of the BCA. The fire hydrant is to be installed in accordance with AS2419-2005. The hydrant booster is proposed to be located within 10m of the building. Therefore, shielding construction is required. Shielding Construction is required to achieve the required FRL of 90/90/90 for 2m either side of the booster connections and 3m above the upper hose connections in accordance with Clause 7.3 of AS2419.1-2005. Further details to be provided at CC stage. If shielding construction cannot be achieved, then a Performance Solution may be required or s188 exemption sought from NSW Fire & Rescue. To be further assessed at CC stage once hydraulic services design is finalised.	CRA Refer Part 5.3 of Report

SECTION E: SERVICES AND EQUIPMENT			
E1.4:	Fire Hose Reels	A fire hose reel is required to be installed where a fire hydrant is provided in accordance with Clause E1.4 of the BCA. A fire hose reel is to be installed in accordance with AS2441-2005. A fire hose reel must be located adjacent to an internal hydrant and within 4 metres of an exit. To be further assessed at CC stage once hydraulic services design is finalised.	CRA Refer Part 5.3 of Report
E1.5:	Sprinklers	The building is not required to be sprinkler protected. The client has advised that the building will be sprinkler protected as an asset protection method. The standard of performance is unknown. It is recommended that the sprinkler system be provided to comply with this clause.	FI/CRA Refer Part 5 of Report
E1.6:	Portable Fire Extinguishers	Clause E1.6 of the BCA outline portable fire extinguishers must be provided as listed in Table E1.6 of the BCA and must be selected, located and distributed in accordance with Sections 1, 2, 3 and 4 of AS2444-2001. Table E1.6 of the BCA, requires extinguishers to be installed in kitchens, compartments less than 500m2 and any other areas as outlined.	CRA Refer Part 5.3 of Report
E1.8:	Fire Control Centres	A fire control centre is not required due to the floor area.	N/A
E1.9:	Fire Precautions During Construction	Information only. Whilst the building is under construction there is to be not less than one fire extinguisher provided at all times to each storey. Once the building has reached an effective height of over 12m the hydrants and hose reels and booster connections must be operational to all levels except the 2 uppermost storeys under construction.	Noted
E1.10:	Provision for Special Hazards	Consideration tot eh plant rooms and chemical storage areas to be made. Estimated quantities to be provided to ensure that fighting fire is available.	CRA Refer Part 5.3 of Report
PART E2 – SMOKE HAZARD MANAGEMENT			
E2.0:	Deemed-to-Satisfy Provisions	Noted	-
E2.1:	Application of Part	Noted	-
E2.2:	General Requirements (including Tables E2.2a and E2.2b)	In accordance with Clause E2.2 of the BCA, the building is exempt from having a smoke hazard management system in accordance with Table E2.2a of the BCA. However, NSW Variation Table E2.2b requires a Class 9b building to be provided with automatic shutdown where any air-handling system (other than non-ducted individual room units with a capacity not more than 1000 L/s and miscellaneous exhaust air systems installed in accordance with Sections 5 and 6 of AS/NZS 1668.1) which does not form part of the smoke hazard management system, on the activation of— (i) smoke detectors installed complying with Clause 5 of Specification E2.2a; and (ii) any other installed fire detection and alarm system, including a sprinkler system complying with Specification E1.5.	CRA Refer Part 5.3 of Report
E2.3:	Provisions for Special Hazards	The building is exempt from these provisions as it is a sporting venue and swimming pool.	Noted
PART E3 – LIFT INSTALLATIONS			
E3.0:	Deemed-to-Satisfy Provisions	Noted	-
E3.1:	Lift Installations	An electric passenger lift installation and electrohydraulic passenger lift installation must comply with Specification E3.1.	CRA Refer Part 5.3 of Report
E3.2:	Stretcher Facility in Lifts	The lift is proposed to have a travel of less than 12m. Therefore, a stretcher facility is not required.	Noted

SECTION E: SERVICES AND EQUIPMENT			
E3.3:	Warning Against Use of Lifts in Fire	Signage warning against using the lift during a fire is to be installed.	CRA Refer Part 5.3 of Report
E3.4:	Emergency Lifts	Emergency lifts not required.	Noted
E3.5:	Landings	Lift landings are of a suitable size. Lift landings are required to comply with Part D of the BCA by this clause.atrq3et	CRA Refer Part 5.3 of Report
E3.6:	Passenger Lifts	The proposed building will be served by a lift to provide access to first floor level. The lift is proposed to have a travel of less than 12m. Therefore, the internal floor dimensions are required to be a minimum of 1100mm by 1400mm. Accessible features are to be provided within any lift in accordance with AS1735.4-1999.	CRA Refer Part 5.3 of Report
E3.7:	Fire Service Controls	The lift is proposed to have a travel of less than 12m.	N/A
E3.9:	Fire Service Recall Operation Switch	The lift is proposed to have a travel of less than 12m.	N/A
E3.10:	Lift Car Service Drive Control Switch	The lift is proposed to have a travel of less than 12m.	N/A
PART E4 – EMERGENCY LIGHTING, EXIT SIGNS AND WARNING SYSTEMS			
E4.0:	Deemed-to-Satisfy Provisions	Noted	-
E4.2:	Emergency Lighting Requirements	Emergency lighting is to be installed in every fire-isolated exit, each floor level, common corridor and the like.	CRA Refer Part 5.3 of Report
E4.3:	Measurement of Distance	Information Only	CRA Refer Part 5.3 of Report
E4.4:	Design and Operation of Emergency Lighting	To comply with AS2293.1-2005.	CRA Refer Part 5.3 of Report
E4.5:	Exit Signs	Exits signs are to be provided above or adjacent to a door providing egress as well as directional signage throughout the entire development where necessary. It is noted that additional exist signage will be required to address the proposed exit system in accordance with BCA Clause D1.4 and D1.5. Refer to Appendix E outlining travel distances.	CRA Refer Part 5.3 of Report
E4.6:	Direction Signs	Where an exit is not readily apparent a directional sign is to be installed indicating the direction of egress being primarily within the carpark areas. It is noted that additional exist signage will be required to address the proposed exit system in accordance with BCA Clause D1.4 and D1.5. Refer to Appendix E outlining travel distances.	CRA Refer Part 5.3 of Report
E4.7:	Class 2 and 3 Buildings and Class 4 Parts: Exemptions	For Information Only	CRA Refer Part 5.3 of Report
E4.8:	Design and Operation of Exit Signs	To comply with AS2293.1-2005 and/or Specification E4.8.	CRA Refer Part 5.3 of Report
E4.9:	Sound Systems and Intercom Systems for Emergency Purposes	Not applicable to this building.	N/A
SPECIFICATION E4.8 – Photoluminescent Exit Signs			
1.	Scope	Noted	-
2.	Application	If used photoluminescent exit signs are to comply with this clause.	CRA Refer Part 5.3 of Report
3.	Illumination	If used photoluminescent exit signs are to comply with this clause.	CRA Refer Part 5.3 of Report

SECTION E: SERVICES AND EQUIPMENT			
4.	Pictorial Elements	If used photoluminescent exit signs are to comply with this clause.	CRA Refer Part 5.3 of Report
5.	Viewing Distance	If used photoluminescent exit signs are to comply with this clause.	CRA Refer Part 5.3 of Report
6.	Smoke Control Systems	If used photoluminescent exit signs are to comply with this clause.	CRA Refer Part 5.3 of Report

SECTION F: HEALTH AND AMENITY			
PART F1 – DAMP AND WEATHERPROOFING			
F1.0:	Deemed-to-Satisfy Provisions	Noted	-
F1.1:	Stormwater Drainage	Stormwater drainage to comply with AS3500.3.	CRA Refer Part 5.3 of Report
F1.4:	External Above Ground Membranes	Waterproofing membranes for external above ground use to comply with AS4654 Parts 1 and 2.	CRA Refer Part 5.3 of Report
F1.5:	Roof Coverings	Roof coverings to comply with this clause.	CRA Refer Part 5.3 of Report
F1.6:	Sarking	The sarking is to comply with AS4200.	CRA Refer Part 5.3 of Report
F1.7:	Water Proofing of Wet Areas in Buildings	Waterproofing to wet areas to comply with AS3740.	CRA Refer Part 5.3 of Report
F1.9:	Damp-proofing	Moisture is to be prevented from reaching the walls above a damp-proof course, and the underside of the suspended floors.	CRA Refer Part 5.3 of Report
F1.10:	Damp-proofing of Floors on the Ground	A vapour barrier in accordance with AS2870 must be installed.	CRA Refer Part 5.3 of Report
F1.11:	Provision of Floor Wastes	In Class 2 or 3 buildings or Class 4 part of a building, a bathroom or laundry is to have a floor waste where the floor is graded to the floor waste to permit the drainage of water.	N/A
F1.12:	Sub-floor Ventilation	Sub-floor plant rooms to comply with this clause.	CRA Refer Part 5.3 of Report
F1.13:	Glazed Assemblies	Glazed assemblies are to comply with AS2047 and AS1288.	CRA Refer Part 5.3 of Report
PART F2 – SANITARY AND OTHER FACILITIES			
F1.0:	Deemed-to-Satisfy Provisions	Noted	-
F2.2:	Calculation of Number of Occupants and Facilities	The number of occupants has been calculated in accordance with D1.13.	CRA Refer Part 5.3 of Report
F2.3:	Facilities in Class 3 to 9 Buildings (including Table F2.3)	The sanitary facilities will be provided on a ratio of male to female patrons assumed at 50:50. Sanitary facilities are to be provided in accordance with the design occupancy outlined in Clause F2.3 and Table F2.3 of the BCA. Individual toilet/urinal amenities are required to have a wash basin in all class 3 to 9 buildings. The following sanitary count is undertaken based on the population assessment under BCA Clause D1.13.	CRA Refer Part 5.3 of Report

SECTION F: HEALTH AND AMENITY

Furthermore, it is noted that in a class 9b and 6 building, patrons and employees can share amenities.

Ground floor aquatic centre:

Based upon the combined patron amenities provided to the pool deck area, the following populations will be served based upon spectator/patron of sporting event type use:-

Patrons	Toilet Pan	Urinal	Wash Basin
Males	4 (1500)	7 (700) 1xAccess WC counted here	8(1200)
Females	11 (680)	-	9 (1250)

Based upon equal numbers and the limiting factor of female WCs then a population of 1220 patrons will be served by these facilities.

Note: there are 5 x accessible bathrooms. One of these has been counted once for each sex as per Clause F2.2. Of the remaining 4 accessible bathrooms these have been counted towards female WCs.

As the Hydro Pool Amenities will be used concurrently with the pool deck area then these facilities have been combined with the main pool deck area facilities (in table above) and a total combined count is included in the table below:-

Patrons	Toilet Pan	Urinal	Wash Basin
Males	6 (2500)	8(800)	9 (1350)
Females	13(820)	-	10(1400)

Based upon equal numbers and the limiting factor of female WCs then a population of 1640 patrons will be served by the pool area amenities.

Additional facilities for patrons and staff are provided elsewhere at this level as follows:-

Ground Floor Café Area Amenities

Based upon the patron amenities provided to the café/office area, the following populations will be served based upon patron of cafe type use:-

Patrons	Toilet Pan	Urinal	Wash Basin
Males	1(100)	1 1xWC counted here(50)	1(50)
Females	2 (50)	-	1(50)

Based upon equal numbers and the limiting factor of female WCs then a population of 100 patrons will be served to this area.

SECTION F: HEALTH AND AMENITY

Ground Floor Pool Deck Staff Amenities

Employees	Toilet Pan	Urinal	Wash Basin
Males	1 (20)	1 1xAccess WC counted here (25)	1 (30)
Females	2(30)	-	1(30)

Based upon equal numbers and the limiting factor of male WCs then a population of 40 staff will be served by these facilities. This is sufficient to serve maximum expected staff to the building.

In summary, the populations served by the sanitary facilities provided at ground floor level will serve a patron population of 1640 + 100 = 1740 and a staff population of 40.

First Floor Gym:
Based upon the facilities provided at first floor level then the following populations will be served based upon a spectator/patron type use) :-

Patrons	Toilet Pan	Urinal	Wash Basin
Males	3 (1000)	3 (300)	6 (900)
Females	6(330)	-	6(950)

Based upon equal numbers and the limiting factor of male urinals then a population of 600 gym patrons will be served which is greater than the expected populations (380) to this level.

For employees the accessible bathroom has been counted once for each sex as follows:-

Employees	Toilet Pan	Urinal	Wash Basin
Males	1(20)	0(10)	1(30)
Females	1(15)	-	1(30)

Based upon equal numbers and the limiting factor of male urinals then a population of 20 staff will be served.

Based on the amenities provided, the gym population has sufficient sanitary facilities to serve a combined employee and patron population.

Shower Facilities:
Shower facilities are not specifically required to be provided for 'patrons' of a gymnasium (or public aquatic centre) but instead should only be provided to 'participants' of a 'sporting venue' which in this instance is not considered to be applicable to an aquatic centre or gymnasium type use. This is open to interpretation and may need to be further considered at CC stage.

SECTION F: HEALTH AND AMENITY			
		However, the client has provided a large number of shower amenities to serve the population.	
F2.4:	Accessible Sanitary Facilities (including Table F2.4)	Refer to separate access report by BCA Logic. Accessible sanitary facilities are to be provided in accordance with BCA Clause F2.4. Accessible sanitary facilities are to be designed and constructed in accordance with Clause 15 of AS1428.1-2009. Any accessible sanitary amenity provided can be counted both once for each male and female amenity required. Ambulant sanitary facilities are to be provided in accordance with BCA Clause F2.4. Ambulant sanitary facilities are to be designed and constructed in accordance with Clause 16 of AS1428.1-2009.	CRA Refer Part 5.3 of Report
F2.5:	Construction of Sanitary Compartments	The door to a fully enclosed sanitary compartment must open outwards or slide or be readily removable from the outside of the sanitary compartment unless there is a clear space of at least 1.2m between the closet pan within the sanitary compartment and the doorway.	CRA Refer Part 5.3 of Report
F2.6:	Interpretation: Urinals and Washbasins	Information Only.	Noted
PART F3 – ROOM SIZES			
F3.0:	Deemed-to-Satisfy Provisions	Noted	-
F3.1:	Height of Rooms and Other Spaces	Ceiling heights will be required to comply with the requirements of Clause F3.1 of the BCA. This clause requires a minimum height of 2.4 metres in all areas including the commercial kitchen and 2.7 metres within corridors and passageways where more than 100 persons are accommodated.	CRA Refer Part 5.3 of Report
PART F4 – LIGHT AND VENTILATION			
F4.0:	Deemed-to-Satisfy Provisions	Noted	-
F4.1:	Provision of Natural Light	Natural light not required by this clause. The Creche is not classified as a playroom in an *early childhood centre*, thus this clause does not require compliance.	N/A
F4.2:	Methods and Extent of Natural Lighting	Natural light not required by this clause. Natural light is obtained through openings in the external wall.	Noted
F4.3:	Natural Light Borrowed From Adjoining Room	Natural light not required by this clause.	N/A
F4.4:	Artificial Lighting	Artificial lighting is to be provided in accordance with Clause F4.4 of the BCA. Generally all artificial lighting requirements can achieve compliance. The artificial lighting system is to be installed in accordance with AS1680.0-2009.	CRA Refer Part 5.3 of Report
F4.5:	Ventilation of Rooms	The building is required to be provided with a system of natural ventilation comply with Clause F4.6 or mechanical ventilation or air-conditioning system complying with AS 1668.2. As the hydro therapy pool will be separated from the remainder of the building by firewalls, they will require their own individual mechanical air systems due to the fire compartmentation or a suitable fire stopping systems to prevent the spread of smoke and fire.	FI/CRA Refer Part 5.3 of Report
F4.6:	Natural Ventilation	Natural ventilation and/or mechanical ventilation is to be provided in accordance with Clause F4.5, F4.6 and F4.7 of the BCA. Mechanical ventilation is to comply with AS	CRA Refer Part 5.3 of Report

SECTION F: HEALTH AND AMENITY			
		1668.2-1991 and AS 3666.1-2011. Generally all ventilation requirements can achieve compliance.	
F4.7:	Ventilation Borrowed From Adjoining Room	Natural ventilation and/or mechanical ventilation is to be provided in accordance with Clause F4.5, F4.6 and F4.7 of the BCA. Mechanical ventilation is to comply with AS 1668.2-1991 and AS 3666.1-2011. Generally all ventilation requirements can achieve compliance.	CRA Refer Part 5.3 of Report
F4.8:	Restriction on Position of Water Closets and Urinals	The proposed sanitary compartments (those containing closet pans or urinals) will not open directly into public or common areas.	CRA Refer Part 5.3 of Report
F4.9:	Airlocks	It is assumed that all bathrooms will be fitted with a mechanical exhaust system in accordance with AS1668.2-2012 thus alleviating the requirement for an airlock to be provided.	CRA Refer Part 5.3 of Report
F4.12:	Kitchen Local Exhaust Ventilation	The Class 6 café kitchen is assumed to be a commercial kitchen as it will also serve the pool patrons. Kitchen exhaust is to be provided to comply with AS 1668.1 and 1668.2 where the electrical/gas inputs/outputs exceed those specified by this clause.	CRA Refer Part 5.3 of Report
PART F5 – SOUND TRANSMISSION AND INSULATION			
F5.0:	Deemed-to-Satisfy Provisions	Not applicable to a Class 9b building.	Noted

SECTION G: ANCILLARY PROVISIONS			
PART G1 – MINOR STRUCTURES AND COMPONENTS			
G1.0:	Deemed-to-Satisfy Provisions	Noted	-
G1.1:	Swimming Pools	A water recirculation system in a swimming pool must comply with AS1926.3. Note: fencing is not applicable by this clause.	CRA Refer Part 5.3 of Report
G1.2:	Refrigerated Chambers, Strong-Rooms and Vaults	Any proposed cool room is required to be provided with internal lighting located internally, an indicator lamp located externally identifying that the interior light is on, and an alarm located outside but controlled from inside that has a minimum 90dB rating. Any cool room is required to be fully openable from within without a key.	CRA Refer Part 5.3 of Report
G1.3:	Outdoor Play Spaces	Creche is not an early childhood centre.	N/A
NSW G1.101:	Provision for Cleaning Windows	The building is less than 3 storeys high.	N/A

SECTION H: SPECIAL USE BUILDINGS
PART H1 – THEATRES, STAGES AND PUBLIC HALLS
This part is not applicable to this development.

SECTION I: MAINTENANCE
PART I1 – EQUIPMENT AND SAFETY INSTALLATIONS
This Part has been deleted in BCA2016.

SECTION J: ENERGY EFFICIENCY (Class 5 and 9)
PART J0 – ENERGY EFFICIENCY
Refer to Section J report compiled by other consultants.

ANNEXURE C

DETAILED ASSESSMENT OF THE DEEMED-TO-SATISFY PROVISIONS OF VOLUME 2 OF BCA2016

BUILDING ASSESSMENT

Outlined below is a detailed assessment of the Deemed-to-Satisfy Provisions of the Building Code of Australia (BCA) including the State variations where applicable.

All Deemed-to-Satisfy clauses that are applicable to the subject building have been referred to below, including a comment adjacent to each clause of the proposal's ability to satisfy each respective clause.

Volume 2 of the BCA2016 specifies the Deemed-to-Satisfy (DTS) provisions as being in the form of either Acceptable Construction Manuals or Acceptable Construction Practice.

This section specifically applies to the Class 10a amenities building and storage building within Gunyama park and recreation areas.

DEEMED TO SATISFY CLAUSE ASSESSMENT SUMMARY

Clause	Comment	Status
PART 3.1 SITE PREPARATION		
PART 3.1.1 – EARTHWORKS		
Acceptable Construction Practice		
3.1.1.0 Application	This clause outlines what constitutes normal site conditions for the purposes of earthworks. Normal site conditions are expected provided no significant or unusual moisture conditions occur on site and the soil classification is either A, S, M, H or E as per AS 2870 (Residential Slabs & Footings Code).	Noted
3.1.1.1 Earthworks	Excavation and fill utilising unprotected embankments can be undertaken as per clause requirements.	CRA Refer Part 5.3 of Report
3.1.1.2 Excavation adjacent to vacant adjoining property	Sets out where excavation work using unprotected embankments can be undertaken near adjoin vacant land.	CRA Refer Part 5.3 of Report
3.1.1.3 Excavation adjacent to existing buildings	Sets out where excavation work using unprotected embankments can be undertaken adjacent to buildings.	CRA Refer Part 5.3 of Report
3.1.1.4 Fill	Sets out where filling works may be carried out.	CRA Refer Part 5.3 of Report
PART 3.1.2 - DRAINAGE		
A. Acceptable Construction Manuals		
3.1.2.0	Drainage requirements are satisfied if it is designed in accordance with AS/NZS 3500.3 – Stormwater Drainage or AS/NZS 3500.5 – Domestic Installations (Section 5 – Stormwater Drainage).	Noted
B. Acceptable Construction Practice		
3.1.2.1 Application	Acceptable practice limited to rainfall intensity and site conditions criteria specified by this clause. Where outside criteria the manuals specified in 3.1.2.0 are to be complied with.	Noted
3.1.2.2 Drainage Requirements	Drainage systems must be installed to collect surface water in the areas around and adjoining the buildings, subsoil drainage to be provided where site conditions dictate to carry water around footings and retaining walls and collect roof water.	CRA Refer Part 5.3 of Report
3.1.2.3 Surface Water Drainage	Surface water must be diverted away from the building, where slab on ground is used, by grading external surface to 50mm of 1m. The finished slab height maintains suitable freeboard above external surfaces.	CRA Refer Part 5.3 of Report
3.1.2.4 Subsoil Drainage	Subsoil drainage systems must have fall of not less than 1:300 and discharge into an external silt pit or sump.	CRA Refer Part 5.3 of Report
3.1.2.5 Stormwater Drainage	The stormwater drainage system must discharge into a point approved and specified by Council. Provision for overflow must be made to prevent overflow from entering the buildings.	CRA Refer Part 5.3 of Report

PART 3.1.3 – TERMITE RISK MANAGEMENT		
3.1.3 Application of this Part.	Termite risk management is required to be provided to the primary building elements of the townhouses and carports. Management is not required if the elements are metal, concrete, masonry, fibre reinforced cement or termite resistant timber (Appendix C of AS 3660.1) or preservative treatment (Appendix D of AS 3660.1).	Noted
A. Acceptable Construction Manuals		
3.1.3.0	Termite management is satisfied if building elements are protected in accordance with AS 3660.1 and a durable notice is installed in the meter boxes.	CRA Refer Part 5.3 of Report
B. Acceptable Construction Practice		
3.1.3.2 Installation of termite barriers	Concrete slabs on ground must have a barrier in accordance with 3.1.3.3 and suspended floors must comply with 3.1.3.4.	CRA Refer Part 5.3 of Report
3.1.3.3 Barriers for concrete slab-on-ground	Slabs on ground used as part of a termite barrier system must be designed and constructed to AS 2870 and have penetrations, control joints and perimeter of slab protected. Slabs not used as barrier must have the full area beneath and the perimeter protected.	CRA Refer Part 5.3 of Report
3.1.3.4 Barriers for suspended floors	Areas beneath a suspended floor must have one of the barrier systems specified (termite shielding, stainless steel mesh, graded stone or chemicals). Sub floor ventilation must be provided and access for visual inspection where needed.	CRA Refer Part 5.3 of Report
3.1.3.5 Attachments to buildings	Attachments to buildings, including services, must have the necessary gaps to allow for inspection except where protection is provided.	CRA Refer Part 5.3 of Report

PART 3.2 FOOTINGS AND SLABS		
A. Acceptable Construction Manuals		
3.2.0	The footings and/or slabs are to be constructed in accordance with AS 2870. Any piled footings are to be designed in accordance with AS 2159.	CRA Refer Part 5.3 of Report
B. Acceptable Construction Practice		
PART 3.2 – FOOTINGS & SLABS		
3.2.1 Application	Compliance with the acceptable construction practices must be within the limitations of this clause. Including slabs not more than 30m long, permanent construction joints not used and limited to timber floor construction on first floor.	Noted
PART 3.2.2 - PREPARATION		
3.2.2.1 Excavation for footings	Any excavation for footings must comply with the requirements of this clause.	CRA Refer Part 5.3 of Report
3.2.2.2 Filling under concrete slabs	Filling under slabs must comply with the requirements of this clause.	CRA Refer Part 5.3 of Report
3.2.2.3 Foundations for footings and slabs	Footings and slabs must be founded on soil with the allowable bearing pressures specified in this clause.	CRA Refer Part 5.3 of Report

3.2.2.4 Slab edge support on sloping sites	Footings and slabs on the low side of the slope must have edge support in accordance with this clause.	CRA Refer Part 5.3 of Report
3.2.2.5 Stepped footings	Any stepped strip footings must be constructed in accordance with this clause.	CRA Refer Part 5.3 of Report
3.2.2.6 Vapour Barriers	A damp proofing membrane must be installed under slab-on-ground construction for all the residences. Materials and installation must comply with the requirements of this clause.	CRA Refer Part 5.3 of Report
3.2.2.7 Edge rebates	Edge rebates, for footing slabs, must comply with the requirements of this clause.	CRA Refer Part 5.3 of Report
PART 3.2.3 – CONCRETE AND REINFORCING		
3.2.3.1 Concrete	Concrete must be manufactured to comply with AS 3600; and) have a strength at 28 days of not less than 20 MPa (denoted as N20 grade) and have a 20 mm maximum nominal aggregate size and have a nominal 100 mm slump. Water must not be added to the mix to increase the slump to a value in excess of that specified. Concrete must be placed, compacted and cured in accordance with good building practice.	CRA Refer Part 5.3 of Report
3.2.3.2 Steel Reinforcement	Materials used for reinforcing steel must comply with AS 2870. Concrete cover must be maintained in accordance with the clearances outlined in this Clause.	CRA Refer Part 5.3 of Report
PART 3.2.4 – SITE CLASSIFICATION		
3.2.4.1 Site Classification	The foundation where the footing is to be located must be classified in accordance with AS 2870.	CRA Refer Part 5.3 of Report
PART 3.2.5 – FOOTING AND SLAB CONSTRUCTION		
3.2.5.1 Footing and slab construction	Footing and slab construction, including size and placement of reinforcement, must comply with the relevant provisions of this part. Requirements are based upon the site classification.	CRA Refer Part 5.3 of Report
3.2.5.2 Footings and slabs to extensions to existing buildings	N/A	-
3.2.5.3 Shrinkage control	Where brittle floor coverings, such as ceramic tiles, are to be used over an area greater than 16m^2, one of the measures specified must be taken to control the effect of shrinkage cracking. At re-entrant or internal corners, two strips, minimum 2 m in length, of 3–L8TM or one strip of 3–L11TM (or 3-N12 bars) must be placed diagonally across the corner.	CRA Refer Part 5.3 of Report
3.2.5.5 Minimum edge beam dimensions	Except for waffle raft slabs, where the edge rebate is more than 150 mm in depth, the width of the edge beam at the base of the rebate must not be less than 200 mm, except that if R10 or N10 ties at 900 mm spacing (or equivalent) are provided to resist vertical forces, the width of the edge beam at the base of the rebate can be reduced to 150 mm.	CRA Refer Part 5.3 of Report
3.2.5.5 Footings for fireplaces on Class A and S sites	N/A	-
3.2.5.6 Stump footing details	N/A	-

PART 3.3 MASONRY		
PART 3.3.1 – UNREINFORCED MASONRY		
A. Acceptable construction manual		
3.3.1.0	Unreinforced masonry construction will comply if it is designed and constructed in accordance with AS 3700 and AS 4773 masonry for small buildings Parts 1 & 2.	N/A
PART 3.3.2 – REINFORCED MASONRY		
A. Acceptable construction manual		
3.3.2.0	Reinforced masonry construction will comply if it is designed and constructed in accordance with AS 3700 and AS 4773 masonry for small buildings Parts 1 & 2.	N/A
PART 3.3.3 – MASONRY ACCESSORIES		
A. Acceptable construction manual		
3.3.3.0	The requirements for masonry accessories are satisfied if they are constructed and installed in accordance with AS 3700 or AS 4773 masonry for small buildings Parts 1 & 2.	N/A
PART 3.3.4 – WEATHERPROOFING OF MASONRY		
3.3.4 Application	This part applies to every masonry external wall of the residences.	Noted
A. Acceptable construction manual		
3.3.4.0	Weatherproofing of masonry is satisfied if it is carried out in accordance with AS 3700 or AS 4773 masonry for small buildings Parts 1 & 2.	N/A

PART 3.4 FRAMING		
PART 3.4.0 – FRAMING		
3.4.0.1 Explanation of terms	Noted	-
3.4.0.2 Structural Software	Sets out the requirements for structural software used in the design	Noted
PART 3.4.1 – SUB-FLOOR VENTILATION		
Acceptable construction practice		
3.4.1.1 Application	Noted	-
3.4.1.2 Sub-floor ventilation	The sub floor space beneath a suspended floor must be provided with ventilation in accordance with this Clause.	N/A
PART 3.4.2 – STEEL FRAMING		
A. Acceptable construction manuals		
3.4.2.0	Steel framing satisfies requirements if it is designed and constructed in accordance with either AS 4100 Steel Structures, AS/NZS 4600 Cold-formed steel structures and NASH Residential and low-rise steel framing Part 1 Design Criteria.	CRA Refer Part 5.3 of Report
B. Acceptable construction practice		
3.4.2.1 Application	Steel framing satisfies requirements if it is designed and constructed in accordance with either AS 4100 Steel Structures, AS/NZS 4600 Cold-formed steel structures and	CRA Refer Part 5.3 of Report

	NASH Residential and low-rise steel framing Part 1 Design Criteria. The frame material has a yield stress of not less than 250 Mpa.	
3.4.2.2 General	This Clause specifies corrosion requirements. The frame must be permanently electrically earthed on completion of fixing.	CRA Refer Part 5.3 of Report
3.4.2.3 Steel floor framing	This Clause specifies provisions relating to suspended floor framing.	N/A
3.4.2.6 Installation of service	Specific requirements are outlined in this Clause to maintain the structural integrity of steel frames.	CRA Refer Part 5.3 of Report
PART 3.4.3 – TIMBER FRAMING		
A. Acceptable construction manuals		
3.4.3.0	The criteria for timber framing are satisfied if it is designed and constructed in accordance with AS 1684.2 Residential timber-framed construction Non-cyclonic areas.	N/A
PART 3.4.4 – STRUCTURAL STEEL MEMBERS		
3.4.4 Explanation of terms	Noted.	-
A. Acceptable construction manuals		
3.4.4.0	The criteria for Structural Steel are satisfied if it is designed and constructed in accordance with either AS 4100 Steel Structures and AS/NZS 4600 Cold-formed steel structures.	CRA Refer Part 5.3 of Report
B. Acceptable construction practice		
3.4.4.1 Application	Noted.	-
3.4.4.2 Structural steel members	Structural members may be used in accordance with this Clause.	CRA Refer Part 5.3 of Report
3.4.4.3 Columns	Columns may support areas specified by this Clause. The effective height, floor area and loading is to be determined in accordance with the figures of this Clause.	CRA Refer Part 5.3 of Report
3.4.4.4 Corrosion protection	Structural steel members that are not built into a masonry wall must be protected against corrosion in accordance with Table 3.4.4.2. (external – alkyd primer or gloss and hot dip galvanised.	CRA Refer Part 5.3 of Report

PART 3.5 ROOF AND WALL CLADDING		
PART 3.5.1 – ROOF CLADDING		
A. Acceptable construction manuals		
3.5.1.0	The criteria for roof cladding are satisfied if it complies with AS2049 Roof tiles & AS2050 Installation of roof tiles, AS 1562.1 Design and installation of sheet roof and wall cladding.	CRA Refer Part 5.3 of Report
B. Acceptable construction practice		
3.5.1.1 Application	Noted	-
3.5.1.2 Roof tiling	Roof tiles must be installed, fixed and flashed in accordance with the relevant provisions of this part.	N/A
3.5.1.3 Metal sheet roofing	Metal sheet roofing must be installed in accordance with this part and protected from corrosion. Where different metals are used in a roof system they must be compatible	CRA Refer Part 5.3 of Report

	with each other as specified, this includes fixings. This Clause also provides the requirements for installation and flashing.	
PART 3.5.2 – GUTTERS AND DOWNPIPES		
A. Acceptable construction manuals		
3.5.2.0	The criteria for gutters and downpipes are satisfied if they are designed and constructed in accordance with AS/NZS 3500.3 Stormwater Drainage or AS/NZS 3500.5 Domestic installations, Section – Stormwater drainage.	CRA Refer Part 5.3 of Report
B. Acceptable construction practice		
3.5.2.1 Application	Noted. This includes ensuring the roof drainage system is designed so that overflow during heavy rain is prevented from flowing back into the building.	-
3.5.2.2 Materials	Gutters, downpipes and flashings must be manufactured in accordance with AS/NZS 2179.1 for metal and be manufactured in accordance with AS 1273 for UPVC components and be compatible with all upstream roofing materials in accordance with 3.5.1.3(c) and not contain any lead if used on a roof forming part of a potable water catchment area.	CRA Refer Part 5.3 of Report
3.5.2.3 Selection of guttering	Gutters must be sized in accordance with this Clause including the average recurrence intervals for eaves gutters and any internal box or valley gutters.	CRA Refer Part 5.3 of Report
3.5.2.4 Installation of gutters	Gutters must have a floor of not less than 1:500 unless fixed to metal fascias. Bracket support must be at 1.2m centres max. Any high fronted gutters must have provision to avoid any overflow back into the building.	CRA Refer Part 5.3 of Report
3.5.2.4 Downpipes – size and installation	Downpipes must not serve more than 12 m of gutter length for each downpipe and be located as close as possible to valley gutters and, if the downpipe is more than 1.2 m from a valley, provision for overflow must be made to the gutter; and be selected in accordance with the appropriate eaves gutter section as shown in Table 3.5.2.2.	CRA Refer Part 5.3 of Report
PART 3.5.3 – WALL CLADDING		
A. Acceptable construction manual		
3.5.3.0	The criteria for metal wall cladding are satisfied if it is designed and constructed in accordance with AS 1562.1.	CRA Refer Part 5.3 of Report
B. Acceptable construction practice		
3.5.3.1 Application	Noted	-
3.5.3.2 Timber weatherboard cladding	Timber weatherboard cladding must be installed in accordance with the requirements outlined in this Clause.	N/A
3.5.3.3 Fibre-cement planks and weatherboard cladding	Fibre cement weatherboard cladding must be installed in accordance with the requirements outlined in this Clause.	N/A
3.5.3.4 Fibre-cement sheet wall cladding	Fibre cement sheets must comply with the requirements of this Clause. Requirements for structural plywood external cladding must comply with AS/NZS 2269.	N/A

3.5.3.5 Eaves and soffit linings	External fibre-cement sheets and linings used as eaves and soffit linings must comply with AS/NZS 2908.2 or ISO 8336 and be fixed in accordance with this Clause.	CRA Refer Part 5.3 of Report
3.5.3.6 Flashings to wall openings	Openings in external wall cladding exposed to the weather must be flashed as follows: (a) All openings must be adequately flashed using materials that comply with AS/NZS 2904. (b) Flashings must be securely fixed at least 25 mm under the cladding and extend over the ends and edges of the framing of the opening	CRA Refer Part 5.3 of Report

PART 3.6 GLAZING		
PART 3.6 – GLAZING		
A. Acceptable construction manuals		
3.6.0	The criteria for glazing is satisfied if glazing and windows are designed and constructed in accordance with AS 2047 and AS 1288 as relevant.	N/A
B. Acceptable construction practice		
3.6.1 Application	Noted	-
3.6.2 Glazing sizes and installation	Glazing used must comply with the limits specified. Glazing must not contain any sharp edges.	N/A
3.6.3 Fully framed glazing installed in the perimeter of the building	Fully framed ordinary annealed glass installed in the perimeter of the buildings must comply with the thicknesses specified dependent on wind classification.	N/A
3.6.4 Human impact safety requirements	This Clause outlines the thickness and type of glazing to be installed in areas that have a high potential for human impact. This includes doors, door side panels, full height glass panels, glazed panels, bathrooms and visibility.	N/A
3.6.4.1 Doors	Glass in doors must be Grade A safety glazing unless separation and sight lines above floor level comply with this Clause.	N/A
3.6.4.2 Door side panels	Grade A safety glazing must be used in side light panels where they are less than 300mm from the doorway unless sight lines above floor level comply with this clause	N/A
3.6.4.3 Full height framed glazed panels	A panel located where it is capable of being mistaken for an unobstructed opening must be glazed with Grade A safety material. This Clause specifies where the opening is not considered as an unobstructed opening.	N/A
3.6.4.4 Glazed panels, other than doors or side panels, on the perimeter of rooms	All framed glazing where the lowest sight line of the glazing panel is less than 500 mm from the highest abutting finished floor level must be Grade A safety glazing material in accordance with Table 3.6.5; or ordinary annealed glass not less than 5 mm nominal thickness provided that the area of the glazing panel is not more than 1.2 m^2.	N/A
3.6.4.5 Bathroom, ensuite and spa room glazing	Safety glazing requirements apply to all glazing bathrooms, ensuites, spa rooms or the like, including shower doors, shower screens, bath enclosures, and associated windows, where the lowest sight line is less than 2.0 m	N/A

	above the highest abutting finished level of the floor, bottom of the bath, or shower base.	
3.6.4.6 Visibility of glazing	Glass, within a door, side panel or other panel must be marked where it can be mistaken as a doorway or an opening.	N/A

PART 3.7 FIRE SAFETY		
PART 3.7.1 – FIRE SEPARATION		
3.7.1.1 Application	Noted.	-
3.7.1.2 General concession – non-combustible materials	Materials specified by this clause may be considered as non-combustible even though they may contain combustible fibres. This includes plasterboard and fibre-reinforced cement sheeting.	Noted
3.7.1.3 External walls of Class 1 buildings	Applies to Class 1 buildings.	N/A
3.7.1.4 Measurement of distances	Noted	-
3.7.1.5 Construction of external walls	External walls or parts required to be fire resisting, must be constructed to achieve the requirements of this clause.	N/A
3.7.1.6 Class 10a buildings	Suitable separation distances have been provided between the residences and the carport structures.	Complies
3.7.1.7 Allowable encroachments	This clause outlines items permitted encroachments or attachments to a building where the external wall is required to be setback from the boundary or another building.	Noted
3.7.1.8 Separating walls	The separating walls, between residences, must commence at footings or slabs and extend to the underside of the non-combustible roof covering.	N/A
3.7.1.9 Fire hazard properties	Sarking material used within the roof must have a flammability index not greater than 5. Flexible ductwork serving exhaust hoods from gas cook tops (or other devices initiating from a flame) must comply with the fire hazard properties set out in AS 4254.	N/A
3.7.1.10 Roof lights	No skylights are currently proposed, where provided they will need to comply with the requirements of this clause.	N/A
PART 3.7.2 – SMOKE ALARMS		
3.7.2.1 Application	Noted.	-
3.7.2.2 Requirements for smoke alarms	Applies to Class 1 buildings.	N/A
3.7.2.3 Location – Class 1a buildings	Applies to Class 1 buildings.	N/A
PART 3.7.3 – HEATING APPLIANCES		
A. Acceptable construction manual		
3.7.3.0	Heating appliances if installed must be in accordance with AS/NZS 2918 – Domestic solid fuel burning appliances.	CRA Refer Part 5.3 of Report
B. Acceptable construction practice		
3.7.3.1 Application	Noted.	-

3.7.3.2 Open fireplace construction	Open fire places must be constructed in accordance with this requirements of this clause.	N/A
3.7.3.3 Chimney construction	Construction of chimneys must be constructed in accordance with this requirements of this clause.	N/A
3.7.3.4. Open fireplace construction	An insert fireplace and flue must be constructed in accordance with this requirements of this clause.	N/A
3.7.3.5 Installation of free standing heating appliances	The installation of free standing heating appliances must be constructed in accordance with this requirements of this clause.	CRA Refer Part 5.3 of Report
PART 3.7.4 – BUSHFIRE AREAS		
A. Acceptable construction manual		
3.7.4.0	A Class 1 buildings or a Class 10a building or deck associated with a Class 1 building is to be constructed in accordance with AS3959 except for Section 9 Construction for Bushfire Attack Level FZ (BAL-FZ).	N/A
PART 3.7.5 – ALPINE AREAS		
	The development has not been located in an alpine area.	N/A

PART 3.8 HEALTH AND AMENITY		
PART 3.8.1 – WET AREAS		
A. Acceptable construction manual		
3.8.1 Definitions	Noted	-
3.8.1.1 Application	Noted.	-
3.8.1.2 Wet Areas	Wet areas in the residences are required to be water proof or water resistant as specified within Table 3.8.1.1. The table specifies the extent to which water proofing must be carried out dependent upon items such as show design and materials. The requirement for wet area waterproofing is satisfied if water proofing and/or water resistant is carried out in accordance with AS 3740 – Waterproofing of wet areas in residential buildings.	CRA Refer Part 5.3 of Report
3.8.1.3 External above ground membranes	Waterproofing membranes for external above ground use must comply with AS 4654 Part 1 and 2.	CRA Refer Part 5.3 of Report
PART 3.8.2 – ROOM HEIGHTS		
3.8.2.1 Application	Noted	-
3.8.2.2 Ceiling Heights	Ceiling heights be not less than— (a) in a *habitable room* excluding a kitchen — 2.4 m; and (b) in a kitchen — 2.1 m; and (c) in a corridor, passageway or the like — 2.1 m; and (d) in a bathroom, shower room, laundry, *sanitary compartment*, airlock, pantry, storeroom, garage, car parking area or the like — 2.1 m; and	Complies

	(e) in a room or space with a sloping ceiling or projections below the ceiling line within— (i) a *habitable room*— (A) in an attic — a height of not less than 2.2 m for at least two-thirds of the floor area of the room or space; and (B) in other rooms — a height of not less than 2.4 m over two-thirds of the floor area of the room or space; and (ii) a non-*habitable room* — a height of not less than 2.1 m for at least two-thirds of the floor area of the room or space, and when calculating the floor area of a room or space, any part that has a ceiling height of less than 1.5 m is not included; and (f) in a stairway — 2.0 m measured vertically above the nosing line.	
PART 3.8.3 – FACILITIES		
3.8.3.1 Application	Noted	-
3.8.3.2 Required facilities	Applies to Class 1 buildings.	N/A
3.8.3.3 Construction of sanitary compartments	The door to a fully enclosed sanitary compartment must— (a) open outwards; or (b) slide; or (c) be readily removable from the outside of the compartment, unless there is a clear space of at least 1.2 m between the closet pan within the *sanitary compartment* and the doorway.	CRA Refer Part 5.3 of Report
PART 3.8.4 - LIGHT		
3.8.4.1 Application	Noted	-
3.8.4.2 Natural lighting	No habitable rooms.	N/A
3.8.4.3 Artificial lighting	Sanitary compartments, bathrooms, shower rooms, airlocks and laundries must be provided with artificial light if natural lighting in accordance with the relevant provisions of 3.8.4.2 is not available— (a) at a rate of not less than one light fitting per 16 m^2 of floor area; or (b) in accordance with AS/NZS 1680.0.	CRA Refer Part 5.3 of Report
PART 3.8.5 - VENTILATION		
A. Acceptable construction manual		
3.8.5.0 Application	The requirements for ventilation are satisfied if mechanical ventilation is provided in accordance with AS 1668.2 – Mechanical ventilation for acceptable indoor air quality. However an exhaust fan from a sanitary compartment, laundry or bathroom must comply with the acceptable construction practice.	Noted
B. Acceptable construction practice		
3.8.5.2 Ventilation requirements	The development proposes that the habitable areas of the building be ventilated by natural means. Windows and	Complies

	doors are required to have an aggregate opening or open able size not less than 5% of the floor area of the room required to be ventilated.	
3.8.5.3 Location of sanitary compartments	Closet pans are suitably located.	Complies
PART 3.8.6 – SOUND INSULATION		
3.8.6.1 Application	Noted	-
3.8.6.2 Sound insulation requirements	Applies to Class 1 buildings.	N/A
3.8.6.3 General insulation requirements for walls	Applies to Class 1 buildings.	N/A
3.8.6.4 Services	Applies to Class 1 buildings.	N/A

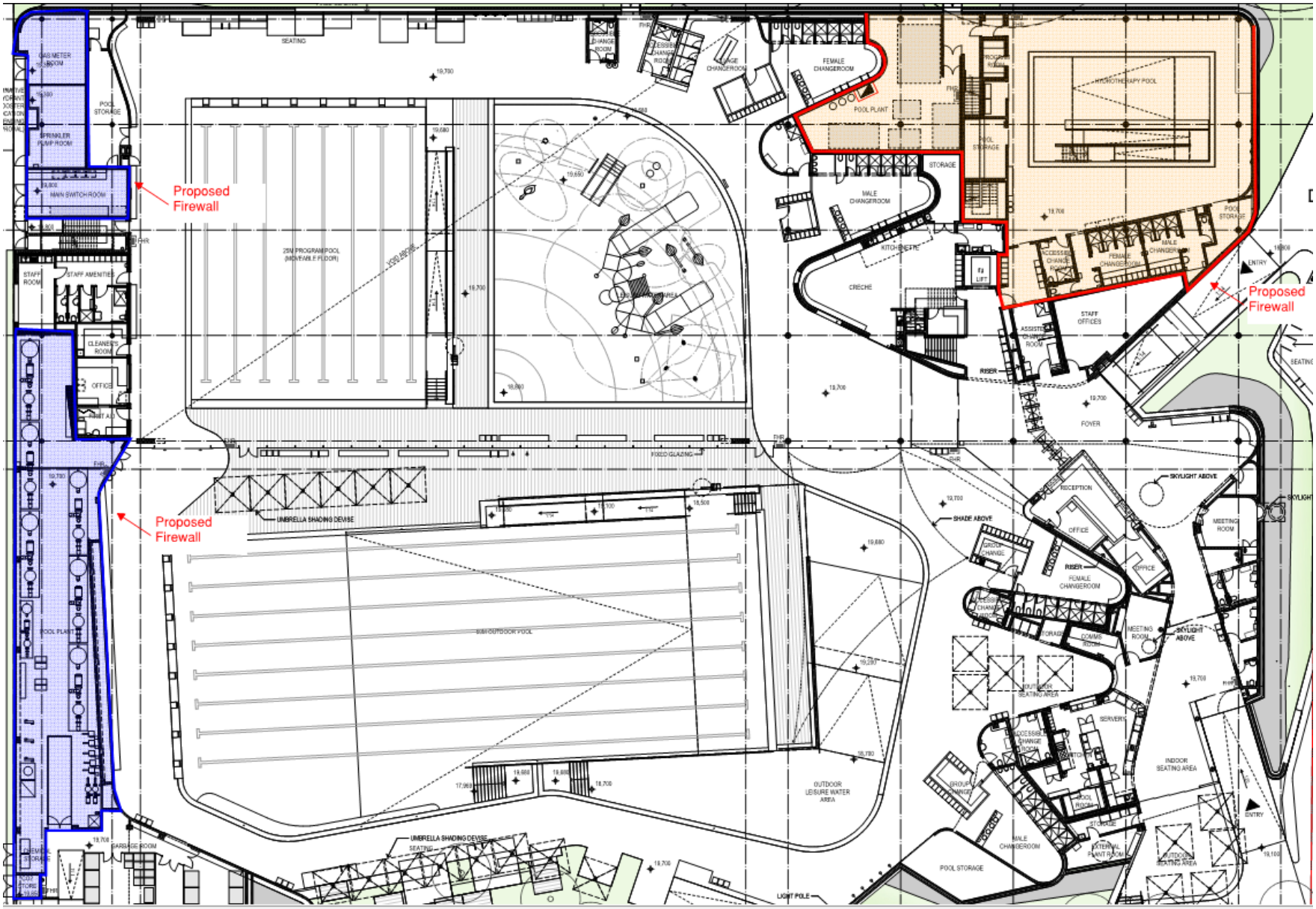
PART 3.9 SAFE MOVEMENT AND ACCESS		
PART 3.9.1 – STAIR CONSTRUCTION		
3.9.1.1 Application	Noted	-
3.9.1.2 General requirements	Stairs within the development must comply with 3.9.1.3 and 3.9.1.4.	N/A
3.9.1.3 Stair construction	The dimensions of goings and risers must be constant throughout each stair flight. A flight of stairs must not have more than 3 winders in lieu of each quarter landing or 6 winders in lieu of each half landing. Treads must have a slip-resistant finish or a suitable non-skid strip near the edge of the nosings.	N/A
3.9.1.4 Riser and going dimensions	The riser and going dimensions must comply with the requirements of this clause. Riser heights must not exceed 190mm and tread must have a minimum width of 240mm. The slope relationship must also be accordance with this clause.	N/A
3.9.1.5 Thresholds	Where a threshold is more than 190 mm above the adjoining surface it must incorporate steps having riser and going dimensions in accordance with 3.9.1.4. This includes the step downs from external doors and paths.	N/A
PART 3.9.2 - BALUSTRADES		
3.9.2.1 Application	Noted	-
3.9.2.2 When balustrades or other barriers are required	A balustrade must be provided where it is possible to fall more than 1m to a surface beneath. Balustrades have been suitably nominated to the balconies and stairs where fall more than 1m occurs.	N/A
3.9.2.3 Balustrades or other barrier construction	The height of a balustrade must be not less than 1m above the finished surface and 865mm above the nosing of the stair treads. Openings in balustrades (including decorative balustrades) or other barriers must be constructed so that any opening does not permit a 125 mm sphere to pass through it and for stairs; the space is tested above the nosing line. A balustrade or other barrier must be designed to take loading forces in accordance with AS/NZS 1170.1.	CRA Refer Part 5.3 of Report

3.9.2.4 Handrails	Handrails to a stairway or ramp must be along at least one side at a height of 865mm above the stair nosings or the ramp.	CRA Refer Part 5.3 of Report

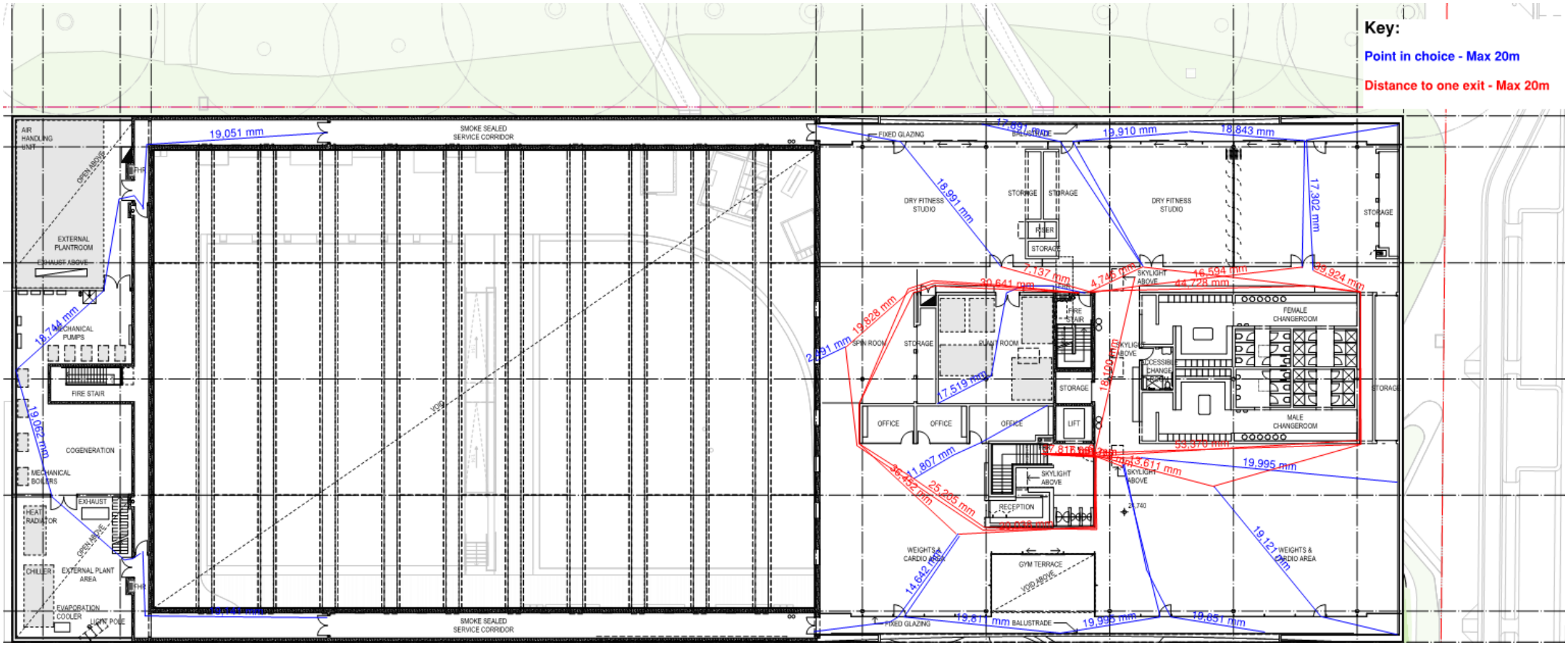
PART 3.11 STRUCTURAL DESIGN MANUALS		
PART 3.11 – STRUCTURAL DESIGN MANUALS		
3.11.1 Application	Noted. This part contains the list of structural design manuals that can be used to design building elements using engineering principles. They can be used in conjunction with the acceptable construction practices. Engineering design using these manuals must be carried out only by suitably qualified engineers.	Noted
3.11.2 Resistance to actions	The resistance of the buildings must be designed greater than the most critical action effect as determined in accordance with this Clause.	Noted
3.11.3 Determination of individual actions	This Clause specifies the magnitude of individual actions including permanent and imposed, wind, snow & earthquake.	Noted
3.11.6 Determination of structural resistance of materials and forms of construction	The structural resistance of materials and forms of construction must be determined in accordance with the standards specified in this Clause.	Noted

ANNEXURE D

Proposed Ground Floor Fire Compartments



ANNEXURE F
First Floor Travel Distances



BCA LOGIC

Building Regulation, BCA,
Fire, Access and Energy Consultants



To:	Andrew Burges Architecture 32/61 Marlborough Street Surry Hills NSW 2010
Project:	GUNYAMA PARK AQUATIC AND RECREATION CENTRE (GPARC)
Report:	Access Assessment Report – DA Stage
Reference No:	105468-Access-r8
Date:	2 June 2016
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DOCUMENT CONTROL

Revision	Date				
105468-Access-r6	03 May 2016	Description:	Access Assessment Report – DA Stage		
105468-Access-r7.1	17 May 2016	Description:	Access Assessment Report – DA Stage		
			Prepared by	Checked by	Approved by
		Name:	Matthew Harriman Building Regulations Consultant	Warwick Hunter Manager	Warwick Hunter Manager
		Signature:			
105468-Access-r8	2 June 2016	Description:	Access Assessment Report – DA Stage		
			Prepared by	Checked by	Approved by
		Name:	Matthew Harriman Building Regulations Consultant	Warwick Hunter Manager	Warwick Hunter Manager
		Signature:			

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1 BASIS OF ASSESSMENT

1.1 Location

The subject site is proposed to be developed into Gunyama Park Aquatic and Recreation Centre.

The proposal includes the development of an Aquatic Centre constructed in a two storey complex comprising a gym, amenities facilities, café, indoor pool, outdoor pool, recreation pools and a hydrotherapy pool. The building will to be constructed of various elements including load-bearing reinforced concrete columns and floors infilled with a combination of glass and masonry facades.

Further to the development of the Aquatic Centre complex, it is proposed to construct Gunyama Park and sports field in which will adjoin/interconnect with the Aquatic centre. The park area will include children's play areas and a sports field bound by natural landscapes where seating and pathways will be located as well as various sanitary amenities.

It is proposed that the main access to the development will be obtained through various entrances surrounding the proposed complex of the aquatic centre and sports field where access to public transport, roads and pathways is obtained. Vehicular parking is proposed to be provided via on-street parking along the roadways bounding the development.

1.2 Purpose

The purpose of this report is to assess the proposed building against the following Deemed-to-Satisfy provisions of the Building Code of Australia 2016 (BCA2016) to clearly outline those areas where compliance is not achieved and provide recommendations to upgrade such areas to achieve relevant compliance:

- Disability Discrimination Act 1992 (DDA);
- Disability Access to Premises Standards 2010 (Premises Standards);
- Building Code of Australia 2016 (BCA2016) – Clause D2.17, D3 and Clauses E3.6 and F2.4;
- City of Sydney Council's Access Development Control Plan 2004 (DCP);
- Applicable Australian Standards AS1428.1:2009, AS1428.4.1:2009 and AS2890.6:2009;
- *Changing Places Australia* sanitary facility design guidelines.

1.3 Limitations

This report is limited to an assessment of the access and amenity provisions for people with a disability against the provisions of the BCA2016 as outlined in 1.2 above. It is not an assessment of the proposal against all provisions of the BCA2016 and if this is required, a separate report will be necessary.

This report does not include nor imply any detailed assessment for design, compliance or upgrading for:

- The structural adequacy or design of the building;
- The inherent derived fire-resistance ratings of any existing or proposed structural elements of the building (unless specifically referred to); and
- The design basis and/or operating capabilities of any existing or proposed electrical, mechanical or hydraulic fire protection services.

This report does not include, or imply compliance with:

- The Disability Discrimination Act (it cannot be guaranteed that that a complaint under the DDA will not be made, however should the building comply with BCA2016 and the Premises Standard then those responsible for the building cannot be subject to a successful complaint);
- BCA2016 Sections B, C, E, F, G, H, I, J, Parts D1 and D2;
- Demolition Standards not referred to by the BCA2016;
- Work Health and Safety Act;
- Construction Safety Act;
- Requirements of other Regulatory Authorities including, but not limited to, Telstra, Telecommunications Supply Authority, Water Supply Authority, Electricity Supply Authority, Work

Cover, Roads and Maritime Services (RMS), Roads and Transport Authority, Local Council, ARTC, Department of Planning and the like;

- Conditions of Development Consent issued by the Local Consent Authority; and
- This report does not assess the safety of the particular aspects of the building but merely the minimum standards called up by the Access provisions of BCA2016.

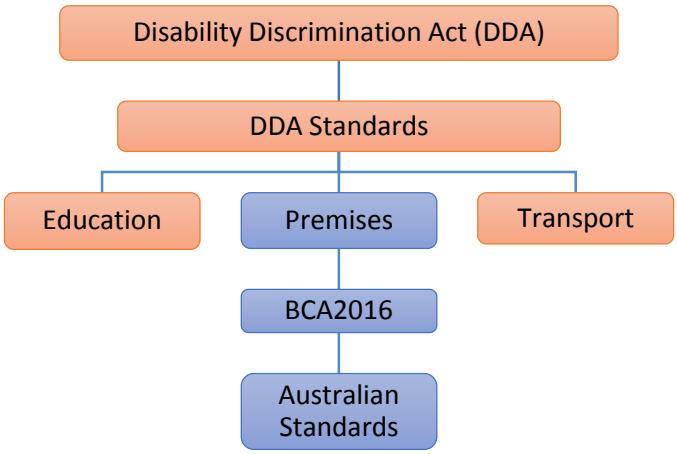
1.4 Federal Disability Discrimination Act (DDA)

Disability is broadly defined and includes disabilities which are physical, intellectual, psychiatric, neurological, cognitive or sensory (a hearing or vision impairment), learning difficulties, physical disfigurement and the presence in the body of disease causing organisms.

All organisations have a responsibility, under the DDA, to provide equitable, dignified access to goods and services and to premises used by the public. Premises are broadly defined and would include all areas included within the subject development.

The DDA applies nationally and is complaint based. While the BCA2016 is recognised as a design standard to satisfy certain aspects of the DDA, compliance with the BCA2016 and the referenced standards does not guarantee that a complaint will not be lodged.

The graph below indicates the current relationship of the BCA2016 to the DDA.



1.5 Disability Access to Premises Standards (Premises Standards)

The aim of the Standards is to provide the building and design industry with detailed information regarding the required access provisions associated with the design and construction of new buildings and upgrade to existing buildings. They do not apply to existing buildings that are not undergoing upgrade. They will only apply to elements addressed within the Standards. All other elements related to premises will still be subject to the existing provisions of the DDA.

The Standards will generally align with the BCA (see below) and reference a range of Australian Standards relating to access and other associated matters. The Disability (Access to Premises - Buildings) Standards aim to provide certainty for the building industry in relation to meeting the requirements for access in new and upgraded buildings.

This Access Appraisal incorporates the key elements of the Standards (as applicable to Premises ie Buildings) but also it is intended to address additional access requirements (ie to the Park) to assist in achieving best practice in the provision of access for all to buildings and adjoining parkland areas.

The Building Code of Australia 2014, in conjunction with the DDA, applies to all new buildings, new building works to existing buildings and buildings undergoing significant refurbishment or alteration.

Provision of access for a person using a wheelchair or mobility aid is often considered to be an indication of effective design to the built environment. However the majority of users of car parks, buildings and outdoor areas are pedestrians who also benefit greatly from wheelchair accessible design. Conversely, they can also be denied appropriate access if barriers are incorporated into designs.

In addition, older persons and people with disabilities within the community have a wide range of access needs that are not necessarily satisfied by just providing access for a person using a wheelchair. People also experience the effects of disability through impairment to:

- Sight;
- Hearing;
- Motor ability;
- Dexterity;
- Balance;
- Mental functioning etc.

Examples of a range of access challenges include:

- People who use wheelchairs face difficulties such as abrupt changes in levels (e.g. steps and steep slopes/gradients) and limited access to gym equipment, playground equipment, under basins, benches and tables. They also need an increased circulation area, particularly at doorways and changes in direction.

- People who experience difficulty walking may have stiff hips, balance problems or uncoordinated movements which require attention to stairs and handrails, seating in waiting areas, slip resistant floor finishes and ramps with a gentle slope/gradient.

- People with manipulatory difficulties (finger or hand control) require appropriately selected handles, switches, buttons (in lifts) and taps to enable usage

- People with sensory disabilities, which affect either their hearing or vision, require clear, easy to understand signage and tactile indicators. This requires attention to a variety of factors including colour, contrast, print size, levels of illumination and the provision of appropriate communication systems in public areas.

- People with intellectual disabilities may have difficulty finding their way in new environments. Therefore, direct access routes and clear directional signage with graphics are important.

As a wide range of physical issues impact on the provision of access for people with disabilities, responsive design, incorporating a continuous accessible path of travel, needs to be equitable and therefore inclusive of the needs of all of the community. Access should cater for both pedestrians and users of wheelchairs and other mobility aids. In addition consideration must be given to the needs of users who may require assistance from other people as well as assistance animals.
As new Class 6, 9b and 10a buildings included within this development, the Premises Standards will apply in this instance. However, with the requirements of the Premises Standards mirroring the requirements of the BCA2016, compliance under BCA2016 will be equivalent to achieve compliance with the Premises Standards.

1.6 Design Documentation

This report has been based on the Design plans and Specifications listed in Annexure A of this Report.

2 BUILDING DESCRIPTION

For the purposes of the BCA2016 and Access Code for Buildings (Premises Standards – Schedule 1) the development may be described as follows.

2.1 Classification

Under the provisions of Clause A3.2 of BCA2016, the building has been classified as follows:

Class	Level	Description
6/9b	Café/Kitchen	Ground level Café accessed via the pool facility and off Zetland Avenue.
5/9b	Hydro Pool	Ground Level Hydro therapy pool for rehabilitating persons.
9b	Gym, pool amenities	Ground level pool amenities for the public and a gym proposed on level 1.
10b	Swimming pools	Proposed swimming pools for use by the public.
10a	Park amenities and storage	Proposed park for use by the public with recreational sporting storage areas.
10b	Perimeter fencing	Perimeter fence being a structure.

2.2 Areas Required to be Accessible

Under the provisions of Clause D3.1 of BCA2016, the following areas of the building are required to be accessible:

Level	Area / Room	Description
Ground Floor	Café/Kitchen	To and within all areas normally used by the occupants
Ground Floor Gym on Level 1	Hydro Pool, Gym, pool amenities	To and within all areas normally used by the occupants, including seating spaces according BCA2016 D3.9 except non-accessible seating areas within the assembly building.
Ground Floor	Swimming pools	To and into swimming pools with a total perimeter greater than 40m associated with an accessible building.
Gunyama Park	Park amenities and storage	To and within the accessible sanitary facility, change room, public shelter or the like within the public non-habitable building
Gunyama Park	Gunyama Park and playground areas	To and around all play equipment, natural landscapes and park grounds.

Note: The limitations and exemptions of Clauses D3.2, D3.3 and D3.4 of the BCA2016 have been considered where applicable in the process of developing the above table.

3 ACCESS REQUIREMENTS FOR PEOPLE WITH DISABILITIES

3.1 Introduction

The table below is a summary of all the individual elements that relate directly to the ability of a person with a disability to access all the portions of Gunyama Park Aquatic and Recreation Centre required to be accessible as outlined in 2.2 of this report.

Accessibility has been assessed against the relevant portions of the BCA2016, Access Code for Buildings, Council Access DCP and the related Australian Standards for each item listed below.

Compliance has been indicated by using the following symbols:

Symbol	Description
✓	Compliance is achieved, and no further information is required.
✓	Specific details are not provided, but compliance can be readily achieved.
✘	From the documentation provided, compliance is not achieved.

3.2 Council's Development Control Plan Requirements (DCP)

Generally, the City of Sydney Access DCP is in line with the requirements of the BCA, AS1428.1-2009 and AS1428.2-1992.

We note that the most current Australian Standard of AS1428.1-2009 provides a higher level of detail and more detailed requirements as opposed to that of Councils DCP and AS1428.2-1992 and therefore, we recommend that AS1428.1 precede the requirements of Council DCP and AS1428.2.

We note the following additional requirements for consideration that are outlined by Councils DCP and not addressed by any specific legislation:

- Clause 4.2.1 – Continuous Accessible Paths of Travel are to:
  - Be provided from both the street alignment, transport stops, passenger loading zones and from designated accessible car spaces to all public areas and facilities within and around a building, unless provision of access to an area or facility would be inappropriate because of the particular purpose for which that area or facility is used;
  - Be well lit (refer to the Exterior Lighting Strategy) and sheltered from the weather where possible;
  - Incorporate rest stations if the travel route is long;
- Clause 4.2.7 – Lift lobbies shall:
  - Be provided with seating.
- Clause 4.2.8 – Where accessible toilets are to be provided they shall comply with the following provisions:
  - Where a staff facility (reception, front desk, office etc) is provided, an emergency call button which complies with AS1428.2 shall be installed in each accessible sanitary facility.
- Clause 4.2.10 – The Public Domain and Street Furniture

  Relevant Standard: Australian Standard 1428.2 Clause 27

  Definition: Street furniture - includes objects such as seats, tables, drinking fountains, planter boxes, rubbish bins and the like.

  Intent:

- To ensure that street furniture is placed so that it does not obstruct the accessible path of travel.
- To ensure that street furniture is designed so that it is accessible by both pedestrians and wheelchair users.

Controls:
- Materials used in the public domain shall be slip resistant.
- Pathways shall have clear sightlines, be well lit and colour contrasted where appropriate to assist people with vision impairments.
- Hazard warnings such as tactile indicators shall be used where appropriate, although the design should aim to avoid hazards and thus the use of warning mechanisms.

Street furniture shall:
- Not protrude into the accessible path of travel;
- Be of a colour that provides a contrast with their background and have a luminance factor of not less than 0.3 (30 percent).

Unstructured Outdoor Environments shall have a shoreline incorporated such as a concrete edge around garden beds, or simply a grass edge, which can be followed by a person who is blind and uses a cane.

- Clause 4.2.11 – Public Telephones

  Relevant Standard: Australian Standard 1428.2 - Clause 30

  Intent:
  - To ensure that where payphones are provided, at least one accessible payphone shall be at an accessible floor level.

  Controls:
  - The accessible phone shall be:
  - Located along the accessible path of travel, but not obstructing it in anyway designated by signage.

- Clause – 4.2.12 Fire Safety

  Relevant Standard: There are no specific requirements in the BCA at this time for egress for persons with a disability, however the Australian Building Codes Board has suggested that specific provisions will be prepared in the future.

  Intent:
  - To ensure that consideration is given to additional needs of people with disabilities when designing egress routes and warning systems.

  Controls:
  Fire Safety issues have considered the following:
  - Accessible fire rated egress routes or waiting spaces for people with mobility impairments;
  - Warning systems have both audible and visual warnings;
  - Preparation of an emergency management plan which identifies strategies to facilitate emergency egress for people with a disability.

  The above items are those not covered by legislation and provided for further design consideration and client selection. As the design develops and specific details are provided, a number of key items listed above will be provided. Our office will assist in providing design advice to ensure these additional features are provided to achieve a level of compliance. We note that large items such as fire safety egress routes can maintain accessibility requirements within the stairways.

3.3 Building Code of Australia 2016 Assessment Summary (BCA2016)

CLAUSE	COMMENT	STATUS
SECTION D: ACCESS AND EGRESS		
PART D2 – CONSTRUCTION OF EXITS		
D2.0: Deemed-to-Satisfy Provisions	Noted	-
D2.17: Handrails	The fire isolated stairwells will need to comply with Clause 11.1(f) and (g) of AS1428.1-2009 which requires each tread to have a luminance contract strip which can be detailed on design documentation at the construction certificate stage. The fire isolated stairwells are required to have a handrail that maintains a 270 degree clearance for a continuous hand hold in accordance with Clause 12 of AS1428.1-2009. The stair treads at the landing are provided with an offset and are therefore consistent with the requirements of AS1428.1-2009.	✓

SECTION D: ACCESS AND EGRESS			
PART D3 - ACCESS FOR PEOPLE WITH A DISABILITY			
D3.0	Deemed To Satisfy Provisions	Noted	-
D3.1	General Building Access Requirements	Aquatic Centre: In accordance with Table D3.1 of the BCA, access is to be provided to and within all areas normally used by the occupants except in a 9b building, access need not be provided to tiers or platforms of seating areas that do not contain wheel chair seating spaces. Access is to be provided to and into swimming pools with a total perimeter greater than 40m. The building is shown to have accessible paths of travels incorporating accessways and ramps to and within the aquatic centre, crèche, hydrotherapy pool and surrounding areas including tiers, seating areas and change rooms. The pools have also been provided with compliant entries/exits. Gunyama Park: Access is to be provided to and within all areas normally used by the occupants within the sheltered and BBQ areas. Class 10a buildings: the amenities block is classified as a Class 10a and is therefore required to be accessible to and within an accessible sanitary facility, a change room facility and public shelter or the like. The proposed amenities block will be accessible.	✓
D3.2	Access to Buildings	Aquatic Centre: An accessway will be provided to the proposed building from the main pedestrian entries at the allotment boundary, public transport drop off points, cafe and the proposed accessible car spaces along Zetland Avenue in accordance with Clause D3.2 of the BCA. Gunyama Park: A series of accessways will be provided from various property entry points located along the adjoining	✓

SECTION D: ACCESS AND EGRESS			
		roadways to the proposed gunyama park, playground and public amenities building in accordance with Clause D3.2 of the BCA.	
D3.3	Parts of Buildings to be Accessible	The proposed ramps throughout the aquatic centre and park have been designed to comply with Clause 10 of AS1428.1-2009. The proposed non-fire isolated stairways within the aquatic centre building have been designed to comply with Clause 11 of AS1428.1-2009. The fire isolated stairways serving the gym and aquatic centre have been designed to comply with Clause 11.1(f) and (g) of AS1428.1-2009 in accordance with clause D3.3 of the BCA. The proposed doors throughout the building that are required to have door circulation spaces as outlined in Clause 13 of AS1428.1-2009 in accordance with BCA Clause D3.3 are required to comply in all areas normally used by the occupants. The doors throughout the building are required to have a minimum approach depth, a hinge side approach width and a latch side approach width. We note that all doors within accessible areas and along accessways are required to be a minimum width of 850mm. The proposed door circulation spaces throughout can achieve compliance. The proposed accessway circulation spaces throughout the building that are normally used by the occupants are required to have circulation spaces as outlined in Clause 6 of AS1428.1-2009 in accordance with BCA Clause D3.3. The Servery will be provided with an automatic sliding door. Location of switches and controls to be provided in accordance with Claus e13 of AS1428.1-2009. <u>Stairways:</u> The following items are noted to be required at CC stage when building specifications are compiled. We bring this to the attention of the design team for further consideration. • Tactile Indicators: Currently, no tactile indicators are shown to serve the non-fire isolated stairs or ramps throughout the common areas including those incorporated along accessways. Tactile indicators are required to be installed at the base and top of any stair flights including any intermediate landings and any ramps. Tactile indicators are required to be installed in accordance with AS1428.1-2009 and comply with AS/NZS1428.4.1. To be shown on the architectural drawings at CC stage. In addition, we note that tactiles are required to be provided where there is an overhead obstruction less than 2m off the floor where no other barrier exists, such as under the stairways.	✓ ✓ ✓

SECTION D: ACCESS AND EGRESS		
	• Handrails: The non-fire isolated stair flights and ramps throughout the entire development) are to comply with Clause 11 and 12 of AS1428.1-2009. Handrails are required to both sides of each stair flight and ramps (except fire isolated stairs – one side only). The required width of any stair flight or ramp is to be a minimum of 1200mm clear of walls to allow 1.0m clear of handrails for egress purposes, and suitable handrail dimensions and clearances from adjacent walls. The stair flights are to be clear of any entry/exit doors and boundaries to accommodate handrail extensions and TGSI's. Refer to Figure below. AS 1428.1-2009 requires a handrail to continue for the width of the last stair tread prior to terminating 300mm horizontally after the last stair tread prior to turning down. • Landings: The stairway landings to all stairways both fire isolated and non-fire isolated are required to be offset from each flight to limit the number of risers in accordance with BCA Clause D2.17 and Clause 11 of AS 1428.1-2009. The landing must continue a further tread width prior to the first riser of the next stair flight. It is also noted that the stairways at the mid-landings where there is a change in directions are required to be offset to allow for the provision of the handrail extension. We note that every accessible ramp provided to serve areas within the building are required to be provided with a flat landing top and bottom. The landings are required to be a minimum length of 1200mm in accordance with Clause 10 of AS1428.1-2009. • Ramps: The ramps throughout the development are shown to have a gradient of 1:14. It is noted that no RL's are provided at intermediate landings at this stage of the design to ensure compliance is achieved. We note that in accordance with Clause 10.3 of AS1428.1-2009, the 1:14 ramps provided are to be a maximum length of 9m. Where the lengths are greater than 9m, landings are required to be incorporated within the ramp to shorten the travel distance. Where the ramp gradients are between 1:14 and 1:20, the travel distance can be interpolated. • Stair Nosings: We also note that all the stairwells will need to comply with Clause 11.1(f) and (g) of AS1428.1-2009 which requires each tread to have a luminance contract strip. This can be detailed on design documentation at the CC stage. Note: The Access to Premises Standards does not provide the concessions provided in sub-cluses (g) and (h) in this clause, hence compliance with the Access to Premises Standards will require the floor covering in the accessible areas to strictly comply with Clause 7.4.1(a) of AS1428.1-2009. This is applicable to the gym floor finish in particular.	

SECTION D: ACCESS AND EGRESS			
D3.4	Exemptions	Certain areas can be exempted under this clause if they pose a health and safety risk for people with disability or access would be inappropriate because the particular purpose for which this area is used. The following areas within this development have been identified as potential excepted areas, subject to certifier's approval: • All plant rooms. • Cleaners store. • Chemical stores. • Furniture storage. • Freezer room. • Cool room. • Electrical/comms rooms. • Commercial Kitchen. Generally, these areas are exempt due to work health and safety issues. It is noted that in part 4.7 of this report various areas permitted to be exempt are actually provided with compliant accessways and accessible features. We refer you to Appendix C highlighting exempt areas in this development. It is noted that certain areas are not exempt such as general storage areas. Furthermore, the client has provided access to exempted areas to permit a wheelchair bound person to enter the room, turn around and exit. This includes the commercial kitchen and servery.	✓
D3.5	Accessible Car Parking	No Accessible car parking is provided within the building. It is noted that there are dedicated on street accessible car spaces proposed to comply with AS2890.6-2009.	✓
D3.6	Signage	Braille and tactile signage complying with Specification D3.6 and incorporating the international symbols as appropriate must identify each sanitary facility (accessible and ambulant), all accessible entrances where an entrance is not accessible and the all exits provided with exit signs. Additional signage and wayfinding signage will be provided throughout the accessways and landscapes. These will be addressed under Part 5 of this report as they are not specifically building related.	✓
D3.7	Hearing Augmentation	Should the building be provided with an inbuilt amplification system, a hearing augmentation system must be provided within a room in a class 9b building or at any ticket office, teller booth or reception area that is screened from the public in accordance with BCA Clause D3.7. This will be further addressed as the internal fitout and proposed intercom systems are identified.	✓
D3.8	Tactile Indicators	Tactile Indicators to be provided in compliance with this Clause, AS1428.1, AS1428.4.1 and AS4586/HB198 at bottom and top of stairs / ramps (except fire-isolated stairways). Tactile Indicators are required to be installed to the full tread width, be colour contrasting with adjacent surfaces, slip resistant and 300mm from the ramp edge of stair riser.	✓

SECTION D: ACCESS AND EGRESS			
D3.9	Wheelchair seating spaces in Class 9b Assembly Buildings	Where fixed seating is provided within the allotment, wheelchair seating spaces are to be provided in accordance with Table D3.9 of BCA Clause D3.9. A minimum of 3 spaces are required where up to 150 fixed seats are provided. Seats are to be suitably grouped and located in accordance with Table D3.9. The proposed design has bleachers and fixed seating. Wheel chair seating spaces have been provided within the aquatic centre and distributed accordingly to achieve inclusive and equitable seating for wheelchair bound persons.	✓
D3.10	Swimming Pools	In accordance with BCA Clause D3.10, each swimming pool is required to be provided with one means of accessible water entry/exit in accordance with Specification D3.10 of the BCA. The pool entry/exit points have been designed with either a fixed ramp and aquatic wheelchair or a Zero depth entry at a maximum gradient of 1:14 and aquatic wheelchair. It is further noted that an additional hoist is provided for entry/exit into both the 25m and 50m pools. The hydro therapy pool is provided with both a fixed ramp and a mechanical hoist that is operated by an occupational therapist. The mechanical hoist is a superior system that allows the user to be placed in the hoist apparatus from within the *Changing Places Australia* sanitary facility and manoeuvred into the hydrotherapy pool.	✓ ✓
D3.11	Ramps	On an accessway a series of connected ramps must not have a combined vertical rise of 3.6m and a landing for a step ramp must no overlap a landing for another step ramp or ramp.	✓
D3.12	Glazing on an Accessway	On an accessway, where there is no chair rail, handrail or transom, all frameless or fully glazed doors, sidelights and any glazing capable of being mistaken for a doorway or opening, must be clearly marked in accordance with AS 1428.1.	✓
SPECIFICATION D3.6 – BRAILLE AND TACTILE SIGNS			
1.	Scope	Noted	-
2.	Location of Braille and Tactile Signs	The location of braille and tactile signs shall be in accordance with AS1428.1 and Specification D3.6.	✓
3.	Braille and Tactile Sign Specification	All accessible signage to comply with this clause and AS1428.1. Tactile characters to be raised in sentence case with matt finish.	✓
4.	Luminance-contrast	All accessible signage to comply with this clause and As1428.1. The sign background to have at least 30% luminance contrast with the 5mm width border, tactile characters and braille. Luminance contrast to be measured on the location once installed. The proposed external signage prepared by *Extrablack*[B] in the signage package proposed for the external areas of the aquatic centre and amenities building are provided with differing colours to generic signage. Based on this, the luminance contrast will be required to be tested and certified prior to installation. To be further assessed at CC stage.	✓
5.	Lighting	Braille and tactile signs to be appropriate illuminated, in complaint with this Clause and AS1428.1. The access	✓

SECTION D: ACCESS AND EGRESS			
		pathway must have a minimum luminance contrast of 30%, in accordance with AS1428.1.	
6.	Braille	Braille must be in accordance with the criteria set out by the Australian Braille Authority.	✓
SPECIFICATION D3.10 – ACCESSIBLE WATER ENTRY/EXIT FOR SWIMMING POOLS			
1.	Scope	Noted	-
2.	Fixed or Movable Ramp	A fixed or movable ramp must have a slip-resistant surface, have a gradient of 1:14 max., handrails complying with AS1428.1, kerbing complying with AS1428.1, extend between 900-1100mm below water level, to have landing on top and bottom of the ramp located between 900-1100mm below water level. Surface slip resistance to be confirmed at CC stage when surface finishes are selected.	✓
3.	Zero Depth Entry	Zero depth entrance must have slip-resistant surface, have a gradient of 1:14 max. and have a continuous single handrail complying with AS1428.1 from top entry point to bottom level area. Level area to be 1500mm long for zero depth entry point width and located at the bottom of the zero depth entry between 900-1100mm below water level.	✓
4.	Platform Swimming Pool Lift	Platform swimming pool lift must be capable to operate within the swimming pool, from the swimming pool surround, on the platform, be located in 1300mm max. water depth, able to width stand up to 160kg and sustaining a static load up to 240kg. It is recommended that the proposed pool lifts are Platform swimming pool lifts. To be confirmed at CC stage.	✓
5.	Sling-style Swimming Pool Lift	Sling-style swimming pool lift to comply with this clause and Figure 5. It is noted that sling style swimming pool lift is not recommended as it is considered undignified in such a large public domain.	✓
6.	Aquatic Wheelchair	Aquatic wheelchair to top surface to have 430mm min. height, 480mm min. seat width, footrest provided, mobile armrest on both sides.	✓

SECTION E: SERVICES AND EQUIPMENT			
PART E3 – LIFT INSTALLATIONS			
E3.0	Deemed-to-Satisfy Provisions	Noted	-
E3.6	Passenger Lifts	Passenger lift to comply with this Clause, Table 3.6a Limitation of Use, Table 3.6b Application of Features and AS1735.12. This will be further documented as the design develops and when a lift manufacturer is nominated at CC stage. Passenger lifts traveling less than 12m will require 1100 wide x1400mm deep minimum lift car internal dimensions. Compliance with Part E3 is readily achievable.	✓

SECTION F: HEALTH AND AMENITY			
PART F2 – SANITARY AND OTHER FACILITIES			
F2.0	Deemed-to-Satisfy Provisions	Noted	-
F2.4	Accessible Sanitary Facilities (including Table F2.4)	Accessible sanitary facilities are required to be provided in accessible areas and are to comply with the requirements of AS1428.1-2009. At each bank of toilets where there is one or more toilets in addition to an accessible sanitary facility, a sanitary compartment for a person with an ambulant disability must be provided in accordance with AS1428.1-2009 for males and females. Where BCA Clause F2.3 requires a sanitary facility/wash closet to be provided within the Class 5/9b, 6, 9b and 10a of the development, then one accessible sanitary facility is required on every storey containing sanitary compartments; and where a storey has more than 1 bank of sanitary compartments containing male and female sanitary compartments, at not less than 50% of those banks. BCA Clause F2.3 does not specifically require showers for patrons within the gymnasium or aquatic centre. However, the design proposal incorporates an accessible shower at every bank of showers for the general population. Where a shower is provided in any proposed Class 10a building, not less than 1 for every 10 showers is to be an accessible unisex shower. There are two accessible showers provided for each sex within the Gunyama park field change rooms. A number of accessible sanitary facilities are proposed. This is to be further assessed as the design develops and in accordance with the population and facility count determined by the BCA Assessment undertaken under separate cover. Compliance with Part F2.4 is readily achievable.	✓

4 STATEMENT OF COMPLIANCE

4.1 General

The design documentation as referred to in this report has been assessed against the applicable provisions of the BCA2016 as outlined in Part 1.2 of this report and it is considered that such documentation complies or is capable of complying (as outlined in Part of this Report) with those documents except for the following non-compliances identified below that require further design consideration:

Note: Part 3.3 of this report provides a detailed assessment of the proposal against all relevant Deemed-to-Satisfy Provisions of the BCA2016. It is important that Part 3.3 of this report is read in conjunction with the items below, as some matters may not have had sufficient information provided to allow a detailed assessment to be undertaken.

Appendix B is provided with figures from relevant Australian Standards specific for this project as a reference for design consideration and compliance.

4.2 Design Certification

Further due to the level of detail provided at this stage the following items are to form part of a design statement or specification:

General

1 Tactile ground surface indicators will be installed at the top and bottom of stairways / ramps (other than fire isolated stairways / ramps); and where an overhead obstruction is less than 2 metres above the floor level. Tactile ground surface indicators will comply with Sections 1 and 2 of AS1428.4.1.

2 On an accessway where there is no chair rail, handrail or transom, all frameless or fully glazed doors, sidelights or glazing capable of being mistaken for a doorway or opening will be clearly marked and comply with Clause 6.6 of AS1428.1-2009. A solid non-transparent contrasting line not less than 75mm wide is to extend across the full width of the glazing panel. The lower edge of the contrasting line is to be located between 900-1000mm above the plane of the finished floor level. The contrasting line is to provide a minimum of 30% luminance contrast when viewed against the floor surface or surfaces within 2 metres of the glazing on the opposite side.

3 All doorways will have a minimum luminance contrast of 30% in accordance with Clause 13.1 of AS1428.1-2009.

4 Fixtures and fittings in accessible sanitary facilities will be provided and installed in accordance Clause 15 of AS1428.1-2009.

5 Fixtures and fittings in ambulant facilities will be provided and installed in accordance Clause 16 of AS1428.1-2009.

6 Walkways will comply with Clause 10 of AS1428.1-2009.

7 For the walkways, the floor or ground surface abutting the sides of the walkway will be firm and level of a different material to that of the walkway at the same level and follow the grade of the walkway and extend horizontally for a minimum of 600mm, or be provided with a kerb or kerb rail in accordance with Clause 10.2 of AS1428.1-2009.

8 Stairways will comply with Clause 11 of AS1428.1-2009.

9 The fire isolated stairs will comply with Clause 11.1(f) and (g) of AS1428.1-2009.

10 Handrails will comply with Clause 12 of AS1428.1-2009.

11 Grabrails will comply with Clause 17 of AS1428.1-2009.

12 Accessible car spaces will achieve compliant headroom clearances in accordance with Clause 2.4 of AS2890.6-2009.

13 Demarcation will be provided in the accessible car space and adjacent shared zone in accordance with Clause 3.1 and 3.2 of AS2890.6. Refer to Annexure B1 for a diagrammatic explanation.

14 Bollards will be provided in the shared disabled car space area in accordance with Clause 2.2.1(e) of AS2890.6-2009. Refer to Annexure B1 for a diagrammatic explanation.

15 Switches and power points will comply with Clause 14 of AS1428.1-2009.

16 Floor and ground floor surfaces on accessible paths and circulation spaces including the external areas will comply with Clause 7 of AS1428.1-2009. Any level difference over 3mm must be ramped according AS1428.1 Clause 10.5.

17 Braille and tactile signage will comply with BCA2016 Clause D3.6.

18 Signage will to comply with Clause 8 of AS1428.1-2009.

19 The passenger lifts will comply with BCA2016 Table E3.6b and AS1735.12.

20 The unobstructed height of a continuous accessible path of travel will be a minimum of 2000mm and 1980mm at doorways.

21 Door handles and the like, will be in accordance with Clause 13.5 of AS1428.1-2009.

5 ADDITIONAL ACCESSIBILITY PROVISIONS

It is noted that as part of our brief, it is in the interest of the client to provide the proposed Gunyama Park Aquatic and Recreation Centre and with accessibility provisions and features that are in addition to that of the standard required by legislation. We provide the following additional commentary that may assist the design development and address the requirements of the client for this specific project.

5.1 Advisory

The following recommendations are only advisory, however we recommend that compliance be maintained as per the requirements of the client.

- The CoS Access DCP recommends that rest stations be provided along accessways. It is noted that within the building development there are a number of areas along accessways where rest can be achieved. The bleachers, café seating areas both indoor and outdoor would suffice to meet the intent of this requirement. The design team may consider rest areas along the accessways within the entry area should there be a crowd due to a high volume of persons. It is noted that the buildings surrounds are covered in the sections below.
- The CoS Access DCP recommends that the lift lobbies be provided with seating. Furniture is not shown at this stage. It is noted that consideration has been made with sufficient lobby space to provide any such seating.
- The CoS Access DCP recommends that accessible fire exits are considered. It is noted that the all non-fire isolated stairways and pathways are provided with accessible features to comply with BCA Part D3 and AS1428.1-2009. The fire stairs serving first floor level are provided with sufficient area to accommodate a person in a wheelchair at the top floor landing and allow patrons to continue egressing. The ground floor of these fire isolated stairwells are also provided with suitable refuge areas.
- Where a turnstyle/automatic entry gate is installed, consideration to provide accessible controls or delayed opening times should be made to allow a wheelchair bound person to pass through at their own pace or a parent with a pram to access the aquatic centre at their own pace.

5.2 Accessible Sanitary Facilities

Generally, any proposed accessible sanitary facility is required to comply with the requirements of AS1428.1-2009. The client has proposed to provide *Changing Places Australia* sanitary facilities. These accessible sanitary facilities provide a larger floor area with additional features that permit the use for persons with extreme disabilities that have limited or no movement. The facility provides space for carers to assist the person with the disability.

The sanitary facility will be listed on a register that allows persons with these disabilities to locate the premises and utilise this particular type of accessible sanitary facility even if they are not utilising the pool facility.

The proposed *Changing Places Australia* sanitary facilities have been designed to achieve compliance with this organisations recommendations.

5.3 Accessible Parking

It is noted that accessible parking will be provided as street parking. We recommend that street parking be provided in accordance with AS2890.6-2009.

An unobstructed continuous accessible pathway is reccomended to be provided between the accessible carparking spaces and the main entrances of the café, aquatic centre and Gunyama park.

The required accessway should comply with AS1428.1-2009.

When providing the accessway from the accessible carparking space to the accessible main entrances of the café, aquatic centre and Gunyama park, any grated drainage will need to be determined to ensure the grate openings are slotted and not greater than 13mm wide and their orientation is transverse to the dominant direction of travel or, the slotted openings can be less than 8mm wide and the length of the slots can continue across the widths of the path of travel. Refer to Clause 7.5 of AS1428.1-2009.

The accessways will also need to account for a pedestrian crossing or safe path of travel for persons with a disability using the roadway.

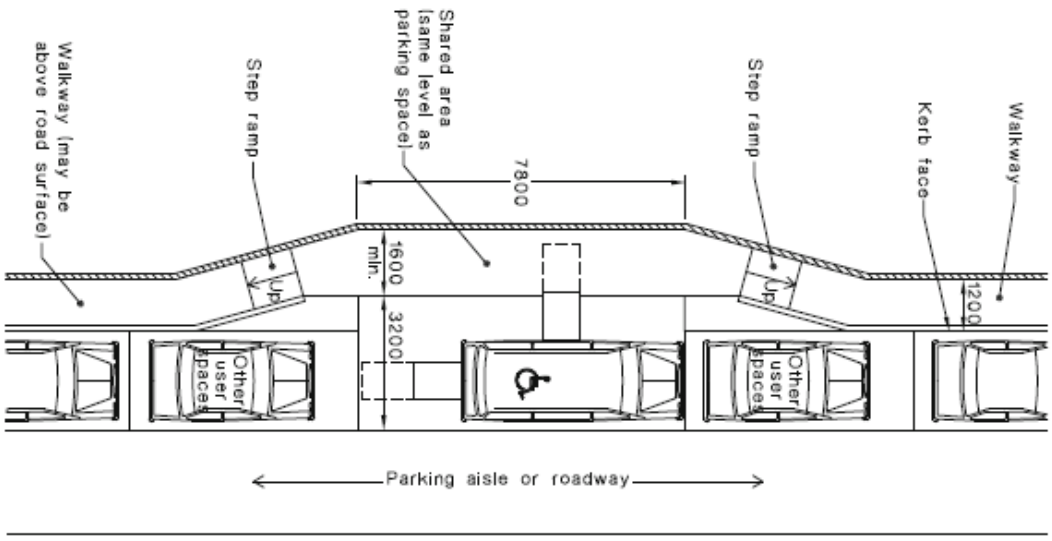


FIGURE 2.5 EXAMPLE OF A PARALLEL PARKING SPACE WITH SHARED AREA AT SAME LEVEL—DIMENSIONS FOR AUSTRALIA ONLY*

DIMENSIONS IN MILLIMETRES

5.4 Gunyama Park Aquatic and Recreation Centre

The extent of access to and within the pool areas, playground areas, fitness/gym areas, BBQ areas and park facilities should not generally be limited to those people that have a disability but should also cater for young children and adults with prams etc.

We note the following as key components have been and are continuously being explored by the design team and relevant consultants for the proposed aquatic centre, playground and park area in addition to standard requirements such as walkways, ramps, stairs etc. The following items are key considerations and have been incorporated within the design to maintain a high level of access throughout the network of accessways.

Accessways and circulation spaces - General:

- Wider pathways of at least 1500mm or preferably 1800mm.
- Clearances to signage and vegetation along accessways.
- Seating with backs and arms at heights suitable for persons with a disability adjoining accessways.
- Boardwalk/pathway materials and finishes to be firm surfaces with limited gaps and transitions to allow for easy travel and transitioning between areas.
- Lighting along accessways and throughout playground areas.
- Suitable signage with generic terminology and luminance contrasting features.
- Pedestrian links to public transport connections.
- Any drinking facility, rubbish bins, dog faeces bins etc to be located along accessways or linked to an accessway.
- Appropriate handrails to support users.
- Suitable spaces such as landings adjacent equipment to allow users to circulate on and off the
- Colour contrast between playground area, fitness areas and accessways.
- Accessible picnic/seating areas with space for a person in a wheelchair.
- BBQ's to be located at accessible heights and within reach ranges specified by AS1428.2-1992.
- Consideration to toe and knee clearances beneath BBQ facilities for wheelchair users should be made if commercially available.
- Any information and wayfinding maps, boards, instruments etc to be located along accessways or linked to an accessway and be positioned at a height suitable for those persons in a wheelchair. Consideration to the circulation area beneath any structure permitting a wheel chair to encroach beneath to allow full interaction and circulation.
- The provision of wheel chair seating and circulation adjacent to park benches.
- Maximising of accessible areas for staff access above the requirements of the BCA. BCA does not address access into Class 10a buildings (external toilet amenities etc) or to, within and throughout

the park areas that do not form part of the building. Certain areas are exempted from being provided with accessible features as they are hazardous areas that require Work, Health and Safety compliance. Plantrooms, pool plant, kitchen cool rooms etc will generally be exempt. The client is proposing accessways to and within a number of these areas.

Aquatic centre - General:

- Consideration to counter areas where persons are required to interact should be provided with set down benches/benches of suitable size to place belongings whilst requiring to complete a task such as a payment or food exchange etc within the café and entry area.
- Any children's pools and leisure water areas could be provided with ramping over the entire entry area to allow easy access for all personnel utilising the area.
- Suitable reach ranges to accommodate persons in a wheelchair.
- The client is proposing to provide staff kitchen amenities including sink with appropriated knee-toe clearances and adjustability, compliant with AS1428.2 Clause 24.1.4.
- The client is proposing to provide a lower reception service desk / counter portion to allow wheel chair users to have a set down area for belongings while interacting with reception. We recommend a height of 870mm max. from FFL. Ensure the counter has appropriate knee-toe clearance and 800mm width top.
- Although not required by the BCA in this building, the client has provided wheelchair seating spaces in bleachers. As a general rule of the thumb, the design team has used the parameters of BCA Clause D3.9 as a benchmark for quantifying these areas.
- It is proposed to provide accessible entry points into the Hydro therapy pool. It is noted that this would be used by professionals for treating persons with injuries and rehabilitation from injuries. Therefore, an overhead hoist within the hydro therapy pool may be considered. As this is specific to a rehabilitation team, and is used by a professionals, the use of any such access entry and exit mechanism would not be classified as undignified access as this area would be used for an individual client at any one time.

Playground - General:

- Playground area surfaces to be accessible surfaces compatible with wheelchairs i.e poured solid rubber.
- Smooth transition between playground area and accessways.
- Variety of accessible play equipment at ground level with access pathways such as swings, rocking mechanisms etc.
- Accessible play equipment to be located throughout playground and facing inwards to other equipment so that an individual is not isolated and can maintain interaction.
- Fitness area surfaces to be accessible surfaces compatible with wheelchairs i.e poured solid rubber.
- Smooth transition between fitness area, playground and accessways.
- Accessible fitness equipment to be located throughout fitness area and facing inwards to other equipment so that an individual is not isolated and can maintain interaction.
- Clear circulation spaces beneath and around fitness equipment to allow wheelchair users to use specific equipment.

Gym - General:

- Suitable reach ranges to accommodate persons in a wheelchair.
- Gym/area surfaces to be accessible surfaces compatible with wheelchairs i.e carpet within the gym facilities.
- Smooth transition between gym area and accessways.
- Accessible gym equipment to be located throughout studio and weights area and facing inwards to other equipment so that an individual is not isolated and can maintain interaction.
- Clear circulation spaces beneath and around gym equipment to allow wheelchair users to use specific equipment.
- Removable seating to fixed equipment to allow wheel chair users to also use the equipment.
- Consideration to provide a lower reception service desk / counter portion to allow wheel chair users to have a set down area for belongings while interacting with reception. We recommend a height of 870mm max. from FFL. Ensure the counter has appropriate knee-toe clearance and 800mm width top.

This lists are not exhaustive but provide parameters for the design team to include as the design develops. These additional features are at the discretion of the client.

We further note, the client also requires future consideration to the provisions of accessible play areas. When providing a play areas within a pool area or park, key consideration to inclusive play is required to be made. Inclusive play is where a person with a disability or is wheelchair bound has the opportunity to interact with others and manoeuvre around the equipment to enable them to be involved in play within the structure and features provided to forma play area. We provide the following considerations:

Pool Area:

- Flat water park/play areas with minimal gradient that has a contrasting floor finish delineating an accessway throughout any play equipment to allow a person in a wheel chair to move to and within any structure or play equipment.
- The provision of play equipment (eg spraying water jet that a user can operate) with clear circulation space around and located at a height suitable for a person in a wheelchair to encourage inclusive play.
- Water jet/stream type features that allow for circulation beneath for persons in a wheel chair to utilise.
- Where timed jets spray water from the surface below, provide additional jets along any accessway beneath the water surface to promote equality for all person utilising the area.
- The proposed *Carronade 2.0* spray jets permit wheel chair users to manoeuvre around and are a form of inclusive play. Consideration to colour section against the floor surface should be made. To be further assessed at CC stage.
- The proposed *DEX Geyser Medium, Puddle 1, Puddle 2* and *Spray Tunnel 4* vertical floor spray allows wheelchair users to manoeuvre over and encourage inclusive play. Consideration to the recessing or protrusion above the floor surface should be made. To be further assessed at CC stage.
- The proposed water slides – *EST-08813* and *Twin Tot Slide* are not specifically inclusive and do not permit wheelchair users to enter the platform. It is noted that circulation spaces are open and clear. This permits carers and parents to assist a wheelchair bound person to use the slide as intended. To be further assessed at CC stage.
- The proposed *Fun-brella* is located at a height of 1013mm from the floor surface. It is noted, subject to the height of an individual, an aquatic wheel chair seat height ranges from 450mm to 550mm and therefore the fun-brella may be at a reasonable height for inclusive play. To be further assessed at CC stage.
- The proposed *Leaflet* and *Waterleaf* is located at a height of 3.8m from the floor surface. Suitable for all patrons. To be further assessed at CC stage.

Park Area:

We have reviewed the proposed playground layout and design proposal. Generally, the playground has been designed to provide dignified and equitable access to and within areas with inclusive play and inclusive play equipment.

We are working with the playground designer to ensure that minimal ramps and stairways are provided. There are a small number of areas that have varying height differences that require further design input. These minor items are addressable to maintain the required high level of access within the park area.

The following general items are identified and the design incorporated these specific items.

- Play areas have minimal floor gradients with hard surfaces and a contrasting floor finishes delineating the various accessways throughout.
- Play equipment has bene sparingly space to allow a person in a wheel chair to move to and within any structure or play equipment.
- The specific play equipment with provision of accessible play have yet to be finalised with tis detail portion still under development. It is noted that the swings incorporate inclusive play swings that allow for other users to interact with those that have a disability pendulum swings with baskets and bucket chair seats adjacent a general swings are proposed.
- Climbing equipment should be provided at shallow inclines and include additional support mechanisms such as grab ropes to allow a user to use different methods to assist with varying disability and mobility limits.
- Any fixed play equipment to be located at heights suitable for wheel chair users.
- A variety of play components that stimulate various senses i.e vision, touch, smell, sound etc.
- No play equipment specifically designed for a wheelchair that isolates the user is proposed.
- Consideration to the step down between the synthetic park field and adjacent areas should be made for wheelchair users. The proposed difference in level is 400mm. Ramps between these

levels are required to comply with AS1428.1-2009. Where this 400mm difference is located along an accessway, kerb ramps should be considered to ensure the safety of wheelchair users, prams and children to prevent falls and injury.

- Consideration to the *Toddler Tunnel* to have a square/flat bottom to permit a child in a wheelchair to enter. To be further discussed with the playground design consultant at CC stage.
- Consideration of large circulation spaces at the base of the slides to permit wheelchair users to manoeuvre at the base of the slide to increase inclusive play and interaction.
- It is recommended that the proposed basket swings are split between general swings to increase inclusive play and other children utilising the baskets whilst a immobile person is using the equipment. This encourages other children to jump on the basket and promote interaction.
- Custom seating to incorporate wheelchair seating spaces to promote inclusive seating. We recommend the use of BCA Clause D3.9 as a benchmark for spacings and range.
- Where picnic benches are provide, suitable circulation spaces between each picnic table set should be included to allow wheelchair persons to sit at the end of picnic benches.

5.5 Furniture and furnishings

Where furniture and public furnishings are proposed, consideration to wheelchair users and persons with ambulant disabilities should be made.

We recommend that furniture and furnishings are provided at heights specified by AS1428.2-1992.

We provide the following comments based on proposed items to be installed:

- Park seating/Street seating – Seat heights at 400mm to 450mm.
  – Armrests at 260mm +/-40mm from the top of the seat.
  – Backrests to have an angle of 105 degrees measured parallel to the seat.
  – Seat depths to be 400 to 450mm deep
- Drinking facilities – height at 695mm to 700mm.
  – Trajectory of spout to be located 80mm to 100mm from top of fountain.
  – Controls to be located 180mm from top of fountain.
- Vending Machines – Operative components to be located between 500mm and 1200mm.
- Any protruding furniture should be located 500mm away from the path of travel.
- Signage, notice boards, information boards etc should be located between 729mm and 1872mm with an average height of 1709mm from the ground to allow for comfortable viewing by wheelchair users and general public.
- Bins should be placed in common reach zones for wheelchair and ambulant persons. Maximum reach height is 1170mm and maximum bin depth 600mm.

5.6 Streetscape and Pedestrian Footpath

The extent of the proposal with regard to the surrounding public footpaths and council streetscape is unknown at this stage.

We would recommend that the development include a general car drop off zone and public transport drop off zone at the main entrance to the aquatic centre and the main entrance to Gunyama Park to allow persons with a disability to be dropped off at the public footpath to access the development.

Furthermore, it is envisaged that the public footpath, kerbs, kerb ramps, traffic light buttons, street furniture and the surface to the public footpath will be in accordance with Council's relevant transport control plans.

It is assumed that Zetland Avenue will be the main public roadway that will be utilised by the public to access both aquatic centre and Gunyama Park.

5.7 Hydro therapy pool

The hydro therapy pool is provided with both a fixed ramp and a mechanical hoist that is operated by an occupational therapist. This hoist will allow for wheel chair bound persons to be hoisted into and out of the pool from the change room by the therapist. It is deemed that this would be a dignified form of access as it is utilised by the occupational therapist for one individual at a time.

Furthermore, it noted that the mechanical hoist is provided to a *Changing Places Australia* accessible sanitary facility. This is to provide a high level of access for immobile persons in a wheelchair with a carer due to the level of disability they may obtain.

5.8 Aquatic centre staff facilities

The design team have proposed that the staff facilities will incorporate additional accessible features and circulation spaces. The following items are noted:

- The café kitchen is generally exempt from being accessible due to the work place health and safety risks. However, the café kitchen facility will be provided with an accessway and adequate turning space to allow a person that is wheel chair bound to access the area for any reason.
- Further discussion relating to the kiosk and the serving of food by a person with a disability is to be provided by the client. The client will need to provide a clear direction to this specific item.
- The staff lunch room will be provided with an adjoining kitchen bench facility that will be adjustable and have a height adjustable sink. This will allow a wheelchair bound person to wash hands, prep food and manoeuvre beneath the bench as required to carry out daily activities.
- The reception desk is also proposed to have a height adjustable counter to allow a person with a disability to operate when within the reception area.

These listed items require further detailing as the design develops at CC stage.

6 FUTURE CONSIDERATIONS

In addition to the proposed accessibility provisions and features proposed for both Gunyama Park Aquatic and Recreation Centre, consideration should be given to the future use and function of these areas once completed. These future considerations could be adopted in the design with provisions for future facility conversions to provide further accessibility to and within all areas as required.

The following list is not exhaustive but may assist with the design of the Gunyama Park Aquatic and Recreation Centre:

- Provision/or considerations for all of Gunyama Park to all be accessible and be of inclusive play including playground equipment.
- Consideration when providing synthetic turf grounds should be made as wheelchair users may experience a level of difficulty. Consideration to a hard underlying surface such as concrete may address this issue and increase the disability of the playing fields for persons with a disability.
- As noted above, in addition to inclusive Aquatic play areas, Aquatic Centre leisure play equipment should be inclusive and located at heights suitable for wheelchair users.
- Consideration to the provision of wheelchair seating spaces in bleachers and throughout the park.
- Consideration of inclusive and intuitive wayfinding throughout all areas of the Aquatic centre and Gunyama Park including from the public entrances. Sign boards, maps outlining the entire development, hearing augmentation in public areas not within the building, electronic signage all to be located, positioned and designed to include and accommodate all users.
- Review of access from carparking and drop off/bus zones to Aquatic Centre and Gunyama Park as the design proposal progresses.
- The provision of highly useable fixtures and fittings to doorways, accessible bathrooms, showers and areas where a person of the public can access or utilise to assist persons with manipulatory disabilities.

7 OPERATIONAL STRATEGIES

In addition to the proposed accessibility provisions and features proposed for both Gunyama Park Aquatic and Recreation Centre, Operational strategies may need to be explored by the end facility operator or the facility management team to address various and unique scenarios and issues that may present themselves and affect the accessibility of the Aquatic Centre or Gunyama Park and its facilities.

The following list is a general outline of possible operational strategies that may be explored to assist the operator to comply with obligations under the Disability Discrimination Act (DDA).

- Staff training - awareness of access requirements for patrons and members of the public.
- Maintenance of publicly available aquatic wheelchairs for pool access.
- The BCA permits the use of accessible sanitary facilities by general patrons when determining sanitary facility requirements. Management may identify damage by general public use and excessive use of the accessible bathrooms as family change rooms. Restrictions may be applied to only permit one person at any onetime and a career at other times when a person with a disability is using the sanitary facility. The use of MLAK keyed access to park accessible facilities.
- Thorough planning of major and non-major public activities that are organised by the facility operator to include inclusive activities and programing for persons with a disability in both the Aquatic Centre and Gunyama Park. Provision for updateable Park signage to be considered for one off events within the Park.
- Personal Emergency Evacuation Plans can be implemented to assist persons with a disability to evacuate the premises in an emergency. This would be dependent on staff numbers, level of training and operational policies.
- The proposed development will only be provided with street parking and as such, the use of on-street parking for disabled persons is open to abuse by members of the public without ongoing parking enforcement activities. Accessible parking for temporary allocation by the centre manager for unique situations could be considered. The design team may incorporate a single accessible carspace and shared zone to address any such issue.
- It is proposed to provide a changing places change room/sanitary facility. This changing places sanitary facility assists the greater community and allows members of the public with disabilities to utilise the sanitary facility without having to be a patron of the premises. The client is proposing to leave these facilities unlocked at all times. The Aquatic Centre and Gunyama Park may require an operational strategy in the event that a sanitary facility is locked or becomes unlocked for any reason whilst the building is occupied.

Annexure A Design Documentation

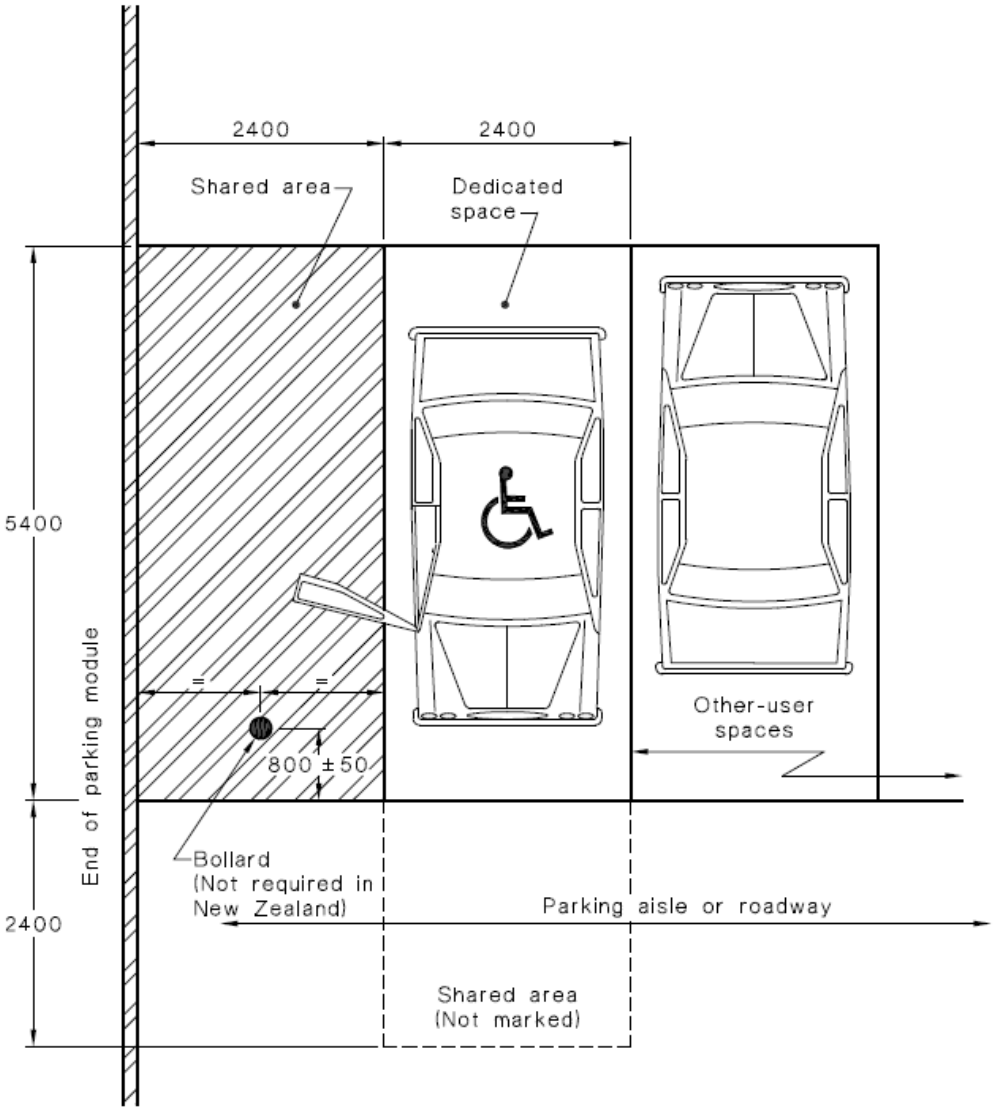
This report has been based on the following design documentation.

Architectural Plans Prepared by ABA Grimshaw

DRAWING NO.	REVISON	DRAWING TITLE	DATE
ARCHITECTURE & LANDSCAPE - ABA / GRIMSHAW / TCL 01.ARCHITECTURE			
ARC-A-011	A	SITE PLAN	31/05/2016
ARC-A-101	A	BASEMENT PLAN	31/05/2016
ARC-A-102	A	GROUND FLOOR PLAN	31/05/2016
ARC-A-104	A	FIRST FLOOR PLAN	31/05/2016
ARC-A-105	A	MAIN ROOF PLAN	31/05/2016
ARC-A-201	A	ELEVATIONS OVERALL	31/05/2016
ARC-A-301	A	SECTIONS OVERALL	31/05/2016
ARC-A-401	A	PARK AMENITIES BUILDING	31/05/2016
02.LANDSCAPE			
ARC-T-DA-001	A	DRAWING LIST & SITE CONTEXT PLAN	27/05/2016
ARC-T-DA-002	A	LANDSCAPE LEGEND & MATERIALS	27/05/2016
ARC-T-DA-003	A	TREE PROTECTION & REMOVAL PLAN	27/05/2016
ARC-T-DA-004	A	GENERAL ARRANGEMENT PLAN	27/05/2016
ARC-T-DA-005	A	FURNITURE & FIXTURES PLAN	27/05/2016
ARC-T-DA-006	A	GRADING PLAN	27/05/2016
ARC-T-DA-007	A	PLANTING PLAN	27/05/2016
ARC-T-DA-008	A	LONG SECTIONS & ELEVATION	27/05/2016
ARC-T-DA-009	A	SECTIONS	27/05/2016
ARC-T-DA-010	A	DETAILED PLAYGROUND PLAN	27/05/2016
ARC-T-DA-011	A	DETAILED PLAYGROUND	27/05/2016
ARC-T-DA-012	A	DETAILED PLAYGROUND	27/05/2016
03.SIGNAGE			
	DA	SIGNAGE STRATEGY AND DRAWINGS	02/06/2016

Annexure B Figures and Drawings Sample

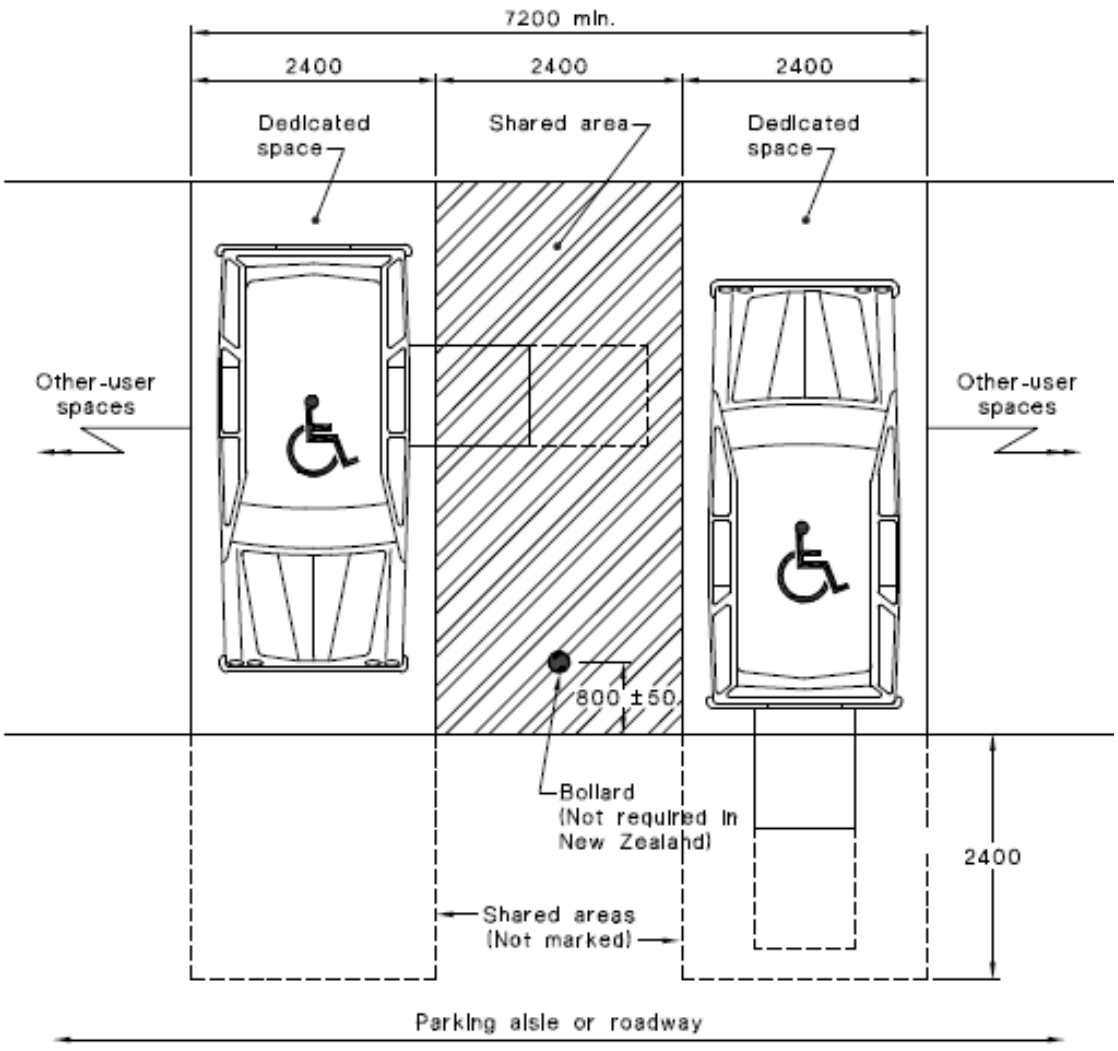
B 1



DIMENSIONS IN MILLIMETRES

FIGURE 2.2 EXAMPLE OF AN ANGLE PARKING SPACE WITH SHARED AREA ON ONE SIDE ONLY—DIMENSIONS FOR AUSTRALIA ONLY*

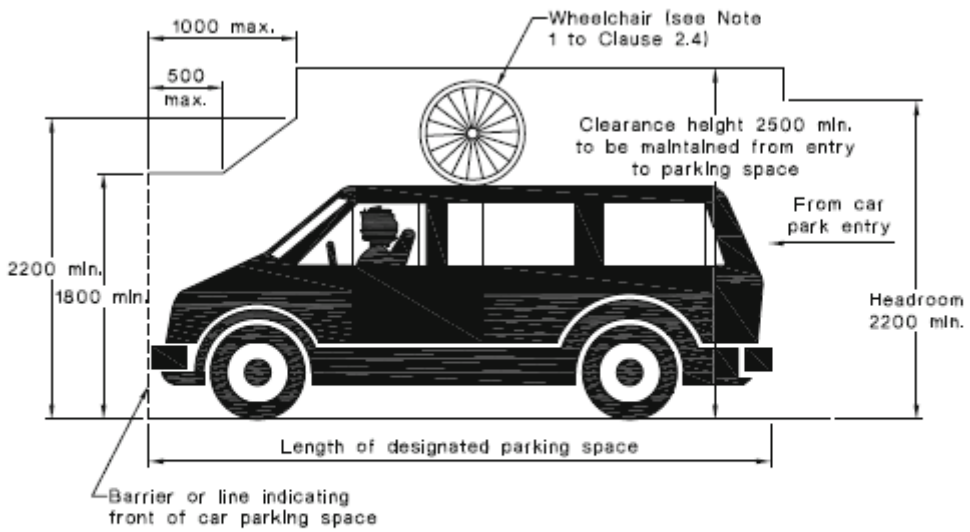
B 2



DIMENSIONS IN MILLIMETRES

FIGURE 2.3 EXAMPLE OF TWO PARKING SPACES WITH A COMMON SHARED AREA—DIMENSIONS FOR AUSTRALIA ONLY*

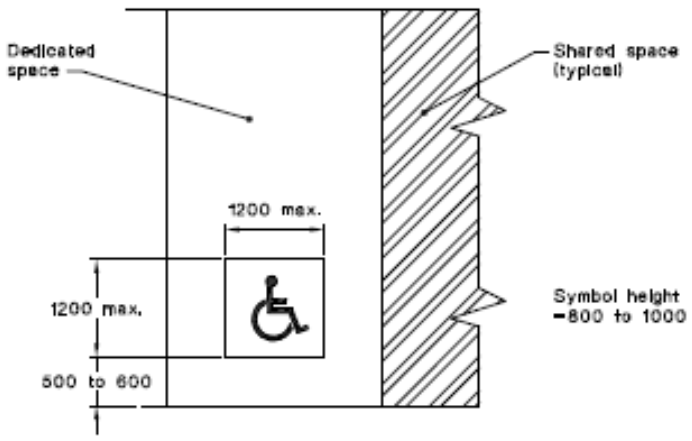
B 3



DIMENSIONS IN MILLIMETRES

FIGURE 2.7 HEADROOM REQUIRED ABOVE CAR SPACES FOR PEOPLE WITH DISABILITIES

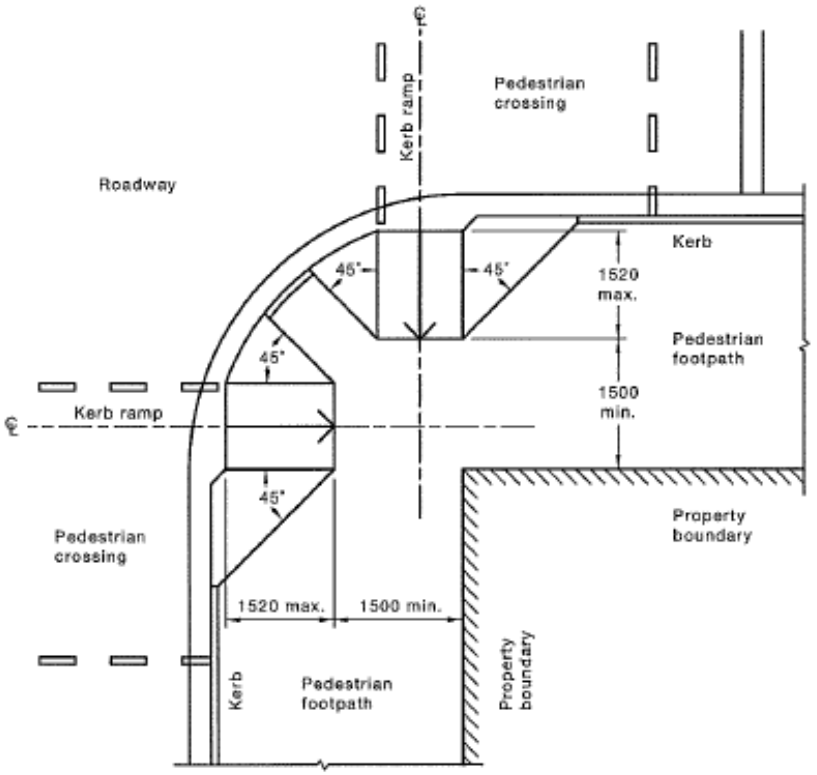
B 4

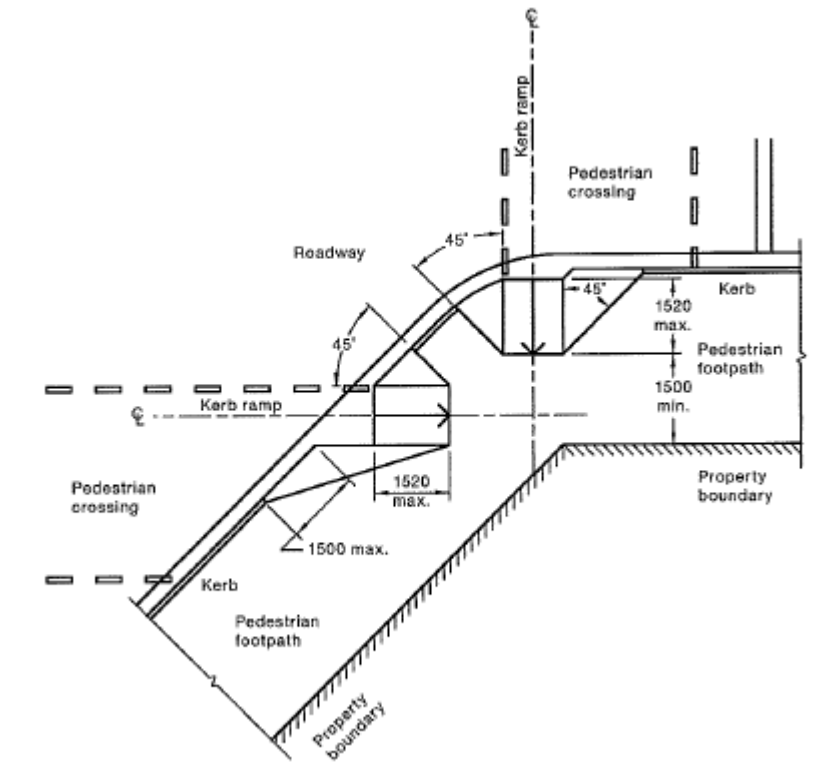


DIMENSIONS IN MILLIMETRES

FIGURE 3.1 USE OF SYMBOL OF ACCESS TO IDENTIFY SPACES

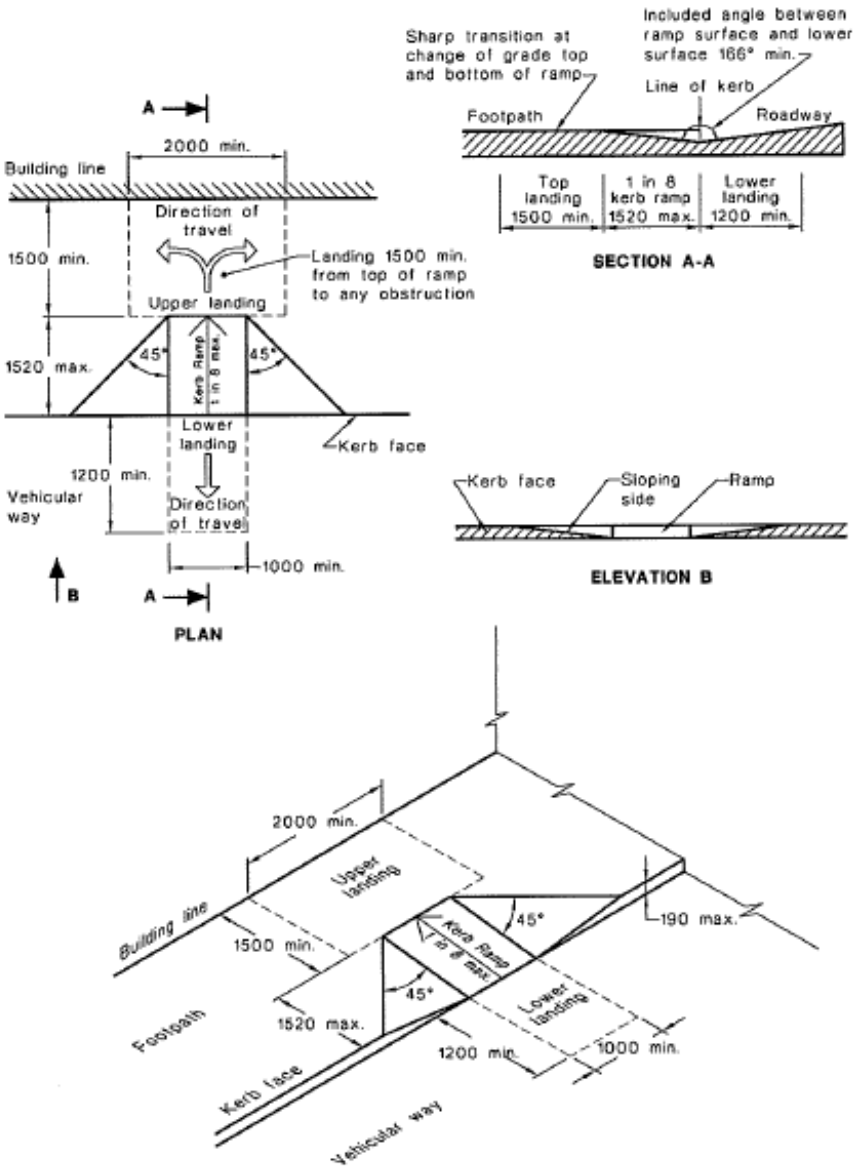
B 5


Kerb ramp
Pedestrian crossing
Roadway
Kerb
45°
45°
1520 max.
Pedestrian footpath
1500 min.
45°
Kerb ramp
45°
Property boundary
Pedestrian crossing
1520 max.
1500 min.
Kerb
Pedestrian footpath
Property boundary


Kerb ramp
Pedestrian crossing
Roadway
45°
45°
Kerb
1520 max.
45°
Pedestrian footpath
1500 min.
Kerb ramp
Property boundary
Pedestrian crossing
1520 max.
1500 max.
Kerb
Pedestrian footpath
Property boundary

NOTES:

B 6

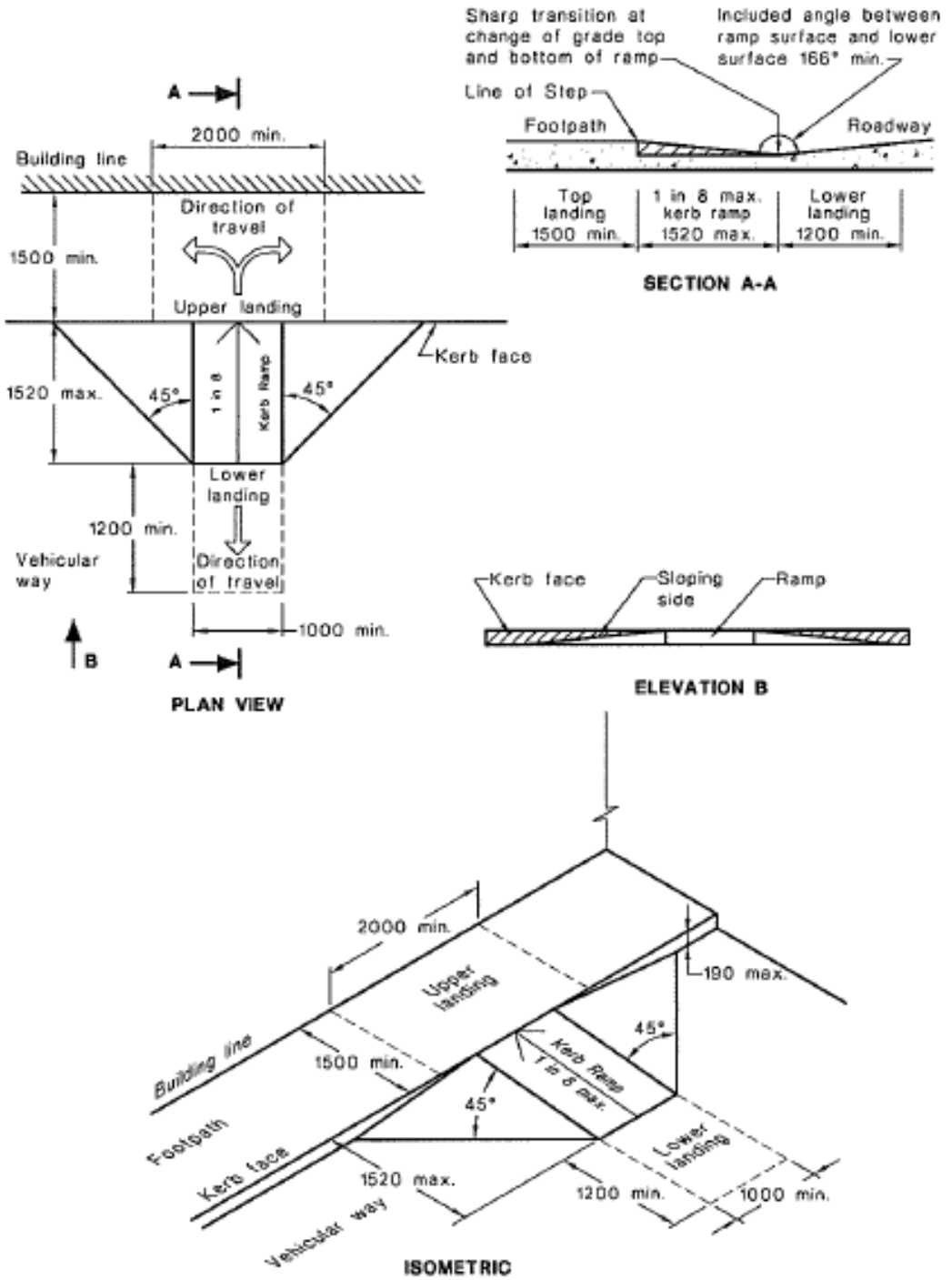


ISOMETRIC VIEW

NOTE: Where there is no turn involved, top landing may be reduced to 1200 mm min. in length.

DIMENSIONS IN MILLIMETRES

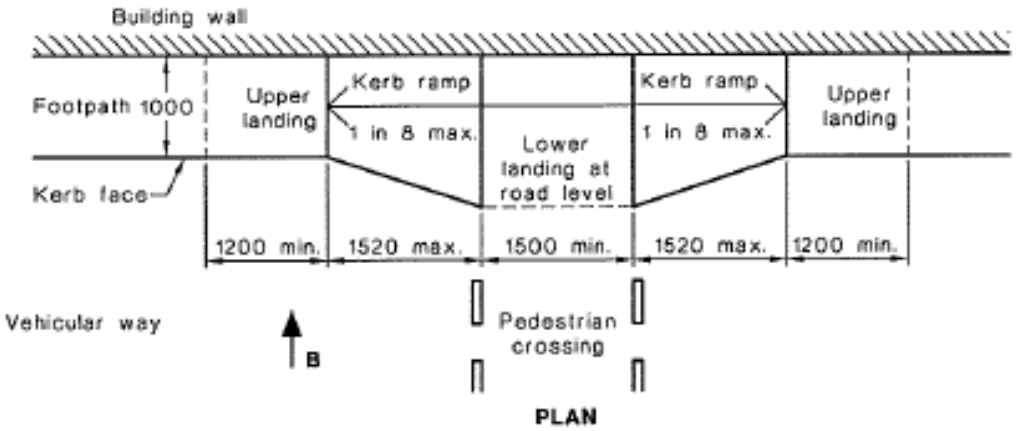
FIGURE 24(A) INSERTED KERB RAMP



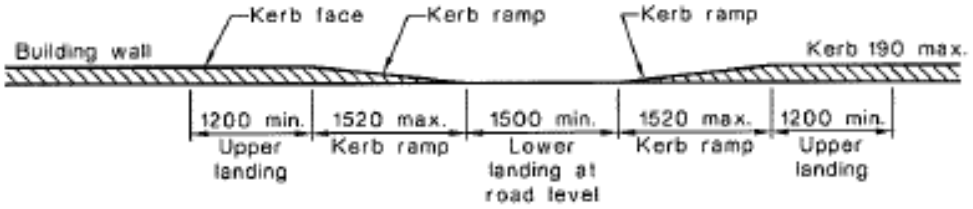
NOTE: Where there is no turn involved, top landing may be reduced to 1200 mm min. in length.

DIMENSIONS IN MILLIMETRES

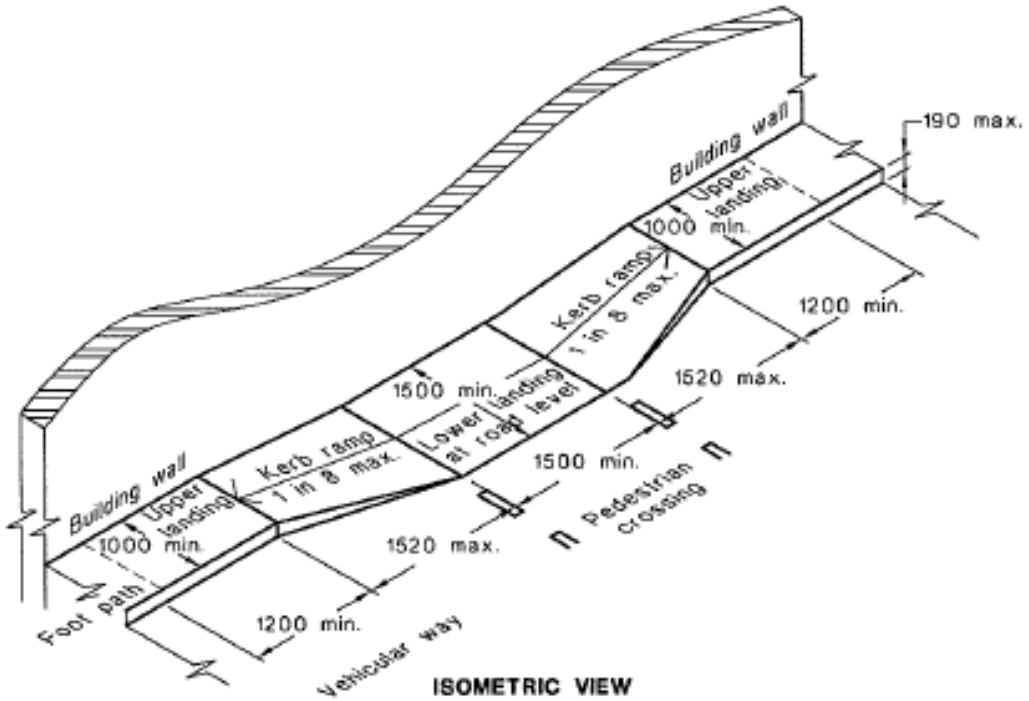
FIGURE 24(B) ATTACHED KERB RAMP



PLAN



ELEVATION B

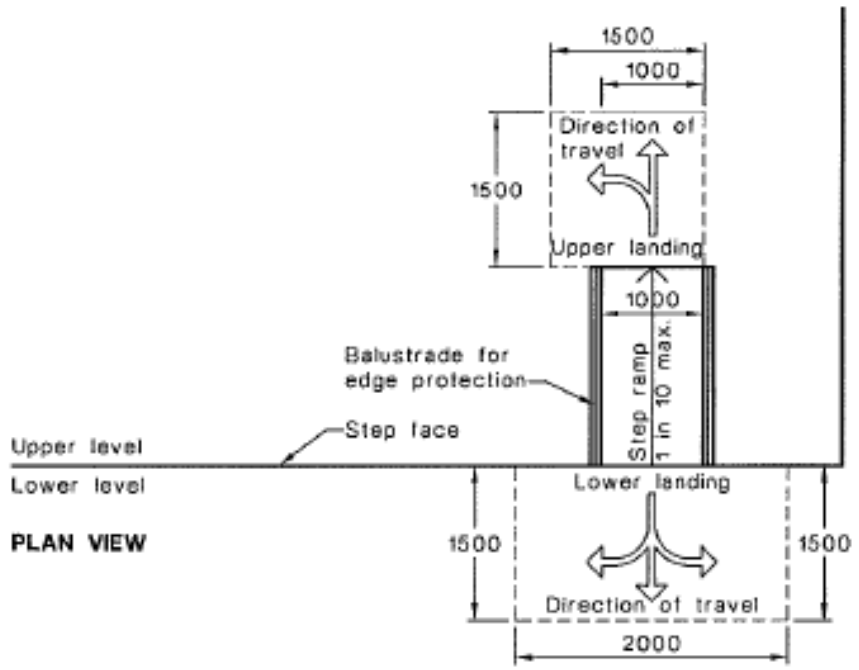


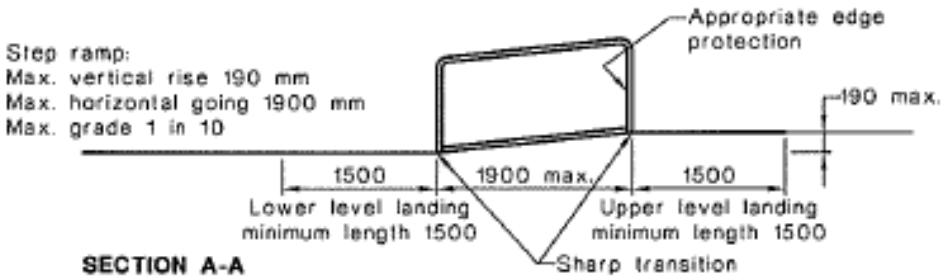
ISOMETRIC VIEW

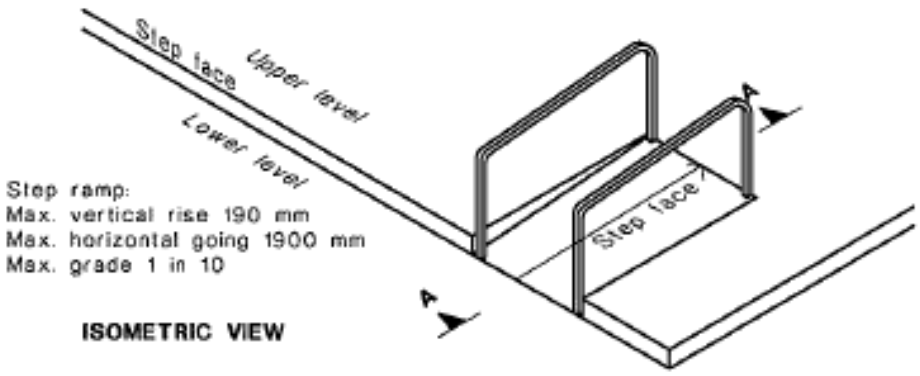
DIMENSIONS IN MILLIMETRES

FIGURE 24(C) IN LINE KERB RAMPS—NARROW FOOTPATHS

B 7







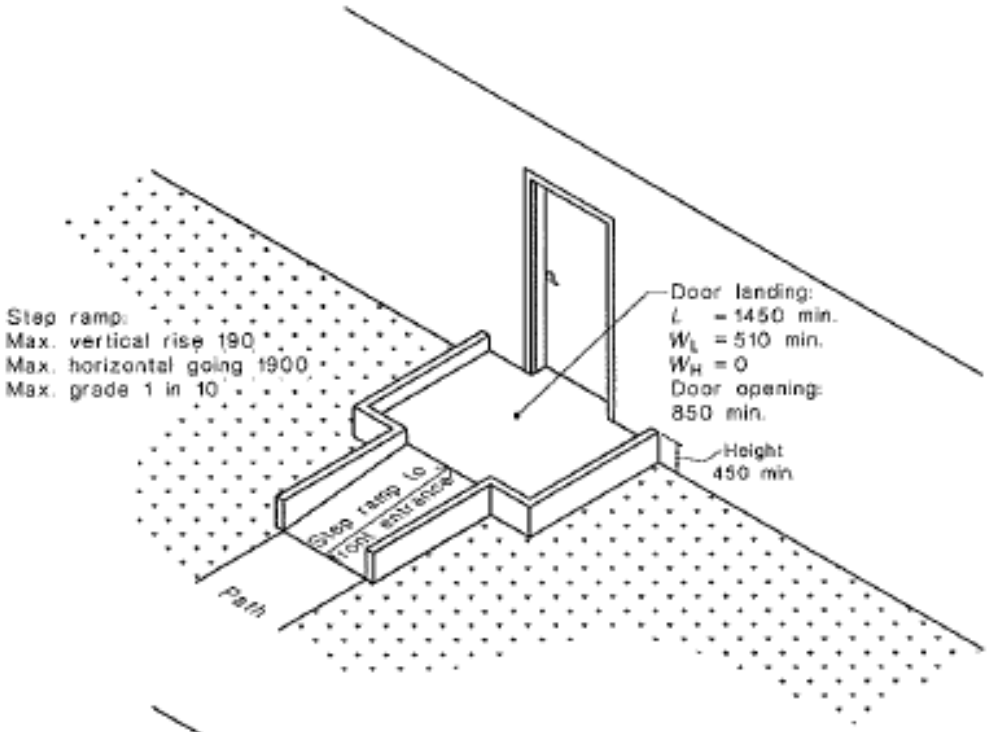
NOTES:

1 Where there is no turn involved, top and bottom landing may be reduced to 1200 mm min. i length.

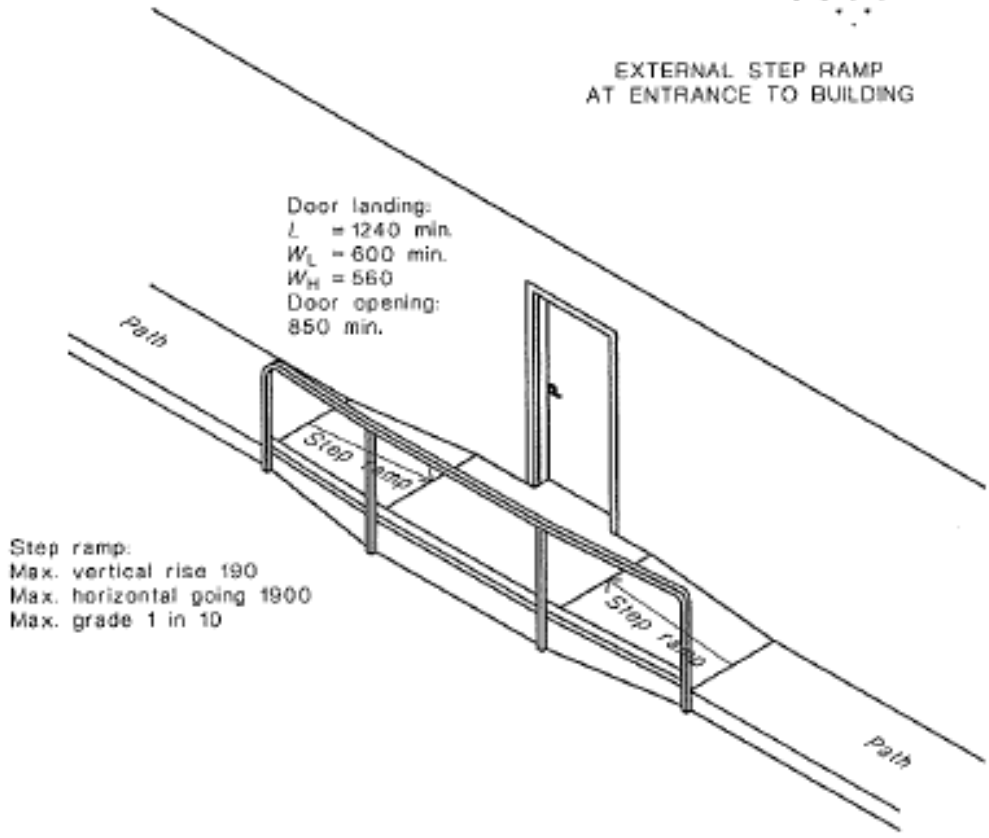
2 Kerbs or kerb rails shall be provided in accordance with Clause 10.6.1 except where splaye sides are provided at a 45° angle.

DIMENSIONS IN MILLIMETRES

FIGURE 22(A) STEP RAMP—INSERTED



EXTERNAL STEP RAMP
AT ENTRANCE TO BUILDING

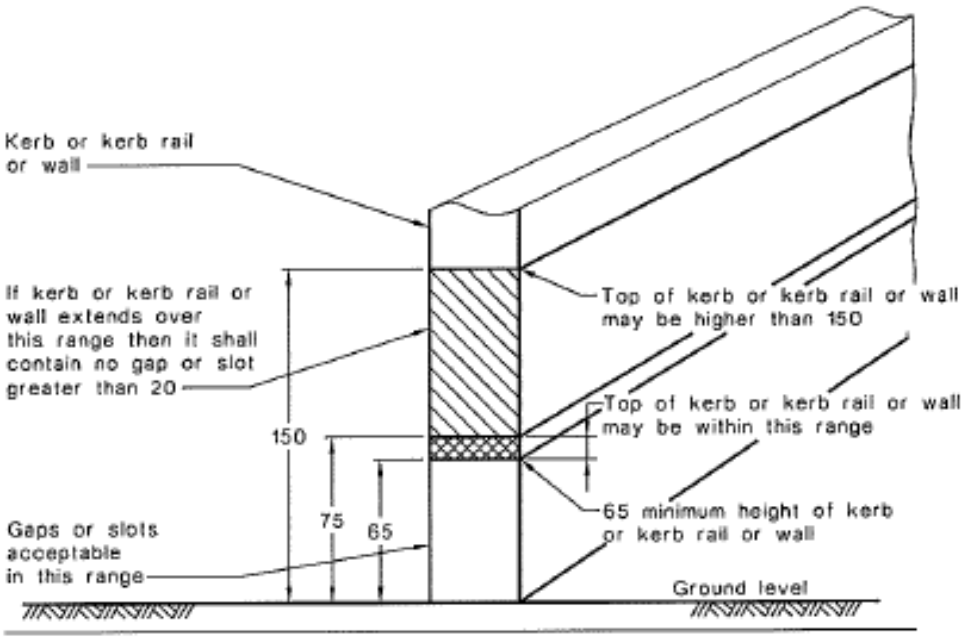


EXTERNAL STEP RAMP
AT ENTRANCE TO BUILDING

DIMENSIONS IN MILLIMETRES

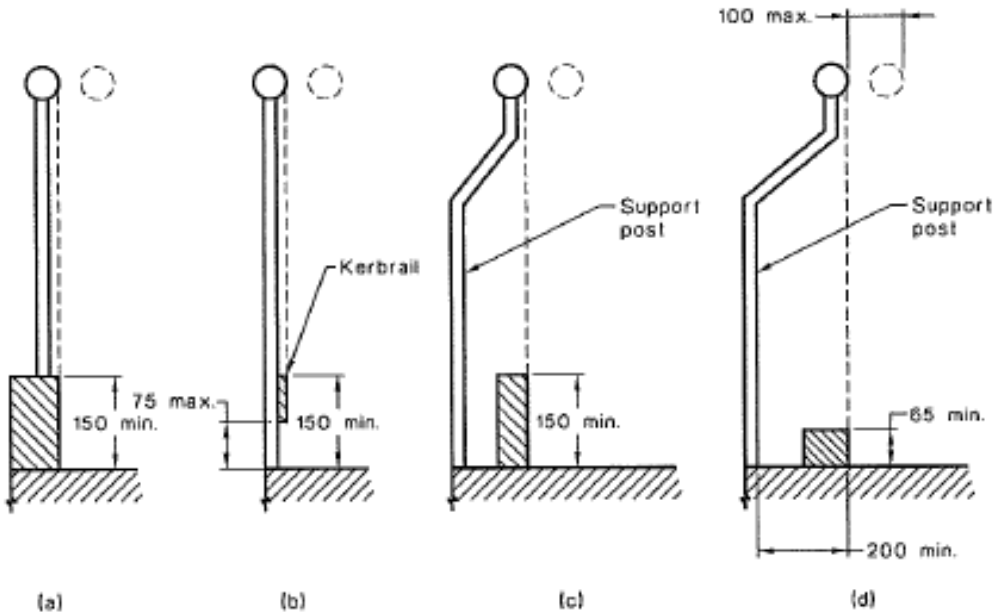
FIGURE 22(B) EXTERNAL STEP RAMPS AT ENTRANCE TO BUILDING

B 8



DIMENSIONS IN MILLIMETRES

FIGURE 18 KERB RAIL

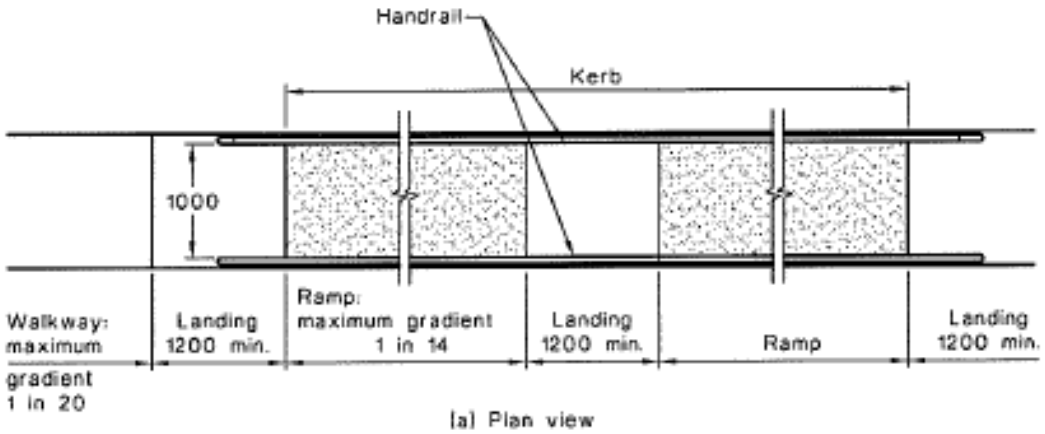


NOTE: See Appendix A for further clarification.

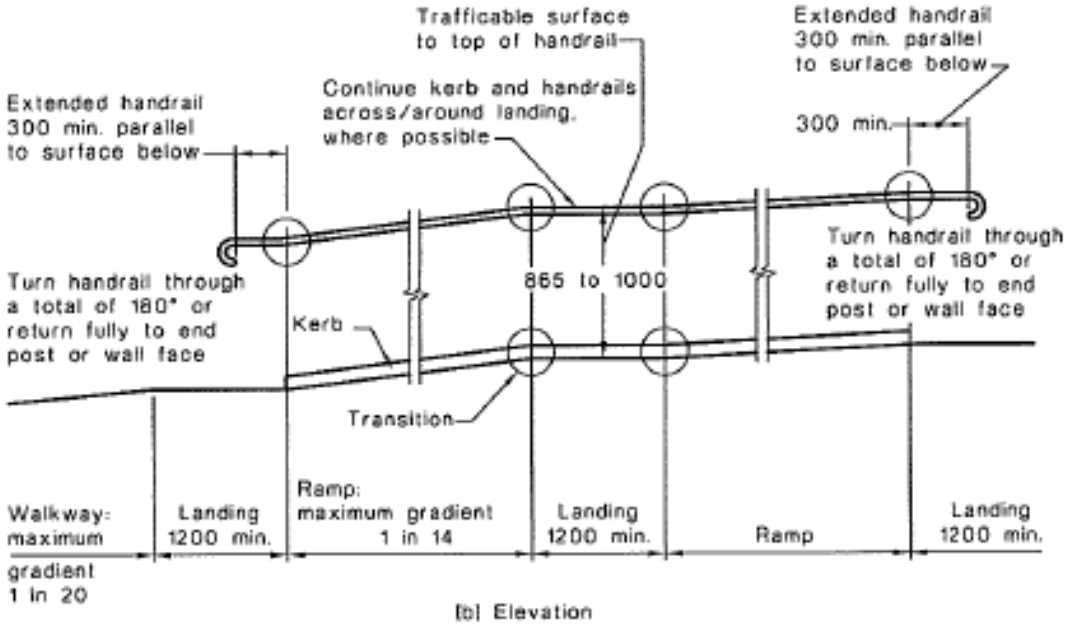
DIMENSIONS IN MILLIMETRES

FIGURE 19 SECTION SHOWING LOCATION OF KERB OR KERB RAIL IN RELATION TO HANDRAIL WITH VERTICAL SUPPORT

B 9



(a) Plan view



(b) Elevation

DIMENSIONS IN MILLIMETRES

FIGURE 14 RAMP HANDRAILS

B 10

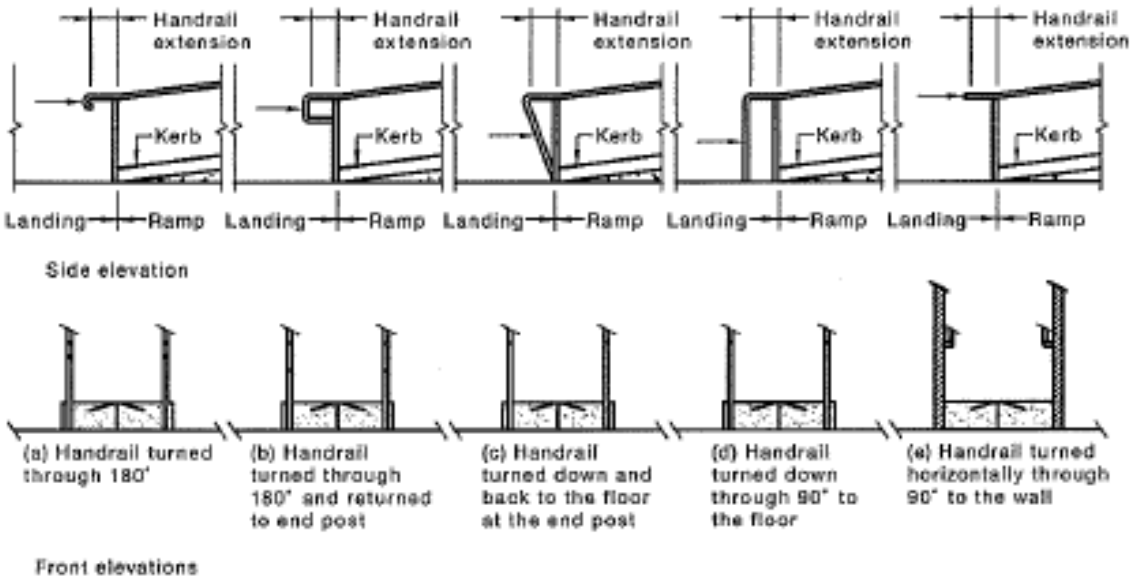
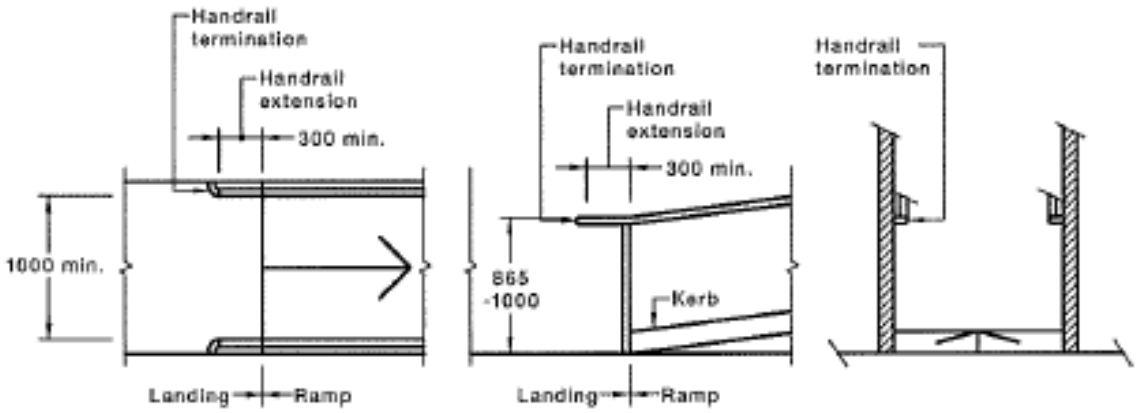


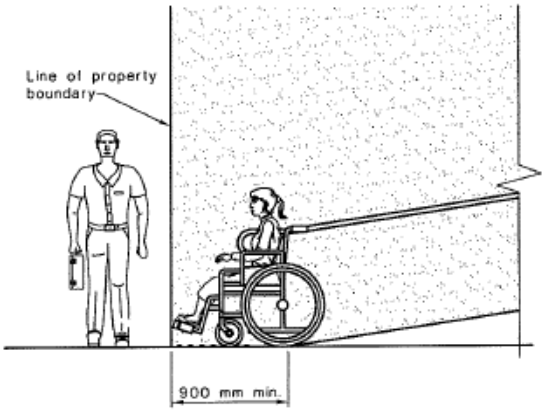
FIGURE 15(A) RAMP HANDRAILS—EXAMPLES OF HANDRAIL TERMINATIONS



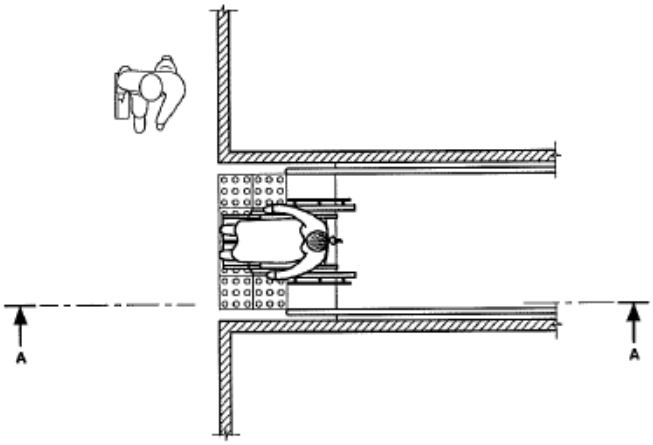
DIMENSIONS IN MILLIMETRES

FIGURE 15(B) RAMP HANDRAILS—DETAIL FOR HANDRAILS TERMINATED BY TURNING HORIZONTALLY THROUGH 90° TO THE WALL

B 11



SECTIONAL ELEVATION A-A

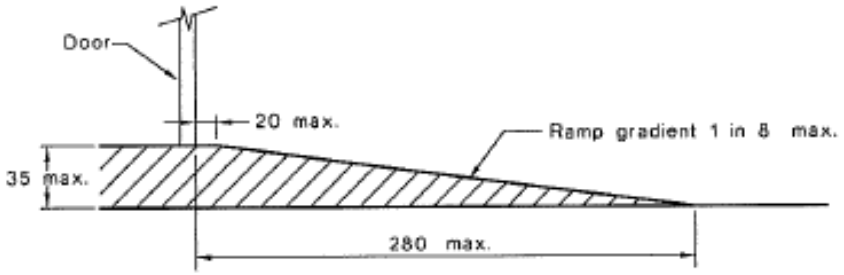


Plan

NOTE: TGSIs to be installed within the property boundary.

FIGURE 16 LOCATION OF RAMP AT A BOUNDARY TO PREVENT PROTRUSION OF HANDRAILS AND TACTILE GROUND SURFACE INDICATORS (TGSIs) INTO A TRANSVERSE PATH OF TRAVEL

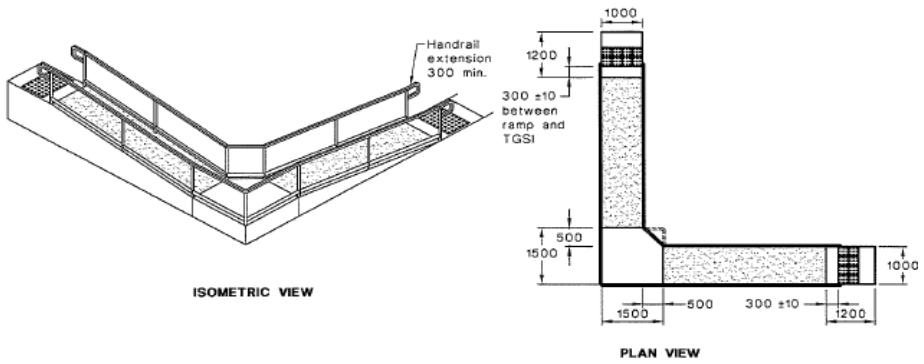
B 12



DIMENSIONS IN MILLIMETRES

FIGURE 21 THRESHOLD RAMP

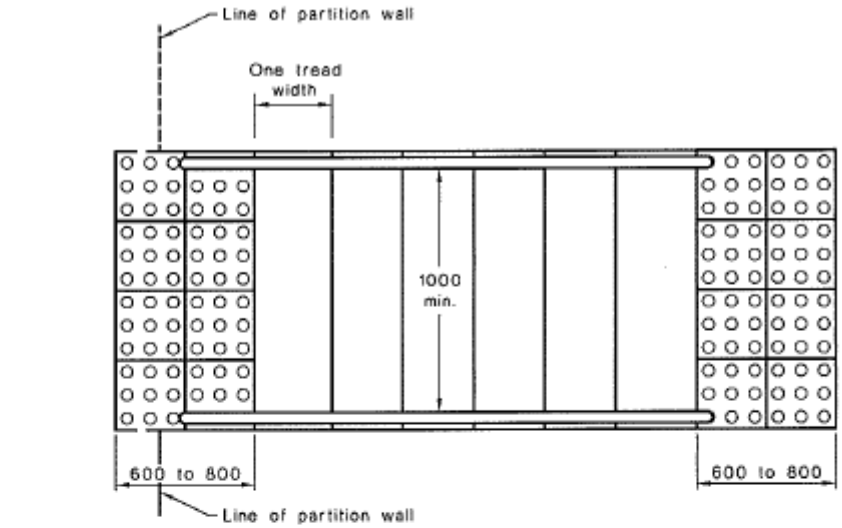
B 13



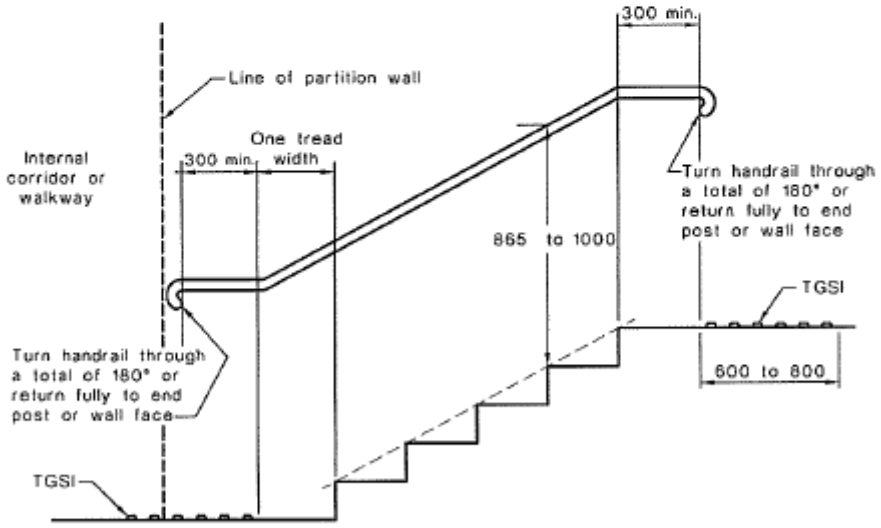
DIMENSIONS IN MILLIMETRES

FIGURE 25(B) RAMPS AND LANDINGS—90° LANDING—INTERNAL

B 14



PLAN

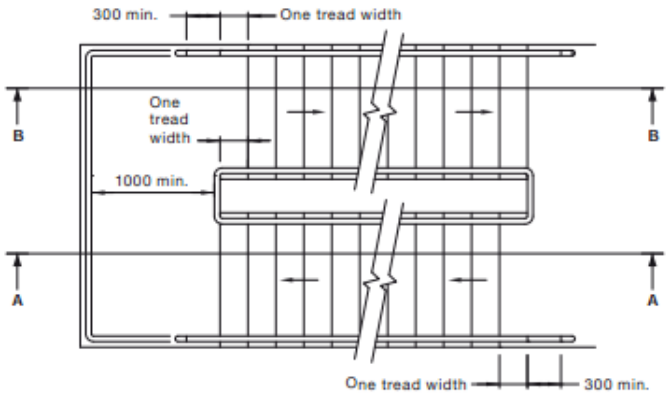


SECTIONAL VIEW

DIMENSIONS IN MILLIMETRES

FIGURE 26(B) STAIRWAY LOCATION AND HANDRAIL EXTENSIONS AT END OF STAIRWAY OTHER THAN AT LINE OF BOUNDARY

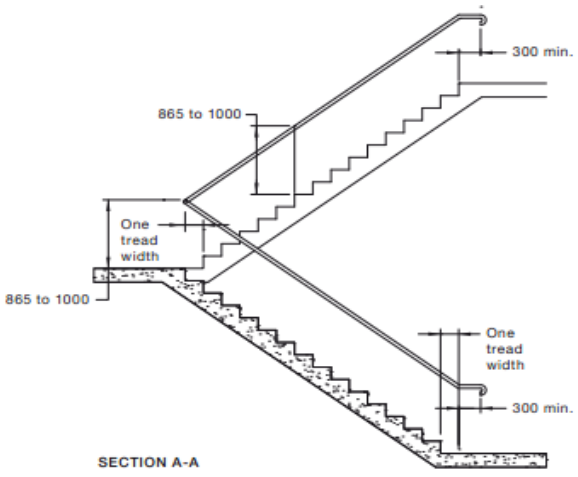
B 15



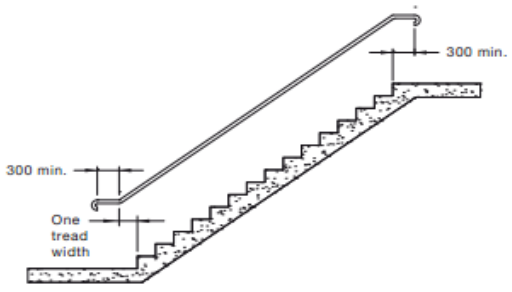
(a) Plan

DIMENSIONS IN MILLIMETRES

FIGURE 28 (in part) HANDRAILS TO STAIRS WITH INTERMEDIATE LANDINGS



SECTION A-A

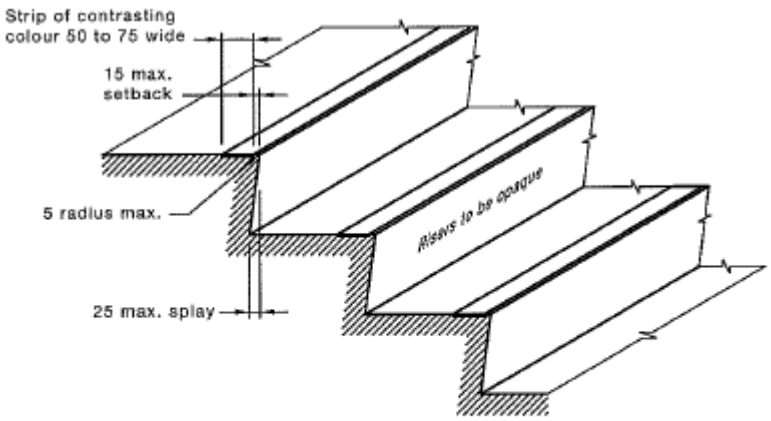


SECTION B-B

(b) Sections

DIMENSIONS IN MILLIMETRES

FIGURE 28 (in part) HANDRAILS TO STAIRS WITH INTERMEDIATE LANDINGS

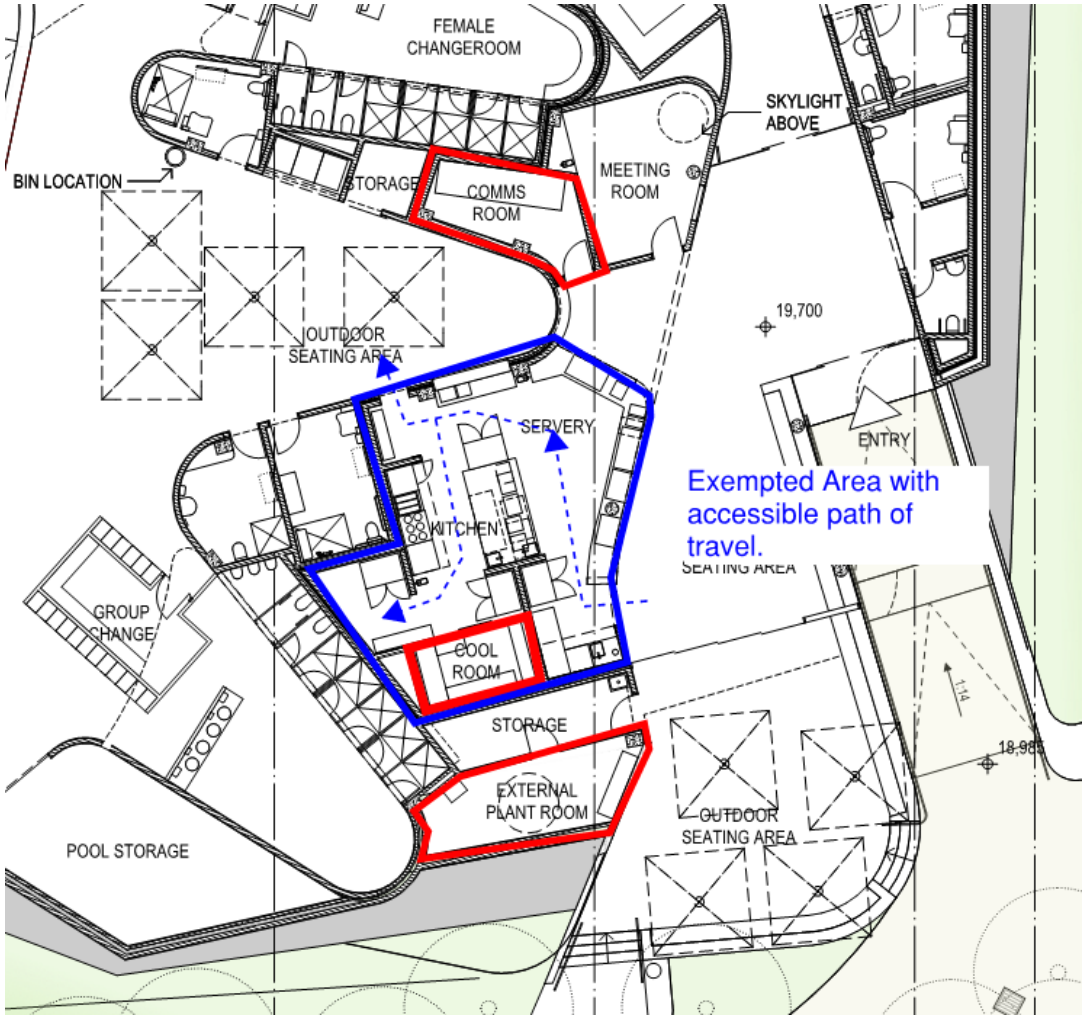


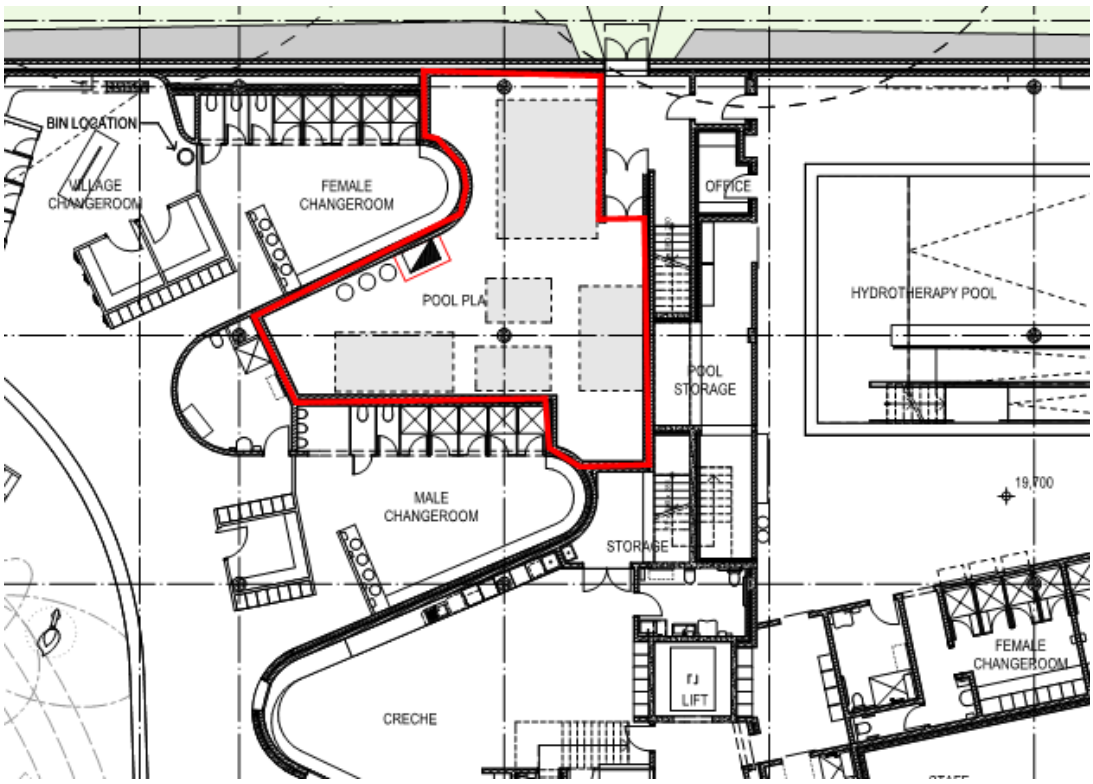
NOTE: A chamfered nosing 5 x 5 mm may be used.

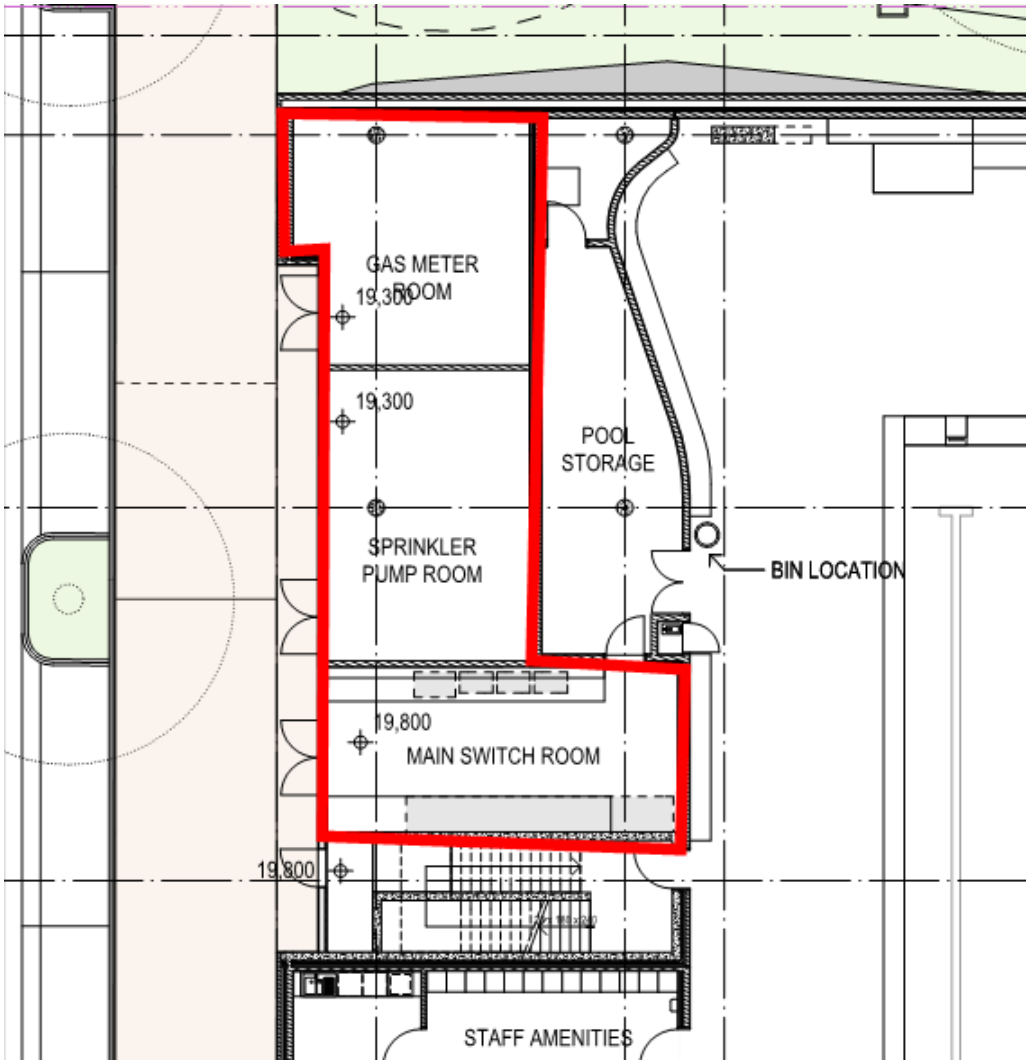
DIMENSIONS IN MILLIMETRES

FIGURE 27(A) A TYPICAL STAIR NOSING PROFILE WITH NOSING STRIP

Annexure C BCA Clause D3.4 – Exempted Areas



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SPRINKLER PUMP ROOM
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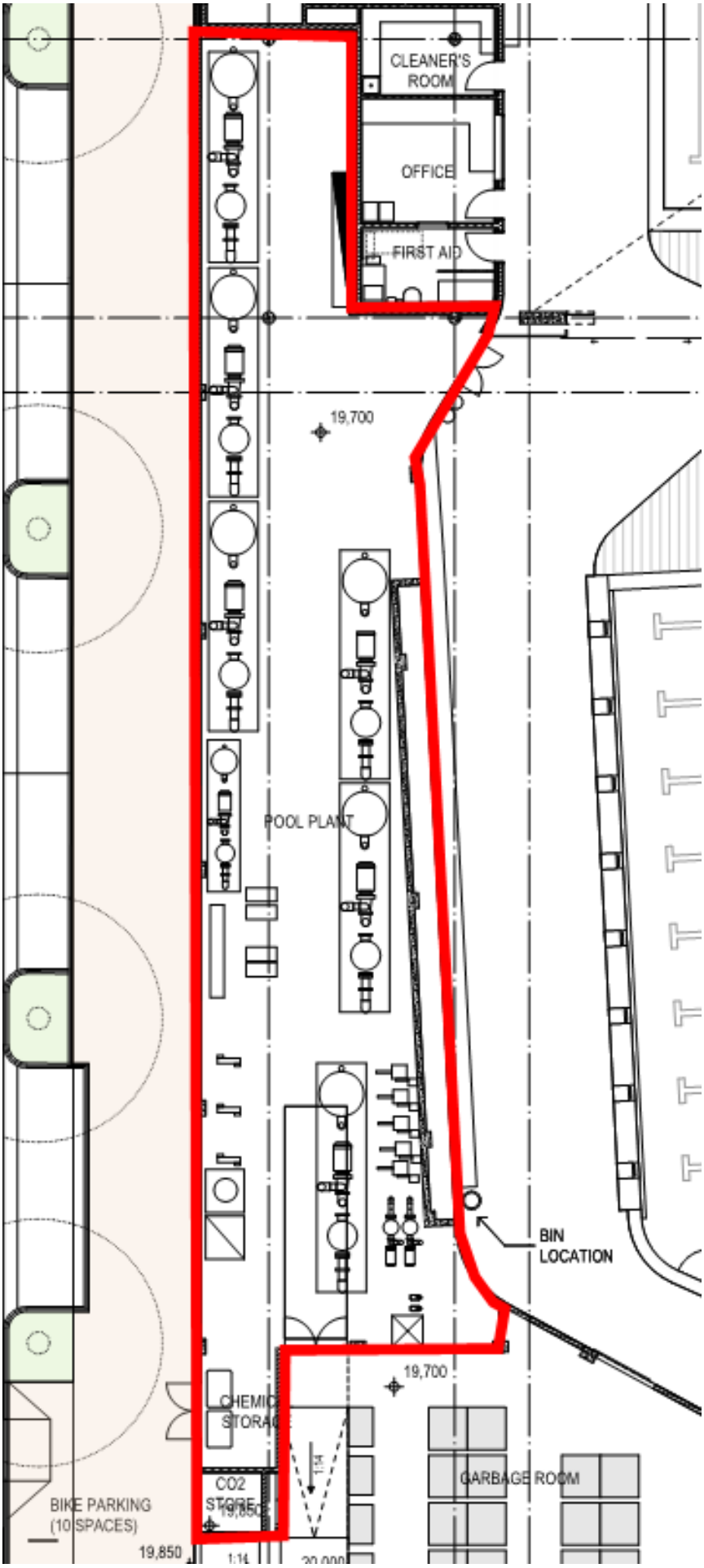
STAFF AMENITIES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FIRST AID
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GARBAGE ROOM
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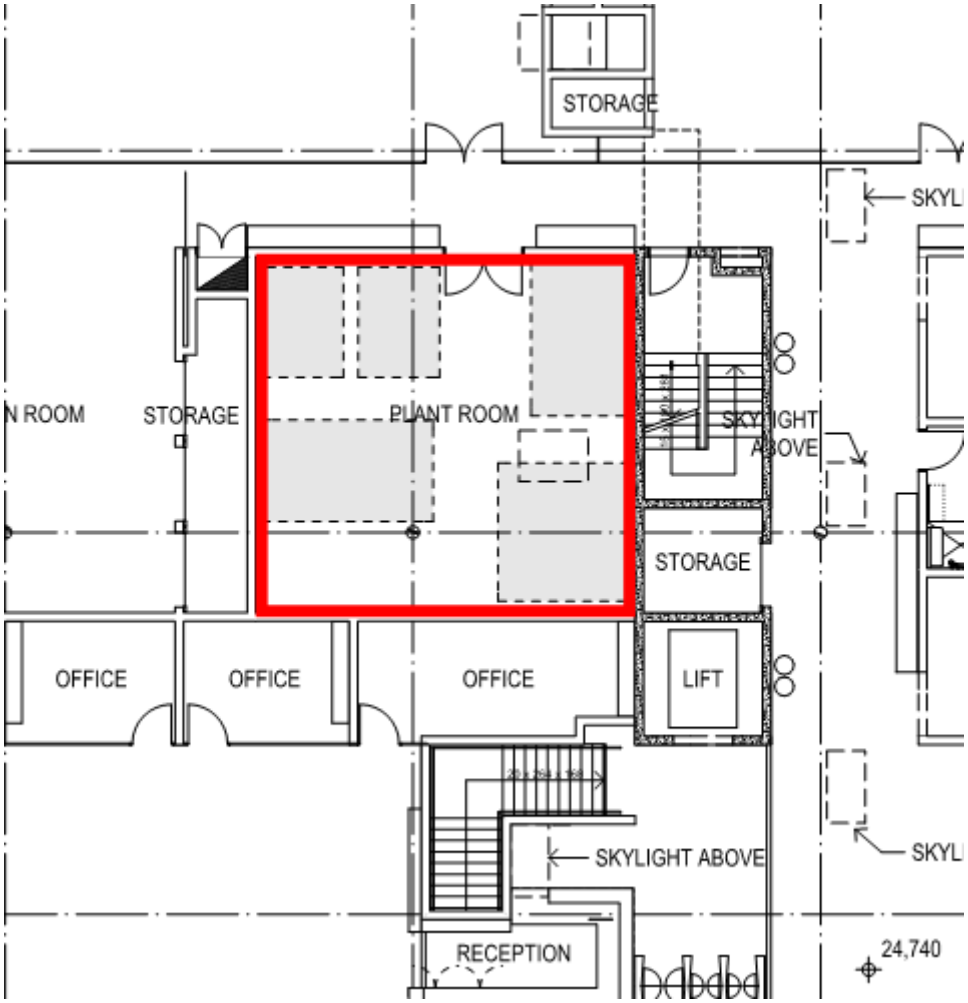
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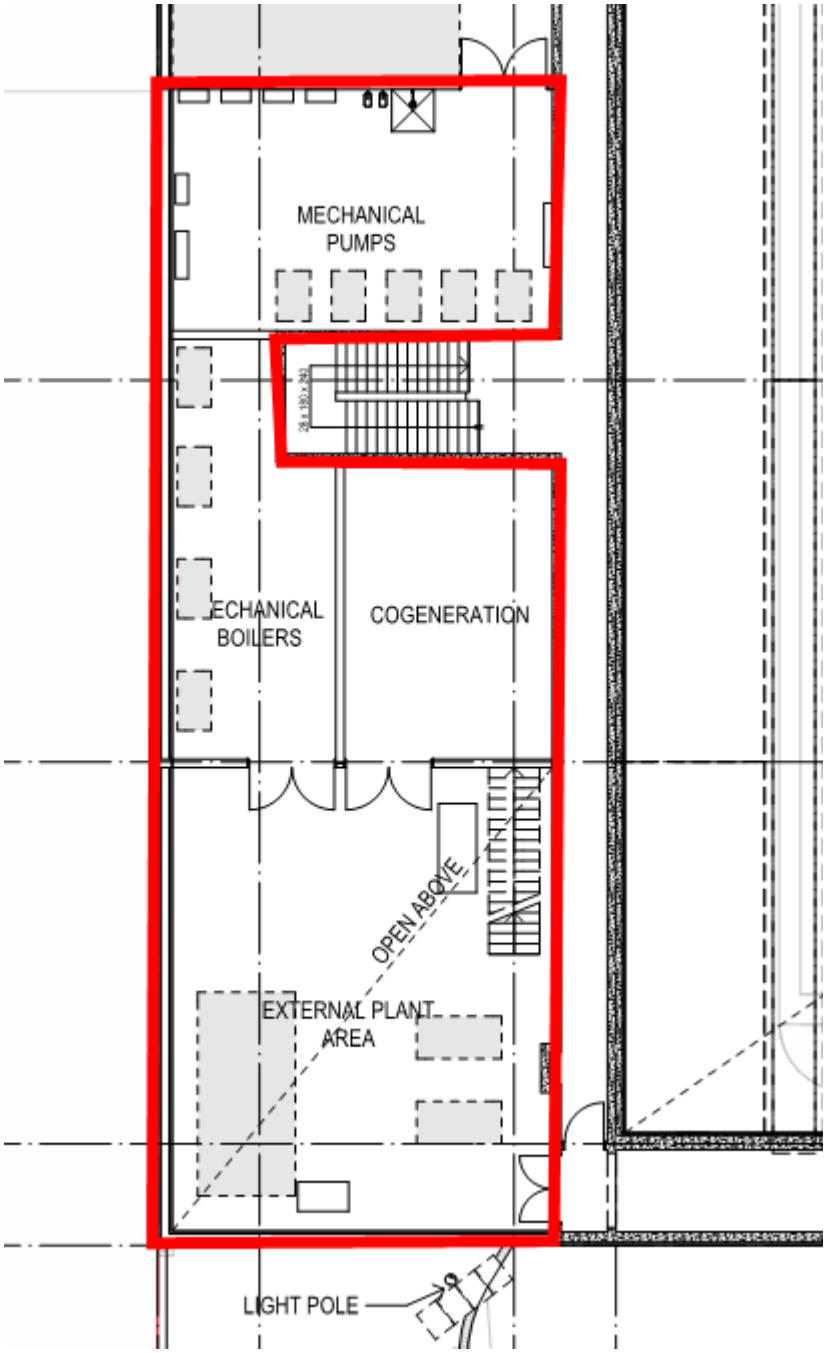
MECHANICAL
PUMPS
ECHANICAL
BOILERS
COGENERATION
OPEN ABOVE
EXTERNAL PLANT
AREA
LIGHT POLE

Energy Efficiency Report

C16113 Gunyama Park Aquatic and Recreation Centre (GPARC)

City of Sydney

Prepared for

Andrew Burges Architects /
Grimshaw

30 May 2016

Reference: 14001

Revision: 03

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1. Introduction

1.1 Purpose of Document

The purpose of this report is to outline the Energy Efficiency considerations and initiatives proposed for the Gunyama Park Aquatic and Recreation Centre project. The report has been prepared on behalf of Andrew Burges Architects and Grimshaw for submission with the Development Application. The development is located within the Green Square redevelopment precinct and will transform an existing industrial site into a vibrant community building and parkland.

This document is to be read in conjunction with the architectural design documents by Andrew Burges Architects, specific consultant reports prepared for the project and City of Sydney planning documents.

1.2 Project Description

The project involves the establishment of a new aquatic and recreation centre and community parkland which will include the following facilities:

- Outdoor 50m heated lap pool and leisure water area;
- Indoor 25m program pool;
- Indoor leisure pool;
- Hydrotherapy pool;
- Crèche;
- Park and outdoor synthetic multipurpose sports field, outdoor fitness station, outdoor BBQ areas and outdoor playground;
- Health and fitness Centre; and
- Café.

The development is located in Alexandria which forms part of the Green Square Town Centre redevelopment by the City of Sydney Council.

1.3 Reference Documents

This report has been prepared in reference to the following documents:

Document Reference	Document Name	By	Revision
ARC-DA-011	Site Plan	Andrew Burges Architects & Grimshaw	A
ARC-DA-012	Site Plan Stage 1		A
ARC-DA-101	Basement Plan		A
ARC-DA-102	Ground Floor Plan		A
ARC-DA-104	First Floor Plan		A
ARC-DA-105	Main Roof Plan		A
ARC-DA-201	Elevations Overall		A
ARC-DA-301	Sections Overall		A
	BCA Assessment Report	BCA Logic	
	Energy Scoping Study	Surface Design	03

2. Environmental Performance Objectives

2.1 City of Sydney Requirements

The City aims to maximise environmental performance in its capital works projects. This project must meet environmental targets listed in the City of Sydney's Environmental Management Plan, Sustainable Asset Management Policy 2006 and 2030 Vision. The project team's response to the 2030 vision for this project is shown in Table 1.

Table 1: Project Response to City of Sydney 2030 Objectives

City of Sydney 2030 Target	Project Response	Proposed Project Target
70% reduction of 2006 emissions by 2030	The project did not exist in 2006 and the emissions produced would exceed this reduction target	20% reduction emissions against the project benchmark
70% electricity produced by trigeneration by 2030	Cogeneration is proposed only which will produce electricity to GPARC building and park and provide heating to pools	No target is proposed at this stage as it is subject to further development
30% electricity by renewables by 2030	Photovoltaics are proposed to the aquatic and recreation Centre roof area	5% electricity to be via photovoltaics for the GPARC building only. A 96-150kW photovoltaic system is proposed to the GPARC building. The final size will depend on available roof space and PV panel efficiencies
100% local energy generation by 2030	Local energy generation is to be limited to renewables for this project at this stage	5-10% electricity for the GPARC building to be via photovoltaics and cogeneration plant and is subject to further design development
No reliance on coal-fired electricity by 2030	Alternative forms of electricity would need to be sourced in future stages of this project	No target
Zero increase in 2006 mains water by 2015	Additional demands to the site may exceed 2006 levels	No target
10% mains water consumption reduction of 2006 levels by 2030	Mains water consumption is being reduced through: – Efficient fixtures and fittings – Efficient pool filtration systems – Rainwater capture and reuse – HVAC System	20% reduction in potable water usage for fixtures and fittings compared to Green Star benchmarks 15% reduction in potable water usage for pool water compared to project benchmark
30% of water demand through recycling using local sources by 2030	Rainwater capture and reuse is to be adopted however the 30% target is not likely to be met due to potable water consumption of the pool	10% of water demand met through rainwater harvesting and recycling OSD tank and connection to Recycled Stormwater Network at South Sydney Hospital Site for irrigation, toilet flushing and pool makeup
50% reduction in stormwater pollutants by 2030	The site stormwater system is to be designed to meet Best Practices for stormwater management	50% reduction in stormwater pollutants by 2030
66% resource recovery of municipal waste by 2014	This initiative relates to residential waste and is not applicable to this project	Not applicable

City of Sydney 2030 Target	Project Response	Proposed Project Target
76% recovery of construction waste by 2014	Construction wastes are to be significantly diverted from landfill and reduced	Minimum 90% of all construction wastes are to be diverted from landfill
63% resource recovery of commercial waste by 2014	This initiative is for the facility management. The aquatic and recreation centre and park is being deigned to incorporate recycling bins that promote resource recovery	50% resource recovery of municipal waste by 2014
50% increase in current canopy cover by 2030 and 70% by 2050	The parkland covers more than 50% of the site which is currently mainly hardscape	50% of the site to be landscaped

2.2 Energy Efficiency

A specific energy efficiency strategy in design and operation has been developed for this project to address a number of the environmental performance objectives above. Section 3 describes this strategy in detail. The Gunyama Park Aquatic and Recreation Centre (GPARC) building is targeting a certified Green Star Design & As-built v1 rating with the Green Building Council of Australia and this rating will assist in delivering energy efficient building performance.

2.3 Other Sustainable Design Measures and Strategies

To meet the other environmental performance objectives for the project listed above, a number of environmental initiatives are proposed to achieve the required sustainable outcomes throughout its lifecycle. These initiatives include:

Management

- Implementation of Environmental Management Plan and system for the duration of the demolition and construction stages;
- Implementation of Waste Management Plans in construction stage with diversion from landfill target at least 90%;
- Implementation of Operational Waste Management with goals to reduce wastes and landfill wastes

Indoor Environment Quality

- Natural daylighting of interior spaces;
- Daylight Glare Control to exterior glazing through building overhangs;
- Efficient lighting that provides visual comfort for occupants;
- Promotion of External Views to exterior environment and surrounding parklands;
- Catering for ideal Internal Noise Levels within the indoor environments;
- Use of Low Volatile Organic Compounds throughout construction for paints, adhesives, sealants and carpets;
- Use of products with reused Formaldehyde content;
- Implementation of Mould Prevention strategies for the pool hall.

Transport

- Provision of Cyclist Facilities and promotion of links to Public Transport networks;
- Development of Travel Access plans to provide recommendations to upgrades to existing public transport networks of bus networks and cycleways to Sydney Buses and City of Sydney Cycleway groups;
- Limited car parking to the site to promote alternative transport

Water

- Promotion of Potable Water Efficiency through efficient fixtures and reuse of rainwater;
- Stormwater Water Management practices across the parkland and within the building;
- Water Meters linked to BMCS to track and monitor water use;
- Reuse of captured rainwater for toilet flushing, pool water makeup and irrigation

Materials

- Use of steel and concrete with reduced environmental impacts;
- Use of Forest Stewardship Council certified Timbers only;
- Precedence to products with Third Party Certifications and EPDs;
- A Lifecycle Assessment of the GPARC building has been conducted during the early design stages of the project which has assisted in developing environmental standard targets for materials and energy operation

Ecology

- Protection of local fauna where appropriate,
- Transformation of the existing industrial site into viable parkland for the community

Emissions

- Mechanical refrigerants used in the project are to have zero Ozone Depleting Potential
- Implementation of energy efficiency initiatives to reduce greenhouse gas emissions of the development in operation

3. Implementation of Energy Efficiency

3.1 Environmental Performance Objective

The following environmental performance objectives apply to City of Sydney infrastructure projects:

1. 70% reduction of greenhouse gas emissions by 2030 (based on 2006 levels)
2. 70% electricity produced by trigeneration by 2030
3. 30% electricity by renewables by 2030
4. 100% local energy generation by 2030.

3.1.1 Project Response

To each of the above energy targets the project response is as follows:

70% Reduction in Greenhouse Gas Emission

The project did not exist in 2006 and as such any emissions produced from this development would exceed the reduction targets that need to be met. As such the project has developed a different energy efficiency target to reduce Greenhouse Gas Emissions by 20% compared to precedent projects and other existing aquatic centres and parklands.

70% Electricity produced by Trigeneration

The project will not include a trigeneration plant. A cogeneration plant will be provided which will produce heating for the pools to the Gunyama Park Aquatic and Recreation Centre (GPARC) building and electricity to the park and building. The cogeneration plant has been estimated to provide around 500kW of heating for the pools with the primary purpose to produce electricity as direct output to the park and GPARC building and heat as by-product.

30% electricity by renewables by 2030 and 100% local energy generation by 2030

The project will incorporate Photovoltaic array and Cogeneration plant to assist in this objective. However, based on preliminary energy assessments of the GPARC energy consumption, any cogeneration and photovoltaics systems would not be able to meet the 30% renewable target or 100% local energy generation due to the operational energy demand of aquatic centre buildings.

3.2 Energy Efficient Initiatives

The following initiatives are proposed to improve energy efficiency of the GPARC building in operation.

3.2.1 Passive Design

The project design incorporates passive measures such as the use of building overhangs to shade glazing along the east and west elevations. The solid roof elements are proposed to be highly insulated to reduce heat loss from the building and the incorporation of a high performance rooflight will provide solar heating to the pool hall during winter months to reduce heating demands within the building. This rooflight will also provide benefit of provide natural daylighting during daylight hours which will reduce the reliance on artificial lighting and reduce operational energy consumption.

3.2.2 Ventilation Systems

The following energy efficiency strategies are proposed to be incorporated into the design of the ventilation systems:

- Exhaust systems to change rooms are to operate under time clock to minimise energy consumption when unoccupied;
- All ventilation systems are to be linked to the BMCS system to identify leakages, equipment faults and system inefficiencies;

- Air is to be provided into the Pool Hall at low velocity, reducing overall fan energy consumption;
- A heat recovery unit is to be designed to the ventilation plant to extract heat from warm extracted air during winter. It is estimated that this will result in approximately 40% savings of overall heat required each year to the pool hall area.

3.2.3 Mechanical Air Systems

No cooling systems are proposed to the GPARC building pool hall or hydrotherapy pool areas. A heating system will be provided only. This will reduce operational energy of the building during summer months. Localised cooling systems are proposed to only limited spaces of the GPARC building to deal with additional loads in summer months to maintain temperatures within preferred comfort zones.

The heating and cooling systems shall only be provided to the project specific areas summarised below:

- Split systems are proposed to staff room, meeting rooms, pool operations room and first aid room;
- Chilled and heated water fan coil units with central heating plant to crèche, level 1 fitness studio and gymnasium areas;
- Hydronic ducted system to pool hall and change rooms.

The zoning of split systems will be based on specific room sizes and each area will have independent on/off and full temperature control to reduce consumption when unoccupied. Heat pump and heat recovery type condenser units shall be used to increase system efficiency and minimise energy consumption.

Temperature sensors are to be located in each space where Fan Coil units will be located to monitor spaces and adjust the plant as required. The sensors are to interface with the BMCS to allow for external monitoring by building management and identify issues as they arise to minimise energy wastage. All units shall have a master on/off time clock control and temperature control.

The pool hall and change room Hydronic Ducted & Air Balance System will provide heating in winter only. Natural ventilation via ducted air shall be the primary method of conditioning during summer, thereby reducing energy consumption associated with cooling. Heating hot water from the hydronic system shall be reticulated to fan coil units in other spaces to make use of the heated water and minimise energy consumption.

All mechanical systems are to be connected to the BMCS to enable automatic control and monitoring to maintain the desired set points. This shall allow systems to operate at their optimum and minimise excessive energy use associated with over heating or over cooling the spaces.

3.2.4 Building Management Control System

A Building Management Control System (BMCS) shall control, monitor and manage building services. The system is to be comprised of a dedicated web server and graphical operator interface to allow Building Management to access the system. The system is to be integrated with all services and standalone services. The BMCS will be a tool to manage the building's performance and provide real time-data, alerts and controls to adjust the mechanical systems. In the event of a fault or failure of the BMCS, an alarm shall be raised as the system identifies major failures.

The tracking and monitoring of the building's systems shall enable building management to observe consumption data and recognise faults in a timely manner. High energy use activities may be pinpointed from data collection allowing opportunities for improvement.

3.2.5 Lighting

The GPARC building's lighting system shall incorporate occupancy sensors installed in appropriate locations to minimise energy consumption when spaces are unoccupied. Additional lighting control systems to be implemented within the building to promote energy efficiency include:

- Lighting zoning to be based on functional spaces. PIR sensors are to be located within the circulation areas and individual rooms to reduce operation of lights when not required
- Individual switches and timers to all meeting rooms and staffrooms to ensure lights can be switched off when not in use.
- Gym areas are to be time clock controlled

- All light fixtures include an addressable system that is to be linked to the BMCS

The exterior lighting shall be as efficient as possible however this is subject to security requirements around the parkland, main building areas and functional requirements for the sports field to provide events at night. The use of LED exterior lighting shall be adopted where possible and feasible for functional reasons.

3.2.6 Cogeneration Plant

The GPARC building is proposed to include a gas engine-based cogeneration system in the order of 200-260kW. The plant is to be located on the southern Level 1 plantroom. The unit is proposed to operate on a time clock, operating for 15 hours per day (7am to 10pm). The system shall read the incoming power from the transformer supply to analyse the capacity requirements at any particular time to ensure output does not exceed electrical requirements.

During times when power imported from the network exceeds 50% of the unit's rated capacity, the cogeneration system will start up and supply the centre. Should the load drop to below 50% of the rated capacity, the unit will shut down and power will be drawn from the grid only. This design shall ensure the unit is operating only at its optimum level at all times.

3.2.7 Photovoltaic System

A 96-150kW photovoltaic system is to be installed to the roof of the GPARC building. The final size will depend on available roof space and system efficiencies. This will provide an alternative energy source to the centre and supply a portion of base load electricity supply to the GPARC building. The final photovoltaic array size is subject confirmation of the final roof availability and PV panel efficiencies.

3.2.8 Responsible Use and Management

- A Building Users' Guide (this guide) is distributed to improve the occupant's understanding of the building's intended mode of operation and the potential energy savings behind the design intent
- Sub-metering is to be provided within the building for substantive energy uses in the building which will include light and power sources
- Reporting of energy consumption to be in accordance with City of Sydney reporting and audit requirements as per remote metering protocol.
- Energy efficient lighting with electronic ballasts shall be installed for all fluorescent fittings. LED lighting options are to be explored for all areas where feasible and to reduce maintenance costs for lighting. All lighting shall be installed to be easily accessible for maintenance.

3.3 Operational Energy Impact

The operational energy consumption of this development is considered to have a high impact on the total lifecycle impact of this development. This is due to the life span of the building and hours of operation. A preliminary lifecycle assessment study has been conducted by Edge Environments who concluded that the greatest opportunity to reduce the project impacts is through a reduction in the operational energy consumption of the development.

3.3.1 Project Response: Benchmarking Study

The GPARC building will be benchmarked against existing aquatic and recreation centres and the parkland areas will also be benchmarked against other comparable facilities for its energy use to develop operational management strategies.

A preliminary benchmarking assessment of the GPARC building against existing centres has been conducted and is summarised below. Data from the following four (4) existing benchmark projects has been collected:

- Ian Thorpe Aquatic Centre (March 2012 – Feb 2013)
- Victoria Park pool (July 2013 – June 2014)
- Andrew Boy Charlton Pool (July 2013 – June 2014)
- Leichhardt Park Aquatic Centre (July 2013 – June 2014)

The following table outlines the main features of each centre in comparison to the proposed Green Square Aquatic Centre.

Table 2: Benchmark Centres Comparison

Project	Outdoor Pools	Indoor Pools	Other Features	Electricity Consumption (kWh/year)	Gas Consumption (GJ/year)
Ian Thorpe Aquatic Centre	-	Leisure Pool, 85kL, 30°C Indoor Program Pool, 117kL, 32°C 50m Main Pool, 1,560kL, 26.5°C	Café Sauna Health & fitness centre Indoor Car Park	2,002	3,400
Victoria Park Pool	50m Main Pool, 1,840kL, 26°C Toddler Pool, 30kL, 30°C	-	Café Crèche Health & fitness centre	638	2,464
Andrew Boy Charlton pool	50m Leisure Pool, 1,800kL 28°C Toddler pool, 144kL	-	Cafe	217	3,389
Leichhardt Pool	50m Olympic Pool 27°C Dive Pool 27°C Mushroom Pool 27°C	18m Program Pool, 31°C Toddler Pool, 31°C Hydrotherapy Pool, 31°C	Café Crèche Health & fitness centre	2,938	9,145
GPARC Building	Leisure Pool, 280kL, 28-30°C 50m pool, 1,976 kL, 26-28°C	Leisure Pool, 55kL, 28-30°C 25m Program Pool, 1,264 kL, 28-32°C Hydrotherapy Pool 200kL, 30-36°C	Café Health & fitness centre Crèche	-	-

The following chart outlines the annual electricity and gas usage for all benchmark centres normalised to the estimated total pool volume for each centre:

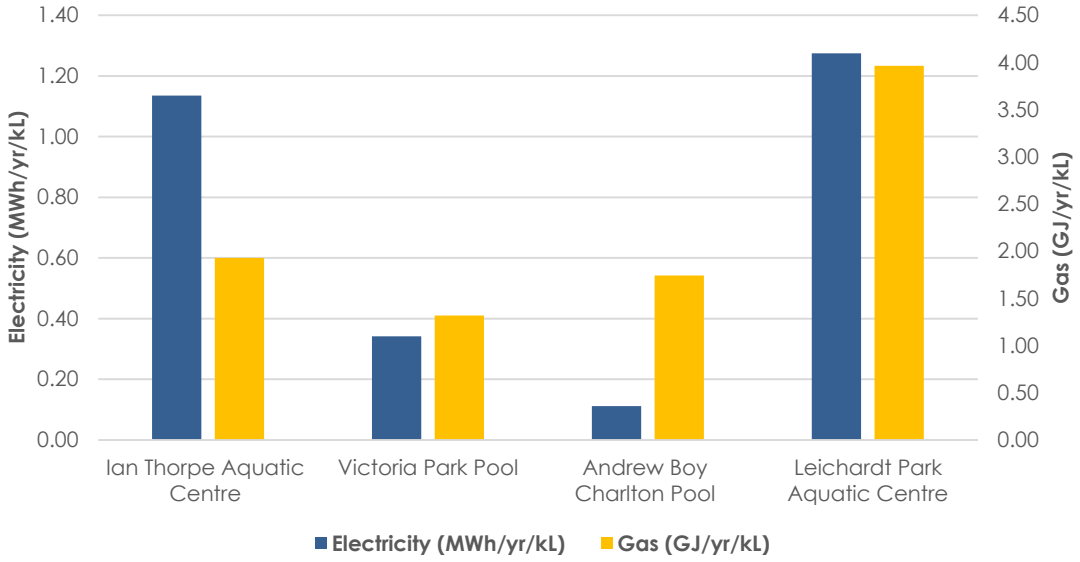

Figure 1: Annual normalised electricity and gas usage for benchmark centres

Two possible benchmarks have been established based on the above projects which most closely represent the mix of pools proposed for the GPARC building:

- **Benchmark 1**: Ian Thorpe Aquatic Centre + Victoria Park Pool
- **Benchmark 2**: Leichhardt Park Aquatic Centre

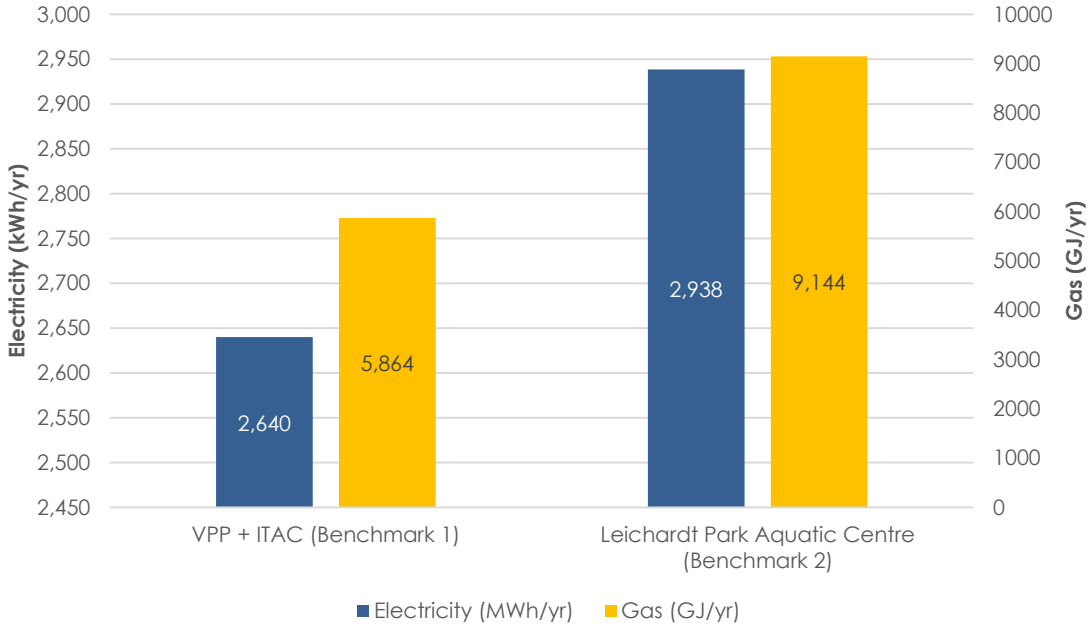

Figure 2: Existing Centres Benchmark Electricity and Gas Consumption

The energy breakdown based on the two Benchmark projects is presented below in Figure 3.

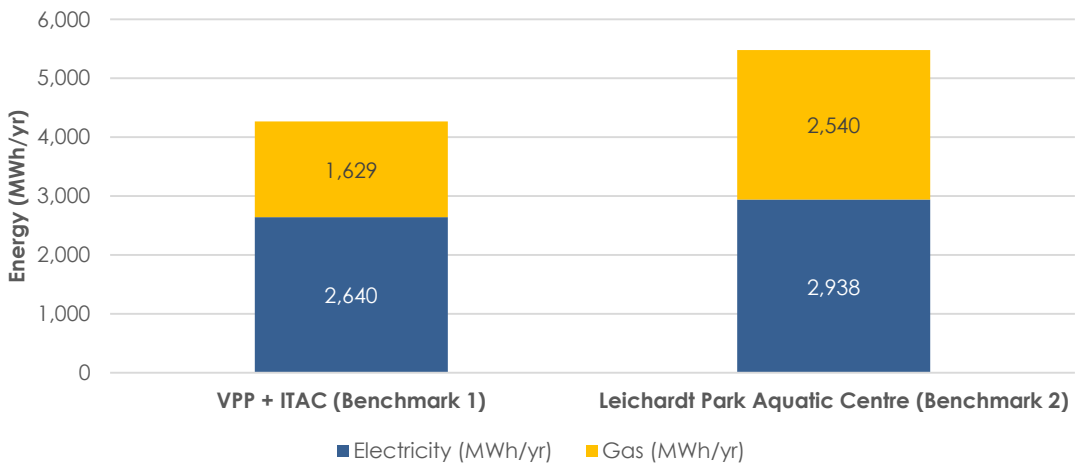

Figure 3: Energy Breakdown for Benchmark Centres

Due to the varying centre sizes, pool temperatures, facilities provided and hours of operation, the benchmarks based on the benchmark centres have a number of limitations, including:

- The specific building form and layout of the GPARC building is not considered. Factors such as building fabric properties, daylighting and shading will have a significant impact on how the centre is used and performs;
- Health and fitness centre energy is included in both Ian Thorpe Aquatic Centre and Victoria Park Pool data sets and cannot be separated. The benchmarks above therefore includes an allowance for two health and fitness centres;
- Operational profiles of all centres differ to the expected hours of operation of GPARC;
- Specific pool temperatures have not been considered;
- Mechanical conditioning and ventilation systems vary in both system type and size;
- Pool sanitation equipment is not known at this stage and has not been considered.

3.3.2 Predictive Energy Assessment of GPARC

An assessment of the operational energy consumption of the GPARC facility will be conducted during the next stages of the project to develop a building fabric design strategy and finalise the energy efficiency initiatives to be implemented for the project. It is anticipated that this study will identify elements that may impact the operational energy, and where possible appropriate initiatives will be identified for the building fabric design and the services design.

3.3.3 Management Practices

It is proposed that in operation of the facility, the following strategies will be implemented:

1. A comprehensive minimum 12 month Building Tuning process will be implemented on completion of the GPARC facility
2. A Building Management Control System for the GPARC building and exterior lighting to the parkland will operate and be readily available for monitoring by City of Sydney Facility Management staff. The BMCS will be linked to energy meters throughout the development to report on all energy use as required
3. Training is to be completed for Facilities Management at Practical Completion to explain how to best operate the plant, equipment and fixtures for optimum performance of the building

3.3.4 Education of Occupants, Community and Staff

The project is to demonstrate to the community the value of sustainable design. Renewable and alternative energy sources will include photovoltaics installed on the roof and a cogeneration plant.

It is anticipated that the educational value of the project will be achieved through displays to the public. Public displays will provide information on the energy efficiency of the building and its operation on renewable and alternative energy sources, and how this is contributing to savings in greenhouse gas emissions on a daily and annual basis.

For facility managers and operational staff, the building energy and water use will be readily available through the building management system, and training of the staff will be conducted to inform them of how to best operate this building to be as energy efficient as possible.

Environmental Management Plan

C16113 Gunyama Park Aquatic and Recreation Centre (GPARC)

City of Sydney

Prepared for

Andrew Burges Architects /
Grimshaw

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06	30 May 2016	Updates to Section 2.3	BK	BK	GM	GM	BMD	

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1. Introduction

1.1 Purpose of Document

The purpose of this Plan is to outline the design and construction planning environmental measures to be implemented in the delivery of the Gunyama Park Aquatic and Recreation Centre (GPARC) project. The development is located in Green Square and will become a unique public facility. This document is to form part of the Development Application of the project and is to act as a guide for the remaining stages of the project on items of:

- Construction site management;
- Materials management and use;
- Energy and water use;
- Reporting; and
- Standards and codes that apply

This document is to be read in conjunction with the architectural design documents by Andrew Burges Architects, the Energy Efficiency Report prepared for the project and City of Sydney planning documents.

1.2 Project Description

The project involves the establishment of a new aquatic and recreation centre and community parkland which will include the following facilities:

- Outdoor 50m heated lap pool and leisure water area;
- Indoor 25m program pool;
- Indoor leisure pool;
- Hydrotherapy pool;
- Crèche;
- Park and outdoor synthetic multipurpose sports field, outdoor fitness station, BBQ areas and outdoor playground;
- Health and fitness Centre; and
- Café.

1.3 Background

This site specific Environmental Management Plan has been prepared with regards to the New South Wales Government Environmental Management Systems Guidelines, Edition 3 dated 2013 and the project Energy Efficiency Report.

This EMP sets guidelines for the development, assesses the site environmental risks specific to this project and describes how these will be managed. Further, roles and responsibilities relevant to the management of the site's environmental risks have been defined and the reporting requirements for the client detailing the environmental performance of the project.

1.4 Reference Documents

This plan has been prepared in reference to the following documents:

Document Reference	Document Name	By	Revision
ARC-DA-011	Site Plan	Andrew Burges Architects & Grimshaw	A
ARC-DA-012	Site Plan Stage 1		A
ARC-DA-101	Basement Plan		A
ARC-DA-102	Ground Floor Plan		A
ARC-DA-104	First Floor Plan		A
ARC-DA-105	Main Roof Plan		A
ARC-DA-201	Elevations Overall		A
ARC-DA-301	Sections Overall		A
	BCA Assessment Report	BCA Logic	

1.5 Definitions & Acronyms

For the purposes of this plan the following definitions apply:

CEMP – Construction Environmental Management Plan

EMP – Environmental Management Plan

ESC – Erosion and Sediment Control

Environmental Impact - Any activity your organisation carries out that has the potential for a positive or negative interaction (impact) with the environment.

GPARC – Gunyama Park Aquatic and Recreation Centre

WHS - Work, Health and Safety Policy

Health and safety hazard - An objective and measurable thing or action that poses a threat to a safe and stable state. Hazards may be dormant, potential, active or mitigated.

IAQ – Indoor Air Quality

WELS – Water Efficiency Labelling and Standards Scheme

1.6 Legal and Other Requirements

The following environmental legal and other requirements apply to this project and should be consulted by the delivery team as required:

- Environmentally Hazardous Chemicals Act 1985
- Protection of the Environment Operations Act, 1997
- Waste Avoidance and Resources Recovery Act 2001 No 58
- Waste Avoidance and Resources Recovery Strategy 2007
- Waste Minimisation and Management Act 1995
- National Waste and Minimisation & Recycling Strategy Wastewise Guidelines
- City of Sydney Policy for Waste Minimisation in New Developments 2005
- Protection of the Environment Operations Act, 1997
- Catchment Management Authorities Act 2003
- Protection of the Environment Operations Act, 1997
- Rivers and Foreshore Improvement Act 1948
- Managing Urban Stormwater- Soils & Construction Protection of the Environment Operations Act, 1997
- Australian Standard AS2436: 1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- The City of Sydney Code of Practice for Construction Hours / Noise 1992
- The City of Sydney Building Site Noise Code- Schedule 1
- Protection of the Environment Operations Act, 1997

- Sydney Water Trade Waste Agreement
- Protection of the Environment Operations Act, 1997
- City of Sydney Council - Tree Protection Order
- City of Sydney Council - LEP / DCP
- Heritage Act 1977 (Section 140)
- Flora and Fauna Assessment and Test of Significance Future Gunyama Park and Green Square Aquatic Centre Site by Ecologist Consultants Australia

2. Environmental Management Targets

2.1 Objectives

This environmental management plan defines the environmental objectives and measures to be implemented by the design and construction team in the delivery of the Gunyama Park Aquatic and Recreation Centre (GPARC). The objectives of this EMP have been prepared in response to the City of Sydney Strategic Directives and are:

1. **Noise Minimisation:** includes the disturbance caused by noise and vibration within the building space and to other buildings within the local community.
2. **Air Quality:** minimisation of dust and odours produced as a result of the development for future occupants, and to maintain air quality for contractors on site working within the space.
3. **Minimisation of materials use:** the project has been designed with consideration of reuse and reconditioning to reduce the amount of materials consumed. Other materials management initiatives have been specified that include diversion from landfill and management during construction. This will ensure that there are fewer wastes generated on site compared to standard benchmarks.
4. **Energy Management:** includes the management of energy during construction and in operation. Initiatives implemented in the design will enable energy reporting and appropriate management of energy uses within the building. Further tracking and reporting of energy uses in construction will enable the delivery team to manage site practices and encourage efforts to be more energy efficient.
5. **Water Management:** includes the management of onsite water points and existing stormwater systems. Implementation of a site ESC plan is to ensure that there is no contamination of waterways or at street level throughout the associated refurbishment works. Spill risks are to be reduced and management techniques employed to ensure no contamination to waterways
6. **Flora and Fauna:** Minimise the disturbance of and impact to known flora and fauna inhabiting this region of Sydney South, specifically bird and mammal species commonly found in suburban environments. Grey-Headed Flying-Foxes, which visit the site to feed on flowers and fruit of trees present, are the only fauna species observed of conservation significance.

2.2 Existing Environment and Site

The site at present is the product of human activity and is mostly paved with concrete and asphalt. The previous uses of the site were industrial uses and activities. The majority of land surrounding the site is currently also industrial and is being and will be developed to residential, with notable flora and fauna habitat areas in the vicinity being Woolwash Park (60m from the site), The Australian Golf Course (~600m) Moore Park Golf Course (~800m), Centennial Park (~1.63km) and Sydney Park (~1.67km) as defined by Ecological Consultants Australia in the Flora and Fauna Report – Gunyama Park and Green Square Aquatic Centre.

The environmental management plan for this development is to set a range of environmental objectives that are to be met in the delivery of the project to meet the needs of the future uses and local community whilst protecting the local environment.

2.3 Overall Environmental Targets

The Gunyama Park Aquatic and Recreation Centre building is to be designed to meet the following environmental objectives in addition to the City of Sydney's Environmental Performance Objective below.

Design and Delivery

The Gunyama Park Aquatic and Recreation Centre building is being designed to achieve a 5 star Green Star Design and As-built v1 rating. To achieve these ratings the project is required to meet the following minimum score:

Minimum **60 points** for a **5 star rating**. This rating is considered "Australian Excellence"

To achieve the minimum 60 point score, the following methodology is proposed across the different environmental categories of Green Star:

Table 1: Project Response to City of Sydney 2030 Objectives

Green Star Category	Points Available	Proposed Project Target
Management	14	14
Indoor Environment Quality	17	9
Energy	22	5.8
Transport	10	9
Water	12	7
Materials	14	6
Land Use & Ecology	6	6
Emission	5	3
Innovation	10	10
Total	**110**	**69.8**

Construction Stage

A number of objectives have been set for the construction stage:

- Diversion of at least 90% of all construction and demolition wastes from landfill
- 20% improvement in operational energy efficiency compared to existing building benchmarks based on greenhouse gas emissions comparison
- 15% improvement in operational water efficiency compared to existing building benchmarks

City of Sydney Objectives

The City aims to maximise environmental performance in its capital works projects. This project is to align with the environmental targets listed in the City of Sydney's Environmental Management Plan, Sustainable Asset Management Policy 2006 and the City's 2030 Vision. The projects response to the City's 2030 vision at this stage of the project is outlined in Table 2 below:

Table 2: Project Response to City of Sydney 2030 Objectives

City of Sydney 2030 Target	Project Response	Proposed Project Target
70% reduction of 2006 emissions by 2030	The project did not exist in 2006 and the emissions produced would exceed this reduction target	20% reduction emissions against the project benchmark
70% electricity produced by trigeneration by 2030	Cogeneration is proposed with some electricity output	No target
30% electricity by renewables by 2030	Photovoltaics are proposed to the aquatic and recreation centre roof area	Minimum 5% electricity to be via photovoltaics. A 96-150kW photovoltaic system is proposed to the GPARC building. The final size will depend on the available roof space and PV panel efficiencies.
100% local energy generation by 2030	Local energy generation is to be limited to renewables for this project at this stage	Minimum 5% electricity to be via photovoltaics and cogeneration plant.
No reliance on coal-fired electricity by 2030	Alternative forms of electricity would need to be sourced in future stages of this project	No target
Zero increase in 2006 mains water by 2015	Additional demands to the site may exceed 2006 levels	No target
10% mains water consumption reduction of 2006 levels by 2030	Mains water consumption is being reduced through: – Efficient fixtures and fittings – Efficient pool filtration systems – Rainwater capture and reuse – HVAC System	20% reduction in potable water usage for fixtures and fittings compared to Green Star benchmarks 15% reduction in potable water usage for pool water compared to project benchmark
30% of water demand through recycling using local sources by 2030	Rainwater capture and reuse is to be adopted however the 30% target is not likely to be met due to potable water consumption of the pool	10% of water demand met through rainwater harvesting and recycling OSD tank and connection to Recycled Stormwater Network at South Sydney Hospital Site for irrigation, toilet flushing and pool makeup
50% reduction in stormwater pollutants by 2030	The site stormwater system is to be designed to meet Best Practices for stormwater management	50% reduction in stormwater pollutants by 2030
66% resource recovery of municipal waste by 2014	This initiative relates to residential waste and is not applicable to this project	Not applicable
76% recovery of construction waste by 2014	Construction wastes are to be significantly diverted from landfill and reduced	Minimum 90% of all construction wastes are to be diverted from landfill

City of Sydney 2030 Target	Project Response	Proposed Project Target
63% resource recovery of commercial waste by 2014	This initiative is for the facility management. The aquatic and recreation centre and park is being deigned to incorporate recycling bins that promote resource recovery	50% resource recovery of municipal waste by 2014
50% increase in current canopy cover by 2030 and 70% by 2050	The parkland covers more than 50% of the site, which is currently mainly hardscape	50% of the site to be landscaped

The environmental strategies adopted in the design of this development are discussed in the following sections including the construction strategies to be implemented.

2.4 Environmental Strategy

The following environmental strategies are to be implemented during the construction stage and during building occupation to reduce the impact on the environment:

2.4.1 Construction Management

A comprehensive hazardous materials survey is to be carried out on the project site to ensure the health and safety of workers during construction and occupants upon the building's completion. Contractors shall refer to this document before commencing works on site and any works that relate to contamination that may be present on the site.

A comprehensive Construction Environmental Management Plan is to be completed prior to demolition stage commencing and all contractors are to be inducted into this plan. This plan is to be documented and implemented by the Head Contractor. The plan should include measures that relate to materials management, noise impacts, air quality, water and energy management

2.4.2 Waste Management

A Demolition and Construction Waste Management Plan is to be documented and implemented on site by the Head Contractor which will outline all measures for reducing wastes, recycling and management of wastes. During the construction stage of the project monthly waste reporting to the client is to be completed by the Head Contractor. This is to form part of the materials tracking and management of the development.

The goal is to divert greater than 90% of all construction and demolition wastes for the project from landfill.

2.5 Indoor Air Quality

The following strategies have been implemented to reduce the impact on the environment during the construction stage and during building occupation:

2.5.1 Material Specifications

There are a number of material specifications required to be met for the project to reduce environmental impacts. Any refrigerants used in the project are to have an Ozone Depleting Potential (ODP) of zero. Low Volatile Organic Compound (VOC) materials are to be adopted during the construction to reduce environmental impact. These include adhesives, and sealants, ceiling and wall coverings, paints, carpets and flooring products.

Composite Timber products used throughout the construction are to have a low formaldehyde emission of E1 or less.

These initiatives are to result in materials and resource savings for the development in design and delivery stage of the project.

2.5.2 Construction Management techniques

It is proposed that any ductwork delivered to the site shall come with plastic protection to ensure dust and debris does not enter the duct during the construction stage and transportation of the materials. Further, all equipment shall be delivered with protection to prevent the damage of the equipment during transportation or temporary storage on site.

2.6 Materials Strategy

To reduce life cycle impacts of the development, the following strategies have been implemented, reducing the impact of materials during the construction stage.

2.6.1 Materials Tracking and reporting

Materials tracking and reporting shall be undertaken by the Head Contractor in the delivery of the project. The contractor shall identify all materials to be used on the project prior to commencement, and track the usage of specific items through construction to completion for timbers, paints, adhesives, sealants, flooring, pipework, cabling and formwork. Regular reporting on the materials used shall be undertaken with the consultant team.

2.6.2 Lifecycle Assessment

A lifecycle assessment has been conducted on the project during the schematic design stage to develop a materials procurement strategy for the project. Outcomes from this study have identified that priority shall be provided to suppliers with verified Environmental Product Declaration and those companies willing to disclose the environmental impacts associated with their products.

2.6.3 Timbers

Recycled timbers are to be encouraged on the project where possible and are to be drawn from the City of Sydney timber stockpile. Any new timber to be used on the project is to hold relevant Forest Stewardship Council certification and Chain of Custody documentation.

These initiatives are to result in materials and resource savings for the development in the design and delivery stage of the project.

2.7 Energy Strategy

The following strategies are to be implemented to enhance the energy efficiency during building operations:

2.7.1 Operational Guides

A Building Users' Guide is to be developed and distributed to the operators of the Aquatic and Recreation Centre to improve the occupant's understanding of the intended mode of operation and the potential energy savings behind the design intent.

2.7.2 Metering and Reporting

Sub-metering shall be provided in the building for all substantive energy uses which will include light and power sources. Meters are to be linked to Building Management System (BMS) that will identify faults, and raise alarms on plant operation as required. It is intended that the BMS will be used for energy reporting and audit requirements.

2.7.3 Daylighting of Interior Spaces

Natural daylighting is to be incorporated into the indoor spaces to reduce the reliance on artificial lighting and improve line of sight to outdoor areas. To reduce the reliance on artificial lighting during the day, the pool hall includes skylights and a glazed façade towards the outdoor pool as well as extensive glazing towards Joynton Avenue.

2.7.4 Lighting Design

Energy efficient lighting with electronic ballasts shall be installed for all fluorescent fittings. LED lighting options are to be explored for all areas where feasible to reduce maintenance costs for lighting. All lighting shall be installed to be easily accessible for maintenance and the Aquatic and Recreation Centre lighting design shall incorporate appropriate zoning and occupancy sensors to reduce operation of lights when not required.

Efficient exterior lighting to the park is to be provided, and where possible, operation of park lighting will be controlled by timers to reduce operational energy.

2.7.5 Building Envelope Design

The Aquatic and Recreation Centre building will be insulated to National Construction Code 2016 provisions and all glazing is to be specified to be efficient for the proposed building operational intent to reduce reliance on mechanical heating systems.

2.7.6 Alternative Energy Sources

The provision of onsite renewable energy sources include photovoltaic cells (96-150kW) and a cogeneration unit (200-260kW). The PV cells will produce electricity and the cogeneration plant will produce both electricity and heat for heating pool water.

2.7.7 Building Services

The pool hall of the Aquatic and Recreation Centre building is not expected to include mechanical cooling system as it is anticipated to be naturally ventilated and cooled during summer months. A heating system will be provided only. Localised cooling systems are proposed to only limited spaces of the GPARC building to deal with additional loads in summer months to maintain temperature within preferred comfort zones.

These initiatives are to result in energy savings for the development in operation and ensure that there is responsible use of energy throughout the construction stage of the project. We refer to the Energy Efficiency report prepared for the development which details the energy efficient provisions in more detail.

2.8 Water Strategy

The project is targeting water efficiency performance which includes reducing overall potable water consumption by around 25% against comparable benchmark projects.

This is to be achieved through:

- Appropriate filtration systems for the pool
- Rainwater harvesting and reuse within the aquatic and recreation centre for toilet flushing, pool water makeup and on site irrigation
- Appropriate selection of water fixtures
- Appropriate storage and management of site stormwater and flood management

The following strategies have been adopted to reduce water consumption throughout the development:

2.8.1 Efficient Fixtures

Water efficient WCs, taps and shower heads are to be installed to minimise potable water consumption. The following minimum WELS ratings and maximum flow rates are proposed:

Water Closets – minimum 4 WELS rated with average flush of 3.5 L

Tapware – minimum 6 WELS rated with flow rate between 4.5 – 5.0 L/min

Showerheads – minimum 3 WELS rated with flow rate between 7 – 7.5 L/min

Cleaners taps – minimum 3 WELS rated with flow rate between 5.0 – 6.0 L/min

2.8.2 Rainwater harvesting and Stormwater Management

Rainwater is to be collected from the Aquatic and Recreation Centre roof and hardscape areas around the site. This water will be stored in a 100kL tank on the site. The collected rainwater will be used for toilet flushing and pool water makeup. A stormwater irrigation tank is proposed to be installed below the parkland to supply irrigation of the turfed areas of the site and the landscape building berms surrounding the aquatic and recreation centre.

2.8.3 Construction Management

During construction stage, an Erosion and Sediment control plan shall be implemented by the Head Contractor which is to manage all overland water flows from the site and identify all Best Management Practices (BMPs) to be implemented on the site. These measures are to include items such as silt traps, silt fences, sausages around drains and stormwater systems, vehicle tyre cleaning stations etc.

These initiatives are to result in water savings for the development in operation and during construction.

3. Monitoring & Implementation

3.1 Overview

This Section of the EMP defines how this plan is to be implemented for the project, including roles and responsibilities for the project team and reporting requirements.

3.2 Roles & Responsibilities

The roles and responsibilities of all parties involved in the delivery of this project are nominated as follows:

ESD Consultant

The ESD Consultant is responsible for documentation of the project EMP and maintaining this document through to the Development Application Stage.

Other Consultants

The Consultant design team is to implement the initiatives as defined in this document and the Energy Efficiency Report as part of their obligations under this Environmental Management Plan. Consultants shall ensure specifications and schedules reflect the intended design initiatives and that nominated materials and products comply with the environmental targets.

Any deviations from these requirements for any specified materials are to be approved by the client or superintendent before substitutions are made.

Head Contractor

The Head Contractor is responsible for documentation and implementation of the Construction Environmental Management Plan (CEMP), ESC and Waste Management Plans. In documenting the CEMP, the contractor shall refer to this EMP and design documents prepared by the Design team.

If the Contractor proposes deviations to the initiatives as defined in this document or any of the design documents, then approval is to be sought with Design Team or Superintendent before substitutions or changes are made.

The Head Contractor shall be responsible for management and reporting to the client of the environmental issues during the construction stage of the project. The EMP is to be developed in accordance with New South Wales Government Environmental Management Systems Guidelines.

Construction Site Personnel

All site personnel will be responsible for managing their individual environmental impacts and working in accordance with the systems and procedures implemented across the refurbishment. This will be detailed by the Head Contractor in the CEMP and implemented by the Site Manager during the site induction.

Notwithstanding this, there are several tasks that have been identified as critical to the environmental management of the project.

3.3 Reporting

Design Stage

This EMP document forms part of the reporting to be conducted by the Design team. This document is to be reviewed by the design team in preparation of their design documents and where any anomalies between this document and the proposed design occurs, this is to be resolved with the Architect. It is the responsibility of the consultant team to report on the environmental issues to be addressed in the design and make adjustments as required with the client.

Through submission of this plan to City of Sydney, the reporting of environmental issues has been addressed by the design team.

Construction Stage

The EMP shall be monitored, audited and reported by the Head Contractor to the City of Sydney at regular intervals of the project during the construction stage. EMP inspection checklists are to be

developed and completed for issue to the City of Sydney on a monthly basis to report on the progress of meeting the targets and goals of this development.

Other records that are to be maintained as above include:

- Inductions and training records
- Safe work method statements
- Non-compliance reports
- Work site Inspection reports
- Audits of the WHS, EMP and Environmental Management System of the company
- Accreditation of the Head Contractor Environmental Management System to ISO14001 requirements

Site Audits

Auditing is a fundamental tool in ensuring that construction stage works pose no threat to the health, safety and welfare of employees, the health and safety of others within those workplaces, or the condition of the local environment. Audits are to be conducted on a regular basis as follows:

- Daily site safety inspections contained in the Project Supervisors site diary, covering all aspects of site from general conditions and emergency procedures to temporary lighting, scaffolding, permits to accidents and incident reporting.
- Weekly WHS walks with results reported to the WHS Department through the WHS consultation statement arranged per individual sites, hazard reporting, safety committee meetings, site based walks with site employees.
- WHS Monthly Inspections conducted by Head Contractor's WHS Supervisor – these audits are to ensure that all project teams are using the available materials effectively and ensuring a high WHS standard on site.

All audits are conducted in line with the guidelines under AS/NZS 4801:2001 self-assessment checklist and AS/NZS ISO 14001:2004 Environmental management systems, and records should be maintained on site.

GUNYAMA PARK AQUATIC & RECREATION CENTRE

132-140 JOYNTON AVENUE, ZETLAND, NSW

HERITAGE IMPACT STATEMENT



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Frontispiece: Detail from Higinbotham and Robinson's map of Waterloo LGA of the mid 1880s with the area of the subject development circled

Source: City of Sydney Archives

1.0 INTRODUCTION

1.1 THE BRIEF

The following report has been prepared to accompany a development application for the redevelopment of a large site to the east side of Joynton Avenue, Zetland, NSW (132-140 Joynton Avenue) for the Gunyama Park Aquatic and Recreation Centre.

This report has been prepared for Grimshaw Architects and Andrew Burges Architects, the architects for the development for the City Of Sydney.

1.2 BACKGROUND

The City of Sydney has committed to redeveloping the site for an aquatic centre and park within the Green Square Urban Renewal Area. In 2014 the City of Sydney issued a brief for a design competition for the development. Grimshaw Architects were selected as the head consultants for the project in association with Andrew Burges Architects.

The site sits within the Epsom Park Precinct, a 19 hectares area within the Green square Urban Renewal Area. The area is currently light industrial but will become a predominantly mixed-use zone. Green Square, to the north, is currently being developed into a high density, residential suburb. The development will include the formation of new roads around the development site including Zetland Avenue to the north, George Julius Avenue to the east and Rose Valley Way to the south.

There will also be a new community precinct on the former Royal South Sydney Hospital Site directly across Joynton Avenue from the development site (not part of this development).

1.3 LIMITATIONS AND TERMS

The terms *fabric, conservation, maintenance, preservation, restoration, reconstruction, adaptation, compatible use and cultural significance* used in this report are as defined in the Australia ICOMOS *Burra Charter.*

1.4 METHODOLOGY

This report was prepared in accordance with the *NSW Heritage Manual* "Statements of Heritage Impact", "Assessing Heritage Significance Guidelines" and the City of Sydney Council guidelines for the preparation of heritage impact statements. The philosophy adopted is that guided by the Australia ICOMOS Burra Charter 2013.

1.5 PREVIOUS REPORTS

There have been numerous studies on the surrounding area related the development of Green Square and the former South Sydney Hospital Site. The following reports related to the development of the area and pertinent to this report include:

City Plan Heritage, *Royal South Sydney Hospital Site Conservation Management Plan*, dated June 2011

City of Sydney, *The Streets of Green Square, The Past Shapes and Future*, dated 2013

Heritage Data Form – Former Joseph Lucas Plant/Larke Hoskins/Honda Building, 146-158 Joynton Avenue, Zetland

Other reports issued post tender include:

Rod Howard Heritage Conservation Pty Limited, *Victoria Park, South Dowling Street, Zetland, Heritage Assessment Survey*, dated 1998

Ed. Karskens, Grace & Melita Rogowsky, *Histories of Green Square*, dated 2004 a joint study by the City of Sydney and the University of New South Wales

City of Sydney, *Proposed Street and Park Names Justification*, undated analysis of the proposed and existing street names

City of Sydney, *The Streets of Green Square. The Past Shapes its Future*, undated summary of the history of the place

Urbis, *Heritage Impact Statement. - The Former Outpatients Building, Former South Sydney Hospital Site (FSSHS), Joynton Avenue, Green Square*, dated August 2014

Design 5 Architects, *South Sydney Hospital – Community Facilities, Heritage Assessment and Heritage Impact Statement*, dated October 2014

1.6 MASTERPLAN

The site is part of the Epsom Park Precinct of Green Square and has been the subject of a Masterplan:

Conybeare Morrison International, *Epsom Park Precinct Green Square Masterplan*, dated December 2009

The Masterplan contains the strategy for the development of the area including layouts, streets, building types and heights. The subject site has been identified for a park and recreation facility.

1.7 ABORIGINAL AND ARCHAEOLOGICAL ASSESSMENT

The development has been the subject of a separate aboriginal and archaeological assessment:

Dominic Steele Consulting Archaeology, *Aboriginal and Archaeological Assessment, Gunyama Park and Green Square Aquatic Centre*, dated March 2015.

(Steele Assessment)

The finding and recommendations in the report are noted below.

1.8 INTERPRETATION STRATEGY

An Interpretation Strategy has been prepared for the project as a separate document.

1.9 AUTHORS AND ACKNOWLEDGMENTS

This report, including all diagrams and photographs, was prepared by John Oultram of John Oultram Heritage & Design, unless otherwise noted. Historical research was prepared by Nicholas Jackson. John Oultram Heritage & Design was established in 1998 and is on the NSW Heritage Office list of heritage consultants.

1.10 THE STUDY AREA

The study area is as follows:

	ADDRESS	LOT	DP
	132-138 Joynton Avenue, Zetland,	Lot 2	DP 850686
	140 Joynton Avenue, Zetland,	Lot 100	DP 1200645
	94-104 Epsom Road, Zetland,	Lot 101	DP 1200645
	106-116 Epsom Road, Zetland	Lot 1	DP 830870
	130 Joynton Avenue, Zetland	Lot 1	DP 850686

in the City of Sydney, Parish of Alexandria and County of Cumberland (Figure 1.1).

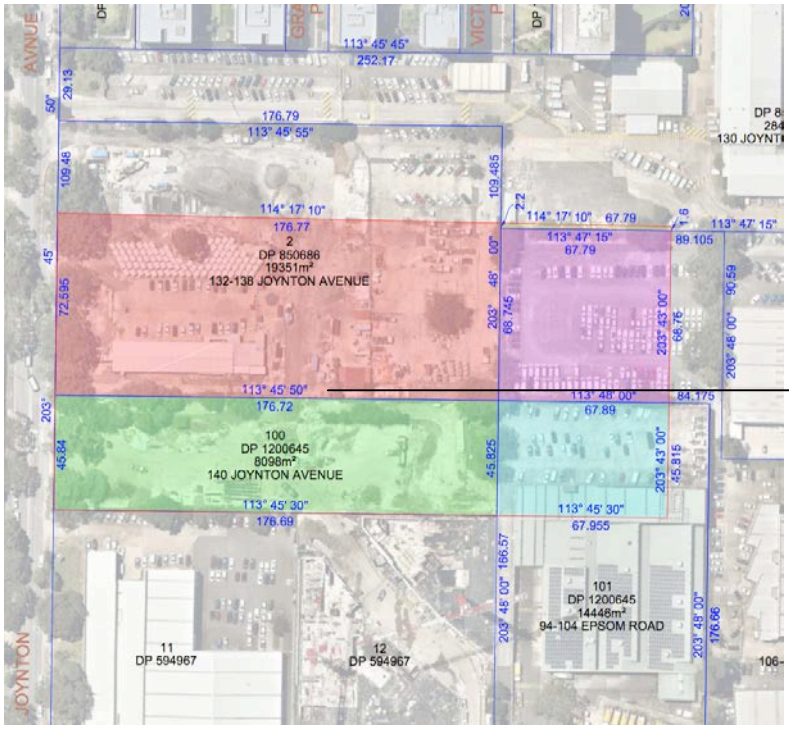


Figure 1.1 The Study Area

The development area is highlighted (coloured sections)

Source: Cardno Hard & Forester, Drawing No. 117244500 Rev. 05 - *Plan showing alignment identification and site areas Gunyama Park and Green Square Aquatic Centre Project*, dated April 2016

2.0 HISTORICAL DEVELOPMENT

2.1 INTRODUCTION

The historical background presents an overview of a period of over 200 years of non-indigenous development of an area of Sydney that was swampland first and in later years had recreational uses, then industrial, and now a mix of commercial and residential uses.

This development history is structured to provide an overview of the development of the precinct prior to c.1950, followed by a detailed history of each component of the site. Most of the information for the overview is drawn from the report prepared for Landcom in 1998 at the time of the replanning of Victoria Park.[1] The information provided in the component history is original research drawn from the planning records held by City of Sydney.

2.2 HISTORICAL OVERVIEW OF THE PRECINCT

2.2.1 Swampland

The low-lying area south of the Sydney CBD between Moore Park and the shore of Botany Bay in its natural state was a land of sand dunes, banksia scrub, and a myriad of creeks feeding large pools of water.

Little is known of the Aboriginal occupation of the area but the freshwater wetlands and sandhills of the Green Square area would have provided a rich storehouse of food including edible roots and tubers, fruits, nectar bearing flowers as well as fish, shellfish, platypus and water birds. It would have also been a source of identity and spiritual beliefs.

With the arrival of the British colonizers the area of Epsom Park precinct was within the Waterloo Swamp. To the west was another drainage system known as Shea's Swamp (discernible by Alexandra Canal today), to the east was the Lachlan Swamp (now the ornamental ponds of Centennial Park), and to the south the Botany Swamps (the Lakes Golf Course).

While the Botany and Lachlan Swamps developed into the source for Sydney's drinking water in the middle decades of the nineteenth century and their catchments were protected from pollutants while in that use, the Waterloo Swamp came into private ownership and became a locale for industries heavily reliant on water, such as fell-mongering and tanning. The water was pooled within a system of reservoirs known as the Big Waterloo Dam, the Little Waterloo Dam, Upper Dam, etc. The Joynton Road frontage of the subject site was part of the Big Waterloo Dam and the area to the east was part of Waterloo Swamp. The swampland remained until the early twentieth century when it was drained and filled. An account of the swamp around 1907 recorded it as:

'a scene of desolation. In the middle distance was a most dreary-looking swamp, almost wholly under water. Nothing more hopeless ever addressed the eye of the unimaginative man (with) … still water and the dank reeds ….'[2]

[1] Rod Howard Heritage Conservation Pty Ltd, 'Victoria Park, South Dowling Street, Zetland, Heritage Assessment Survey', prepared for Landcom, 1998 (Rod Howard 1998)
[2] Quoted in Rod Howard 1998, p.5

The name Waterloo was bestowed by Governor Macquarie to commemorate the British victory at the Battle of Waterloo in the Napoleonic Wars. The Waterloo Swamp derived its name from the area that was owned by Daniel Cooper and Solomon Levey from 1825. The Waterloo Estate contained 1,400 acres distributed across a region familiar now as the suburbs of Alexandria, Waterloo, Zetland, and Rosebery. When the area was incorporated in 1860 the new council adopted the name Waterloo.

Cooper and Solomon were emancipated convicts who by the 1820s were co-owners of a substantial mercantile, whaling, and banking empire that traded as the Waterloo Company. Levey returned to England in 1827, and was followed by Cooper in 1831. Levey died in 1833, and under his will left a share of his estate to his son, but issues concerning the estate took a number of years to resolve. In the early 1840s Daniel Cooper acquired sole ownership of his former business partners' real estate.[3] The Cooper family managed their lands in leasehold where it was disposed of at a low ground rental to lessees on long-term leases (usually 99 years).

The western and northern parts of the Waterloo Estate developed from the 1850s into an industrial zone with soap works, wool washes, breweries, a rope works, a pottery, and brickyard. Around the present day intersection of Epsom Road with Link Road (to the north of Dalmeny Avenue) stood George Anderson's extensive Rose Valley wool wash that commenced business in the 1860s.[4] The name Rose Valley is continued today in the suburb of Rosebery. The western length of Epsom Road (then so named) had been formed by the 1880s, possibly to provide access to Anderson's premises from Botany Road.

Elsewhere the southern and eastern parts remained undeveloped largely, but presumably there were small market gardens and dairies.

The suburb of Waterloo by the 1880s was very much confined to the northwest corner of the municipality. With the cheap ground rents, speculative developers opened up 'green field' sites for housing putting down streets, mostly in leasehold but also freehold. Around Hanover Street there was Victoria Town, a development by George Robert Whiting in 1879. There was also Zetland between Tilford and Portman Streets developed in 1885, the Salisbury and Chester estates between Hansard and Queen Streets were released in 1886, and across Botany Road were the Hill View and Beaconsfield estates between Johnson and Beaconsfield Streets also released in 1886.

[3] Broomham, R., 'The Coopers of Woollahra: Land Dealings on the Point Piper Estate 1820-1920', unpublished report for Woollahra Council, 2001
[4] 'Our Leading Wool Firms', Illustrated Sydney News, 9/1/1890, p.15

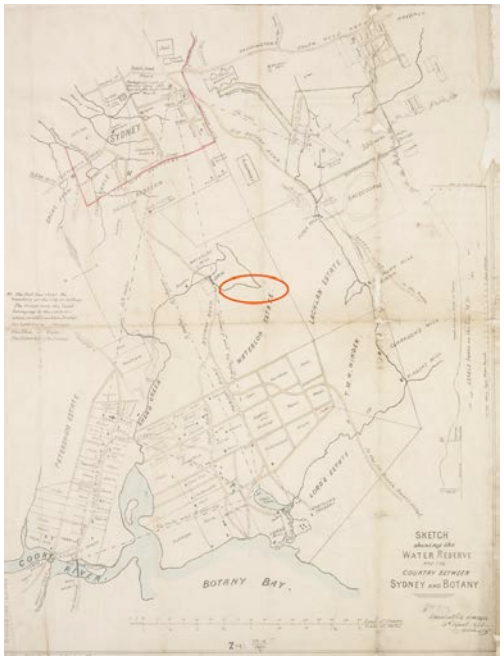


Figure 2.1 A sketch prepared by surveyor WH Wells showing the water reserve and the country between Sydney and Botany in 1850. The approximate area of the proposed development is circled

Source: State Library of NSW (M2 811.18/1850/1)



Figure 2.2 Detail from Higinbotham and Robinson's map of Waterloo LGA of the mid 1880s with the area of the subject development circled

Source: City of Sydney Archives



Figure 2.3 A watercolour by Samuel Elyard dated May 1873 of the industry and scrub encountered in the Waterloo Estate. Location was noted as 'Old Botany Road continuation of Bourke St.' 1873

Source: State Library of NSW (DGD 5 f.18)

2.3 VICTORIA PARK RACECOURSE

Development of the subject site commenced in 1907 with the purchase of 115 ½ acres for 14,467 pounds by Sir James Joynton Smith from the Cooper family. While leasehold had proved quite lucrative for the Cooper family in the nineteenth century, gradual changes in the taxation system from the mid 1890s placed a heavy financial burden on them as owners and in the 1900s and 1910s the Waterloo estate was broken up through subdivision in freehold, and conversion of leasehold to freehold.

Joynton Smith (1858-1948) was born in London as James John Joynton and arrived in Sydney around 1890. In the 1890s he managed hotels in the city and married into the Smith family of hoteliers and took the name Joynton Smith. By 1896 he had acquired the lucrative lease of the Imperial Arcade Hotel. In the 1900s he invested in horse racing tracks, firstly at Rockdale in 1901, at Forest Lodge (which became the Harold Park trotting ground), and finally at Zetland with the Victoria Park track. Joynton Smith had many other business interests including newspapers (*Smith's Weekly* and the *Daily Guardian*), and radio stations (2SB), and an active public life in being alderman, and mayor, of City of Sydney, and director/founder of charitable institutions associated with hospitals. He was also a MLC between 1912-1934.

Victoria Park was one of the numerous proprietary or pony racing tracks that operated in Sydney prior to the early 1940s. Within southern Sydney there were Rosebery, Kensington, and Ascot at Botany.

As distinct from the Australian Jockey Club that fostered interest in breeding and horsemanship with betting controlled by the Tattersall's Club, the proprietary tracks were run by businessmen with profit being the main motivation. On course betting through bookmakers was permitted and with more accommodating rules on the entrants, the courses provided very exciting entertainment.

The opening of Victoria Park followed the passing of the Gaming and Betting Act in 1906, which regulated some aspects of the running of the proprietary tracks - minimum length, licensing, and reduction in the number of meets. Joynton Smith had found the Forest Lodge (Harold Park) track could not meet these requirements and caused him to set up Victoria Park. As with Forest Lodge, the track at Zetland was serviced by a government tram service down in 1903 running down a section of Joynton Avenue.

Joynton Smith's purchase was fortuitous in there being a number of major land releases in the district at the time. Sited opposite Epsom Road and with a site area of 300 acres, the Town Planning Company of Australia Ltd released the Rosebery Estate in 1913. Rosebery was another of Richard Stanton's 'model' suburbs, but unlike Haberfield offered opportunity for both residential and industrial development. Across Dowling Street (and within the municipality of Randwick) was the Kensington Estate of 570 acres that dated originally from the late 1880s, but development only began in interest in 1909 following the purchase of the freehold by George Frederick Todman. To service this emerging populous South Sydney Hospital opened in 1913.

The track at Victoria Park was developed by draining part of Waterloo Swamp by a channel feeding into Sheas Creek. By the beginning of 1908 the new track was completed aside from the grandstand. The track took in the whole site, with all the principal features, grandstand, leger, stables, totalisator, etc. being located at the northwest corner beside Joynton Avenue throughout the operative years. The course was also used for flight displays, public events and community events. The track was closed in 1942 owing to the war emergency, and between 1942 and in late 1943 housed an ordinance unit of the Australian Army.

From 1945 Victoria Park was used as a training track by the AJC under lease, which had previously used Kensington (closed in 1940) and redeveloped in the post war years for what is now the University of New South Wales.

In April 1946 the freehold of Victoria Park was conveyed to Lord Nuffield[5] for 205,000 pounds. The AJC lease was to expire in 1948, but extensions were permitted through to August 1952.

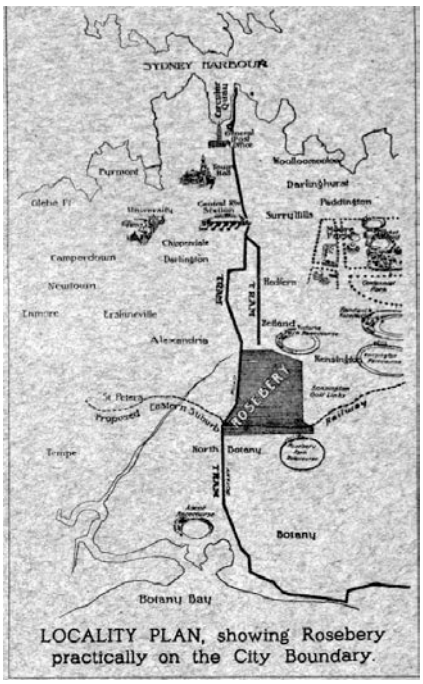


Figure 2.4 The proximity of the new suburb of Rosebery to the city was promoted in this sales brochure published in 1913. Its virtues were the tram link, the parklands of Moore Park, and the racetracks at Randwick, Zetland, Kensington, Rosebery, and Ascot

Source: National Library of Australia (Rosebery, the Town Planning Company of Australia Ltd, issued 1913)

[5] Torrens Title Vol. 4136 Fol. 228

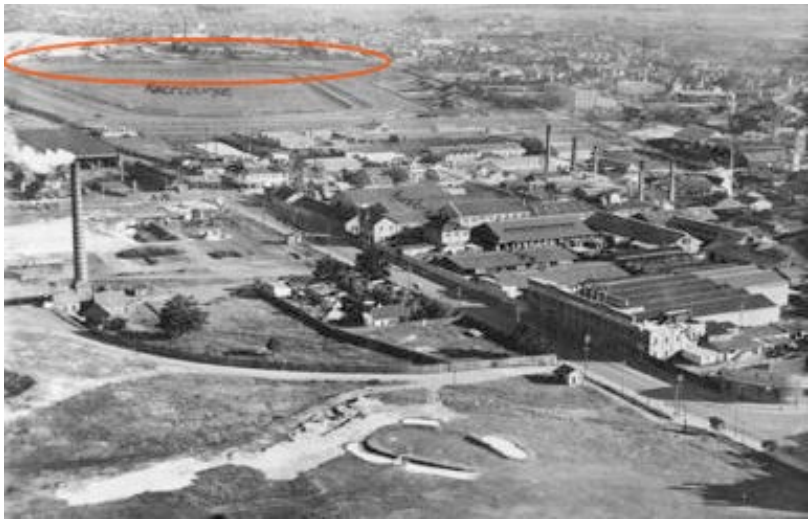


Figure 2.5 An oblique aerial view looking south across Moore Park to Victoria Park in the 1930s. The approximate location of the proposed development is circled

Source: City of Sydney Archives (CRS 538/360)

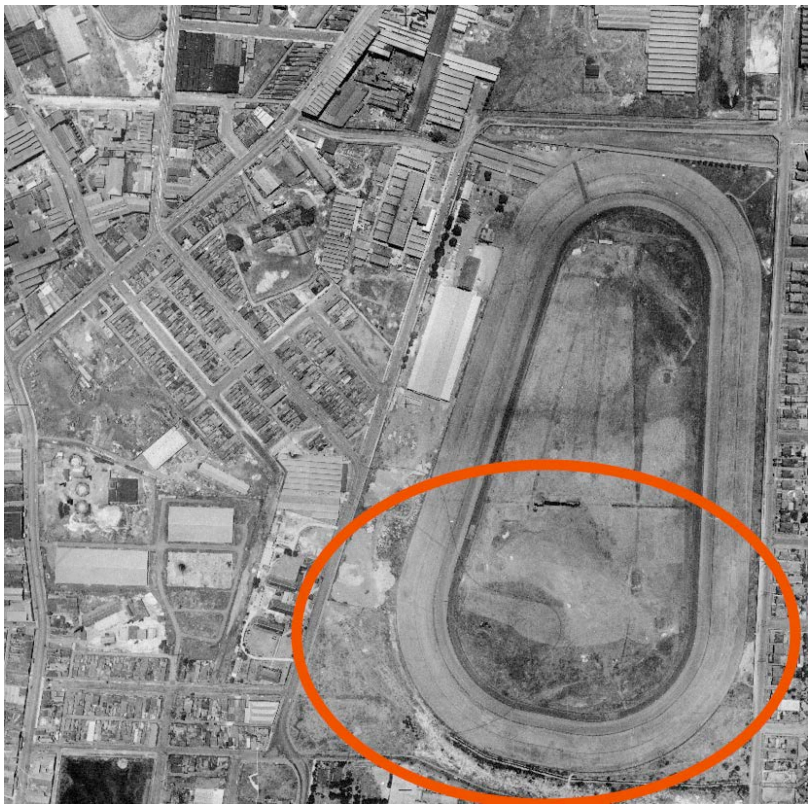


Figure 2.6 Aerial view of Victoria Park racecourse in 1948 (and then in use as a training track). A drainage channel is visible along the southern boundary, which seems to have been constructed in the 1920s. It was continued to cross Joynton Avenue in the 1950s. The approximate location of the proposed development is circled

Source: City of Sydney Archives (Sheet A014)

2.4 INDUSTRY AND COMMERCE

Lord Nuffield, born William Richard Morris Nuffield (1877-1963), was the founder and proprietor of Morris Motors Ltd. The first Morris cars went into production in 1913. An Australian branch of the company was incorporated in May 1945.

In 1952 the Victoria Park racecourse was subdivided. The northern part, with an area of 57 acres, was retained by Nuffield (Australia) Pty Ltd for its new car plant, and the southern third was subdivided to form eleven allotments. A new road, Link Road, was put through at the southeast corner, and O'Dea Avenue, named after Sydney Lord Mayor EC O'Dea, along the northern boundary was formed at the time.

The subject sites are located within the southern third of the racecourse where the allotments varied in area between two and nine acres. Being cleared sites in close proximity to the city and a resident workforce, the lots sold quickly and the precinct was developed over 1954-1955 with factories and warehouses. Many of the original owners were associated with the automotive trade inclusive of:

- Joseph Lucas (Australia) Pty Ltd, Lot 1, sales and service centre erected in 1955
- James N Kirby Holdings Pty Ltd, Lots 3 & 4, automotive factory erected in 1955
- Olympic Tyre and Rubber Co, Lots 2, 5 & 6, warehousing and offices erected in 1955

Other owners included The Distillers Company Ltd, Lots 8 & 9, warehousing, bottling plant, and offices erected in 1954

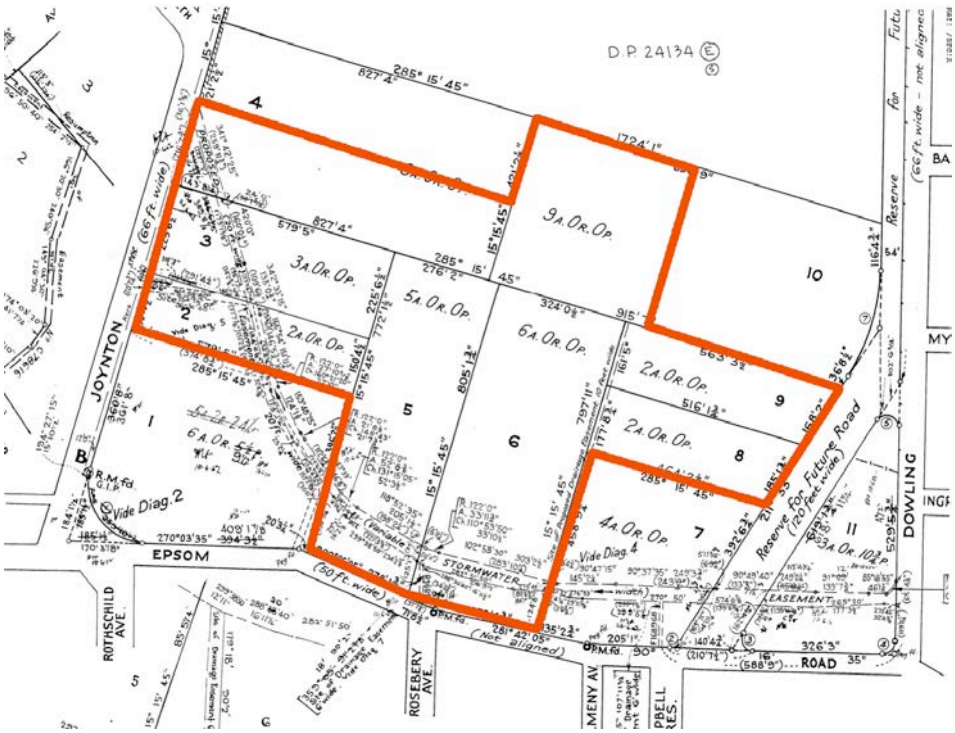


Figure 2.7 Detail from Deposited Plan 24134 with the original allotments that form the site of the proposed staged development (highlighted)

Source: Land and Property Information



Figure 2.8 Looking east along Epsom Road, around 1950. Within a decade the area depicted was fully developed with warehousing and factories. The site of the proposed development is at left of the photograph

Source: City of Sydney Archives (CRS 44/256)



Figure 2.9 Looking west along Epsom Road, around 1950. The site of the proposed development is at right of the photograph

Source: City of Sydney Archives (SRC5573)

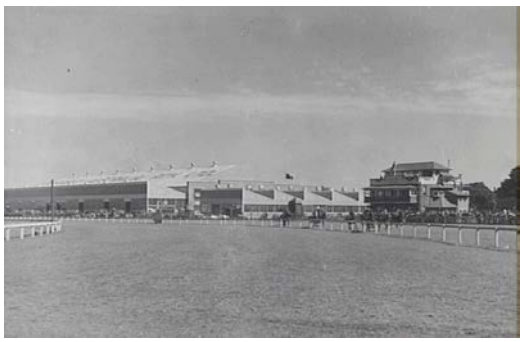


Figure 2.10 The old and the new in 1950. The brand new car assembly plant in the background and the soon to be removed vestiges of horse racing in the foreground

Source: City of Sydney Archives (SRC6872)

Nuffield's car plant in the northern half opened in 1950 while much of the infrastructure of the former racetrack was still standing. In the following years, the car plant developed from a factory where imported components were assembled locally to a fully fitted car manufacturing plant.

In 1952 Nuffield's English operations, which included the marques of Morris, MG, Riley, and Wolseley, merged with its rival Austin Motor Company to form the British Motor Corporation, with the Australian subsidiary being BMC (Australia). The beleaguered post war British car industry underwent further rationalisation in 1968 when BMC became part of the newly formed British Leyland Motor Corporation (BLMC). In 1974 BLMC restructured its Australian operations closing the Zetland plant and expanding its plant at Enfield. With the closure of the car plant, the site was sold to the Commonwealth and became a centralised supply centre for the Australian Navy.

The closure of the car plant was representative of a general contraction and rationalisation of industry in the 1970s within southern Sydney. This was inclusive of the now closed Australian Glass Works and Resch's brewery on South Dowling Street, and the WD and HO Wills tobacco factory on Todman Avenue, as well as countless smaller enterprises.

Commencing in the late 1990s the then owner of the former car plant, Landcom, instigated a series of planning investigations as part of the wider Green Square development, an area of 278 ha across four precincts within the established suburbs of Waterloo, Zetland, and Rosebery, with the former Victoria Park now being the Epsom Park precinct. Another major planning initiative of the time was the upgrading of South Dowling Street into a major arterial road linking the city with the airport and southern suburbs.

2.5 SITE COMPONENTS

2.5.1 Introduction

The proposed development is located within that part of the former Victoria Park racecourse subdivided in 1952. It comprised the following:

Street Address	Existing Lot/DP	Original Lot/DP	Owners to c.1980
132-138 Joynton Avenue	Lot 2 DP 850686	Lot 3 DP 24134	1954 James N Kirby Holdings Pty Ltd 1964 Sydney County Council
		part Lot 10 DP 24134	1952 Leyland Motors 1960 Sydney County Council
140-144 Joynton Avenue	Lot 2 DP 24134	Lot 2 DP 24134	1955 Olympic Tyre & Rubber Co Ltd
94-104 Epsom Road	Lot 5 DP 235181	Lot 5 DP 24134	1955 Olympic Tyre & Rubber Co Ltd

Street Address	Existing Lot/DP	Original Lot/DP	Owners to c.1980
106-116 Epsom Road	Lot 1 DP 830870	Lot 6 DP 24134	1955 Olympic Tyre & Rubber Co Ltd c. 1973 The Distillers Company Ltd
		Lots 8 & 9 DP 24134	1952 The Distillers Company Ltd
130 Joynton Avenue	Lot 1 DP 850686	part Lot 4 DP 24134	1952 James N Kirby Holdings Pty Ltd 1963 Sydney County Council

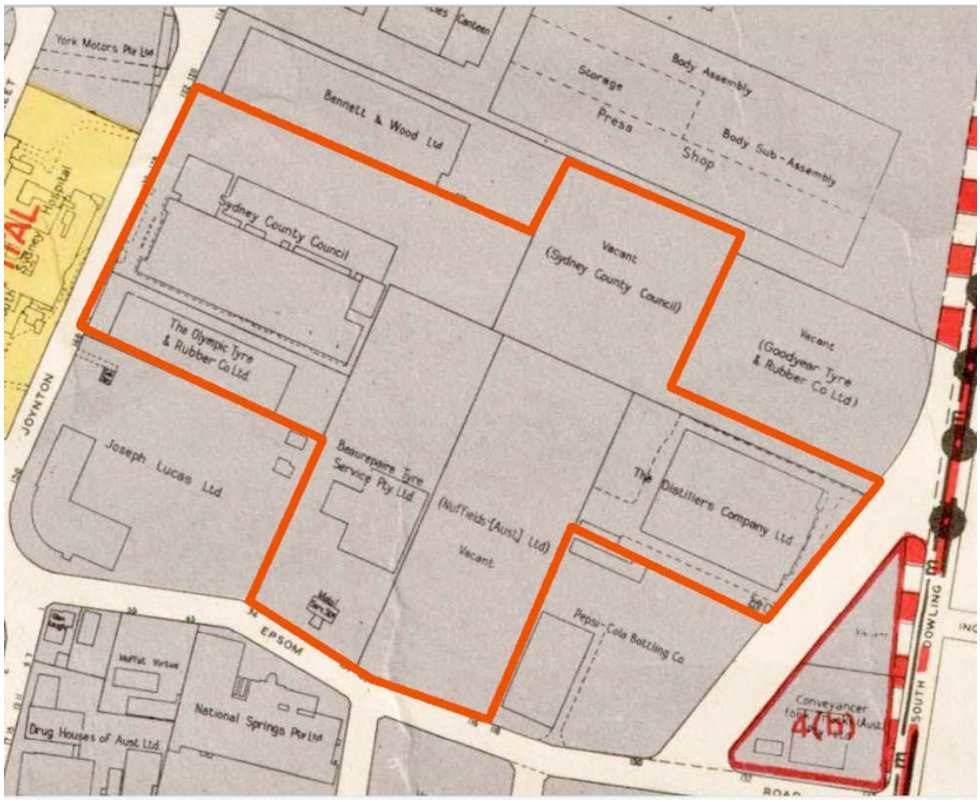


Figure 2.11 Detail from the City of Sydney Planning Scheme of 1971 showing the original allotments that form the site of the proposed staged development and state of development within

Source: City of Sydney Archives

2.6 130-138 JOYNTON AVENUE

2.6.1 James N Kirby Holdings

This site has frontage to Joynton Avenue and comprised Lot 3, the southern half of Lot 4, and the western half of Lot 10 in DP 24134. The eastern end of the site has frontage to Link Road that comprised original Lots 8 and 9 in DP 24134 and is discussed below.

Lots 3 and 4 were purchased by James N Kirby Holdings Pty Ltd between 1952 and 1954, while Lot 10 was originally owned by Leyland Motors. James N Kirby Holdings Pty Ltd was incorporated in 1946 being formed from a private business established by James Norman Kirby (1899-1971) in the 1920s as a manufacturer of automotive parts. James N. Kirby Holdings Pty Ltd also manufactured consumer goods such as refrigerators, washing machines, etc. for which there was an emerging market in the post war years.[6]

[6] www.kirbyfoundation.com.au

Within Lot 3 the company erected in 1955 a large factory for its automotive division, together was a detached powerhouse, at a cost of 160,000 pounds.[7] The architect was Francis Eugene Feledy (1904-1962), who designed most of the buildings for Lord Nuffield's car factory.

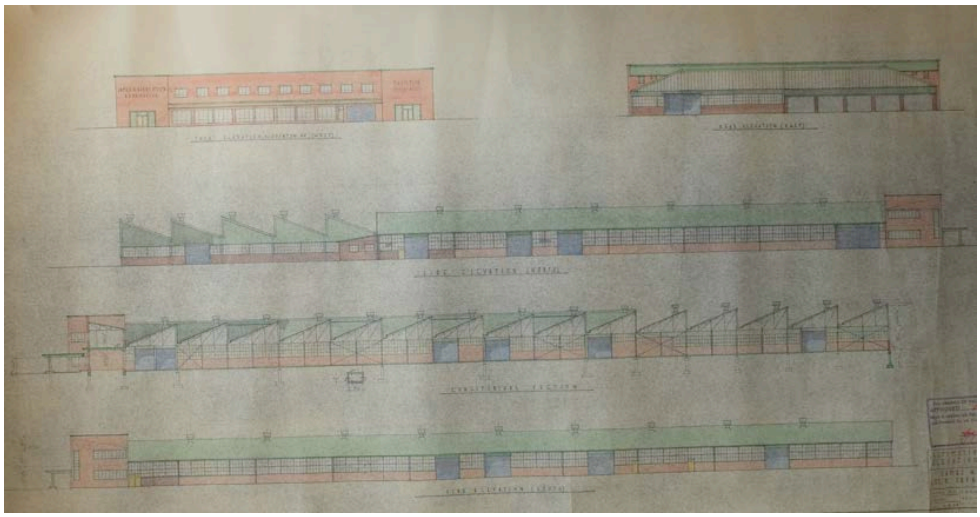


Figure 2.12 Architectural drawing of the now demolished factory located at Nos. 132-138 Joynton Avenue. It was built in 1955 for the automotive division of James N Kirby Holdings Pty Ltd. The architect was Francis Eugene Feledy

Source: City of Sydney Archives (Building Application Plan 640/54)

2.6.2 Sydney City Council

Kirby's factory on Lot 3 was purchased in 1964 by Sydney County Council[8] (SCC), while the southern part of neighbouring Lot 4 was purchased by SCC in 1963.[9] SCC had acquired the western half of Lot 10 in 1960.[10]

SCC was established in 1936 from the former electricity department of the City Council, and it was responsible for the supply originally as well as maintenance of the electricity network of numerous municipalities. This Zetland site was their main workshop, and they had buildings across Link Road and on the opposite side of Epsom Road.

The former Kirby's automotive factory was converted into its main maintenance facility and a new single storey workshop was erected to the north (within Lot 4) in 1964.[11] Within these buildings SCC undertook electrical fitting, testing, instrumentation work, etc. Both now demolished.

Within the western portion of Lot 10 SCC erected a complex of buildings that are still standing. It has not been possible to determine the background to these buildings, but they post date 1971.

[7] City of Sydney Building Application File 640 of 1954
[8] Torrens Title Dealing J593502
[9] Torrens Title Dealing J581358
[10] Torrens Title Dealing H561797
[11] City of Sydney Building Application File 2139 of 1963

2.6.3 The Distillers Company Ltd

The site takes in Lots 8 and 9 of DP 24134 that were purchased in 1952 and 1953 by John Dewar & Sons Ltd[12] and associated company The Distillers Company Ltd.[13] By 1954 The Distillers Company Ltd owned both allotments and erected a two storey warehouse with bottling plant and office space.[14] The plant distributed Dewar's branded whisky. The architect was John P Tate and Associates. The building was demolished in 1993 for the existing car yard.[15]

The Distillers Company Ltd purchased in the early 1970s the neighbouring property that has frontage to Nos. 106-116 Epsom Road (Lot 6 in DP 24134). In 1973 the company erected a new two storey warehouse fronting Nos. 106-116 Epsom Road (see entry below).[16] Additional warehousing behind the Epsom Road building was erected over the following decade with the addition of two buildings. The architects for this were Paynter Dixon.[17] All three buildings are standing.

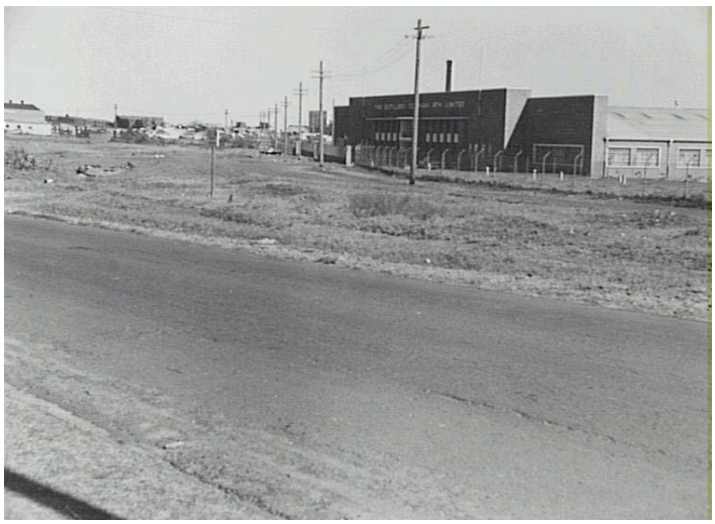


Figure 2.13 The now demolished whiskey bottling plant and office of The Distillers Company Ltd. in 1956. It was built in 1954 and lasted just 40 years. The architect was John P Tate and Associates

Source: City of Sydney Archives (SRC11861)

[12] Torrens Title Dealing F723355
[13] Torrens Title Dealing F97964
[14] City of Sydney Development Application File 208 of 1954
[15] City of South Sydney BA/1993/611
[16] City of Sydney Building Application File 360 of 1972
[17] City of Sydney Central Activity File 44 83 2092; City of Sydney Central Activity File 45 83 5168

2.7 140-144 Joynton Avenue and 94-104 Epsom Road

The Joynton Avenue frontage is Lot 2 (Nos. 140-144) and the Epsom Road site is Lot 5 (Nos. 94-104) in the original subdivision (DP 24134). These allotments were purchased by the Olympic Tyre & Rubber Co Ltd in 1954 and 1955.

The first development completed was on Lot 2, 140-144 Joynton Avenue, with the construction in 1955 of a single storey warehouse and office for the storage of tyres and rubber goods, at a cost of 100,000 pounds.[18] The architect for the building was Francis Eugene Feledy. Now demolished.

The company had lodged a BA for the construction of a similar building on Lot 5 (94-104 Epsom Road) in 1954.[19] The proposal was revisited in mid 1955 and another warehouse and office was erected for the company at a contract price of 135,390 pounds.[20] There was also a service station erected in 1957.[21] The architect for both buildings was Francis Eugune Feledy. The store was demolished in 1974 for the erection of a new single storey workshop for the Olympic Tyre & Rubber Co Ltd, at a cost of $100,000. This facility provided a tyre store and fitting premises. The architect was Edward S Sculley.[22] The service station was retained.

The building at 94-104 Epsom Road was altered in 1981 for Eastern Suburbs Newspapers as their printery, and the former warehouse at 140-144 Joynton Avenue was converted to a newsprint store at the same time (since demolished). The architects were Brewster Murray and Partners. Again the service station was retained.[23] In 1982 the newsprint store on Joynton Avenue was extended for a general office area.[24] That extension still stands.

The existing buildings at 94-104 Epsom Road were erected from 1989 for City of South Sydney Council as amenities and servicing buildings of the Council's Works Department.[25] Further alterations and additions were undertaken in the 1990s for the Works Department.[26]

2.8 Nos. 106-116 Epsom Road

This site was purchased by the Olympic Tyre & Rubber Co Ltd in 1955.[27] It remained vacant land until 1973 when a two storey warehouse was erected for The Distillers Co Pty Ltd as an adjunct to its whiskey bottling plant fronting Link Road. The architects were the Melbourne firm of Smith, Ogg & Serpell.[28] See entry for 130-138 Joynton Avenue for the later buildings behind.

[18] City of Sydney Development Application File 517 of 1954
[19] City of Sydney Building Application File 2842 of 1954
[20] City of Sydney Building Application File 1182 of 1955
[21] City of Sydney DA129/57 cited in BA/DA street card
[22] City of Sydney Building Application File 363 of 1973
[23] City of Sydney Development Application File 508 of 1979
[24] City of Sydney Central Activity File
[25] City of Sydney DA72/89 cited in BA/DA street card
[26] City of South Sydney BA/1994/142; BA/1994/247; BA/1998/218
[27] Torrens Dealing G206463
[28] City of Sydney Building Application File 360 of 1972

2.9 GREEN SQUARE REDEVELOPMENT[29]

2.9.1 Green Square Early Proposals

The Green Square has long been site for planning visions for its redevelopment. The area fell under the jurisdiction of several planning authorities including the City of Sydney (1949) and South Sydney Council (1968[30] and 1989). Early planning focused on zoning rather than wholesale development but the area also changed due to the decline of its manufacturing sector and gradual gentrification.

2.9.2 South Sydney Plan

The South Sydney Plan (1997) amalgamated past schemes for urban renewal and triggered the planning for what would become known as the Green Square Project. The name derived from local MP Frederick Green. In 1990 the newly formed South Sydney Council embarked on the process of redevelopment and renewal through its discussion paper *Planning for the Future* with an emphasis on community participation. This led to the completion of a *Discussion Draft* in 1993 with a train station at Green Square being the hoped for focal point of the area.

2.9.3 Green Square Masterplan

South Sydney Council announced the *Visions for Green Square Urban Design Competition* in 1995 coinciding with the State government's selection of the area for urban renewal with the aim of providing housing for 20,000 people.

Council developed their policies in the South Sydney Plan, a suite of three documents with the emphasis on sustainable development. By 1997 a draft masterplan for the redevelopment of Green Square had been developed by Council's consultants, Stanisic Turner in association with Hassell Pty Limited. The masterplan dealt with a variety of planning issues in three design options that was then issued for public consultation and to various stakeholders including the Department of Urban Affairs and Planning (DUAP) and developers.

The South Sydney Development Corporation was established to drive the proposals and the area was broken into two sections with Epsom Road the divider. The controls were regulated by the Local Environmental Plan and Development Control Plan.

2.9.4 Competition for Green Square Town Centre

In 2001 South Sydney Council ran a design competition for the initial design of the Green Square Town Centre and was sponsored by the South Sydney Development Corporation and Landcom. It attracted 21 worldwide entries and five teams were shortlisted. The winner was announced at the end of 2001, Turner & Associates, Arets Architect + Associates BV, McGregor & Partners & Holos Consulting. The design was a gleaming, futuristic design.

The scheme is now under construction with large areas being complete. Some parts of the development have not been completed as envisioned with less employment and business use. Some of the early housing areas have been altered by the development companies.

[29] Ed. Karskens, Grace & Melita Rogowsky, *Histories of Green Square*, dated 2004 a joint study by the City of Sydney and the University of New South Wales, Chapter 14 The Roots of Green Square. A Planning History

[30] The area came under the City of Sydney for period of eight years during this time

2.9.5 Epsom Park Precinct Masterplan

In 2009 Conybeare Morrison International prepared a masterplan for the Epsom Park Precinct for the City Plan Development Unit of the City of Sydney. The masterplan include the subject sites and set out the street layout and site area that is largely that currently proposed. The subject site was identified for a Health and Recreation Centre facing Joynton Avenue and a park (Epsom Park) to the centre of the precinct.

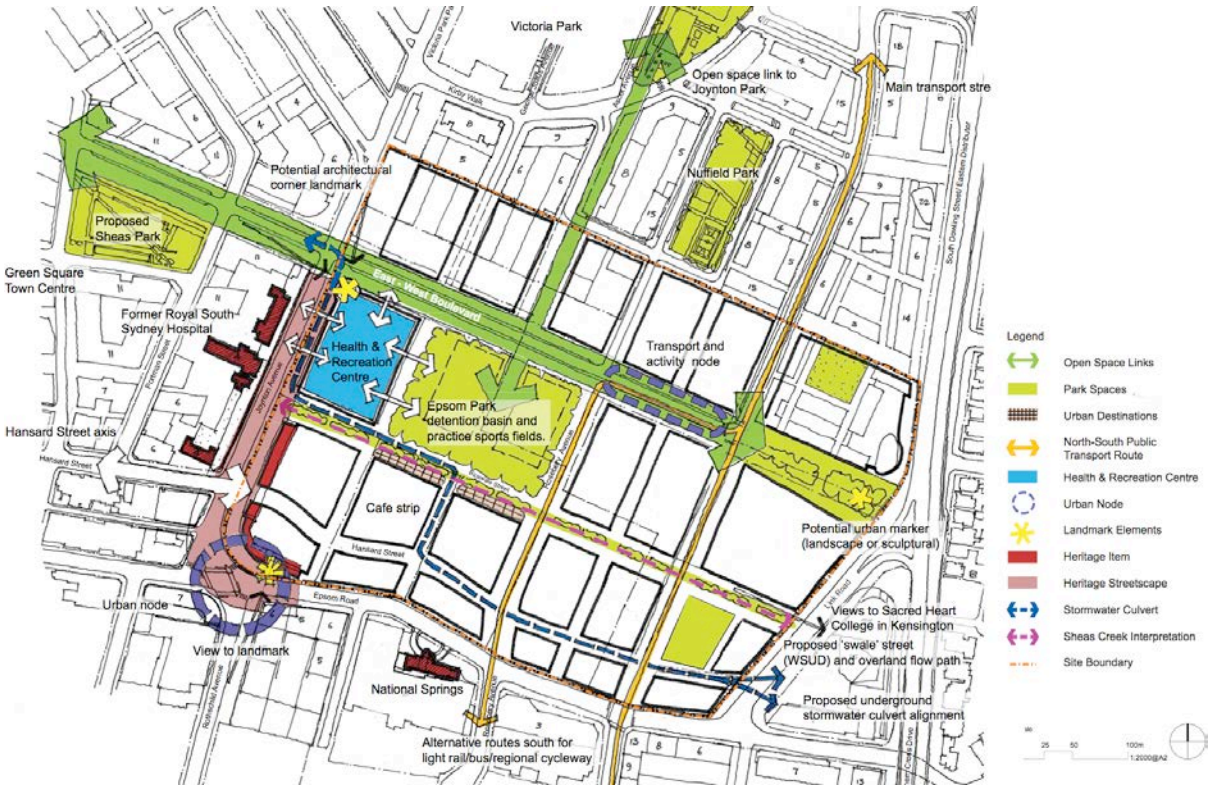


Figure 2.14 Masterplan for the Epsom Precinct

Source: Conybeare Morrison International. *Epsom Park Precinct Masterplan*, dated December 2009, p. 30

2.9.6 Aquatic Centre Competition

The City of Sydney committed to redeveloping the site for an aquatic centre and park within the Green Square Urban Renewal Area. In 2014 the City of Sydney issued a brief for a design competition for the development. Grimshaw Architects in association with Andrew Burges Architects were selected as the head consultants for the project.

3.0 PHYSICAL DESCRIPTION

An inspection of the development site was carried out by John Oultram in March 2015. A current site layout is shown in Figure 3.1.

The site has been divided into four sections for the purposes of this report reflecting the historic development of the sites.

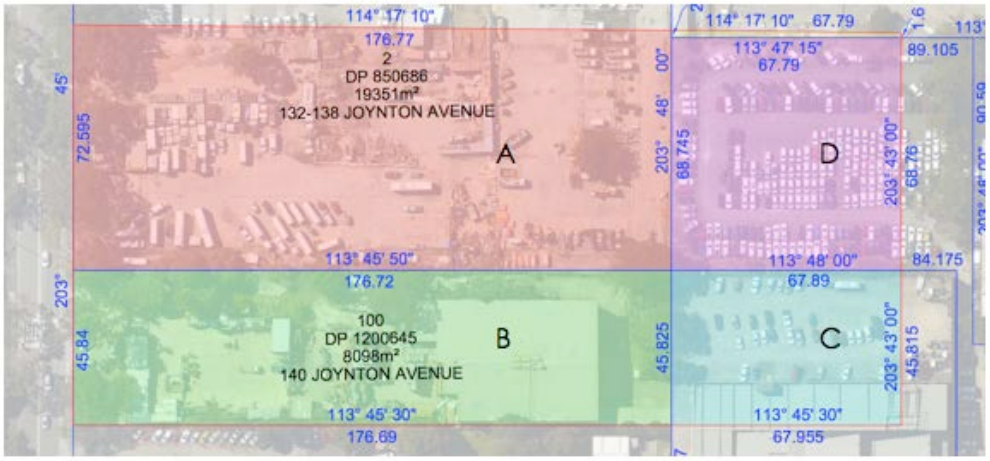


Figure 3.1 Site Plan showing the site lots keyed to the descriptions in this report

3.1 AREA A – PART 132 138 JOYNTON AVENUE

The site is large, level site bounded to the west by Joynton Avenue and is slightly raised from the street. The site is largely laid with a concrete slab and gravel and has a collection of temporary site sheds to the south. Part of the site to the north extends outside of the development area but the site slabs and cover extend into this area. The site is bounded by a low, brick wall to the street with two entrance drives with brick piers. There is a planted boundary area to Joynton Avenue with a collection of large trees including Angophoras and Callistemons. There is a mature Eucalypt to the centre of the site.

There is a cyclone fence to the east of the site with planting along the boundary. There is a temporary fence to the rear with a planted bank to part of the development site to the east.

3.2 AREA B - 140-144 JOYNTON AVENUE

The site is a narrow, level site to the southern part of the development site. The site is connected to the site at the rear (Area C). The site has a large, concrete hardstand with metal fences to the north and south. There is a low, brick, retaining wall to the street with brick piers and a cyclone fence gate at the entrance drive.

To the centre, is a modern, three storey building in brick and metal with a flat roof. The rear of the building abuts the site to the east and has a concrete loading area with a covered, concrete walkway to the Council depot. There is an access path to the south and a concrete drive to the west.

3.3 AREA C COUNCIL DEPOT

To the east of the site is a large collection of buildings forming the City of Sydney Depot. The site extends to Epsom Road. Within the development site is a large, single storey depot building that is built to the site boundaries and that has a car parking area to its flat roof. The car park is accessed by a long, concrete ramp from the south[31].

The site has a variety of buildings with a metal roofed storage area to the south of the raised car park.

3.4 AREA D – CAR STORAGE

To the eastern section of the site is a raised area that was, till recently, used for car storage.

3.5 ENVIRONS

The site is set to the east side of Joynton Avenue, a busy, tree lined thoroughfare through the suburb. It is lined with commercial premises to the south and the new, multi-storey, apartment buildings at Green Square to the north. Opposite the site on the west side of Joynton Avenue is the former South Sydney Hospital a large complex of buildings dating from the Edwardian period onwards that is currently being developed for community use.

Figures 3.2 – 3.13 below

[31] Lots to the south are to be redeveloped and a DA has been approved for a multi-storey apartment building at 84-92 Epsom Road. The depot site will be redeveloped following completion of the Aquatic and Recreation Centre but will be used a temporary flood basin until the new street layouts (including the widening and raising of Joynton Avenue) are complete



Figure 3.2 Gunyama Park Aquatic & Recreation Centre

View to the site from Joynton Avenue



Figure 3.3 Gunyama Park Aquatic & Recreation Centre

View to the site from Joynton Avenue



Figure 3.4 Gunyama Park Aquatic & Recreation Centre

View looking southwest



Figure 3.5 Gunyama Park Aquatic & Recreation Centre

View to the site looking south



Figure 3.6 Gunyama Park Aquatic & Recreation Centre

View to the site looking east



Figure 3.7 Gunyama Park Aquatic & Recreation Centre

View to the apartment development to the north



Figure 3.8 Gunyama Park Aquatic & Recreation Centre

View to the site looking north



Figure 3.9 Gunyama Park Aquatic & Recreation Centre

View to the buildings at 140 Joynton Avenue to be demolished



Figure 3.10 Gunyama Park Aquatic & Recreation Centre

View to the adjoining depot building part of which will be demolished



Figure 3.11 Gunyama Park Aquatic & Recreation Centre

View to the eastern portion of the site



Figure 3.12 Gunyama Park Aquatic & Recreation Centre

View to the pathology building at the former South Sydney Hospital



Figure 3.13 Gunyama Park Aquatic & Recreation Centre

View to the Nurses' home at the former South Sydney Hospital

4.0 HERITAGE LISTINGS & CONTROLS

4.1 NON STATUTORY LISTINGS

4.1.1 National Trust of Australia (NSW)

The development site is not classified on the Register of the National Trust of Australia (NSW).

4.2 STATUTORY LISTINGS

4.2.1 Heritage Division of the NSW Office of Environment & Heritage

State Heritage Register

Under the Heritage Act 1977 (as amended), the Heritage Division of the NSW Office of Environment and Heritage administers and maintains the State Heritage Register (SHR), a register of items and places that are considered to have heritage significance at a state level. The development site is not listed on the Register.

State Heritage Inventory

The Branch also compiles the State Heritage Inventory, a collated database of all places listed on statutory heritage lists, including Local Environmental Plans. The development site is not listed on the Inventory.

4.2.2 Local Authorities

The local authority for the area is the City of Sydney. The development site is not listed as a heritage item in Schedule 5 Part 1 of the *Sydney Local Environmental Plan 2012* (LEP) and is not within a conservation area. The site is in the vicinity of heritage items at:

REF	ADDRESS	ITEM	RANKING
I1379	1-3 Roseberry Avenue	Former Moffat Virtue warehouse and office building including interiors	Local
I2206	64-74 Epsom Road	Electrical substation including interior	Local
I2210	Joynton Avenue	Street trees in Joynton Avenue between O'Dea Avenue and Gadigal Avenue	Local
I2212	100-106A Joynton Avenue	Former Victoria Park Racecourse Group including former Totalisator building, park and interpretation device	Local
I2207	10-12 Hansard Street	Semi-detached houses including interiors	Local
I2208	15 Hansard Street	Cottage including interior	Local
I2209	24 Hansard Street	Terrace house including interior	Local
I2218	65-69 Portman Street	Terrace group including interiors	Local
I2219	71-75 Portman Street	Terrace group including interiors	Local
I2214	Joynton Avenue cnr Elizabeth Street	Horse Trough	Local
I2205	934 Elizabeth Street	Cottage including interior	Local
I2220	37 Tilford Street	Cottage including interior	Local

The site is also in the vicinity of two heritage conservation areas identified in Schedule 5 Part 2 of the LEP:

REF	ADDRESS	ITEM	RANKING
C72		Hansard Street	Local
C73		Zetland Estate	Local

The heritage provisions in the LEP relating to the development in the vicinity of a heritage item and heritage conservation area would apply.

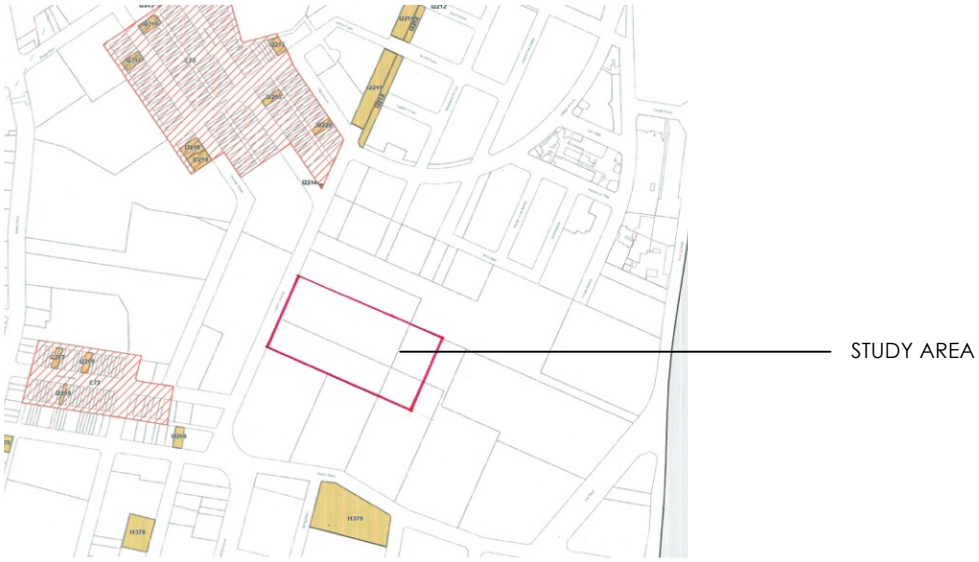


Figure 4.1 Sydney Local Environmental Plan 2012 – Heritage Map Sheet HER_018

Source: City of Sydney

4.3 South Sydney Local Environmental Plan 1998

The site was formerly within the South Sydney Council LGA and the following property is listed as a heritage item in Schedule 2 of the *South Sydney Local Environmental Plan 1998* (as amended) (SSLEP):

REF	ADDRESS	ITEM	RANKING
I554A	3 Joynton Avenue	Former South Sydney Hospital Group	Local

The heritage provisions in the SSLEP relating to the development in the vicinity of a heritage item would apply.

The site is outside of the area covered by the Green Square Town Centre Development Control Plan 2012 (as amended).

5.0 DISCUSSION OF SIGNIFICANCE

5.1 ABORIGINAL AND ARCHAEOLOGICAL SIGNIFICANCE

5.1.1 Aboriginal Archaeology

An assessment of the Aboriginal significance of the place has been carried out in a separate report. The Steele Assessment noted that were no documented Aboriginal archaeological sites or objects known to occur in the study area.

The site had been extensively disturbed from the damming of the creeks from the 1820s onwards and any Aboriginal archaeological remains are likely to have either have been destroyed or disturbed by subsequent activity, though there exists the potential for remains.

5.1.2 Post-European archaeology

The Steele Assessment notes that archaeological remains from the early periods of development would have been impacted by fill on the site and subsequent industrial development after the Second World War.

5.2 HISTORIC SIGNIFICANCE

The site has an interesting history though there are few remains that signal its early, European development.

5.2.1 Swampland and Dams

The area formed part of a series of swamps stretching from Botany to Centennial Park that were developed as a source for Sydney's drinking water. As the area was developed for industry and came under private ownership the swamp and creeks were dammed and the Joynton Avenue frontage of the subject area was the site of the Waterloo dam at the head of the swamp that ran east and north into the site.

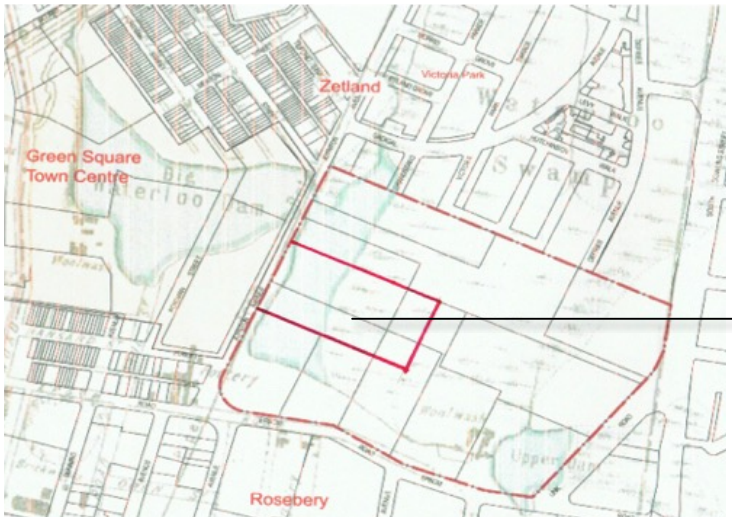


Figure 5.1 Current lot layout superimposed on early plan of the swamp and dams with the subject site highlighted

Source: Conybeare Morrison International. *Epsom Park Precinct Masterplan*, dated December 2009, p. 19

Little is known of the early detail of the area and the dams though, to western eyes, the area was quite desolate, a view coloured no doubt by its limited development and farming potential. The area was named by Governor Macquarie after the British victory at Waterloo in the Napoleonic War.

5.2.2 Early Development

Early industries close to the site included the Rose Valley Wool Wash that commenced business in the 1860s. In the late 1880s the area was developed for housing with Victoria Town (1879) and the Salisbury and Chester Estates (1886).

5.2.3 Victoria Park Racecourse

The first major development of the site was the Victoria Park Racecourse that commenced in 1907 with the purchase of a large tract of land by Sir James Joynton Smith. Smith married into the hotel trade and took an interest in horse racing investing in tracks at Rockdale, Forest Lodge and later Zetland. The tracks were more widely popular than today and there were tracks at Roseberry, Kensington and Ascot prior to the early 1940s.

The development in the early 1900s of large housing estates to the south (Roseberry Estate) and east (Kensington) would have been a great boost to trade, though the impact of the opening of the South Sydney Hospital in 1913 may have been less in Joynton's favour.

The development was large and included the drainage of the swamp and the construction of a track, grandstand, leger, stables totalisor etc. The buildings were constructed at the northern end of the course and none were located in the subject site.

The site was sold to Lord Nuffield in 1946 though the track survived till 1952. Only one of the racecourse buildings survives.

5.2.4 Industry and Commerce

Following the demise of the racetrack, the northern part of the site was developed for a car manufacturing plant by Lord Nuffield (William Richard Morris Nuffield) the founder and proprietor of Morris Motors Limited,

The car plant opened in 1950 and was a very extensive development that initially assembled car from overseas materials but later developed into a fully-fledged manufacturing plant. The plant closed in the 1970s.

The plant attracted component suppliers to the surrounding sites and the northern section of the subject site (Area A) was developed by James N. Kirby Holdings, an automotive parts manufacturer. In 1955 they erected a large factory on the site designed by architect Francis Feledy who had designed most of the buildings for Nuffield's car factory to the north. The factory was later converted to a maintenance facility by the Sydney County Council who acquired the site in 1964. The earlier building has been demolished.

The southern section of the subject (Area B) site and the northern section of the Council depot were purchased by the Olympic Tyre and Rubber Company in 1954 and 1955. On the Joynton Street site they erected a single storey warehouse in 1955 (also to the design of Feledy) and proposed a similar building to the Epsom Street frontage. Both buildings have been demolished and the sites were developed by South Sydney Council in 1989 for the current depot buildings.



Figure 5.2 Aerial View of the Morris car plant dated March 1957

The subject site is the area to the top and is undeveloped

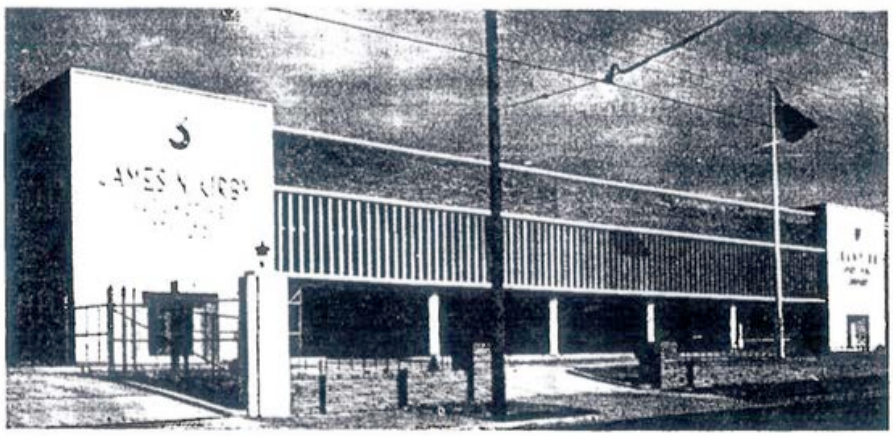
Source: Rod Howard Heritage Conservation Pty Limited, *Victoria Park, South Dowling Street, Zetland, Heritage Assessment Survey*, dated 1998, p. 41



Figure 5.3 City Building Surveyors Detail Sheets c. 1956 Sheet 24

Source: City of Sydney Archives

This later phase is emblematic of the Post War boom in manufacturing that reflected the economic optimism of the 1950s, though little of the built development survives.



JAMES N. KIRBY AUTOMOTIVE PTY. LTD.
The new building, which has a floor area of 80,000 sq. ft., is the first stage in the development of an eleven-acre site. The clean, simple lines of the facade are appealing.

Figure 5.4 James Kirby Automotive Pty Limited

Source: *Building Lighting and Engineering*, 24 December 1955



THE NEW OLYMPIC TYRE BUILDING.
JOYNTON AVENUE. ZETLAND, SYDNEY.
Architect: F. E. Faledy. Builders: Kell & Rigby Pty. Ltd.
As the facade faces west, adjustable aluminium louvres cover the whole of the windows and impart distinction to the elevation.

Figure 5.5 The new Olympic Tyre Building

Source: *Building Lighting and Engineering*, 24 November 1956

5.3 GREEN SQUARE

The site of now part of the Green Square urban renewal project that represents the aims and aspirations of the former South Sydney Council and the City of Sydney to redevelop the area following the decline of its industrial base.

5.3.1 Historical Associations

The site has some historical associations with Sir James Joynton Smith (1858-1948) who developed the Victoria Park Racecourse and who was a keen investor in the horse racing business and active in Sydney's hotel trade. He had numerous business interests including newspapers and radio stations and was active in public life being and alderman and mayor of the City of Sydney and later a MLC.

5.4 AESTHETIC SIGNIFICANCE

(See Figure 3.1 above for site area references)

The sites are largely cleared and the only structures are the depot buildings in Areas B and C. These are both, nondescript late twentieth century buildings of no merit.

Area A and B are bounded by low walls to Joynton Avenue that are likely the entry walls to the Post War automotive factories (now demolished). There are humble remnants of the former development there and are in themselves are of no aesthetic merit.

5.5 SOCIAL SIGNIFICANCE

The sites may have some social significance for local residents who can remember the former uses of the site and particularly the Victoria Park Racecourse that would have provided a lively social scene and been a hive of activity on race days.

The development of the site represents the aims and aspirations of South Sydney Council and the City of Sydney to redevelop the area to provide high quality housing and community facilities including parks and green areas following the decline of the its industrial base and the site is part of Green Square, one of the largest urban renewal projects in the Sydney.

5.6 TECHNICAL/SCIENTIFIC SIGNIFICANCE

The archaeological potential of the place is covered in the Steele Assessment. The archaeological potential of the site is low.

6.0 ASSESSMENT OF SIGNIFICANCE

6.1 CRITERIA FOR ASSESSMENT

The Heritage Office of New South Wales has issued guidelines as part of the NSW Heritage Manual regarding the assessment of heritage significance.

An item will be considered to be of State (or) local significance if, in the opinion of the Heritage Council of NSW, it meets one or more of the following criteria.

Criterion (a)	*An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area)*
	The subject site is part of the Waterloo swamp that was the one of the early sources for Sydney's drinking water that was later dammed as the Waterloo dam to provide water for industrial uses
	The site is part of the Victoria Park Racecourse that was established on the swamp in 1907 by Sir James Joynton Smith and that continued on the site till the 1950s
	The site was part of the Post War development of the area for the automotive industry and was developed by James N.Kirby Holdings (1955) and the Olympic Tyre and Rubber Company (1955)
	The site is to become a recreation hub in the Green Square redevelopment, one of the largest urban renewal projects in Sydney
	Local Significance
Criterion (b)	*An item has strong or special associations with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)*
	The place has associations with Sir James Joynton Smith (1858-1948) who developed the Victoria Park Racecourse and who was a keen investor in the horse racing business and active in Sydney's hotel trade. He had numerous business interests including newspapers and radio stations and was active in public life being and alderman and mayor of the City of Sydney and later a MLC
	Local Significance
Criterion (c)	*An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)*
	The current buildings, structures and landscaping on the site are of no aesthetic merit
	Does not meet the criterion
Criterion (d)	*The item has strong or special association with a particular community or cultural group in NSW (or the local area) for social or spiritual reasons*
	The place may have some special association for those with memories of the Victoria Park Racecourse that dominated the local area and that would have provided a lively social scene
	The development of the site represents the aims and aspirations of South Sydney Council and the City of Sydney to redevelop the area following the decline of its industrial base and the site is part of Green Square, one of the largest urban renewal projects in Sydney
	Local Significance
Criterion (e)	*An item has the potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area)*
	The archaeological potential of the place is low
	Does not meet the criteria

Criterion (f)	*An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area)*
	The site is a mid to late Twentieth Century industrial site that are common in the area
	Does not meet the criterion
Criterion (g)	*An item is important in demonstrating the principal characteristics of the local area's:* *Cultural or natural places; or* *Cultural or natural environments)*
	The place is an example of a mid to late Twentieth century industrial site
	Does not meet the criterion at a State level
	(or a class of the local area's: *Cultural or natural places; or* *Cultural or natural environments)*
	The place is an example of a mid to late Twentieth Century industrial site
	Historically Representative Locally Socially Representative Locally

6.2 STATEMENT OF SIGNIFICANCE

The subject site is part of the Waterloo swamp that was the one of the early sources for Sydney's drinking water that was later dammed as the Waterloo dam to provide water for industrial uses. The site was later part of the Victoria Park Racecourse that was established on the swamp drained in 1907 by Sir James Joynton Smith and that continued on the site till the 1950s.

The site was also part of the Post War development of the area for the automotive industry by Lord Nuffield and the Morris Motor Company. The subject site was developed by James N.Kirby Holdings (1955) and the Olympic Tyre and Rubber Company (1955) for support industries to the motor plant.

The site is to be come a recreation hub in the Green Square and Epsom Precinct redevelopment, one of the largest urban renewal projects in Sydney

The place has associations with Sir James Joynton Smith (1858-1948) who developed the Victoria Park Racecourse and who was a keen investor in the horse racing business and active in Sydney's hotel trade. He had numerous business interests including newspapers and radio stations and was active in public life being and alderman and mayor of the City of Sydney and later a MLC.

The place may have some special association for those with memories of the Victoria Park Racecourse that dominated the local area and that would have provided a lively social scene.

The development of the site represents the aims and aspirations of South Sydney Council and the City of Sydney to redevelop the area following the decline of its industrial base.

7.0 THE CURRENT PROPOSALS

7.1 Overview

The Gunyama Park Aquatic and Recreation Centre is part of the redevelopment of the area that includes various parks and community facilities. The area is part of the Epsom Park Precinct and the redevelopment will involve the creation of new streets between Gadigal Avenue and Epsom Road including a tree lined boulevard to the north of the subject site (Zetland Avenue). It is anticipated that sites in the area will be amalgamated into the redevelopment area.

The Green Square project is transforming the southern precinct of the area into a vibrant and sustainable, urban environment and Green Square is emerging as a place of innovative housing design and bespoke business and retail centres. Green Square is set to become a new exemplar of sustainable high density living with developments linked to recycled water, shops, parks, gardens, entertainment, and bike and walking routes. At the heart of the Green Square development is the new town centre, a major new residential, retail and cultural hub. The City has committed substantial funds over the next 10 years to deliver quality infrastructure and community facilities such as a new library and plaza, aquatic and recreation centre, parks and open space, public art, a childcare centre and community creative hub.

7.2 Current Proposals

The City of Sydney is proposing to redevelop the site for a new Park and Aquatic/Recreation Centre including a new sports field and playground.

The proposals include:

7.3 Site Works

- Demolition of all the current buildings and most of the structures on the site
- Retention of some trees along the Joynton Avenue boundary

- Excavation for the new pool structures, water tanks
- Site clearance and some cut to reduce and fill to raise levels
- New topography of landscaped mounds

7.4 Aquatic an Recreation Centre

- New, two storey building to Joynton Avenue

7.4.1 Ground Floor

- Indoor and outdoor pools
- Reception, community foyer, administration facilities, staff offices and meeting rooms
- Public amenities and indoor and outdoor changing rooms
- Café with kitchen and kiosk
- A crèche
- Plant and storage areas

7.4.2 First Floor

- Health and fitness area with reception, dry fitness studios, gymnasium, spin room and change rooms
- Mechanical plant including cogeneration

The building is set close to Joynton Avenue with a landscaped area to the street. The main entrances are from the corner of Joynton Avenue, the new Zetland Avenue and from Zetland Avenue via the café fronting the park. The building is in rendered masonry with panelled cladding to the first floor with a flat roof with skylights.

The covered pool hall is a high space with skylights. The service areas to the northern perimeter are earth covered in a winding footprint that provides a green backdrop to the park and new avenue.

The first floor is set over the northern section of the ground floor.

7.5 GUNYAMA PARK

7.5.1 Gunyama Park

The Park is to the east of the Aquatic and Recreation Centre and includes:

- Synthetic sports field with filed lighting
- Change rooms and public amenities
- BBQ areas
- Children's playground and skate facilities
- Outdoor fitness station
- Natural lawn areas

The remainder of the site will be re-landscaped. The sports field is set into the landscape with a perimeter path linking the park facilities. The playground is within a topography of mounds with the play equipment integrated into the new levels. The new amenities' building is set between the sports field and playground and there is seating, bike parking, lighting and the like as for any park.

7.5.2 Landscaping

The planting design has been developed by Taylor Cullity Lethlean and includes:

- Rain garden and overland flow path
- Bermed landscape
- Concrete and timber promenade
- Indigenous plantings

Set within the rain garden zone, along the overland flow path, will be public artwork (sculptures) that form part of the interpretation of the site. The interpretation devices or the site are covered in the Interpretation Strategy prepared for the project.

8.0 IMPACT OF THE PROPOSED DEVELOPMENT

8.1 GENERALLY

The proposal is part of the ongoing development in Green Square that is being revitalized as a major residential suburb close to the heart of the City. The development has seen the replacement of the former industrial sites with housing for thousands of residents and the development of sites close to for community facilities and parks that will provide the sporting and recreational facilities to support the new developments. The former South Sydney hospital site is being transformed with new community facilities and a community park that will add richness to the area while revitalizing this important heritage site.

The pool and park site has a rich history but the built elements are gone and the site is ideally located to provide new community facilities. The site has no heritage elements of note but the development will allow the interpretation of its cultural development from the Aboriginal times onwards and introduce new uses suited to the new century and the ongoing development of the area.

8.2 DEMOLITIONS AND ARCHAEOLOGY

8.2.1 Demolitions

Some of the post WWII factory buildings on the site have been demolished and the remaining buildings on the site will be removed to allow for the new development.

These are buildings of very limited significance and their demolition will allow for the comprehensive development of the site.

8.2.2 Aboriginal Archaeology

Little is known of the aboriginal occupation and use of the site but the area was low lying with creeks feeding the intermittent swampland. It was likely used as a source of materials and food and the site has some archaeological potential.

The Aboriginal use of the site will be interpreted as part of the development.

8.2.3 Excavation and Archaeology

The site has been cleared but was the site of previous structures including the:

- Waterloo dam
- Victoria Park Racecourse
- Automotive factories and suppliers for the nearby Morris plant

There is little evidence of any of these apart from the slabs to the former factories and the brick boundary walls along Joynton Avenue. These will be removed as part of the development.

The former uses will be interpreted as part of the development of the site.

Excavation of the site should be the subject of monitoring and any finds assessed and recorded by a suitably qualified archaeologist.

8.3 PROPOSED DEVELOPMENT

8.3.1 Use

The area was formerly part of the Victoria Park racecourse that could be considered a recreational use that dated from the earliest European development of the area. The racecourse was used for aerial displays, other public displays and community events that amplified its recreational use. The proposal will introduce a water element into the site that can be seen as an interpretation of the wetland nature of site pre settlement. The new pools are located on the site of the former Waterloo Dam that may in itself have been used for swimming.

The proposed use is in line with the former recreational use of the site and the introduction of both the aquatic and recreation centre and park is reflective of the historic use of the site.

8.3.2 Aquatic and Recreation Centre

The proposed aquatic and recreation centre is a simple, two storey structure that has many layers of complexity in its design. It is substantially lower than the high-rise apartment buildings to the north and is in line with the general two and three storey scale of development in the area including the previous buildings on the site and the redevelopment of the former South Sydney Hospital site opposite.

The aquatic and recreation centre is sensibly placed to the west to allow a continuous landscaped area to the east while providing a built edge to Joynton Avenue with a landscaped area setback along the street that retains some of the current trees on this section of the site.

The building design has been developed over a considerable time and has a complex and sophisticate layout with a simple and elegant structure over the covered pool that sits on the curved, earth banks to the north and floats over the main pool deck.

The outside pool is separated from the park by a landscaped bank that avoids high fencing to the park and allows views over the new landscaped areas to the east. The design engages with the surrounding streets while providing the sense of enclosure and visual protection required for the use.

The building has a simple and high quality palette of materials and colours that reflect some of the themes in the Interpretation Strategy.

The centre will also include interpretive devices exploring the rich history of the site including large span architecture characteristic of the industrial history and these will also be amplified by the park with a rain garden and landscaped mounds suggestive of the former sand hills.

The design is a well-considered piece of modern architecture with a coherent yet complex design strategy that would grace any site.

8.3.3 Park and Landscaping

The park proposals do not raise any heritage issues in regard to their design and the layout of the park is largely driven by the provision of a sports field that is set to the centre of the site with perimeter landscaping.

The proposal include elements that are reflective of the former use and topography including:

- A water garden that will symbolise the former wetlands with plantings suggestive of the original
- Sculptures (water carriers) that interpret the Aboriginal use of the site
- A raised area at the playground that is suggestive of the former sand hills to the east of the site



Figure 8.1 Dunes to the southeast corner of the Victoria Park Racecourse

Source: State Library of NSW, Sam Hood, Home and Away 7893

The plantings will be largely Australian natives including trees. Tree cover to the site was probably limited in its earliest days as the area was sand hills but the introduction of trees will provide shade and greenery to reflect the new use.

The central amenities block is a single storey structure sensibly set at the interface of the sports field and playground and the walking track provides a continuous ribbon to link all areas of the park while reflecting the sinuous planning of parts the pool.

The park will include interpretive devices and play equipment that reflect the historic development of the site including:

- Horse racing play equipment
- Planes play equipment
- Motor cars play equipment and structure colours

The park will provide much needed green space for the housing developments close to and is a superb response to the site.

8.3.4 Interpretation

An interpretation Strategy has been developed for the site and this will be implemented as part of the proposals.

8.4 CITY OF SYDNEY LOCAL ENVIRONMENTAL PLAN

8.4.1 Impact on Heritage Items in the Vicinity

The development site is in the vicinity of a number of heritage Items:

REF	ADDRESS	ITEM	RANKING
I1379	1-3 Roseberry Avenue	Former Moffat Virtue warehouse and office building including interiors	Local
I2206	64-74 Epsom Road	Electrical substation including interior	Local
I2210	Joynton Avenue	Street trees in Joynton Avenue between O'Dea Avenue and Gadigal Avenue	Local
I2212	100-106A Joynton Avenue	Former Victoria Park Racecourse Group including former Totalisator building, park and interpretation device	Local
I2207	10-12 Hansard Street	Semi-detached houses including interiors	Local
I2208	15 Hansard Street	Cottage including interior	Local
I2209	24 Hansard Street	Terrace house including interior	Local
I2218	65-69 Portman Street	Terrace group including interiors	Local
I2219	71-75 Portman Street	Terrace group including interiors	Local
I2214	Joynton Avenue cntr Elizabeth Street	Horse Trough	Local
I2205	934 Elizabeth Street	Cottage including interior	Local
I2220	37 Tilford Street	Cottage including interior	Local

The items are some way from the subject site and the scale of the proposal will have no immediate impact on the significance and setting of the items. The development will read as part of the larger, Green Square development to the north and will be linked to it across the new boulevard along Zetland Avenue.

Former South Sydney Hospital Group

The development site is also in the vicinity of a heritage item listed in Schedule 2 of the *South Sydney Local Environmental Plan 1998* (as amended) (SSLEP):

REF	ADDRESS	ITEM	RANKING
I554A	3 Joynton Avenue	Former South Sydney Hospital Group	Local

The hospital is an important group of former health buildings that were opened in 1913 with later buildings from the Inter War and Post War periods. The hospital use has discontinued and the site is currently being redeveloped for housing and pocket parks with the adaptive reuse of the existing buildings for community uses.

The listing sheet for the property (SHI 2420800) contains a statement of significance for the site:

The former Royal South Sydney Hospital, is significant to the local area for the historic, aesthetic and social values of the site and the particular constituent elements. The Administration and Pathology buildings are examples of late Federation hospital buildings, opened in 1913 and continually adapted to meet the health needs of the community which it served for 90 years. The Outpatients Building is an example of an Inter-War Georgian Revival style hospital building and was opened in 1935. The Esme Cahill Building (former Nurses Quarters) is an example of an Inter-War Georgian Revival style hospital building constructed in two stages, c. 1938 and 1957. The site landscaping has local significance for its aesthetic, historic and streetscape values and is associated with the development of the hospital site over time.

The site is partly opposite the subject site but is separated by Joynton Avenue and there are street plantings that limit views between the sites. The visual separation is reinforced by the landscape strip to the front of the new pool where some the existing trees will be retained and reinforced by new plantings.

The sites have no historical connection and the new development will read as part of the much larger Green Square housing development that provides its built context and background. The new aquatic and recreation centre is close to the former South Sydney Hospital site and the listing sheet contains a management recommendation relating to new works there:

Any additions to significant buildings must be of a subservient scale and simple form.

This relates to the Hospital site but could be applied to sites nearby. The proposed aquatic and recreation centre is low scale and superbly detailed with simple façades in a robust but simple palette of high quality materials.

We consider that the scale of the development (particularly as much of the site will be parkland) is not such that it will have any impact on the setting or significance of the former South Sydney Hospital site.

8.4.2 Impact on Heritage Conservation Areas in the Vicinity

The development site is also in the vicinity of two heritage conservation areas:

REF	ADDRESS	ITEM	RANKING
C72		Hansard Street	Local
C73		Zetland Estate	Local

The development will read as part of the larger Green Square development to the north and will be linked to its across the new boulevard along Zetland Road. The conservation areas are some way from the subject site and the scale of the proposals will have no immediate impact on their significance and setting.

8.5 City of Sydney Development Control Plan 2012 (DCP)

As the site is not a heritage item and is not in a conservation area there are no relevant heritage provision in the DCP that would apply to the development.

The impact on heritage items and heritage conservation areas in the vicinity are addressed above.

9.0 SUMMARY AND RECOMMENDATIONS

9.1 SUMMARY

In summary, there are no heritage issues that would preclude development of the site for a park and aquatic and recreation centre in the manner proposed and the development is a superb response to the site providing for a new aquatic and recreation centre building of considerable architectural quality. The proposed parkland has been very well considered and responds well to the historic qualities of the site while providing for a rich and much needed park and recreation area for the Green Square housing development.

In heritage terms, we would recommend that the proposal be approved.

9.2 RECOMMENDATIONS

We would recommend the following:

9.2.1 Reference Documentation

Assemble, catalogue and make readily available, copies of all known historical drawings, pictorial documents and major written primary and secondary records relating to the place in a permanent archive (e.g. City of Sydney Archives).

9.2.2 Archaeology

Treat the place as having some archaeological potential. Monitor any excavation works for evidence of previous structures and allow an assessment of any finds by a suitably qualified archaeologist. Record all archaeological finds. Document and safely house all finds that have been, or are in future, removed from the place. Store in one location, apart from items that might be distributed elsewhere for particular research or interpretative reasons.

9.2.3 Photographic Survey

Carry out, catalogue and archive a systematic photographic survey of the place before, during and after any works in accordance with the Heritage Branch Guidelines for archival photographic recording using digital capture.

9.2.4 Interpretation

The site has an interesting history and the works include interpretation of the history and development of the place based on the Interpretation Strategy using introduced devices (e. g. landforms, water, sculptures and play equipment) based on the available historical information and maps.



JOHN OULTRAM

GUNYAMA PARK AQUATIC & RECREATION CENTRE

INTERPRETATION STRATEGY



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1.0 INTRODUCTION

1.1 THE BRIEF

The following report has been prepared to provide an interpretation strategy for the redevelopment of a large site in Joynton Avenue (132-140 Joynton Avenue) Zetland for the Gunyama Park Aquatic and Recreation Centre for the City of Sydney.

The report has been prepared on behalf of Grimshaw Architects who have been appointed head consultants for the development in association with Andrew Burges Architects.

1.2 THE STUDY AREA

The study area is part of the following:

	ADDRESS	LOT	DP
	132-138 Joynton Avenue Zetland,	Lot 2	DP 850686
	140 Joynton Avenue Zetland,	Lot 100	DP 1200645
	94-104 Epsom Road, Zetland,	Lot 101	DP 1200645
	106-116 Epsom Road, Zetland	Lot 1	DP 830870
	130 Joynton Avenue, Zetland	Lot 1	DP 850686

in the City of Sydney, Parish of Alexandria and County of Cumberland (Figure 1.1).



Figure 1.1 The Study Area

The development area is outlined in red

Source: Cardno

1.3 LIMITATIONS AND TERMS

The terms *fabric, conservation, maintenance, preservation, restoration, reconstruction, adaptation, compatible use and cultural significance* used in this report are as defined in the Australia ICOMOS *Burra Charter.*

1.4 PREVIOUS REPORTS

The development has been the subject of a heritage assessment and heritage impact statement prepared by this office[1]:

Proposed Gunyama Park and Green Square Aquatic Centre, Heritage Assessment and Impact Statement, dated April 2015

(Assessment)

Proposed Gunyama Park Aquatic & Recreation Centre, Heritage Impact Statement, dated May 2016

(HIS)

An Aboriginal and archaeological assessment of the site has also been prepared:

Dominic Steele Consulting Archaeology, *Aboriginal and Archaeological Assessment, Gunyama Park and Green Square Aquatic Centre*, dated March 2015.

(Steele Report)

The development area has been the subject of numerous heritage reports that include histories and information on the site and associated areas:

City Plan Heritage, *Royal South Sydney Hospital Site Conservation Management Plan*, dated June 2011

City of Sydney, *The Streets of Green Square, The Past Shapes and Future*, dated 2013

Heritage Data Form – Former Joseph Lucas Plant/Larke Hoskins/Honda Building, 146-158 Joynton Avenue, Zetland

Rod Howard Heritage Conservation Pty Limited, *Victoria Park, South Dowling Street, Zetland, Heritage Assessment Survey*, dated 1998

Ed. Karskens, Grace & Melita Rogowsky, *Histories of Green Square*, dated 2004 a joint study by the City of Sydney and the University of New South Wales

(Karskens)

City of Sydney, *Proposed Street and Park Names Justification*, undated analysis of the proposed and existing street names

1.5 AUTHORS AND ACKNOWLEDGMENTS

This report was prepared by John Oultram of John Oultram Heritage & Design, unless otherwise noted. John Oultram Heritage & Design was established in 1998 and is on the NSW Heritage Office list of heritage consultants.

[1] Note the project name has now been changed but the reports were issued under this heading

2.0 INTERPRETATION

2.1 DEVELOPMENT OF AN INTERPRETATION POLICY

Interpretation of a place can play an important role in understanding the historical and physical development of the place. The interpretation can inform the public and specialists alike and allow the place to be understood and change to be readable.

Interpretation is not limited to descriptive plaques but can be represented in the methods used to make changes to allow that change to be readable. Interpretation can also include representation of previous forms, or layouts, with modern materials (e.g. landforms and drainage). It can also include simply leaving material in place even it has been modified (e.g. boundary walls)

Interpretation is based on the known history of a place and the assessment of significance of the place and its elements. This assessment is contained in the heritage assessment prepared for the site. The focus of interpretation is usually based on the more significant events or elements at the place, but should also reflect the more mundane roles of a place as the collective memory of a place is based on both important and insignificant events.

The built methods for interpretation can be quite subtle, or more pronounced, depending on the required readability or significance of the element being altered. The work may involve *conservation restoration*, or *reconstruction*[2] to maintain a place or return it to a known, previous state. Decisions as to this work should be guided by the heritage studies that have been prepared and the relative significance of the elements.

This process is well illustrated in the *Illustrated Burra Charter*[3] that gives a good background as to why the process is important and the methods for achieving it. These methods can be quite subtle, or more pronounced, depending on the required readability or significance of the element being altered.

There are several areas that can be interpreted:

- Aboriginal Settlement and Use
- Swampland and Dams

- Historical Development including:

- Victoria Park Racecourse
- Recreation
- Industry and car manufacturing
- Swimming

2.2 PUBLIC ART STRATEGY

The project includes a Public Art Strategy:

Jonathan Jones with Andrew Burges Architects, Grimshaw & TLC, *Public Art Strategy Statement*, dated May 2016

The Strategy focuses on the Aboriginal use and occupation of the place and the proposed elements are described in Section 5.0 below.

[2] As defined in the *ICOMOS Burra Charter* 1999
[3] Marquie-Kyle, Peter & Meredith Walker 1992

3.0 HISTORICAL DEVELOPMENT

The history of the place is well documented and a summary of the development of the place is noted below.

3.1 ABORIGINAL AND ARCHAEOLOGICAL SIGNIFICANCE

3.1.1 Aboriginal Archaeology

The Steele Assessment noted that were no documented Aboriginal archaeological sites or objects known to occur in the study area.

The report notes that the site had been extensively disturbed from the damming of the creeks from the 1820s onwards and that any Aboriginal archaeological remains will likely have have been destroyed or disturbed by subsequent activity, though there exists the potential for remains.

The site was part of the wetlands fed by local creeks and was likely used for gathering of water, materials and food where the plant species and wildlife would have provide a rich crop.

The vegetation once found around Green Square included:

...varied heath, scrub and low forest vegetation with a rich variety of shrubs, including *Banksia aemula*, *Monotoca elliptica*, *Eriostemon australasius*, *Ricinocarpos pinifolius* and *Xanthorrhoea resinosa*... *Eleocharis sphacelata* would have been a characteristic species, as it is today, and in the shallower water, *Baumea articulate*, *Baumea rubiginosa* and *Juncus species* would have been abundant...Native Broom, *Viminaria juncea*, was common. Other common shrub species included *Banksias errata* and *Eriostemon australasius* while 'small soaks and concentra- tions of organic matter in the sand formed locally wet habitats for *Goodenia stelligera*, *Callistemon citrinus*, Button Grass, *Gymnoschoenus sphaerocephalus*, and other swamp heath plants'.[28] On the floodplain of Waterloo Swamp, the paperbark *Melaleuca quinquenervia*, would also have thrived….[4]

Local fauna would have included bandicoots, possums, kangaroo and swamp wallaby, lizards and snakes and quoll[5].

3.1.2 Post-European archaeology

The Steele Assessment notes that archaeological remains from the early periods of development would have been impacted by fill on the site and subsequent industrial development after the Second World War. The Post War car plants have been demolished though the site retains a drainage line that has recently been upgraded.

[4] Doran, Jason, Pre European Environmental Landscape of Green Square, pp26 & 27. Part of Karskens
[5] Ibid p. 28

3.2 POST-EUROPEAN SETTLEMENT HISTORY

3.2.1 Swampland and Dams

The area formed part of a series of swamps stretching from Botany to Centennial Park that were developed as a source for Sydney's drinking water. As the area became developed for industry and came under private ownership, the swamp and creeks were dammed and the Joynton Avenue frontage of the subject area was the site of the Waterloo Dam at the head of the swamp that ran east and north into the site.



Figure 3.1 Current site area and lot layout superimposed on early plan of the swamp and dams

Source: Conybeare Morrison International. *Epsom Park Precinct Masterplan*, dated December 2009, p. 19 with mark up by author

Little is known of the early detail of the area and the dams though the earliest descriptions noted that the area was quite desolate, a view coloured no doubt by its limited development and farming potential. The area was reputedly named after the Waterloo Mills close to the Waterloo Dam, the name Waterloo being bestowed by Governor Macquarie to commemorate the British victory at the Battle of Waterloo in the Napoleonic Wars.

3.2.2 Early Development

Early industries close to the site included the Rose Valley Wool Wash that commenced business in the 1860s. In the late 1880s the area was developed for housing with Victoria Town (1879) and the Salisbury and Chester Estates (1886).

3.2.3 Victoria Park Racecourse

The first major development of the site was the Victoria Park Racecourse that commenced in 1907 with the purchase of a large tract of land by Sir James Joynton Smith. Smith married into the hotel trade and took an interest in horse racing investing in tracks at Rockdale, Forest Lodge and later Zetland. The tracks were more widely popular than today and there were tacks at Roseberry, Kensington and Ascot prior to the early 1940s.

The development in the early 1900s of large housing estates to the south (Roseberry Estate) and east (Kensington) would have been a great boost to trade, though the impact of the opening of the South Sydney Hospital in 1913 may have been less in Joynton's favour.

The development was large and included the drainage of the swamp and the construction of a track, grandstand, leger, stables totalisor etc. The buildings were constructed at the northern end of the course and none were located in the subject site.



Figure 3.2 *Psalmist* wins a race at Victoria Park in 1935

Source: State Library of NSW Sam Hood, 'Psalmist'

The site was sold to Lord Nuffield in 1946 though the track survived till 1952. Only one of the racecourse buildings survives.

3.2.4 Industry and Car Manufacturing

Following the demise of the racetrack, the northern part of the site was developed for a car manufacturing plant by Lord Nuffield (William Richard Morris Nuffield) the founder and proprietor of Morris Motors Limited,

The car plant opened in 1950 and was a very extensive development that initially assembled car from overseas materials but later developed into a fully-fledged manufacturing plant. The plant closed in the 1970s.

The plant attracted component suppliers to the surrounding sites and the northern section of the subject site was developed by James N. Kirby Holdings, an automotive parts manufacturer. In 1955 they erected a large factory on the site designed by architect Francis Feledy who had designed most of the buildings for Nuffield's car factory to the north. The factory was later converted to a maintenance facility by the Sydney County Council who acquired the site in 1964. The building has been demolished.

The southern section of the subject site and the northern section of the Council depot were purchased by the Olympic Tyre and Rubber Company in 1954 and 1955. On the Joynton Street site they erected a single storey warehouse in 1955 (also to the design of Feledy) and proposed a similar building to the Epsom Street frontage. Both buildings have been demolished and the site was developed by South Sydney Council in 1989 for the current depot buildings.



Figure 3.3 Aerial View of the Morris car plant dated March 1957

The subject site is the area to the top and is undeveloped

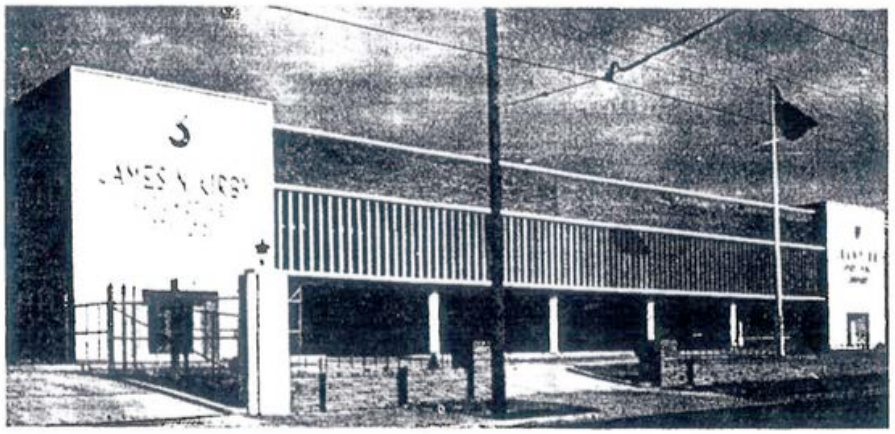
Source: Rod Howard Heritage Conservation Pty Limited, *Victoria Park, South Dowling Street, Zetland, Heritage Assessment Survey*, dated 1998, p. 41



Figure 3.4 City Building Surveyors Detail Sheets c. 1956 Sheet 24 with site highlighted in red

Source: City of Sydney Archives

This later phase is emblematic of the Post War boom in manufacturing that reflected the economic optimism of the 1950s, though little of the built development survives.



JAMES N. KIRBY AUTOMOTIVE PTY. LTD.
The new building, which has a floor area of 80,000 sq. ft., is the first stage in the development of an eleven-acre site. The clean, simple lines of the facade are appealing.

Figure 3.5 James Kirby Automotive Pty Limited

Source: *Building Lighting and Engineering*, 24 December 1955



THE NEW OLYMPIC TYRE BUILDING.
JOYNTON AVENUE. ZETLAND, SYDNEY.
Architect: F. E. Faledy. Builders: Kell & Rigby Pty. Ltd.
As the facade faces west, adjustable aluminium louvres cover the whole of the windows and impart distinction to the elevation.

Figure 3.6 The new Olympic Tyre Building

Source: *Building Lighting and Engineering*, 24 November 1956

3.2.5 Recreation and Swimming

There were few recreational facilities at Waterloo in the Nineteenth and Twentieth Century and the closest pool was at Prince Alfred Park (1956). However the local creeks and swamps had been dammed and the waterholes and brickpits would have provided ample opportunities. The construction of the Alexandra Canal (1887-1905) would have afforded another place to swim.

The sand hills close to the site would have made an easy route to the sea pools and beaches along the coast and at Botany Bay[6] providing a link between freshwater and saltwater, a 'tension' that was reflected in the architects' design response to the competition brief and the proposed public artwork.

3.2.6 Green Square

The site of now part of the Green Square urban renewal project that represents the aims and aspirations of South Sydney Council and the City of Sydney to redevelop the area following the decline of the its industrial base that is one of the largest renewal projects in the Sydney.

3.3 Historical Associations

The site has some historical associations with Sir James Joynton Smith (1858-1948) who developed the Victoria Park Racecourse and who was a keen investor in the horse racing business and active in Sydney's hotel trade.

3.4 Statements of Significance

The heritage assessment contained assessments of the significance of the site and the statement of significance:

The subject site is part of the Waterloo swamp that was the one of the early sources for Sydney's drinking water that was later dammed as the Waterloo dam to provide water for industrial uses. The site was later part of the Victoria Park Racecourse that was established on the swamp in 1907 by Sir James Joynton Smith and that continued on the site till the 1950s.

The site was also part of the Post War development of the area for the automotive industry by the Lord Nuffield and the Morris Motor Company and the subject site was developed by James N.Kirby Holdings (1955) and the Olympic Tyre and Rubber Company (1955)

The site is to be come a recreation hub in the Green Square redevelopment, one of the largest urban renewal projects in Sydney

The place has associations with Sir James Joynton Smith (1858-1948) who developed the Victoria Park Racecourse and who was a keen investor in the horse racing business and active in Sydney's hotel trade. He had numerous business interests including newspapers and radio stations and was active in public life being and alderman and mayor of the City of Sydney and later a MLC.

The place may have some special association for those with memories of the Victoria Park Racecourse that dominated the local area and that would have provided a lively social scene. The development of the site represents the aims and aspirations of South Sydney Council and the City of Sydney to redevelop the area following the decline of its industrial base and Green Square is one of the largest urban renewal projects in the Sydney.

[6] Murray, Lisa, City Historian, *Swimming in Waterloo*, unpublished research paper

4.0 INTERPRETATION POLICY

4.1 INTERPRETATION DEVICES

From the above it is possible to develop policies for the interpretation of the place in regard to its:

- Aboriginal Use
- Archaeology
- Post European Settlement Historical Development
- Remnant built elements
- Assessments of Significance
- Use
- Landscaping

Interpretation is likely to be in the form of introduced devices like sculptures and play equipment but is also be reflected in the building design, landform, plantings, and place name. *Gunyama* is an Aboriginal word for *winds from the southwest*.

If any Aboriginal artefact or evidence of occupation or use are located this would require a specialised examination that is outside of the scope of this report and it is likely that any such finds would lead to their protection in situ.

If any archaeological deposits are located during the work (e.g. remains of the Waterloo Dam) these can be incorporated into the design or interpreted depending on their quality and extent.

Much of the built elements of the site relating to its Post War development for the automotive industry have been demolished with only the front boundary walls signalling the former buildings along Joynton Avenue. These are not of such quality or significance that they would be retained and there is no significant fabric or elements on the site that can play a meaningful role in interpretation.

This interpretation policy largely relates to interpretation that will be in the form of introduced devices that will likely be water features, sculptures and play equipment. However the early landform, and likely Aboriginal use, can also be interpreted by the built form in the treatment of landscaping and selection of plantings.

The term *introduced devices* refers to features, sculptures and the like that may demonstrate, describe or reflect an important aspect of the site.

The devices will largely reflect the historical development of the place.

The themes and information for the interpretation are identified in Appendix A.

4.2 PROPOSED INTERPRETATION POLICIES

Policy A1 Interpret the following as being of high significance:

	Event	Device
	Aboriginal occupation and use of the area	Introduced Devices
		Place names
		Landform (drainage channels and swales)
		Sculptures, ground materials
		Plantings
	Swampland and Dams	Landform (drainage channels and swales)
		Plantings
		Introduced Devices
	Swimming and Recreation	The Aquatic and Recreation Centre
		Introduced Devices
	Early Development	Introduced Devices
	Victoria Park Racecourse	Play equipment
		Introduced Devices
	Industry and Commerce	
	Automotive Industry	Play equipment and colours
		Introduced Devices

Policy A2 Interpret the following as being of moderate significance:

	Historical Associations	
	Sir James Joynton Smith	Introduced Devices
	Lord Nuffield	Introduced Devices
	Morris Motor Company	Play equipment
		Introduced Devices

4.3 ASSESSMENTS OF SIGNIFICANCE

Policy A5 Interpret the following as being of moderate significance:

	Item	Device
	Post War industrial development of Zetland	Introduced Devices



JOHN OULTRAM

5.0 INTERPRETATION DEVICES

The implementation of the interpretation strategy has been developed by the consultant team including the architects, landscape architect, signage consultant, heritage consultant and Aboriginal artist, Jonathan Jones in association with Aunty Julie Freeman. The works will include:

5.1 AQUATIC AND RECREATION CENTRE

The centre is placed over part of the former wetlands and reintroduces a waterscape to the site that will reflect this aspect of the site. The new swimming facilities will reflect this early recreational use of the site including swimming in the water holes and pits nearby. The later recreational events at the racecourse are reflected by the recreational facilities of the centre.

The roof structure with its large, open span is of an industrial scale that is related to the former uses on the site that had large, open plan industrial buildings.

Colours used will include references to the Joseph Lycett paintings of the area and the Morris car colours.

5.2 DRAINAGE SWALE AND WATER GARDEN

The overland flow path and rain garden will reflect the drained swampland and the dam that stood on this section of the site. The overland flow path is located at the edge of the aquatic and recreation centre and to the west of the sports field and will a setting for sculptural elements and plantings that reflect the Aboriginal use of and occupation of the site and plantings that reflect the early flora found in the area.

5.3 PUBLIC ART

The Public Art Strategy includes the theme:

- Saltwater/Freshwater

5.3.1 Water Carrier Sculptures

Large water carrier sculptures (*bangala* or Eora water vessels) in bronze based on traditional Aboriginal designs will be placed along the rain garden with rushes growing around them.



Figure 5.1 Water carrier sculpture (not the actual)

Source: Public Art Strategy

5.4 LANDSCAPE AND PLANTINGS

The rain garden will include the introduction of swamp and wetland plants that were used by local Aborigines as a food or material source.

Plantings in other areas will also relate to the coastal heath and wetlands. Early views of the area indicate that it was undulating sand hills and the mounded form and plantings in the playground area and around the pools will reflect this.

5.4.1 Recreation and Swimming

The two pools in the aquatic centres will be the most obvious reflection of the theme of swimming and they could be considered to act as indicators of the former dams on the site as the pools are sited over the southern portion of the former wetlands (See Figure 3.1). The aquatic and recreation centre are reflective of the former recreational uses of the site.

The playground will include a water weir that reflects the history of water at the site.

5.4.2 Play Equipment

Play equipment will reflect some of the later uses or important events at the site including car manufacturing (cars). The large, industrial type tubes in the playground reflect the former manufacturing/industrial aspects of the site.

The customised paly equipment in the playground will use colours based on the common colours used for the cars emerging from the Morris Factory.

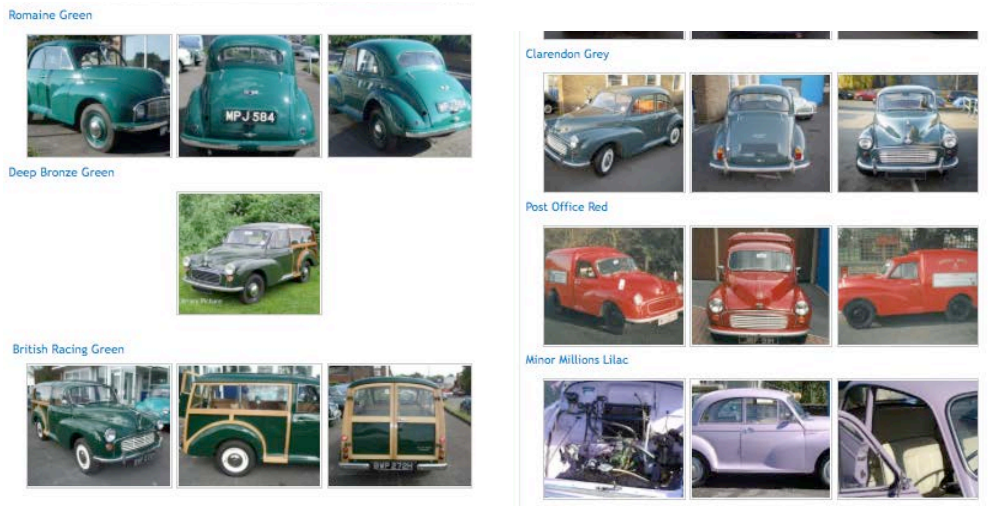


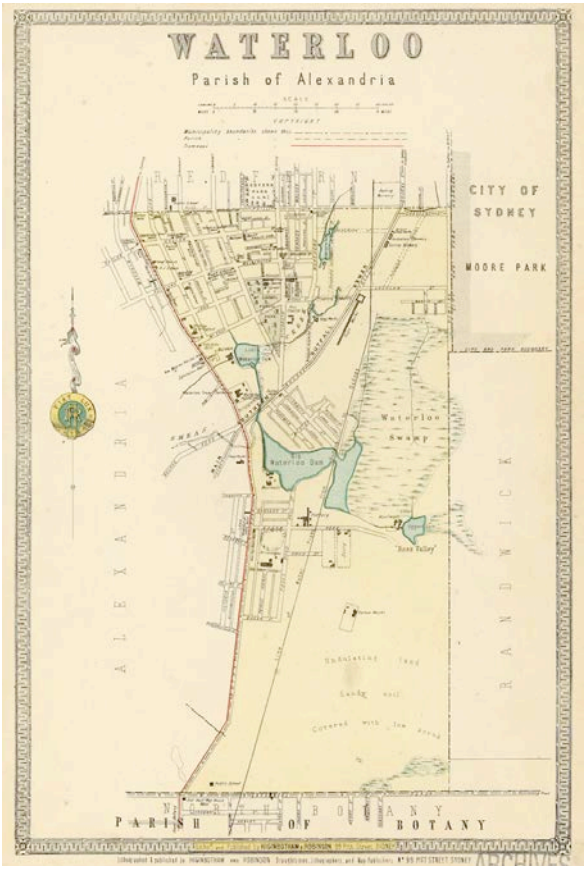
Figure 5.2 Morris Paint Colours

Source: Charles Ware Morris Minor Centre, Bristol

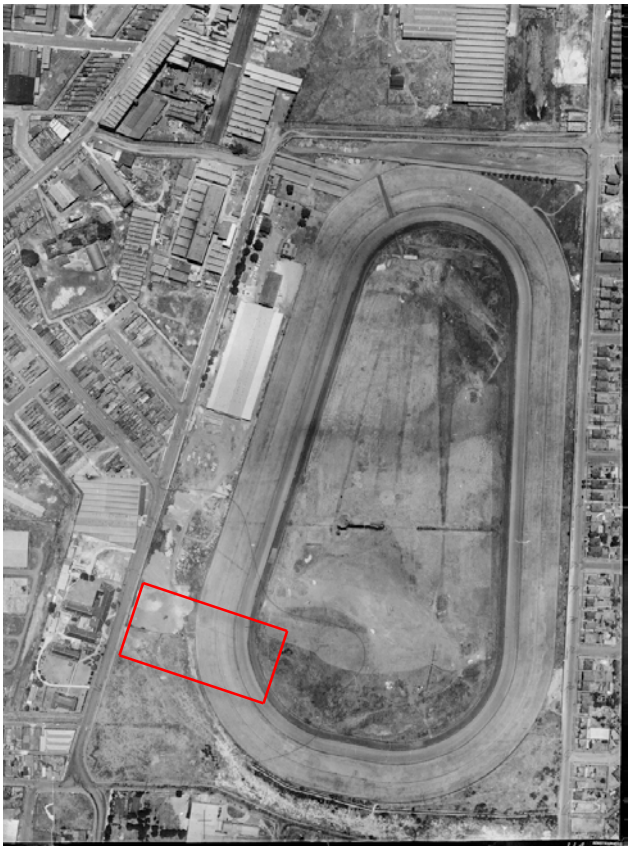
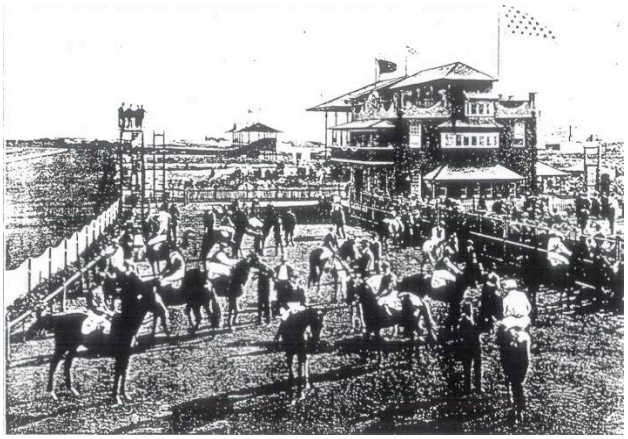
Information for the respective themes is shown in Appendix A.

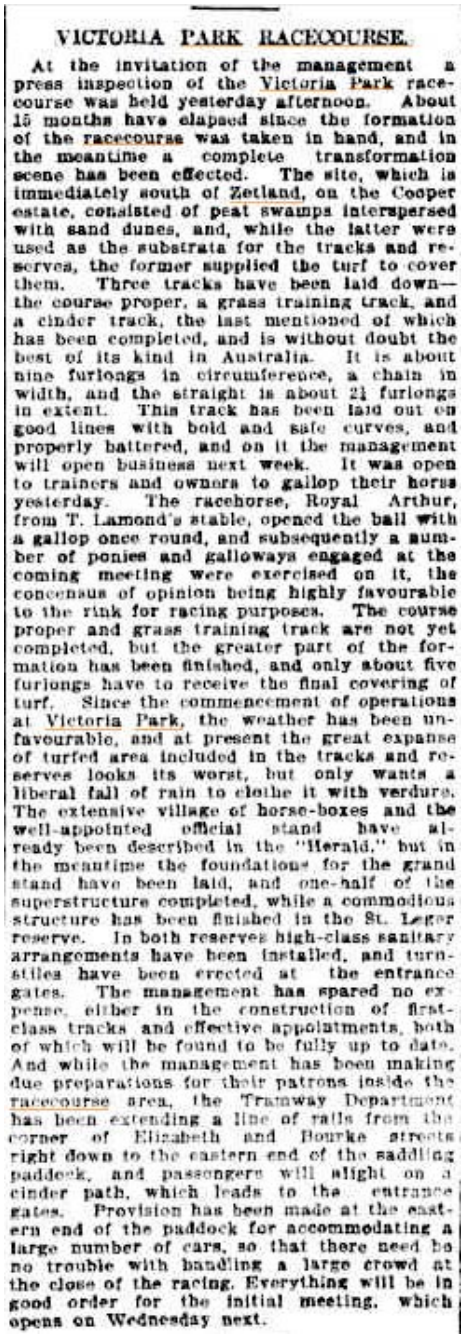
6.0 APPENDIX A – THEMES AND INFORMATION FOR INTRODUCED DEVICES

INTERPRETATION	
THEME	REPRESENTATION
Aboriginal occupation	The Aboriginal use and occupation of the area is not recorded and there are no images relating to the use of the site. However, it would be safe to assume that the wetlands was a source of water, food and materials for manufacture
	Place names
	Landform – overland flow path, rain garden and mounds
	Plantings – wetland and coastal heath plantings
	Water carrier sculptures

INTERPRETATION	
THEME	REPRESENTATION
Wetlands and Dams	The extent of the swamp/wetlands and dams at European settlement is well documented though the detail of the dam is not known
	Landform – overland flow path and mounds
	Pools
	Plantings – wetland plantings
	Water weir in playground
GS 1	
	Detail from Higinbotham and Robinson's map of Waterloo LGA of the mid 1880s
	Source: City of Sydney Archives
GS 2	
	Dunes at the south-eastern corner of Victoria Park Racecourse, Zetland
	Source: State Library of NSW, Sam Hood, Home and Away 7893

INTERPRETATION	
THEME	REPRESENTATION
Recreation and Swimming	The local wetlands, pool and brick pits provided swimming places for locals
	The aquatic and recreation centre will reflect this theme

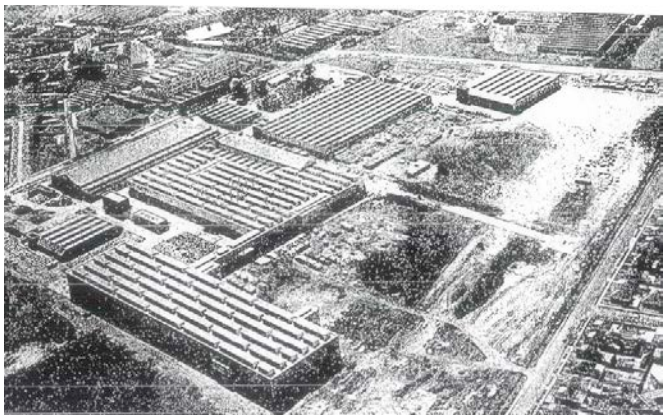
INTERPRETATION	
THEME	REPRESENTATION
Victoria Park Racecourse	A major development of the area was the establishment of the Victoria Park Racecourse in 1907 by Sir James Joynton Smith
	Recreational facilities across the site
	The aquatic and recreation centre
GS 3	
	Aerial view of Victoria Park racecourse in 1949 with approximate location of site overlaid
	Source: City of Sydney Archives (Sheet A014) (HIS)
GS 4	
	Victoria Park Racecourse
	Source: *The Theatre*, 1 April 1911 (Howard p. 26)

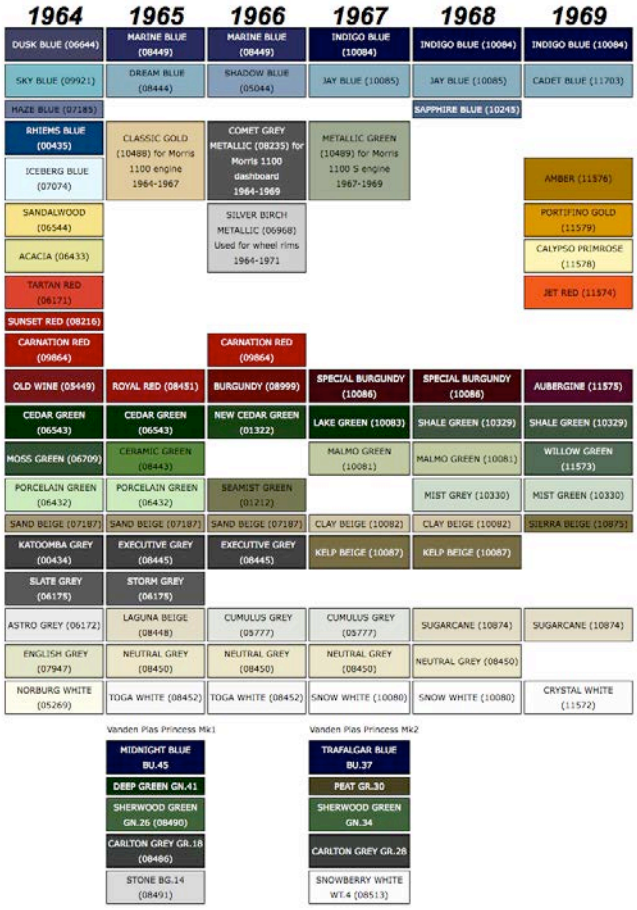
INTERPRETATION	
THEME	REPRESENTATION
Victoria Park Racecourse	
GS 5	
	Victoria Park Racecourse
	Source: *Sydney Morning Herald*, 10 January 1908, p.4

VICTORIA PARK RACECOURSE.

At the invitation of the management a press inspection of the Victoria Park racecourse was held yesterday afternoon. About 15 months have elapsed since the formation of the racecourse was taken in hand, and in the meantime a complete transformation scene has been effected. The site, which is immediately south of Zetland, on the Cooper estate, consisted of peat swamps interspersed with sand dunes, and, while the latter were used as the substrata for the tracks and reserves, the former supplied the turf to cover them. Three tracks have been laid down—the course proper, a grass training track, and a cinder track, the last mentioned of which has been completed, and is without doubt the best of its kind in Australia. It is about nine furlongs in circumference, a chain in width, and the straight is about 2¼ furlongs in extent. This track has been laid out on good lines with bold and safe curves, and properly battered, and on it the management will open business next week. It was open to trainers and owners to gallop their horse yesterday. The racehorse, Royal Arthur, from T. Lamond's stable, opened the ball with a gallop once round, and subsequently a number of ponies and galloways engaged at the coming meeting were exercised on it, the concensus of opinion being highly favourable to the rink for racing purposes. The course proper and grass training track are not yet completed, but the greater part of the formation has been finished, and only about five furlongs have to receive the final covering of turf. Since the commencement of operations at Victoria Park, the weather has been unfavourable, and at present the great expanse of turfed area included in the tracks and reserves looks its worst, but only wants a liberal fall of rain to clothe it with verdure. The extensive village of horse-boxes and the well-appointed official stand have already been described in the "Herald," but in the meantime the foundations for the grand stand have been laid, and one-half of the superstructure completed, while a commodious structure has been finished in the St. Leger reserve. In both reserves high-class sanitary arrangements have been installed, and turnstiles have been erected at the entrance gates. The management has spared no expense, either in the construction of first-class tracks and effective appointments, both of which will be found to be fully up to date. And while the management has been making due preparations for their patrons inside the racecourse area, the Tramway Department has been extending a line of rails from the corner of Elizabeth and Bourke streets right down to the eastern end of the saddling paddock, and passengers will alight on a cinder path, which leads to the entrance gates. Provision has been made at the eastern end of the paddock for accommodating a large number of cars, so that there need be no trouble with handling a large crowd at the close of the racing. Everything will be in good order for the initial meeting, which opens on Wednesday next.

INTERPRETATION	
THEME	REPRESENTATION
Victoria Park Racecourse	
Aerial Displays GS 6	
	Guillaux performing before a large crowd at Victoria Park Racecourse during his first aerobatic display in Sydney on 2 May 1914
	Source: Powerhouse Museum Gift of S. Dyson 1982
GS 7	
	On 9 December 1909 at Victoria Park Racecourse Colin Defries left the ground in a Wright model A that he named *Stella*
	Source: Powerhouse Museum

INTERPRETATION	
THEME	REPRESENTATION
Industry and Commerce	Automotive Industry - British Motor Corporation (BMC) Plant Leyland
	Aquatic and Recreation Centre design will reflect the former industrial nature of the site with its long span roof
	Play Equipment - cars
	Play equipment - industrial scale tubes
GS 8	
	Aerial view from 1958
	Construction Review, October 1958, p. 13 (Howard)
GS 9	**48,000 MORRIS MINORS** The British Motor Corporation (Australia) plant at Zetland, N.S.W., has produced its 48,000th Morris Minor. Production of the cars began in 1950. Work on the first assembly plant began in 1948, when the Victoria Park racecourse, on which the plant stands, was still being used as a training track. The plant now covers about 30 acres and represents an investment of £13-million. Many of the workmen who assembled the first Morris Minor are still at the Zetland works. At present, two shifts are being worked on the production line to cope with the demand for Minors, which BMS (Australia) officials describe as "a car here to stay."
	48,000 Morris Minors
	Source: *Western Herald* (Bourke) 23 May 1958 p. 8

INTERPRETATION	
THEME	REPRESENTATION
Industry and Commerce	Automotive Industry - British Motor Corporation (BMC) Plant
	Play Equipment Colours
GS 12	
	Colours for locally made Morris 1100s 1500s, Minis and Austin 1800s
	morriselevenhundred website

INTERPRETATION	
THEME	REPRESENTATION
Sir James Joynton Smith (1858-1943)	
	Sir James Joynton Smith was a hotelier, racecourse and newspaper owner who established the Victoria Park racecourse in 1909. Appointed to the Legislative Council in 1912 he was later member for Bligh from 1916 till 1918 and was the 48th Lord Mayor of Sydney.
Lord Nuffield (1877-1963)	Born William Richard Morris Nuffield (1877-1963), Nuffield was the founder and proprietor of Morris Motors Ltd. The first Morris cars went into production in 1913. An Australian branch of the company was incorporated in May 1945. In 1952 the Victoria Park racecourse was subdivided. The northern part, with an area of 57 acres, was retained by Nuffield (Australia) Pty Ltd for its new car plant

Andrew Burges Architecture &
Grimshaw Architects

Gunyama Park Aquatic and Recreation Centre

Acoustic Design Report

Rev I | 31 May 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 240516-00

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ARUP

Document Verification

ARUP

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Issue	31 Jul 2015	**Description**	Issue		
			Prepared by	Checked by	Approved by
		Name	Jon Osborne / Daniel Jimenez	Jon Osborne	Nick Boulter
		Signature			
Rev A	16 Oct 2015	**Filename**	2015-10-16 GPGSAC Design Report Scheme Stage.docx		
		Description	Schematic Design Stage		
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		Name	Jonathan Osborne	Jonathan Osborne	Nick Boulter
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		Name	Jonathan Osborne	Jonathan Osborne	Nick Boulter
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			Prepared by	Checked by	Approved by
		Name	Daniel Jimenez	Nick Boulter	Nick Boulter
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Revision	**Date**	**Filename**	2016-03-04 GPGSAC Acoustic Design Report (RevD).docx		
Rev D	4 Mar 2016	**Description**	Final 80% Acoustics Design Report for 100% DD deliverable: Updated in line with 90% DD architectural drawings		
			Prepared by	Checked by	Approved by
		Name	Daniel Jimenez	Jonathan Osborne	Nick Boulter
		Signature			
Rev E	1 Apr 2016	**Filename**	2016-04-01 GPGSAC Acoustic Design Report (RevE).docx		
		Description	Updated Acoustics Design Report in line with 100% DD architectural drawings and 90% DD mechanical services design		
			Prepared by	Checked by	Approved by
		Name	Daniel Jimenez	Jonathan Osborne	Nick Boulter
		Signature			
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			Prepared by	Checked by	Approved by
		Name	Daniel Jimenez	Jonathan Osborne	Nick Boulter
		Signature			
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		Description	Revised CoS comments. Issued for DA		
			Prepared by	Checked by	Approved by
		Name	Daniel Jimenez	Jonathan Osborne	Nick Boulter
		Signature			
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Document Verification

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			Prepared by	Checked by	Approved by
		Name	Daniel Jimenez	Jonathan Osborne	Nick Boulter
		Signature			
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		Description	Addressed CoS comments. Final Issue for DA.		
			Prepared by	Checked by	Approved by
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		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

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Appendices

Appendix A

Glossary of Acoustic Terms

Appendix B

Noise Criteria

Appendix C

Environmental Noise Survey

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Sound Insulation Performance Mark-up

Appendix E

Review of Australian and International Design Guidelines for Swimming Pools

Appendix F

Preliminary Room Acoustic Modelling Results

Appendix G

GPARC Outdoor Events Noise Impact Assessment

Executive Summary

Arup has been commissioned to provide acoustic design for the Gunyama Park Aquatic and Recreation Centre (GPARC). This report is based on the ABA / Grimshaw 100% Design Development Documentation Package, received 25 March 2016, and provides updates to our 50% Design Report.

As part of our work, a precedent study of two swimming pools in Sydney has been completed. These are the Cook and Phillip Aquatic Centre, and the Ian Thorpe Aquatic Centre. Potential and actual acoustic issues within these facilities have been identified, including any solutions. Of particular note are the challenges of protecting noise sensitive areas from adjacent noise generating areas, and providing adequate control of reverberant sound. Issues and solutions from the precedent study have been considered for the GPARC and have informed the design.

Relevant acoustic criteria have been determined based on local and national guidance, requirements for Green Star accreditation and international best practice. They are provided for internal noise levels including noise ingress, internal finishes, environmental noise emissions and emergency equipment.

An environmental noise assessment has been completed at the GPARC site. Data from the noise assessment has been used to set noise limits for local current and future noise-sensitive receivers according to the NSW Industrial Noise Policy (INP). City of Sydney Council noise criteria have also been derived from the survey for future road and residential developments.

Preliminary design advice is provided for the GPARC, including identification of key acoustic challenges, and indicative solutions for how these will be addressed. Providing adequate control of internal acoustics to the leisure and program pool areas is important. An extensive study has been carried out to find harmony between a satisfactory acoustic performance and the architectural vision of the project. The treatments necessary to achieve the Green Star requirements are also given. In many cases, achieving the Green Star room acoustics criteria will require significantly more acoustic treatment to the room surfaces than would otherwise be the case.

Other aspects of the acoustic design such as partitions, internal finishes and mechanical services will be developed in conjunction with the architect as the project progresses.

The acoustic considerations and impacts of this project are in line with other developments within the City of Sydney and surrounds. With adequate design and careful management practices employed, this application is recommended for approval with regard to acoustics.

1 Introduction

Arup has been commissioned to provide acoustic design for the Gunyama Park Aquatic and Recreation Centre (herein referred to as GPARC). This report is based on the ABA / Grimshaw 100% Design Development Documentation Package, received 25 March 2016.

This document:

- Sets acoustic criteria for the development setting of acoustic criteria based on local and national guidance and international best practice;
- Summarises results from an environmental noise survey undertaken on site;
- Provides benchmarking analysis of two existing Sydney swimming pool facilities
- Identifies acoustic challenges and throughout the proposed GPARC development and proposes design solutions in accordance with the current level of design.

This report is the second of three reports being developed in line with the project design.

Acoustic terminology used in this report is defined and described in the Glossary in Appendix A.

1.1 Development Description

A map of the subject site and nearby residential noise-sensitive receivers is given in Figure 1.

Figure 1: Site location and nearest noise sensitive receivers



It should be noted that the residential receivers shown in Figure 1, and Zetland Avenue, George Julius Avenue and Rose Valley Way do not currently exist. The design includes these areas as they are expected to be built as part of the development of Green Square.

1.2 Facilities

The GPARC development includes:

Front of house	• Forecourt (external) • Entry • Café / Kiosk • Crèche / Shared use • Circulation core
Administration	• Management offices • Meeting rooms • Staff amenities • Staff bicycle parking (external)
Aquatic Centre	• Pool and leisure hall • Outdoor pool (external) • Wet change rooms and lockers • First aid • Hydrotherapy • Plant and store
Health & Fitness Centre	• Health and fitness offices • Gym • Dry fitness studios • Dry change rooms and lockers • Circulation
Back of house	• Garbage room • Plant • Cogeneration / Trigeneration Plant
Other	• Substation • Cogeneration/ Trigeneration Related Plant
Park	• Field Amenities • Public Amenities • Sports Field • Playground • Outdoor Fitness • BBQ Areas

2 Acoustic Criteria

Criteria for internal noise levels and reverberation times are provided in AS/NZS 2107[1] and Green Star Design and As Built v1 Submission Guidelines[2].

Green star acoustic points are awarded to projects that provide appropriate levels of acoustic amenity to occupants. Green star requirements for internal noise levels and reverberation are generally in line with good acoustic design, and with Australian standards and acoustic design guidelines.

2.1 Internal Noise Levels

A summary of criteria relevant to this project is provided below in Table 1. These criteria are intended to apply to the sum of the noise intrusion from external sources and noise from ventilation and air conditioning systems (i.e. mechanical services noise). It is intended to target the 'satisfactory' criteria, recognising that the 'maximum' criteria may sometimes be appropriate and cost-effective.

Table 1: Internal Noise Level Criteria

Activity Area	Category Name	Room Name	AS/NZS 2107 Recommended Design Sound Level, dBL_{Aeq}		Green Star Requirement
			Satisfactory	Maximum	
Front of House	Entry	Foyer/ Reception/ Ticketing/ Merchandise Area	45	50	50
		Cash Handling Room	45	50	50
	Café/Kiosk	Indoor Seating	45	50	50
		Servery/Kitchen	50	55	55
	Crèche/ Shared use	Indoor Play Area	45	50	50
Administration	Management offices	Pool Operations Office	40	45	45
		Manager's Office	40	45	45
		Staff Office	40	45	45
	Meeting Rooms	Meeting Room 1	40	45	45

[1] Australian / New Zealand Standard AS/NZS 2107:2000. Acoustics – Recommended design sound levels and reverberation times for building interiors.
[2] Green Building Council of Australia – Green Star Design & As Built v1 Submission Guidelines

Activity Area	Category Name	Room Name	AS/NZS 2107 Recommended Design Sound Level, dBL$_{Aeq}$		Green Star Requirement
			Satisfactory	Maximum	
		Meeting Room 2	40	45	45
	Staff Amenities	Staff Room	40	45	45
Aquatic Centre	Pool and Leisure Hall	Program Pool and Leisure Water Area	50[1]	55[1]	55[1]
	Wet Changerooms and Lockers	Wet Changerooms	45	55	50
		Assisted Changerooms	45	55	50
	First Aid	First Aid	40	45	45
	Hydrotherapy	Hydrotherapy Pool	45[2]	50[2]	50[2]
		Hydrotherapy Changerooms	45	55	50
Health and Fitness Centre	Health and Fitness Offices	Manager's Office	40	45	45
		Consultation Room	40	45	45
	Gym	Weights and Cardio	45	55	50
		Spin Room	45	55	50
	Dry Fitness Studios	Dry Fitness Studio 1	45	55	50
		Dry Fitness Studio 2	45	55	50
	Dry Changerooms and Lockers	Dry Changerooms	45	55	50

Note 1. In the absence of specific AS/NZS 2107 guidance for swimming pools, we provide a limit for mechanical services noise and external noise ingress. Based on our experience and the precedent study, the total noise level including noise from pool drainage may exceed the limits given above.

Note 2. In the absence of specific AS/NZS 2107 guidance for hydrotherapy pools, we provide a limit for mechanical services noise and external noise ingress. Based on hydrotherapy pool usage i.e. that it is a therapeutic environment, we have recommended more stringent criteria than for the main pool areas. This is based on our experience in the acoustic design of swimming pools and results from the precedent study.

It should be noted that AS/NZS 2107 excludes the evaluation of occupancy noise and transient or variable noise sources (e.g. aircraft noise, construction noise, railway noise, crowd noise, emergency vehicle audible warning devices, etc.). Rain noise is also considered a transient noise source given the unpredictable and infrequent nature of this event in the Sydney area. However, it is recommended to consider strategies to minimize the impact of these noise sources within the building spaces where a feasible and reasonable approach can be implemented.

Green star requirements are based on AS/NZS 2107, which does not provide specific guidance for swimming pools. In the absence of guidance, we provide criteria based on measured results from the precedent study (see Appendix B).

From Arup's previous experience in the design of swimming pools, it is suggested that an overall noise level of less than 60 dB(A) is unlikely to be achievable due to noise from pool drains. The pool filtration services noise (i.e. water flow at drains) is considered "specialist equipment" and impractical to control to the AS/NZS 2107 criteria and should therefore excluded from assessment. However, industry best practice methods for drain design are recommended to be set in place to reduce noise from water filtration as far as is practicable. An example of this is a gradual incline of the drain slope, which can reduce the noise generated by the water collected around the pool.

2.2 Room Acoustics and Internal Finishes

Relevant Reverberation Time (RT) criteria are provided below, with Arup recommendations. These criteria relate to the mid frequencies only (500 Hz to 1 kHz octave bands).

Table 2: Mid Frequency Reverberation Time criteria

Activity Area	Category Name	Room Name	AS/NZS 2107 Recommended RT(s)	Arup Recommended RT	Green star requirement
Front of House	Entry	Foyer/ Reception/ Ticketing/ Merchandise Area	Minimize as far as practicable	$\leq$ 1.5 s	Absorption to 50% of ceiling area (minimum)
		Cash Handling Room	Minimize as far as practicable	$\leq$ 1.5 s	Absorption to 50% of ceiling area (minimum)
	Café/Kiosk	Indoor Seating	Minimize as far as practicable	$\leq$ 1.5 s	Absorption to 50% of ceiling area (minimum)
		Servery/Kitchen	0.7 – 1.0	$\leq$ 1.0 s	1.0 s

Activity Area	Category Name	Room Name	AS/NZS 2107 Recommended RT(s)	Arup Recommended RT	Green star requirement
	Crèche/ Shared use	Indoor Play Area	Not provided – follow guidance for Games Rooms (<1.0)	< 1.0 s	N/A
Administration	Management offices	Pool Operations Office	0.4 – 0.6[2]	≤ 0.8 s	0.6 s
		Manager's Office	0.4 – 0.6[2]	≤ 0.8 s	0.6 s
		Staff Office	0.4 – 0.6[2]	≤ 0.8 s	0.6 s
	Meeting Rooms	Meeting Room 1	0.6 – 0.8	≤ 0.8 s	0.8 s
		Meeting Room 2	0.6 – 0.8	≤ 0.8 s	0.8 s
	Staff Amenities	Staff Room	0.4 – 0.6[2]	≤ 0.8 s	0.6 s
Aquatic Centre	Pool and Leisure Hall	Program Pool and Leisure Water Area	Note[1]	< 2.5 s	Absorption to 50% of ceiling area (minimum)
	Wet Changerooms and Lockers	Wet Changerooms	Not provided	≤ 1.5 s	N/A
		Assisted Changerroms	Not provided	≤ 1.5 s	N/A
	First Aid	First Aid	0.4 – 0.6[2]	≤ 0.8 s	0.6 s
	Hydrotherapy	Hydrotherapy Pool	Note[1]	< 2.5 s	Absorption to 50% of ceiling area (minimum)
		Hydrotherapy Changerooms	Not provided	≤ 1.5 s	N/A
Health and Fitness Centre	Health and Fitness Offices	Manager's Office	0.4 – 0.6[2]	≤ 0.8 s	0.6 s
		Consultation Room	0.4 – 0.6[2]	≤ 0.8 s	0.6 s
	Gym	Weights and Cardio	Minimize as far as practicable	≤ 1.7	Absorption to 50% of ceiling area (minimum)
		Spin Room	Minimize as far as practicable	≤ 1.7	Absorption to 50% of ceiling area (minimum)

Activity Area	Category Name	Room Name	AS/NZS 2107 Recommended RT(s)	Arup Recommended RT	Green star requirement
	Dry Fitness Studios	Dry Fitness Studio 1	1 – 1.1	$\leq 1.5^3$	1.1
		Dry Fitness Studio 2	1 – 1.1	$\leq 1.5^3$	1.1
	Dry Changerooms and Lockers	Dry Changerooms	Not provided	$\leq 1.5^3$	N/A

Note 1: Arup recommends that the AS/NZS 2107 guideline is followed for control of reverberation of swimming pool areas. In practice, the reverberation time of a swimming pool will be determined by the volume of the room, the area available for absorption, which would typically be limited to the ceiling and possibly some high level areas of the walls, and the performance of the acoustic absorption. The ratio of ceiling area available to room volume will therefore largely determine how much the reverberation time can be minimised. Further reductions in reverberation time may be achieved by the addition of acoustic banners. City Aquatics have stipulated an RT design range for the indoor pools of 1.5 to 2.0s, with a preference for 1.5s. This is explored in Section 3.3.1.

Note 2: Our professional opinion, based on our experience in the acoustic design of offices is that the AS/NZS 2107 recommendation is too low; a longer reverberation time has therefore been recommended. However, should a green star point be sought, the maximum of the AS/NZS 2107 range should be designed for.

Note 3: Our professional opinion, based on our experience is that 1.5 seconds is an appropriate target for adequate room acoustic control in rooms of this type.

2.3 Sound Insulation

Requirements for sound insulation will be developed to allow for noise sensitive and noise generating activities to take place throughout the GPARC building. In addition, the acoustic design will be developed to ensure that horizontal and vertical sound insulation requirements meet the requirements for speech privacy and internal noise levels, and comply with Green Star requirements.

The Green Star Design and As Built Submission Guidelines v1 state that under 10.3 *Acoustic Separation*:

> *1 point is available where the nominated enclosed spaces have been built to minimise crosstalk between rooms, and between rooms and open areas.*

The criteria for this green star point are as follows:

- The partition between two enclosed spaces should be constructed to achieve a weighted sound reduction index (R_w) of at least 45.

OR

- The sound insulation between enclosed spaces shall comply with $D_w + L_{AeqT} > 75$, where:
  - D_w is the weighted sound level difference between two spaces, and;
  - L_{AeqT} is the indoor ambient noise level in the space adjacent to the enclosed space.

Sound insulation requirements, constructions and details will be developed in subsequent stages of design.

2.4 Environmental Noise Emissions

Environmental noise emissions from GPARC are to be assessed under the NSW EPA Industrial Noise Policy[3] and the City of Sydney Council Standard Conditions of Development Consent[4]. A summary of criteria requirements for each are provided in Appendix B for reference.

In order to determine criteria for noise emissions from GPARC, an environmental noise survey was conducted in the vicinity of the proposed development site. Details of this survey are presented in Appendix C.

A summary of project specific criteria is presented in Table 3 to Table 5. In each case, the most stringent criteria form the basis of assessment.

Table 3: INP noise criteria for new industrial plant at residential receivers

Location	Time Period[1]	Intrusiveness Criterion $dBL_{Aeq,15min}$	Amenity Criterion $dBL_{Aeq,period}$	Project Specific Criterion
Residential receivers Along Future Zetland Avenue (North of site) and George Julius Avenue (East of site)	Day	61	**54**	54 $dBL_{Aeq, period}$
	Evening	52	**50**	50 $dBL_{Aeq, period}$
	Night	**46**	47	46 $dBL_{Aeq, period}$
Residential receivers Along Rose Valley Way (South of site)	Day	55	**51**	51 $dBL_{Aeq, period}$
	Evening	52	**46**	46 $dBL_{Aeq, period}$
	Night	48	**42**	42 $dBL_{Aeq, period}$

[1] Time periods are defined by the NSW INP as Day (0700h1800h), Evening (1800h2200h) and Night (2200h0700h).

[3] NSW EPA Industrial Noise Policy, January 2000
[4] City of Sydney Council Standard Conditions of Development Consent, 2 April 2012

Table 4: City of Sydney Criteria – General Noise, Mechanical Plant and Equipment

Location	Time Period	CoS Conditions									
		$dBL_{Aeq,15min}$	Noise - General (b) $dBL_{eq,15min}$ – Octave Band Centre Frequency (Hz)								
			31.5	63	125	250	500	1k	2k	4k	8k
Residential and commercial receivers (when in use) Along Future Zetland Avenue (North of site) and George Julius Avenue (East of site)	Day	61	65	69	59	54	52	54	51	43	32
	Evening	52	58	62	53	48	47	46	41	32	20
	Night	46	54	59	50	43	41	39	34	26	17
Residential and commercial receivers (when in use) Along Rose Valley Way (South of site)	Day	55	61	63	56	49	48	50	40	28	16
	Evening	52	56	59	53	46	47	47	37	22	15
	Night	48	51	55	50	43	43	42	31	18	15

It is understood that the café facility at the GPARC development will be licenced. Table 5 summarises CoS conditions in relation licenced premises uses.

Table 5: City of Sydney Criteria – Licensed Premises and Entertainment Venues

Location	Time Period	CoS Conditions								
		Noise – Licenced premises $dBL_{10,15min}$ – Octave Band Centre Frequency (Hz)								
		32	63	125	250	500	1k	2k	4k	8k
Residential receivers (at boundary, when in use) Along Future Zetland Avenue (North of site) and George Julius Avenue (East of site)	Day	67	71	61	56	54	56	53	45	34
	Evening	60	64	55	50	49	48	43	34	22
	Night	N/A								
Residential receivers (at boundary, when in use) Along Rose Valley Way (South of site)	Day	63	65	58	51	50	52	42	30	18
	Evening	58	61	55	48	49	49	39	24	17
	Night	N/A								
Commercial receivers (indoors, when in use) Along Future Zetland Avenue (North of site) and George Julius Avenue (East of site)	Day	65	69	59	54	52	54	51	43	32
	Evening	58	62	53	48	47	46	41	32	20
	Night	N/A								
Commercial receivers (indoors, when in use) Along Rose Valley Way (South of site)	Day	61	63	56	49	48	50	40	28	16
	Evening	56	59	53	46	47	47	37	22	15
	Night	N/A								

It should be noted that conditions 'Noise – General' part (a) and 'Noise – Mechanical Plant and Equipment' are equivalent to the intrusiveness criterion from the NSW INP for residential receivers.

The City of Sydney Standard Noise Criteria refer to the $L_{A90,\ 15min}$ parameter applicable at any time of day. In order to define suitable targets for the purpose of design, typical criteria have been developed independently for the day, evening and night time periods in accordance with the NSW INP definitions. Consistent with the NSW INP, the RBL has been used as a conservative measure of the $L_{A90,\ 15min}$ for each time period.

Compliance with the noise condition in relation to inaudibility of the noise generated by the swimming pool pumps shall be addressed through detailed design of the plant room to mitigate as far as practicable the noise impact upon the adjacent receivers.

Noise criteria shall be developed in consideration of future traffic noise levels at a later stage of design, based on projected future traffic flows of new roads.

2.5 Emergency Equipment

Emergency equipment will be designed to meet the following internal noise criteria during emergency operations, as per recommendations given in AS/NZS 1668.1:1998.

Table 6: Emergency Equipment Noise Criteria

Area	Noise Level
Occupied space	65 dB(A)
Fire isolation passage	80 dB(A)

An acoustic review of the mechanical services design including plant equipment source levels, duct layouts and plant equipment locations will be completed. Recommendations for acoustic attenuation will be provided as part of this work.

2.6 Construction Noise and Vibration

2.6.1 Construction Noise

A detailed construction noise and vibration management plan will be required once more precise construction activity information becomes available. The site-specific management plan shall be required to be submitted to City of Sydney Council for comment and approval prior to a Construction Certificate (CC) being granted. The plan will be developed to minimise the construction noise impact to the neighbourhood and be in accordance with City of Sydney Building Sites Noise Code (1988).

It is recommended that the noise control measures recommended in Australian Standard AS2436 (1981) *Guide to noise control on construction, maintenance and demolition sites* be followed.

Construction noise will also be managed in accordance with the NSW Office of Environment and Heritage (OEH) *Interim Construction Noise Guideline* (2009) which is aimed at managing noise from construction works regulated by the NSW Environment Protection Authority (EPA).

2.6.2 Construction Vibration

Vibration levels caused by activities on the site (including plant) should not exceed the levels specified in the DEC Assessing Vibration Guideline at any place of different occupancy at and around the site. The Assessing Vibration Guideline provides operational vibration criteria for maintaining human comfort within different space uses based on guidance within BS 6472-1992, *Evaluation of human exposure to vibration in buildings (1 – 80 Hz).*

The DEC Guideline provides both “Preferred” and “Maximum” limiting vibration levels. The “Preferred” limits have been adopted as limiting criterion for this project and they are summarised in the following Table 7.

Table 7: Vibration limits for the project

Location	**Z-axis weighted rms vibration acceleration limit (m/s^2)**		**Vibration Dose Value limit ($m/s^{1.75}$)**
	Continuous	Impulsive	Intermittent
General areas	0.020	0.64	0.40

3 Assessment and Recommendations

3.1 Mechanical services

The internal noise level associated with the mechanical services noise will be assessed against the targets set out in section 0 as the design progresses.

A review of the 100% Design Development Mechanical Services design has been carried out. In coordination with the mechanical services consultant it has been established that mechanical services ductwork throughout the Aquatic Centre will include a minimum 75 mm internal duct lining to mitigate the noise impact on all internal spaces with the exception of return air ductwork from the Pool Hall and the Hydrotherapy Pool. Attenuators will be included as required for these return air paths as the design progresses.

General advice for controlling mechanical services noise to noise-sensitive spaces is given below:

- Fan noise should be controlled through a combination of expansion plenums (most effective for low-frequency noise), lined duct and duct attenuators (most effective for mid-frequency and high-frequency noise).
- All large fans /AHUs are likely to require attenuators on the room side and atmospheric side of the system.
- Aerodynamic noise should be controlled by sizing ducts so that duct velocity is not too high, with careful attention to the aerodynamic efficiency of ductwork and selection of terminal units (VAV boxes, if used, and diffusers).
- Fan coil units serving noise sensitive spaces (e.g. offices) should not be located in the ceiling void above the room. Locate these units above a less noise-sensitive space (e.g. circulation or storage areas).
- Acoustic louvres should be used to mitigate the noise break-out from plant room equipment to noise sensitive receivers. Additional internal wall lining to the plant room should be considered as needed to further reduce the noise break-out from the plant-room.
- Flexible ductwork can cause high levels of aerodynamic noise if the duct routing is convoluted. For noise sensitive spaces, try to avoid flexible ductwork where possible and minimise the length of duct where unavoidable (taking care that the flexible ductwork is routed as directly as possible between the spigot and the terminal unit).

Table 8 provides an indicative maximum noise level allowed for each of the units serving indoor spaces at the Aquatic Centre. These have been calculated to meet Green Star criteria established in Section 0.

Table 8: Indicative maximum noise level allowed for mechanical services units at GPARC

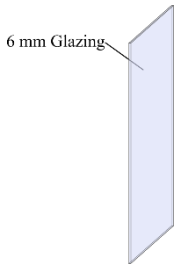
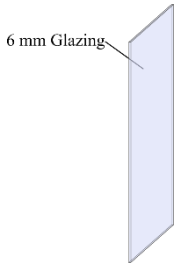
Area of Service	Unit ID	Direction	Air flow, l/s	Maximum sound power level, dB							
				Octave Band Centre Frequency (Hz)							
				63	125	250	500	1k	2k	4k	8k
Pool and leisure hall	FC-1	Supply Inlet	18000	86	85	91	81	76	71	66	66
	FC-1	Supply Outlet	9000	83	82	88	78	73	68	63	63
	FC-1	Return Inlet	18000	86	85	91	81	76	71	66	66
	FC-1	Return Outlet	18000	86	85	91	81	76	71	66	66
Hydrotherapy pool	FC-2	Supply Inlet	5000	80	79	85	75	70	65	60	60
	FC-2	Supply Outlet	5000	80	79	85	75	70	65	60	60
	FC-2	Return Inlet	5000	80	79	85	75	70	65	60	60
	FC-2	Return Outlet	5000	80	79	85	75	70	65	60	60
Hydrotherapy changerooms	FC-3	Supply Inlet	1000	73	72	78	68	63	58	53	53
	FC-3	Supply Outlet	1000	73	72	78	68	63	58	53	53
	FC-3	Return Inlet	1000	73	72	78	68	63	58	53	53
	FC-3	Return Outlet	1000	73	72	78	68	63	58	53	53
Wet Changerooms	FC-4	Supply Inlet	1650	75	74	80	70	65	60	55	55
	FC-4	Supply Outlet	1650	75	74	80	70	65	60	55	55
	FC-4	Return Inlet	1800	70	69	75	65	60	55	50	50
	FC-4	Return Outlet	1800	76	75	81	71	66	61	56	56
Foyer	FC-5	Supply	950	73	72	78	68	63	58	53	53
	FC-5	Return	950	73	72	78	68	63	58	53	53
Indoor Play Area	FC-6	Supply	450	70	69	75	65	60	55	50	50
	FC-6	Return	450	70	69	75	65	60	55	50	50
Staff Office	FC-7	Supply	360	64	63	69	59	54	49	44	44
	FC-7	Return	360	64	63	69	59	54	49	44	44
Indoor Seating	FC-8	Supply	900	62	61	67	57	52	47	42	42
	FC-8	Return	900	62	61	67	57	52	47	42	42
Merchandise Area	FC-9	Supply	1200	66	65	71	61	56	51	46	46
	FC-9	Return	1200	66	65	71	61	56	51	46	46
Weights and Cardio	FC-10	Supply	6500	81	80	86	76	71	66	61	61
	FC-10	Return	6500	78	77	83	73	68	63	58	58
Dry Fitness Studio 2	FC-11	Supply	1300	74	73	79	69	64	59	54	54
	FC-11	Return	1300	74	73	79	69	64	59	54	54
Dry Fitness Studio 1	FC-12	Supply	2500	77	76	82	72	67	62	57	57
	FC-12	Return	2500	77	76	82	72	67	62	57	57
Spin Room	FC-13	Supply	400	69	68	74	64	59	54	49	49
	FC-13	Return	400	69	68	74	64	59	54	49	49

Area of Service	Unit ID	Direction	Air flow, l/s	Maximum sound power level, dB							
				Octave Band Centre Frequency (Hz)							
				63	125	250	500	1k	2k	4k	8k
Dry Changerooms	FC-14	Supply Inlet	2700	77	76	82	72	67	62	57	57
	FC-14	Supply Outlet	2700	77	76	82	72	67	62	57	57
	FC-14	Return Inlet	2700	77	76	82	72	67	62	57	57
	FC-14	Return Outlet	2700	77	76	82	72	67	62	57	57
Consultation Room	FC-15	Supply	350	28	28	37	41	42	38	31	24
Manager’s Office	FC-16	Supply	350	28	28	37	41	42	38	31	24
Consultation Room	FC-17	Supply	350	28	28	37	41	42	38	31	24
Pool Operations	AC-1	Supply	350	28	28	37	41	42	38	31	24
First Aid	AC-2	Supply	350	28	28	37	41	42	38	31	24
Staff Room	AC-3	Supply	350	28	28	37	41	42	38	31	24
Meeting Room 1	AC-4	Supply	350	28	28	37	41	42	38	31	24
Reception/ Ticketing	AC-5	Supply	350	28	28	37	41	42	38	31	24
Meeting Room 2	AC-6	Supply	350	28	28	37	41	42	38	31	24
Kitchen/Food Preparation	EC-2	Supply	800	63	76	72	69	67	64	60	62

3.2 Building Envelope and Façade

Translucent surfaces (e.g. glazing and ETFE) on the façade and roof represent areas of acoustic weakness. Table 9 presents the minimum performance required for these surfaces on the building façade as per the extent shown in the 100% Design Development architectural drawings. Should the glazed area increase, the acoustic performance is likely to increase.

Table 9: Minimum acoustic performance requirements and example constructions

Noise source	Envelope element	Indicative minimum performance requirement	Example construction to achieve minimum performance requirement
Aircraft and traffic noise	Façade	R_w 32	
Rain noise	Roof	R_w 32	

3.2.1 Aircraft Noise

The following assumptions were made to predict the minimum construction acoustic performance requirements for the roof build-up:

- The area of the translucent section of the roof is approximately 1350 m^2.
- The volume of the main pool hall is approximately 20,000 m^3.
- The room acoustic performance of the pool and leisure hall is controlled to achieve a reverberation time target < 2.0s (details are discussed in Section 3.3.1)

Results are summarized in Table 10.

Table 10: Summary of aircraft noise break-in through indicative roof build-up alternatives

Indicative roof build-up	Sound reduction index, R_w	Predicted noise level perceived in the main pool hall due to aircraft noise	Meets internal background noise level criterion of 50 dB(A)
ETFE pillows	R_w 7	60 dB(A)	×
Polycarbonate panels	R_w 21	48 dB(A)	✓
6mm single glass panels	R_w 32	37 dB(A)	✓

Noise levels were measured on-site and comprised unattended and attended measurements. Noise events from local air traffic were observed to occur approximately three minutes. Source noise levels were based on measured single event aircraft flyovers, corrected for the number of events in the time period.

From the above, it can be seen that to meet the internal noise criterion based on aircraft noise alone, polycarbonate panels are predicted to comply. However, considering other noise sources, an increased construction is required as discussed below.

3.2.2 Traffic Noise

The dominant source of measured traffic noise is vehicle traffic along Joynton Avenue.

The highest measured noise levels occurred during the daytime period, on weekdays, due to traffic noise. The typical weekday daytime noise level is 65 dB(A). The façade acoustic performance has been designed to comply with these levels.

Glazed surfaces on the façade represent areas of acoustic weakness and comprise approximately 30% of the total façade areas as per the 100% Design Development architectural drawings. A 6 mm single glazed panel (R_w 32) is recommended as the basis of design. The remainder of the façade is of solid construction and has been designed to meet a minimum requirement of R_w 40.

3.2.3 Rain Noise

Rain noise levels inside the training pool and adjacent areas has been predicted for three different roof build-ups, based on ISO 140-18:2006. This defines a laboratory measurement of sound generated by rainfall on building elements for:

- Intense rainfall (15 mm/hr)
- Rain velocity of 4 m/s
- Drop diameter of 2 mm

Results of internal noise levels are presented for different roof constructions in Table 11.

Since the nature of rain noise is intermittent, and the maximum is likely to seldom occur for short periods of time, a relaxation of the ambient noise limit of 10 dB is proposed. The rain noise design criterion is therefore 60 dB(A). At this level, public address

announcements could still be intelligible. At levels significantly higher than this, the intelligibility of public address or emergency warning messages may be compromised.

Table 11: Predicted rain noise levels in the main pool hall for three different roof build-ups

Indicative roof build-up	Sound reduction index, Rw	Predicted noise level perceived in the main pool hall due to rain noise	Meets internal background noise level criterion of 60 dB(A)
ETFE pillows	R_w 7	75 dB(A)	×
ETFE pillows with rain suppression mesh	R_w 7	65 dB(A)	×
Polycarbonate panels	R_w 21	69 dB(A)	×
6mm single glass panels	R_w 32	58 dB(A)	✓

According to the Australian Government Bureau of Meteorology, based on a standard 30-year climatology statistic, the expected average number of days with rainfall is:

- 30 – 40 (per year) with rainfall greater than 10 mm
- 10 – 15 (per year) with rainfall greater than 25 mm

Considering the average number of days with "intense" rainfall (or more severe conditions), it is not expected that the predicted worst case conditions will be met more than 4% - 8% of time throughout the course of a year and therefore the noise level due to rain in the main pool hall will comply with the proposed criteria under normal circumstances, provided the inclusion of a rain suppression mesh on top of the ETFE panels.

The client may be considering first installing ETFE, with post-construction installation of a rain suppression mesh later if required. We leave it to the client to decide on the desired approach.

3.3 Room Acoustics and Internal Finishes

3.3.1 Program and Leisure Pool Hall

Noise within the Program and Leisure Pool Hall is expected as a result of learn to swim programs and the nature of the leisure pool as an indoor water playground.

As discussed in Section Appendix E there does not appear to be a definitive requirement for fixing the upper limit of the mid-frequency reverberation time to < 2 s, particularly for larger volume pool halls. However, in response to City Aquatics comments that the reverberation time of the pool be designed to a mid-frequency reverberation time of 1.5 – 2.0s, we have assessed options for how this may be achieved.

An acoustic assessment of the Program and Leisure Pool Hall has been completed, including a ray-tracing computer model. The following assumptions were made in coordination with the architect and based on the 100% Design Development Architectural Drawings:

- All internal walls to the pool and leisure hall are straight (i.e. perpendicular to the floor and ceiling; no walls or section of walls were modelled at inclined angles)
- 100% of the upper section of the south, east and west internal walls which form the perimeter of the main pool hall are lined with perforated FC panel with acoustic absorption backing. 50% of the north wall upper section area had the same treatment (the other 50% north upper wall area was modelled as a glass window to the gym). The absorptive panel product used as basis of design is:
    - 5 mm round hole perforated (10% open area) 6mm thick DecorLux Fibre Cement sheeting, with 50mm void behind with 75mm thick Polymax polyester insulation compressed into the backing void
- The area between the timber rafters are lined with perforated FC panel with acoustic absorption backing, i.e. the same product as for upper walls. The underside of the acoustic lining is located at 300mm above the underside of the timber beams.
- The low ceiling section of the pool hall just outside the changerooms and the foyer entrance includes uniformly distributed ceiling/soffit absorption to 50% of the area of the low ceiling section of the pool hall
- ETFE panels on roof covering the area between pairs of timber beams.

Two configurations were modelled in detail to assess the effect of including acoustic banners as additional absorptive surfaces to the acoustic treatment listed above. The results are presented in Table 12.

Table 12: Predicted reverberation time assessment for acoustic treatment options

Configuration	Predicted Mid-Frequency RT in the *double height* space of the Main Pool Hall	Predicted Mid-Frequency RT in the *single height* space of the Main Pool Hall	Complies with Green Star requirement?
Option A (no banners): EFTE panels on roof ~ 720 m^2 perforated FC absorptive panels to high level walls, ~ 350 m^2 perforated FC absorptive panels to areas between timber beams, ~ 230 m^2 perforated FC absorptive panels to underside of low ceiling section outside changerooms and foyer	1.7 – 2.0 s	1.8 - 2.1 s	✓
Option B (with banners): EFTE panels on roof ~ 720 m^2 perforated FC absorptive panels to high level walls ~ 350 m^2 perforated FC absorptive panels to areas between timber beams, ~ 230 m^2 perforated FC absorptive panels to underside of low ceiling section outside changerooms and foyer **~710 m^2 acoustic banners** with indicative dimensions 35000 mm long x 2000 mm high x 40 mm thick, hanging just below each pair of timber beams *Banner Notes:* • the banners modelled are taller than your proposed Armstrong banner standard product sizes (i.e. 2000mm high in model but Armstrong standard size is only 400mm high) • the indicative absorption performance requirement for each side of the banner panel is NRC 0.6	1.4 – 1.6 s	1.7 – 2.0 s	✓
Option C (no banners): Polycarbonate panels on roof ~ 720 m^2 perforated FC absorptive panels to high level walls, ~ 350 m^2 perforated FC absorptive panels to areas between timber beams, ~ 230 m^2 perforated FC absorptive panels to underside of low ceiling section outside changerooms and foyer	1.8 – 2.2 s	1.9 - 2.1 s	✓

Arup demonstrated the impact of acoustic finishes on speech intelligibility and background noise through SoundLab demonstrations at earlier stages of design (see details in Appendix F). While the final agreement on design criteria have not been formalised, we advise that the acoustic environment will be designed to achieve a subjectively 'good' level of speech

intelligibility, within a well-controlled acoustic environment. Further stages of design will balance the acoustic needs with architectural constraints.

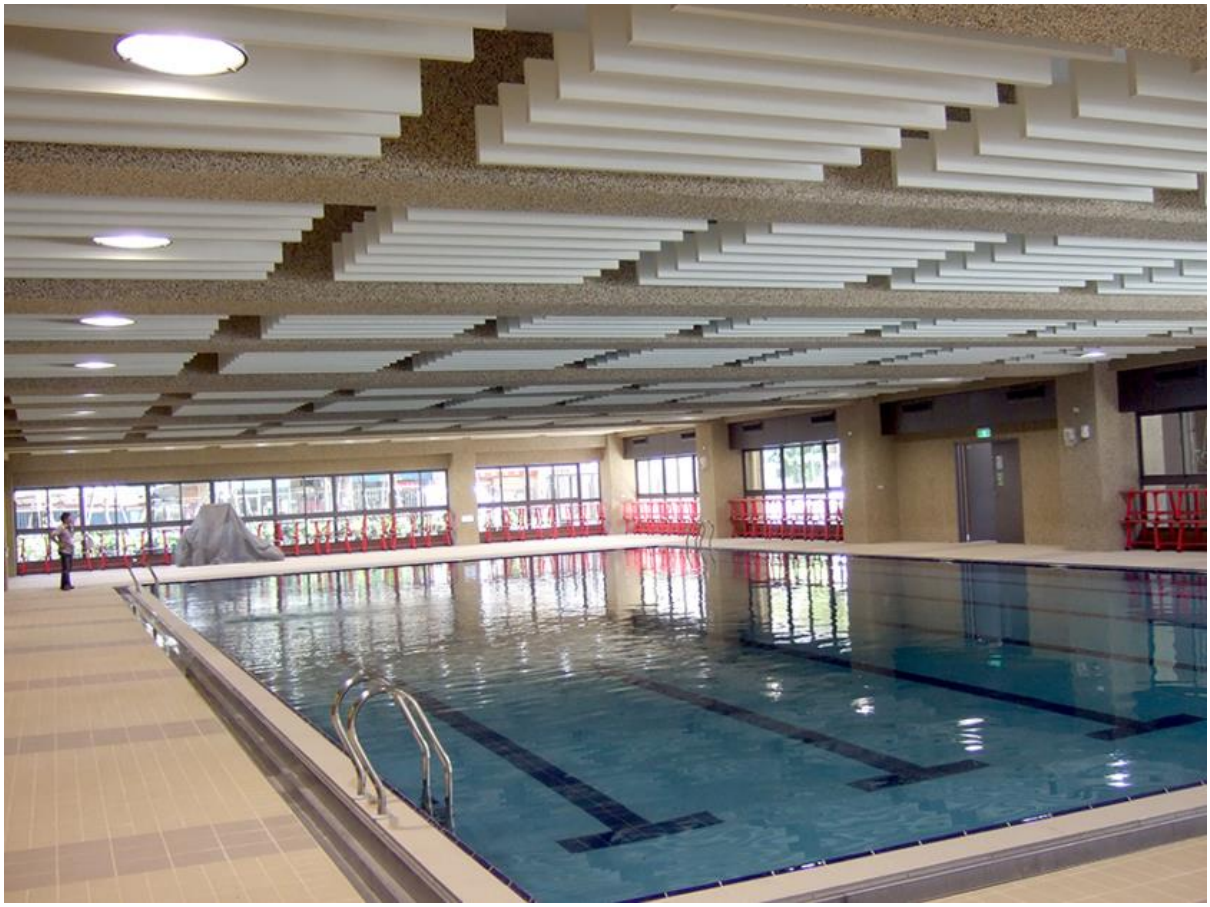


Figure 2: Acoustic absorptive baffles which allow for increased levels of ceiling absorption where the ceiling was not accessible for absorptive finishes

3.3.2 Acoustic Control Other Areas

The following key acoustic design challenges and solutions for further exploration are listed below.

Issue	Potential Solutions
Control of sound in areas that have the potential to generate high levels of noise	Gym – provide acoustic absorption to ceiling and walls to allow for intelligible amplified speech and controlled noise environment. Crèche – provide acoustic absorption to ceiling and walls to minimise reflected sound. This is to be architecturally integrated.

Control of sound spill from noise generating areas to noise sensitive areas	Crèche to Hydrotherapy pool – add acoustic absorption to corridor to minimise reflections from Crèche via corridor to Hydrotherapy area, either by: • Adding absorption to corridor walls and ceiling, or • Creating a 'lined bend' which uses partial partitions, lined with acoustic absorption to prevent a direct line of sight via the corridor from the Crèche area to the Hydrotherapy pool

In addition to the above recommendations, a summary of the indicative areas of acoustic treatment required to meet AS/NZS 2107, Arup RT targets and Green Star requirements is provided in Table 13. The recommendations are based on the Accommodation Breakdown and Architectural Drawings provided with the 100% DD Architectural drawings.

Areas of absorption are based on use of an acoustic absorptive product with minimum performance of NRC 0.6. Should the acoustic absorption achieve less than this performance, larger areas will be required.

The locations and types of acoustic absorption are to be developed in further detail with the architect as the design progresses.

Table 13: Summary of indicative acoustic treatment areas required to meet RT recommendations.

Activity Area	Category Name	Room Name	Green star requirement	Acoustic Treatment – Indicative minimum area required to achieve Green Star requirement	Estimated reverberation time achieving Green Star requirement
Front of House	Entry	Foyer/Reception/ Ticketing/ Merchandise Area	Absorption to 50% of ceiling area (minimum)	180 m^2	1.1 s
		Cash Handling Room	Absorption to 50% of ceiling area (minimum)	5 m^2	1.0 s
	Café/Kiosk	Indoor Seating	Absorption to 50% of ceiling area (minimum)	23 m^2	0.9 s
		Servery/Kitchen	1.0 s	15 m^2	1.0 s
	Crèche/Shared use	Indoor Play Area	N/A	-	-

Activity Area	Category Name	Room Name	Green star requirement	Acoustic Treatment – Indicative minimum area required to achieve Green Star requirement	Estimated reverberation time achieving Green Star requirement
Administration	Management offices	Pool Operations Office	0.6 s	16 m^2	0.6 s
		Manager's Office	0.6 s	16 m^2	0.6 s
		Staff Office	0.6 s	56 m^2	0.6 s
	Meeting Rooms	Meeting Room 1	0.8 s	14 m^2	0.8 s
		Meeting Room 2	0.8 s	24 m^2	0.8 s
	Staff Amenities	Staff Room	0.6 s	23 m^2	0.6 s
Aquatic Centre	Wet Changerooms and Lockers	Wet Changerooms	N/A	-	-
		Assisted Changerooms	N/A	-	-
	First Aid	First Aid	0.6 s	11 m^2	0.6 s
	Hydrotherapy	Hydrotherapy Pool	Absorption to 50% of ceiling area (minimum)	192 m^2	1.7 s
		Hydrotherapy Changerooms	N/A	-	-
Health and Fitness Centre	Health and Fitness Offices	Manager's Office	0.6 s	20 m^2	0.6 s
		Consultation Room	0.6 s	12 m^2	0.6 s
	Gym	Weights and Cardio	Absorption to 50% of ceiling area (minimum)	300 m^2	1.0 s
		Spin Room	Absorption to 50% of ceiling area (minimum)	40 m^2	1.2 s
		Dry Fitness Studio 1	1.1	160 m^2	1.1 s

Activity Area	Category Name	Room Name	Green star requirement	Acoustic Treatment – Indicative minimum area required to achieve Green Star requirement	Estimated reverberation time achieving Green Star requirement
	Dry Fitness Studios	Dry Fitness Studio 2	1.1	100 m^2	1.1 s
	Dry Changerooms and Lockers	Dry Changerooms	N/A	-	-

3.3.3 Locations of Acoustic Finishes

Location of acoustic finishes requires design consideration in order to optimise their effect. A discussion of finishes for the Program and Leisure Pool Hall is given in Section 3.3.1.

3.4 Sound Insulation

3.4.1 Horizontal Sound Insulation

An assessment of sound insulation requirements has been made for each room or areas based on:

- The noise sensitivity of activities occurring in the room, including
- The speech privacy of activities occurring in the room
- The potential noise generation from within the room
- The background noise level in the room

The following should be considered in relation to achieving a stated sound insulation performance:

- It is not possible to achieve a sound insulation performance of greater than Rw 35 without a full-height partition (or a separate continuous solid acoustic ceiling in each room).
- Doors represent areas of acoustic weakness within partitions, and achieving high sound insulation from door sets is costly and challenging. We recommend that doors to the ground floor offices/meeting rooms and first floor Consultation Rooms be fitted with compressible acoustic seals to head, jambs and threshold. The doors themselves should be minimum 45mm thick solid core timber.

- These factors have been considered for each room in order to determine the required sound insulating constructions. Partition details and requirements are to be developed in conjunction with the architect as the project and design progresses.

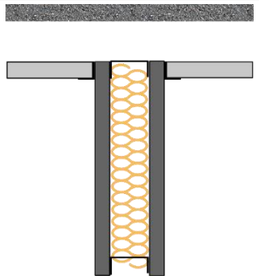
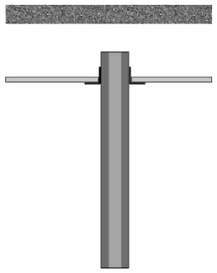
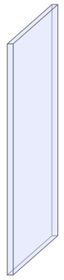
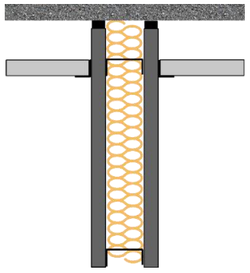
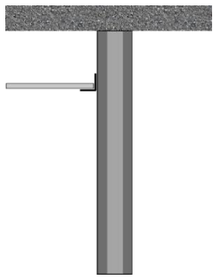
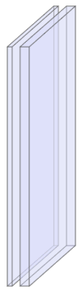
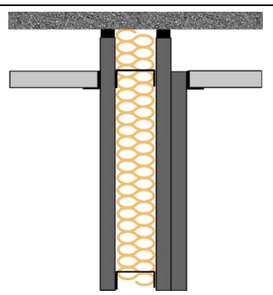
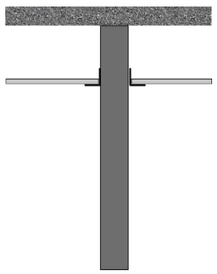
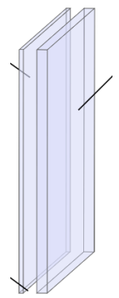
Indicative constructions for wall types are given in Table 14. Mark-ups for required sound insulation performance are given in Appendix D.

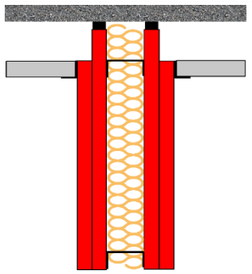
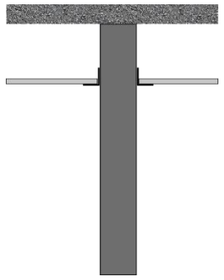
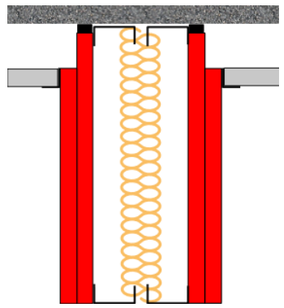
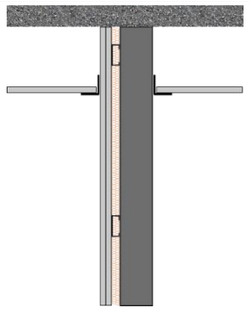
The Green Star requirements for sound insulation between two enclosed spaces are set out in Section 2.3.

For the purposes of this exercise, an enclosed space is considered to be one that has a closing door with partitions that run full-height. Designing partitions to areas that do not comply with this description is irrelevant unless there is a specific reason; to do so would result in unnecessary cost and materials to achieve the same results as a lower-rated partition.

In many cases, the Green Star requirements are less onerous than would be required for the spaces to function effectively.

Table 14: Indicative constructions to meet sound insulation ratings

Rating	Drywall Build-up	Masonry	Glazing	Door
R_w 35	 1 x 13 mm plasterboard 64 mm stud with 50 mm sound absorptive material in cavity 1 x 13 mm plasterboard	 110mm hollow blockwork	 12mm glass	40mm solid core door with threshold & perimeter seal
R_w 40	 1 x 13 mm plasterboard 64 mm stud with 50 mm sound absorptive material in cavity 1 x 13 mm plasterboard Floor to slab construction	 140mm hollow blockwork Floor to slab construction	 10mm | 12mm air gap | 6.38mm acoustic laminate	40-45mm solid core door with high performance rebated frame & threshold seals
R_w 45	 1 x 13 mm plasterboard 64 mm stud with 50 mm sound absorptive material in cavity 2 x 13 mm plasterboard Floor to slab construction	 110mm solid blockwork Floor to slab construction	 10mm | 16mm air gap | 12.5 acoustic laminate	Specialist proprietary acoustic doorset rated to Rw 35.

Rating	Drywall Build-up	Masonry	Glazing	Door
R_w 50	 2 x 13 mm high-density plasterboard 50 mm sound absorptive material in cavity 2 x 13 mm high-density plasterboard Floor to slab construction	 140mm solid blockwork Floor to slab construction	N/A	Specialist proprietary acoustic doorset rated to Rw 40.
R_w 55	 2 x 13 mm high-density plasterboard Double steel stud with 20mm gap between studs and 150 mm sound absorptive material in cavity 2 x 13 mm high-density plasterboard Floor to slab construction	 2 x 13 mm plasterboard + 25mm steel stud + 25mm sound absorptive material in cavity + 110mm solid blockwork Floor to slab construction	N/A	Specialist proprietary acoustic doorset rated to Rw 45.

3.4.1.1 Operable Walls

There is a desire to use operable acoustic partitions in the dry fitness studio 1. While products exist that claim very high sound insulation performances (up to around R_w 45), in practice the performance falls significantly once installed and operated. In addition, acoustic operable partitions can be challenging to open and close due to their weight and seals.

Our recommendation is that programming of activities in spaces separated by operable partitions is sensitive to the reduced sound insulation performance provided by them. For example, amplified music and yoga would not occur subsequently.

We recommend a better performing operable wall than the design target. Operable walls usually have a lower on-site performance than that measured under controlled conditions shown in the acoustic test data. Some factors that may hinder the operable wall performance are:

- Poor maintenance procedures (e.g. perimeter seals should be maintained and adjusted regularly),
- Wall above should provide a build-up of equal acoustic performance as the operable wall sound insulation rating, and structural loads should be verified to make sure this construction can be achieved,
- Doors can be specified for the operable wall however, in general the overall performance of the partition will likely be lower than specified,
- Flaking noise transmission between rooms through adjacent partitions with lower sound insulation ratings (e.g. operable wall against a glass façade),
- Uneven floor surface preventing drop-down seals to fully cover the partition perimeter.

As a minimum we recommend installing an Rw55 operable partition (100mm, 66 kg/m^2) for the Fitness Studio 1 space. In practice, the acoustic performance of the operable partition will depend on how sensitive the activities carried out in these spaces are. These considerations are recommended to be considered in conjunction with cost. We recommended including acoustically absorptive finishes to operable partitions.

3.4.2 Vertical Sound Insulation

3.4.2.1 Dry Fitness Studio

Dry fitness studio 1 is located directly above the hydrotherapy pool.

Fitness studio 2 and the outdoor gym area are located above less noise-sensitive common areas.

In order to minimise disturbance to the Hydrotherapy pool, the following floor construction is recommended:

- 8mm Regupol Everroll on 30mm thick Regupol PL30
- Minimum 150 mm concrete slab
- Suspended plasterboard ceiling

While the above represents a reasonable precaution to impact noise, there is a risk that weight lifting equipment dropped from a height may be audible in the space below the gym. However, it is not expected that the noise generated by this activity will not adversely affect activities carried out in the space below.

Based on this construction, music noise in the gym shall be limited to the following level in order to minimise disturbance to the hydrotherapy pool.

Table 15: Limiting music noise spectrum for gym

	dB(A)	Mid-Frequency Octave Band (Hz)							
		63	125	250	500	1k	2k	4k	8k
Limiting music noise level (L_{max})	90	80	80	83	84	84	83	83	83

3.5 Green Square Aquatic Centre Operation

Daily regular facility usage including announcements over PA, whistles, squad training, aqua classes including music reproduction over a portable loudspeaker.

Regular intended uses of the outdoor space around the Green Square Aquatic Centre are understood to be as follows:

- Regular use for sporting activities is expected to attract 40 - 60 spectators.
- Synchronised swimming events may involve music and up to 50 spectators, occurring once per week
- Underwater hockey and waterpolo training may occur once per week with up to 50 spectators.

In addition to these regular activities, one-off or infrequent events may occur based on guidance from City Aquatics as follows:

- School carnivals which are expected to involve 300 – 500 children, and occur twice per week during the month of February.

Future events such as these will be part of the core business of the Aquatic Centre. In response to The City Projects' previous comments, we have completed a noise study in order to determine typical source levels and noise impact at local noise-sensitive receivers for outdoor events.

A noise study of the licenced café use has also been carried out and assessed against the relevant criteria at the nearest noise sensitive receivers.

The assessment has recognized the potential noise impact on the future residential noise receivers from the proposed uses outlined by City Aquatics and City Projects. The noise criteria for the site are based on the level of existing noise at site. Currently the site is unused and it has been reasonably assumed that ambient

noise in the area will change as a result of the new residential uses and associated roads are constructed.

The assessment has found that the intended outdoor uses of the aquatic centre development will exceed the current established noise criteria (which are based on the *existing* noise environment). However, it is not expected that the noise levels from events will adversely impact on future nearby noise sensitive receivers as the noise environment is expected to change as a result of upcoming development of the area.

A summary of the assessment against the current established noise criteria is presented in Table 16.

Table 16: Summary of compliance assessment of predicted noise impact from outdoor events at nearest noise sensitive residential receivers against project specific criteria

Condition	Outdoor event type	Time Period	Complies with project specific criteria based on current noise environment?	Complies with project specific criteria based on future noise environment?
NSW INP Project Specific Criterion, and City of Sydney Noise – General (b) condition	Sporting event	Day	×	✓
		Evening	✓	✓
		Night	N/A	
	School carnival	Day	×	✓
		Evening	✓	✓
		Night	N/A	
	Licenced café	Day	✓	✓
		Evening	✓	✓
		Night	N/A	
City of Sydney Noise – Licenced premises condition		Day	✓	✓
		Evening	✓	✓
		Night	N/A	

Details of the outdoor noise assessment are presented in Appendix G.

3.6 Emergency Equipment

Emergency mechanical services equipment will be designed to meet criteria given in Table 6.

3.7 Construction Noise and Vibration

A detailed construction noise and vibration management plan will need to be developed once more precise construction activity information becomes available.

The site-specific management plan will be submitted to City of Sydney Council for comment and approval prior to a Construction Certificate (CC) being granted. The plan will be developed to minimise the impact to the neighbourhood and be in accordance with City of Sydney Building Sites Noise Code (1988).

Appendix A

Glossary of Acoustic Terms

A1 Glossary of Acoustic Terminology

Ambient Noise Level

The noise level in a space measured in the absence of the noise being investigated. For example, if a fan located on a city building is being investigated, the ambient noise level is the noise level without the fan running. This would include sources such as traffic, birds, people talking and other nearby fans.

Decibel

The decibel scale is a logarithmic scale which is used to measure sound and vibration levels. Human hearing is not linear, which allows hearing over a large range of sound pressure levels. Therefore a logarithmic scale, the decibel (dB) scale, is used to describe sound levels.

dB(A)

dB(A) is a single number to describe a sound pressure level and includes a frequency weighting to reflect the subjective loudness level.

The frequency of a sound affects its perceived loudness. Human hearing is less sensitive at low and very high frequencies, the A-weighting is used to account for this effect. An A-weighted decibel level is written as dB(A).

An increase of approximately 10 dB corresponds to a subjective doubling of the loudness of a noise. The minimum increase or decrease in noise level that can be noticed is typically 2 to 3 dB. Some typical dB(A) levels are shown below.

Sound Level dB(A)	Example
130	Human threshold of pain
120	Jet aircraft take-off at 100 m
110	Chainsaw at 1 m
100	Inside nightclub
90	Large trucks at 5 m
80	Beside busy street
70	Loud stereo in living room
60	Office or restaurant with people present
50	Domestic fan heater at 1m
40	Living room (without TV, stereo, etc)
30	Background noise in a theatre
20	Remote rural area on still night
10	Acoustic laboratory test chamber
0	Human threshold of hearing

dBL_1

The dBL_1 statistical level is often used to represent the maximum level of a sound level that varies with time.

Mathematically, the dBL_1 level is the sound level exceeded for 1% of the measurement duration. As an example, 87 $dBL_{A1,15min}$ is a sound level of 87 dB(A) or higher for 1% of the 15 minute measurement period.

dBL_{10}

The dBL_{10} statistical level is often used as the “average maximum” level of a sound level that varies with time.

Mathematically, the dBL_{10} level is the sound level exceeded for 10% of the measurement duration. dBL_{10} is often used for road traffic noise assessment. As an example, 63 $dBL_{A10,18hr}$ is a sound level of 63 dB(A) or higher for 10% of the 18 hour measurement period.

dBL_{90}

The dBL_{90} statistical level is often used as the “average minimum” or “background” level of a sound level that varies with time.

Mathematically, dBL_{90} is the sound level exceeded for 90% of the measurement duration. As an example, 45 $dBL_{A90,15min}$ is a sound level of 45 dB(A) or higher for 90% of the 15 minute measurement period.

dBL_{eq}

The 'equivalent continuous sound level', L_{eq}, is used to describe the level of a time-varying sound or vibration measurement.

dBL_{eq} is often used as the "average" level for a measurement where the level is fluctuating over time. Mathematically, it is the energy-average level over a period of time. When the dB(A) weighting is applied, the level is denoted $dBL_{Aeq.}$ Often the measurement duration is quoted, thus $dBL_{Aeq,15\ min}$ represents the dB(A) weighted energy-average level of a 15 minute measurement.

dBL_{max}

The dBL_{max} statistical level can be used to describe the "absolute maximum" level of a sound or vibration level that varies with time.

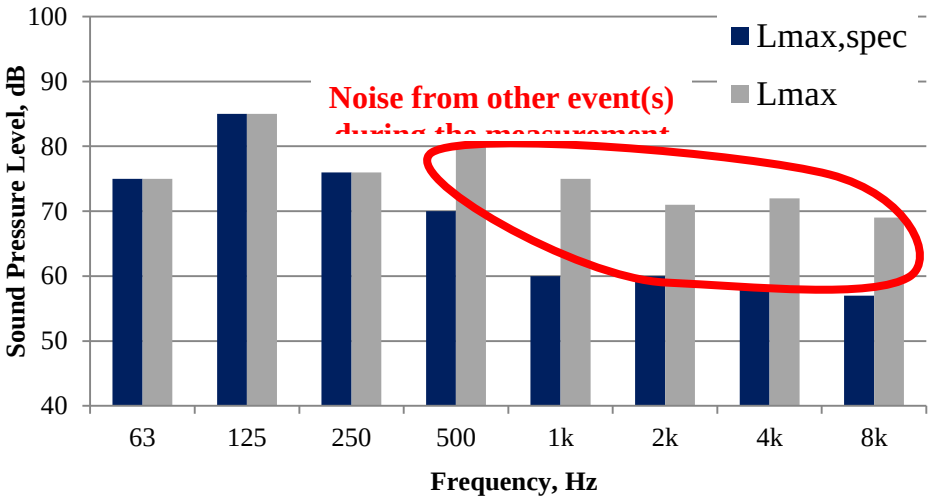
Mathematically, dBLmax is the highest value recorded during the measurement period. As an example, 94 dBL_{Amax} is a highest value of 94 dB(A) during the measurement period.

Since dBL_{max} is often caused by an instantaneous event, dBL_{max} levels often vary significantly between measurements.

$dBL_{max\ spec}$

Another representation of the highest noise or vibration levels during the measurement period.

$L_{max\ spec}$ is the spectrum of the event that caused the highest overall sound or vibration level during the measurement period is denoted by $dBL_{max\ spec}$. An example of the relationship between dBL_{max} and $dBL_{max\ spec}$ is shown below.



dBL_{max} (see definition above), when measured on an octave band or 1/3 octave band meter, is the spectrum obtained by recording the highest measured value in each band. Hence, $dBL_{max\ spec}$ represents a real event, while dBL_{max} is often the mathematical addition of frequency band values from different times and often does not represent a real-world event.

Since $dBL_{max\ spec}$ is caused by an instantaneous event, $dBL_{max\ spec}$ levels often vary significantly between measurements.

Frequency

Frequency is the number of cycles per second of a sound or vibration wave. In musical terms, frequency is described as “pitch”. Sounds towards the lower end of the human hearing frequency range are perceived as “bass” and sounds with a higher frequency are perceived as “high pitched”.

Vibration

Waves in a solid material are called “vibration”, as opposed to similar waves in air, which are called “sound” or “noise”. If vibration levels are high enough, they can be felt; usually vibration levels must be much higher to cause structural damage.

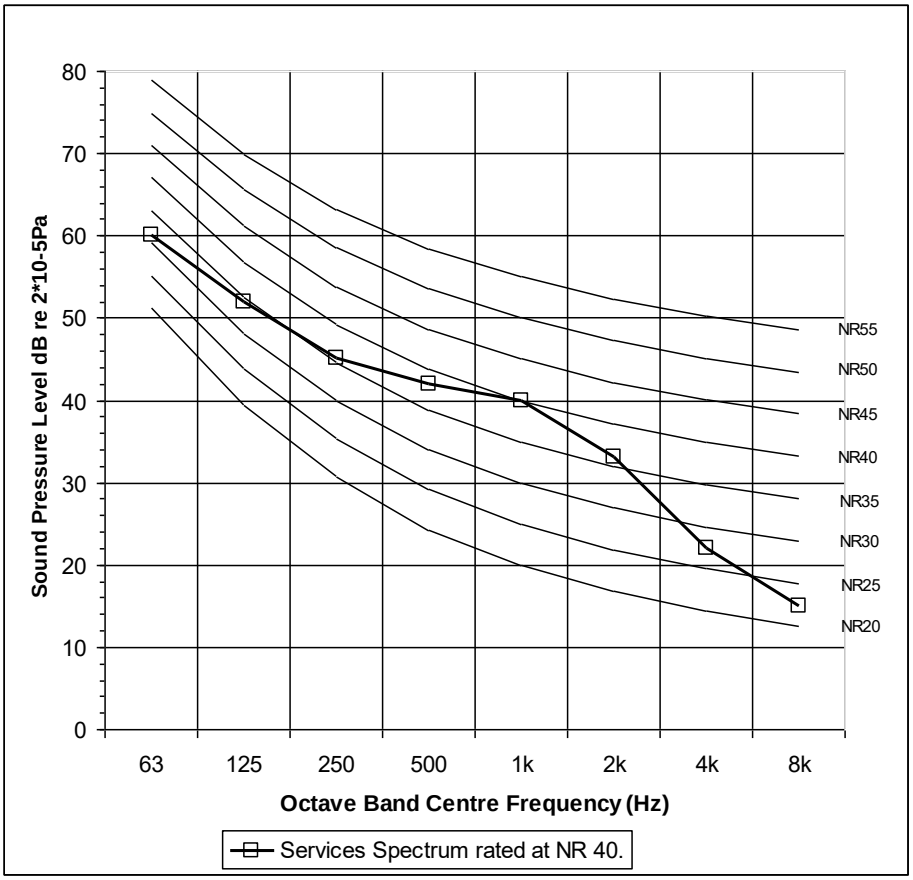
A vibrating structure (eg a wall) can cause airborne noise to be radiated. Structureborne vibration limits are sometimes set to control the noise level in a space.

Vibration levels can be described using measurements of displacement, velocity and acceleration. Velocity and acceleration are commonly used for structureborne

noise and human comfort. Either metric units (such as mm, mm/s and mm/s2) or using a decibel scale are used to describe vibration.

Noise Rating Curves

Noise rating (NR) curves are a set of internationally-agreed octave band sound pressure level curves, based on the concept of equal loudness. The curves are commonly used to define building services noise limits. The NR value of a noise is obtained by plotting the octave band spectrum on the set of standard curves. The highest value curve which is reached by the spectrum is the NR value. Shown below is a plant noise spectrum that is equivalent to NR 40.



Percentage Articulation Loss of Consonants (%AL_{cons})

A method for predicting the speech intelligibility, normally of an electroacoustic system (ie one in which the signal is transmitted through loudspeakers) based upon the number and directivity of the loudspeakers, the room volume, the reverberation time and the distance of the listener from the nearest source. %ALcons can be converted into a RASTI equivalent using a simple equation.

Reverberation Time (RT_{60})

The time, in seconds, taken for a sound within a space to decay by 60 dB after the sound source has stopped is denoted at the reverberation time. The RT is an important indicator of the subjective acoustic within an auditorium. A large RT subjectively corresponds to an acoustically 'live' or 'boomy' space, while a small RT subjectively corresponds to an acoustically 'dead' or 'flat' space.

Sound Level Difference (D)

The sound insulation required between two spaces may be determined by the sound level difference needed between them. A single figure descriptor, the weighted sound level difference, D_w, is sometimes used (as defined in AS/NZS ISO 717.1).

The terms used to describe the airborne sound insulation rating of a building element when tested on-site are the weighted normalised level difference ($D_{n,w}$), which corrects the measured sound level difference to a reference absorption area in the receiving room, or the weighted standardized level difference ($D_{nT,w}$), which corrects the measurements to a reference reverberation time in the receiving room.

These single numbers are determined by comparing the spectral sound insulation test results (as defined in ISO 140-4) with reference values, as outlined in AS/NZS ISO 717.1.

Sound Power and Sound Pressure

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level (L_p) varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its mass), which is not affected by the environment within which the source is located.

Sound Reduction Index (R)

The sound reduction index (or transmission loss) of a building element is a measure of the loss of sound through the material, i.e. its sound attenuation properties. It is a property of the component, unlike the sound level difference, which is affected by the common area between the rooms and the acoustics of the receiving room. The weighted sound reduction index, R_w, is a single figure description of sound reduction index and is defined in BS EN ISO 717-1: 1997. R_w values are calculated from measurements in an acoustic laboratory. Sound

insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as apparent sound reduction index (R'_w) ratings.

Speech Transmission Index (STI)

A technical index, predictable and measurable using specialised equipment, for assessing speech and vocal intelligibility.

Appendix B

Noise Criteria

B1 City of Sydney Noise Criteria

City of Sydney noise criteria relevant to the GPARC project are given below.

Noise – General

(a) The emission of noise associated with the use of the premises including the cumulative operation of any mechanical plant and equipment, air conditioning and vehicle movements on the property (excluding entertainment noise) shall comply with the following:

(i) The $L_{Aeq,\ 15\ minute}$ noise level emitted from the use must not exceed the project specific noise level for that receiver as determined in accordance with the NSW EPA Industrial Noise Policy. Noise must be measured in accordance with the Industrial Noise Policy and relevant requirements of Australian Standard AS 1055-1997 Acoustics – Description and measurement of environmental noise.

(ii) Project specific noise levels shall be determined by establishing the existing environmental noise levels, in complete accordance with the assessment $L_{A90,\ 15\ minute}$ / rating $L_{A90,\ 15\ minute}$ process to be in accordance with the requirements for noise monitoring listed in the NSW EPA Industrial Noise Policy and relevant requirements of Australian Standard AS1055-1997 Standard AS 1055-1997 Acoustics – Description and measurement of environmental noise.

(iii) Modifying factors in Table 4.1 of the NSW EPA Industrial Noise Policy are applicable.

(b) A cumulative $L_{Aeq,15\ minute}$ noise level emitted from the use must not exceed the $L_{A90,\ 15\ minute}$ noise level by more than 3dB in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) when assessed inside any habitable room of any affected residence or noise sensitive commercial premises provided that:

(i) Where the $L_{A90,\ 15\ minute}$ noise level is below the threshold of hearing, T_f at any Octave Band Centre Frequency as defined in Table 1 of International Standard ISO 226: 2003- Normal Equal Loudness-Level Contours then the value of T_f corresponding to that Octave Band Centre Frequency shall be used instead.

(ii) The $L_{Aeq,15\ minute}$ noise level and the $L_{A90,15\ minute}$ noise level shall both be measured with all external doors and windows of the affected residence closed.

(iii) The relevant background noise level ($L_{A90,\ 15\ minute}$) is taken to mean the day, evening or night rating background noise level determined in complete accordance with the methodology outlined in the NSW EPA Industrial Noise Policy and Australian Standard AS1055.1997 Acoustics – Description and measurement of environmental noise.

(iv) *Background noise shall be established in the absence of all noise emitted from the use but with the ventilation equipment normally servicing the affected residence operating. Background noise measurements are to be representative of the environmental noise levels at the affected location.*

(v) *Modifying factors in Table 4.1 of the NSW EPA Industrial Noise Policy are applicable. Internal Noise measurements are not to be corrected for duration.*

Noise – Licenced Premises and Entertainment Venues

(a) *The $L_{A10,\ 15\ minute}$ noise level emitted from the commercial uses on site must not exceed the background noise level ($L_{A90,\ 15minute}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 5dB between the hours of 7.00am and 12.00 midnight when assessed at the boundary of any affected residence.*

(b) *The $L_{A10,\ 15\ minute}$ noise level emitted from the use must not exceed the background noise level ($L_{A90,\ 15\ minute}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) between the hours of 12.00 midnight and 7.00am when assessed at the boundary of any affected residence.*

(c) *Notwithstanding compliance with (a) and (b) above, noise from the use when assessed as an $L_{A10,\ 15\ minute}$ enters any residential use through an internal to internal transmission path is not to exceed the existing internal $L_{A10,\ 15\ minute}$ (from external sources excluding the use) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) when assessed within a habitable room at any affected residential use between the hours of 7am and 12midnight. Where the $L_{A10,\ 15\ minute}$ noise level is below the threshold of hearing, T_f at any Octave Band Centre Frequency as defined in Table 1 of International Standard ISO 226: 2003- Normal Equal-Loudness-Level Contours then the value of T_f corresponding to that Octave Band Centre Frequency shall be used instead.*

(d) *Notwithstanding compliance with (a), (b) and (c) above, the noise from the use must not be audible within any habitable room in any residential use between the hours of 12.00 midnight and 7.00am.*

(e) *The $L_{A10,\ 15\ minute}$ noise level emitted from the use must not exceed the background noise level ($L_{A90,\ 15\ minute}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 3dB when assessed indoors at any affected commercial premises.*

Noise – Mechanical Plant and Equipment

Noise associated with the use of mechanical plant and equipment must not give rise to any one or more of the following:

1) *Transmission of "offensive noise" as defined in the Protection of the Environment Operations Act 1997 to any affected receiver.*

2) *A sound pressure level at any affected receiver that exceeds the background ($L_{A90,\ 15\ minute}$) noise level by more than 5 dB(A). The background noise level*

must be measured in the absence of noise emitted from the use in accordance with Australian Standard AS 1055.

Swimming Pool Pumps in Residential Premises

The swimming pool pump shall not be heard within a habitable room in any other residential premises (regardless of whether any door or window to that room is open):

Before 8am or after 8pm on any Sunday or public holiday, or before 7am or after 8pm on any other day.

Appendix C

Environmental Noise Survey

C1 Methodology

C1.1 Unattended Long Term Noise Measurements

Unattended noise monitoring equipment was used to gain an understanding of typical noise levels at the subject site. Noise monitoring devices were installed on 22 July to 30 July, 2015 at two locations shown in Figure 3.

Long-term noise measurements were made in 15-minute intervals, with a 'fast' time weighting. Broadband and octave band L_{Aeq}, L_{A10} and L_{A90} measurements were made. This equipment measured continuous noise data for 7 days.

Meteorological conditions were monitored during the survey period. Measured data was removed as required to account for the influence of any adverse weather conditions and extraneous noise events.

C1.2 Attended Short Term Noise Measurements

Attended noise measurements were undertaken by Daniel Jimenez on Wednesday, 22 July 2015 and Thursday, 30 July 2015 to validate unattended noise measurements. Broadband and octave band L_{Aeq}, L_{A10} and L_{A90} measurements were made.

C2 Measurement Locations

Figure 3 shows a map of the area, annotated with the locations of the two noise loggers. Logger locations were chosen as representative of the current conditions at the project site, and of the nearest current and future potentially affected residential receivers, within site security and access constraints.

Location 1 is considered to be representative of the future noise environment expected at residential receivers in close proximity to Joynton Avenue.

Location 2 is considered to be representative of the future residential and commercial receivers to the south of the project site.

Figure 3: Noise logging locations at project site



Additional work in the following stages of design will be required to determine noise criteria appropriate to future developments in close proximity to future roads including Zetland Avenue (North of site), George Julius Avenue (East of site) and Rose Valley Way (South of site).

C3 Equipment

Equipment used to measure the baseline noise levels is detailed in Table 17. All equipment was checked for calibration before and after measurements with no significant drift in calibration being recorded. All equipment held a current NATA calibration certificate at the time of the survey.

Table 17: Noise Survey Equipment

Equipment manufacturer and type	Description of Equipment	Serial No.
RTA04-007	Sound logging meter	T229742
RTA04-009	Sound logging meter	T229740
Brüel and Kjær 2270	Type 1 sound level meter	2754328
Brüel and Kjær 4231	Sound level meter calibrator	2445716

C4 Long Term Unattended Noise Logging Results

A summary of measured unattended broadband noise levels is provided in Table 18. A summary of unattended octave band results is provided in Table 19. Results are presented under Day, Evening and Night time periods as defined in the NSW Industrial Noise Policy.

Long term noise measurements were checked and validated against short-term attended measurements.

Table 18: Summary of measured noise indices

Location	Time Period	Rating Background Level (RBL) – dB(A)	$L_{Aeq\ (period)}$, dB
Location 1	Day (7:00 – 18:00)	56	64
	Evening (18:00 – 22:00)	47	60
	Night (22:00 – 7:00)	41	57
Location 2	Day (7:00 – 18:00)	50	61
	Evening (18:00 – 22:00)	47	56
	Night (22:00 – 7:00)	43	52

Table 19: L_{A90} octave band unattended noise survey results (scaled to RBL values)

Location	Time Period	$dBL_{A90,\ 15min}$ (RBL) – Octave band centre frequency (Hz)								
		31.5	63	125	250	500	1k	2k	4k	8k
Location 1	Day	62	66	56	51	49	51	48	40	29
	Evening	55	59	50	45	44	43	38	29	17
	Night	51	56	47	40	38	36	31	23	14
Location 2	Day	58	60	53	46	45	47	37	25	13
	Evening	53	56	50	43	44	44	34	19	12
	Night	48	52	47	40	40	39	28	15	12

Appendix D

Sound Insulation Performance Mark-up



01 GROUND FLOOR PLAN
- 1:200

NOTE: CURB ALIGNMENT / CROSSING LEVELS TO BE CONFIRMED BY CoS

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PROJECT NORTH TRUE NORTH

GRAPHICAL SCALE
0 1 2 4 6 8 10m

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ALL LEVELS RELATIVE TO AUSTRALIAN HEIGHT DATUM

KEY PLAN

REV	DATE	ISSUE
M	24/03/16	FOR COORDINATION
L	04/03/16	90% DESIGN DEVELOPMENT
K	25/02/16	FOR COORDINATION
J	23/02/16	FOR COORDINATION
I	09/02/16	FOR COORDINATION
H	18/12/15	50% DESIGN DEVELOPMENT
G	04/12/15	FOR COORDINATION
F	06/11/15	100% SCHEMATIC DESIGN
E	02/10/15	90% SCHEMATIC DESIGN
D	11/09/15	80% SCHEMATIC DESIGN
C	10/08/15	50% SCHEMATIC DESIGN
B	31/07/15	40% SCHEMATIC DESIGN
A	03/07/15	30% SCHEMATIC DESIGN

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PROJECT

Gunyama Park and Green Square Aquatic Centre

XX Zetland Avenue
Zetland NSW 2017
Australia

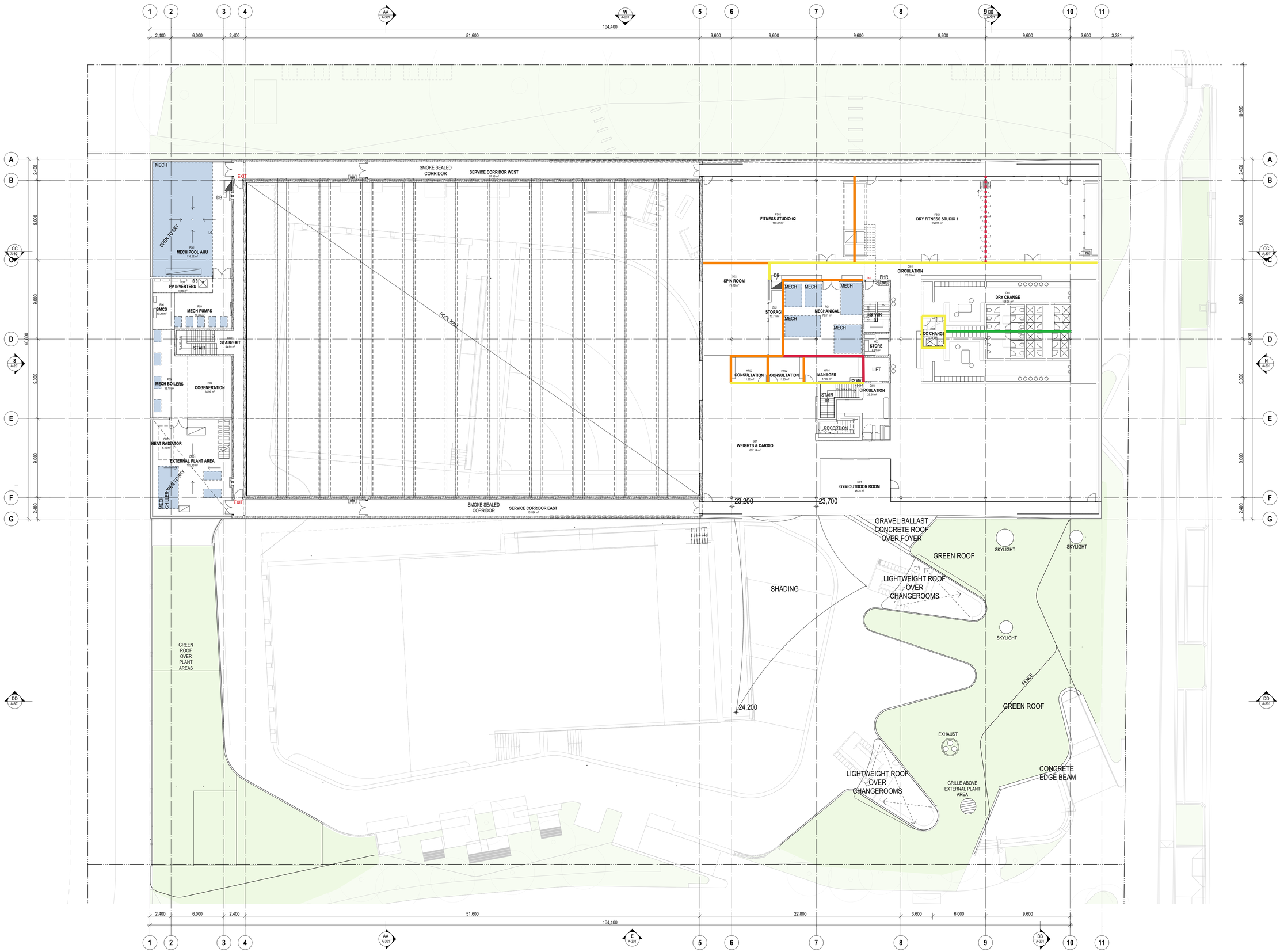
TITLE

INTRODUCTORY DOCUMENTS
GROUND FLOOR PLAN

DRAWN:	CM
CHECKED:	GH
SCALE:	1:200 @ A1
FIRST ISSUE:	03/07/15
DRAWING NO	REV

ARC-A-102 M

PRELIMINARY



01 LEVEL 01 PLAN
- 1:200

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PROJECT

Gunyama Park and Green Square Aquatic Centre

XX Zetland Avenue
Zetland NSW 2017
Australia

TITLE

INTRODUCTORY DOCUMENTS
FIRST FLOOR PLAN

DRAWN: CM
CHECKED: GH
SCALE: 1:200 @ A1
FIRST ISSUE: 03/07/15

DRAWING NO ARC-A-104 REV M

PRELIMINARY

Appendix E

Review of Australian and International Design Guidelines for Swimming Pools

E1 Review of Relevant Design Criteria

The following section summarises the relevant guidance used in the Arup Acoustic Design Report to establish the recommended design target for the reverberation time in the Main Pool Hall at GPARC.

E1.1 Summary of Room Acoustic Design Guidelines for Swimmming Pools

In response to the concerns raised by City of Sydney and City Aquatics in regards to the reverberation time targets for the Pool and Leisure Hall provided in Table 2, a review of relevant Australian and international design guidelines was carried out to clarify the reasoning behind the proposed targets.

From this review we note the following:

- The Royal lifesaving Society's "Guidelines for Safe Pool Operation" interprets AS/NZS 2107 recommended reverberation time to be under 2 seconds and sets a preferred target of 1.2 – 1.3 seconds.
- The Australian Standard AS/NZS 2107 recommendation for indoor sport buildings is to minimize the reverberation time as far practicable.
- Green Star does not set a reverberation time target for swimming pools but requires a minimum area of absorptive treatment.
- British Standard BS EN 15288-1:2008+A1:2010 does not specify the frequency bands affected by the recommended reverberation time or the inherent dependency of reverberation time to the volume of the space under design.
- *Building Bulletin BB93* as part of the British Building Regulations recommends a reverberation time target for *typically smaller* school swimming pools of 2.0 seconds.

Details of this review as well as the room acoustic performance of similar spaces Arup has worked for are presented in Appendix E

E1.2 AS/NZS 2107:2000

Australian/New Zealand Standard 2107:2000 *Acoustics - Recommended Design Levels and Reverberation Times for Building Interiors* provides recommended design criteria for conditions affecting the acoustic environment within different types of occupied spaces. The recommended reverberation times are for the occupied state of the space.

AS/NZS 2107:2000 defines reverberation time and notes that "*the optimum reverberation time for a particular space is dependent on the room volume*".

The recommended times provided in AS/NZS 2107:2000 "*are referred to the medium frequencies (e.g. 500 Hz or 1000 Hz)*" and it notes that "*for large volumes, the recommended reverberation times assume two-thirds occupancy*".

The Standard does not include a dedicated space type for swimming pools. However, the recommended reverberation time included in Table 1 for Indoor Sports Buildings references Note 3, which reads:

> "*Reverberation time should be minimized as far as practicable for noise control.*"

In the preface of the Standard it is also noted that "*the word 'shall' refers to practices which are mandatory for compliance with this Standard. The word 'should' refers to practices which are advised or recommended*".

In summary, **AS/NZS 2107:2000 does not recommend a reverberation time target for swimming pools**. This is contrary to what City Aquatics has previously advised to CoS.

E1.3 Green Star

As outlined in the Acoustic Design Report, the Green Star Design and As Built Submission Guidelines v1 state that under IEQ credit 10.2 *Reverberation*:

> *1 point is available where the nominated area has been built to reduce the persistence of sound to a level suitable to the activities in the space.*

The assessment criterion for achieving this is demonstrating that reverberation time in the nominated area is below the maximum stated in the 'Recommended Reverberation Time' provided in Table 1 of AS/NZS 2107:2000.

It is also noted that:

> *Where Note 3 of AS/NZ 2107 applies and requires that reverberation times be minimised as far as practical, acoustic absorption should be installed in the noise sensitive space. The amount of acoustic absorption must be equivalent to at least 50% of the area in the space.*

In summary, **Green Star does not set a reverberation time target for swimming pools but requires a minimum area of absorptive treatment**.

E1.4 Additional Guidelines

The following guidelines are additional to those presented within the current issue of the Arup Acoustic Design Report.

E1.4.1 BS EN 15288-1:2008+A1:2010

British Standard BS EN 15288-1:2008+A1:2010 *Swimming Pools Part 1: Safety Requirements for Design* provide recommendations in regards to the conditions to be met in the design of indoor swimming pools.

The standard notes that "*the structural elements, materials, finishes and details, including the pool hall enclosure (if any), basin and equipment and the way they are assembled should be those which are the most appropriate to achieving a safe-to-use physical environment*".

In regards to the acoustic conditions it recommends "*the acoustic design of indoor swimming pools shall ensure that reverberation time doesn't adversely influence communication*", noting the "*recommended reverberation time range is 1.5 s to 2.0 s*".

It should be noted that BS EN 15288-1:2008+A1:2010 does not specify the frequency bands affected by the recommended reverberation time or the inherent dependency of reverberation time to the volume of the space under design.

E1.4.2 Building Bulletin 93 – Acoustic Design of Schools: Performance Standards

It is presumed that the extract from "English Guidelines" was found in Building Bulletin 93 (BB93) *Acoustic Design of Schools*. BB93 sets out minimum performance standards for the acoustics of school buildings, and describes the normal means of demonstrating compliance with the UK Building Regulations.

The objective of BB93 in regards to reverberation time and acoustic absorption in sports halls and swimming pools is to provide suitable targets for "*clear communication of speech between teacher and student and clear communication between students*"

An extract of BB93 showing the target reverberation times recommended is provided below:

Type of room	T_{mf} seconds	
	New build	Refurbishment
Indoor sports hall, swimming pool	≤ (1.5 - 2.0) dependant on size of space. See section 1.6.2	≤ 2.0

Section 1.6.2 provides guidance on the performance standards for sports halls as a function of area. Table 7 (extracted from BB93, under section 1.6.2) is shown below:

Table 7: performance standards for sports halls T_{mf} as a function of floor area

Floor area	Maximum T_{mf} seconds
<280 m^2	1.5
280-530 m^2	2.0 – ((530-floor area)/500)
>530 m^2	2.0

It must be noted that BB93 is based on an assumption of smaller pools more typical of a local school with areas in the range shown in Table 7 above. Arup comment that the BB93 Table 7 has not accounted for the fact there will be a theoretical size limit above which it is impractical or even impossible to achieve 2.0 s reverberation time in a pool.

In the context of the typical smaller size of school pools BB93 is applied to in practice this potential oversight likely does not become a problem. However, for comparison, the Main Pool Hall at GPARC is approximately 1900 m^2 with volume of 17000 m^3 (nearly 4 times larger than the pool floor areas more commonly dealt with by BB93).

In summary, **BB93 recommends a reverberation time target for *typically smaller* school swimming pools of 2.0 seconds.**

E2 Precedent Design Review

Arup has worked on pools for international competitions with large to very large volumes where the design is primarily based upon the intelligibility of the sound systems.

E2.1 Berlin Schwimmsporthalle

This project was originally designed to support the Berlin bid for the 2000 Olympics but was subsequently modified and built anyway.

The main pool hall (volume about 122,000 m³) includes a 50m pool and an Olympic size diving pool and was initially designed with a mid-frequency reverberation time (RT) of **3 s**. Subsequent design changes resulted in a loss of absorption and the predicted, and subsequently measured, RT was 4.2 s. As a result the speech intelligibility decreased. We were confident that the targeted minimum speech intelligibility target would have been achieved should the 3 s RT target had been met.

E2.2 London Aquatic Centre

The main pool hall contains a 50m pool and an Olympic size diving pool.

Arup were involved in the Zaha Hadid design for the 2012 Olympics. Mid-frequency design targets for this project were upper limits of **3 s** for the main pool and 2.2 s for the training pool.

The intelligibility target is subjectively qualified as good under certain conditions in both Olympic and Legacy Modes. Volumes are 188,000m³ and 100,000m³ respectively.

E2.3 Dubai Sports Complex

The main pool hall contains a 50m pool and an Olympic size diving pool, but also includes seating for 18,000 spectators.

The design results in limitations on loudspeaker types and locations which requires a mid-frequency RT of **2.2 s** to obtain the necessary intelligibility. This, together with a high pool hall volume of 280,000m³, requires large areas of high performance absorption.

Appendix F

Preliminary Room Acoustic Modelling Results

F1 Preliminary Room Acoustics Assessment for the Pool and Leisure Hall

A Preliminary room acoustic assessment was carried out using computer modelling for the following configurations to understand the the acoustic performance of various acoustic control alternatives for the Pool and Leisure Hall at GPARC:

Configuration	Predicted Mid-Frequency RT, s
ETFE panels on the roof only	2.5 – 3.0
EFTE panels on roof ~ 650 m^2 absorptive panels to high level walls, NRC 0.94[1]	2.0 – 2.1
EFTE panels on roof 8 x 100m^2 hanging banners, NRC 0.56	1.9 – 2.0
ETFE panels on roof 8 x 100m^2 hanging banners, NRC 0.56 Long pool side wall angled 5º upwards	1.6 – 1.8

[1] Megasorber P50 used as basis of design

Based on the above, additional absorption is required to lower the reverberation time to around 2.0s.

Introduction of acoustic banners include challenges of maintenance and cost, and may pose an architectural challenge. In addition, acoustic banners may impact on the operation of the PA system, depending on the system configuration.

The results of the computer acoustic modelling were used to generate an auralisation in the Arup SoundLab to the City Aquatics and City Properties staff on 27 October 2015. This included examples of the first three configurations presented in Table 12 and from the reference pool study for comparison. The examples presented were auralised at source-receiver distances of 2 m, 10 m and 40 m to allow better understating of the influence of reverberation time on the subjective experience of typical activity sounds in the space

Appendix G

GPARC Outdoor Events Noise Impact Assessment

G1 Details of Acoustic Assessment

G1.1 Operating Hours

The operating hours of the facility are (as per the Management Plan).

- Monday to Friday (indoor) 5.30am – 11.00pm
- Monday to Friday (outdoor) 5.30am – 10.00pm
- Saturday, Sunday and Public Holidays 6.00am – 9.00pm

Noise generating sources and equipment associated with outdoor pool activities will be restricted as per the Management Plan to:

- Monday to Friday
  - (NDST) Not before 7.00am and not after 9.00pm
  - (DST) Not before 7.00am and not after 10.00pm
- Saturday, Sunday and Public Holidays
  - (NDST) Not before 8.00am and not after 8.00pm
  - (DST) Not before 8.00am and not after 9.00pm

G1.2 Sound Sources Noise Levels

G1.2.1 Patron Noise

Noise emission from groups of people is variable and difficult to predict, particularly for informal settings such as outdoor events. As an indicative calculation for noise emission from a group of people, the Hayne et al[5] methodology has been used. The empirical methodology is based on a large number of measurements of patron noise at bars and restaurants and has been shown to be reasonably accurate. The equation linking the source level of a crowd based on the number of people is as follows:

L_w (L_{Aeq}) = 15 log N + 64, where N is the number of patrons

L_w (L_{A10}) = 15 log N + 67, where N is the number of patrons

An attendance of around ~500 people (e.g. children and adults) is expected for events such as school carnivals and around ~200 people for sporting events. For modelling purposes, randomly distributed smaller gatherings of up to 50 people were assessed, resulting in a sound power level of 90 dB(A) per group. For noise modelling purposes, these groups were then distributed at various locations to make up the population totals noted above.

5 Hayne, Taylor, Rumble and Mee (2011) *Prediction of Noise from Small to Medium Sized Crowds*, Proceedings of Acoustics 2011, Gold Coast

Table 20: Noise spectrum of a single group of 50 people

Source	Level Descriptor	Sound Power Levels (dB)							
		Octave band centre frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Group of 50 people (raised voice)	L_{eq}	74	80	86	89	85	81	75	70
	L_{10}	77	83	89	92	88	84	78	73

Figure 4 shows the location of the noise sources used for prediction within the aquatic centre model.

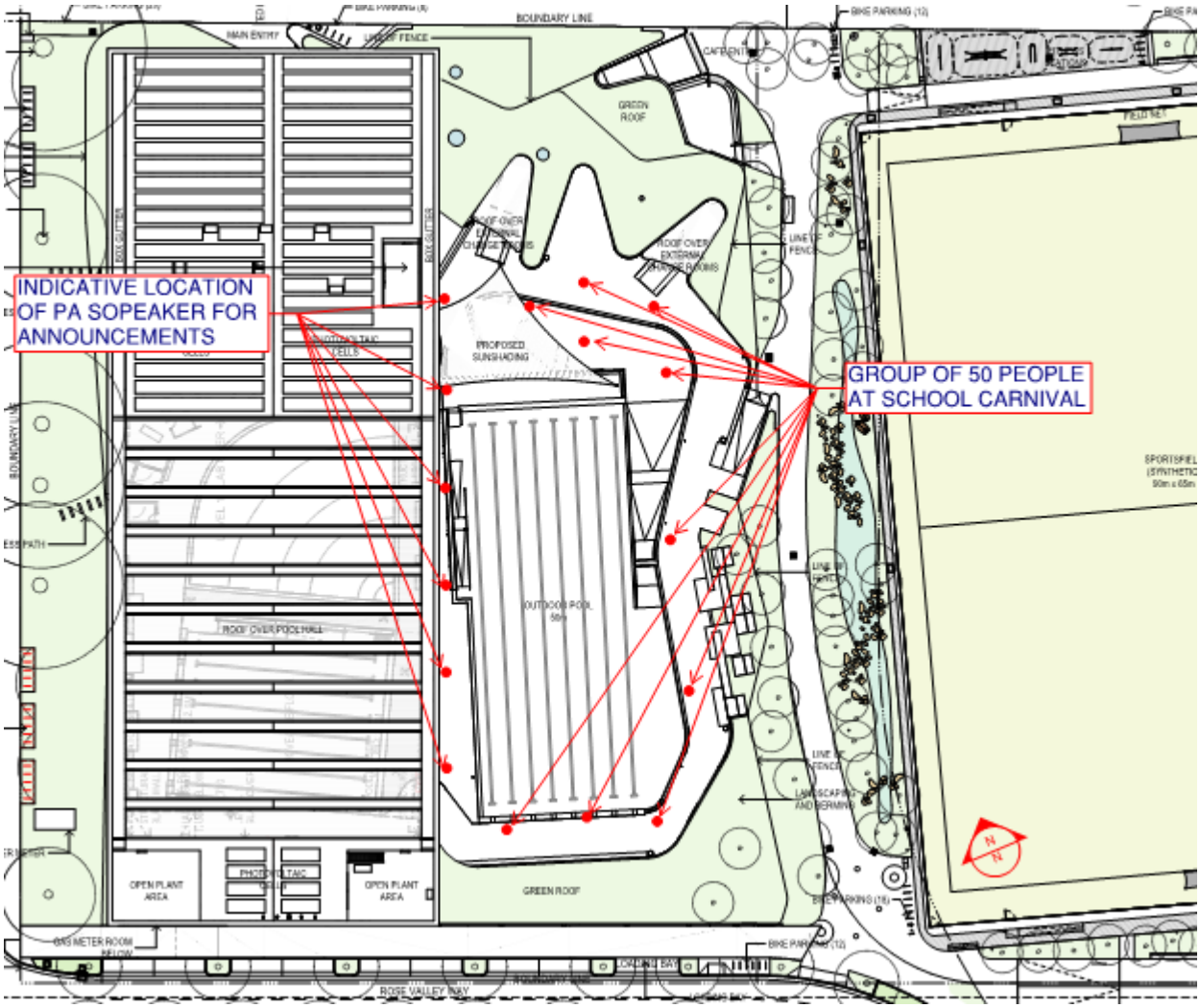

Figure 4: Site plan of the aquatic centre showing locations of noise sources during school carnivals.

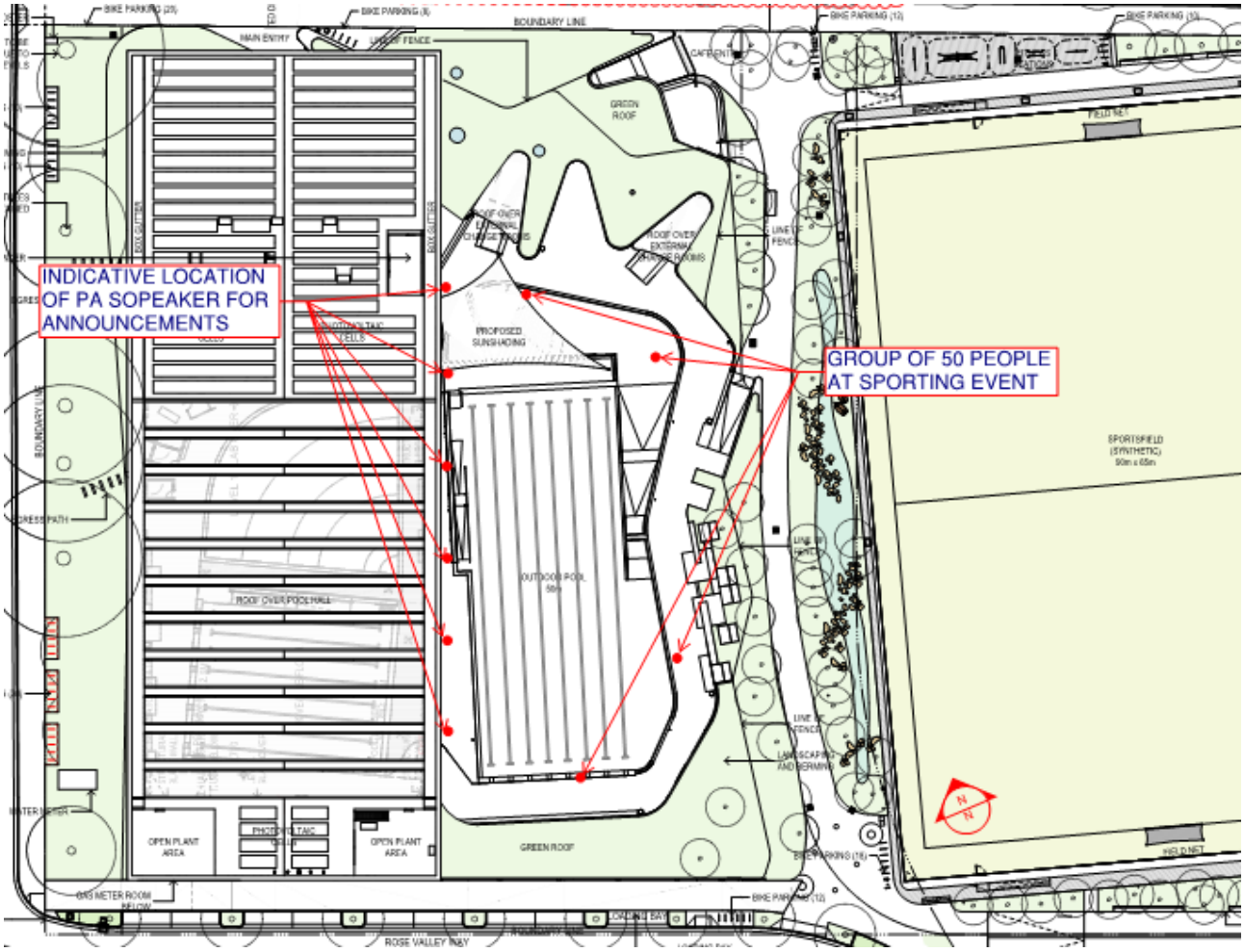

Figure 5: Site plan of the aquatic centre showing locations of noise sources during sporting events.

G1.2.2 Outdoor Pool

The sound spectrum of a swimming pool was extracted from the sound spectrum library available in the acoustic modelling software SoundPLAN. The spectrum was then scaled to resemble the results of the attended measurements carried out at Ian Thorpe Aquatic Centre as it is expected a similar drainage system will be available for the pools at Green Square Aquatic Centre.

The assumed noise level from the outdoor pool when in use is 65 dB(A) at ~1.5 m from the edge of the pool. Table 21 provides the noise spectrum of the outdoor swimming pool used for the acoustic model.

Table 21: Noise spectrum of the outdoor swimming pool

Source	Level Descriptor	Sound Power Levels (dB)							
		Octave band centre frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Outdoor swimming pool	L_{eq}	99	100	94	95	100	97	85	77

G1.2.3 PA System

An indicative layout of the PA system to be used during outdoor events at the Aquatic Centre (consisting of 6 loudspeakers distributed along the eastern façade of the main building) is shown in Figure 4. Expected uses of the PA system include:

- Amplified speech for announcements
- Amplified music during the event

An amplified use of the PA system may include a public speaking event, sporting event announcements, amenity music, etc. A typical loudspeaker frequency spectrum shape (with low-frequency allowance) has been assumed to represent a worst case use or event with foreground music (refer to Table 22). The sound level was modelled to target a sound pressure level of 70 dB L_{Aeq} at the left most boundary of the aquatic centre based Arup experience from noise measurements at similar events. From this, the calculated sound power for each loudspeaker is as shown below and the locations of the loudspeakers shown in Figure 4 and Figure 5 above.

Table 22: Noise spectrum of the each loudspeaker for the outdoor PA system

Source	Level Descriptor	Sound Power Levels (dB)							
		Octave band centre frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
PA system	L_{eq}	85	85	88	87	87	87	89	89

G1.3 Noise Receiver Locations

A preliminary acoustic model was developed to predict the noise levels of various outdoor uses at the aquatic centre. The assessment demonstrates the worst case scenario at the nearest noise receiver. It is assumed the nearest affected noise sensitive receiver will be located (See Figure 6):

- South of the site across the future Rose Valley Way near the intersection with Pony Race Link; ~20 m from the site boundary.
- North of the site across the future Zetland Avenue West of the intersection with future Grandstand Parade; ~30 m from the site boundary.

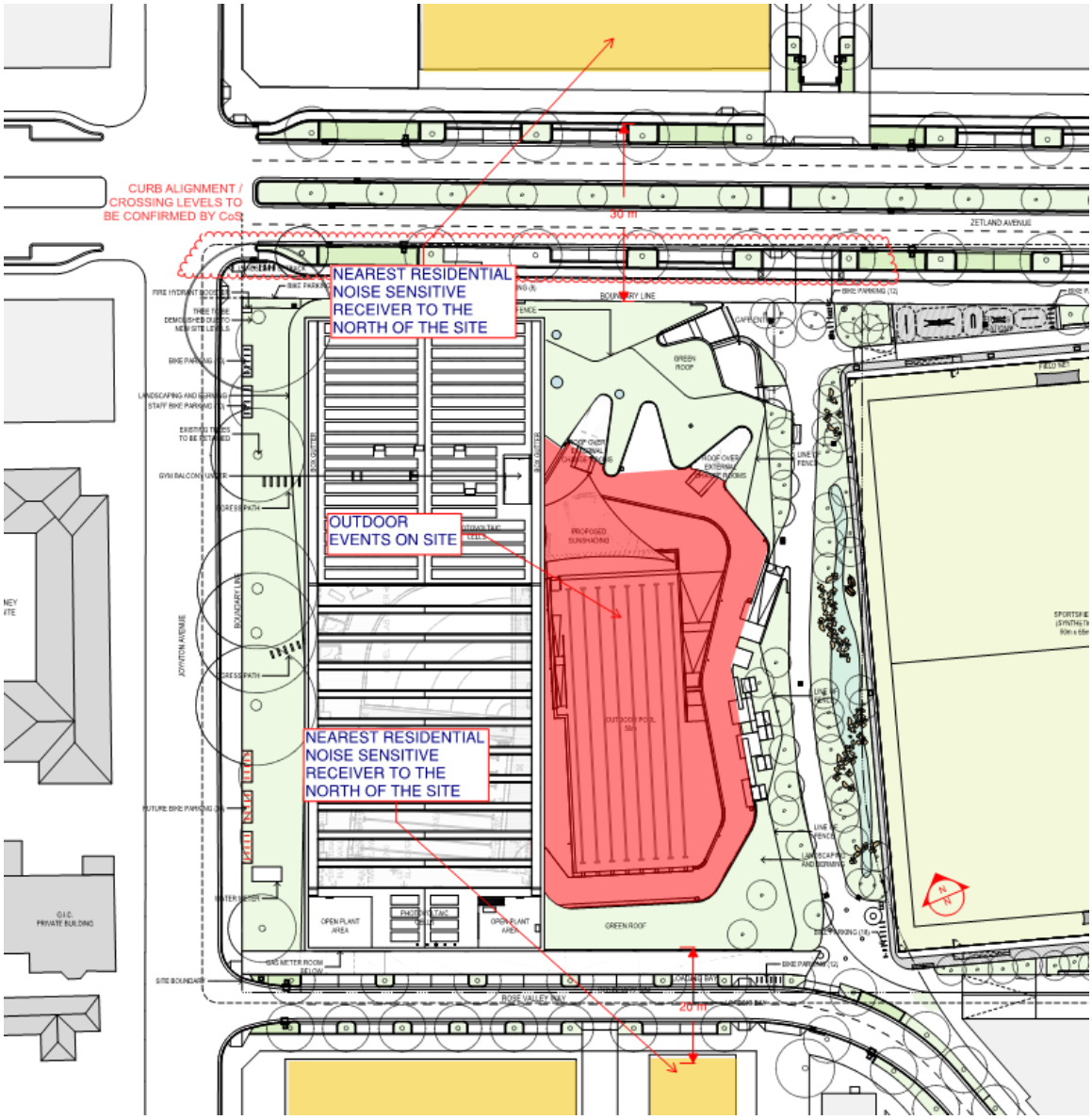

Figure 6: Site plan showing locations of nearest noise sensitive residential receivers.

The general operational use of the outdoor pool throughout the day is not predicted to generate significant continuous noise levels to the surrounding community.

G1.4 School Carnival

The following assumptions were considered for the acoustic model in order to predict the noise levels at the nearest noise sensitive receiver:

- Maximum number of patrons: 500 people (children and adults)
- Outdoor pool in use
- PA system for announcements and music (i.e. 6 x 15" loudspeakers on poles).
- It is assumed events of this type will be carried out within the day and evening time periods (7:00 a.m to 10:00 pm) with the greatest noise generation occurring between 10:00 a.m. and 4:00 p.m.

It is understood that this type of event occurs twice a week during the month of February.

The noise levels have been predicted for the future nearest residential receiver (South of the site). The predicted noise levels are summarized in Table 23. Also shown in the table are the project noise criteria, derived from surveys of the existing noise environment.

The noise levels are assessed against the current project specific criteria for the nearest receivers to the site (South of the Aquatic Centre). However, it is expected that the background noise environment will change as a result of upcoming development of the area and resemble the criteria established for the receivers north of the proposal site.

Table 23: Predicted noise levels at the nearest noise sensitive receiver generated by a school carnival event assessed against project relevant noise criteria

Location	Time Period	NSW INP Project Specific Criterion $dBL_{Aeq,period}$	City of Sydney Noise – General (b) condition Octave Band Noise Levels $dBL_{Aeq,15min}$							
			63	125	250	500	1k	2k	4k	8k
Residential receivers Along Rose Valley Way (South of site)	Predicted day-time noise level	54	50	51	49	50	51	47	37	27
	Current project specific day criteria	51	63	56	49	48	50	40	28	16
	Complies with criteria?	+3	✓	✓	✓	+2	+1	+7	+9	+11
	Expected future project specific day criteria	54	69	59	54	52	54	51	43	32
	Complies with criteria?	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Predicted evening noise level	45	42	42	40	41	42	39	29	18
	Current project specific evening criteria	46	56	59	53	46	47	47	37	22
	Complies with Criteria?	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Expected future project specific evening criteria	50	62	53	48	47	46	41	32	20
	Complies with criteria?	✓	✓	✓	✓	✓	✓	✓	✓	✓

The current noise environment at the South of the site has low levels of traffic and general occupational noise making the criteria based on the existing environment unrealistically stringent for future development planned around the site. An inevitable effect of the future residential development will be a general increase in ambient along Rose Valley Way.

Therefore, calculated exceedances of up to +10 dB during the day time period and +5 dB during the evening period are considered acceptable when allowance is made for the future increase in general ambient noise resulting from the planned population changes. These allowances are based on the observed background levels during the noise survey and the difference in the noise environment character closer to Joynton Avenue.

Due to the natural variations in speech level overall and octave band frequency spectra and fluctuation in the dynamically changing background noise conditions on site in practice, a 1 – 4 dB exceedance in an isolated octave band is considered acceptable within the tolerances of our assumed source levels.

Additional exceedances predicted in high-frequency octave bands 4 kHz and 8 kHz are also considered acceptable due to greater levels of fluctuation in source levels and the unlikelihood of these high frequency bands leading to noise complaints from speech sources in practice.

G1.5 Sporting Event

The following assumptions were considered for the acoustic model in order to predict the noise levels at the nearest noise sensitive receiver:

- Maximum number of patrons: 200 people
- Outdoor pool in use
- PA system for announcements and music (i.e. 6 x 15" loudspeakers on poles).
- It is assumed events of this type will be carried out within the day and evening time periods (7:00 a.m. to 10:00 pm) with the greatest noise generation occurring between 10:00 a.m. and 4:00 p.m.

It is understood that this type of event occurs will have recurrent iterations throughout the year as it is expected to be part of the core business of the aquatic centre.The predicted noise levels at the nearest noise sensitive receiver (South of the site) are summarized in Table 24.

Table 24: Predicted noise levels at the nearest noise sensitive receiver generated by a sporting event assessed against project relevant noise criteria

Location	**Time Period**	**NSW INP Project Specific Criterion[1]** $dBL_{Aeq,period}$	**City of Sydney Noise – General (b) condition Octave Band Noise Levels** $dBL_{Aeq,15min}$							
			63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Residential receivers Along Rose Valley Way (South of site)	Predicted day-time noise level	53	50	51	48	47	50	47	36	26
	Current project specific day criteria	51	63	56	49	48	50	40	28	16
	Complies with criteria?	+2	✓	✓	✓	✓	✓	+7	+8	+10
	Expected future project specific day criteria	54	69	59	54	52	54	51	43	32
	Complies with criteria?	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Predicted evening noise level	44	42	42	39	39	41	38	27	17
	Current project specific evening criteria	46	56	59	53	46	47	47	37	22
	Complies with Criteria?	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Expected future project specific evening criteria	50	62	53	48	47	46	41	32	20
	Complies with criteria?	✓	✓	✓	✓	✓	✓	✓	✓	✓

Noise from smaller events such as sporting events are expected to cause a lesser impact than events such as school carnivals. However, exceedances of the established criteria are expected for the overall daytime period criteria and at high frequency octave bands.

It is noted that the criteria established for the future residential receivers located south of the aquatic centre does not account for future increase in noise levels due to traffic noise on Rose Valley Way. Therefore, exceedances of the criteria are considered acceptable due to the forecasted change in the background noise conditions on site as the surrounding development progresses.

G1.6 Licenced Café

Predictions of licensed café use with 50 patrons outdoors have been carried out to the nearest future residential receiver (located ~30 m North of the site boundary) and are summarised in Table 25 against the relevant noise limiting criteria.

The predictions have been carried out to the nearest receiver (North of site). The licenced café premises are located on the north end of the site with an outdoor area connecting to the outdoor pool as described in the 100% Scheme Design Drawings provided by the Architect. We have assumed that any music from the café would be at a low level.

Assessment against the night-time criteria is not relevant for the purposes of this document as it is assumed that the hours of operation for the licenced café will be the same as the aquatic centre.

Table 25: Predicted noise levels at the nearest noise sensitive receiver generated by the licenced cafe.

Location	Time Period	NSW INP Project Specific Criterion $dBL_{Aeq,period}$	City of Sydney Noise – General (b) condition Octave Band Noise Levels $dBL_{Aeq,15min}$							
			63	125	250	500	1k	2k	4k	8k
Residential receivers Along Rose Valley Way (South of site)	Predicted day-time noise level	48	41	44	38	39	45	42	28	13
	Project specific day Criteria	54	69	59	54	52	54	51	43	32
	Complies with Criteria?	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Predicted evening noise level	40	32	35	29	30	37	34	19	4
	Project specific evening Criteria	50	62	53	48	47	46	41	32	20
	Complies with Criteria?	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 26: Predicted noise levels at the nearest noise sensitive receiver generated by the licenced cafe.

Location	Time Period	City of Sydney Noise – Licenced Premises condition Octave Band Noise Levels $dBL_{A10,15min}$							
		63	125	250	500	1k	2k	4k	8k
Residential receivers Along Rose Valley Way (South of site)	Predicted day-time noise level	44	47	41	42	48	45	31	16
	Project specific day Criteria	71	61	56	54	56	53	45	34
	Complies with Criteria?	✓	✓	✓	✓	✓	✓	✓	✓
	Predicted evening noise level	35	38	32	33	40	37	22	7
	Project specific evening Criteria	64	55	50	49	48	43	34	22
	Complies with Criteria?	✓	✓	✓	✓	✓	✓	✓	✓

As shown in Table 25 and Table 26, it is expected that the noise criteria for licenced premises will be met throughout the hours of operation of the aquatic centre for the noise generated by the use of licenced premises on site.

Prepared for City of Sydney

C16113
Gunyama Park Aquatic and Recreation Centre

Lighting Design DA Report

LR-003

Issue 2 | 25 May 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 240516

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Document Verification

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Appendices

Appendix A – Design Benchmarks

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Appendix C - External Lighting Calculations

1 Introduction

This report summarises the recommended lighting design approach and technical design parameters. The report to be read in conjunction with the DA documentations.

2 Design Approach/Strategy

2.1 Exterior Lighting

The exterior lighting design has carefully considered the park's uses and the intended hierarchy of interventions during the hours of darkness. The design recommendations are based on the pedestrian traffic volume and crime rate within the area. P2 category, appropriate for high volume of traffic and medium level of crime is adopted through the park pathway and BBQ areas. Lighting is only provided along the pathways and the landscape is not illuminated. Lighting level compliance with the associated Australian Standards (included in Section 3 of this report) is provided to the sports field and the external swimming pool. Safety, comfort and sustainability are all important aspects considered during the design process. The approach to address these aspects is provided in more detail in the below sections for different areas.

2.1.1 Park Lighting

Pole mounted fittings are the primary luminaires to maximise performance and minimise visual cluttering within the park. City of Sydney approved fittings (the GE Twin Contemporary), are to be provided on 6m poles through the park, 4.5m poles are used at the southern pathway along Rose Valley Way and adjacent to the future residential development. This allow the lighting scheme to be consistent with the general city lighting design guide.

2.1.2 Sports Field and External Pool Lighting

The sports field and swimming pool luminaires are to be mounted on high level masts, allowing for area floodlighting as required to achieve illuminance requirements across the field and pools. LED luminaires are utilised throughout the project including the swimming pool areas.

However due to technological limitations, the sports field is to be illuminated by metal halide floodlights. LED has significantly improved over the years and are generally adopted in commercial environments. However the high lumen output luminaires are still limited to swimming pool application and not yet available for sports lighting.

These are only to be operational during pre-curfewed hours, and will be turned off at curfew hours to ensure that obtrusive lighting to the residential is minimised.

2.1.3 BBQ Area

The BBQ areas will be illuminated with the City of Sydney approved GE Twin Contemporary fittings, mounted on 4.5m light poles, adjacent to the BBQ bench. The fitting selection along with the park lighting is to create a holistic look across the entire park.This is in line with the overall City of Sydney design guide.

2.2 Interior Lighting

Creating a welcoming, open atmosphere in the public accessible space is a key consideration for the interior lighting design. This combined with the lower lighting power density targets, the different spaces within the building will utilise strategies appropriate for their use.

2.2.1 Entrance Lobby/Reception

The entrance lobby is to be illuminated primarily via surface mounted downlights. This will be supplemented by a continuous linear extrusion mounted alongside the slab edge along the eastern perimeter adjacent to the high level windows this is supplemented decorative pendants at dedicated areas through the space.

Localised pendants are suspended above the reception desk providing localised lighting at the desk level and vertical lighting at the face level to the receptionist.

2.2.2 Café

Suspended circular pendants in the café area provide direct/indirect lighting to the space, both accentuating the ceiling and floor plane while creating a welcoming atmosphere to the area.

2.2.3 Internal Pools

Uplighting to the ceiling is an important strategy in creating an open atmosphere within the space. LED projectors are directed upwards along the structural beams to provide highlighting, while the skylight will remain unlit to provide the contrast against the beams as well as avoiding reflected glare from the luminaires.

The pool will be illuminated by high power LED floodlight mounted at the perimeter, projecting light to the pool area.

Maintenance and longevity of the light fittings are key considerations for the interior lighting design. LED floodlights are selected at the double height ceiling space, while LED downlights are to be installed at the low ceiling height space below at the pool hall. This allows a long product life and reduced maintenance requirement.

Both the functional and accent luminaires are mounted within areas where mobile scaffolding can be placed for maintenance purpose. At the low height area, it has been advised that the water depth is shallow and therefore maintenance of the recessed downlights can be carried out via a ladder.

2.2.4 Hydrotherapy Pool

To create a softer environment, the hydrotherapy pool area is to be illuminated by LED floodlights pointing upward. The reflected light provides the required lighting level to the pool area, while the ceiling is highlighted.

2.2.5 Dry Fitness Studios and Gymnasium

The gymnasium is to be illuminated by suspended direct-indirect luminaires. Uplighting to the ceiling provides a consistent look from the interior pool into the gym through the glazing. Direct viewing of the light source is mitigated with diffusers specified in all luminaires within the gymnasium.

2.2.6 Offices/Meeting Rooms/Creche Office

Offices are to be illuminated by troffers with a high efficiency and visual comfort. To provide some indirect lighting (with the aim to satisfy the Green Star requirement), a semi-recessed fitting with the optic protruding from the ceiling is proposed, allow some side throw of lighting back onto the ceiling.

2.2.7 Change Rooms

Change rooms are to be illuminated by surface mounted downlights within a continuous perimeter pelmet lighting. This provides both the functional lighting as well as accentuating the vertical surfaces within the space.

2.2.8 Commercial Kitchen

Recessed LED troffers with diffusers will provide the lighting for the kitchen.

2.2.9 Plantroom

Plantrooms will be illuminated by surface mounted LED battens with diffusers.

3 Performance and Standards

3.1 Codes and Standards

The design complies with the following codes and standards:

- NCC Section J6
- AS1158 – Lighting for Roads and Public Spaces
- AS1680 – Interior and Workplace Lighting
- AS2560 – Sports Lighting
- AS4282 – Control of the Obtrusive Effects of Outdoor Lighting
- City of Sydney External Lighting Design Guide

- Green Star Interior

Refer to Appendix A for the agreed lighting design parameters

3.2 Maintenance

Maintenance of luminaires for the internal pool is critical for the project. Ease of access during maintenance is a key design consideration, which was achieved by utilising LED throughout the project where the technology allows. Increased longevity and energy efficiency of the products will significantly reduce the operation and maintenance cost for the luminaires. A limited number of suppliers are proposed for the project for the ease of procurement and fitting replacement during maintenance.

4 Australian Standards Compliance – External Lighting

4.1 Park and Street Lighting

The park lighting design complies with AS1158.3.1, category P2 for pathways with high pedestrian traffic and medium crime rate. Below is the design parameter as recommended in AS1158.3.1.

TABLE 2.6

VALUES OF LIGHT TECHNICAL PARAMETERS AND PERMISSIBLE LUMINAIRE TYPES FOR ROADS IN LOCAL AREAS AND FOR PATHWAYS

1	2	3	4	5	6
Lighting subcategory	Light technical parameters				Permissible luminaire type (see Table 2.10)
	Average horizontal illuminance[a,b] ($\bar{E}_h$) lux	Point horizontal illuminance[a,b] (E_{Ph}) lux	Illuminance (horizontal) uniformity[c] Cat. P (U_{E2})	Point vertical illuminance[a,b] (E_{Pv}) lux	
P1	7	2	10	2	Type 4 where part of a road reserve or Types 2, 3, 4 or 6 elsewhere
P2	3.5	0.7	10	0.7	
P3[e]	1.75	0.3	10	0.3[d]	
P4[e]	0.85	0.14	10	N/A	
P5[e]	0.5	0.07	10	N/A	

The design complies with the recommendation. As demonstrated below from the calculation results, the design complies with the Australian Standards recommendation.

No.	Designation	Type	Grid	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]
1	Pathway Horizontal Overall	perpendicular	128 x 128	11	0.93	33
2	Pathway Vertical - North	vertical, 5.0°	128 x 16	8.88	0.70	34
3	Pathway Vertical West	vertical, 90.0°	128 x 128	8.74	1.68	27
4	Pathway Vertical East	vertical, 270.0°	128 x 128	7.85	0.80	32
5	Pathway Vertical South	vertical, 0.0°	128 x 128	7.96	0.77	40
6	Rose Valley Pedestrian Horizontal	perpendicular	128 x 16	9.18	1.00	15
7	Rose Valley Pedestrian Vertical	vertical, 0.0°	128 x 16	8.19	0.89	28
8	Rose Valley Road Horizontal	perpendicular	128 x 16	5.31	2.32	10
9	Rose Valley Road Vertical	vertical, 0.0°	128 x 16	3.22	0.67	11

Detailed pseudo colour results are included in Appendix C1.

4.2 Sports Field Lighting

Due to the close distance between the sports field and the future residential development as indicated on the current architectural plan, the brightness of the sports lighting infrastructure and the lighting effect on the sports field will require a fine balance with the potential obtrusive effects.

Aiming and location of the sports field lighting have been carefully considered to ensure that the lighting provides minimal impact to the residential development while providing sufficient lighting for the sports field. The operation hours of the sports field will not exceed the standard curfewed hours, eliminating any obtrusive lighting during these time.

Appendix C2 demonstrated that the calculation complies with the AS2560 Sports Lighting requirement. The design also complies with AS4282 Obtrusive Lighting recommendation during pre-curfewed hours. The lighting will be turned off after curfewed hours.

4.3 Obtrusive Lighting from Street Lighting

As per Australian Standards AS4282, clause 1.4.10, the standard does not apply to "lighting provided for the purposes of all-night safety and security on public roads, cycle paths, footpaths and pedestrian movement areas within public parks and gardens."

Assessment was carried out as requested to demonstrate that street lighting along Rose Valley within the project boundary would be compliance with the standard on the residential development on 84-94 Epsom Road.

Refer to Appendix C3. The results demonstrated that the street lighting design complies with AS4282, with minimum impact to the residential developments.

5 Green Star Compliance

The adaptation of Green Star on the project ensures the lighting design delivers a visually comfortable environment and a sustainable solution. Below are the lighting related Green Star points that are achieved in the project.

5.1 Credit 11.1 General Illuminance and Glare Reduction

This point is applicable to artificial lighting only.

Glare reduction is applied to all fittings by ensuring that glare reduction accessories, including louvres and diffusers have been installed within all luminaires.

5.2 Credit 11.2 Surface Illuminance

To achieve this point, either "the architectural finish on the ceiling has an average reflectance of 0.75 (white colour)", or "the ceiling area has an average surface illuminance of at least 30% of the lighting levels on the working plane".

The credit is only applicable to front of house areas. Back of house/plantrooms are not included as part of the credit assessment.

All interior areas have been considered to achieve this point. Due to the ceiling height, mounting location, architectural design intent, functionality of the spaces and architectural finishes, only the following areas complies with the credit:

- Creche Office
- Cash handling room
- Managers Office
- Meeting Room 01
- Meeting Room 02
- Indoor Seating
- Wet Change Room (M)
- Wet Change Room (F)
- Weights & Cardio
- Spin Room
- Fitness Studio 01
- Fitness Studio 02
- Consultation Rooms

5.3 Credit 11.3 Localised Control

Localised control (by definition of Green Star, light switches) allows users of a space to determine the operation of the lighting from within each space to suit how they are using the environment through light switches that allow activation/deactivation as well as dimming of lighting.

The credit is only applicable to front of house areas. Back of house/plantrooms are not included as part of the credit assessment.

As the building will be accessible by the general public, localised control are not suitable in all of the spaces. Public areas shall be controlled by the facility manager through a centralised lighting control system and not allowing the general public within the space to alter the lighting condition. Localised control is only provided for staff accessible areas, including the following:

- Creche Office
- Cash handling room
- Manager Office
- Meeting Room 01
- Meeting Room 02
- Consultation Rooms

5.4 Credit 27.0 Light Pollution to Neighbouring Bodies

Exterior lighting is designed to comply with lighting complies with AS4282 – Obtrusive Lighting.

5.5 Credit 27.0 Light Pollution to Night Sky

All fittings on the project have a Upward Waste Lighting Ratio (UWLR) of less than 95% (ie. Only 5% of lighting is redirected upward). Uplighting is not used in open areas. Any uplighting is installed either under canopies or within indoor environments.

Appendix A– Design Benchmarks

A1 Proposed Lighting Design Parameters for Internal Area and Sports Field

	AS1680.2.1	AS2560.2.3	AS2560.2.5	CoS	AFL Code	Project Recommmendation
Pool (Recreational)	N/A	N/A	120 lx	N/A	N/A	120 lx
General Circulation	80 lx	N/A	N/A	N/A	N/A	80 lx
Change Room, Locker Room	80 lx	N/A	N/A	N/A	N/A	80 lx
Toilet	80 lx	N/A	N/A	N/A	N/A	80 lx
Accessible Toilet	200 lx	N/A	N/A	N/A	N/A	200 lx

A2 Lighting Design Parameters for Exterior Area

	AS1158.3	AS2560.2.3	AS2560.2.5	CoS	AFL	Project Recommmendation
Pool (Recreational)	N/A	N/A	120 lx	N/A	N/A	120 lx
Pool Surrounding (Major Pathway)	14 lx	N/A	N/A	3.5 lx	N/A	7 lx
Boardwalk (Minor Pathway)	3.5 lx	N/A	N/A	1.75 lx	N/A	3.5 lx
Sports Field (Professional Competition)	N/A	500 lx (Max)	N/A	N/A	500 lx	100 lx (based on instruction received from CoS on 12th June)

A3 AS4282 Obtrusive Lighting Parameters

TABLE 2.1

RECOMMENDED MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS FOR THE CONTROL OF OBTRUSIVE LIGHT

(See Clause 2.7)

1	2	3	4	5
Light technical parameter	Application or calculation conditions (see also Figure 2.1 and Section 5)	Recommended maximum values		
		In commercial areas or at boundary of commercial and residential areas*	Residential areas	
			Light surrounds†	Dark surrounds‡
Illuminance in vertical plane (E_v)	*Pre-curfew:* Limits apply at relevant boundaries of nearby residential properties, in a vertical plane parallel to the relevant boundary, to a height commensurate with the height of the potentially affected dwellings. Values given are for the direct component of illuminance	25 lx	10 lx	10 lx
	Curfewed hours: Limits apply in the plane of the windows of habitable rooms of dwellings on nearby residential properties. In the absence of development (i.e. vacant allotment), the limits apply on the potentially affected property, in a vertical plane parallel to the relevant boundary, at the minimum setback permitted for a dwelling, to a height commensurate with land use zoning provisions. Values given are for the direct component of illuminance	4 lx	2 lx	1 lx
Luminous intensity emitted by luminaires (I)	*Pre-curfew:* Limits apply to each luminaire (irrespective of the number on a head frame) in the principal plane, for all angles at and above the control direction, when aimed in accordance with the installation design	Limits as determined from Table 2.2. Alternatively, the limits and method of assessment associated with curfewed hours may be applied, at the discretion of the designer (see Clauses 2.7.1 and 2.7.2)		
	Curfewed hours: Limits apply in directions where views of bright surfaces of luminaires are likely to be troublesome to residents, from positions where such views are likely to be maintained, i.e. not where momentary or short-term viewing is involved	2 500 cd	1 000 cd	500 cd
Threshold increment (TI)	Limits apply at all times where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and viewing directions in the path of travel	20% based on adaptation luminance ($\bar{L}$) of 10 cd/m²	20% based on adaptation luminance ($\bar{L}$) of 1 cd/m²	20% based on adaptation luminance ($\bar{L}$) of 0.1 cd/m²

A4 Green Star

✔ Achieved

▬ Achieved in areas as outlined in Section 4 of the report

	9.1	Ventilation System Attributes	1	1	1
	9.2	Provision of Outside Air	2	1	1
	9.3	Exhaust or Elimination of Pollutants	1	0	1
	10.1	Internal Noise Levels	1	1	1
	10.2	Reverberation	1	1	1
	10.3	Acoustic Separation	1	1	1
✔	11.0	Lighting Comfort	Prerequisite	Prerequisite	Prerequisite
✔	11.1	General Illuminance and Glare Reduction	1	1	1
▬	11.2	Surface Illuminance	1	1	1
▬	11.3	Localised Lighting Control	1	1	1
✔	27.0	Light Pollution to Neighbouring Bodies	Prerequisite	Prerequisite	Prerequisite
✔	27.1	Light Pollution to Night Sky	1	1	1
	28.1	Legionella Impacts from cooling systems	1	0	0
	29.1	Refrigerants Impacts	1	0	1

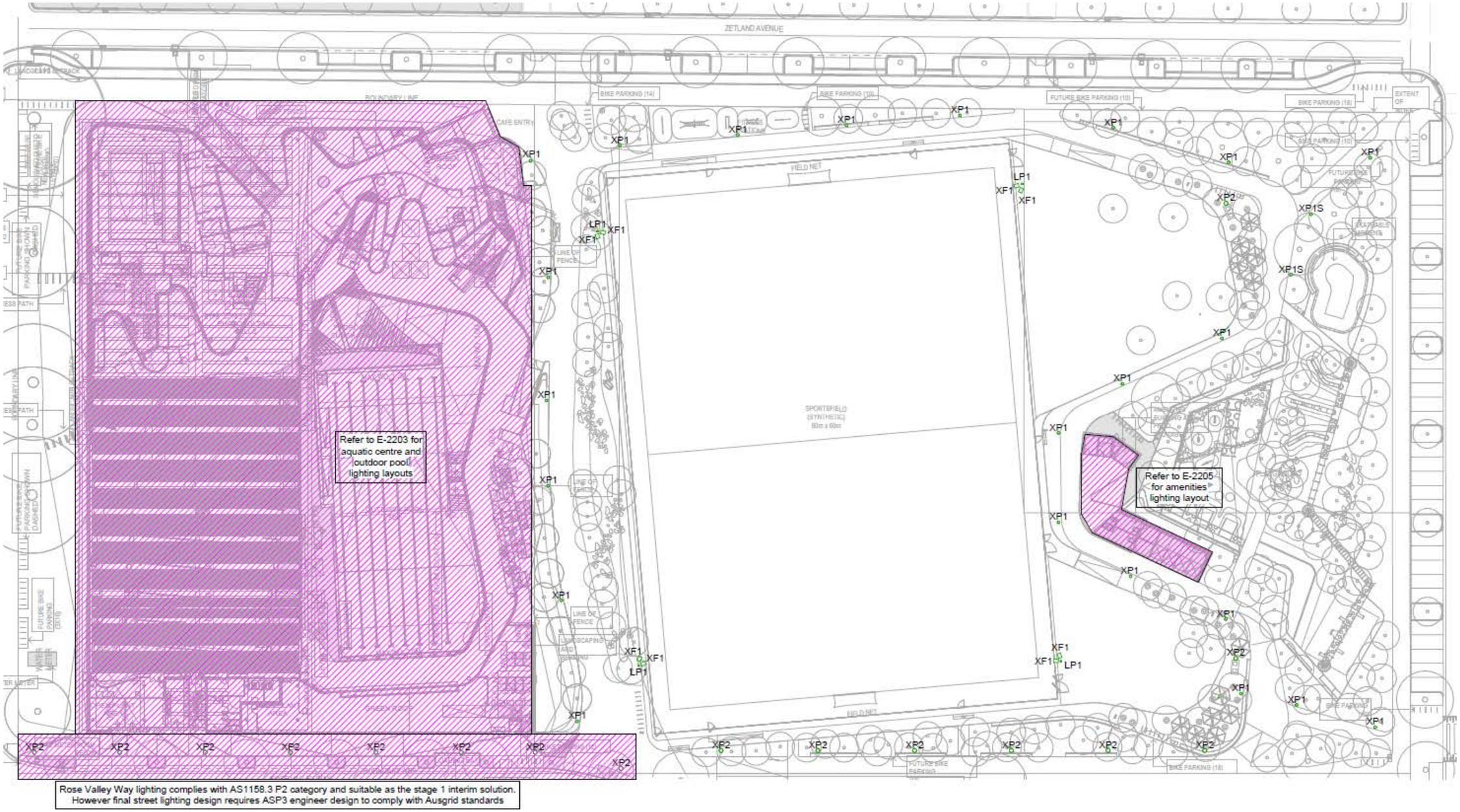
A4.1 11.2 Surface Illuminance

Pool Hall, Pool Concourse, Hydrotherapy Pool, Change Rooms, Dry Fitness Studios and Spin Rooms are excluded from this point due to functionality restriction.

A4.2 11.3 Localised Lighting Control

Due to the building accessible by the general public, localised control are only allowed for staff accessible area. Public access areas should only be controlled by the facility manager and not allowing users within the space to alter the lighting condition.

Appendix B - Site Lighting Layout and Luminaires


ZETLAND AVENUE
BIKE PARKING (14)
BIKE PARKING (10)
FUTURE BIKE PARKING (10)
BIKE PARKING (18)
BIKE PARKING (10)
EXTENT OF WORKS
CAFE ENTRY
LINE OF FENCE
FIELD NET
SPORTSFIELD (SYNTHETIC) 90m x 60m
FUTURE BIKE PARKING
BIKE PARKING (18)
Refer to E-2203 for aquatic centre and outdoor pool lighting layouts
Refer to E-2205 for amenities lighting layout
Rose Valley Way lighting complies with AS1158.3 P2 category and suitable as the stage 1 interim solution.
However final street lighting design requires ASP3 engineer design to comply with Ausgrid standards

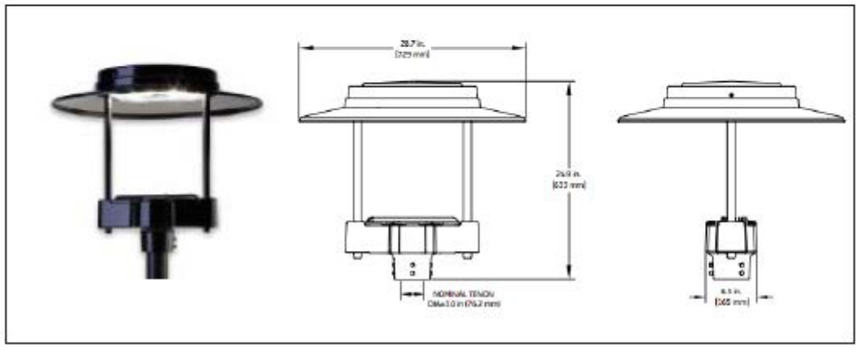
E-2201

Luminaire Location:	-	Luminaire Reference:	**XP1/XP1-S**
Purpose of Issue:	Development Approval	Date:	May 2016

General Description

CoS approved post top luminaire on 6m tapered round pole

General Appearance



Nominated Luminaire Description

Manufacturer / Supplier	GE + International Poles
Range	Twin Contemporary + 6m pole
Code	Tiered Circular
IP Rating	IP65
Finish	Black
Colour	Black

Additional Details

Optic	E5 asymmetric
Mounting	Post Top
Trim	-

Light Source

Manufacturer	GE
Lamp Type	LED
Wattage	83W
Number of Lamps	-
Total Watts	83W
Colour Temperature	4100K Cool White
CRI	70+
Glare Control	-
NOTE	In areas with no Green Star glare control requirement

Control Gear / Power Supply

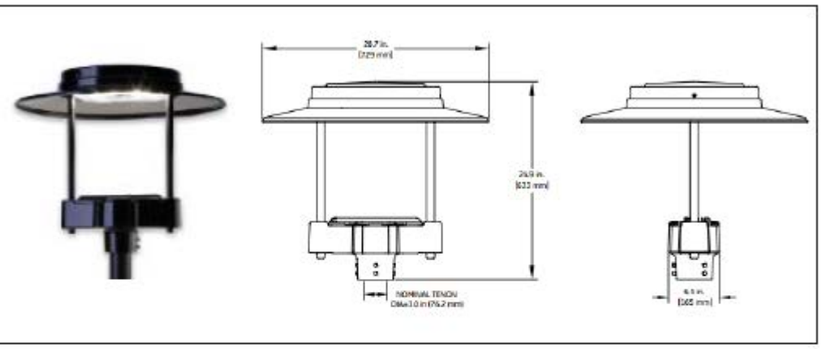
Type	Non-dimmable
Control	Electronic
Integral / Remote	Integral

Luminaire Location:	-	Luminaire Reference:	**XP2**
Purpose of Issue:	Development Approval	Date:	May 2016

General Description

CoS approved post top luminaire on 4.5m tapered round pole

General Appearance



Nominated Luminaire Description

Manufacturer / Supplier	GE + International Poles
Range	Twin Contemporary + 4.5m pole
Code	Tiered Circular
IP Rating	IP65
Finish	Black
Colour	Black

Additional Details

Optic	C3 Symmetrical
Mounting	Post Top
Trim	-

Light Source

Manufacturer	GE
Lamp Type	LED
Wattage	48W
Number of Lamps	-
Total Watts	48W
Colour Temperature	4100K Cool White
CRI	70+
Glare Control	-
NOTE	In areas with no Green Star glare control requirement

Control Gear / Power Supply

Type	Electronic
Control	Non Dimmable
Integral / Remote	Integral

Luminaire Location:	-	Luminaire Reference:	**XF1**
Purpose of Issue:	Development Approval	Date:	May 2016

General Description

Exterior post top flood light

General Appearance



Dimensions: 795mm (L) x 620mm (W) x 228mm (H)

Nominated Luminaire Description

Manufacturer / Supplier	Siteco / Gerard Lighting
Range	SiCOMPACT® A3 MAXI
Code	5NA76901WB03
IP Rating	IP65
Finish	Aluminium
Colour	White

Additional Details

Optic	Narrow asymmetric
Mounting	Pole mounted
Trim	-

Control Gear / Power Supply

Type	Non-dimmable
Control	Electronic
Integral / Remote	Remote (within pole)

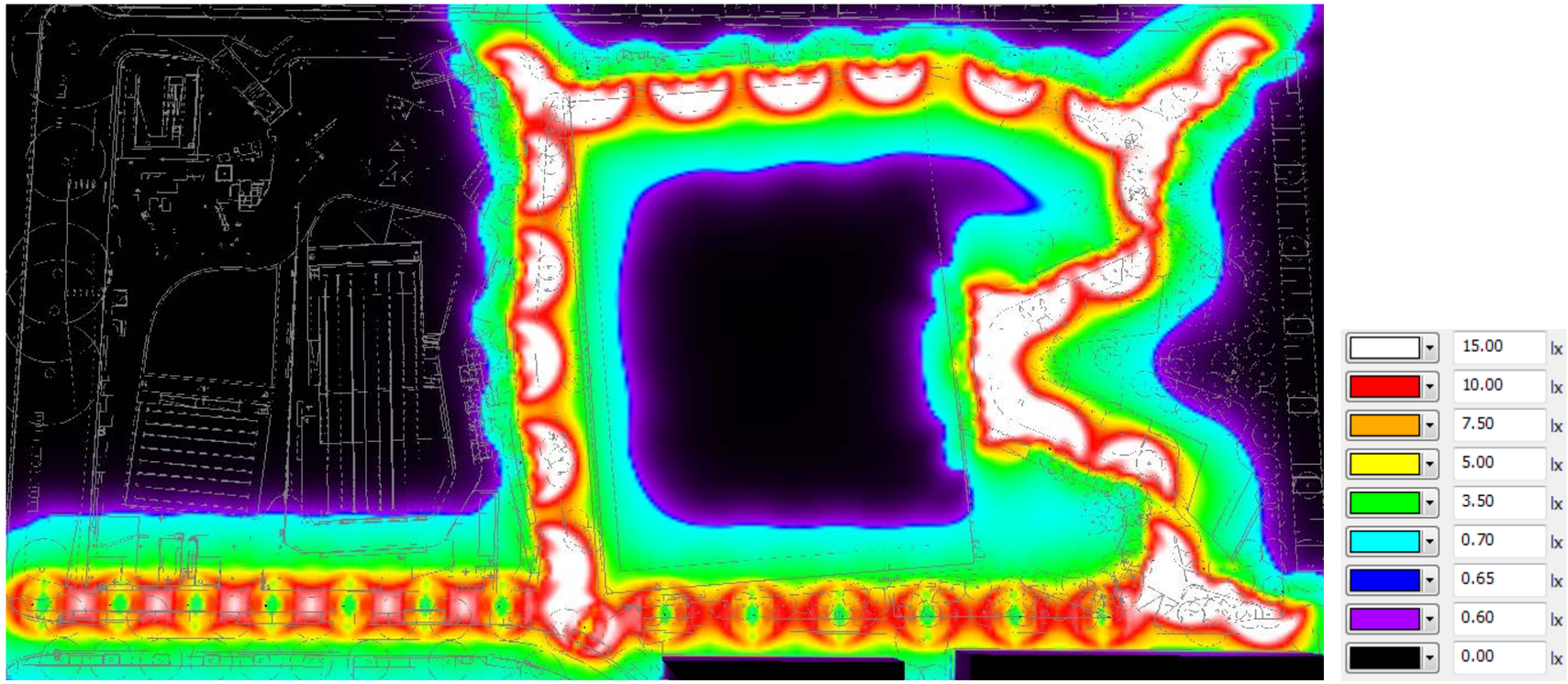
Light Source

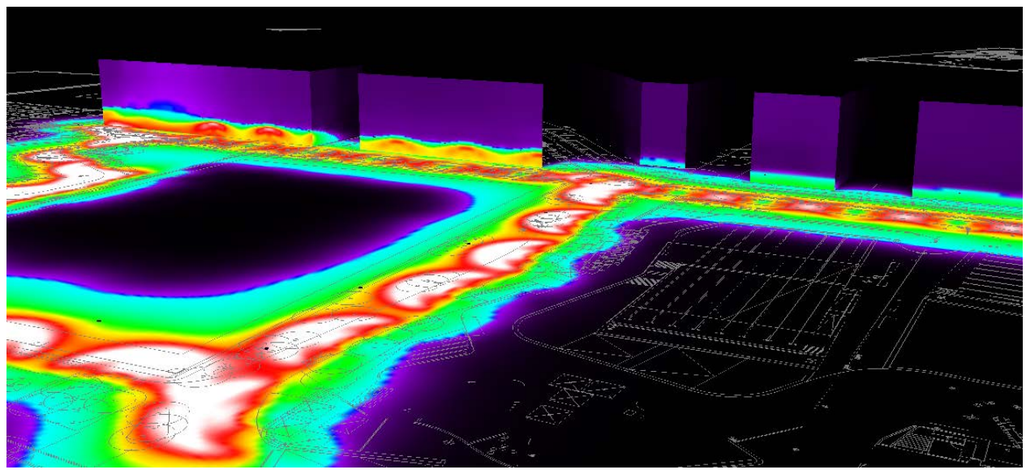
Manufacturer	Siteco
Lamp Type	1x HIT-DE l=274 2000W
Wattage	2000W
Number of Lamps	-
Total Watts	2000W
Colour Temperature	-
CRI	70
Glare Control	Glare shield where required
NOTE	In areas with no Greenstar glare control requirement

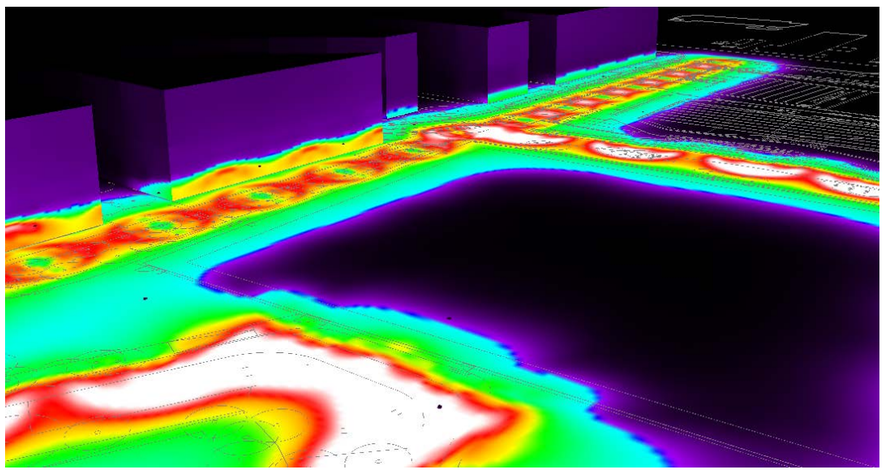
NOTE: LED floodlight currently under design consideration

Appendix C- External Lighting Calculations

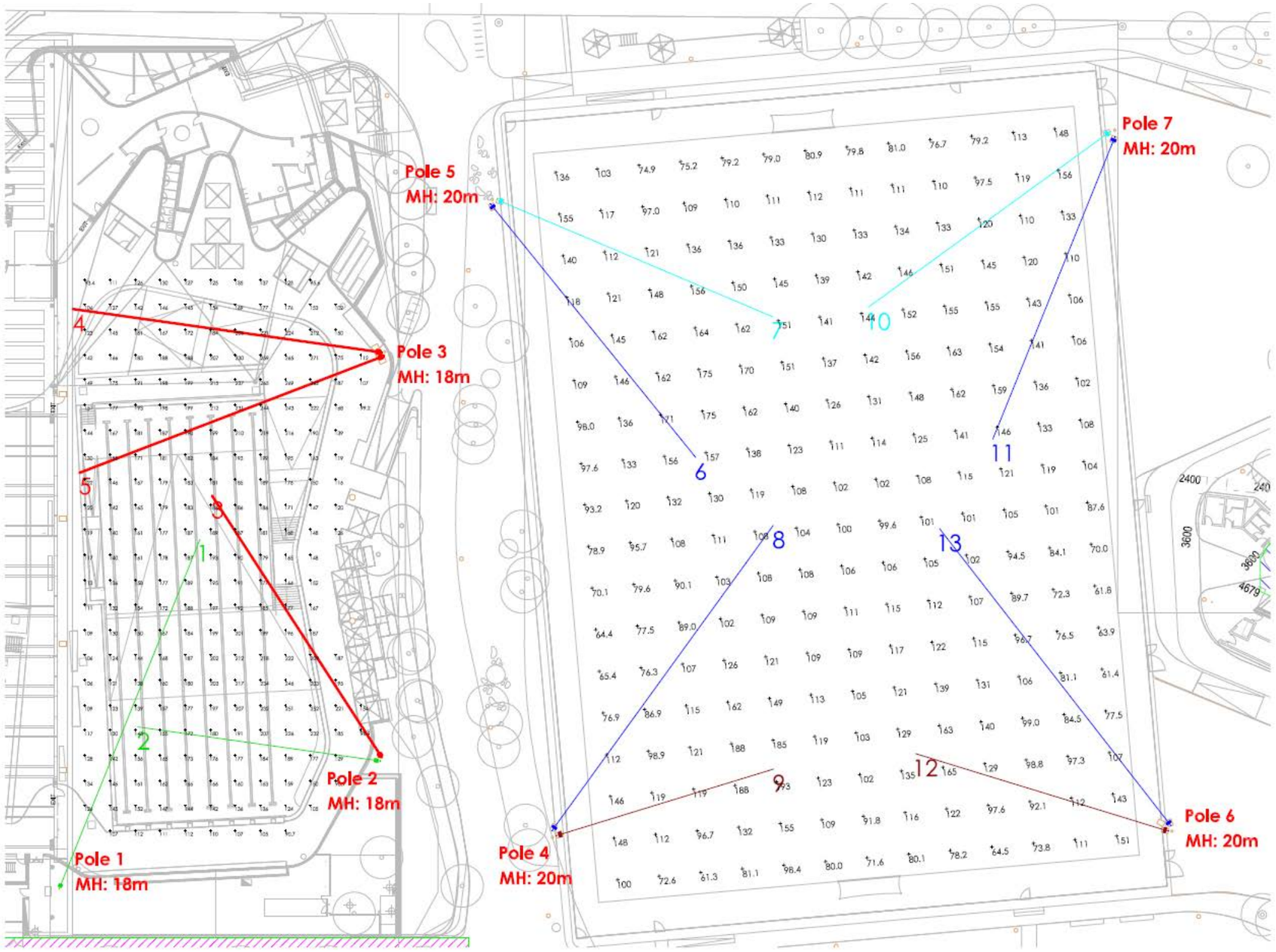
C1 Park Lighting







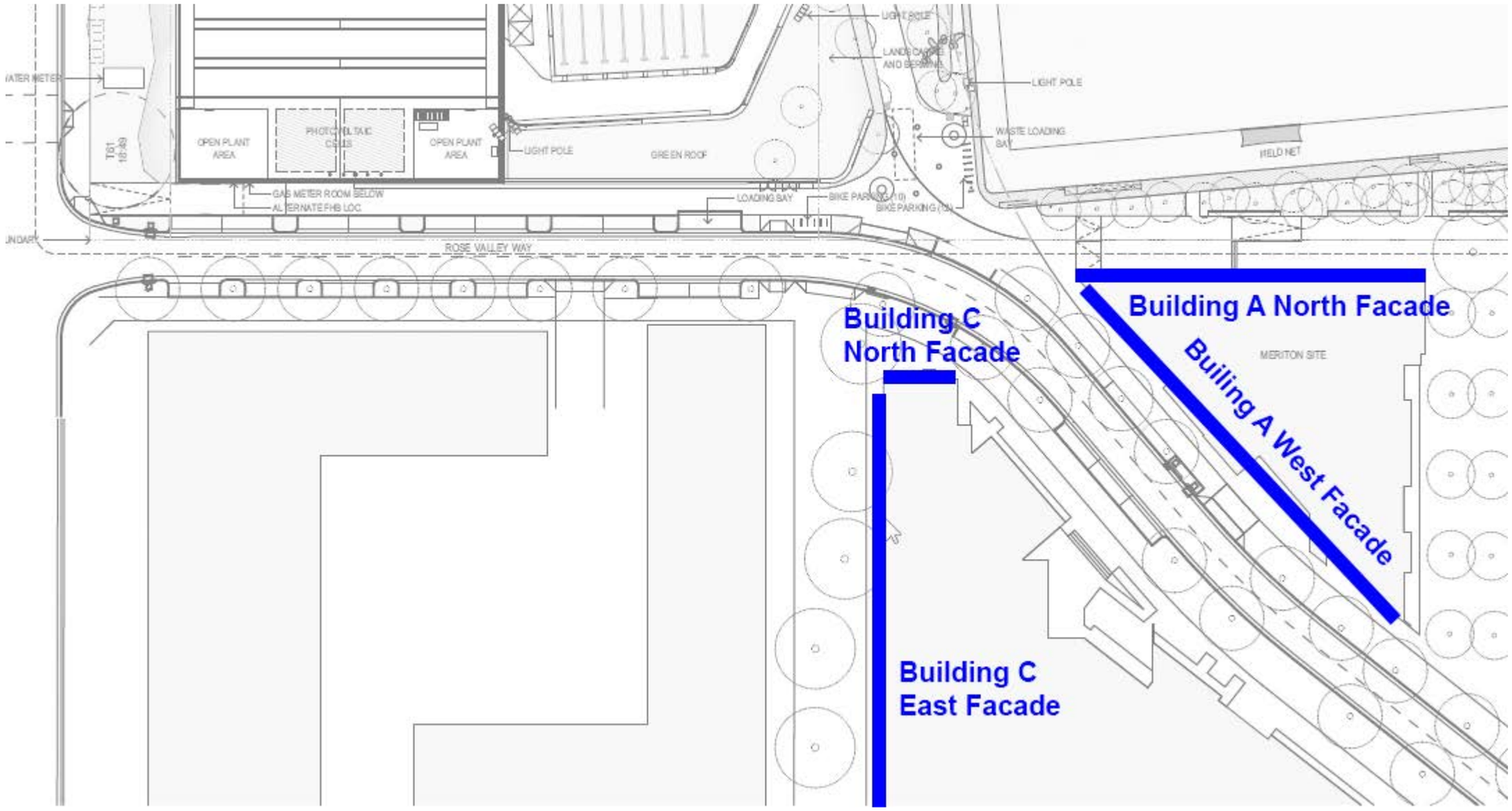
C2 Sports Field Lighting



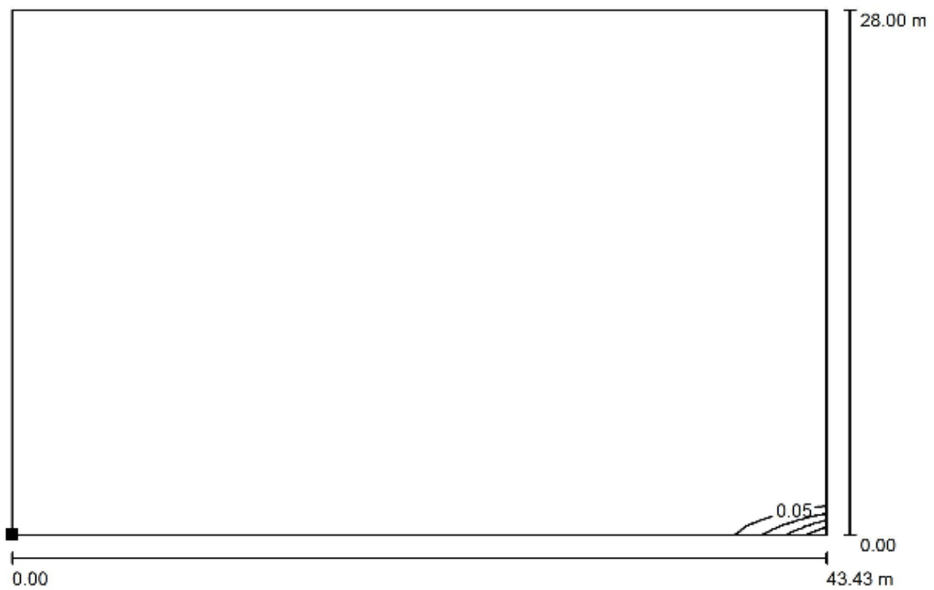
Note: Pole 1 is mounted on top of building roof, 18m above pool deck floor level

Calculation Summary									
Label	**CalcType**	**Units**	**Avg**	**Max**	**Min**	**Min/Avg**	**Min/Max**	**PtSpcLr**	**PtSpcTb**
Soccer Field	Illuminance	Lux	117.38	193	61.3	0.52	0.32	5	5
Pool	Illuminance	Lux	168.10	271	90.7	0.54	0.33	3	3
ObtrusiveLight_Zetland Avenue_Ill_Seg1	Obtrusive Light - Ill	Lux	0.33	2.7	0.0	N.A.	N.A.	5	1
ObtrusiveLight_TI_2	Obtrusive Light - TI	%	0.02	1	0	N.A.	N.A.	1	0
ObtrusiveLight_TI_1	Obtrusive Light - TI	%	0.43	1	0	N.A.	N.A.	1	0
ObtrusiveLight_Joynton Avenue_Ill_Seg1	Obtrusive Light - Ill	Lux	0.18	0.7	0.0	N.A.	N.A.	5	1
ObtrusiveLight_Bottom boundary_Ill_Seg1	Obtrusive Light - Ill	Lux	1.02	7.1	0.0	N.A.	N.A.	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.85	2.8	0.1	0.12	0.04	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.88	2.8	0.2	0.23	0.07	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.91	2.8	0.1	0.11	0.04	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.91	2.8	0.2	0.22	0.07	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.90	2.8	0.2	0.22	0.07	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.91	2.6	0.1	0.11	0.04	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.94	2.6	0.2	0.21	0.08	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.37	1.3	0.1	0.27	0.08	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.43	1.5	0.1	0.23	0.07	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.86	7.1	0.0	N.A.	N.A.	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.50	1.8	0.1	0.20	0.06	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.56	2.0	0.1	0.18	0.05	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.57	2.1	0.1	0.18	0.05	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.60	2.2	0.1	0.17	0.05	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.64	2.2	0.1	0.16	0.05	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.68	2.4	0.1	0.15	0.04	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.70	2.6	0.1	0.14	0.04	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.71	2.6	0.1	0.14	0.04	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.71	2.6	0.1	0.14	0.04	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.75	2.7	0.1	0.13	0.04	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.82	2.8	0.1	0.12	0.04	5	1
ObtrusiveLight_Bottom boundary_1_Ill_Seg	Obtrusive Light - Ill	Lux	0.03	0.1	0.0	N.A.	N.A.	5	1

C3 Street Lighting Obtrusive Lighting Assessment



Park pathway Obtrusive / Meriton Building A / Building A North Facade / Isolines (E)



Values in Lux, Scale 1 : 311

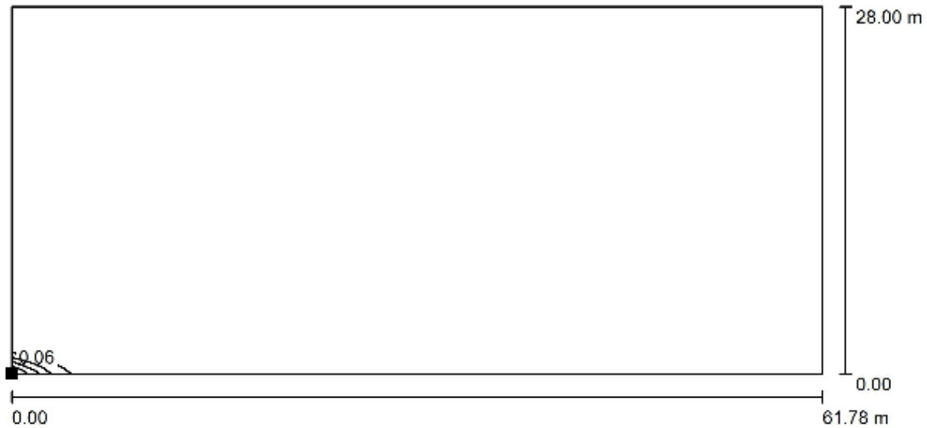
Position of surface in external scene:
Marked point: (231.026 m, 73.283 m, 0.000 m)



Grid: 64 x 64 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
0.00	0.00	0.23	0.120	0.000

Park pathway Obtrusive / Meriton Building A / Building A West Facade / Isolines (E)



Values in Lux, Scale 1 : 442

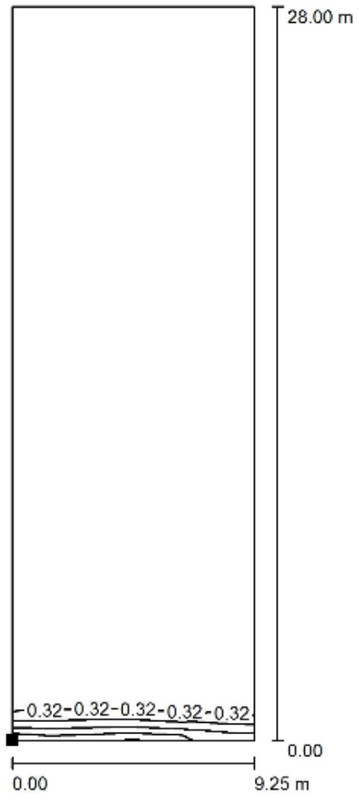
Position of surface in external scene:
Marked point: (187.600 m, 73.282 m, 0.000 m)



Grid: 128 x 64 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
0.00	0.00	0.31	0.084	0.000

Park pathway Obtrusive / Meriton Building C / Building C North Facade / Isolines (E)



Values in Lux, Scale 1 : 219

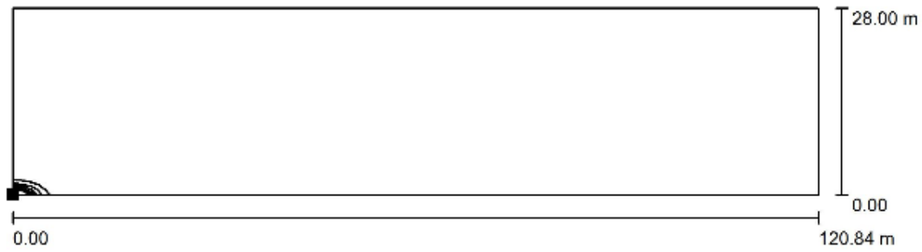
Position of surface in external scene:
Marked point: (172.887 m, 60.544 m, 0.000 m)



Grid: 64 x 128 Points

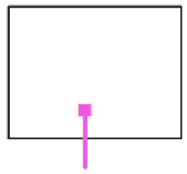
E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
0.04	0.00	1.58	0.072	0.002

Park pathway Obtrusive / Meriton Building C / Building C West Facade / Isolines (E)



Values in Lux, Scale 1 : 864

Position of surface in external scene:
Marked point: (163.637 m, 60.544 m, 0.000 m)



Grid: 128 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
0.00	0.00	0.07	0.026	0.000

Gunyama Park Aquatic and Recreation Centre

Clause 4.6 variation to Height of Buildings

June 2016

mecone

1 Introduction

This Clause 4.6 variation accompanies the Development Application (DA) for the Gunyama Park Aquatic and Recreation Centre (GPARC) at 132-140 Joynton Avenue, Zetland. The DA relates to the redevelopment of the site to service the growing Green Square community, and will include:

- Clearing of site and removal/demolition of structures;
- Site earthworks;
- Construction of an Aquatic and Recreation Centre, which will contain
  - A 50m heated outdoor pool;
  - A 25m indoor program pool;
  - A heated outdoor leisure pool;
  - An indoor leisure pool;
  - An indoor hydrotherapy pool;
  - An indoor crèche;
  - A licensed café;
  - An indoor health and fitness centre and outdoor balcony Green Roof (in part) and mounded garden beds to Aquatic and Recreation Centre;
- Construction of Gunyama Park including
  - An outdoor playground and shade structure;
  - An outdoor all ages synthetic sports field;
  - An outdoor skate bowl and skate moments;
  - An outdoor fitness station;
  - Park amenity buildings
  - BBQ areas;
  - Landscaping (mounded garden beds and rain gardens)
  - Paved circuit path;
  - Open lawn areas;
  - Timber terrace and seating edge; and
  - Artwork.

This Clause 4.6 variation relates to the 3m Height of Buildings control in the Sydney Local Environmental Plan 2012 (SLEP 2012). This control will be breached by 2.5m when measured from existing ground level, or 1m when measured from future ground level, to the top of the shade structure of the park amenity building.

2 Clause 4.6 Exceptions to Development Standards

Clause 4.6 of the SLEP 2012 enables an exception to the height standard upon consideration of a written request from the applicant justifying the contravention in the terms stated below. Clause 4.6 of the SLEP 2012 reads as follows:

Clause 4.6 Exceptions to development standards

(1) The objectives of this clause are as follows:

(a) to provide an appropriate degree of flexibility in applying certain development standards to particular development,

(b) to achieve better outcomes for and from development by allowing flexibility in particular circumstances.

(2) Development consent may, subject to this clause, be granted for development even though the development would contravene a development standard imposed by this or any other environmental planning instrument. However, this clause does not apply to a development standard that is expressly excluded from the operation of this clause.

(3) Development consent must not be granted for development that contravenes a development standard unless the consent authority has considered a written request from the applicant that seeks to justify the contravention of the development standard by demonstrating:

(a) that compliance with the development standard is unreasonable or unnecessary in the circumstances of the case, and

(b) that there are sufficient environmental planning grounds to justify contravening the development standard.

(4) Development consent must not be granted for development that contravenes a development standard unless:

(a) the consent authority is satisfied that:

(i) the applicant's written request has adequately addressed the matters required to be demonstrated by subclause (3), and

(ii) the proposed development will be in the public interest because it is consistent with the objectives of the particular standard and the objectives for development within the zone in which the development is proposed to be carried out, and

(b) the concurrence of the Director-General has been obtained.

(5) In deciding whether to grant concurrence, the Director-General must consider:

(a) whether contravention of the development standard raises any matter of significance for State or regional environmental planning, and

(b) the public benefit of maintaining the development standard, and

(c) any other matters required to be taken into consideration by the Director-General before granting concurrence.

3 The Development Standard to be varied

As identified in the Height of Buildings (HOB) map below, the subject site includes two height limits. The development standard to be varied is on the eastern side of the GPARC site, labeled 'A' on the HOB map. This has a corresponding height limit of 3m, and is the portion of the development in which the outdoor public open space known as 'Gunyama Park' will be developed. The amenity building within Gunyama Park will exceed this HOB control. The remainder of the site is labeled 'T2' on the HOB map. This has a corresponding height limit of 27m. The development is

compliant with this provision, which is where the Aquatic and Recreation Centre will be constructed.



Figure 1 Height of Buildings LEP Map
Source: SLEP 2012

4 Extent of Variation to the Development Standard

The definition of 'building height' under SLEP 2012 is:

(a) in relation to the height of a building in metres—the vertical distance from ground level (existing) to the highest point of the building, or

(b) in relation to the RL of a building—the vertical distance from the Australian Height Datum to the highest point of the building,

including plant and lift overruns, but excluding communication devices, antennae, satellite dishes, masts, flagpoles, chimneys, flues and the like.

As play equipment and shade structures may be undertaken by a public authority as 'exempt development' pursuant to Clause 66 of *State Environmental Planning Policy (Infrastructure) 2007*, this Clause 4.6 variation applies only to the height of the amenity buildings located within Gunyama Park.

The site of the proposed park amenity building currently has a ground level of approximately RL 18.50. This will be filled by 1.5m as part of site works to an average RL 20.00. The park amenity building will have a maximum height of RL 24.00 to the top of the shade structure. This represents a height above existing ground level of 5.5m, or 4.0m above proposed ground level.

The non-compliance associated with the roof of the amenity building only relates to a small portion of the site within Gunyama Park. The encroachment above the 3m HOB control by 1.5m (or 1.0m when measured from future ground level) is considered to be minor, and will provide a high level of amenity to park users and the functional management and operation of Gunyama Park. Although the amenity building will be visible from the public domain, the variation itself will not be overly discernible as the amenity building and its shade structure are appropriate in height, not excessive in bulk, and will integrate well with the surroundings.

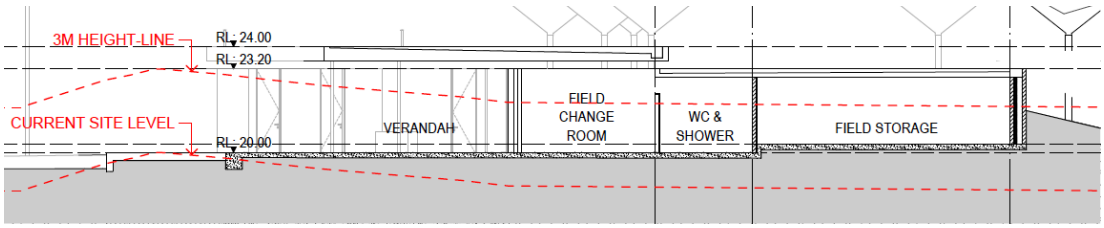


Figure 2 Proposed elevation of amenity building with height control

Source: ABA

5 Objectives of the Standard

The objectives of the Clause 4.3 Height of Buildings are as follows:

(1) The objectives of this clause are as follows:

(a) to ensure the height of development is appropriate to the condition of the site and its context,

(b) to ensure appropriate height transitions between new development and heritage items and buildings in heritage conservation areas or special character areas,

(c) to promote the sharing of views,

(d) to ensure appropriate height transitions from Central Sydney and Green Square Town Centre to adjoining areas,

(e) in respect of Green Square:

(i) to ensure the amenity of the public domain by restricting taller buildings to only part of a site, and

(ii) to ensure the built form contributes to the physical definition of the street network and public spaces.

6 Objectives of the zone

The objectives of the B4 Mixed Use zone are as follows:

- *To provide a mixture of compatible land uses.*

- *To integrate suitable business, office, residential, retail and other development in accessible locations so as to maximise public transport patronage and encourage walking and cycling.*
- *To ensure uses support the viability of centres.*

7 Assessment

Clause 4.6(3)(a) - Is Compliance with the development standard unreasonable or unnecessary in the circumstances of the case

Compliance with the height standard is unreasonable and unnecessary given the following circumstances of this case:

- The non-compliance associated with the amenity building shade structures is only associated with a small portion of the site, towards the future George Julius Avenue, while the remainder the proposal complies with the maximum HOB control;
- The amenity building is to be located within the highly embellished Gunyama Park. Surrounding trees, light poles, play equipment and shade structure, which are not covered by the HOB control and may be undertaken as exempt development, will exceed the height of the amenity buildings. As such, there would be no benefit in strictly applying the standard in these circumstances;
- The proposed amenity building and associated shade structure will allow for the functional and orderly use of Gunyama Park as well as providing an all weather undercover area;
- The area of non-compliance will not impact upon the amenity of surrounding sites;
- The proposed development is consistent with the objectives of the height standard and B4 Mixed Use zone as described below;
- The contravention of the height standard does not raise any matter of State or regional planning significance;
- The proposed development has been subject to a design excellence process, thereby confirming the high level of architectural merit which is being achieved in the development as a whole; and
- There is no public benefit in maintaining the standard in the circumstances of the case as explained below.

For these reasons, strict compliance with the development standard in this case is considered unreasonable and unnecessary.

Clause 4.6(3)(b) - Are there sufficient environmental planning grounds to justify contravening the development standard?

There are sufficient environmental planning grounds for the contravention to the height standard as follows:

- The Land and Environment Court in its recent decisions in *Four2Five vs Ashfield Council* has ruled that a clause 4.6 variation must do **more than** demonstrate that the development meets the objectives of the development standard and the zone, a test commonly referred to as the Wehbe Test #1 (which are matters dealt with further below). The clause 4.6 objection must **also** demonstrate some other environmental planning grounds that justify contravening the development standard, preferably

some that are specific to the site, although that is not essential, according to the Court of Appeal decision in *Four2Five vs Ashfield Council*. The decision also suggests that the requirements under Clause 4.6(3)(a) and (b) must not be 'watered down' and must be adequately addressed;

- In this instance *Wehbe* test # 3 also applies, that is, that strict compliance would tend to hinder the attainment of the objects of the Act. That is because a compliant envelope would not allow for appropriate community buildings within the park. The additional height in this instance allows for improved amenity and functionality of the open space. It can readily be seen that this is "a better outcome" (one of the objectives of Clause 4.6) than a compliant envelope, which would restrict the provision of community building, or associated structures on the site. As such, strict compliance with the development standard would tend to hinder the attainment of the objects of the Act, for example 'the orderly and economic use and development of land'. This means that Wehbe test # 3 is satisfied, as is *Four2Five vs Ashfield Council*;
- The non-compliance associated with the amenity building shade structure only relates to a small portion of the site, and integrates well with the remainder of Gunyama Park;
- The encroachment allows for an appropriately sized and dimensioned amenity building which will contain change rooms, a WC and shower area, a verandah, and field storage areas, improving the overall function of the park;
- The additional height will not significantly impact upon the amenity of Gunyama Park in terms of overshadowing, view loss and privacy, or enjoyment of its use by future residents;
- The proposed height of the development is consistent with surrounding development and the proposed embellishment of Gunyama Park itself, noting that the Aquatic and Recreation Centre, many trees, and ancillary structures such as light poles, the park shade structure and the pipe tunnel play structure would be higher than the amenity building; and
- Given the above strict compliance with the height controls would hinder the attainment of the objects of the Act, and would not result in the orderly and economic use and development of land.

Clause 4.6(4)(a)(ii) - Is the proposed development in the public interest because it is consistent with the objectives of the particular standard and the objectives for development within the zone in which the development is proposed to be carried out

In the court case *Four2Five Pty Ltd v Ashfield Council* [2015] NSWLEC 90, Commissioner Pearson stipulates that the consent authority is to be satisfied the proposed development will be in the public interest because it is consistent with:

a) *the objectives of the particular standard, and*

b) *the objectives for development within the zone in which the development is proposed to be carried out.*

The objectives of the development standard and the zone are addressed below under the relevant headings:

a) the objectives of the particular standard

The particular development standard is Clause 4.3 Height of Buildings of the SLEP 2012 and the relevant objectives are addressed below:

(a) to ensure the height of development is appropriate to the condition of the site and its context,

The height of the proposed development is considered appropriate to the future condition of the site and its context. When measured from proposed ground level, the building height would be measured at 4m which is only 1m above the development standard. Surrounding development, including proposed elements of the surrounding natural and built environments, will exceed this height and as such the building will not stick out in bulk and scale.

(b) to ensure appropriate height transitions between new development and heritage items and buildings in heritage conservation areas or special character areas,

The heights of buildings and structures within the development do not prevent this particular objective being achieved. The nearest heritage item (Item 2280 in SLEP 2012 "Former Joseph Lucas office, stairs and showroom including interiors and building setback") is approximately 200m to the southwest at 146-258 Joynton Avenue, and will be not be impacted by the encroachment above the 3m height of buildings control.

(c) to promote the sharing of views,

The proposed development allows for the sharing of views. The amenity building is in fact two parts physically linked by a shade structure floating on top. This opening between the two parts of the amenity building ensures visual links between the playground and playing fields are provided. Gunyama Park will also remain relatively open, with the vast majority of embellishments remaining within the 3m height of buildings control.

(d) to ensure appropriate height transitions from Central Sydney and Green Square Town Centre to adjoining areas,

Appropriate height transitions between Central Sydney and Green Square Town Centre to adjoining areas are strengthened by the development. The tallest section of the development, at the Aquatic and Recreation Centre, will rise approximately 13.01m above ground, which is generally in line with or lower than the maximum height of building controls for surrounding sites.

(e) in respect of Green Square:

(i) to ensure the amenity of the public domain by restricting taller buildings to only part of a site, and

(ii) to ensure the built form contributes to the physical definition of the street network and public spaces.

The tallest and most prominent building/structure, being the Aquatic and Recreation Centre, is located only toward the western portion of the site. This is in line with the HOB control and the above objective.

b) the objectives for development within the zone in which the development is proposed to be carried out.

The objectives of the B4 Mixed Use zone are as follows:

- *To provide a mixture of compatible land uses.*

  The development of GPARC is compatible with the surrounding land uses in that it provides community recreation uses for future residents. The Green Square area is a fast growing and densely populated inner city suburb, and therefore providing for recreation uses is considered an ideal outcome for the site.

- *To integrate suitable business, office, residential, retail and other development in accessible locations so as to maximise public transport patronage and encourage walking and cycling.*

  The development is located within walking distance of the Green Square Railway Station, numerous bus routes, and future bicycle and walking paths. Further, off-street car parking is limited. Together, these will all encourage the use of public transport, as well as walking and cycling, to access the site.

- *To ensure uses support the viability of centres.*

  The proposed development of the site will provide community facilities that encourage residents to visit and remain within the Green Square area. This in turn will support the viability of the Green Square Town Centre which is within walking distance of the site. Minor commercial spaces within the GPARC development will not detract from the Green Square Town Centre.

The proposal is considered to be in the public interest as it is consistent with the objectives of the development standard and the B4 Mixed Use zone.

Furthermore, there is no significant benefit in maintaining the height standard as the height variation is relatively minor which facilitates a better planning outcome with improved amenity to the future users of Gunyama Park and no significant adverse environmental impact.

8 Any matters of significance for State or regional environmental planning

The contravention of the height standard does not raise any matter of State or regional planning significance.

9 Conclusion to variation to height standard

This is a written request for an exception to the height standard under Clause 4.6 of the SLEP 2012. It justifies the contravention to the height standard in the terms required under Clause 4.6 of the LEP, and in particular demonstrates that the proposal provides a significantly better planning outcome with no significant adverse environmental impacts, and therefore in the circumstances of the case:

- compliance with the height standard is unreasonable and unnecessary;
- there are sufficient environmental planning grounds for the contravention;
- it is in the public interest in being consistent with the objectives of the height standard and zone;
- the design has been subject to an intensive design excellence process; and
- there are no matters of State or regional planning significance and no public benefits in maintaining the height standard.



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Security Management Plan

City of Sydney
Town Hall House
456 Kent Street
Sydney NSW 2000

Gunyama Park Aquatic and Recreation Centre



City Operations

April 2016

Sydney2030/Green/Global/Connected
city of villages

CITY OF SYDNEY 2030

Gunyama Park Aquatic Centre – Security Brief

The facility will be fitted with an electronic access control and security alarm system which will be monitored by the City of Sydney Security and Emergency Management Unit. The alarm system will provide perimeter protection of all perimeter doors through the installation of reed switches. Passive infra-red (PIR) detection will also be installed in high risk internal spaces for additional protection.

Primary access into the building will be by way of swipe card reader on the main entry of the facility for staff and maintenance contractor access outside of normal business operation hours. Secondary maintenance contractor and group access is provided with a video intercom system at external service entry points. Within the facility additional swipe access control points will be installed to monitor and control access to select designated authorised staff only areas and minimise the number of mechanical keys required.

Staff will be responsible for arming and disarming the alarm system on a daily basis. They will also be responsible for ensuring all doors and windows are closed and locked prior to leaving. Contractors will be responsible for arming and disarming the alarm system for after hours maintenance and cleaning as required.

CCTV cameras will be installed at point of sale positions, vending machines, cash handling areas, locker facilities and public entry point into the facility. The CCTV cameras will be recorded locally with the ability to monitor the system onsite.

The perimeter fence will be fitted with a microphonic perimeter sensor cable type alarm system to detect attempted intrusions into the outdoor pool area either by cutting or climbing of the fence. This system will be connected to the main security alarm system for monitoring.

External and selective internal doors will be fitted with master keyed locks. The master key system will be owned and managed by the City of Sydney on behalf of the facility operators.

-

Reflectivity Report

Gunyama Park Aquatic and Recreation Centre

City of Sydney

Prepared for
City of Sydney
Date: 30 May 2016

Reference: 14011

Revision: 02

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Executive Summary

This reflectivity study has been carried out in order to verify that the façade of the proposed project Gunyama Park Aquatic and Recreation Centre will not cause an unacceptable risk of solar reflections causing disability glare to drivers and pedestrians.

The City of Sydney requires that visible light reflectivity from building materials used on the facades of the building shall not exceed 20 per cent and shall be design so as to minimise glare. This study and report has been carried out to determine if there are areas of the façade with a requirement for a lower external reflectivity.

The glare assessment has been carried out as per the methodology outlined in the technical bulletin "Reflectivity: Dealing with Rogue Solar Reflections" written by David Hassall

The analysis has been carried out based on the architectural drawings provided by Andrew Burges Architects for DA approval.

A total of 4 viewpoints have been selected for this study to represent possible views from drivers and pedestrians of the proposed project. These include viewpoints driving North and South along Joynton Avenue, travelling east at the traffic lights at Zetland Avenue and driver travelling west along Zetland Avenue.

It has been assessed that all aspects of the façade pose minimal risk of solar reflection causing disability glare as the zones fall outside the 20% iso-glare loops.

The finishes and design currently specified for the Gunyama Park Aquatic and Recreation Centre is capable of achieving the development approval condition to minimise glare for pedestrian and driver safety.

1. Introduction

1.1 Purpose of the Report

This report details the results of a reflectivity study that aims to identify the potential for adverse reflected solar glare that may affect drivers and pedestrians within the proximity of Gunyama Park Aquatic and Recreation Centre.

This report should be read in conjunction with the DA Architectural documents prepared by Andrew Burges Architects.

1.2 Site Location

The site has been assessed to determine appropriate viewpoints where drivers (red) are able to see the building façade in their direct line of vision.

It has been assessed that the building is visible to drivers from the following locations:

- Travelling North along Joynton Avenue (VP1)
- Travelling South along Joynton Avenue (VP2)
- A car exiting the driveway onto Zetland Avenue (VP3)
- Traveling West along Zetland Avenue (VP4)

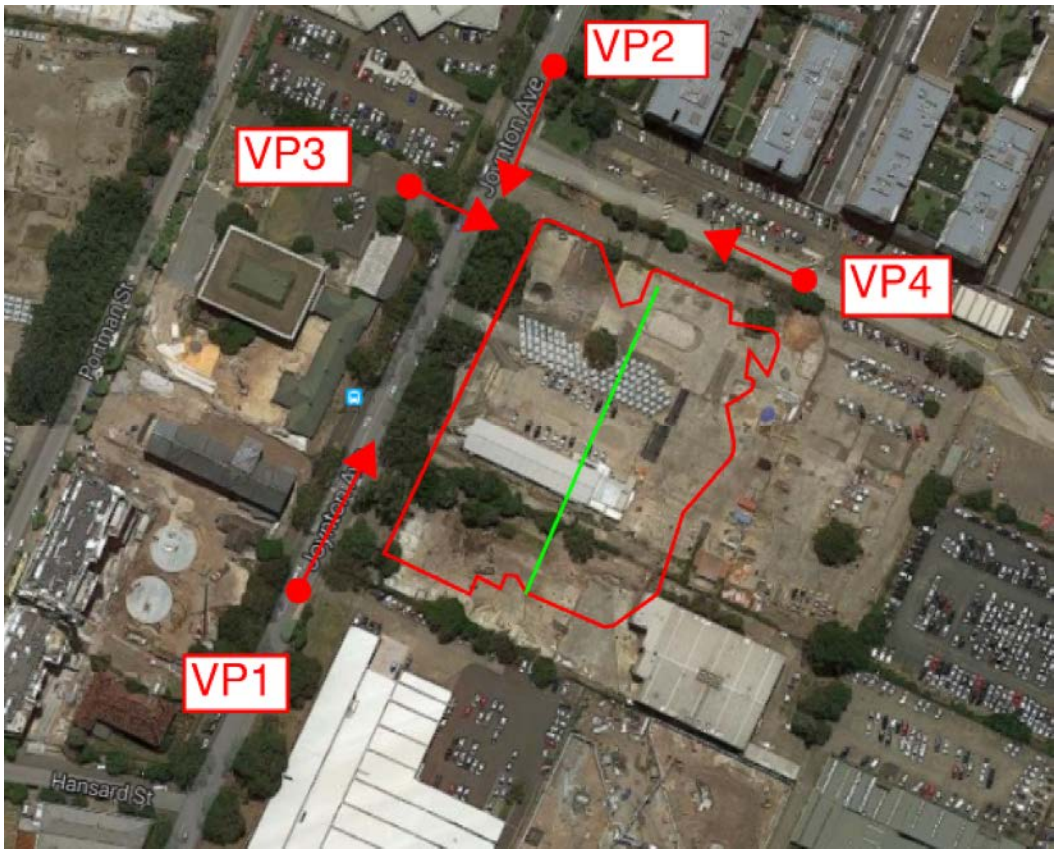

Figure 1 - Satellite Image with Viewpoints[1]

[1] Image from Google Maps

1.3 Site Orientation

The Gunyama Park Aquatic and Recreation Centre has a simple geometry with half the façade aspects viewable to drivers and pedestrians. The façade is uniform in height across all 2 levels. The ground floor façade consists of sloped green façades at an angle of approx. 30-45 degrees. Part of the North and West aspect of the façade are glazed. All vertical glazing is positioned at a 90 degree angle with the slab. The first floor façade consist of a CFC cladded façade with a single glazed opening (glazing recessed) on the east and west façade.

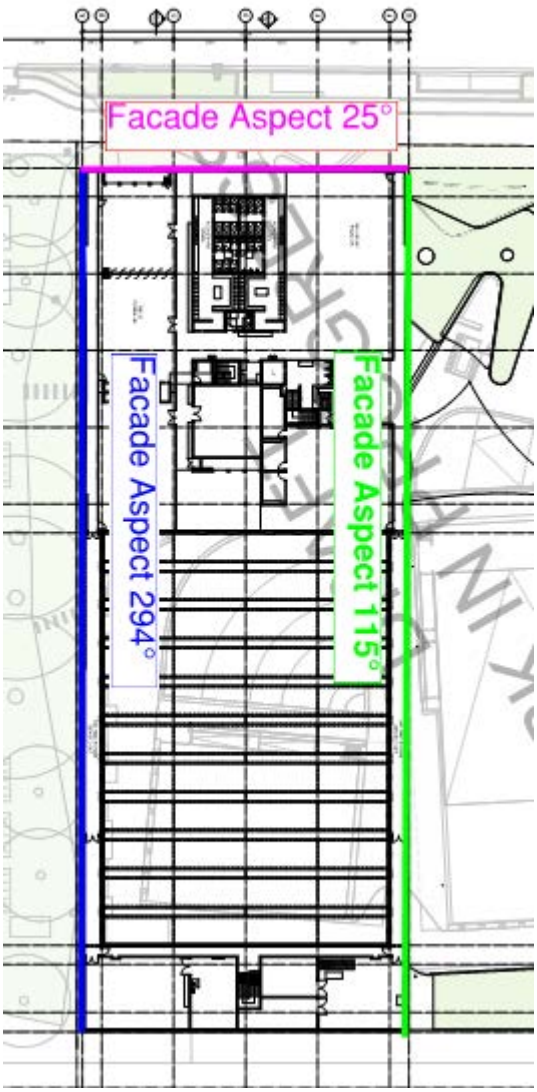

Figure 2 – Gunyama Park Aquatic and Recreation Centre with Orientation Aspect

1.4 Stereographic Sun Chart

The position of the sun in the sky throughout the year varies depending on the latitude of the location of assessment. A stereographic sun chart is a two dimensional representation of this path of the sun for a particular line of latitude.

This chart is used in order to determine the location of a virtual reflected sun in accordance with the Hassall methodology in order to assess the potential for glare. Refer to Section 2 of this report for more detailed information on the assessment methodology

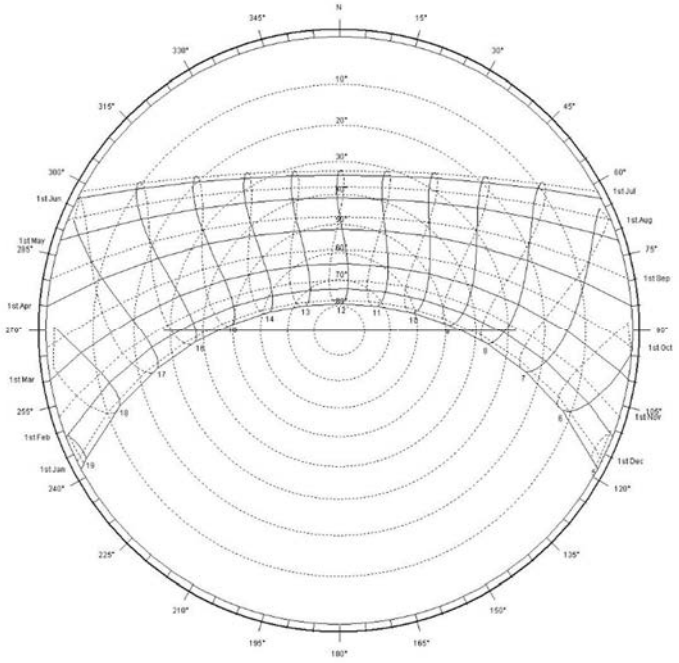

Figure 3 **– Stereographic Sun Chart for Sydney (34 degree latitude)**

1.5 Project Description

The project involves the establishment of a new aquatic centre and community parkland which will include the following facilities:

- Outdoor 50m heated lap pool and leisure water area;
- 25m program pool;
- Indoor leisure pool;
- Hydrotherapy pool;
- Crèche;
- Park and outdoor synthetic multipurpose sports field, outdoor fitness stations and outdoor playground;
- Health and fitness Centre; and
- Café.

1.6 Reference Documents

This plan has been prepared in reference to the following documents:

Document Reference	Document Name	By	Revision
ARC-DA-011	Site Plan	Andrew Burges Architect Grimshaw	A
ARC-DA-012	Site Plan Stage 1		A
ARC-DA-101	Basement Plan		A
ARC-DA-102	Ground Floor Plan		A
ARC-DA-104	First Floor Plan		A
ARC-DA-105	Main Roof Plan		A
ARC-DA-201	Elevations Overall		A
ARC-DA-301	Sections Overall		A

2. Assessment Methodology

2.1 Analysis Philosophy

The glare assessment has been carried out as per the methodology outlined in the technical bulletin "Reflectivity: Dealing with Rogue Solar Reflections" written by David Hassall from the Faculty of Architecture at the University of New South Wales.

This methodology defines a glare (I_v) limit of 500 candelas/m^2, calculated to the Holladay formula, to which a driver can be exposed without causing disability.

Viewpoints have been defined from which it is expected that either drivers or pedestrians where they are crossing the road, are able to see the building. A stereographic sun path diagram and the building geometry are then used to determine whether a viewpoint will be subject to the reflected sun during the year.

A glare protractor, oriented in the direction of drivers or pedestrians as appropriate, is used to determine the glare based on the reflectivity of the surface and the apparent angle of viewing.

2.2 Virtual Sun Location

The virtual suns location is determined with the stereographic sun chart for the project location.

This is completed by plotting the virtual sun on the stereographic sun chart based on the orientation of the façade. The apparent reflective surface of the façade is plotted based on the bounding horizontal and vertical angles from the viewpoint.

2.3 Glare Assessment

In order to allow assessment of buildings for glare David Hassall has developed a glare protractor that provides a diagrammatic limit of 500 candelas/m^2 based on viewing angle and inclination and reflectivity of the viewing surface. This glare protractor is shown in Figure 5 and is used where the stereographic sun path indicates that there is glare to a particular viewpoint.

A brief description of the calculation of the glare (equivalent veiling luminance) is provided below for reference. The glare protractor has thereafter been used in this assessment.

The equivalent veiling luminance (I_v) is calculated based on the Holladay formula (1), which defines the illumination of a viewer's eye based on a calculated illuminance perpendicular to the surface (EG) and a factor based on the angle of viewing (θ).

$$I_v = 10 \times EG \div \theta^2 \quad (1)$$

The angle of viewing (θ) is based on the angle between the direct line of sight and the glare source (α) and the inclination between a viewing normal and the glare source (β). This is calculated with trigonometry based on Equation 2 below and is shown diagrammatically in Figure 4.

$$\theta = ATAN \times [\sqrt{\{\tan^2(\beta) + \sin^2(\alpha)\}} \div \cos(\alpha)] \quad (2)$$

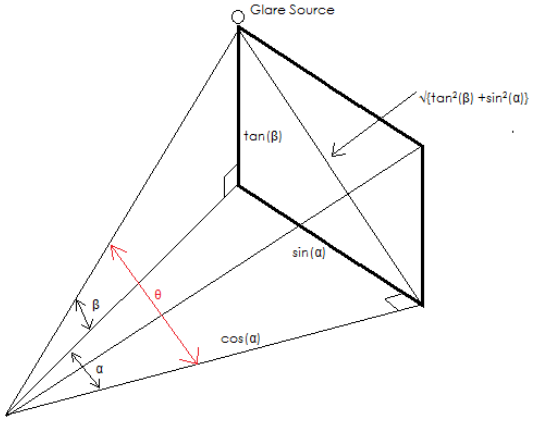

Figure 4 – Diagrammatic Angle of Viewing Calculation

The illumination of the viewer's eye normal to the light source (EG) is calculated based on the solar illumination (E), the reflectivity of the surface (R) and the angle of viewing (θ) calculated in Equation 2. The solar illumination is calculated in Equation 4 based on the solar power (W), which is dependent on the inclination of the virtual sun (β) and the luminance efficacy (l_e).

$$EG = E \times R \times \cos(\theta) \quad (3)$$

$$E = W \times l_e \quad (4)$$

The solar power is determined as 50 watts per degree up to 10 degrees and 15 watts per degree thereafter.

The luminance efficacy is 90 lumens/watt at 7.5° and 117 lumens/watt at 25° and is interpolated for other angles.

The glare protractor by Hassall joins points at incremental reflectivity (iso-glare loops) with varying a and β values in order to set a limit where the equivalent veiling luminance is limited to 500 candelas/m^2.

By overlaying the glare protractor on a photo or computer generated image in the direction of viewing and aligning the verticals with the building it is possible to graphically determine the maximum reflectivity to not cause disability glare.

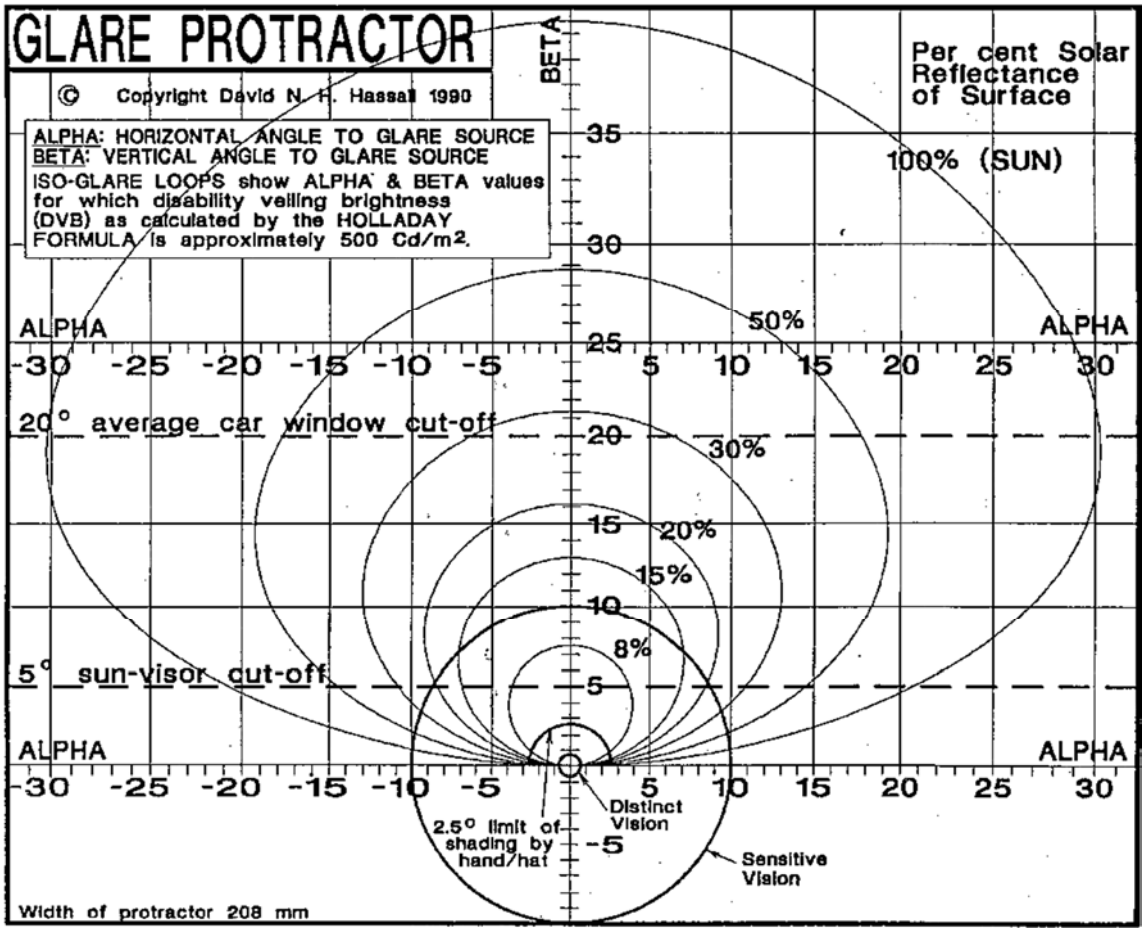

Figure 5 – Glare Protractor[2]

[2] "Reflectivity: Dealing with Rogue Solar Reflections" – David Hassall

3. Results

3.1 General

The aspects of the facades pertaining to each view point has been assessed. Where it is identified that there is reflected image, the glare protractor is applied in order to determine the maximum reflectivity allowable on the façade surface to achieve a maximum equivalent veiling luminance of 500 candelas/m^2.

Detailed results have been included as part of Appendix A. A summary of these results is provided in this section.

3.2 Viewpoint 1

Viewpoint 1 has been taken at a distance of 17m from the South-West apex of the building. It is taken from the viewpoint of a driver travelling North along Joynton Avenue.

The path of the reflected sun has been plotted for the 294° façade aspect that is visible from this viewpoint, refer to Appendix A.

It was determined that reflected image of the sun from the building does not reach the driver on the road. No further actioned required.

3.3 Viewpoint 2

Viewpoint 2 has been taken at a distance of 21m from the North East aspect of the building. It is taken from the viewpoint of a driver travelling South along Joynton Avenue.

The path of the reflected sun has been plotted for 294° façade aspect that is visible from this viewpoint, refer to Appendix A.

It was determined that reflected image of the sun from the building does not reach the driver on the road. No further actioned required.

3.4 Viewpoint 3

Viewpoint 3 has been taken at a distance of 12.6m from the west façade. It is taken from the viewpoint of a driver exiting their driveway onto current Joynton Avenue, this viewpoint is equivalent to the future Zetland Avenue traffic lights

The path of the reflected sun has been plotted for 294° façade aspect that is visible from this viewpoint, refer to Appendix A.

There is a reflected image of the sun that reaches Viewpoint 3 from Façade Aspect 294°. In accordance with the Hassall methodology any aspect of the façade above the 5° visor cut off is to be excluded from the assessment.

The façade below the 5° visor cut off is the ground floor façade which is set back (shaded) from the facade line of the floors above. The façade below the 5° cut off will not have the potential to cause disability glare to drivers. No further action required.

3.5 Viewpoint 4

Viewpoint 4 has been taken at a distance of 17.7m from the North-West apex of the building. It is taken from the viewpoint of a Driver travelling West along Zetland Avenue.

The path of the reflected sun has been plotted for 116° and 25° façade aspect that is visible from this viewpoint, refer to Appendix A.

It was determined that reflected image of the sun from the building does not reach the driver on the road. No further actioned required.

4. Conclusion

This reflectivity study has been carried out in order to address the potential for disability glare to pedestrians and drivers caused by this project. The analysis has been completed based on the architectural drawings provided Andrew Burges Architect for DA approval.

The glare assessment has been carried out as per the methodology outlined in the technical bulletin "Reflectivity: Dealing with Rogue Solar Reflections" written by David Hassall.

A total of 4 viewpoints have been selected for this study to represent possible views from drivers and pedestrians of the proposed project. These include viewpoints driving North and South along Joynton Avenue, West along Zetland Avenue and a driver at the traffic lights onto Zetland Avenue.

Reflection of the sun is controlled through the selection of low reflectivity surfaces and glazing to the facade.

It has been assessed that all aspects of the façade pose minimal risk of solar reflection causing disability glare as the zones fall outside the 20% iso-glare loops.

Overall the proposed DA design for Gunyama Park Aquatic and Recreation Centre achieves sufficient glare control for pedestrian and driver safety in the precinct.

Appendix A

Appendix A – Detailed Results

Viewpoint 1

Viewpoint 1 has been taken at a distance of 17 from the South-West apex of the building. It is taken from the viewpoint of a driver travelling North along Joynton Avenue.

On Figure 6 below the blue lines have been drawn to represent the bearing angles to the two extreme façade aspects of the precinct respectively. The red arrow indicates the direction of travel and viewing.

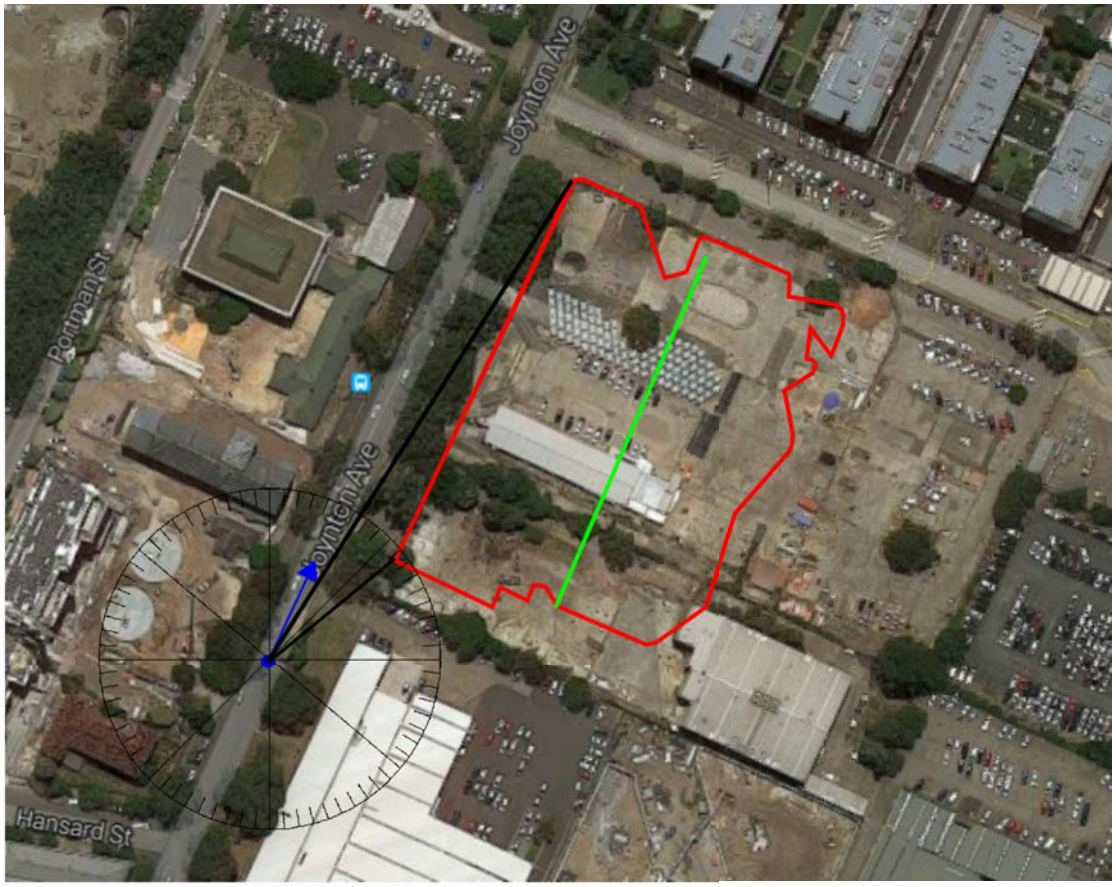

Figure 6 – Viewpoint 1 Façade Aspect 294°[3]

The vertical bearing angles have been calculated for the building

B = $\tan^{-1}(6.1\text{m} \div 14.7\text{m})$

= 22.53°

Viewing Direction	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
			Façade Aspect 294°	
	Lower Bound	Upper Bound	Right Bound	Left Bound
25°	0°	22.6	30°	60°

These bearing angles have been plotted on the reflected sun path diagram in figure 7 below.

[3] Google Maps

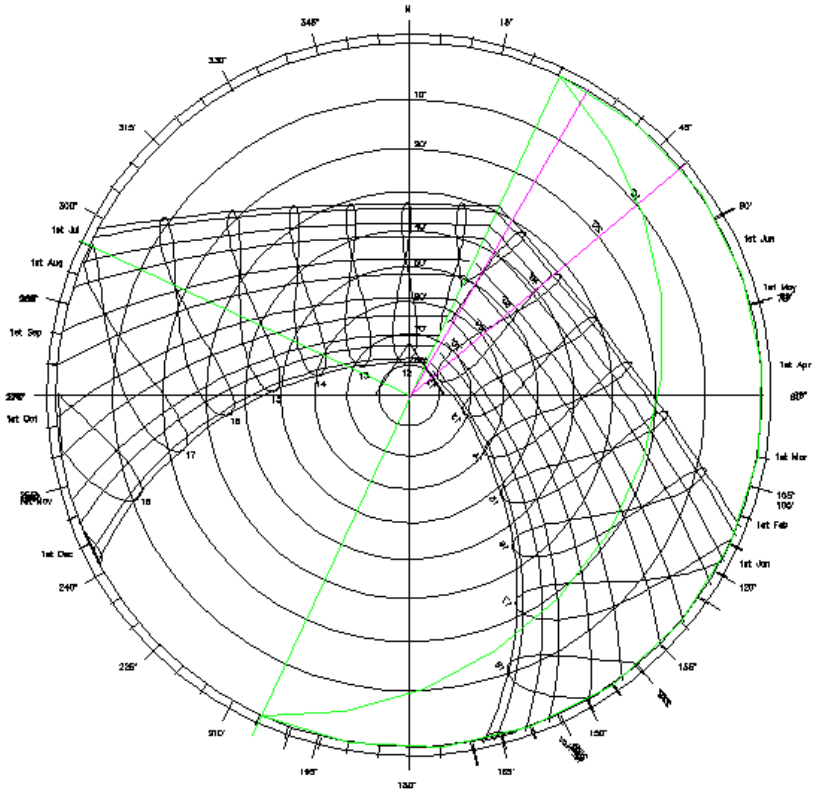

Figure 7 – 294° Façade Aspect Reflected Virtual Sun from Viewpoint 1

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 294° of the building.

Viewpoint 2

Viewpoint 2 has been taken at a distance of 21m from the North East aspect of the building. It is taken from the viewpoint of a driver travelling South along Joynton Avenue.

On Figure 8 below the black lines have been drawn to represent the bearing angles of the building, with the blue arrow indicating the direction of travel and viewing.

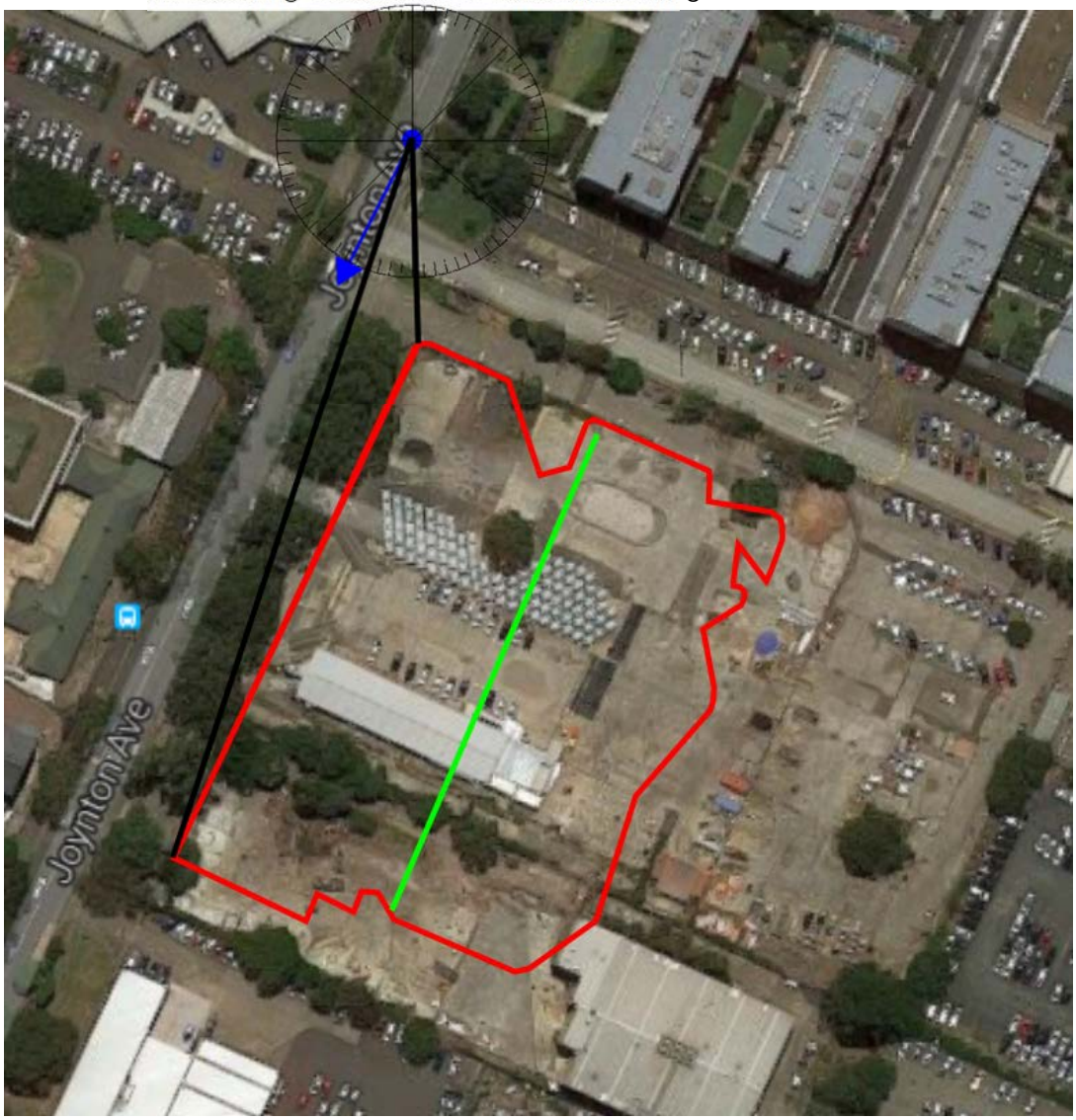

Figure 8 – Viewpoint 2 Façade Aspect 294°[4]

The vertical bearing angles have been calculated for the development.

B = $\tan^{-1}$(6.1m ÷ 20.7m)

= 16.4°

Viewing Direction	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
			Façade Aspect 294°	
	Lower Bound	Upper Bound	Left Bound	Right Bound
215°	0°	16.4°	210°	180°

[4] Google Maps

These bearing angles have been plotted on the reflected sun path diagrams in Figure 9 below.

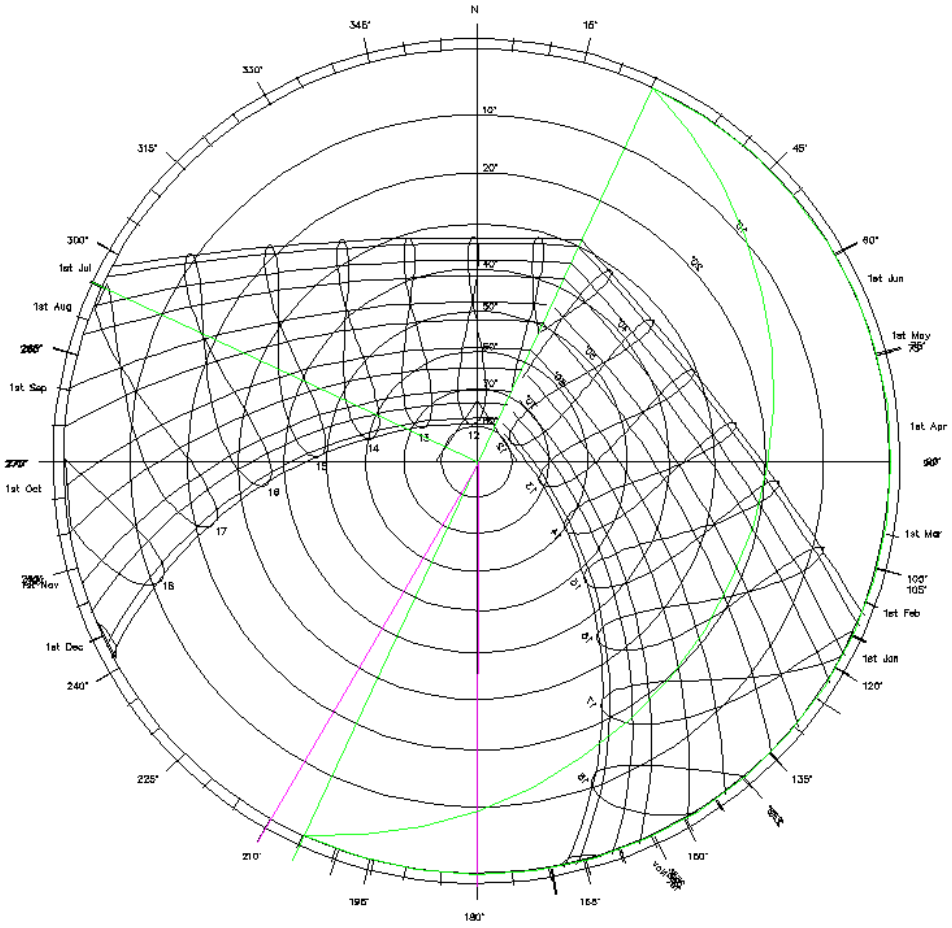

Figure 9 – 294° Façade Aspect Reflected Virtual Sun from Viewpoint 2

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 294° of the building.

Viewpoint 3

Viewpoint 3 has been taken at a distance of 12.6m from the west façade. It is taken from the viewpoint of a driver exiting their driveway onto Joynton Avenue (this viewpoint is equivalent to the future Zetland Avenue traffic lights).

On Figure 11and 12 below pink lines have been drawn to represent the bearing angles to extreme aspects of the facade. The blue arrow indicates the direction of travel and viewing.

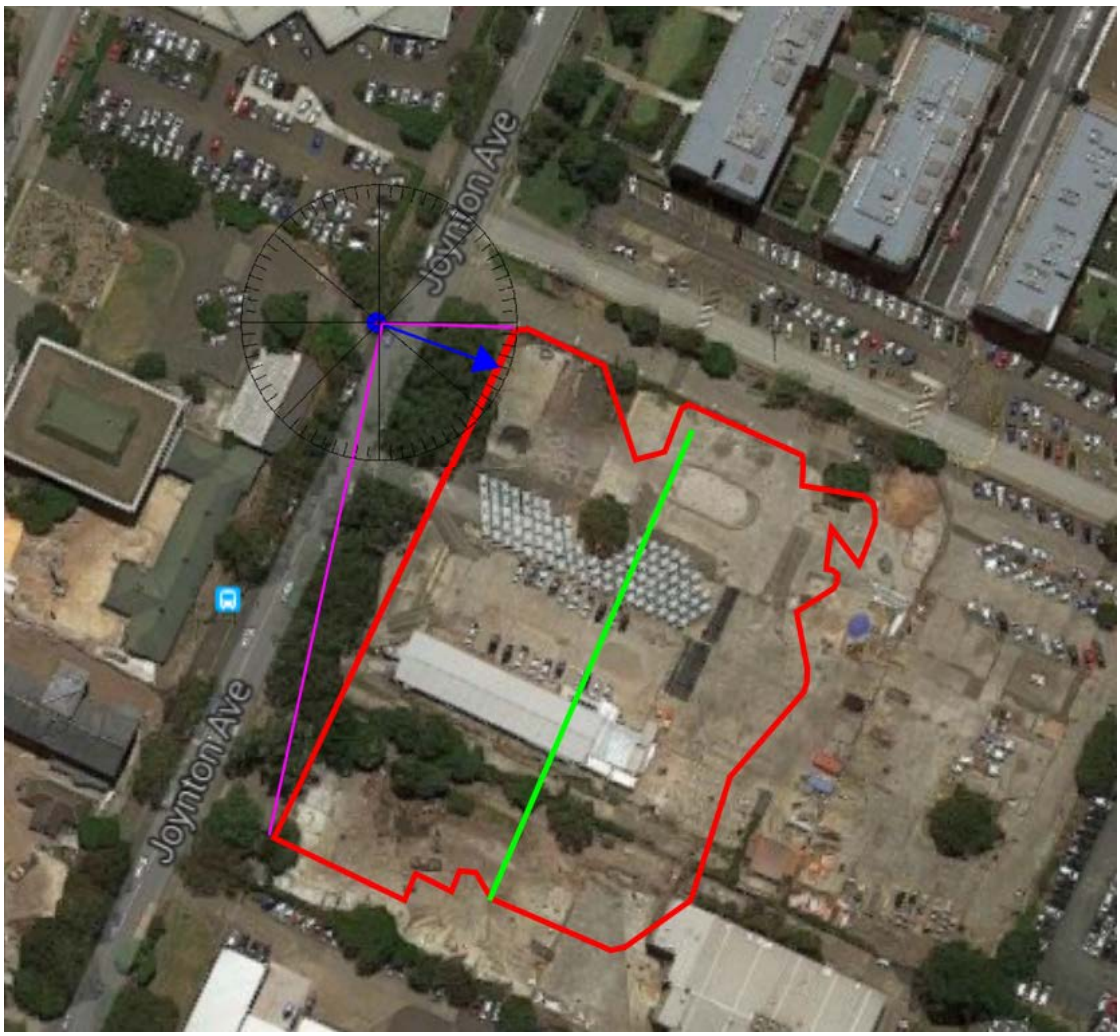

Figure 10 – Viewpoint 3 – Façade Aspect 294°[5]

The vertical bearing angles have been calculated for the Building

B_{podium} = $\tan^{-1}(6.1m \div 12.6m)$

= 25.34°

Viewing Direction	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
			Façade Aspect 294°	
	Lower Bound	Upper Bound	Left Bound	Right Bound
120°	0°	25.34°	90°	190°

[5] Google Maps

These bearing angles have been plotted on the reflected sun path diagrams and below.

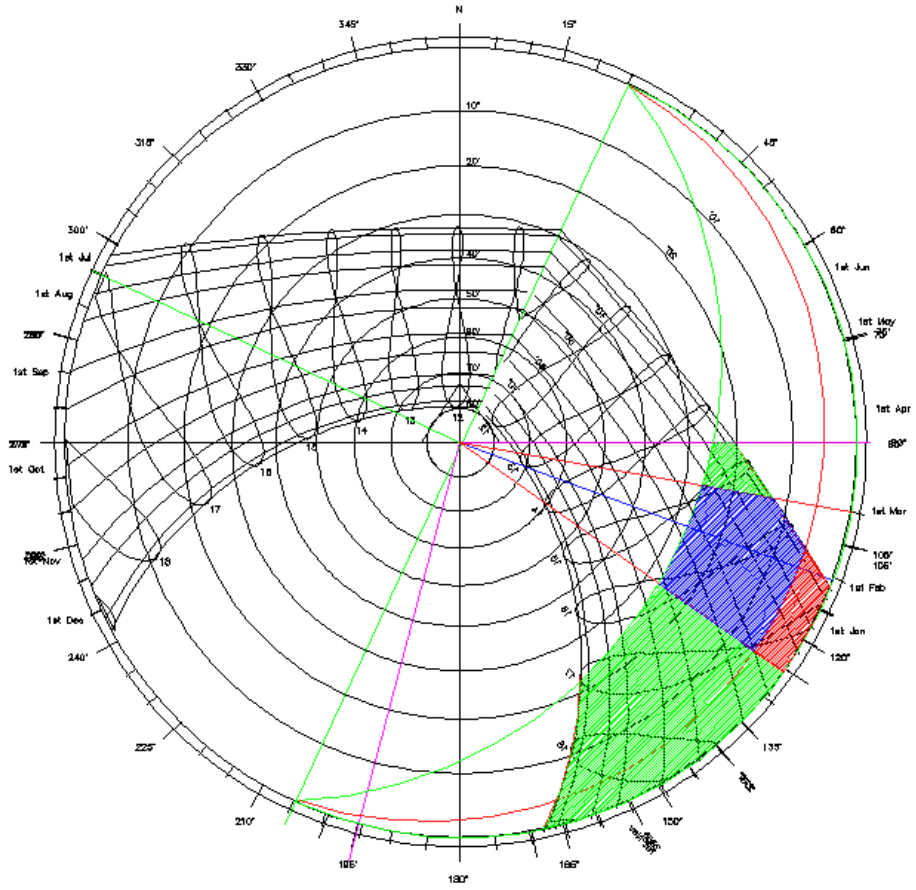

Figure 11 – 294° Façade Aspect Reflected Virtual Sun from Viewpoint 3

There is a reflected image of the sun that reaches viewpoint 3 from façade Aspect 294°. The reflected image of the sun has the potential to reach viewpoint 3 between 5pm and 6pm between July and August. In order to assess the façade a photo has been taken and a protractor is then applied at scale.

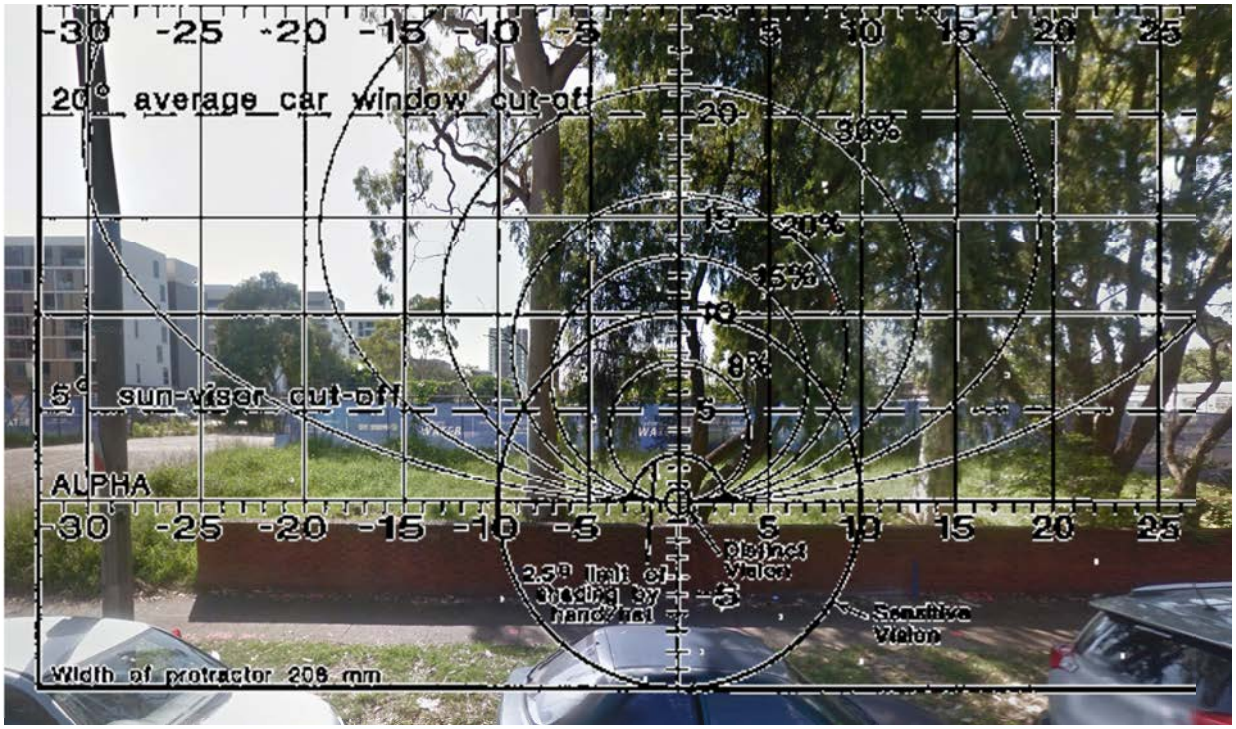

Figure 12 – 101° Façade Aspect Reflected Virtual Sun from Viewpoint 3

There is a reflected image of the sun that reaches Viewpoint 3 from Façade Aspect 294°. In accordance with the Hassall methodology any aspect of the façade above the 5° visor cut off is to be excluded from the assessment.

The façade below the 5° visor cut off is the ground floor façade which is set back (shaded) from the facade line of the floors above. The façade below the 5° cut off will not have the potential to cause disability glare to drivers. No further action required.

Viewpoint 4

Viewpoint 4 has been taken at a distance of 17.7m from the North-West apex of the building. It is taken from the viewpoint of a Driver travelling West along Zetland Avenue.

On Figure 13 below black and pink lines have been drawn to represent the bearing angles to the two extreme façade aspects of the building. The blue arrow indicates the direction of travel and viewing.



Figure 13 – Viewpoint 4 Façade Aspect 116°, 25°

The vertical bearing angles have been calculated for the building

B_{podium} = $\tan^{-1}(6.1m \div 17.57m)$

= 57.7°

Viewing Direction	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)			
			Façade Aspect 116°		Façade Aspect 25°	
	Lower Bound	Upper Bound	Left Bound	Right Bound	Left Bound	Right Bound
290°	0°	57.46°	235°	280°	280°	290°

These bearing angles have been plotted on the reflected sun path diagrams in Figure 14.

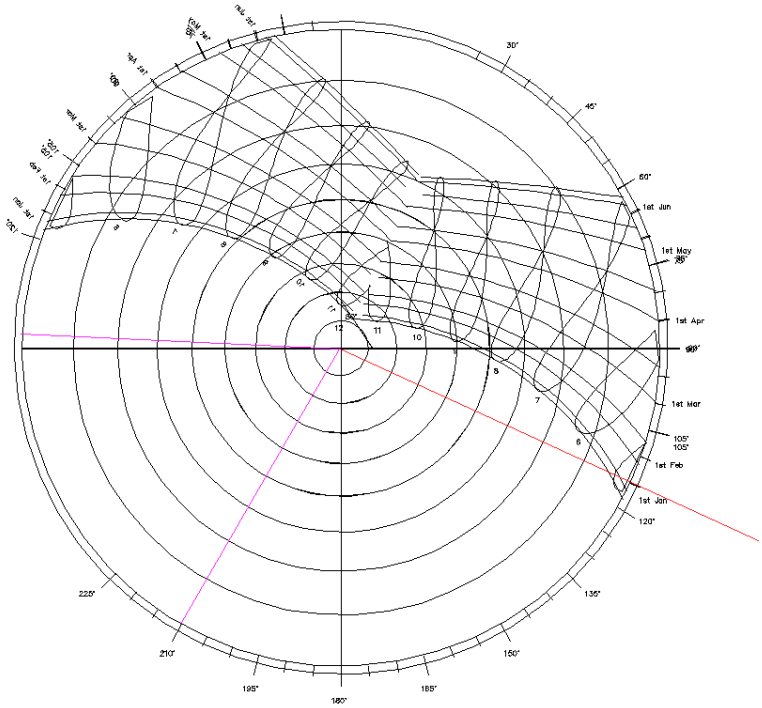

Figure 14 – 116° Façade Aspect Reflected Virtual Sun from Viewpoint 4

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 116° of the building.

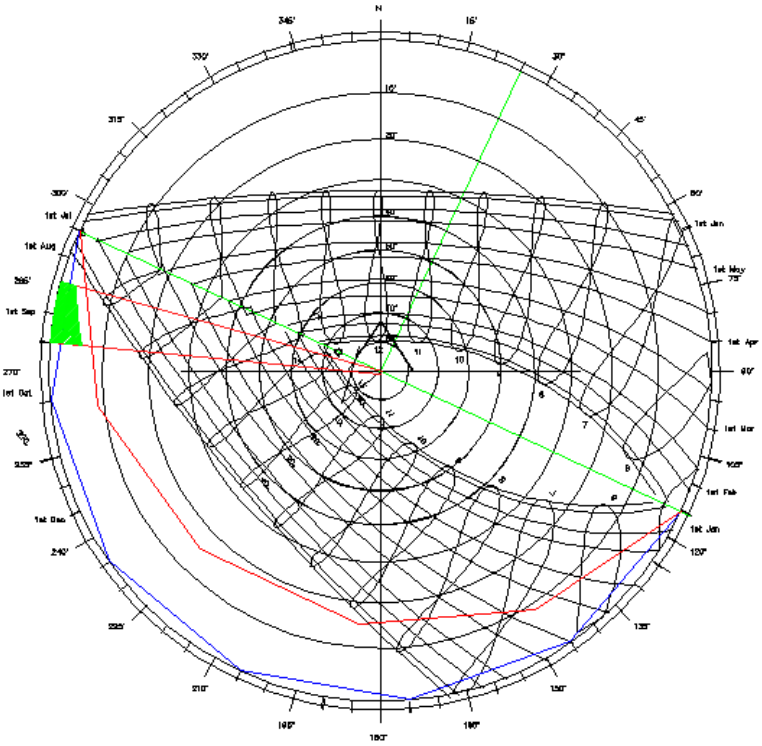

Figure 157 – 25° Façade Aspect Reflected Virtual Sun from Viewpoint 4

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 25° of the building.

GUNYAMA PARK AQUATIC AND RECREATION CENTRE (GPARC)

DESIGN STATEMENT

ABA GRIMSHAW + TCL

31 MAY 2016



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1.0 INTRODUCTION

This report outlines the project Design Statement from the Architect and Landscape Architect for Gunyama Park Aquatic and Recreation Centre (GPARC). Following a successful Stage 1 competition entry, Andrew Burges Architects (ABA) invited Grimshaw Architects (Grimshaw) and Taylor Cullity Lethlean (TCL) to form a project team for the Stage 2 competition phase. As the winning project team, ABA Grimshaw and TCL were engaged by The Council of the City of Sydney as Architects and Landscape Architects for the project (with Grimshaw Architects contracted as the Head Design Consultant).

This Design Statement outlines:

- The architectural and landscape concepts and key elements that have shaped the project design.
- Descriptions of the site influences that have shaped the design, including site histories incorporated into the design.
- The material palette for the aquatic and recreation centre and the park.
- The sustainability principles that have shaped the project through the design process are also outlined, including the development of GPARC as the first facility of its type to target a certified 5 star Design & As-Built Green Star rating from the Green Building Council of Australia.

Influential in the project's design development has been a thorough process of consultation and engagement as well as integrating stakeholder expertise. This included a range of events for local residents and community members, as well as targeted consultation with key stakeholders and user groups (swimmers with disabilities, Green Square Primary School, Weave Youth & Community Services, cafe operators, aquatic centre operators, Royal Life Saving Society NSW, Local Health District, key park user groups, Inclusion Advisory Panel, Guide Dogs Australia, and Vision Australia).

Consultation and engagement has also included presentations, and feedback from, the Design Advisory Panel (DAP), including two DAP meetings with the original design competition jury in attendance, as well as presentations to and feedback from the Public Art Advisory Panel (PAAP). Minutes from all DAP and PAAP presentations are included as appendices in the DA package.

With ongoing consultation and stakeholder expertise, the project development has continued, and advanced, the key design goals and project elements that characterised our competition winning proposal, through schematic design to development application.

2.0 GPARC SITE AND CONTEXT

2.1 Project Site

The project site is located in the suburb of Zetland, in the Green Square urban renewal area. It lies within the Epsom Park precinct of Green Square and comprises a number of existing lots currently owned by City of Sydney, as well as lots currently owned by others. The site is located opposite the former South Sydney Hospital site, and following the completion of Green Square public domain works, it will be bound by Zetland Avenue to the north, George Julius Avenue to the east, Joynton Avenue to the west, and Rose Valley Way along the south-western edge. Along the south-eastern site edge will be a pedestrian way with mix-use developments opening directly onto the site. The site is divided by a 15m wide drainage easement for overland flow and a 5.5m wide underground trunk drainage culvert, which defines the eastern aquatic and recreation centre building edge of GPARC.

2.2 Green Square Context

The Green Square development is one of the largest and most strategically important urban regeneration projects in NSW. It is centrally located between the Sydney CBD and the Kingsford Smith Airport on the northern edge of Botany Bay. It has a train station on the Airport Line, and is served by bus routes linking predominantly to the west, north and south of the site, as well as some routes linked to destinations east of the site.

Major road arteries run north to south around the site. East-west street connections are often more local in nature and dislocated between the major north-south arteries of Bourke Rd, O'Riordan St, Botany Rd and Southern Cross Drive. A

possible future light rail is proposed to run east-west along the new Zetland Avenue, linking Green Square station to the future Kensington Line of the South East Light Rail project.

The GPARC site is situated within the Epsom Park precinct, located east of the new Green Square Town Centre precinct. It sits adjacent to a heritage area, the former South Sydney Hospital, and connects to the Green Square Town Centre via Zetland Avenue, which will run along the GPARC site's northern boundary when completed.

The Epsom Park precinct will be characterised by medium to high density mixed use apartment buildings, varying between 13-40m in height. GPARC will create a recreational focal point for the surrounding high density mixed use occupants, providing a combination of active and passive recreational activities through a diverse range of park and aquatic and recreation centre offerings. The GPARC project will be one of several public domain and community facility projects developed by the City of Sydney for the new Green Square Town Centre and surrounds. These projects will facilitate a diverse and active public realm, including the Green Square Plaza and Public Library, and the Drying Green park. The community facilities will provide the basis for a sound social infrastructure, offering opportunities for social interaction and place-making that will form the basis of a cohesive, connected and inclusive community.

The site has a number of proposed and planned residential and commercial developments located directly on its southern boundary, as well as to the north and east on the opposite sides of adjoining streets. To the west, opposite Joynton Avenue, the former South Sydney Hospital site will house mixed community facilities, while a park connection to Woolwash Park and Biyangbing Park takes place to the north of the site.

2.3 Site Histories Incorporated In the Design

Green Square is currently experiencing significant physical transformation to its urban geography, leaving behind a rich and layered physical and industrial history of the site and surrounding areas. As part of our contextual response, we have attempted to make visible many of the layers and traces of local history and urban form erased through the process of urban renewal. Outlined below is a summary of some of the key histories and geographies that have shaped the design narrative for the GPARC proposal.

2.3.1 Waterloo Swamp and the Banksia Scrub Landscape

Observed from 19th Century depictions of the local natural landscape, the Gunyama Park site was previously immersed within a waterscape of swamps, linked to Botany Bay and Cooks River to the south. The main physical geography in its indigenous condition was the banksia scrub landscape common to south-eastern Sydney.

The proposed design engages this early history through the development of the park with a base planting schedule drawn from the indigenous banksia scrub landscape.

2.3.2 Bangala Water Carriers

The traditional owners of this land knew this area as a swampland with sand dunes and banksia scrub plants.

Returning the site to its wetland landscape, two public artwork sculptures of traditional indigenous water carriers – or bangala - will acknowledge the Aboriginal ancestry and their cultural use of place.

2.3.3 Industrialisation and the Emergence of Large Span Roof-Scapes

The water source of Waterloo Swamp became an attractor for water-intensive industries from the 1850's, including soap works, wool washes, brickyards and breweries. As industry became more established through the 20th Century, the South Sydney area developed a very distinctive constructed geography, with large, sprawling industrial buildings often characterised by repetitive bays of sawtooth roofs. This urban pattern formed through the 20th Century by large span industrial footprints within the Zetland and Alexandria area is still recognisable as a unique pattern of development within Sydney' urban footprint, albeit one that is quickly eroding through the area's rapid urban transformation.

The proposed design engages this urban pattern of industrial roof-scapes by conceiving the upper level of the GPARC design as a large scale, rationalised floating structure reminiscent of the large span footprint of this industrial heritage.

2.3.4 Urban form – Patchwork of Scales

In support of the rapid growth of local industry and general increase in Sydney's population, housing within the South Sydney suburbs of Zetland, Waterloo and Alexandria took the form of tight-knit urban streets and laneways with terrace houses as the dominant housing type, with the inhabitants often working at the adjacent factories. The continuity of this urban form was broken by the continued growth of industry replacing some housing stock, and urban renewal policies from the 1940's that encouraged 'slum clearance'. Today, the local urban form contains a patchwork of scales, including fragments of this high density, fine grain, low scale housing intermixed with larger industrial footprints (some of which are now vacant) and newer multi-level apartment buildings.

The proposed design engages this patchwork of scales by exploring elements that create a diverse range of scale readings within the facility, varying from fine grain, small scale elements such as cabana change rooms to the very large scale singularity of the floating 'industrial' roof of the pool enclosure.

2.3.5 Industrial Production – The Colours of the Morris Minor

In 1950 Morris Motors established a manufacturing plant in the vicinity of the GPARC site. This development led to a series of factories within the area being established for the automotive trade. Production at the Morris factory (which became British Motor Corporation) included the popular Morris Minor vehicle.

As a secondary representation of the site's industrial history, the design includes the Morris Minor colour palette of cars previously produced on the site for children's play elements, including the children's outdoor playground equipment and the indoor leisure water equipment.

2.3.6 Changing Urban Form Through Urban Renewal

With the decline of industry, the physical character of South Sydney is being radically transformed through contemporary programs of densification and urban renewal. Multi-level mixed use and apartment blocks are transforming brownfield sites, reorganised loosely along the perimeter block model, albeit with significant variability of building heights. The transformation also includes the introduction of new streets, lanes, pedestrian and cycle links and new parks. This change in uses is resulting in the erasure of large parts of the industrial landscape, and its replacement by typologies that have shaped a significantly different urban form in both plan and section.

The proposed design anticipates the future urban context of commercial and mixed use surrounding buildings with variable heights by creating a low, singular roof profile for the aquatic and recreation centre that establishes a consistent height with many of the former South Sydney Hospital site new cultural facilities. Creating this link in terms of building height will help create a commonality between the network of public and cultural facilities that provide the civic core for the new Green Square area.

3.0 PROJECT DESIGN CONCEPTS

3.1 GPARC Project Goals

The development of the GPARC proposal has maintained and further enhanced the key goals established in the original competition winning entry. Outlined below is a summary of the key project goals established and further resolved from the competition scheme to the Development Application proposal.

3.1.1 A Unified Park and Aquatic and Recreation Centre

In response to the scale and density of the future Green Square area, we established in our competition entry that the

perception of the park footprint should be maximised. To do this, we proposed a unified concept for park and aquatic and recreation centre that produces an integrated proposition of an aquatic and recreation centre within a park, with a coherent and coordinated design language, and design elements, throughout the building and park.

3.1.2 Bringing Presence to the Site's Historical Layers

In the face of a rapidly changing urban form, our proposal attempts to develop an urban and landscape proposal that is informed by a historical understanding of the formation of the Green Square urban landscape from its pre-European indigenous condition, through the phases of its industrial history, to its contemporary transformation. The design proposes an engagement with, and foregrounding of, this history in an integrated way within the main elements of the GPARC proposal – the landscape concept, the building form and structure, and the project colour and material palette.

3.1.3 Grafting the Beach into the City – Taking Inspiration from the Coastal Pool Tradition

To maximise the pleasurable dimension of swimming, we have taken inspiration from the playful atmosphere of the beach and coastal pools as a catalyst for expanding the project's social and community appeal. Through analysis of the physical and social characteristics of the very successful civic tradition of Sydney's coastal pools, the project attempts to orchestrate, and create an atmosphere for, a range of appealing, passive recreational opportunities in conjunction with the active recreational functions, that the park and aquatic and recreation centre will provide.

3.1.4 Orchestrating Diverse Community Uses

Linked to our concept of the beach as an expansive social and community element, is a general goal across the aquatic and recreation centre and park to seek opportunities to create a diversity of recreational possibilities for a rapidly transforming high density neighbourhood with a high level of multilevel strata occupation. This diversity will include:

- Passive activities such as social gathering and relaxed recreation (aquatic centre bleachers, outdoor beach pool, café, park seating, park lawn areas, park BBQ facilities).
- Active and passive recreation for children and young people (sports field, sports field edge seating and viewing terrace, children's playground, skate facilities, park circuit trail for running or riding, aquatic centre leisure water, program pool and outdoor beach pool).
- Active recreation for local residents and workers (sports field, outdoor fitness equipment, park circuit trail for running or bike riding, health and fitness centre, 50m outdoor lap pool, program pool).
- Active and passive recreation and recuperative facilities for aged, injured or community members with disabilities (outdoor beach pool, hydrotherapy pool, program pool, aquatic centre bleachers, café, health and fitness centre, outdoor fitness equipment, park circuit trail for strolling or jogging, park seating, inclusive playground facilities, park BBQ areas, sports field, sports field edge seating and viewing terrace).
- Social interaction and connections between a broad range of park participants (sports field and sports field edge seating and viewing terraces, children's playground and BBQ areas, lawns and BBQ areas, sports field and lawns, children's playground and skate facilities, park circuit path and adjacent seating and terraces/ sports field/ fitness station/ outdoor pool/ and cafe).
- Engagement with flora and fauna indigenous to the local area (park planting and ecology planning).

3.2 GPARC Architectural and Landscape Project Elements

From these key project goals, the conceptual basis of our design has been developed through a series of architecture and landscape elements that attempt to animate and give form to the project's conceptual intent. Outlined below is a description of key elements that form the design approach.

3.2.1 Indigenous Wetland / Banksia Scrub Landscape and Ecology

The site is re-imagined in its indigenous condition, immersed within the wetlands of the Waterloo and Botany swamp and banksia scrub landscape. This re-imagined landscape condition becomes the base from which other interventions on the site are conceived. The site will be planted with iconic Angophoras and Eucalypts, with a diverse and textural under-story of indigenous banksia scrubland plants to create a unifying landscape context for the park.

This proposal of site planting will contribute to the urban ecology of the wider area. By re-introducing a diverse range of indigenous under-story plants on both ground topography and buildings across the site, conditions are created to establish microclimates, habitat and food sources. These combined will foster native fauna to live on the site and attract animals that are migrating locally in the area.

Within the concept of returning the site to an indigenous wetland and banksia scrub condition, the site has been designed to capture and treat its own rainfall run-off within the garden beds of the park. In essence, all the garden areas of the park are working as ‘rain gardens’, collecting and treating the rain run-off from the adjacent hard pavements. The landscape in the overland flow path will act as a rain garden to treat stormwater run-off from adjacent areas during low flow events.

As if left in the landscape by traditional owners, a pair of oversized indigenous water carrier (bangala) sculptures will be placed within the wetland landscape along the rain garden. As water features, the bangala sculptures will appear to be like freshwater springs, filling to the rim and spilling over into the landscape, engaging the dialogue of the typology of the saltwater pools introduced into a site previously immersed in freshwater swamps, and enhancing the concept of water and wetland that binds building and park in a continuous landscape.

3.2.2 Bermed Topography

The ground floor pool components are introduced into the banksia scrub landscape as a bermed topography that establishes a continuous park presence across the full dimension of the site. This bermed landscape and green roof which has an organic, undulating geometry, forming bays and headlands contained by curved masonry walls, defines the main outdoor and indoor pool concourse while housing ground level components such as the front of house and reception, administration areas, change rooms, hydrotherapy pool, and pool plant.

Along Zetland Avenue, this landscape topography peels open to create two building entries. The first, approached from the corner of Zetland Avenue and Joynton Avenue, runs diagonally under the main floating roof structure, providing lines of sight across the pool concourse and park beyond. The second, approached from Zetland Avenue at its junction with the main Gunyama Park entry, is interlinked with a public indoor/ outdoor café activating the junction of the building and park. The two entries provide an engaging and activated street edge together with a strong planting presence along the principal frontage of Zetland Avenue. Internally, these two entries expand into a generous community space, containing a public ‘living room’ area, meeting rooms and café which together extend the community provisions associated with the public face of GPARC.

The bermed landscape reduces in height along the western Joynton Avenue edge and at the junction between building and park to create continuous sight lines that make the park visible from key circulation points within the outdoor pool areas, and between the public realm of Joynton Avenue and the new cultural precinct at the former South Sydney Hospital Site.

Within the interior of the bermed topography, large circular skylights set into the green roofs and berms bring natural daylight into meeting rooms and the entry foyer, which also receives generous natural lighting through large glazed door panels at the two building entries. Also contained within this bermed topography of the ground level is the hydrotherapy pool with highlight glazing between the berm walls and the floating roof structure above, ensuring ample natural light while creating a private atmosphere for users.

3.2.3 Embedded Recreational Landscape

Carved out of the indigenous wetland and banksia scrub planting, is a contemporary, recreational landscape containing the pool concourse, pools, sports field, playground, and skate facilities. This embedding, of recreational activities in the landscape establishes the geometry of the pool concourse and main circuit path within the topography of bays and headlands.

Defining the threshold between indigenous landscape and recreational activities, the promenade circuit path is formed as a concrete pathway and a continuous timber seat edge, weaving its way thought the park as a single, geometric band that links all the parks elements. The promenade animates the recreational landscape while serving as a walkway, a jogging track, a bicycle path, a vehicular access route for park maintenance, a seating edge, and a decking space to occupy; for recreation, sports viewing, or family BBQs.

At a thickening of the pathway on an expanded timber decking zone along the promenade are located two BBQ areas adjacent recreational lawns of natural grass. They each consist of an electric BBQ and clusters of picnic tables and chairs with shade umbrellas. The BBQ areas will be a destination on the edge of the native landscape, dappled with trees, looking across the natural grass lawns towards the clearing of the sports field.

Situated centrally in the park as a recreational clearing, the sports field provides multipurpose opportunities for community-based sport, catering for social, junior or modified forms of Rugby league and Rugby Union, Soccer-football, and AFL as well as being open to recreational use. The surface will be synthetic to maximise hours of play. The timber terrace and promenade surrounding the field creates a continuous elevated edge which acts as a protective barrier to the sports field against flooding and also serves as a seating edge and viewing terrace for spectators.

Also located along the promenade circuit is a fitness station with a combination of exercise equipment situated at the north end of the park adjacent Zetland Avenue and opposite the sports field. The fitness station provides a destination in its own right whilst also linking into the park path network.

3.2.4 Park ‘Headland’

Located between the two natural grassed recreational areas at the eastern end of the site, a park ‘headland’ is created by the winding geometry of the promenade path and a clustering of amenities buildings. Containing public amenities, field change rooms, and field storage, the headland is formed by a similar language of topographic landscape zones and masonry walls that define the landscape character of the aquatic and recreation centre structures at the western edge of the site. The park ‘headland’ forms a clear gateway entry from the promenade into the area of the playground and skate facilities.

3.2.5 Nature-Based Play - The ‘Pipe Play’ Playground and Skate Facilities

The playground is located on the eastern side of the park, with clear connections to the family BBQ areas to its north and south, as well as the amenities structures located to its immediate west.

Referencing the site’s industrial past, the playground is based on a series of large pipe tunnels. The pipe tunnels establish an exploratory space for kids as well as becoming the armature to attach slides, climbing nets, ladders, swings, and climbing poles, and being a space to discover play elements to the interior of the pipes. Two pipe tunnels are located on the ground, central to the junior play space, incorporating a series of portals for young or less able-bodied children to climb through, slide from, play in and explore.

The playground is set within the native gardens of the park, with textural plants that weave through the space under the elevated pipe tunnels, creating a natural setting for kids to explore and discover. The play space has been designed to be engaging for older children as well as providing a dedicated junior play area for the 1- 4 year olds, and offering inclusive play facilities.

Adjacent the playground is a small dedicated skate bowl designed as a space framed by the topography of the playground. With clear connections to the playground, this will be an intermediate bowl but open to skaters of all abilities and ages. Other skate moments in the park are integrated with the promenade and park landscape.

3.2.6 Pool Concourse – ‘Beach’, ‘Boardwalk’ and Pools

The main pool concourse, containing an internal 25m program pool and internal leisure water and a 50m outdoor pool is shaped in a free-form geometry, created by clustering the pools together as a single water body surrounded by an outer edge of ‘beach’ concourse. A ‘boardwalk’ concourse links all the pools. Added to the 50m outdoor pool is a curved edge on the park side, forming an outdoor leisure water area with beach entry to offer additional recreational opportunities and programs

for the main outdoor pool beyond lap swimming. Defining the edge of the 'beach' is a range of elements that animate the pool concourse – the rendered masonry walls of the bays and headlands, brightly coloured cabana change spaces, and bleachers and 'rocks' for poolside relaxing.

3.2.7 Poolside Elements – Cabanas, Bleachers and 'Rocks'

Servicing the pool concourse are a number of elements derived from our study of coastal pool landscapes that expand the recreational opportunities and coastal pool atmosphere of the aquatic and recreation centre.

Small scale 'cabanas' provide functional individual and group change areas outside of the male/ female change rooms, providing flexibility in use while evoking beach side huts with a sun-bleached colour palette of painted timber. Their small dimension provides a fine grain within the larger open spaces of the pool concourse and the monolithic scale of the floating roof structure.

The bleachers and 'rocks' act as landscape elements supporting passive recreation and social interaction. As well as providing seating for spectators watching activities within the pools, the bleachers form terraced platforms for poolside relaxation. The 'rocks' provide a series of terraces and platforms, combining concrete and timber finishes to establish more defined zones for sun baking and poolside relaxation. The more jagged, stepping edge of the rocks allows for easy integration of wheelchair access, increasing the inclusive nature of the GPARC poolside experience.

3.2.8 Industrial Scale Roof Trellis

Referencing the large span roof structures characteristic of the area's industrial past, the rectangular roof floating over the organic geometry of the ground level berms is conceived as a remnant, industrial scale urban trellis, filtering light and shading the spaces below. This roof provides enclosure for the pool hall, as well as housing the health and fitness centre and services plant elements. The simple, continuous skin that clads the upper pool hall enclosure lifts to form arched openings for the health and fitness centre, allowing natural ventilation, daylight and views out towards the outdoor pool and park to the east and to the existing and new trees lining Joynton Avenue to the west.

The indoor double height pool hall will be bathed in natural light from its semi-transparent Ethylene Tetrafluoroethylene (EFTE) plastic roofing, spanning between deep timber beams that frame the major roof skylights. The wall separating the health and fitness centre from the pool hall is punctured by openings, ensuring views to the indoor pools and borrowed daylight from the double height pool hall. Connecting the floating roof structure to the pool concourse is a fully glazed eastern façade and glazing between berms on the western facade. To reduce glare and summer solar penetration, the floating roof structure overhangs the lower glazing, reducing summer heat gain while allowing solar penetration in winter. The EFTE roof membranes have a fritted pattern for sun protection.

4.0 PROJECT COLOUR AND MATERIALS

4.1 Colour Palette

The proposed colour palettes for GPARC have been developed taking inspiration from three sources:
- A sun-bleached coastal pools palette
- An indigenous landscape palette
- The original Morris Minor paint colours palette

In developing the sun-bleached coastal pools palette, inspiration has been drawn from both the qualities of the physical environment of coastal pools – strongly contrasting painted lines, reflected colours between sky, water and painted concourse, light green hues reflected against mottled concrete walls – and the transitory cultural environment of elements and accessories that accompany people to the coastal pools– brightly coloured shade umbrellas, beach towels and bags, and food and ice cream signage.

The second source of inspiration for the colour palette has been the landscape indigenous to the South Sydney context.

Paintings from Sir Joseph Banks' Florilegium as well as colonial artist Joseph Lycett have been used to further expand a colour palette of greys, deep olive greens and browns to compliment the sun-bleached colours developed from the coastal pool analysis.

Thirdly, the original colours of Morris Minors produced on this site when it was home to car factories supplement the sun-bleached coastal pools palette and indigenous palette with pastels in green, blue and grey hues, linking to local heritage.

4.2 Material Palette

A limited and robust material palette is proposed for GPARC, with materials selected for their appropriateness, durability, maintainability, sustainability, reflectance suitability, slip resistance, cleanability, and suitability for life-cycle replacement.

4.2.1 Concourse and Boardwalk Materials

The design of the pool concourse and park promenade takes inspiration from two sources related to the coastal pools concept - the 'beach' and the 'boardwalk'. The concourse area around the outer edge of the pools is proposed as an exposed aggregate concrete whose colour and aggregate mix draws on the colour tones and texture of the beach. The park pathway is also proposed as an exposed aggregate finish closely matched to the pool concourse. Connecting the concourse between the pools is a boardwalk proposed as concrete planks.

Running on the inner ring of the main concrete circuit path in the park is a timber edge of varying width that forms a continuous timber seat edge to the sports field. This timber edge expands for recreational uses associated with the natural lawn areas and sports field support facilities to create broad public terraces that complement the concrete pathway. The timber decking is proposed as a 40x30mm Australian hardwood.

4.2.2 Facade Materials

The upper external façade of the aquatic and recreation centre building is proposed as CFC panels in a natural concrete finish. The design of the lower walls surrounding the pool concourse reinforces the coastal pool palette with the primary wall finish being whitewashed, textured rendered walls in combination with planted berm walls. This simple rendered wall texture is highlighted at key thresholds and openings with colour drawing from the sun-bleached colour palette.

4.2.3 Pool Hall Materials

The internal pool hall is characterised by a light and natural material palette with large span timber beams fixed to concrete walls, clad with perforated CFC panels with acoustic insulation behind. The roof is EFTE pillows spanning between the timber beams, creating a continuous rhythm of daylight and structure through the main internal pool hall.

4.2.4 Cabana and Bleacher Materials

Occupying the edge of the pool concourse are a number of smaller structures that further expand on the coastal pool theme while providing functional spaces for passive recreation and leisure as well as group and small change rooms. The group and small change rooms have been conceived as timber 'cabanas' also painted in the sun-bleached colour palette of the coastal pools. Around the edge of the pools are a series of bleachers conceived as precast concrete 'rocks' with timber infill between that create spaces for gathering and relaxing adjacent the pools.

4.2.5 Shading Materials

The shading material palette is coordinated across the pool and park areas with a combination of two shade types – umbrellas and tensile shade structures. The umbrellas are used in areas of social, passive recreation such as the poolside bleacher seats and the BBQ areas in the park. The tensile fabric shade structures are used in zones where a greater area of coverage is required, such as the outdoor leisure water area and the children's playground.

5.0 ENVIRONMENTALLY SUSTAINABLE DESIGN (ESD)

The development of sustainability principles throughout the design process for GPARC has been a key consideration. The following is a summary of these considerations in aiming to meet objectives in City's 2030 Vision where possible, and targeting a 5 star Design and As-built Green Star rating; the first facility of this type to set such an ambitious sustainability target.

5.1 Ecology and Land

- Re-use of an existing brownfield site.
- Indigenous species to be planted throughout the park.
- Remediation of contaminated land.
- Excavated material to be re-used on site to establish new topography, thereby reducing carbon emissions by avoiding transport of contaminated soil to landfill.
- Earth berms surrounding the aquatic and recreation centre building provide insulation and thermal mass to internal spaces.
- Planting to earth berms reduces water runoff.

5.2 Pool Design

- Waste heat from a cogeneration system provides heat for pool water.
- Thermal blankets help to reduce heat loss and water evaporation in the outdoor pool outside hours of operation.
- Variable speed pumps and filtration systems minimise energy consumption of pool plant equipment.
- Backwash recovery systems reduce waste backwash water.

5.3 Ventilation – Winter

- Façade to pool hall is closed in winter with controlled exhausts at a high level to provide ventilation.
- HVAC System: Low velocity air supply utilises the natural buoyancy of air to encourage air movement, reduce condensation and reduce energy consumption.

5.4 Ventilation – Summer

- Natural ventilation in summer through openable glazing at the pool concourse level and high level exhausts.
- High roof design assists with air flow and ventilation rates.

5.5 Daylighting & Passive Solar Design

- Extensive glazing to façades and ETFE roof provides direct natural light to the pool hall and health & fitness centre, minimising the need for artificial lighting during daylight hours.
- Roof overhang shelters glazing in summer and allows solar penetration in winter.
- 65% coverage with silver dots on EFTE roof membranes provides protection from sun and ultraviolet light and reduces glare in the pool hall.

5.6 Materials & Systems

- Durable materials selected for long life in a corrosive environment, including concrete, timber and glass.
- Use of recycled timber from the City of Sydney timber stockpile where possible. All new timber such as the timber roof beams to be sourced from certified, sustainably managed sources.
- Zero Ozone Depleting Potential (ODP) in refrigerants used.
- Maximal use of LED lighting, and use of other energy-efficient lights where LED cannot be achieved. Control of artificial

lighting by timers and sensors to reduce operational energy.
- Insulation to reduce reliance on mechanical heating systems.
- Photovoltaic panels located on the roof to provide electricity to the aquatic and recreation centre and park.
- Cogeneration to produce electricity for operation of the aquatic and recreation centre and park, and heat as a by-product to be used for heating of pool water.

5.7 Waste

- 90% of all construction and demolition waste diverted from landfill.
- Waste sorting in separate bins to promote resource recovery from recycling bins.

5.8 Water

- Rain gardens to provide bio-filtration and enable water collected from external hardscape surfaces in the park and aquatic and recreation centre to be re-used for irrigation and toilet flushing.
- Connection to the City's new Recycled Water Network at the former South Sydney Hospital site for additional supply to irrigation and toilet flushing.
- Water collected from aquatic and recreation centre roof to be used for pool top-up.
- Water-efficient fixtures and fittings and pool filtration systems.
- Erosion and sediment control to reduce water use in operation and during construction.

5.9 Transport

- Site is close to public transport including buses, train and future light rail.
- Local population within walking distance.
- Bicycle racks and end-of-trip change facilities encourage and support bicycle riding by aquatic and recreation centre staff and users as well as park visitors.

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Additional Geotechnical Investigation

Gunyama Park Aquatic and Recreation Centre
Joynton Avenue, Zetland

Prepared for
The Council of the City of Sydney

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Appendix E: Laboratory Test Results

Report on Additional Geotechnical Investigation
Gunyama Park Aquatic and Recreation Centre
Joynton Avenue, Zetland

1. Introduction

This report presents the results of an additional geotechnical investigation undertaken for the proposed Gunyama Park Aquatic and Recreation Centre on the eastern side of Joynton Avenue, Zetland. The work was commissioned by The Council of the City of Sydney, developers of the site.

It is understood that the project will involve the construction of an aquatic centre on the western portion of the site adjacent to Joynton Avenue. The facility will house indoor and outdoor swimming pools, gymnasiums and other health-related facilities. The concourse levels in the aquatic centre will be in the order of RL 19.7 m relative to the Australian Height Datum (AHD). The eastern portion of the site will feature Gunyama Park which will cater for both active and passive recreational activities, and will include an amenities block and light towers. The proposed surface levels in the park area are between approximately RL 19.5 m and RL 20 m AHD.

Additional investigation was undertaken to provide more detailed information on the subsurface conditions on the site and included the drilling of boreholes, the installation of groundwater monitoring wells, cone penetration testing, laboratory analysis and engineering interpretation. Details of both the previous and current the field work, and comments relevant to design and construction are given in this report. This report supersedes the previous *Report on Geotechnical Investigation Rev2* for Project 73743 dated 25 September 2015.

2. Site Description and Geology

The development site is bounded by residential unit buildings to the north, an Ausgrid depot to the east, a City of Sydney depot, residential construction site and car dealership to the south, and Joynton Avenue to the west. At the time of the investigation the western portion of the site was being used as a depot by a civil engineering contractor. The eastern portion of the site was being used as a vehicle parking area for the Ausgrid depot and a separate new-vehicle storage area.

The ground surface on the site is relatively flat with a slight downwards grade to the north. The area used for storing new vehicles to the east of the site is elevated on a pad that is approximately 2 m above the surrounding ground surface levels.

The *Sydney 1:100 000 Geological Series Sheet* shows that the site is underlain by Quaternary-aged medium to fine-grained marine sands with podsols. The sands are expected to be underlain by Hawkesbury Sandstone which comprises medium to coarse-grained quartz sandstone with minor shale and laminite lenses.

3. Field Work Methods

3.1 Previous Investigation

The previous field work included the drilling of four cored boreholes (BH1 to BH4), one augered borehole (BH5) and the completion of 12 cone penetration tests (CPT1 to CPT12).

The cored boreholes were drilled to depths of between 20.0 m and 21.2 m using truck-mounted Scout and DT100 drilling rigs. They were commenced using solid flight augers to drill through the overburden materials. Disturbed soil samples were collected from the tip of the auger and Standard penetrometer tests (SPTs) were undertaken at regular depth intervals throughout the filling/soil profile. Rotary drilling equipment was used to progress the bores to prevent hole collapse below the groundwater table. Once weathered rock was encountered, NMLC-sized diamond core drilling equipment was used to obtain 50 mm diameter continuous core samples of the rock for identification and strength testing purposes.

The augered borehole was drilled to a depth of 5.0 m using solid flight augers. SPTs were also undertaken within this bore.

Two boreholes (BH3 and BH5) were converted to groundwater monitoring wells at the completion of drilling. This involved inserting Class 18 uPVC screen and casing to the required depth, backfilling the screened length with gravel, plugging the top of the gravel with bentonite pellets and backfilling the casing with drilling spoil. A vented LevelTROLL 500 groundwater level logger was installed in each of the wells on 10 February 2014. The loggers were configured to record groundwater levels at 2 hourly intervals until they were removed on 22 April 2014.

The construction details of the groundwater monitoring wells are provided in Table 1.

Table 1: Construction Details of Previous Groundwater Monitoring Wells

Well Location	RL of Ground Surface	RL of Top of Screen	RL of Base of Screen
BH3	18.2	12.2	9.2
BH5	18.6	16.6	13.6

Notes: All levels are in metres and relative to AHD

The cone penetration tests (CPTs) were undertaken to depths of between 5.0 m and 6.0 m to assess the near-surface soil conditions. A CPT involves pushing a 35 mm diameter instrumented cone and friction sleeve into the ground using hydraulic thrust from a ballasted truck-mounted testing rig. Measurements of cone resistance and sleeve friction are made at 20 mm depth intervals and are stored on a portable computer for subsequent analysis and interpretation.

All previous test locations are shown on Drawings 1A and 1B in Appendix B. The ground surface levels at the bores and CPTs were measured to AHD using an automatic level, relative to temporary benchmarks on the site.

3.2 Current Investigation

The current field work included the drilling of 21 cored boreholes (BH115, BH118, BH119, BH122, BH128 and BH130 to BH145) and the completion of 30 cone penetration tests (CPT101 to CPT130).

The cored boreholes were drilled to depths of between 19.7 m and 29.1 m using truck-mounted Scout and Explora drilling rigs. They were commenced using solid flight augers to drill through the overburden materials. Disturbed soil samples were collected from the tip of the auger and SPTs were undertaken at regular depth intervals throughout the filling/soil profile. Rotary drilling equipment was used to progress the bores to prevent hole collapse below the groundwater table. Once weathered rock was encountered, NMLC-sized diamond core drilling equipment was used to obtain 50 mm diameter continuous core samples of the rock for identification and strength testing purposes.

Six boreholes (BH115, BH118, BH122, BH128, BH134 and BH144) were converted to groundwater monitoring wells at the completion of drilling. This involved inserting Class 18 uPVC screen and casing to the required depth, backfilling the screened length with gravel, plugging the top of the gravel with bentonite pellets and backfilling the casing with drilling spoil.

The construction details of the groundwater monitoring wells are provided in Table 2.

Table 2: Construction Details of Additional Groundwater Monitoring Wells

Well Location	RL of Ground Surface	RL of Top of Screen	RL of Base of Screen
BH115	18.6	15.6	6.6
BH118	20.3	17.3	8.3
BH122	19.9	16.9	7.9
BH128	17.8	14.8	5.8
BH134	18.5	15.5	6.5
BH144	19.0	16.0	7.0

Notes: All levels are in metres and relative to AHD

The current CPTs were undertaken to depths of between 13.8 m and 24.9 m to assess the soil conditions. A CPT involves pushing a 35 mm diameter instrumented cone and friction sleeve into the ground using hydraulic thrust from a ballasted truck-mounted testing rig. Measurements of cone resistance and sleeve friction are made at 20 mm depth intervals and are stored on a portable computer for subsequent analysis and interpretation.

All currents test locations are shown on Drawings 1A and 1B in Appendix B. The ground surface levels at the bores and CPTs were measured to AHD using a high-precision differential Global Positioning System (dGPS) receiver.

4. Field Work Results

The subsurface conditions encountered during the current field work are presented in the borehole logs and results sheets in Appendix C. The field work results from the previous investigation are included in Appendix D. Notes defining descriptive terms and classification methods are included in Appendix A.

The cored boreholes drilled on the site encountered:

- FILLING – concrete and asphalt pavement, underlain by gravelly sand, crushed sandstone, sandy clay, silty sand and building rubble (including bonded asbestos fragments) to depths of between 0.7 m and 6.0 m;
- NATURAL SOILS – loose to dense sands to depths of between 7.0 m and 16.1 m, and firm to hard clays to depths of between 12.5 m to 21.0 m depth. Some layers of peat/organic clay were also encountered;
- BEDROCK – sandstone which was initially extremely low to very low strength, becoming low, medium or high strength from depths of between 14.5 m and 24.4 m, to the base of the cored bores at 19.7 m to 29.1 m depth.

Tables 3A to 3C summarise the levels at which different materials were encountered in the cored bores. The rock has been classified in accordance with a system developed by Pells et al (1998) which classifies rock strata depending on strength, fracturing and defects. Class V rock is typically very low strength, highly weathered and highly fractured rock whereas Class I rock is typically high strength, fresh and unbroken rock.

Table 3A: Summary of Material Strata Levels and Rock Classifications

Strata	RL of Top of Material Strata (m, AHD)								
	BH1	BH2	BH3	BH4	BH115	BH118	BH119	BH122	BH128
Ground Surface/ Filling	18.4	18.2	18.4	19.1	18.6	20.3	18.6	19.9	17.8
Natural Sands	14.4	16.6	13.9	17.9	17.2	17.3	17.8	15.9	17.1
Natural Clays	5.8	9.7	8.5	12.1	4.6	4.2	5.2	3.9	5.0
Class V/IV Sandstone	4.6	5.7	2.4	5.0	1.3	-0.7	1.3	-0.4	3.7
Class III Sandstone	2.6	3.0	2.2	4.6	-4.1	-4.1	-0.1	-0.8	2.8
Class II/I Sandstone	-0.5	0.5	0.4	0.8	-7	-6.7	-3.7	NE	NE
Base of Test	-1.7	-2.6	-2.8	-0.9	-10	-7.8	-5.6	-6.6	-4.9

Notes: NE = not encountered; Rock classification in accordance with Pells et al (1998)

Table 3B: Summary of Material Strata Levels and Rock Classifications

Strata	RL of Top of Material Strata (m, AHD)							
	BH130	BH131	BH132	BH133	BH134	BH135	BH136	BH137
Ground Surface/ Filling	18.5	18.4	18.5	18.6	18.5	18.1	18.5	18.5
Natural Sands	16.0	12.4	14.1	16.6	13.6	14.9	14.2	15.7
Natural Clays	2.5	5.9	8.1	5.7	5.8	6.0	5.7	4.5
Class V/IV Sandstone	-2.0	1.1	1.4	-1.8	0.8	3.1	2.0	2.7
Class III Sandstone	-3.9	0.9	-0.3	-2.9	-1.0	2.9	-0.5	-2.5
Class II/I Sandstone	NE	-1.1	-2.0	-3.4	-3.5	-1.5	-2.6	-3.3
Base of Test	-10.6	-5.2	-4.2	-8.9	-5.6	-3.2	-3.3	-5.6

Notes: NE = not encountered; Rock classification in accordance with Pells et al (1998)

Table 3C: Summary of Material Strata Levels and Rock Classifications

Strata	RL of Top of Material Strata (m, AHD)							
	BH138	BH139	BH140	BH141	BH142	BH143	BH144	BH145
Ground Surface/ Filling	18.1	18.5	18.5	18.5	18.5	18.2	19.0	19.1
Natural Sands	15.3	13.7	15.8	17.5	14.2	13.9	15.0	15.3
Natural Clays	6.8	6.1	5.6	5.5	7.0	6.5	5.5	6.6
Class V/IV Sandstone	3.5	4.5	0.9	1.0	4.0	4.0	2.2	5.8
Class III Sandstone	2.1	NE	-0.5	-2.1	NE	-2.6	-1.2	3.1
Class II/I Sandstone	-1.5	-1.3	-3.1	-3.5	2.2	NE	NE	NE
Base of Test	-4.0	-4.2	-5.3	-5.2	-3.0	-3.1	-2.1	-0.6

Notes: NE = not encountered; Rock classification in accordance with Pells et al (1998)

The CPTs typically encountered filling to depths of between 1.1 m and 5.0 m, loose to very dense sands to depths of between 8.9 m and 16.0 m, and stiff to hard clays to the base of the tests at 13.8 m to 24.9 m depth. There were some layers of interbedded sands and clays and also some peaty layers encountered.

Groundwater was observed at depths of between 1.6 m and 4.3 m (RL 13.6 m to RL 17.3 m AHD) in the previous and current boreholes at the time of the field work.

A graphical summary of the previous monitoring data from the level loggers is shown in Figure 1 (BH3) and Figure 2 (BH5). Daily rainfall information recorded by the Bureau of Meteorology at Sydney Airport is also included on the graphs.

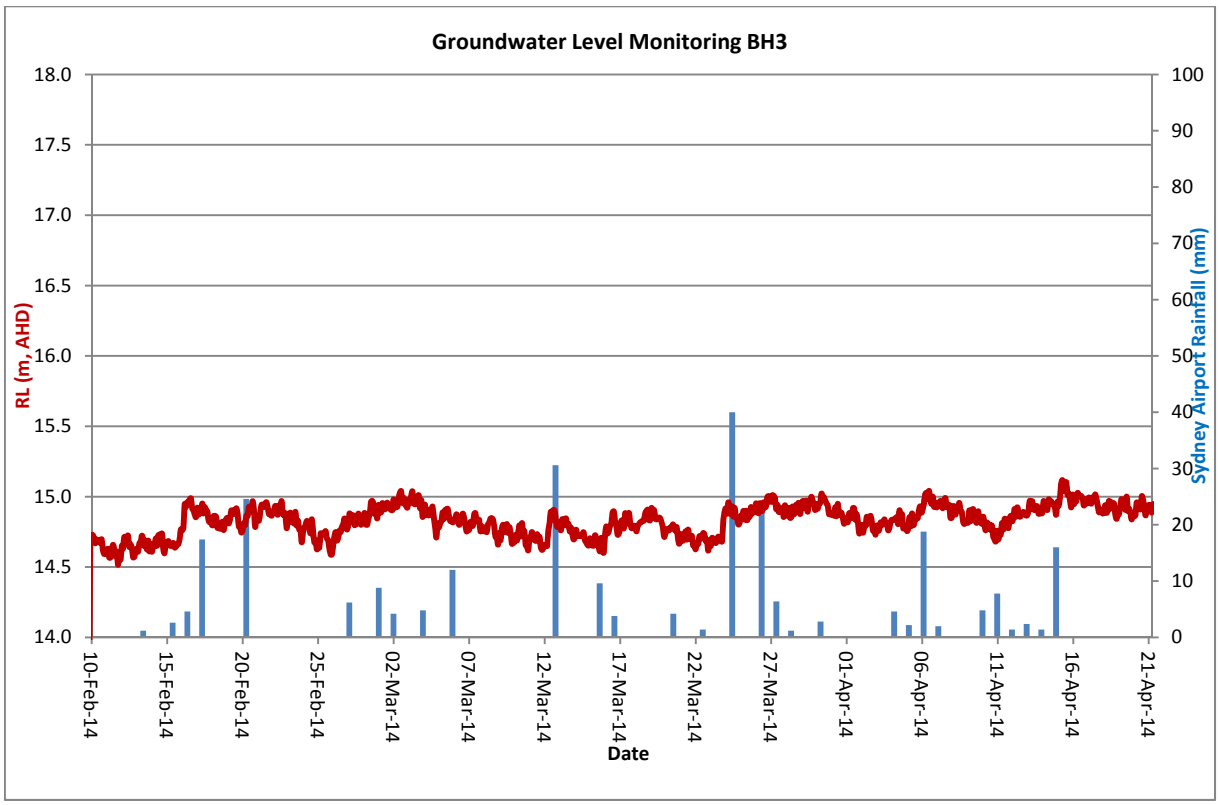

Figure 1: Monitoring results for bore BH3

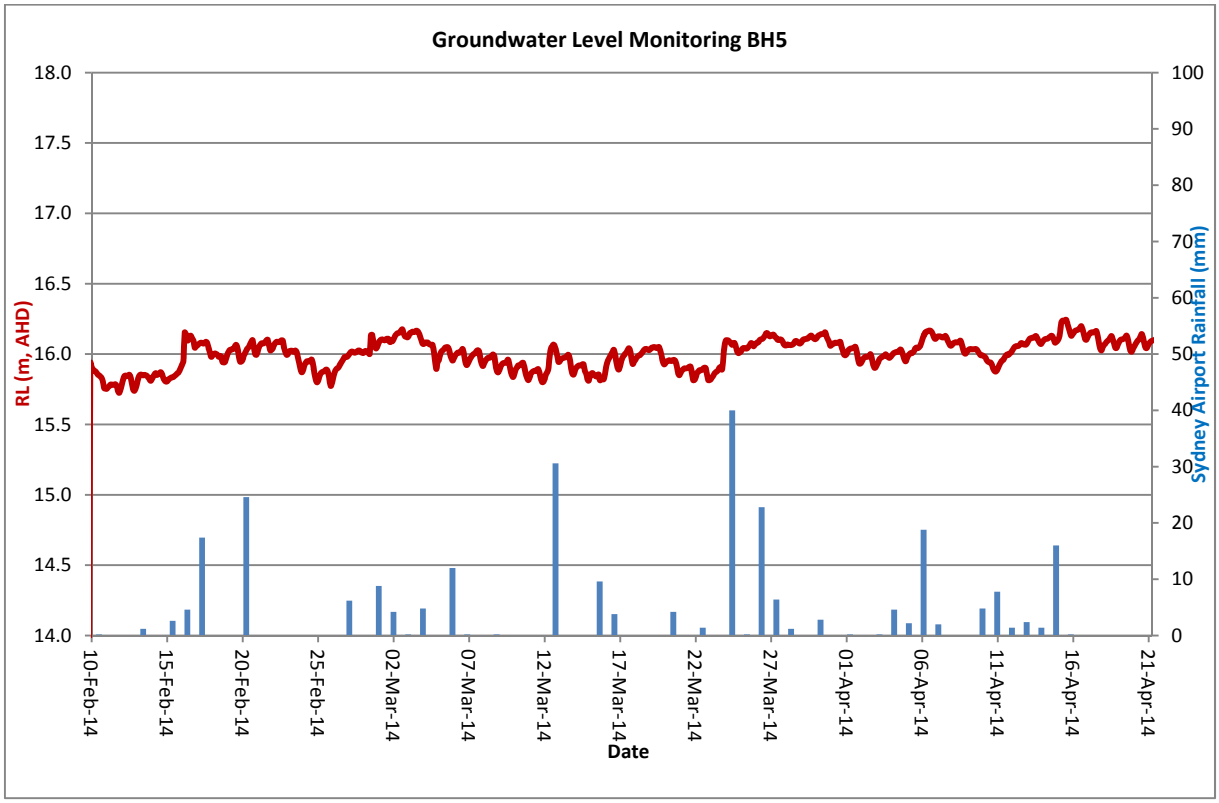

Figure 2: Monitoring results for bore BH5

Additional groundwater measurements were made 6 April 2016 and are summarised in Table 4.

Table 4: Summary of Groundwater Measurements on 6 April 2016.

Location	Depth to Groundwater (m)	Level of Groundwater (m, AHD)
BH3	3.1	15.3
BH5	3.1	15.5
BH115	3.1	15.5
BH118	4.3	16.0
BH122	4.1	15.8
BH128	2.2	15.6
BH134	3.0	15.5
BH144	3.7	15.3

5. Laboratory Testing

5.1 Rock Samples

175 samples selected from the better quality rock core were tested for axial point load strength index (Is_{50}). The results ranged between 0.1 MPa and 2.4 MPa which correspond to very low to low strength, and high strength rock respectively. These Is_{50} results suggest an unconfined compressive strength (UCS) in excess of 40 MPa for the high strength rock encountered during the investigation.

5.2 Soil Samples

Four soil samples obtained from the boreholes were analysed to assess the aggressivity of the soil. The results are summarised in Table 5 and are attached in Appendix E.

Table 5: Summary of Soil Aggressivity Results

Sample/ Depth (m)	Description	pH (pH units)	EC (µS/cm)	Chloride (mg/kg)	Sulphate (mg/kg)
BH1/2.5-2.95	Filling	8.2	250	20	250
BH2/5.5-5.95	Sand	6.2	150	20	180
BH3/8.5-8.95	Sand	6.0	38	10	28
BH4/10.0-10.45	Clay	4.7	120	20	170

Notes: EC = electrical conductivity; All samples mixed at a ratio of 1(soil):5(water) prior to testing

6. Geotechnical Model

A geotechnical model for the site is presented in Sections A-A to F-F in Drawings 2 to 7 which are included in Appendix B. A summary of the geotechnical model is shown in Table 6.

Table 6: Summary of Geotechnical Model

Geological Unit	Description
Unit A	Filling comprising concrete and asphalt pavement, gravelly sand, crushed sandstone, sandy clay, silty sand and building rubble
Unit B	Loose to very dense sand with some interbedded clays and peaty/organic clay layers
Unit C	Typically stiff to hard clays with some interbedded sands and clayey sand/sandy clay layers
Unit D	Sandstone bedrock which typically has a thin veneer of Class V/IV material overlying Class III and in some locations Class II/I rock
Groundwater	Measured at depths of between 1.6 m and 4.3 m (RL 13.6 m to RL 17.3 m AHD) and is likely to fluctuate over time.

7. Proposed Development

The project will involve the construction of an aquatic centre on the western portion of the site adjacent to Joynton Avenue. The facility will house indoor and outdoor swimming pools, gymnasiums and other health-related facilities. The concourse levels in the aquatic centre will be in the order of RL 19.7 m AHD. The eastern portion of the site will feature Gunyama Park which will cater for both active and passive recreational activities, and will include an amenities block and light towers. The proposed surface levels in the park area are between approximately RL 19.5 m and RL 20 m AHD.

The geotechnical issues considered relevant to the proposed development include excavation and site preparation, excavation support, groundwater, foundations and pavements. Comments on seismicity and aggressivity are also provided.

8. Comments

8.1 Excavation and Site Preparation

Excavations for the proposed structures and any remediation works required on the park site are likely to be limited to less than 3 m depth. Excavation will therefore primarily be required within filling and soils above the groundwater table which should be readily achievable using conventional earthmoving equipment such as a hydraulic excavator with bucket attachment. Bulk excavation in rock will not be required and vibrations associated with such activities will therefore not be transmitted.

It should be noted that any off-site disposal of spoil will generally require assessment for re-use or classification in accordance with current *Waste Classification Guidelines* (NSW EPA, 2014).

The subgrade conditions in the area of the proposed park appear to consist of very loose to loose granular filling to depths of about 2 m. The suitability of this material for supporting the park area will depend on: (a) the design levels of the park, (b) the infrastructure proposed and whether any additional loads will be applied to the existing filling, (c) the settlement allowances for the park surface and drainage structure, and (d) the suitability of the filling to remain on the site from a human-health and ecological perspective. The designer will have to determine the suitability of the existing filling but it is likely that some re-working and/or replacement will be required, at least in some areas of the site.

A good proportion of the site is underlain by concrete pavements/slabs. The average thickness of the concrete at the borehole/CPT locations was 145 mm. The maximum thickness was 390 mm and the minimum thickness was 80 mm.

The slabs in areas where closely spaced piles are to be installed will probably need to be removed to facilitate effective piling. Saw cutting holes in the concrete at the pile locations could be undertaken, although the practical implications of removing significant areas of slab for this purpose need to be considered. Any slabs removed could be crushed on site for re-use as granular filling or possibly taken off site to a recycling facility.

Areas that do not require significant numbers of piles (e.g. Gunyama Park) may not require the removal of the concrete slabs. If densification of the existing filling is proposed then the slabs will need to be removed to provide access to the filling. Similarly to piling works, if extensive trenching for services is required in the park then it may be more practical to remove the slabs at the outset.

However, if access to the filling is not required then the slabs can probably remain in place as long as drainage is provided to allow for the effective removal of seepage water from the filling between the ground surface and the concrete slabs. Without drainage, seepage water could be trapped in this material causing it to lose strength and create issues with park performance.

Any filling required to raise site levels could be undertaken using the following methodology:

- Compact and test-roll the subgrade and remediate any compressible zones that may not have sufficient strength to support the new filling;
- Place the filling material in 200 mm to 250 mm thick layers and compact to achieve a dry density ratio of at least 98% relative to Standard compaction. If the filling exhibits clay-like properties then the moisture content should be within 2% of optimum; and
- Undertake density testing in each layer in accordance with Australian Standard AS 3798 to check the compaction levels achieved.

Settlement of the existing materials is likely to occur due to the placement of the new filling. The magnitude of the settlement will depend on the depth of uncontrolled filling and the thickness of the newly placed filling at any particular location on the site, but is likely to be in the order of 20 mm to 40 mm. The majority of the settlement is likely to occur soon after placement of the new filling.

8.2 Excavation Support

8.2.1 General

Vertical excavations in filling and soil are not expected to be self-supporting for any extended period of time. Temporary batters are expected to be feasible for supporting excavations on the site and should be not steeper than 1(H):1(V) for cuts up to 3 m depth. This advice is provided on the assumption that excavation below the groundwater table is not required and that there is sufficient space to construct batters. Temporary shoring support is therefore assumed to be unnecessary.

8.2.2 Earth Pressures

Excavation faces retained permanently will be subjected to earth pressures from the ground surface down to the base of the excavation. Table 7 outlines material and strength parameters that could be used for the design of excavation support structures.

Table 7: Material and Strength Parameters for Excavation Support Structures

Material	Bulk Density (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Earth Pressure at Rest (K_o)	Ultimate Passive Earth Pressure
Filling	20	0.4	0.6	K_p = 2.5
l to md Sand	20	0.35	0.5	K_p = 3.0
v to vd Sand	20	0.3	0.45	K_p = 3.5
st to vst Clay	20	0.3	0.45	100 kPa
Class V/IV Rock	22	NA	NA	2000 kPa

Notes: NA = not applicable

Cantilevered retaining walls could be designed by assuming a triangular lateral earth pressure distribution (increasing linearly with depth). A rectangular lateral earth pressure distribution could be assumed for retaining walls fully propped at the top and bottom. Lateral pressures due to surcharge loads from adjacent buildings, water pressure, road pavements and construction machinery should be included where relevant.

8.3 Groundwater

The groundwater levels measured during the previous and current field work vary between RL 13.6 m to RL 17.3 m AHD. The average current groundwater level appears to be in the order of RL 15.5 m AHD. The previous monitoring programme shows that the levels have fluctuated by about 0.5 m during the monitoring period and that there is a relationship between rainfall and groundwater level. The groundwater surface appears to dip downwards towards the west.

On the basis of the information available to date, a site groundwater level of RL 16 m AHD could be assumed. It is recommended that a design groundwater level of at least 2 m above the average site groundwater level (i.e. RL 18 m AHD) be adopted for the project to allow for increases in water levels which would be expected to occur from time to time.

Although the proposed pool structures are slightly above the water levels measured during the investigation, they are within the suggested design groundwater level and may be exposed to buoyancy uplift forces if the pools are emptied when the groundwater levels are above the base of the pools. This will need to be considered in the design of the pools by either: (a) providing sufficient deadweight or structural elements to resist uplift forces, (b) providing pressure relief valves in the pools, (c) providing permanent groundwater level monitoring devices to ensure the pools are only emptied when not subjected to uplift forces, or (d) a combination of these strategies.

8.4 Foundations

8.4.1 Spread Footings

Isolated spread footings (e.g. pad footings and strip footings) will not be suitable for the major structures on the site due to the presence of uncontrolled filling. Although a raft slab(s) may technically be feasible, it is understood that piles are likely to be the preferred foundation solution and therefore comments on raft slab design have not been included in this report.

8.4.2 Piles for Large Structures

Piles will probably be required to support the major structures. Suitable pile types include concrete or grout-injected CFA piles, bored piles drilled with temporary or permanent casing, or driven pile-types such as precast concrete, steel tube or steel H-section piles.

CFA piles and bored piles could be designed using the parameters provided in Table 8. Parameters for both the working stress and limit-state design approaches have been provided.

Table 8: Design Parameters for CFA and Bored Piles

Material Description	Allowable End-Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)[1]	Ultimate End-Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)[1]
Medium Dense Sand	500[2]	25	1250[2]	50
Dense Sand	1500[2]	50	3500[2]	100
Class V/IV Rock	1000	50	3000	150
Class III Rock	3500	300	20000	800
Class II/I Rock	6000	600	60000	1500

Notes: [1]Reduce by 50% for uplift loads and ensure cone-pullout criteria are met
[2]Provided that weaker material is not present within 5 piles diameters of the pile toe

It should be noted that the serviceability limit-state is likely to govern the design of the piles and the ultimate bearing pressures provided in Table 8 are unlikely to be achieved in practice. An appropriate geotechnical strength reduction factor should be applied when using the limit-state approach as outlined in AS 2159 – 2009 *Piling – Design and installation*.

Settlement of a pile is dependent on the loads applied to the pile and the foundation conditions in the socket zone and below the pile toe. The total settlement of a pile designed using the 'allowable' parameters provided in Table 8 would be expected to be less than 5 mm upon application of the design load.

Driven piles are often used to support high column loads on sites in which driving is practicable. The capacity of a pile driven to near-refusal in rock is likely to be governed by the structural capacity of the pile and the weight/efficiency of the driving equipment. The installation of test piles and pile load testing should then be undertaken to confirm driving conditions, pile set, pile capacity and an appropriate geotechnical strength reduction factor.
Settlement of a driven pile should be estimated using load test data obtained during the design confirmation stage of the piling process.

Vertical uplift loads could be resisted by socketing the piles into the bedrock.

The performance of laterally loaded piles can be assessed using the 'spring-stiffness' or lateral modulus of subgrade reaction (k_h). For preliminary design purposes, the value of k_h for the materials encountered on the site could be calculated from the expression $k_h = E_h/d$ where E_h is the horizontal modulus of elasticity and d is the pile diameter. Suggested modulus of elasticity values for the different materials are provided in Table 9 for both vertical and horizontal settlement/movement analysis.

Table 9: Modulus of Elasticity Values for Various Materials

Material	Vertical Modulus of Elasticity E_v (MPa)	Horizontal Modulus of Elasticity E_h (MPa)
Uncontrolled Filling	10 to 20	7.5 to 15
Controlled Filling*	30	22.5
Medium Dense Sand	30	22.5
Dense Sand	75	55
Class V/IV Rock	100	75
Class III Rock	500	375
Class II/I Rock	1000	700

Note: *Compacted to 98% Standard

8.4.3 Piles and Footings for Small Structures

Piles founded within the medium dense (or denser) sands below the filling could be used to support lightly-loaded structures such as concourse areas, amenities buildings, electricity substations, retaining walls etc. End-bearing piles such as CFA piles, cased bored piles and steel screw piles could be used to support these structures and could be designed using the parameters provided in Table 10. A minimum pile length of 3 m should be provided when using these parameters.

Table 10: Design Parameters for Lightly-Loaded End-Bearing Piles

Material Description	Allowable End-Bearing Pressure (kPa)[1]
Medium Dense Sand	500
Dense Sand	1500

Notes: [1]Provided that weaker material is not present within 5 piles diameters of the pile toe

Settlement of a pile is dependent on the loads applied to the pile and the foundation conditions below the pile toe. The total settlement of a pile designed using the 'allowable' parameters provided in Table 10 would be expected to be less than 10 mm upon application of the design load. Differential settlements between piles would be expected to be less than 50% of the total settlements.

Small structures such as minor retaining walls in the park areas could be supported on steel screw piles designed using the parameters provided in Table 10. It may also be possible to use strip footings to support minor retaining walls provided that they are founded within, and 1.5 times the footing width above the base of, densified filling prepared in accordance with Section 8.5.1 of this report.

In such case, strip footings could be designed on the basis of an allowable bearing pressure of 100 kPa. It is noted that articulation of retaining walls will be required to accommodate differential movements along the walls which are difficult to quantify but could be in the order of 10 mm to 20 mm depending on the thickness of uncontrolled filling below the improved materials.

8.5 Pavements

8.5.1 Subgrade Preparation

The conditions encountered during the current investigation indicate that the site is underlain by significant depths of filling which is uncontrolled and poorly compacted. This material is considered unsuitable for supporting road pavements in its current condition and some form of subgrade improvement should be undertaken to densify the subgrade. Two potential options for subgrade improvement are discussed below.

Option 1 involves excavation and replacement of a sufficient depth of filling to adequately compact the upper 1 m to 2 m of pavement subgrade. Once the filling has been removed and stockpiled, the exposed surface should be test-rolled with a steel smooth-drum roller of at least 15 t weights in the presence of a geotechnical professional. Areas exhibiting unacceptable movement may require treatment to rectify the causes of the movement.

The filling could then be replaced after removing any deleterious materials (e.g. over-sized particles, organic matter etc.), placing the filling in 250 mm thick layers and compacting it to a dry density ratio of at least 100% relative to Standard compaction.

Inspections and testing of this work should be undertaken in accordance with the requirements of Australian Standard AS 3798 – 2007 *Guidelines on earthworks for commercial and residential developments*.

Option 2 involves densification of the filling in-place using an impact roller. An impact roller is an irregular shaped steel roller that is towed behind a tractor and uses kinetic energy to densify materials beyond a depth normally possible with a conventional roller. Settlements are normally monitored throughout the rolling process which is discontinued when settlements become negligible. The number of passes required to achieve adequate densification is often in the order of 40 or 50.

The filling is generally granular with numerous inclusions and therefore impact rolling is likely to densify the upper 2 m of filling which is considered to be the zone of influence of the pavement subgrade. Settlement monitoring, and cone penetration testing before and after testing, can be used to determine the effectiveness of the densification procedure.

It is noted that Option 2 will cause vibrations which could cause damage to nearby structures and discomfort to nearby residents. Vibration monitoring and adequate community notification may help to alleviate these issues, although restrictions on vibrations may result in impact rolling being deemed unsuitable for this site.

Vibrations should be limited to a peak particle velocity of 5 mm/s (any vector component) at the foundation level of adjacent structures. A trial should be undertaken once the impact roller is on site to determine appropriate buffer distances from sensitive structures.

8.5.2 Design Parameters

The conditions encountered in the boreholes and CPTs indicate that the pavement subgrade is likely to be of relatively good quality when compacted to a dry density ratio of about 100% relative to Standard compaction. Providing subgrade improvement and/or select filling works are undertaken in accordance with the recommendations provided in this report, a design subgrade CBR of 10% is considered appropriate for the granular materials encountered during the investigation.

8.6 Seismicity

A Hazard Factor (Z) of 0.08 would be appropriate for the development site in accordance with Australian Standard AS 1170.4 – 2007 *Structural design actions – Part 4: Earthquake actions in Australia*. The site sub-soil class would be Class D_e based on the strengths of the materials encountered in the boreholes and CPTs.

8.7 Aggressivity

The previous laboratory test results for soil aggressivity were compared with the exposure classifications outlined in Australian Standard AS 2159 – 2009 *Piling – Design and installation*. Table 11 summarises the exposure classifications for steel and concrete piles based on the laboratory test results.

Table 11: Exposure Classifications for Steel and Concrete Piles

Type of Laboratory Analysis	Exposure Classification for Steel Piles	Exposure Classification for Concrete Piles
Soil	Mild	Moderate

Appropriate allowances for concrete cover, concrete strength, steel-section loss and steel protection requirements should be made in the design of the piles.

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for Gunyama Park & Green Square Aquatic Centre in accordance with the Standard Consultancy Agreement between The Council of the City of Sydney and Douglas Partners Pty Ltd (Ref: RFQ 11615). The conditions associated with the use of this report are outlined in the agreement. This report should not be used by any party not entitled to use it.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling locations.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP.

DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical/groundwater components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

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Appendix A

About this Report

About this Report

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

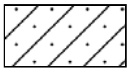
Soils


Topsoil

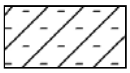

Peat


Clay

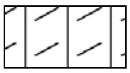

Silty clay

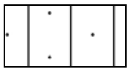

Sandy clay

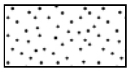

Gravelly clay

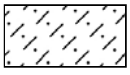

Shaly clay

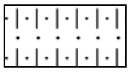

Silt


Clayey silt


Sandy silt

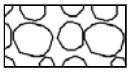

Sand

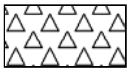

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

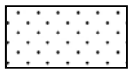

Talus

Sedimentary Rocks

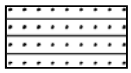

Boulder conglomerate

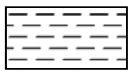

Conglomerate


Conglomeratic sandstone

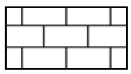

Sandstone


Siltstone


Laminite

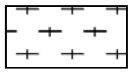

Mudstone, claystone, shale

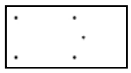

Coal


Limestone

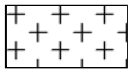
Metamorphic Rocks

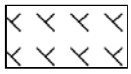

Slate, phyllite, schist

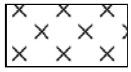

Gneiss

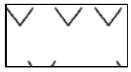

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Cone Penetration Tests

Douglas Partners

Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance q_c
- Sleeve friction f_s
- Inclination (from vertical) i
- Depth below ground z

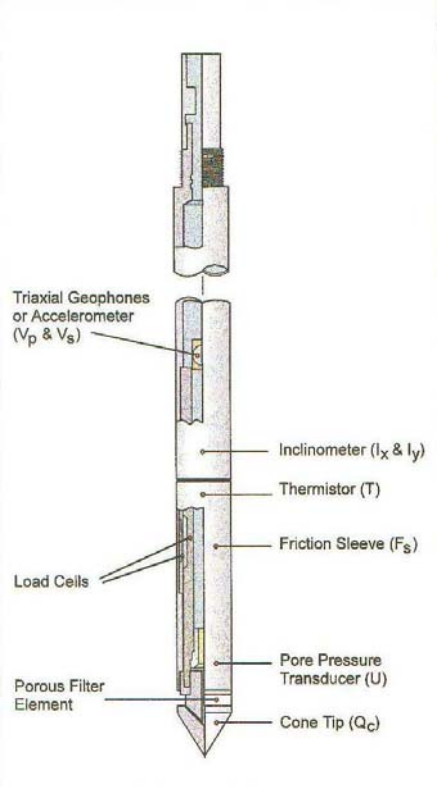


Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.



Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

Type	Measures
Standard	Basic parameters (q_c, f_s, i & z)
Piezocone	Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters
Conductivity	Bulk soil electrical conductivity (σ) plus basic parameters
Seismic	Shear wave velocity (V_s), compression wave velocity (V_p), plus basic parameters

Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

Cone Penetration Tests

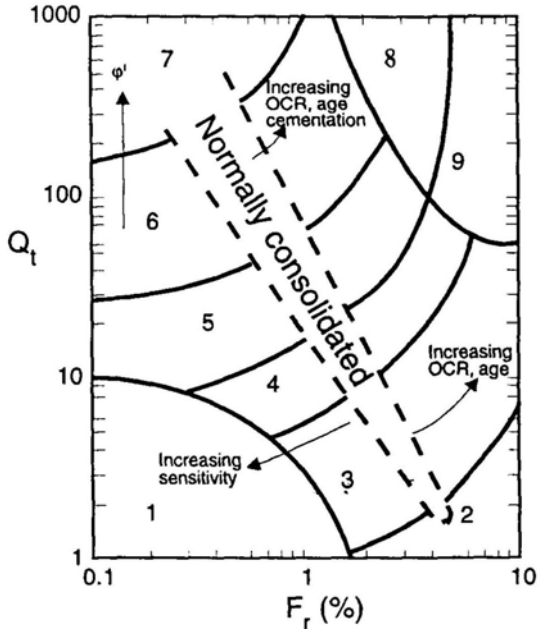


Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

Settlement

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

Pile Capacity

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

Dynamic or Earthquake Analysis

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus G_0. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

Other Applications

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

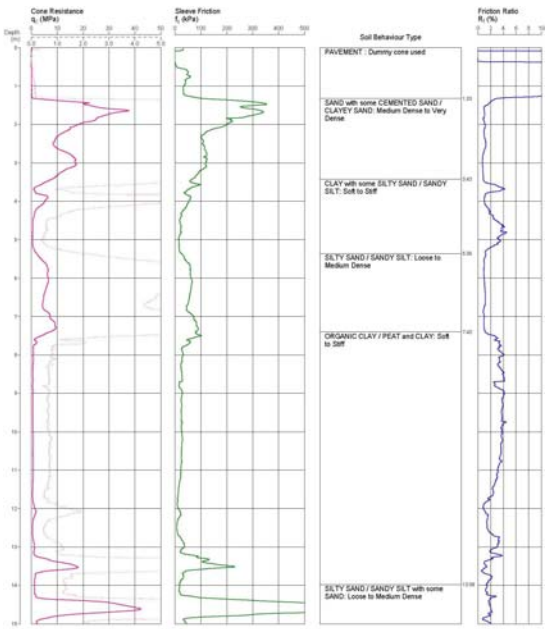
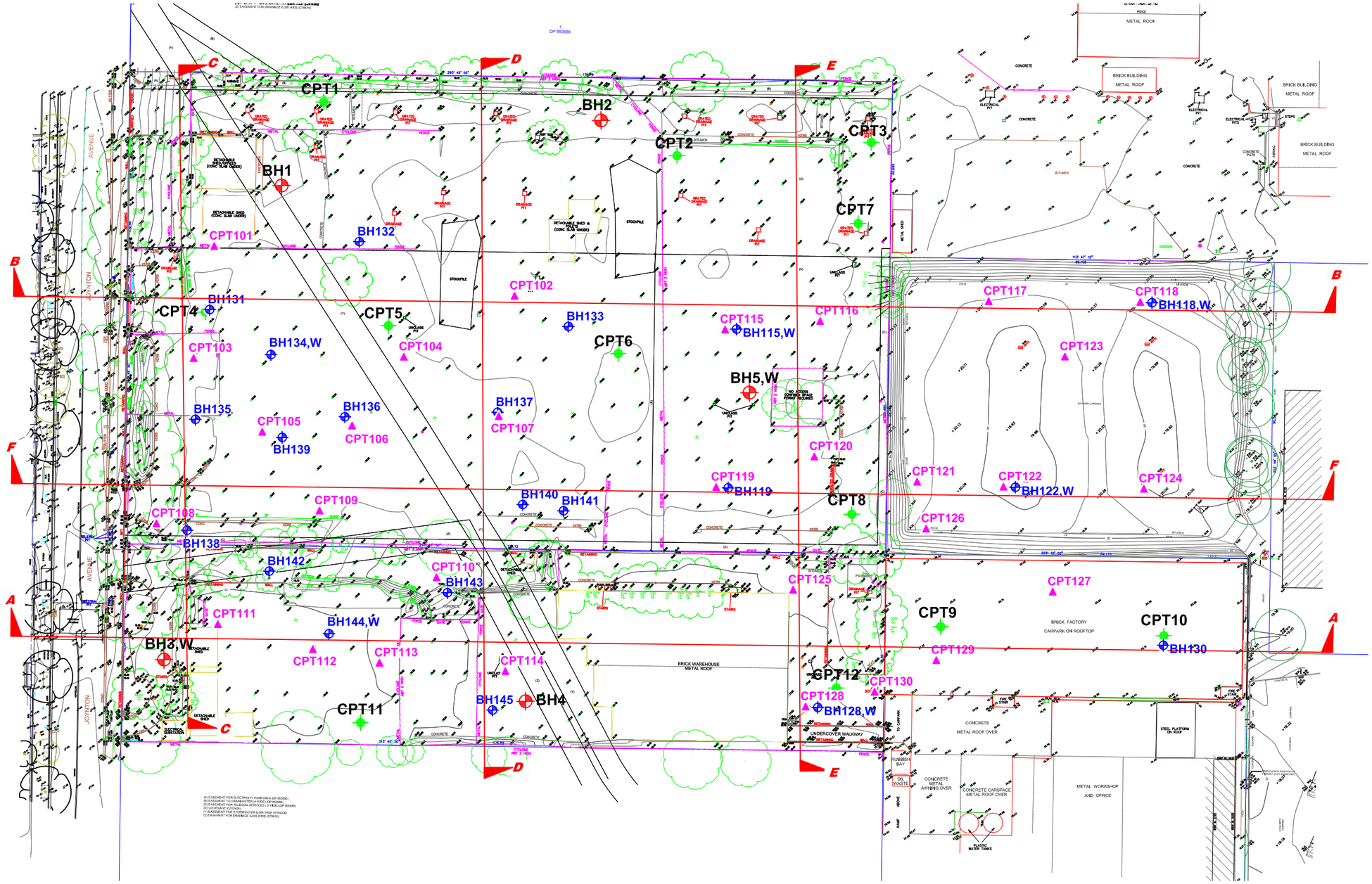


Figure 4: Sample Cone Plot

Appendix B

Drawings



NOTE:

1: Base drawing from Cardno Hard & Forester (Dwg 117244001, dated 13.12.2014)

0 10 20 30 40 50 75 100m

1:1000 @ A3

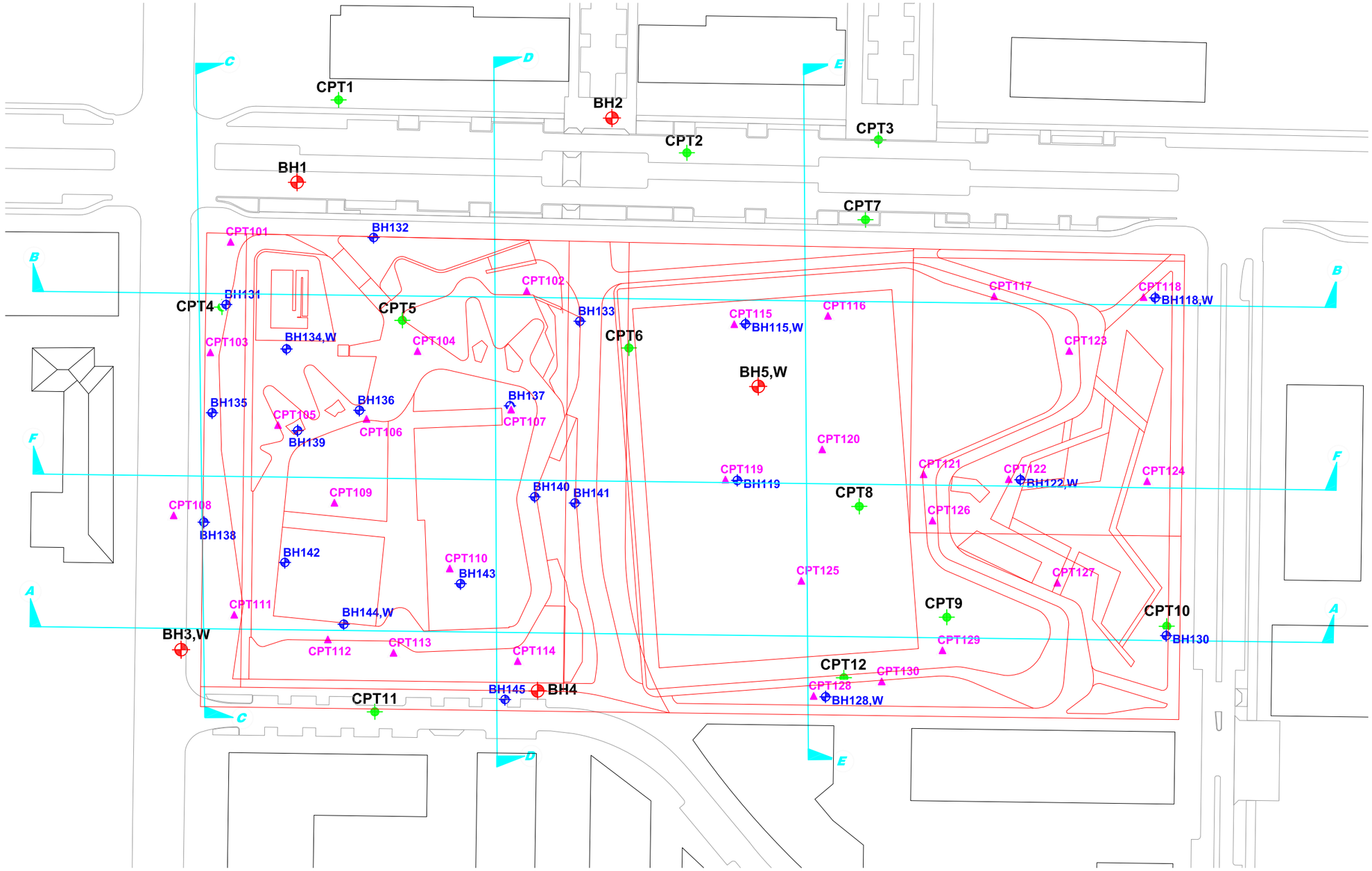
LEGEND

- Borehole Location (2016)
- Cone Penetration Test Location (2016)
- Borehole Location (2013)
- Cone Penetration Test Location (2014)
- W Groundwater Well Location
- A A' Geotechnical Cross Section A-A'

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Sydney Council		TITLE: **Locations of Tests** **Gunyama Park Aquatic and Recreation Centre** **Joynton Avenue, Zetland**
OFFICE: Sydney	DRAWN BY: PSCH	
SCALE: 1:1000 @ A3	DATE: 8.04.2016	

PROJECT No:	73743.02
DRAWING No:	1A
REVISION:	C



NOTE:
1: Base drawing from Cardno Hard & Forester (Dwg 117244001, dated 13.12.2014)

0 10 20 30 40 50 75 100m
1:1000 @ A3

LEGEND

- Borehole Location (2016)
- Cone Penetration Test Location (2016)
- Borehole Location (2013)
- Cone Penetration Test Location (2014)
- W Groundwater Well Location
- A A' Geotechnical Cross Section A-A'

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Sydney Council		TITLE: **Locations of Tests** **Gunyama Park Aquatic and Recreation Centre** **Joynton Avenue, Zetland**
OFFICE: Sydney	DRAWN BY: PSCH	
SCALE: 1:1000 @ A3	DATE: 8.04.2016	

PROJECT No: 73743.02
DRAWING No: 1B
REVISION: C

A

A

ELEVATION (AHD)

25 20 15 10 5 0 -5 -10 -15 -20 -25

CPT111 Offset 1.8m — Bottom Depth 14.94 m
142 Offset 13.8m — Bottom Depth 21.49 m
144 Offset 2.1m — Bottom Depth 21.1 m
CPT113 Offset - 8.1m — Bottom Depth 16.6 m
143 Offset 7.7m — Bottom Depth 21.3 m
145 Offset - 19.7m — Bottom Depth 19.7 m
128 Offset 14.0m — Bottom Depth 22.7 m
CPT129 Offset - 10.5m — Bottom Depth 16.98 m
CPT127 Offset 4.6m — Bottom Depth 13.76 m
130 Offset 1.2m — Bottom Depth 29.06 m

UNIT A
UNIT B
UNIT C
UNIT D

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

0 20 40 60 80 100 120 140 160 180 200 220 240 260

DISTANCE ALONG PROFILE (m)

LEGEND

- Core Loss
- Ironstone
- Clay
- Clayey Sand
- Concrete
- Filling
- Peaty Sand
- Sand
- Sandstone coarse grained
- Sandstone fine grained
- Sandy Clay
- Silty Clay
- Silty Sand

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
Water level

GEOLOGICAL UNITS
UNIT A FILLING
UNIT B SANDS
UNIT C CLAYS
UNIT D BEDROCK

0 15
Horizontal Scale (metres)

Vertical Exaggeration = 3.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Sydney Council		PROJECT No: 73743.02
OFFICE: Sydney	DRAWN BY: PMO/LD/PSCH	DRAWING No: 2
SCALE: 1:750 (H) 1:250 (V) @ A3	DATE: 8.04.2016	REVISION: B

TITLE: **Cross-Section A-A**
Gunyama Park Aquatic and Recreation Centre
Joynton Ave, Zetland

B

B

ELEVATION (AHD)

25 20 15 10 5 0 -5 -10 -15 -20 -25

0 20 40 60 80 100 120 140 160 180 200 220 240 260

DISTANCE ALONG PROFILE (m)

131 Offset - 7.2m — Bottom Depth 23.55 m
134 Offset - 16.8m — Bottom Depth 24.07 m
132 Offset - 10.1m — Bottom Depth 22.7 m
CPT102 Offset - 0.8m — Bottom Depth 21.06 m
133 Offset - 7.2m — Bottom Depth 27.5 m
115 Offset 5m — Bottom Depth 28.6 m
CPT116 Offset - 3.2m — Bottom Depth 23 m
CPT117 Offset 3.3m — Bottom Depth 22.9 m
CPT123 Offset - 9.1m — Bottom Depth 24.12 m
118 Offset 1.3m — Bottom Depth 28.1 m

UNIT A
UNIT B
UNIT C
UNIT D

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Filling
- Sand
- Clay
- Sandstone fine grained
- Sandstone coarse grained
- Concrete
- Silty Clay
- Sandy Clay
- Clayey Sand
- Laminite
- Silty Sand

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
▽ - Water level

GEOLOGICAL UNITS
UNIT A FILLING
UNIT B SANDS
UNIT C CLAYS
UNIT D BEDROCK

0 15
Horizontal Scale (metres)

Vertical Exaggeration = 3.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Sydney Council		TITLE: **Cross-Section B-B**
OFFICE: Sydney	DRAWN BY: PMO/LD/PSCH	**Gunyama Park Aquatic and Recreation Centre**
SCALE: 1:750 (H) 1:250 (V) @ A3	DATE: 8.04.2016	**Joynton Ave, Zetland**

PROJECT No:	73743.02
DRAWING No:	3
REVISION:	B

C

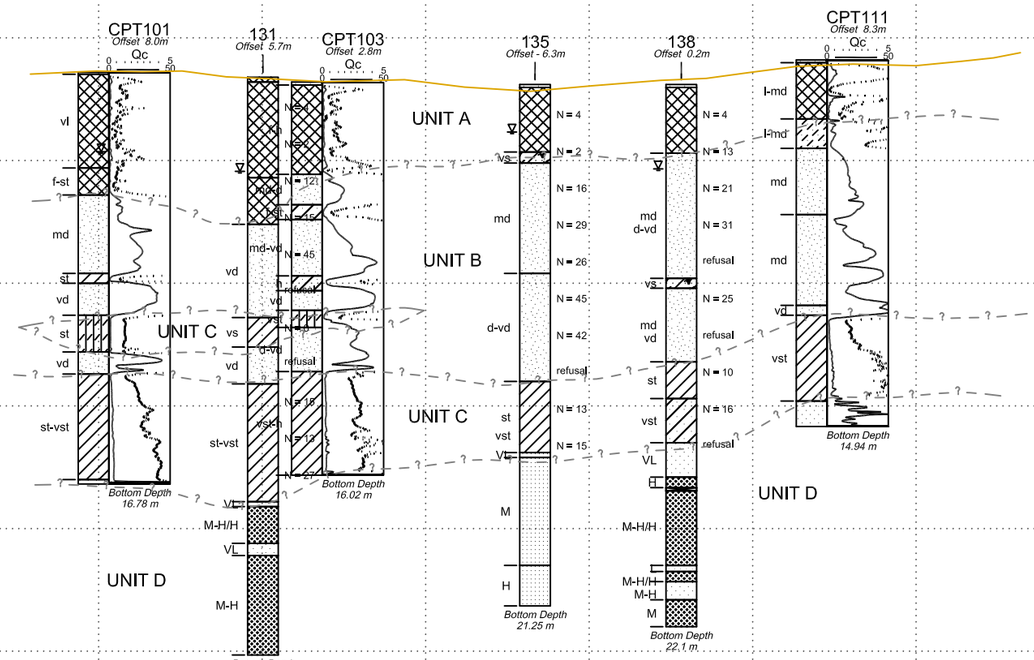
C

ELEVATION (AHD)

25 20 15 10 5 0 -5 -10 -15 -20 -25

0 20 40 60 80 100 120 140 160 180 200 220 240 260

DISTANCE ALONG PROFILE (m)



NOTE: Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Clay
- Clayey Sand
- Clayey Silt
- Concrete
- Filling
- Laminite
- Peaty Clay
- Sand
- Sandstone
- Sandstone coarse grained
- Sandstone fine grained
- Sandy Clay

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
▼ - Water level

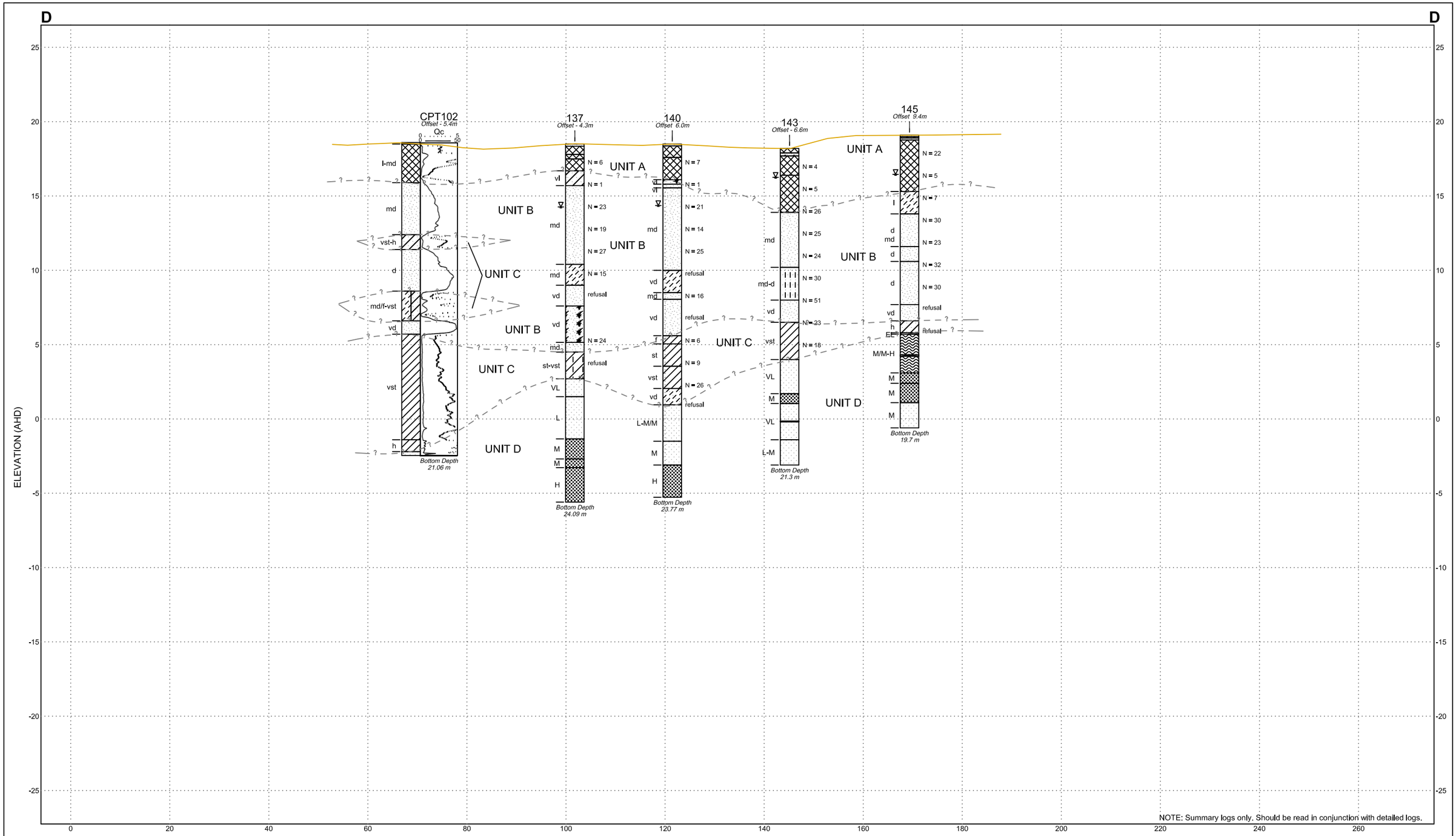
GEOLOGICAL UNITS
UNIT A FILLING
UNIT B SANDS
UNIT C CLAYS
UNIT D BEDROCK

0 15
Horizontal Scale (metres)

Vertical Exaggeration = 3.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Sydney Council	TITLE: **Cross-Section C-C**	PROJECT No: 73743.02
OFFICE: Sydney / DRAWN BY: PMO/LD/PSCH	**Gunyama Park Aquatic and Recreation Centre**	DRAWING No: 4
SCALE: 1:750 (H) 1:250 (V) @ A3 / DATE: 8.04.2016	**Joynton Ave, Zetland**	REVISION: B



LEGEND

- Core Loss
- Ironstone
- Clay
- Clayey Sand
- Concrete
- Filling
- Peaty Sand
- Sand
- Sandstone coarse grained
- Sandstone fine grained
- Sandy Clay
- Silty Clay
- Silty Sand

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

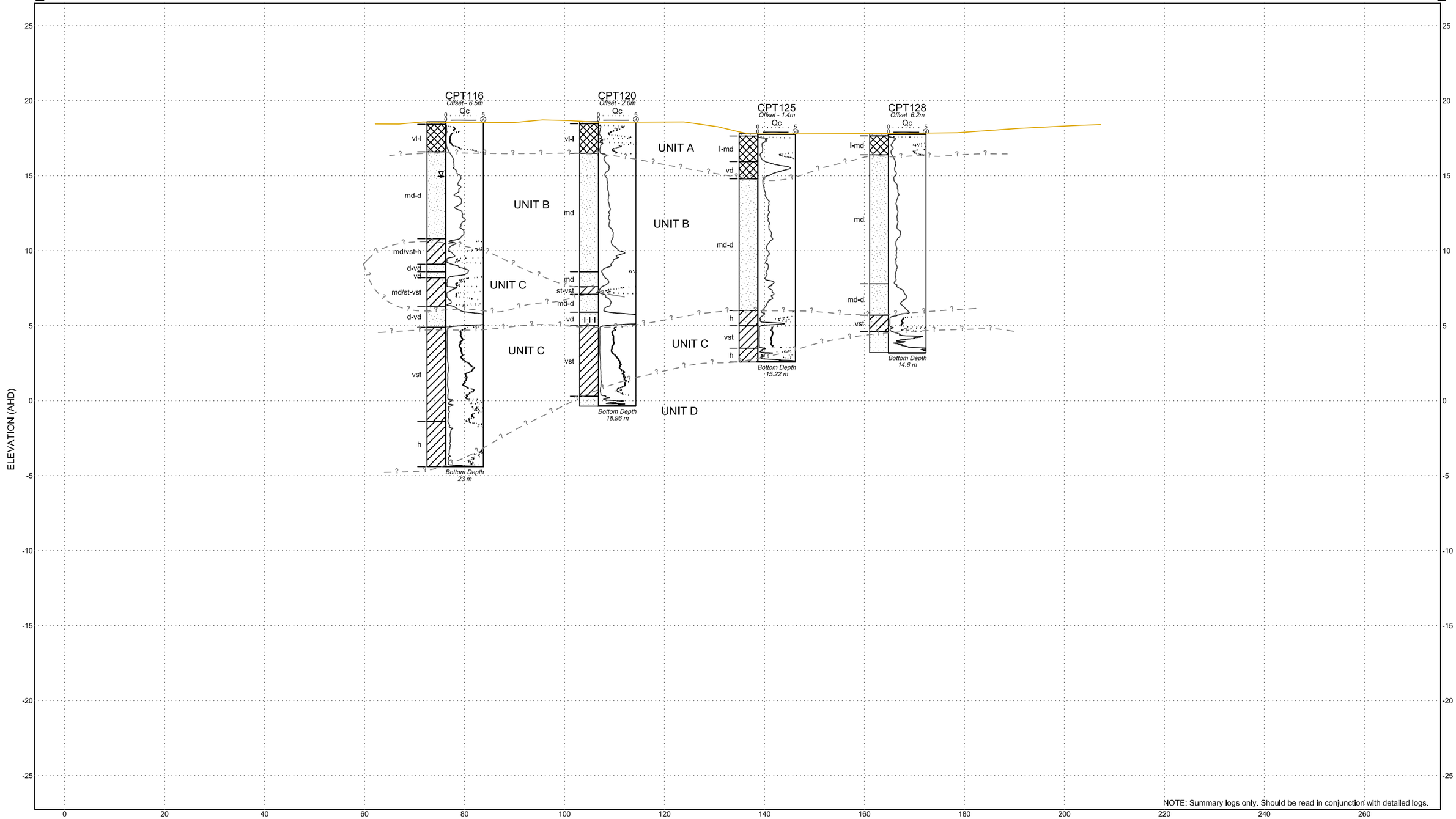
TESTS / OTHER
N - Standard penetration test value
- Water level

GEOLOGICAL UNITS
UNIT A FILLING
UNIT B SANDS
UNIT C CLAYS
UNIT D BEDROCK

0 15
Horizontal Scale (metres)
Vertical Exaggeration = 3.0

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: City of Sydney Council	TITLE: **Cross-Section D-D**	PROJECT No: 73743.02
	OFFICE: Sydney / DRAWN BY: PMO/LD/PSCH	**Gunyama Park Aquatic and Recreation Centre**	DRAWING No: 5
	SCALE: 1:750 (H) 1:250 (V) @ A3 / DATE: 8.04.2016	**Joynton Ave, Zetland**	REVISION: B

E



E

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

DISTANCE ALONG PROFILE (m)

LEGEND

- Concrete
- Filling
- Sand
- Sandy Clay
- Clay
- Silty Sand
- Sandstone fine grained

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
▼ - Water level

GEOLOGICAL UNITS
UNIT A FILLING
UNIT B SANDS
UNIT C CLAYS
UNIT D BEDROCK

0 15
Horizontal Scale (metres)

Vertical Exaggeration = 3.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Sydney Council		TITLE: **Cross-Section E-E**
OFFICE: Sydney	DRAWN BY: PMO/LD/PSCH	**Gunyama Park Aquatic and Recreation Centre**
SCALE: 1:750 (H) 1:250 (V) @ A3	DATE: 8.04.2016	**Joynton Ave, Zetland**

PROJECT No:	73743.02
DRAWING No:	6
REVISION:	B

F

F

ELEVATION (AHD)

25 20 15 10 5 0 -5 -10 -15 -20 -25

0 20 40 60 80 100 120 140 160 180 200 220 240 260

DISTANCE ALONG PROFILE (m)

138 *Offset - 1.9m*
N = 4, N = 13, N = 21, N = 31, refusal, N = 25, refusal, N = 10, N = 16, refusal
md d-vd | vs | md vd | st | vst | VL | M-H/H | M-H/H | M-H | M
Bottom Depth 22.1 m

CPT109 *Offset 1.7m* Qc 0 5 50
vl-l | f-st | md | md | md-d | d-vd | vst | vst-h
Bottom Depth 16 m

140 *Offset 1.2m*
N = 7, N = 1, N = 21, N = 14, N = 25, refusal, N = 16, refusal, N = 6, N = 9, N = 26, refusal
md | vd | md | vd | f | st | vst | vd | L-M/M | M | H
Bottom Depth 23.77 m

CPT119 *Offset 3.9m* Qc 0 5 50
vl-md | md-d | vd | vst
Bottom Depth 16.66 m

CPT120 *Offset 10.6m* Qc 0 5 50
vl-l | md | md | st-vst | md-d | vd | vst
Bottom Depth 18.96 m

CPT121 *Offset 3.4m* Qc 0 5 50
l-md | st-h | md-d | st-h | l-md | st-vst | md-d
Bottom Depth 15.16 m

CPT122 *Offset 1.5m* Qc 0 5 50
md | md-d | d-vd/vst-h | vd | vst | h
Bottom Depth 20.66 m

CPT124 *Offset 0.0m* Qc 0 5 50
d-vd | vst-h | md-d | vd | st-vst | vd | st-h | vd | vst | vst-h | st-vst
Bottom Depth 24.86 m

UNIT A
UNIT B
UNIT C
UNIT D

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Clay
- Clayey Sand
- Clayey Silt
- Concrete
- Filling
- Laminite
- Peaty Clay
- Peaty Sand
- Sand
- Sandstone coarse grained
- Sandstone fine grained
- Sandy Clay
- Silty Clay
- Silty Sand

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
▼ - Water level

0 15
Horizontal Scale (metres)

Vertical Exaggeration = 3.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: City of Sydney Council		PROJECT No: 73743.02
OFFICE: Sydney	DRAWN BY: PMO/LD	DRAWING No: 7
SCALE: 1:750 (H) 1:250 (V) @ A3	DATE: 8.04.2016	REVISION: A

TITLE: **Cross-Section F-F**
Gunyama Park Aquatic and Recreation Centre
Joynton Ave, Zetland

Appendix C

Results of Current Field Work

CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.6

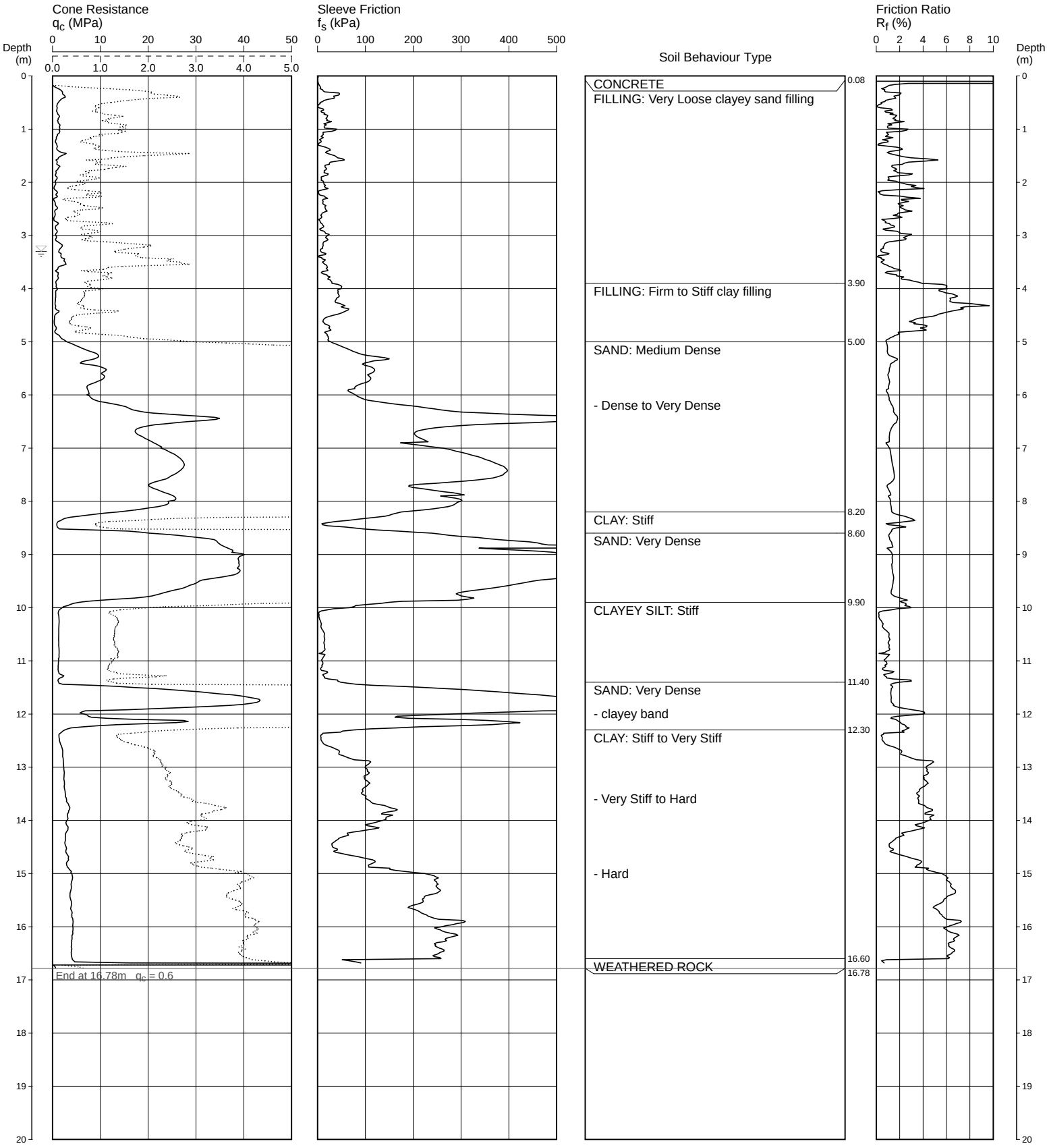
COORDINATES: 334278E 6246560N

CPT101

Page 1 of 1

DATE 18/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 80MM. GROUNDWATER MEASURED AT 3.3M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 3.30m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT101.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

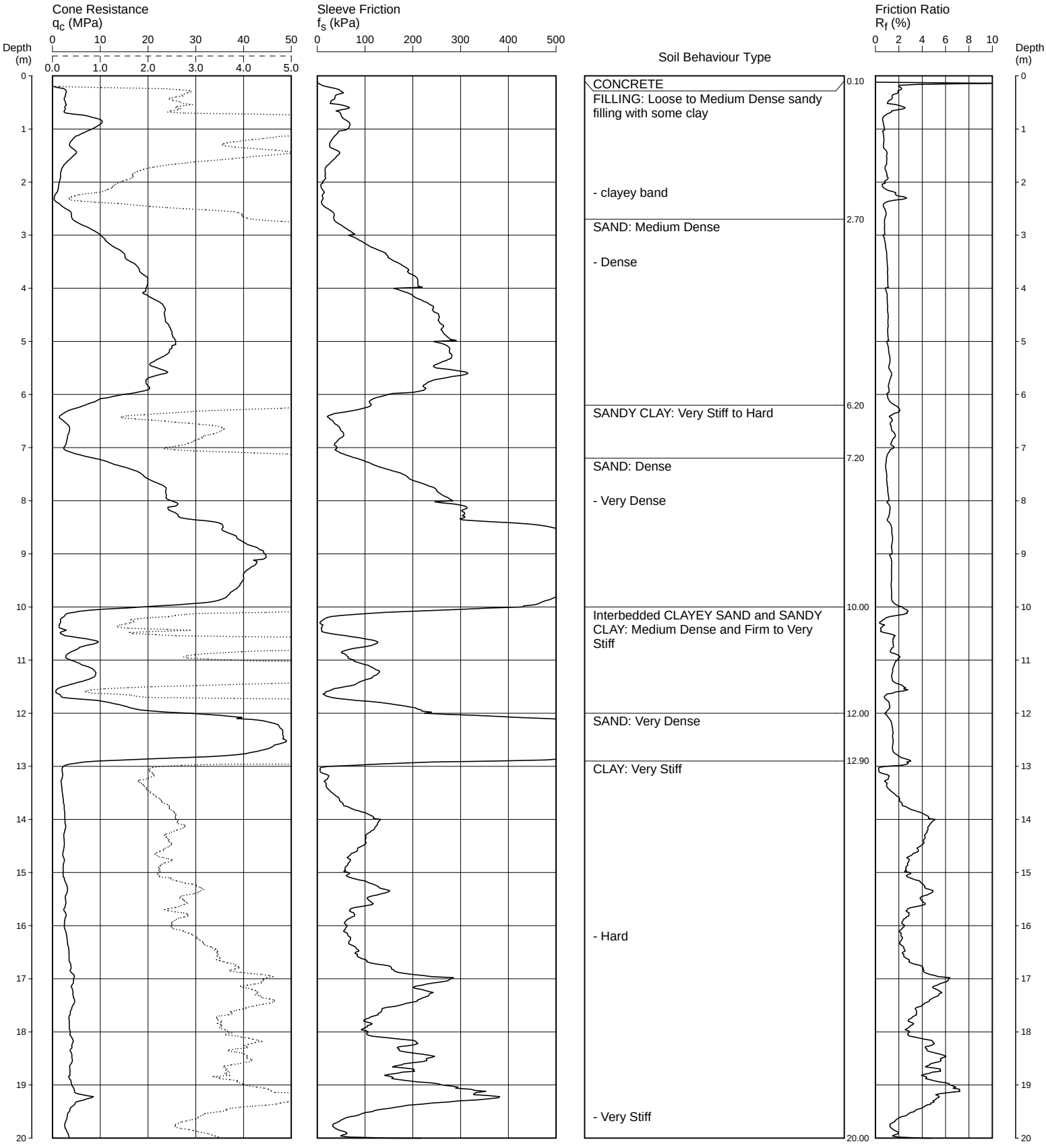
REDUCED LEVEL: 18.6

COORDINATES: 334337E 6246522N

CPT102

DATE 18/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 100MM. HOLE COLLAPSE AT 4.65M DEPTH AFTER REMOVAL OF RODS.

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Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

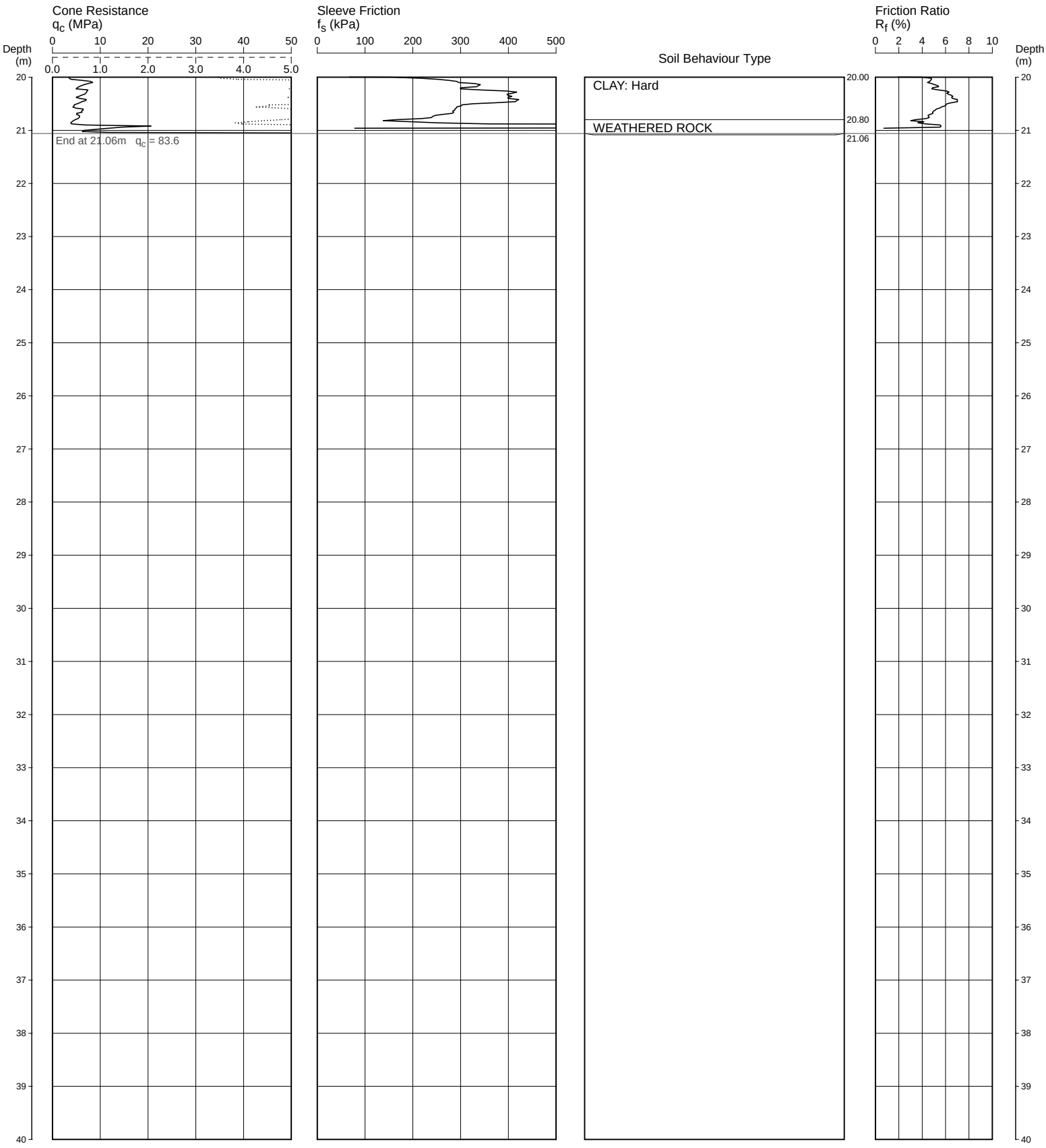
REDUCED LEVEL: 18.6

COORDINATES: 334337E 6246522N

CPT102

DATE 18/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 100MM. HOLE COLLAPSE AT 4.65M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT102.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.2

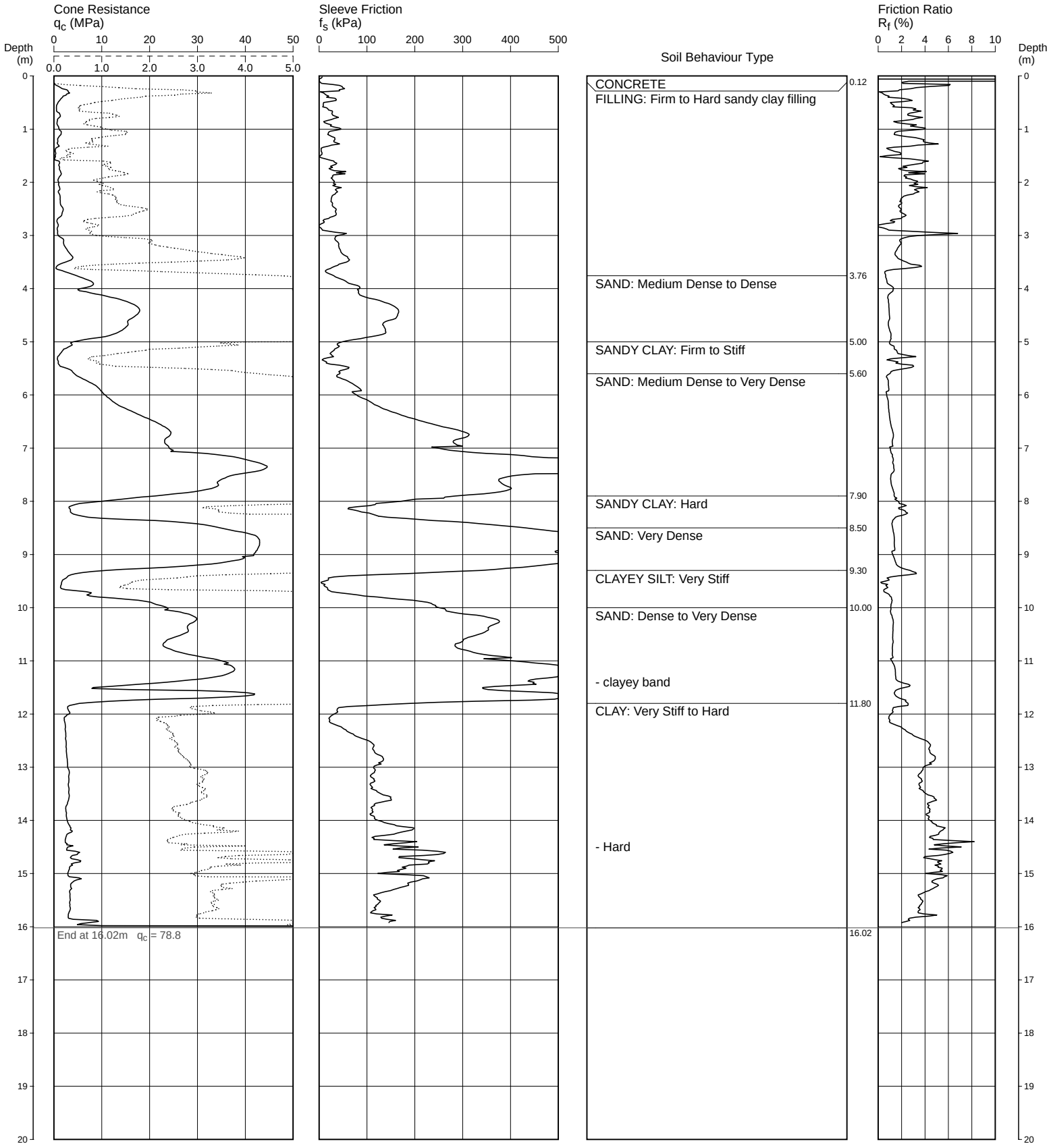
COORDINATES: 334263E 6246538N

CPT103

Page 1 of 1

DATE 16/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 120MM. GROUNDWATER DEPTH UNKNOWN AFTER REMOVAL OF RODS DUE TO RAINFALL.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT103.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.6

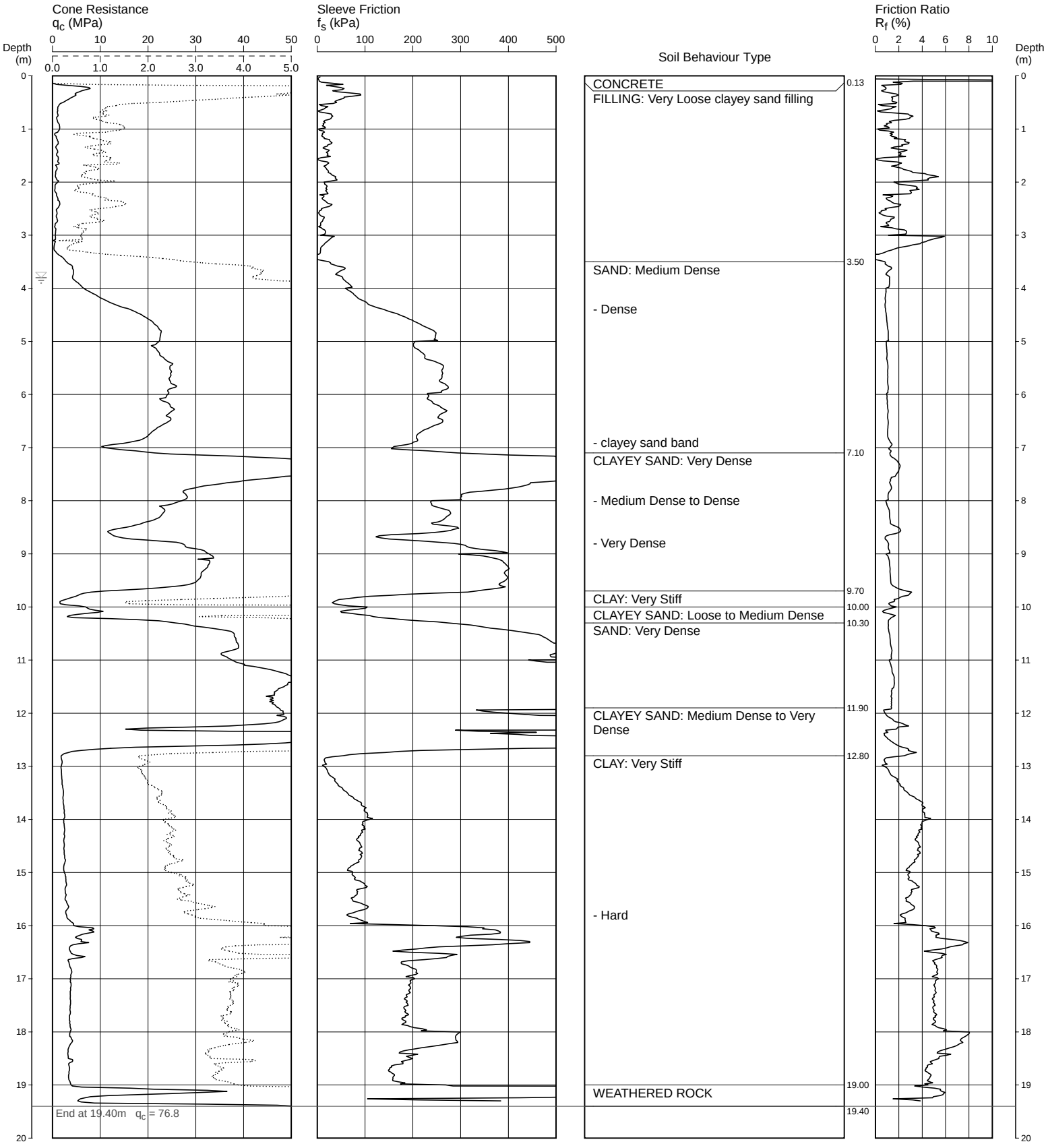
COORDINATES: 334308E 6246519N

CPT104

Page 1 of 1

DATE 16/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 130MM. GROUNDWATER MEASURED AT 3.8M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 3.80m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT104.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

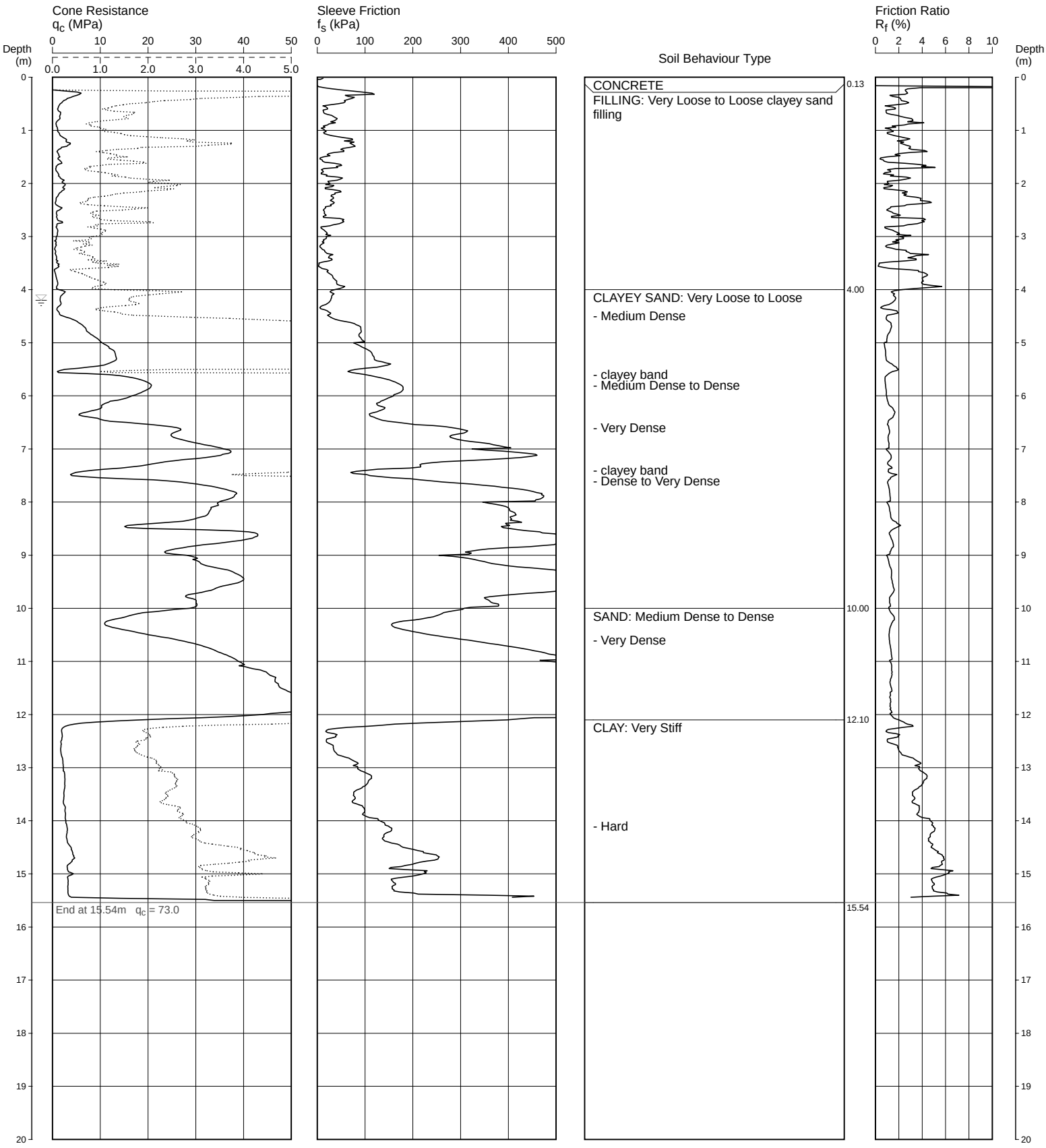
REDUCED LEVEL: 18.6

COORDINATES: 334271E 6246516N

CPT105

DATE 16/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 130MM. GROUNDWATER MEASURED AT 4.2M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 4.20m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT105.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.6

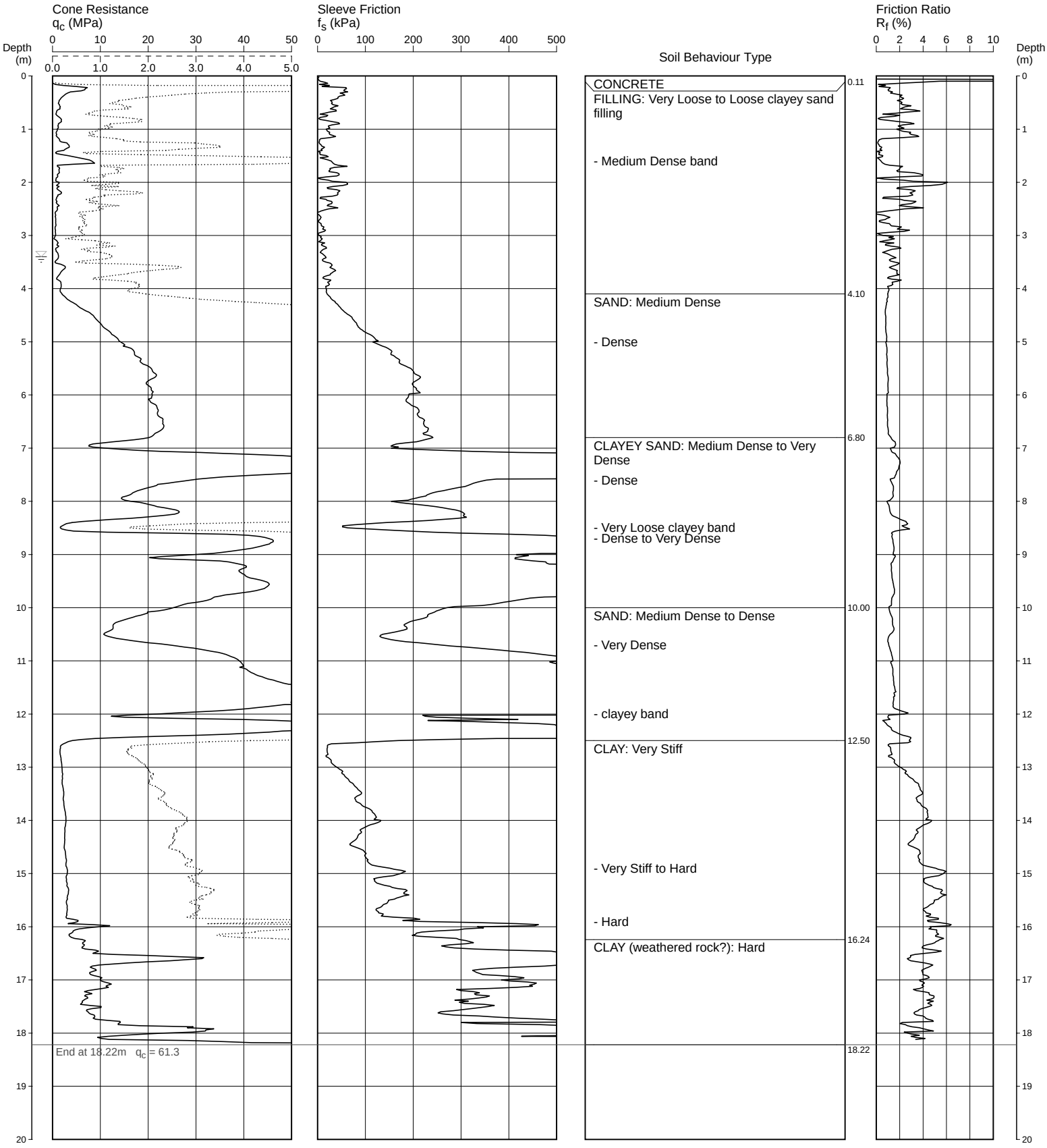
COORDINATES: 334291E 6246509N

CPT106

Page 1 of 1

DATE 16/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 110MM. GROUNDWATER MEASURED AT 3.4M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 3.40m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT106.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.5

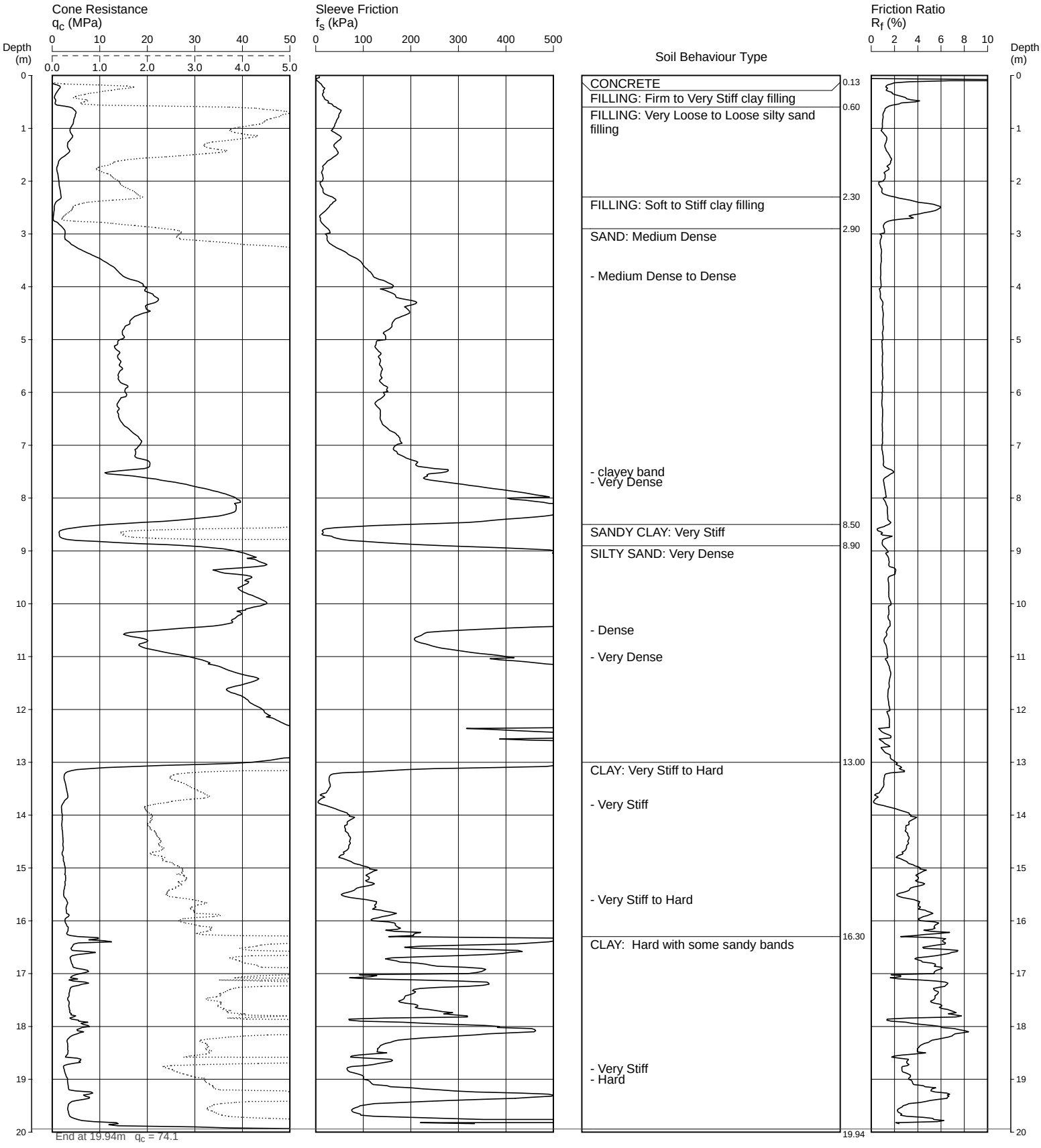
COORDINATES: 334323E 6246498N

CPT107

Page 1 of 1

DATE 18/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 130MM. HOLE COLLAPSE AT 4.5M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT107.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.1

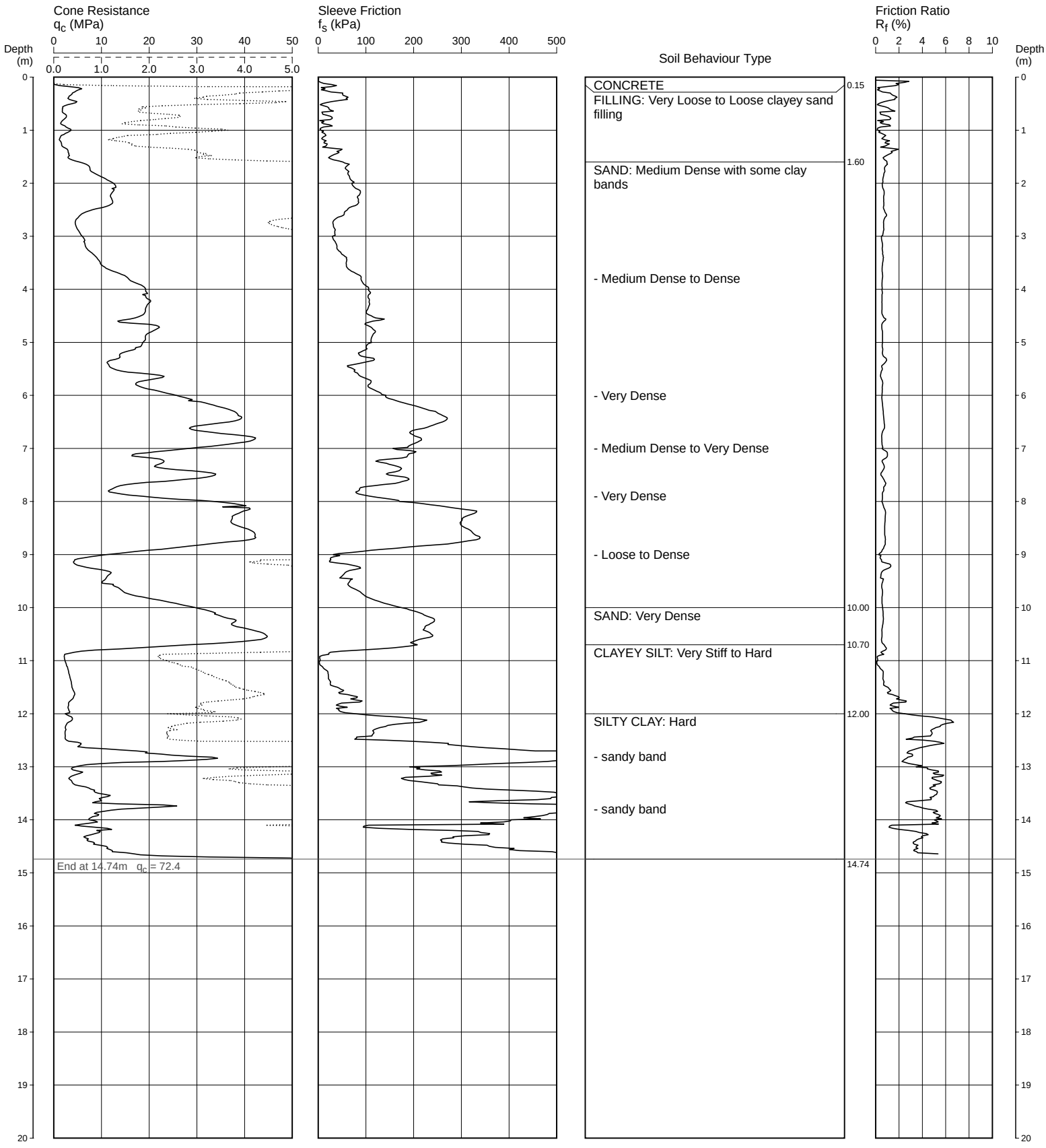
COORDINATES: 334240E 6246506N

CPT108

Page 1 of 1

DATE 22/12/2015

PROJECT No: 73743.02



REMARKS:

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT108.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.5

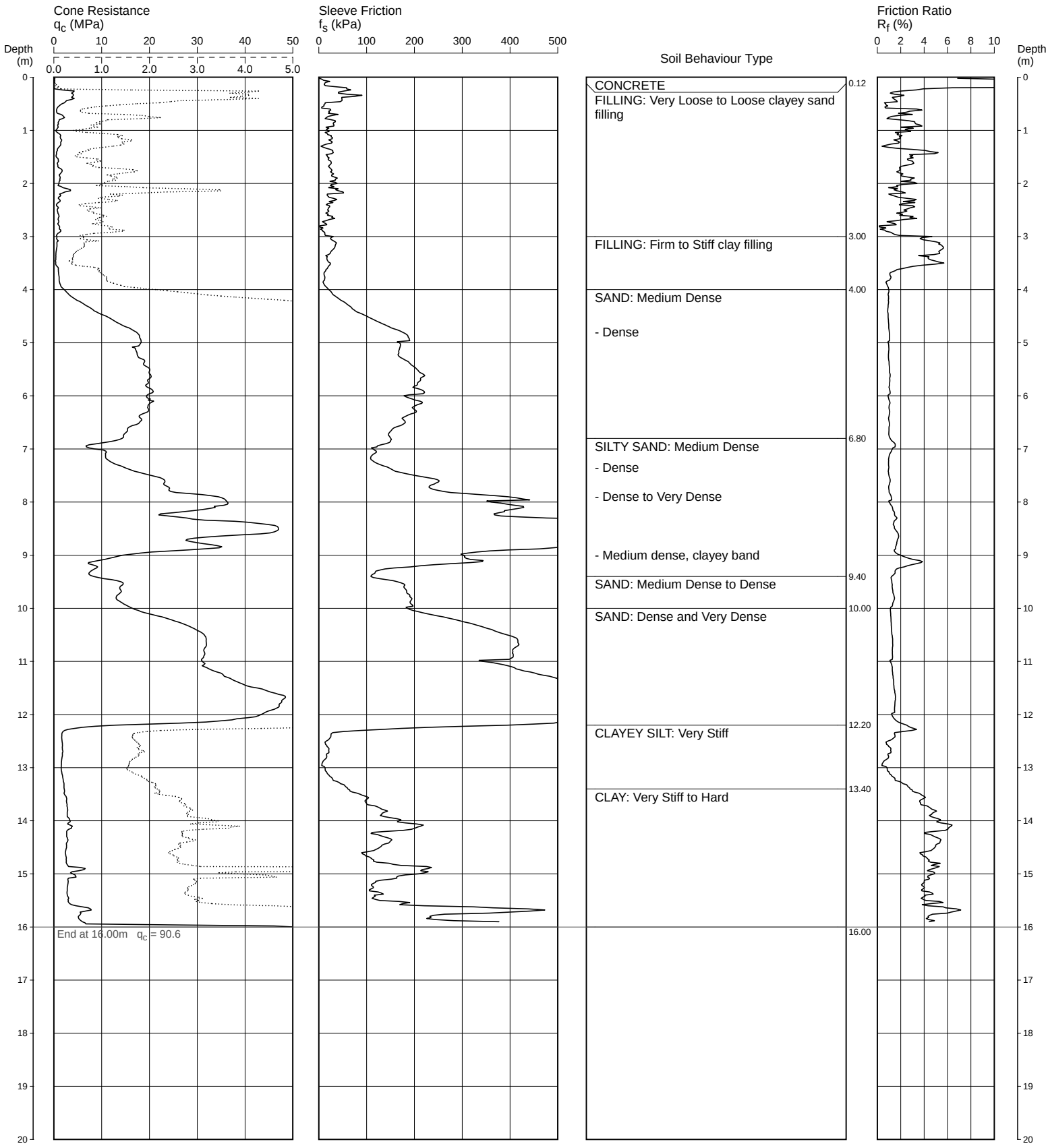
COORDINATES: 334276E 6246494N

CPT109

Page 1 of 1

DATE 18/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 120MM. HOLE COLLAPSE AT 3.9M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT109.CP5
Cone ID: 120630 **Type:** I-CFXY-10

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 17.8

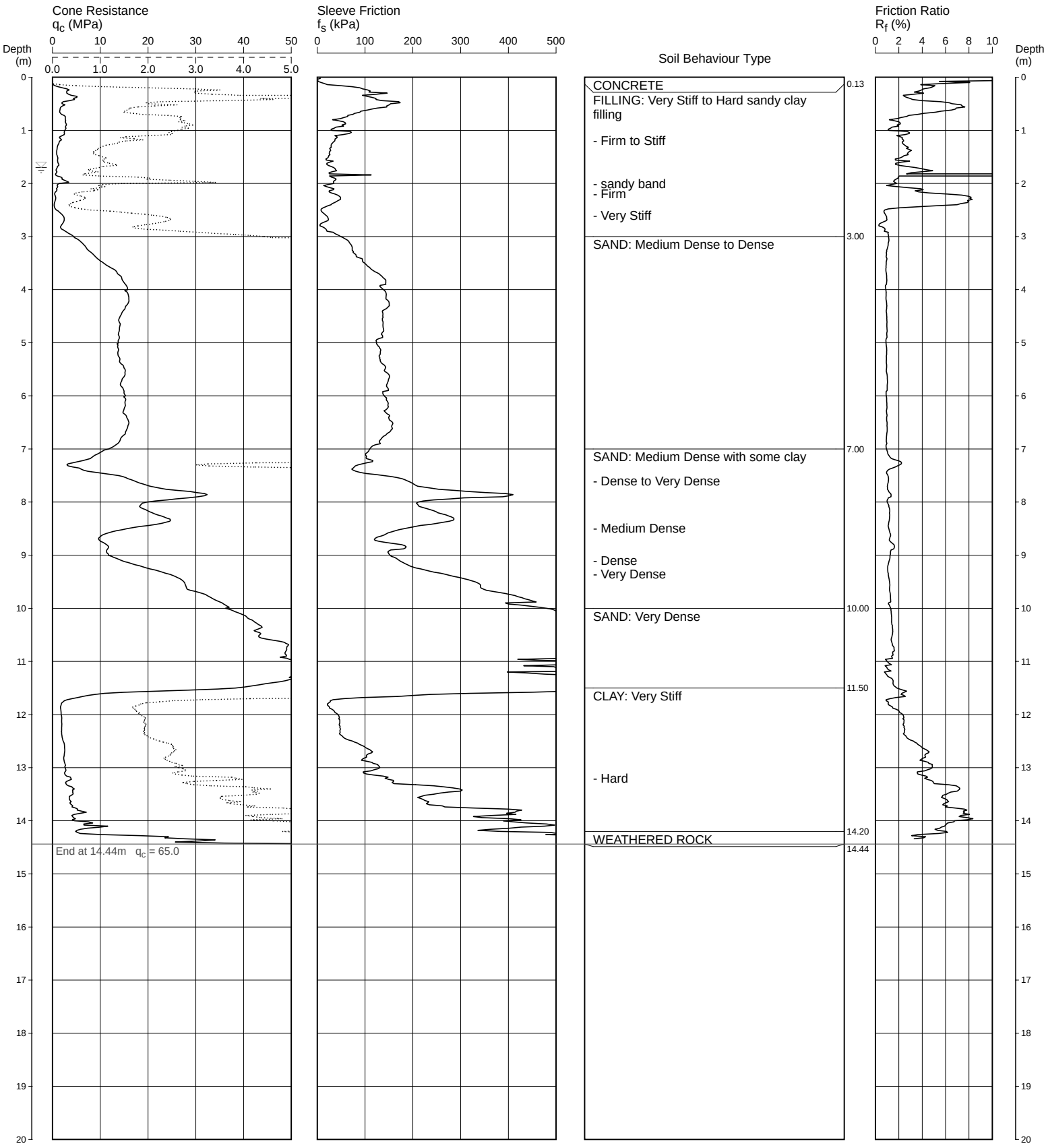
COORDINATES: 334295E 6246469N

CPT110

Page 1 of 1

DATE 17/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 130MM. GROUNDWATER MEASURED AT 1.7M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 1.70m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT110.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 19.1

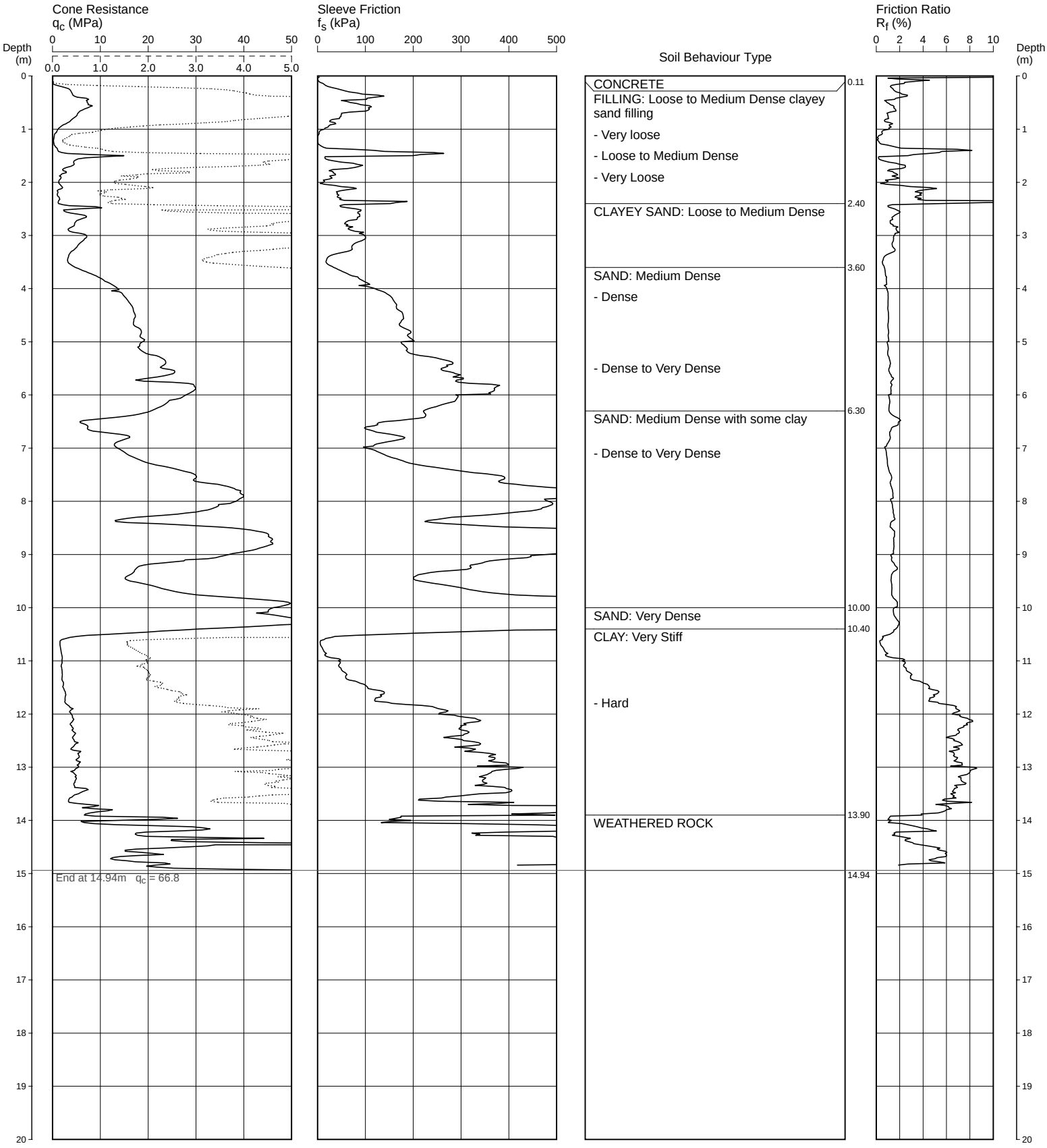
COORDINATES: 334244E 6246479N

CPT111

Page 1 of 1

DATE 18/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 110MM. HOLE COLLAPSE AT 4.5M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT111.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

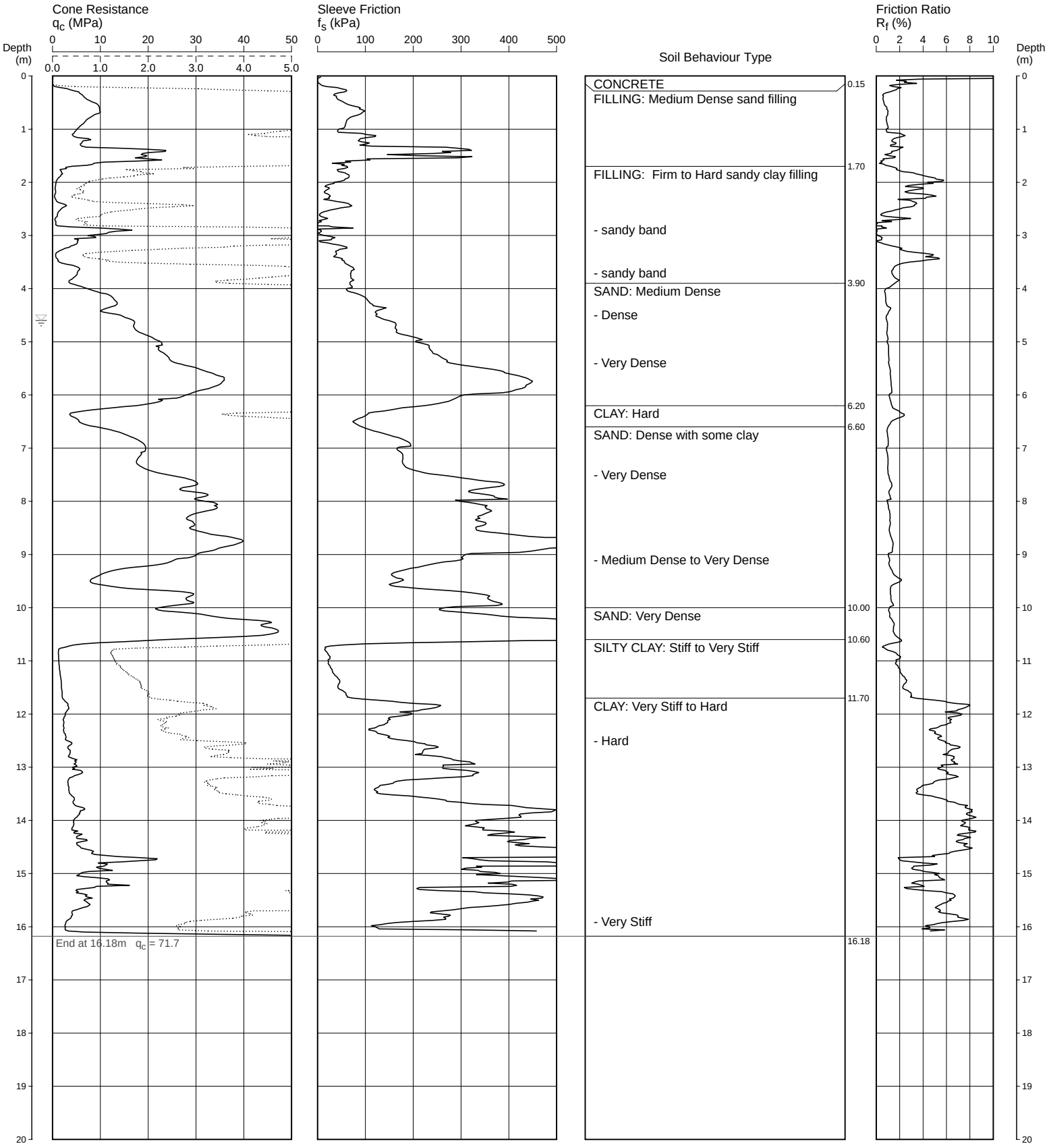
REDUCED LEVEL: 19.0

COORDINATES: 334262E 6246465N

CPT112

DATE 16/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 150MM. GROUNDWATER MEASURED AT 4.6M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 4.60m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT112.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.9

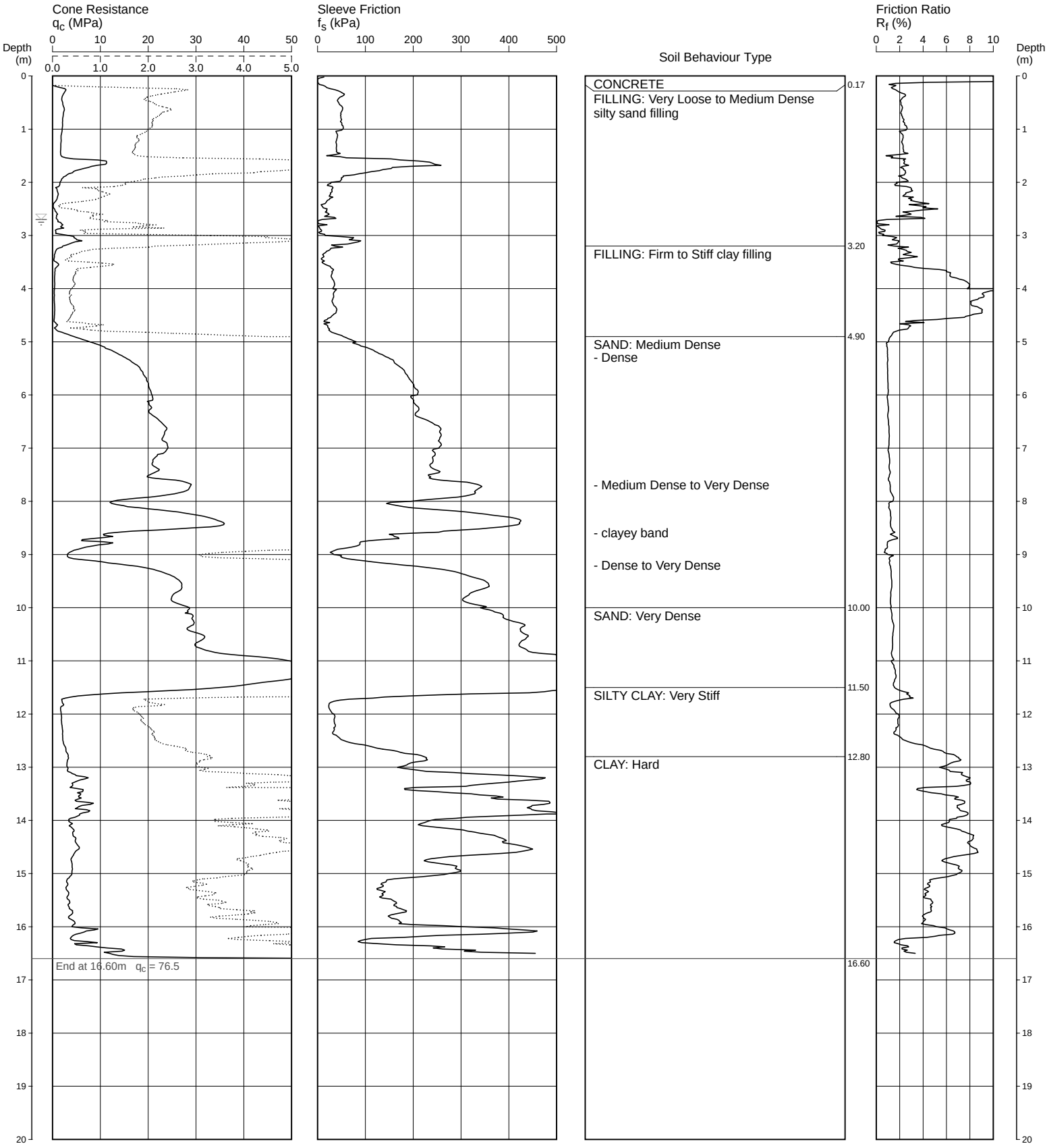
COORDINATES: 334275E 6246456N

CPT113

Page 1 of 1

DATE 17/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 170MM. GROUNDWATER MEASURED AT 2.7M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 2.70m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT113.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 19.1

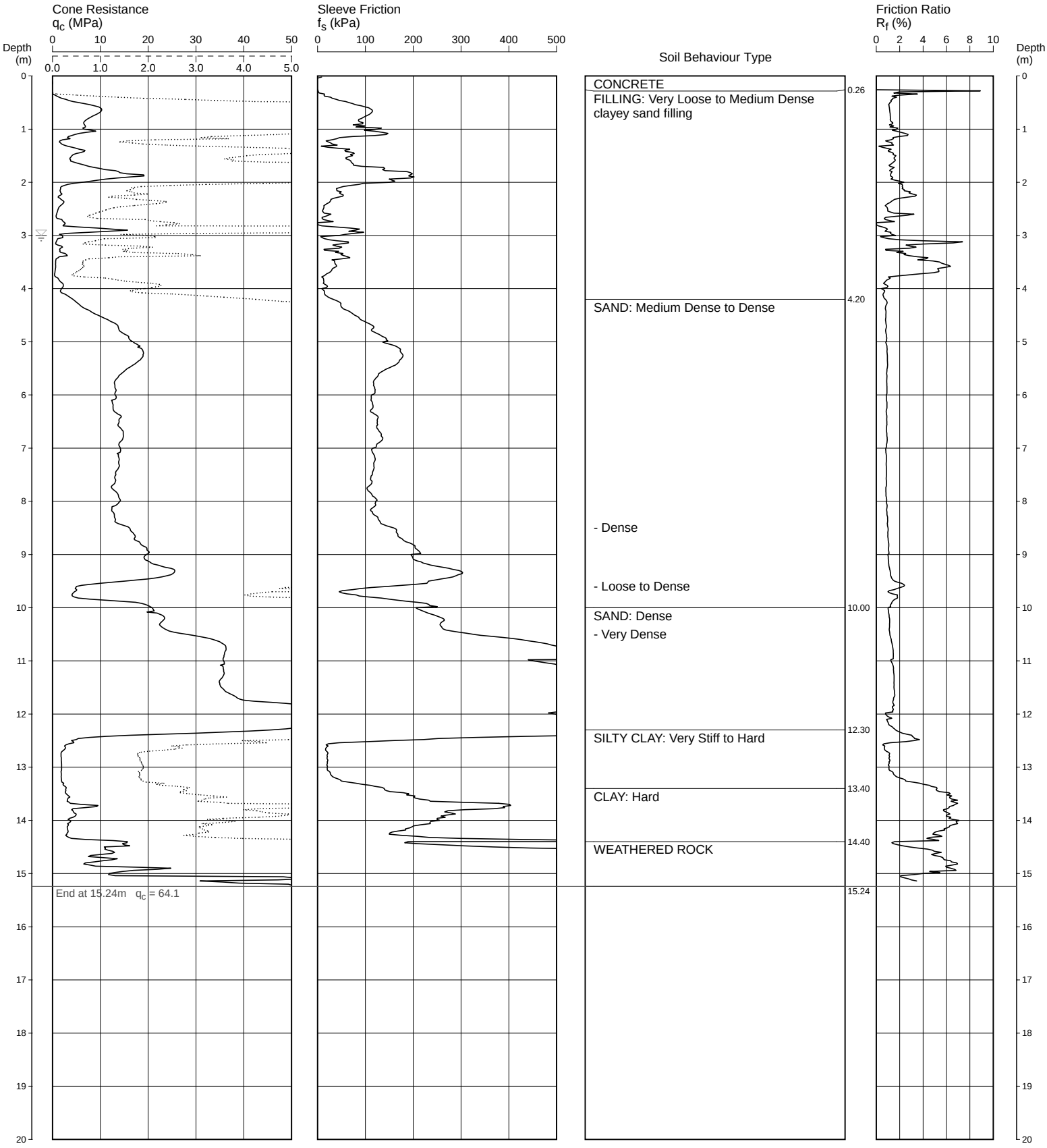
COORDINATES: 334301E 6246443N

CPT114

Page 1 of 1

DATE 16/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 260MM. GROUNDWATER MEASURED AT 3.0M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 3.00m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT114.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

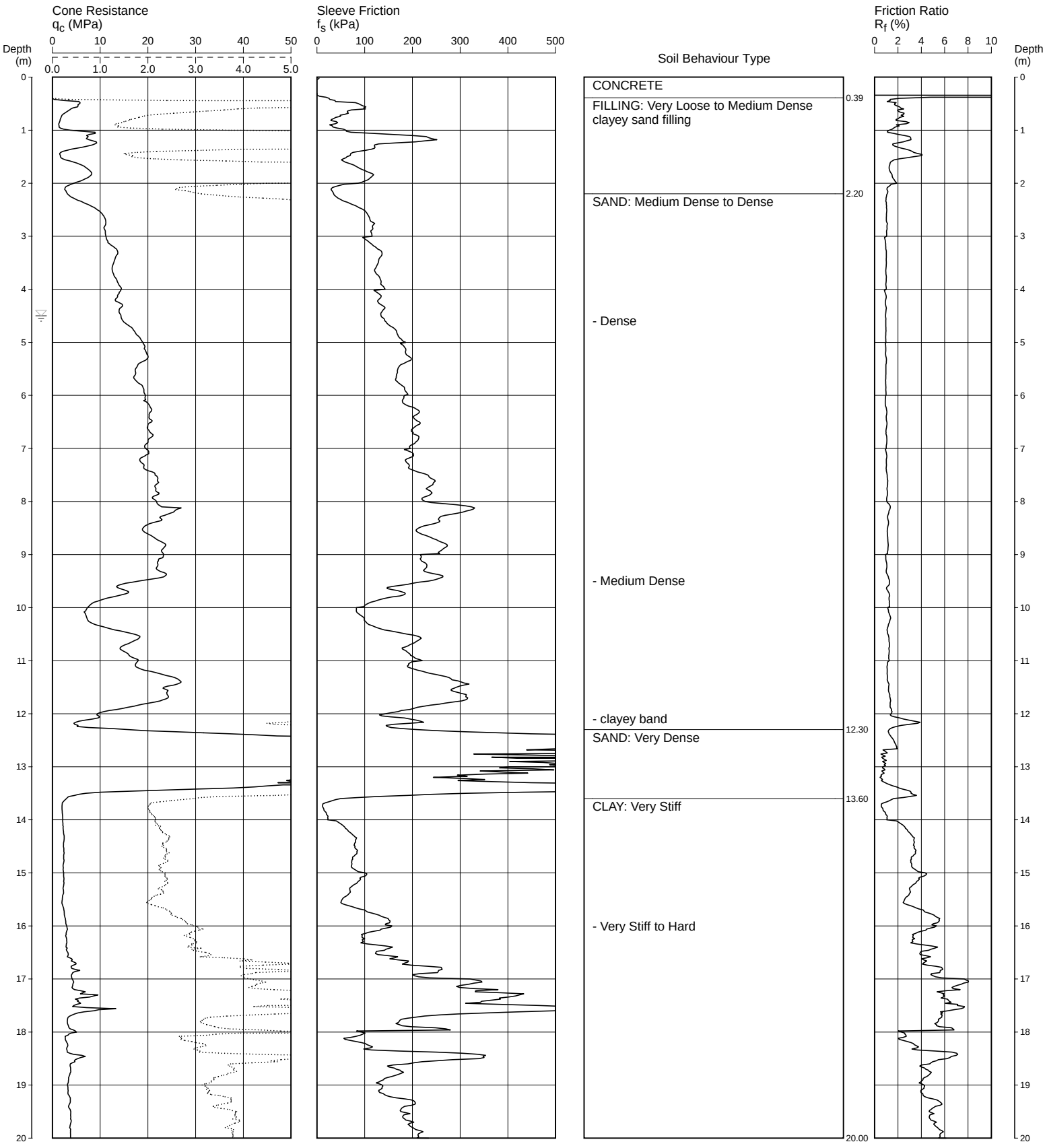
REDUCED LEVEL: 18.6

COORDINATES: 334379E 6246496N

CPT115

DATE 17/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 390MM. GROUNDWATER MEASURED AT 4.5M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 4.50m depth (assumed)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT115.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

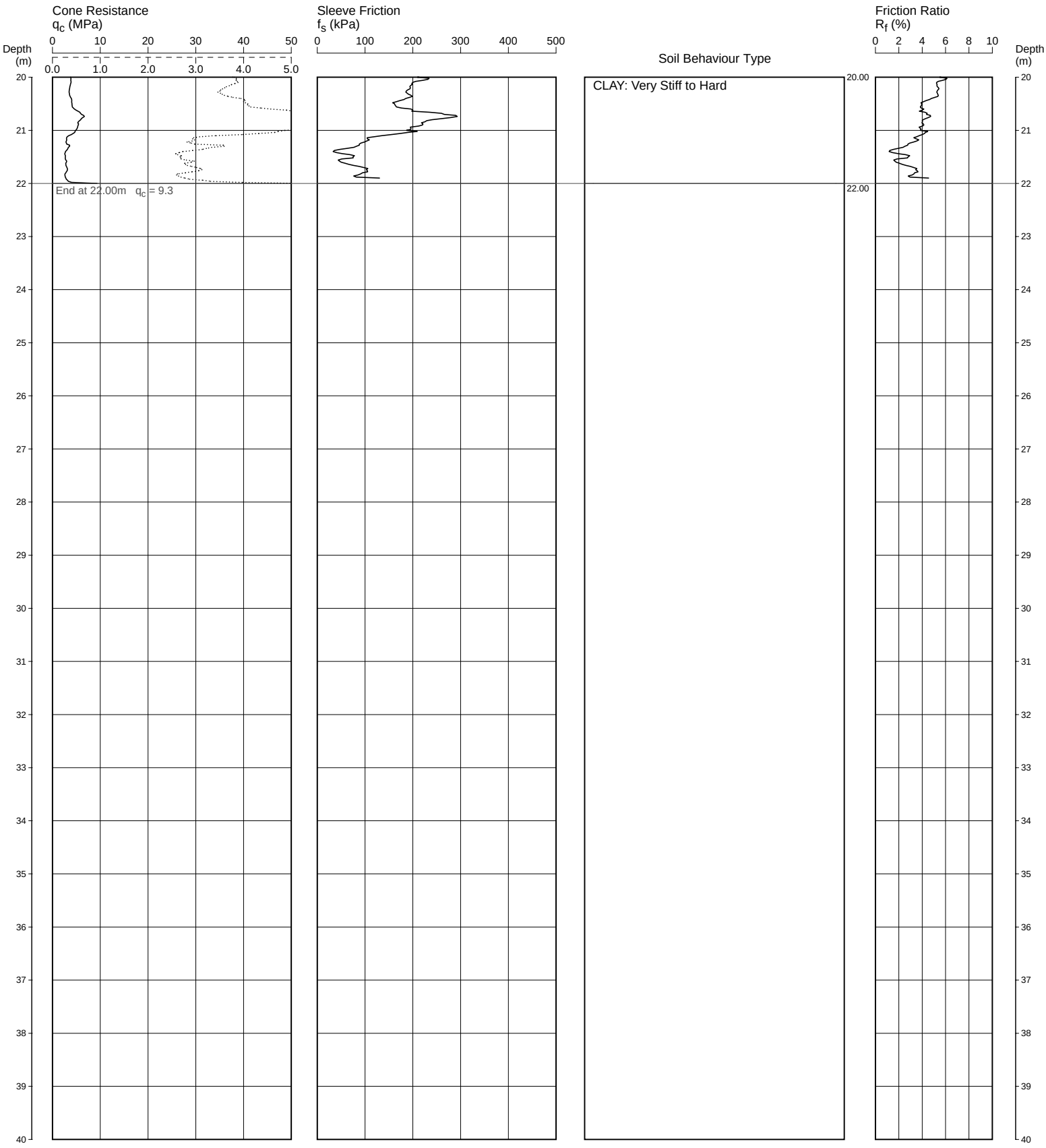
REDUCED LEVEL: 18.6

COORDINATES: 334379E 6246496N

CPT115

DATE 17/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 390MM. GROUNDWATER MEASURED AT 4.5M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 4.50m depth (assumed)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT115.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

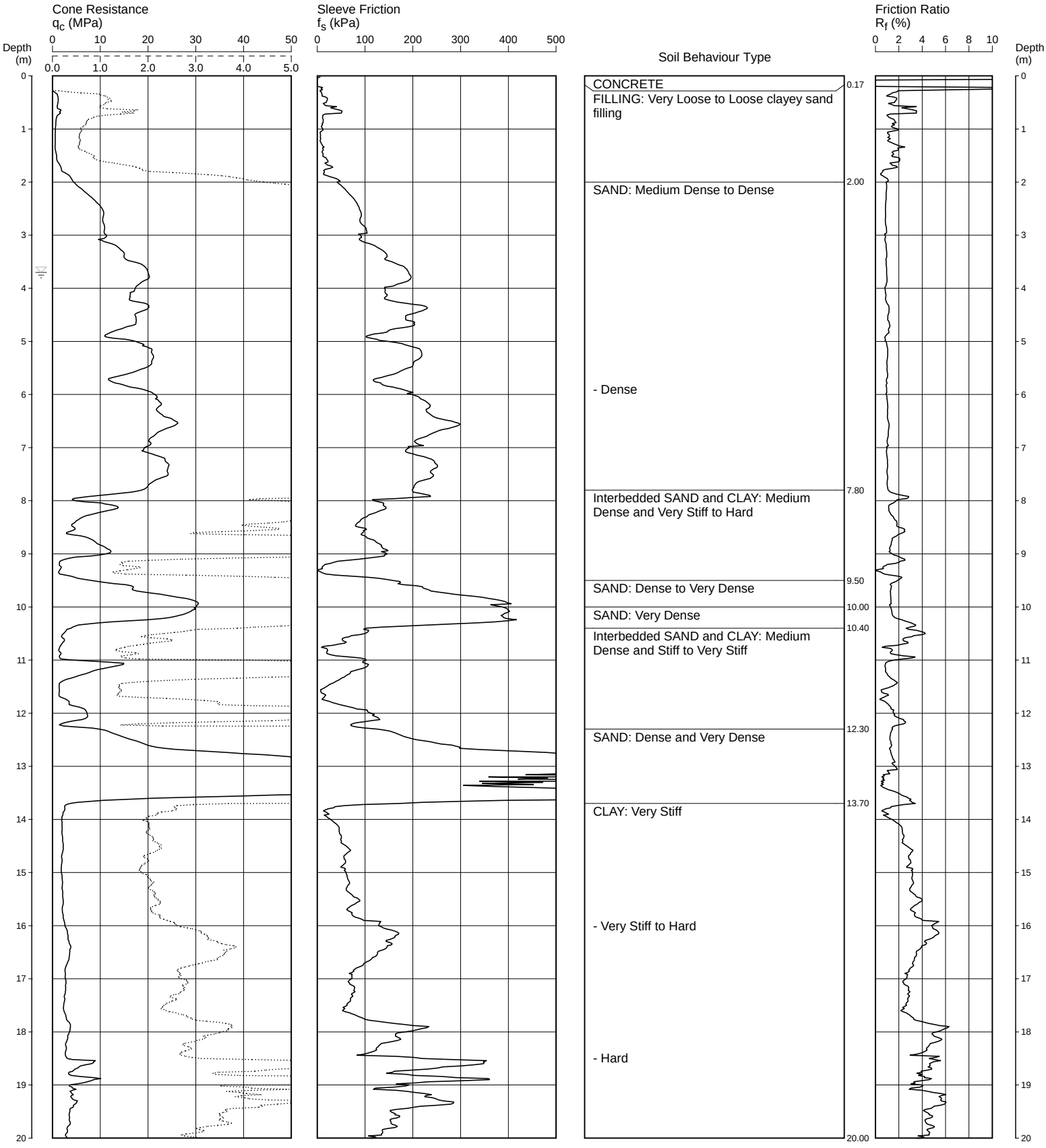
REDUCED LEVEL: 18.6

COORDINATES: 334400E 6246489N

CPT116

DATE 17/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 170MM. GROUNDWATER MEASURED AT 3.7M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 3.70m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT116.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

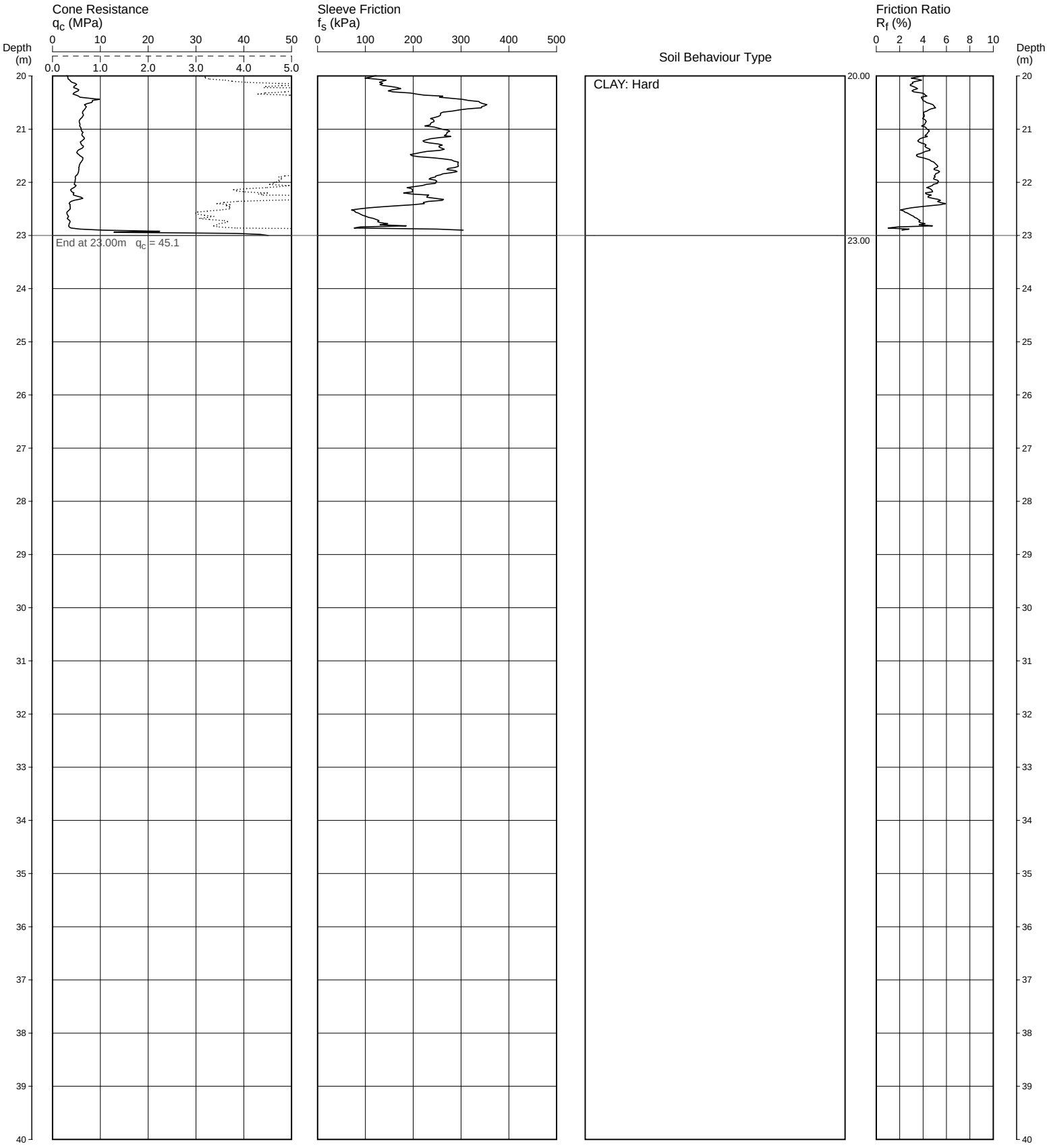
REDUCED LEVEL: 18.6

COORDINATES: 334400E 6246489N

CPT116

DATE 17/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 170MM. GROUNDWATER MEASURED AT 3.7M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 3.70m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT116.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

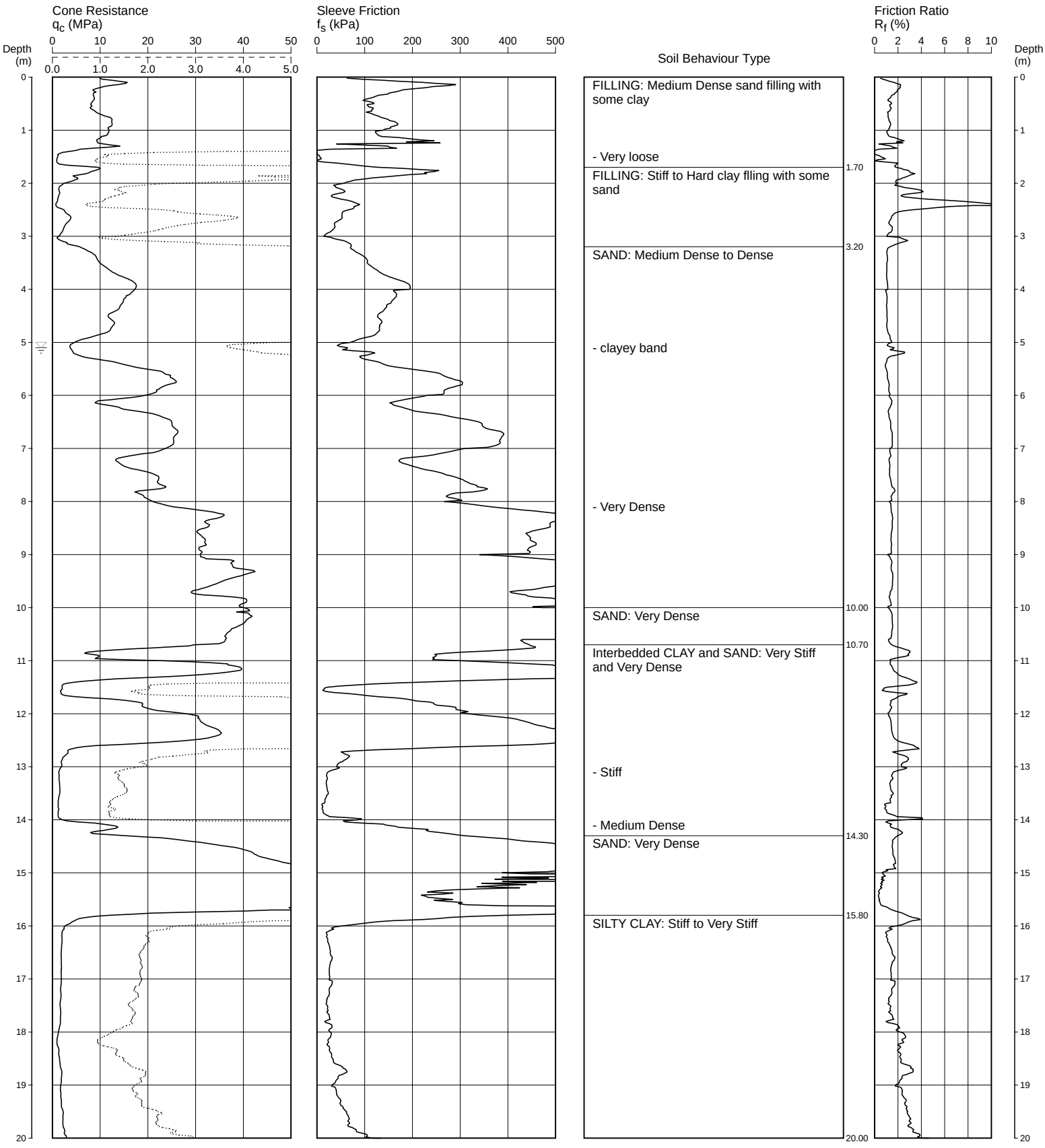
REDUCED LEVEL: 20.1

COORDINATES: 334438E 6246478N

CPT117

DATE 21/12/2015

PROJECT No: 73743.02



REMARKS: GROUNDWATER MEASURED AT 5.1M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 5.10m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT117A.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

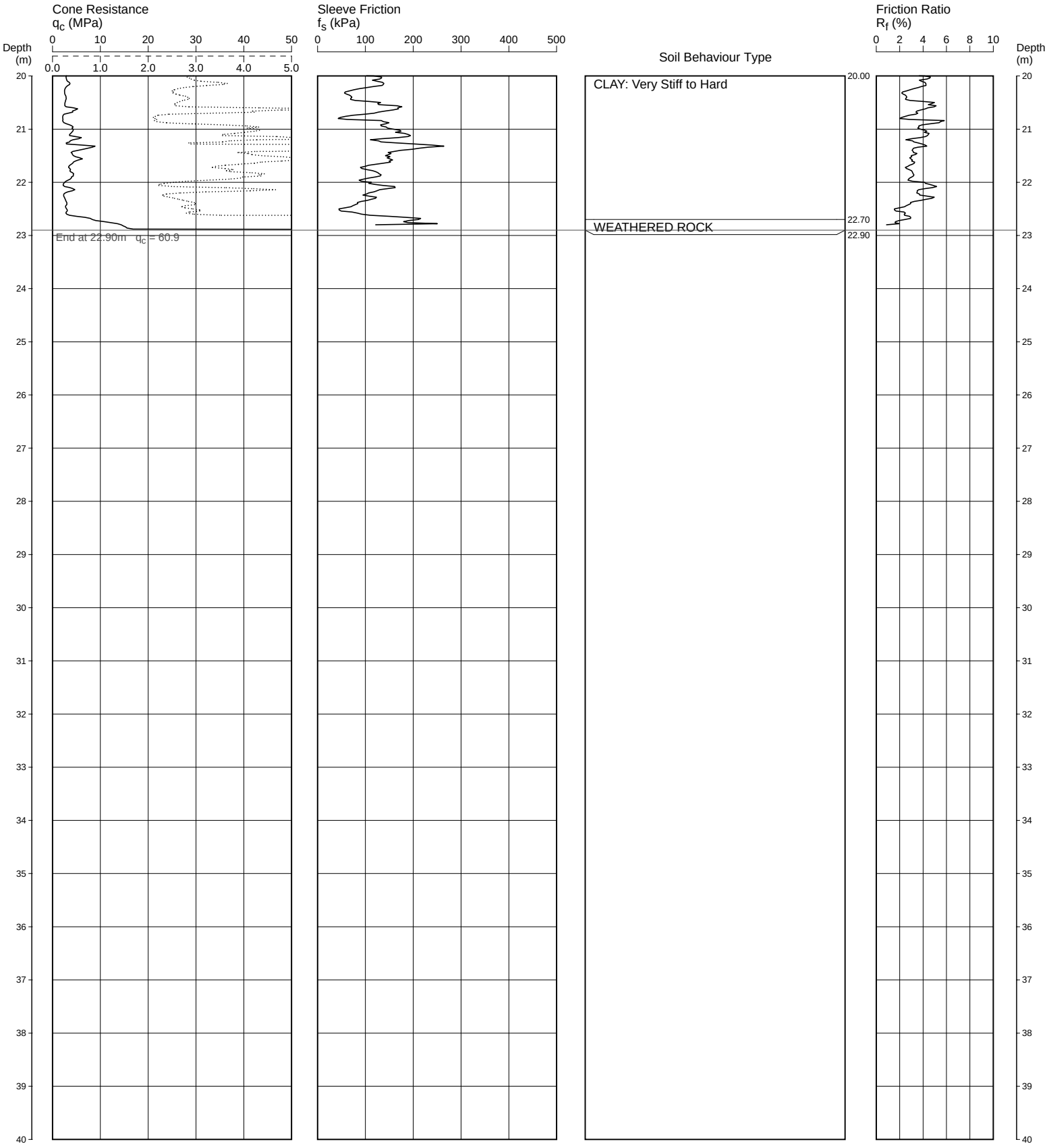
REDUCED LEVEL: 20.1

COORDINATES: 334438E 6246478N

CPT117

DATE 21/12/2015

PROJECT No: 73743.02



REMARKS: GROUNDWATER MEASURED AT 5.1M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 5.10m depth (measured)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT117A.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

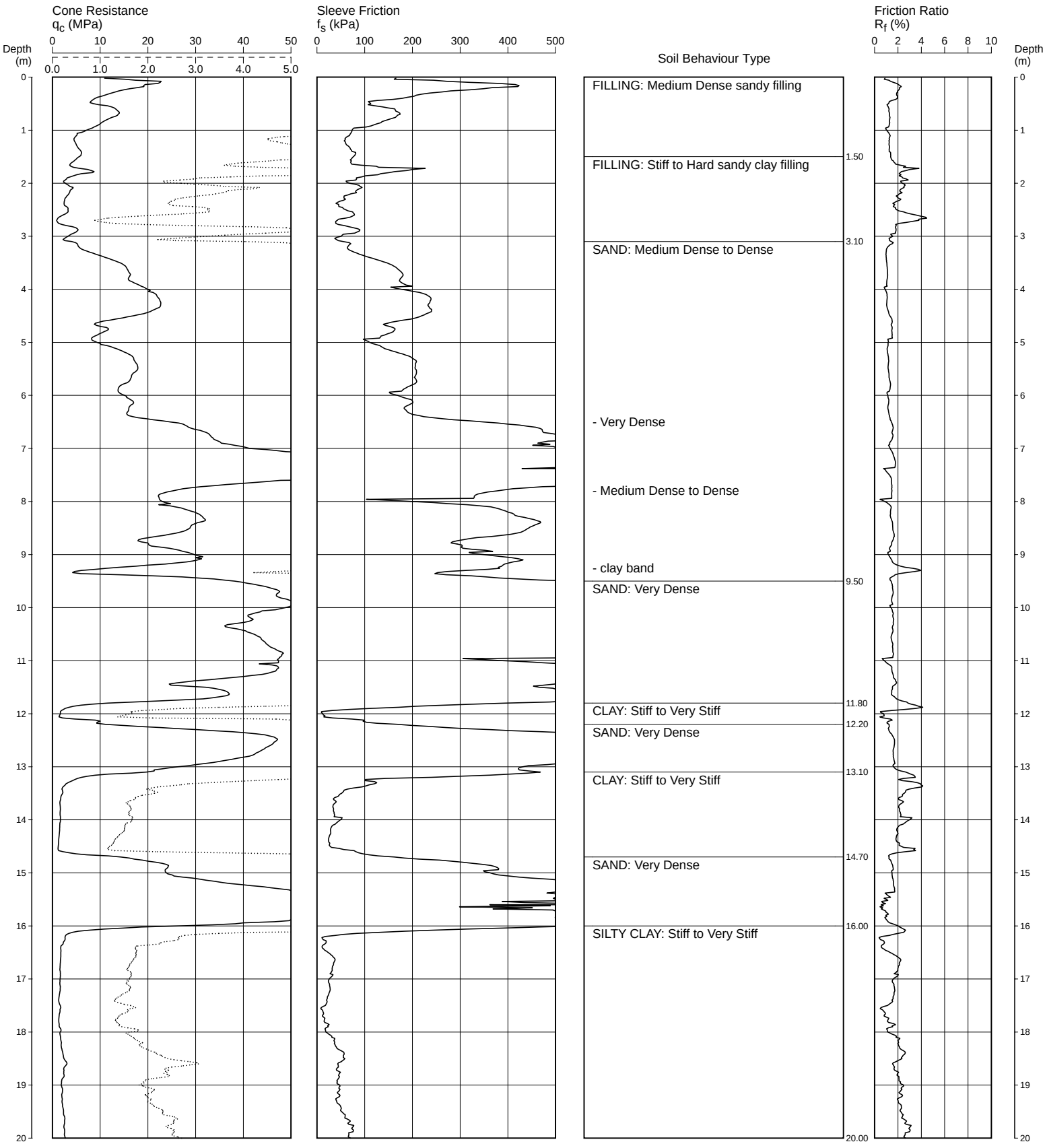
REDUCED LEVEL: 20.3

COORDINATES: 334470E 6246464N

CPT118

DATE 21/12/2015

PROJECT No: 73743.02



REMARKS: GROUNDWATER MEASURED AT 4.75M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT118.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

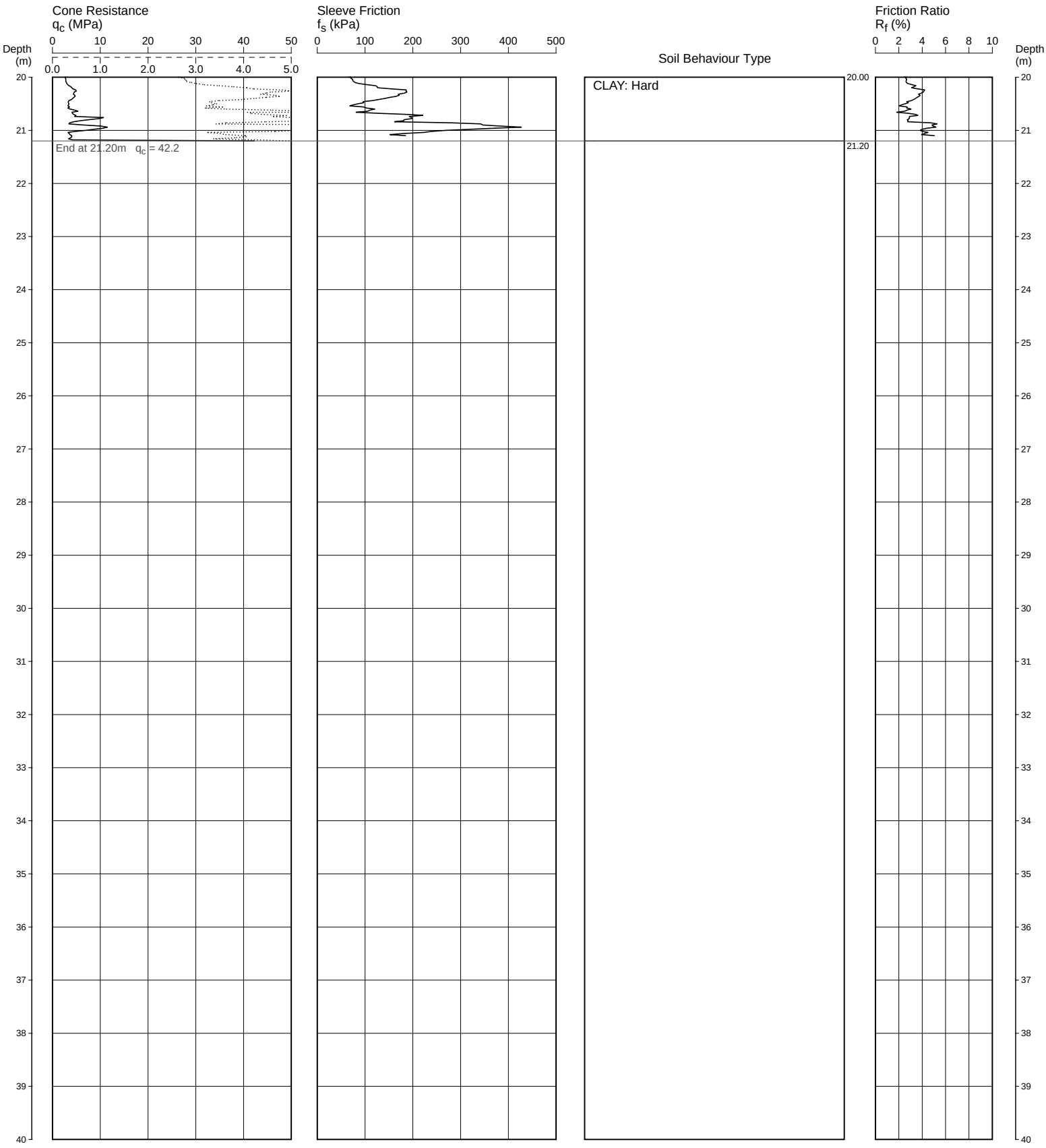
REDUCED LEVEL: 20.3

COORDINATES: 334470E 6246464N

CPT118

DATE 21/12/2015

PROJECT No: 73743.02



REMARKS: GROUNDWATER MEASURED AT 4.75M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT118.CP5
Cone ID: 120630 **Type:** I-CFXY-10

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.6

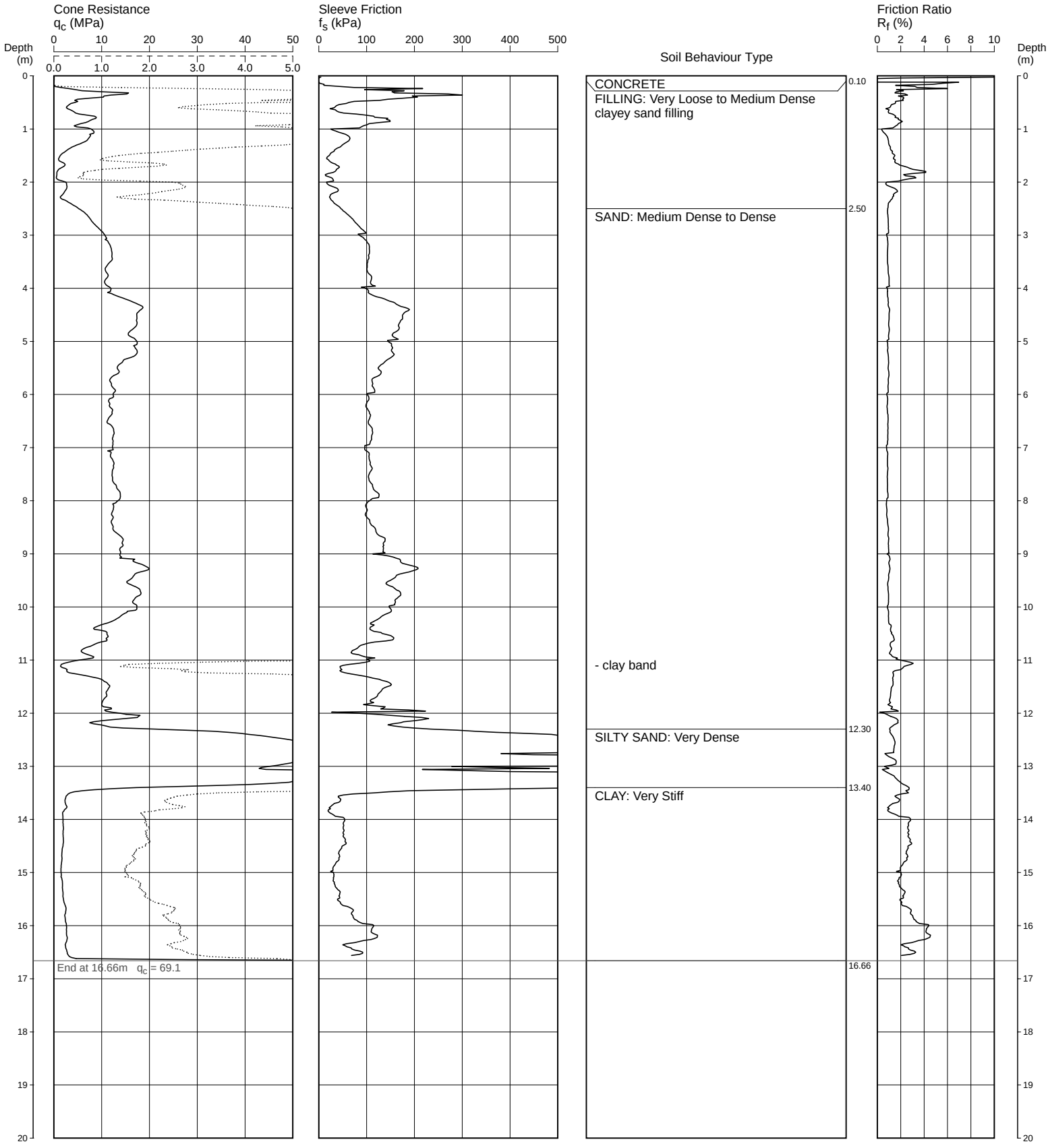
COORDINATES: 334363E 6246463N

CPT119

Page 1 of 1

DATE 18/12/2015

PROJECT No: 73743.02



REMARKS: DUMMY CONE TO 0.3M DEPTH.
CONCRETE DEPTH 100MM. HOLE COLLAPSE MEASURED AT 4.65M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT119.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2
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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.6

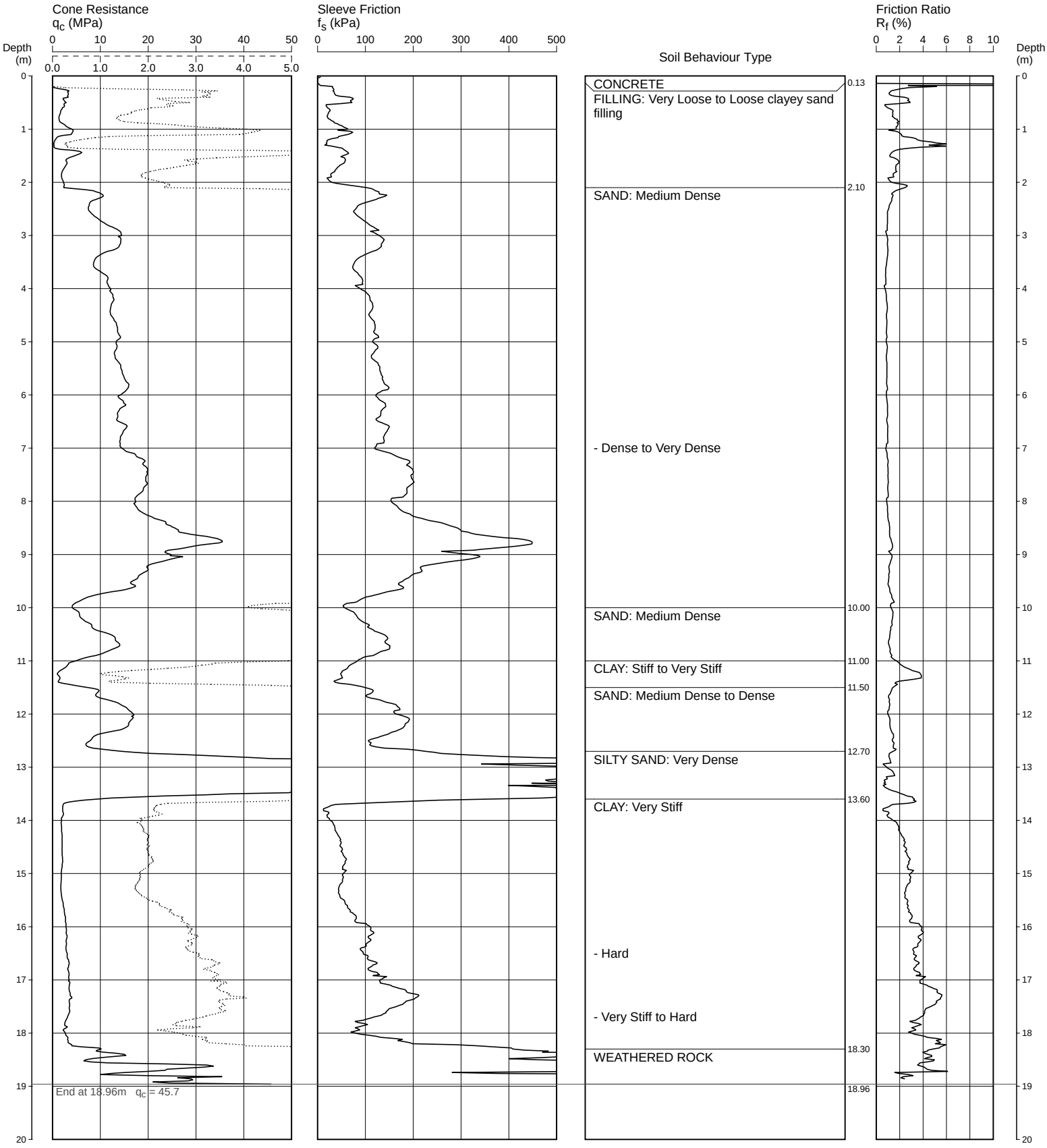
COORDINATES: 334387E 6246461N

CPT120

Page 1 of 1

DATE 17/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 130MM. HOLE COLLAPSE MEASURED AT 4.6M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT120.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 20.4

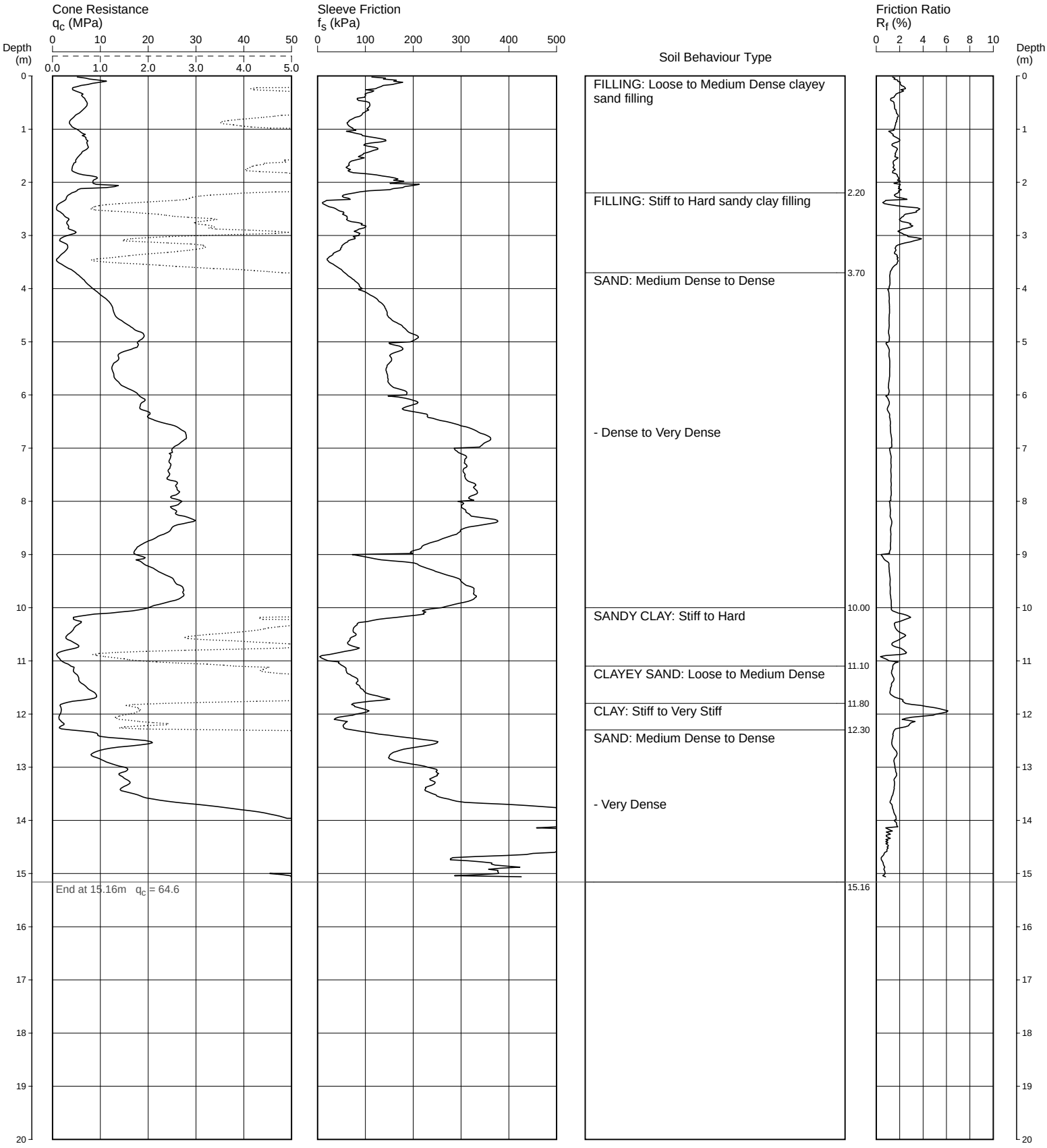
COORDINATES: 334406E 6246446N

CPT121

Page 1 of 1

DATE 21/12/2015

PROJECT No: 73743.02



REMARKS: TEST ENDED DUE TO TRUCK LIFTING. HOLE COLLAPSE MEASURED AT 5.5M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT121.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2
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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

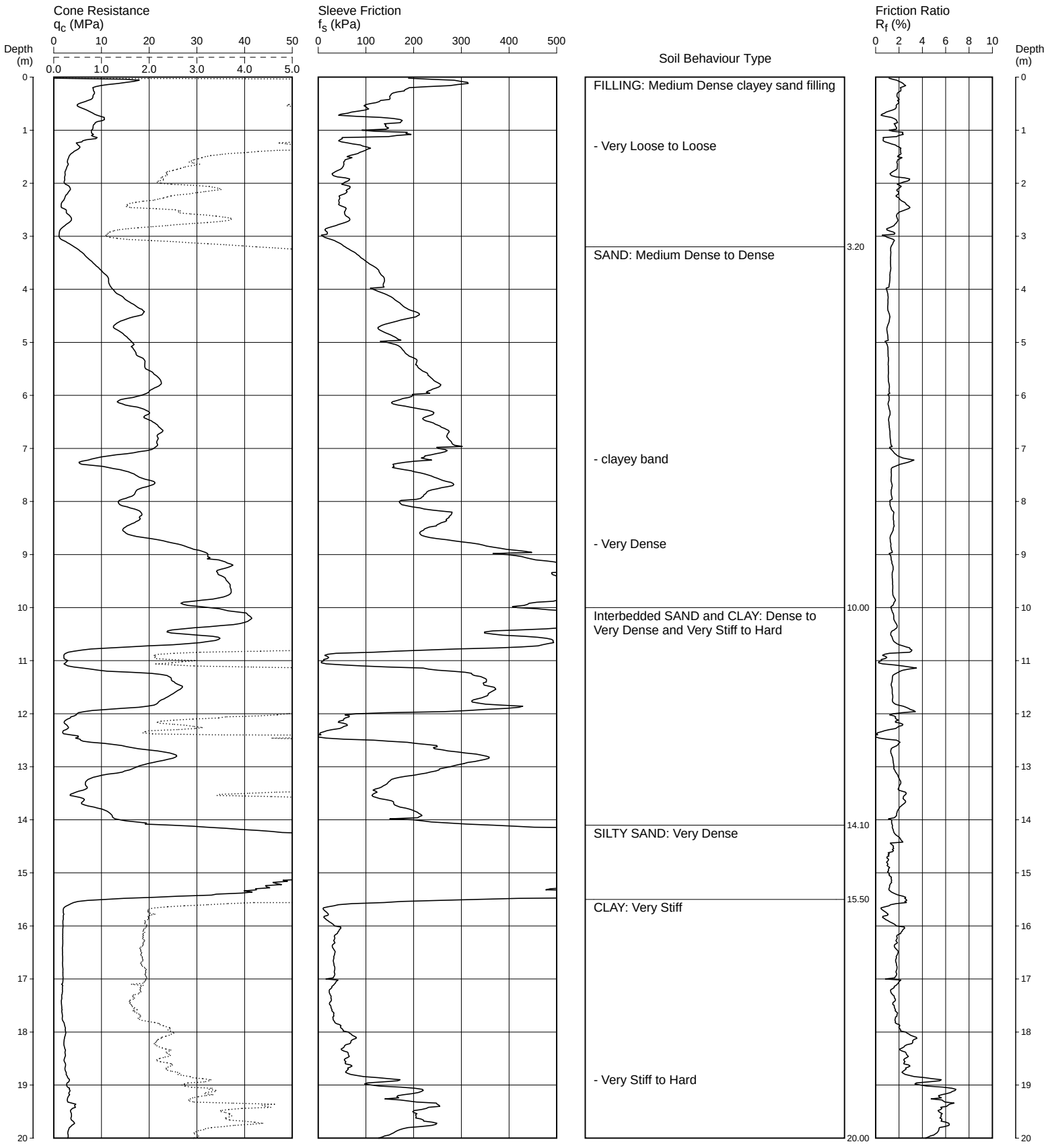
REDUCED LEVEL: 19.9

COORDINATES: 334424E 6246437N

CPT122

DATE 22/12/2015

PROJECT No: 73743.02



REMARKS: GROUNDWATER MEASURED AT 5.7M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT122.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

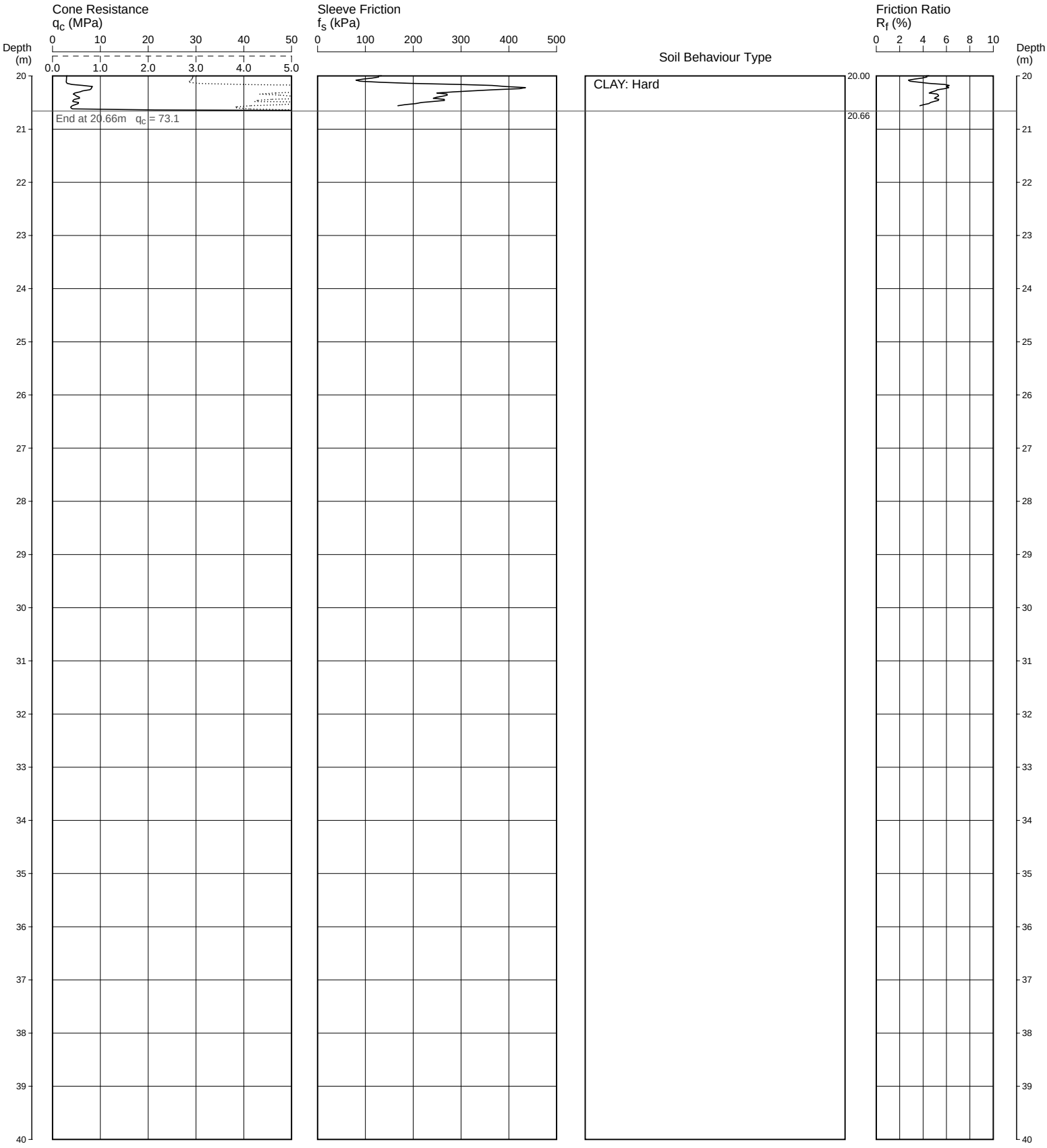
REDUCED LEVEL: 19.9

COORDINATES: 334424E 6246437N

CPT122

DATE 22/12/2015

PROJECT No: 73743.02



REMARKS: GROUNDWATER MEASURED AT 5.7M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT122.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

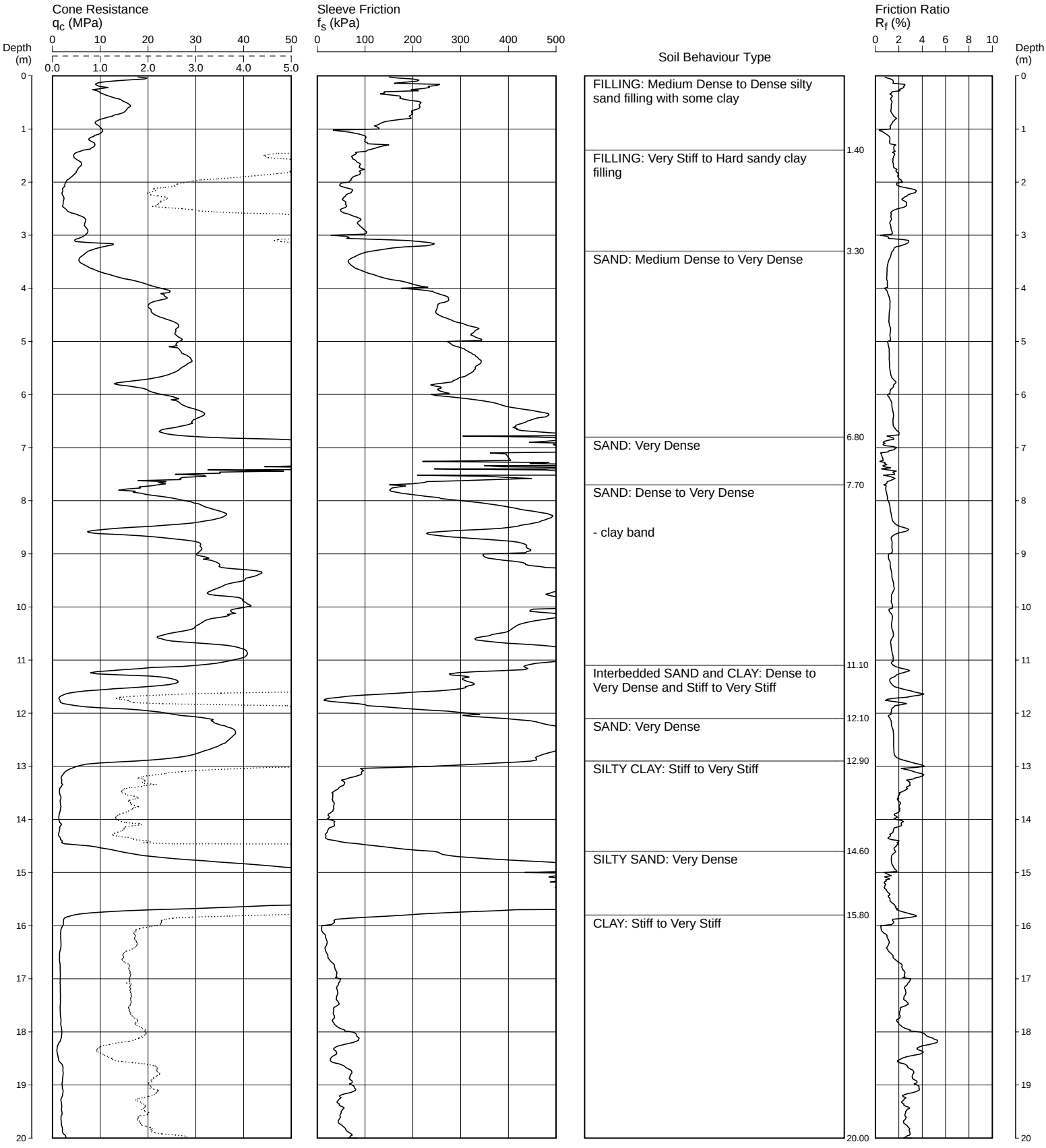
REDUCED LEVEL: 20.3

COORDINATES: 334449E 6246459N

CPT123

DATE 21/12/2015

PROJECT No: 73743.02



REMARKS: HOLE COLLAPSE MEASURED AT 5.0M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT123.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

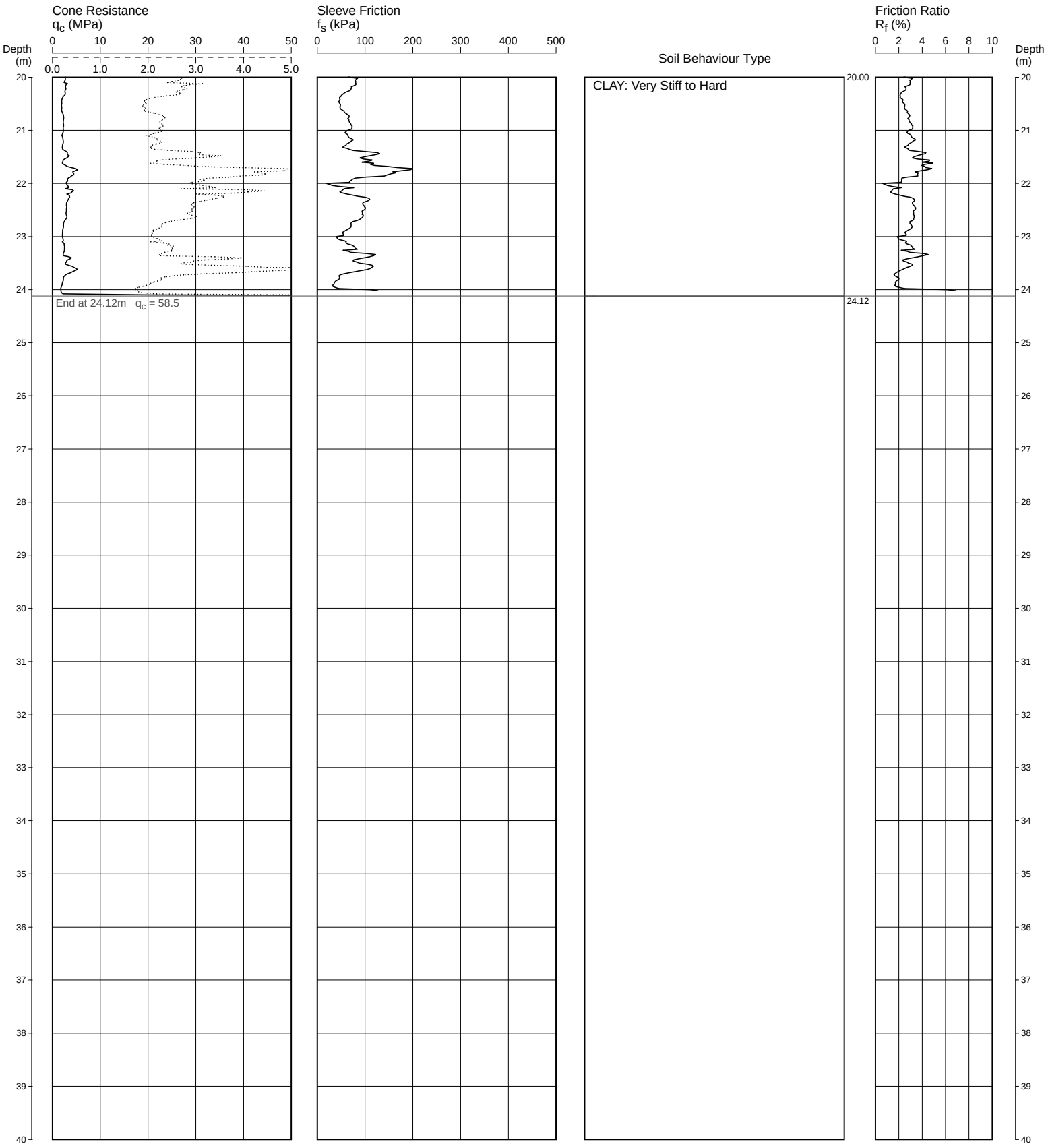
REDUCED LEVEL: 20.3

COORDINATES: 334449E 6246459N

CPT123

DATE 21/12/2015

PROJECT No: 73743.02



REMARKS: HOLE COLLAPSE MEASURED AT 5.0M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT123.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

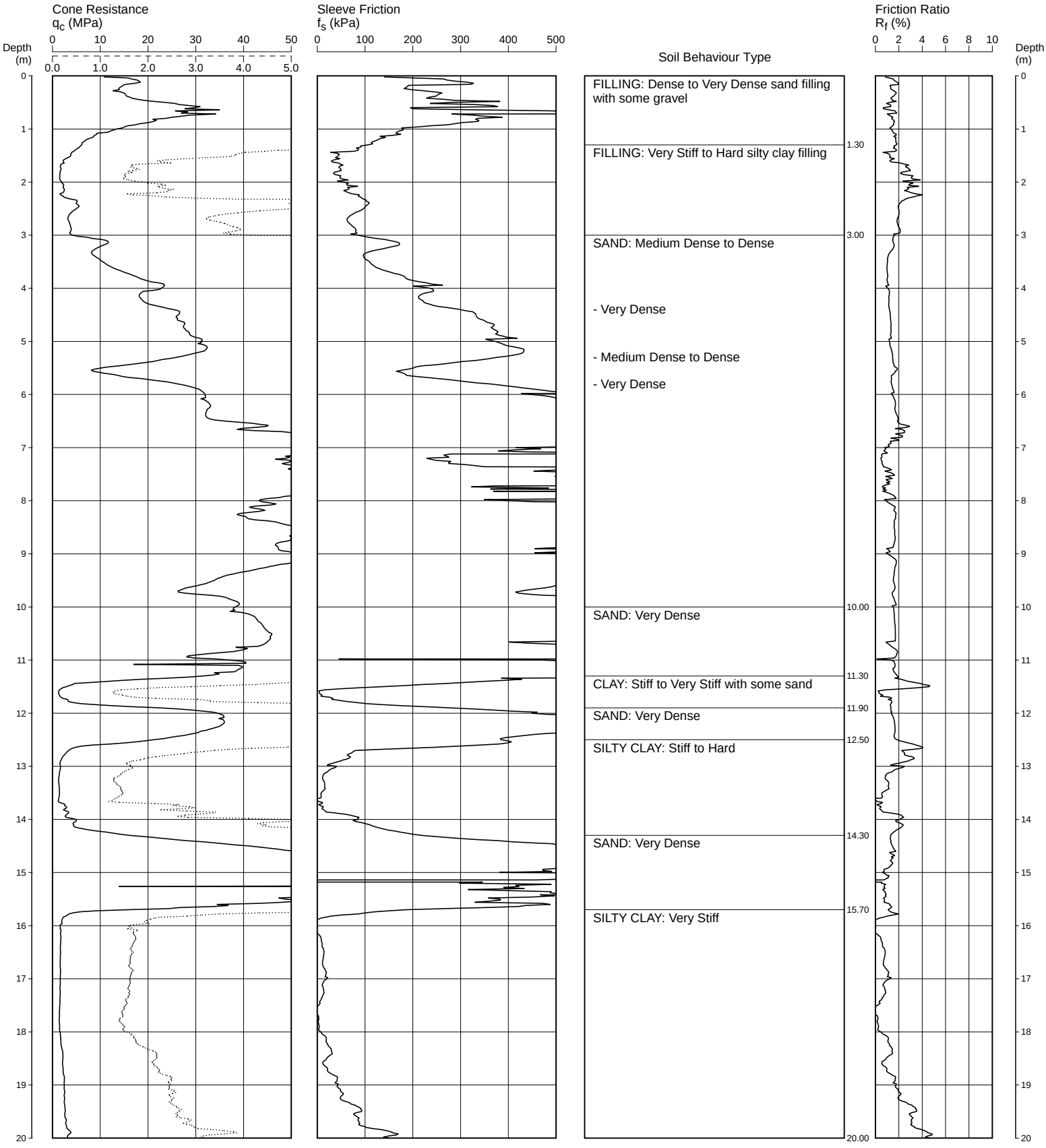
REDUCED LEVEL: 19.9

COORDINATES: 334454E 6246424N

CPT124

DATE 22/12/2015

PROJECT No: 73743.02



REMARKS: GROUNDWATER MEASURED AT 4.9M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT124.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

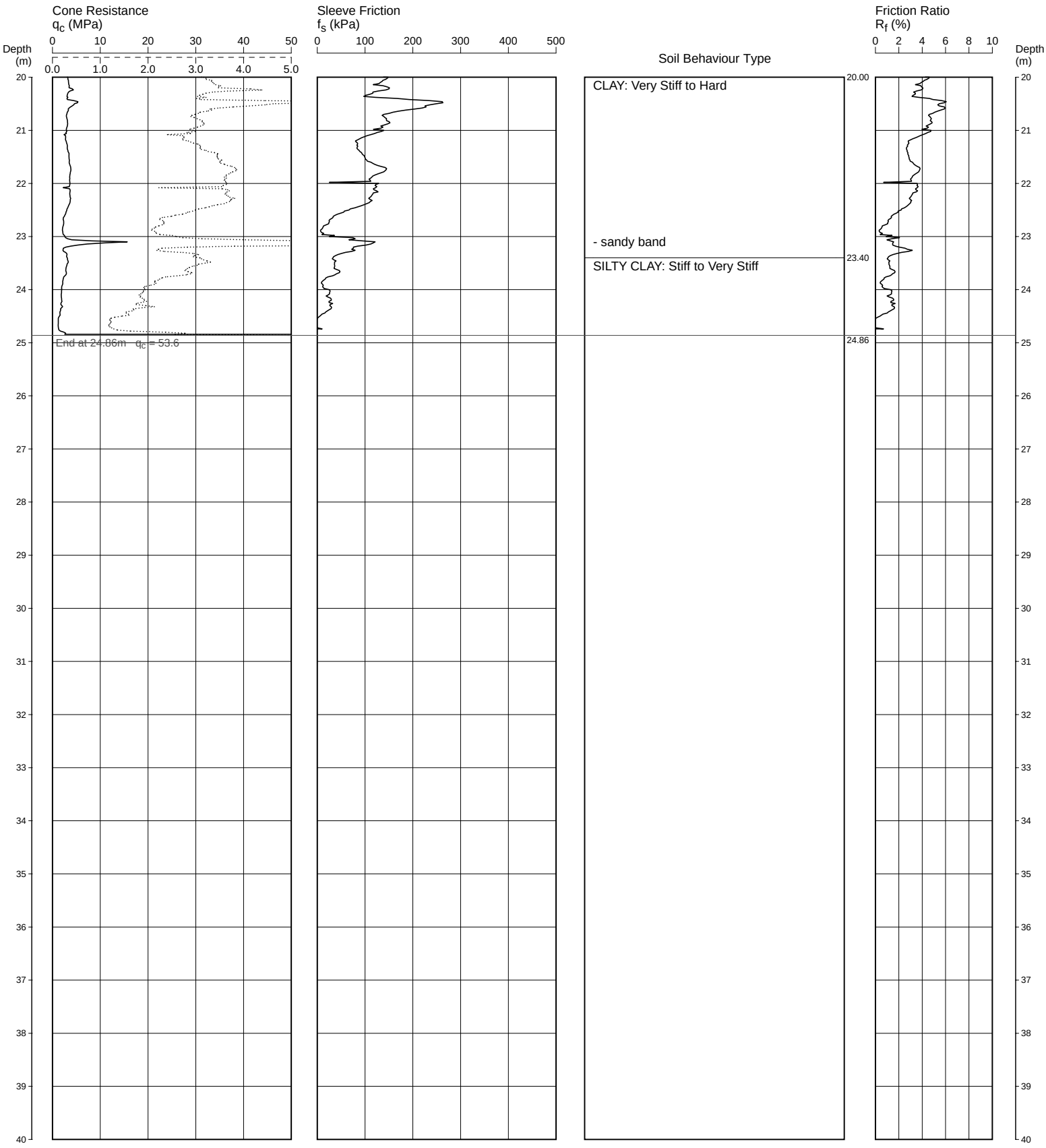
REDUCED LEVEL: 19.9

COORDINATES: 334454E 6246424N

CPT124

DATE 22/12/2015

PROJECT No: 73743.02



REMARKS: GROUNDWATER MEASURED AT 4.9M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT124.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 17.8

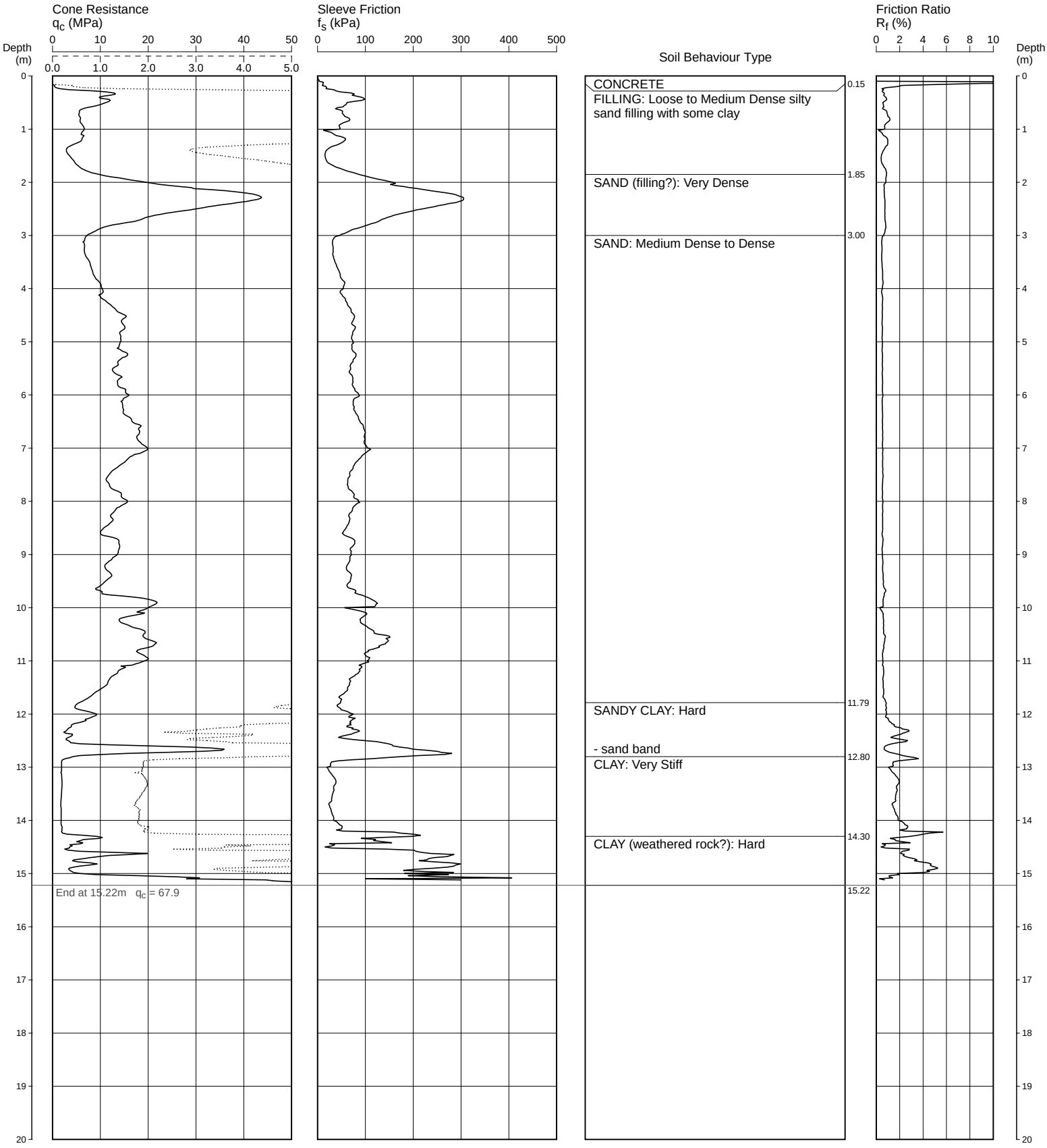
COORDINATES: 334370E 6246434N

CPT125

Page 1 of 1

DATE 22/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 150MM. HOLE COLLAPSE MEASURED AT 4.15M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT125.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

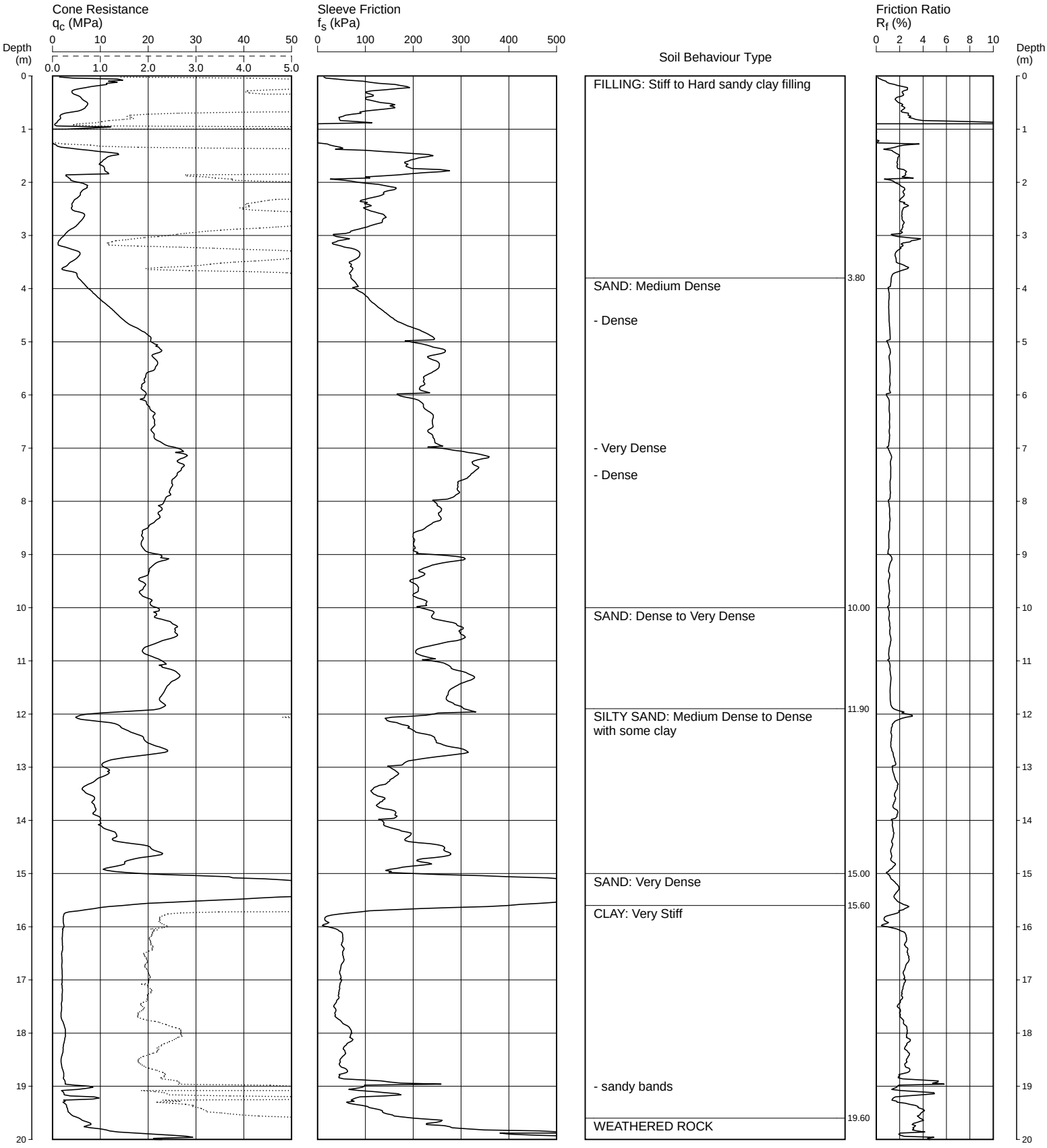
REDUCED LEVEL: 20.2

COORDINATES: 334404E 6246435N

CPT126

DATE 21/12/2015

PROJECT No: 73743.02



REMARKS: DUMMY CONE FROM 1.0M TO 1.5M DEPTH. HOLE COLLAPSE MEASURED AT 6.0M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT126.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

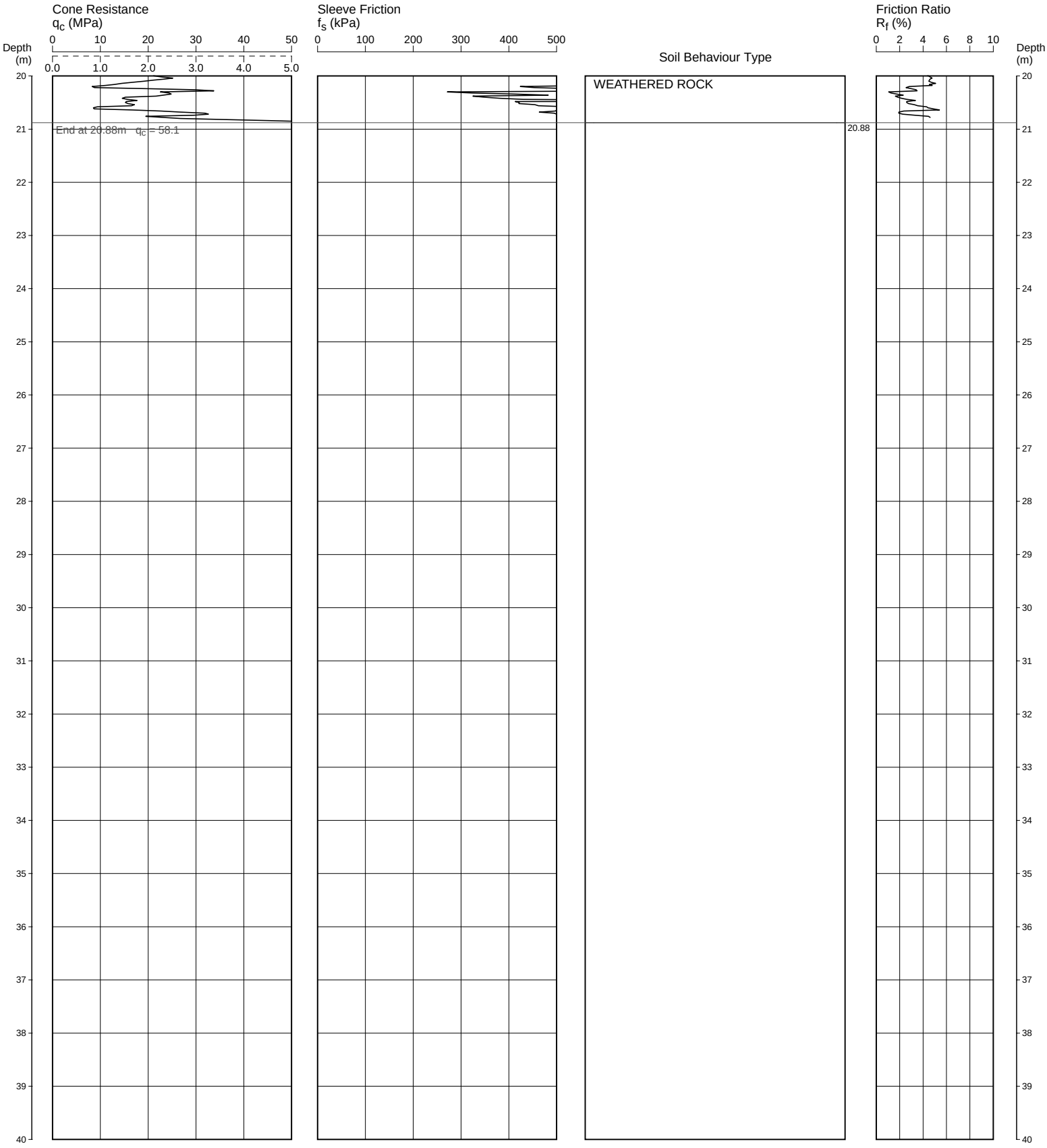
REDUCED LEVEL: 20.2

COORDINATES: 334404E 6246435N

CPT126

DATE 21/12/2015

PROJECT No: 73743.02



REMARKS: DUMMY CONE FROM 1.0M TO 1.5M DEPTH. HOLE COLLAPSE MEASURED AT 6.0M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT126.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.5

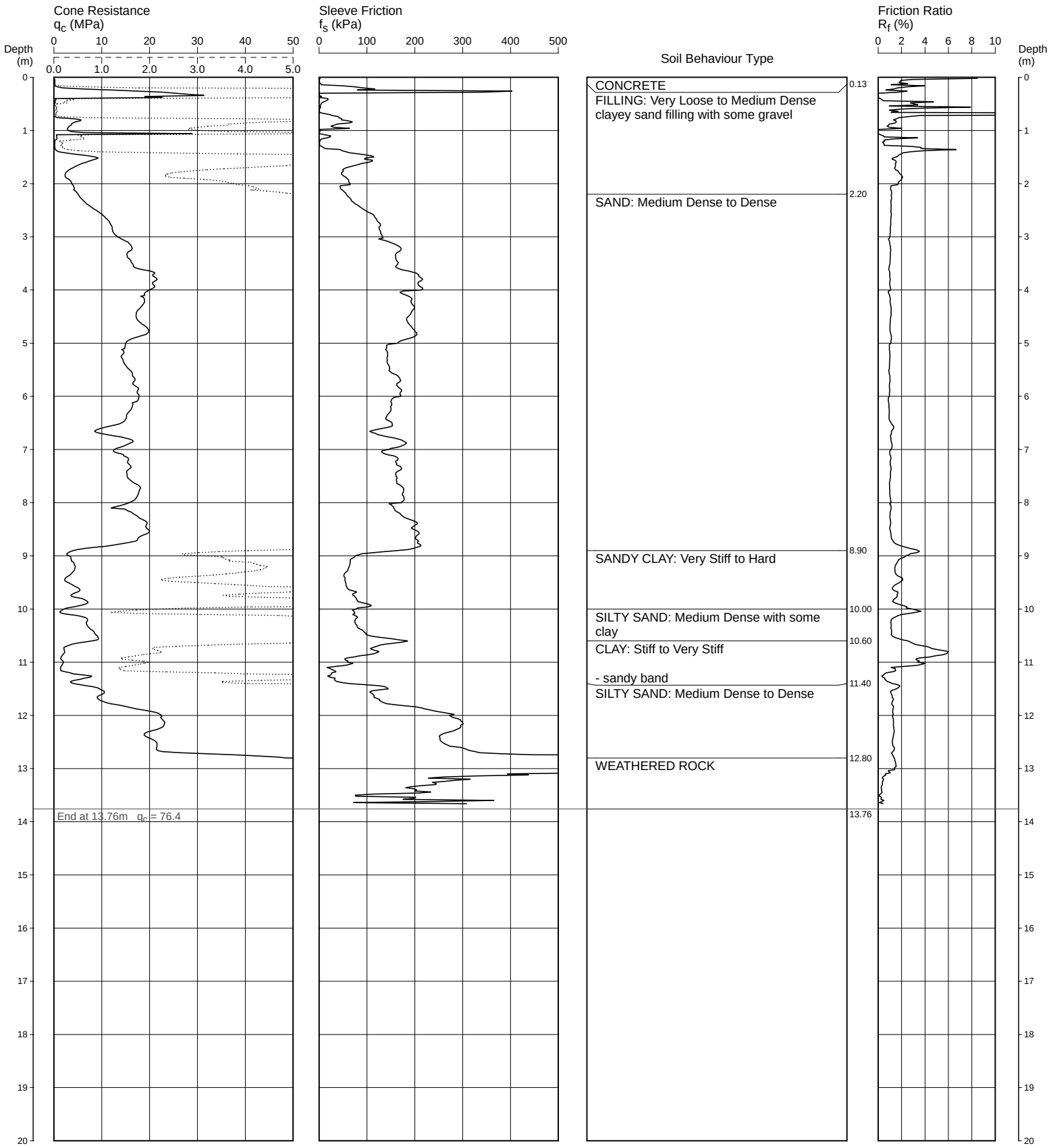
COORDINATES: 334425E 6246410N

CPT127

Page 1 of 1

DATE 17/12/2015

PROJECT No: 73743.02



REMARKS: DUMMY CONE FROM 0.38M TO 0.8M AND 1.06M TO 1.5M DEPTHS.
CONCRETE DEPTH 130MM. GROUNDWATER MEASURED AT 4.6M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT127.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2
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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 17.8

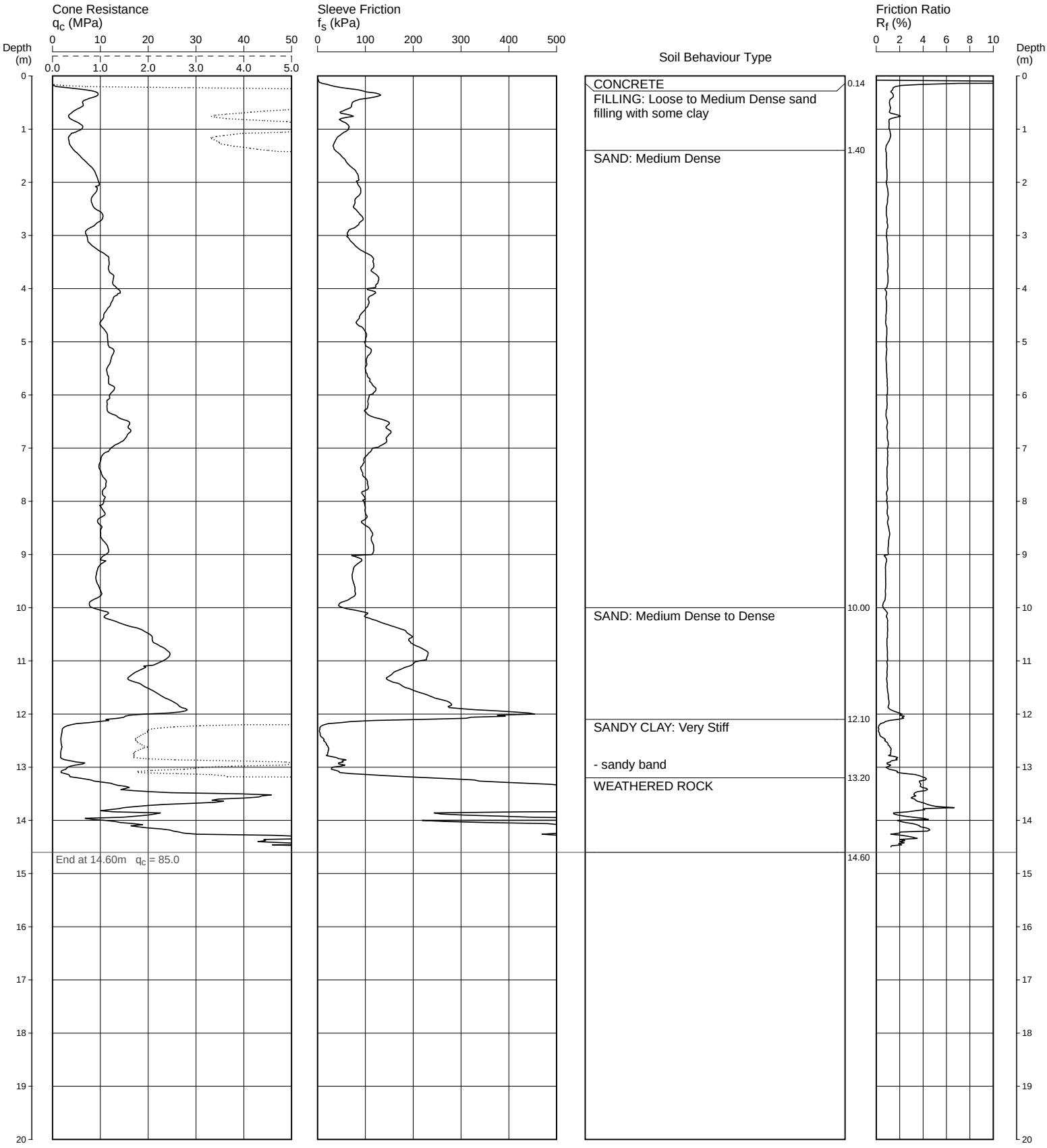
COORDINATES: 334362E 6246408N

CPT128

Page 1 of 1

DATE 22/12/2015

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 140MM. GROUNDWATER MEASURED AT 4.3M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT128.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.5

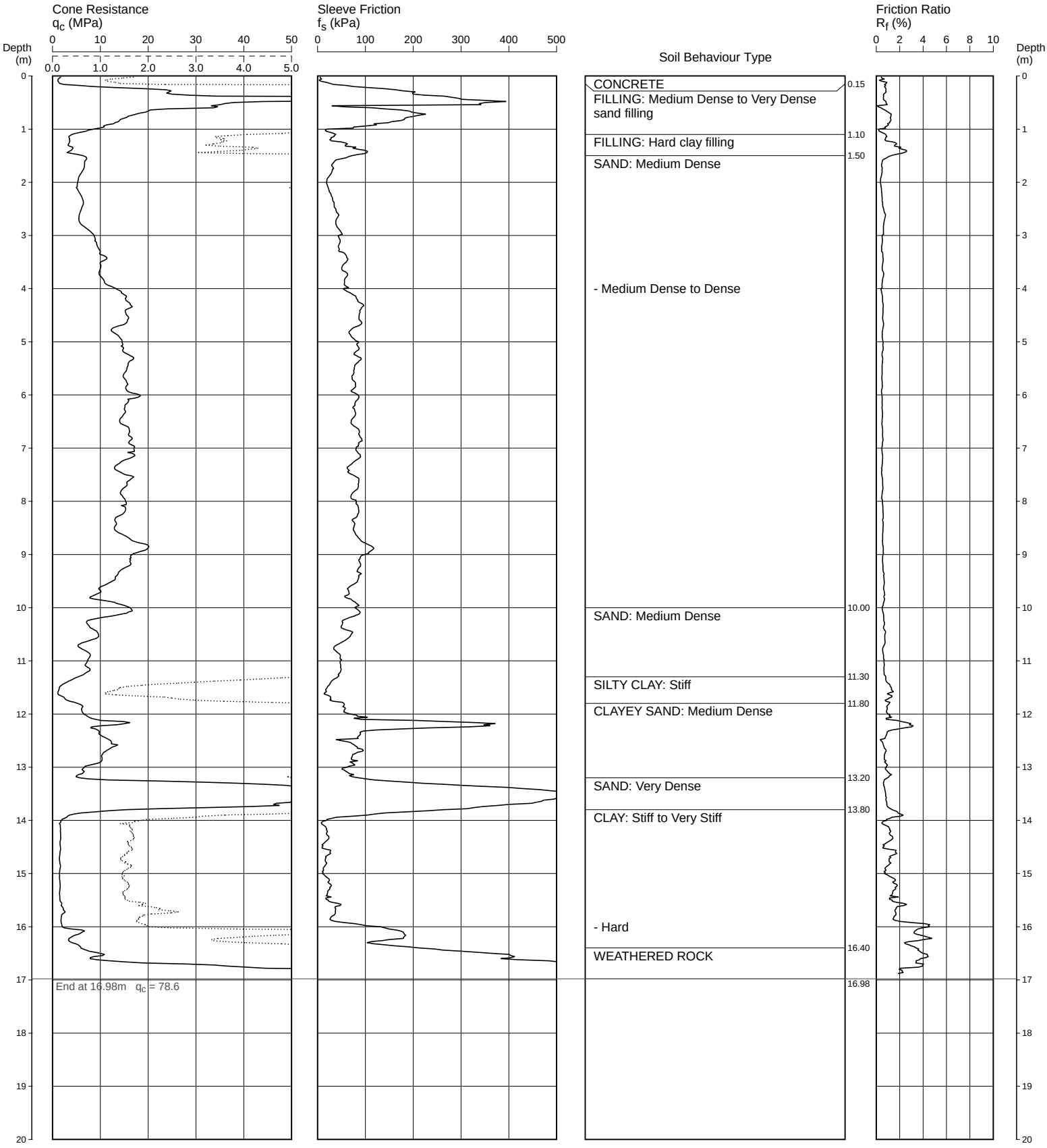
COORDINATES: 334394E 6246406N

CPT129

Page 1 of 1

DATE 11/01/2016

PROJECT No: 73743.02



REMARKS: CONCRETE DEPTH 150MM. HOLE COLLAPSE MEASURED AT 4.5M DEPTH AFTER REMOVAL OF RODS.

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT129.CP5
Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

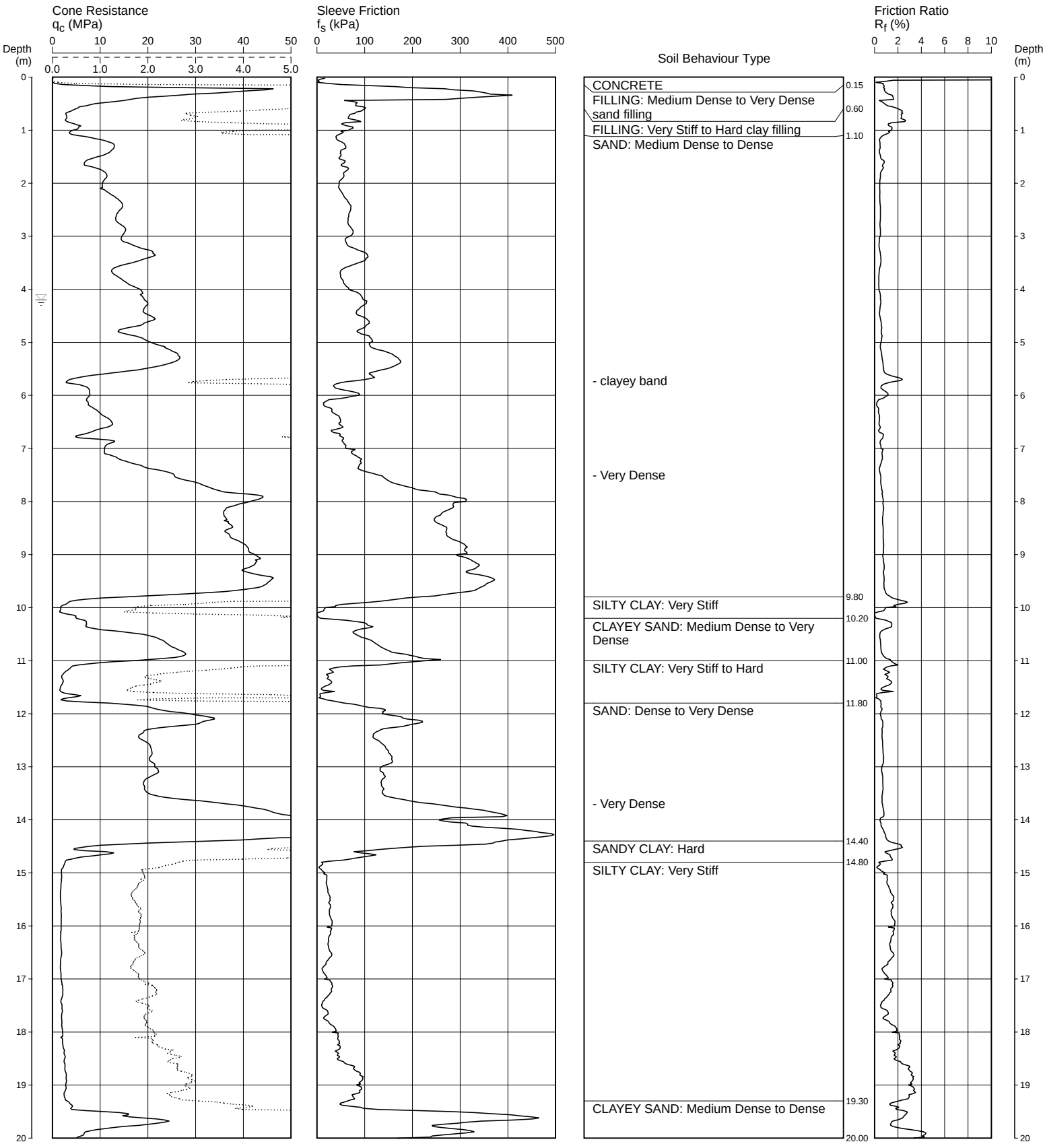
REDUCED LEVEL: 18.5

COORDINATES: 334378E 6246405N

CPT130

DATE 11/01/2016

PROJECT No: 73743.02



REMARKS: CONCETE DEPTH 150MM. GROUNDWATER MEASURED AT 4.2M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 4.20m depth (assumed)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT130.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GUNYAMA PARK AQUATIC AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

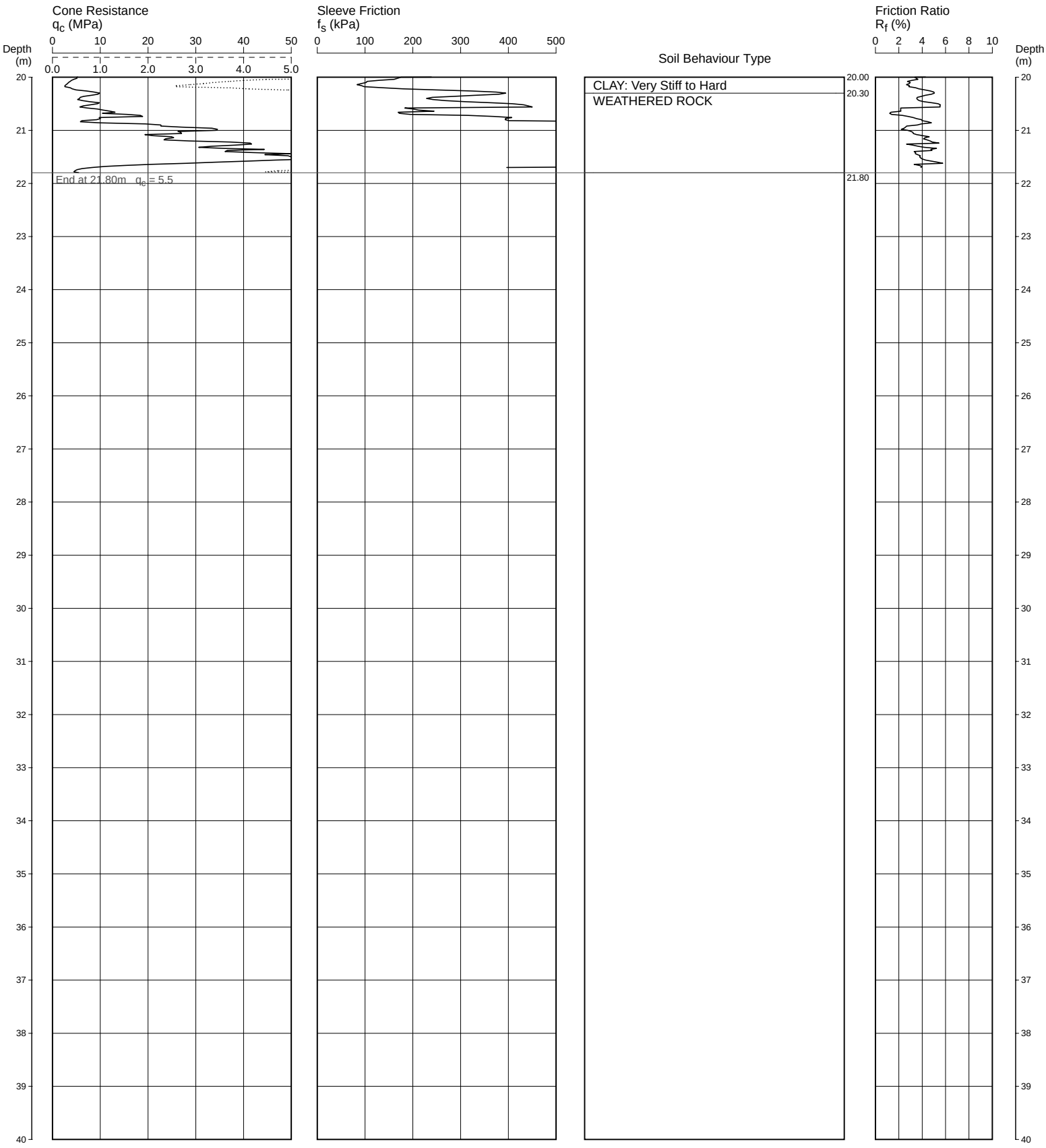
REDUCED LEVEL: 18.5

COORDINATES: 334378E 6246405N

CPT130

DATE 11/01/2016

PROJECT No: 73743.02



REMARKS: CONCETE DEPTH 150MM. GROUNDWATER MEASURED AT 4.2M DEPTH AFTER REMOVAL OF RODS.

Water depth after test: 4.20m depth (assumed)

File: P:\73743.02 - ZETLAND GS Sport & Rec Detailed Invstgtn\4.0 Field Work\4.2 Testing\CPTs\CPT130.CP5

Cone ID: 120630 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING: 334379
NORTHING: 6246496
DIP/AZIMUTH: 90°/--

BORE No: 115
PROJECT No: 73743.02
DATE: 25/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.4	CONCRETE										
		FILLING - dark brown, fine to medium clayey sand filling with some silt, some gravel and traces of glass fragments, moist							A			
	1								A			
									S			4,7,3 N = 10
17	1.4	SAND - medium dense, light yellow-brown, medium to coarse sand, moist										
	2											
16									S			3,5,7 N = 12
	3											
15												
	4					▼						
		4.1m: becoming wet							S			4,6,7 N = 13
14												
	5											
13									S			8,7,8 N = 15
	6											
12												
	7								S			10,12,12 N = 24
11												
	8											
10									S			10,13,15 N = 28
	9											
9												

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JS **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.4m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.3m; NMLC-Coring to 28.6m

WATER OBSERVATIONS: Free groundwater observed at 4.1m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING: 334379
NORTHING: 6246496
DIP/AZIMUTH: 90°/--

BORE No: 115
PROJECT No: 73743.02
DATE: 25/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
8		SAND - medium dense, light yellow-brown, medium to coarse sand, moist *(continued)*							S			8,6,8 N = 14
11		10.3m: becoming brown-grey, with some silt										
7	11.3	SAND - dense, light grey-brown, fine to medium sand with some clay							S			10,17,25 N = 42
12												
6		13.0m: becoming very dense							S			25/100mm refusal
13												
5	14.0	CLAY - stiff, dark grey-brown clay										
14									S			2,5,8 N = 13
4		15.0m: becoming very stiff, grey mottled red and light brown clay										
15												
3									S			3,7,11 N = 18
16								Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
2												
17	17.3	SANDSTONE - extremely low to very low strength, extremely weathered, highly to slightly fractured, fine grained sandstone										pp >600
1												
18								18.1m: J45°, ir, ro, fe stn 18.25m: J80°- 90°, pl, ro, fe stn	C	100	0	pp >600
0												
19												pp >600
-1								19.6m: J80°, pl, ro, fe stn	C	100	20	

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JS **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.4m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.3m; NMLC-Coring to 28.6m

WATER OBSERVATIONS: Free groundwater observed at 4.1m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING: 334379
NORTHING: 6246496
DIP/AZIMUTH: 90°/--

BORE No: 115
PROJECT No: 73743.02
DATE: 25/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDSTONE - extremely low to very low strength, extremely weathered, highly to slightly fractured, fine grained sandstone *(continued)*						20.83m: J45°, ir, ro, cln	C	100	20	pp >600 pp >600
	22.0	SANDSTONE - low and medium strength, moderately weathered, fractured and slightly fractured, orange-brown, medium to coarse grained sandstone						22.5-22.58m: fg				PL(A) = 0.1
	22.9	SANDSTONE - medium and high strength, fresh stained then fresh, slightly fractured to unbroken, light grey and brown, medium to coarse grained sandstone						22.82m: B5°, he, ca 22.86-22.96m: J80°, cu, ro, cln 22.91-22.96m: J90°, pl, ro, cln 23.16m: B0°, ro, cly 23.81m: B0°, ro, cly	C	100	96	PL(A) = 0.7 PL(A) = 1.7 PL(A) = 0.5
	25.8	SANDSTONE - high strength, fresh, slightly fractured to unbroken, light grey, medium grained sandstone						24.94-25.1m: J80°, pl, ro, cln 26.19m: B0°, ro, cly 26.23m: B0°, ro, cly 26.8m: B0°, ro, cly 26.92-27.07m: J70°, pl, ro, cln	C	100	99	PL(A) = 0.9 PL(A) = 1.2 PL(A) = 1.5
	28.6	Bore discontinued at 28.6m										PL(A) = 2.1

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JS **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.4m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.3m; NMLC-Coring to 28.6m

WATER OBSERVATIONS: Free groundwater observed at 4.1m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 20.3 AHD
EASTING: 334470
NORTHING: 6246464
DIP/AZIMUTH: 90°/--

BORE No: 118
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
20	0.02	ASPHALT							A			
	0.4	FILLING - light grey-brown, crushed sandstone, medium to coarse sand and fine to medium sandstone gravel, damp							A			
19	1	FILLING - dark brown, silty sand with some clay and fine to medium basaltic gravel, humid							S			3,3,5 N = 8
18	2											
	2.5	PEAT - soft to firm, dark grey-black, sandy peat, moist							S			2,2,2 N = 4
17	2.95	SAND - medium dense, light grey, fine sand, moist 3.0m: becoming wet				▼						
16	4								S			2,8,11 N = 19
15	5											
	5.5	SAND - very dense, brown to dark brown, fine sand							S			20/100mm refusal
14	6											
13	7								S			13,25/100mm refusal
12	8											
11	9								S			10,15,18 N = 33
	10.0											

RIG: Scout 2 **DRILLER:** WG/GT **LOGGED:** JHS/PO/JES **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 21.8m; NMLC-Coring to 28.1m

WATER OBSERVATIONS: Free groundwater observed at 3.0m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 20.3 AHD
EASTING: 334470
NORTHING: 6246464
DIP/AZIMUTH: 90°/--

BORE No: 118
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
10		SAND - very dense, light grey, fine to medium sand							S			22,25/100mm refusal
9	11											
8		11.5-13.45m: with pockets of organic clay/peat							S			15,22/100mm refusal
7	12											
6	13								S			15,19,11 N = 30
5	14											
4	14.5	SANDY CLAY - stiff, dark grey, fine to medium sandy clay							S			1,3,7 N = 10
3	15 14.95	SAND - very dense, pale grey-white, fine sand										
2	16								S			25/100mm refusal
1	16.1	SANDY CLAY - firm, grey-pale grey, fine to medium sandy clay										
	17								S			1,3,2 N = 5
	18 17.95	SANDY CLAY/CLAYEY SAND - pale grey, fine to medium sandy clay/clayey sand										
	19								S			3,4,6 N = 10
	19.45	CLAYEY SAND - medium dense, mottled pale grey-white, orange-brown, red-brown, fine to medium clayey sand										

RIG: Scout 2 **DRILLER:** WG/GT **LOGGED:** JHS/PO/JES **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 21.8m; NMLC-Coring to 28.1m

WATER OBSERVATIONS: Free groundwater observed at 3.0m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 20.3 AHD
EASTING: 334470
NORTHING: 6246464
DIP/AZIMUTH: 90°/--

BORE No: 118
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
		CLAYEY SAND - medium dense, mottled pale grey-white, orange-brown, red-brown, fine to medium clayey sand *(continued)*										
									S			5,12,16 N = 28
	20.95	SANDSTONE - extremely low strength, light grey-brown, fine to medium grained sandstone						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	21.8	SANDSTONE - very low strength, highly weathered, slightly fractured, grey, medium grained sandstone with ironstone bands						22.87m: B0°, pl, ro, fe	C	100	0	
								24.07m: B0°, pl, ro				
	24.35	SANDSTONE - low to medium strength, moderately weathered, fractured, grey mottled yellow, medium grained sandstone with ironstone bands						24.28m: Cs, 50mm 24.35-24.85m: J80°, partially he, pl, ro, fe 24.51m: B5°, pl, ro, fe 24.64m: B5°, pl, ro, fe 24.9m: B0°, pl, ro				PL(A) = 0.4 PL(A) = 0.5
	25.0	SANDSTONE - medium and low to medium strength, fresh, slightly fractured, light grey, medium grained sandstone						25.36-25.78m: B (x4) 0°-5°, pl, ro, cly 25.6-25.66m: J45°, pl, ro, cly 25.93m: J55°, pl, ro, cly 26m: J50°, pl, ro, cly 26.31m: J60°, pl, ro, cly 26.43m: Cs, 200mm	C	100	90	PL(A) = 0.4 PL(A) = 0.3
	27.0	SANDSTONE - high strength, fresh, slightly fractured, light grey, medium to coarse grained sandstone						26.73-26.9m: J80°, pl, ro 27.16m: J50°, pl, ro, cly 27.45m: B0°- 5°, pl, ro, cly 27.59m: B0°, - 5°, pl, ro, cly, 3mm 27.93m: B0°, pl, ro, cly	C	100	95	PL(A) = 0.4 PL(A) = 1.2
	28.1	Bore discontinued at 28.1m										

RIG: Scout 2 **DRILLER:** WG/GT **LOGGED:** JHS/PO/JES **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 21.8m; NMLC-Coring to 28.1m

WATER OBSERVATIONS: Free groundwater observed at 3.0m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING: 334363
NORTHING: 6246463
DIP/AZIMUTH: 90°/--

BORE No: 119
PROJECT No: 73743.02
DATE: 22/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.1	CONCRETE										
		FILLING - poorly compacted, dark grey, fine to medium sand filling with some gravel and crushed sandstone							A			
	0.8	SAND - loose, dark brown-brown, fine to medium sand							A			
	1								S			4,4,4 N = 8
17		1.6m: becoming wet				▼						
	2											
16		2.5m: becoming medium dense							S			2,5,5 N = 10
	3											
15												
	4	4.0m: becoming yellow							S			3,6,9 N = 15
14												
	5											
13		5.5m: becoming dark grey, slightly silty							S			6,6,6 N = 12
	6											
12												
	7								S			4,6,6 N = 12
11												
	8											
10									S			5,6,8 N = 14
	9											
9	10.0											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JEH/AT **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.10m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.3m; NMLC-Coring to 24.2m

WATER OBSERVATIONS: Free groundwater observed at 1.6m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING: 334363
NORTHING: 6246463
DIP/AZIMUTH: 90°/--

BORE No: 119
PROJECT No: 73743.02
DATE: 22/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SAND - medium dense, dark brown-brown, fine to medium sand							S			6,10,12 N = 22
									S			3,6,8 N = 14
	13	13.0m: very dense							S			25/100mm refusal
	13.4	SILTY CLAY - stiff, grey, silty clay										
	15 15.0	CLAY - very stiff, light grey, clay with some sand							S			3,5,7 N = 12
	16	- becoming sandy at 16.4m						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			5,9,14 N = 23
	17.3 17.44	SANDSTONE - extremely low strength, light brown, fine to medium grained sandstone						17.44m: B0°, pl, ro, cln				pp = 320
	18	SANDSTONE - very low to low strength, highly weathered, slightly fractured, grey, medium grained sandstone with ironstone bands						17.73m: B5°, pl, ro, cln				PL(A) = 0.1
	18.72	SANDSTONE - low to medium then medium strength, slightly weathered, slightly fractured, grey-brown, medium grained sandstone						18.57m: Cs, 11mm 19.37m: B0°, pl, un, fe co, 2mm	C	100	92	PL(A) = 0.3 PL(A) = 0.5
									C	100	94	

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JEH/AT **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.10m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.3m; NMLC-Coring to 24.2m

WATER OBSERVATIONS: Free groundwater observed at 1.6m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING: 334363
NORTHING: 6246463
DIP/AZIMUTH: 90°/--

BORE No: 119
PROJECT No: 73743.02
DATE: 22/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2	21	SANDSTONE - low to medium then medium strength, slightly weathered, slightly fractured, grey-brown, medium grained sandstone *(continued)*						20.07m: B5°, cln co, 2mm 20.09m: Cs, 20mm 20.11m: B5°, fe co, 5mm 20.31m: Cs, 80mm				PL(A) = 0.8
-3	22							21.36m: B5°, cln, v? 21.41-21.88m: J85°, pl, ro 21.58m: Cs, 10mm 22.08m: B0°, cln, v?	C	100	94	PL(A) = 0.6
-4	22.31	SANDSTONE - medium to high then high strength, fresh, slightly fractured, grey, medium grained sandstone						22.31m: B0°, cln, v? 22.48m: B5°, cln co, 2mm 22.99m: B5°, cln co, 1mm				PL(A) = 1
-5	23							23.44m: Cs, 10mm 23.56m: B5°, cln, v? 23.68m: B5°, cln, f? 23.99m: J30°, pl, ro	C	100	99	PL(A) = 2
-6	24							24.1m: B5°, cln 24.15m: B0°, cln, v?				
	24.2	Bore discontinued at 24.2m										
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JEH/AT **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.10m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.3m; NMLC-Coring to 24.2m

WATER OBSERVATIONS: Free groundwater observed at 1.6m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 19.9 AHD
EASTING: 334424
NORTHING: 6246437
DIP/AZIMUTH: 90°/--

BORE No: 122
PROJECT No: 73743.02
DATE: 1/2/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing			
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
19	0.5	FILLING - apparently well compacted, light grey-brown, fine to coarse sand and fine to coarse, gravel filling, moist							A			
	1	FILLING - dark grey-brown, silty sand filling with rootlets and a trace of medium to coarse gravel, moist 1.0-1.45m: as above							S			2,4,4 N = 8
18	2											
17	3					▼			S			2,3,2 N = 5
16	4.0	SAND - medium dense, light brown to brown, fine sand, moist							S			3,6,8 N = 14
15	5											
14	6								S			6,8,10 N = 18
13	7								S			6,8,9 N = 17
12	8											
11	9								S			10,13,16 N = 29
10	10.0											

RIG: Scout 2 **DRILLER:** GT **LOGGED:** PO/JEH/SI **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 20.3m; NMLC-Coring to 26.5m

WATER OBSERVATIONS: Free groundwater observed at 3.0m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 19.9 AHD
EASTING: 334424
NORTHING: 6246437
DIP/AZIMUTH: 90°/--

BORE No: 122
PROJECT No: 73743.02
DATE: 1/2/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
9	11	SAND - medium dense, brown to dark brown, fine grained sand							S			5,10,14 N = 24
8	12	11.5-11.95m: grey							S			6,7,7 N = 14
7	13								S			1,6,7 N = 13
6	14	14.5-14.9m: pale grey-white, very dense							S			8,19,25/100mm refusal
5	15											
4	16 16.0	CLAY - stiff, black-dark grey clay							S			4,4,6 N = 10
3	17	17.5-17.45m: light grey, firm							S			1,2,4 N = 6
2	18											
1	19	19.0-19.45m: very stiff							S			5,12,14 N = 26
0												

RIG: Scout 2 **DRILLER:** GT **LOGGED:** PO/JEH/SI **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 20.3m; NMLC-Coring to 26.5m

WATER OBSERVATIONS: Free groundwater observed at 3.0m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 19.9 AHD
EASTING: 334424
NORTHING: 6246437
DIP/AZIMUTH: 90°/--

BORE No: 122
PROJECT No: 73743.02
DATE: 1/2/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CLAY - stiff, black-dark grey clay *(continued)*						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	20.3											
	20.65	SANDSTONE - very low strength, highly weathered, slightly fractured, light grey, fine to medium grained sandstone										PL(A) = 0.3
-1	21	SANDSTONE - low to medium then medium strength, slightly weathered, slightly fractured, light grey-brown, medium grained sandstone						20.88m: J80°, pl, ro, cly 20.92m: B5°- 10°, pl, ro, cly 21.03m: B0°, pl, ro, cly 21.16m: J60°, pl, ro, cly 21.2m: B0°- 5°, pl, ro, cly 21.46-21.77m: J80°, pl, he	C	100	88	PL(A) = 0.4
-2	22							22.22-22.45m: J80°, pl, ro, cly				PL(A) = 0.7
-3	23							23.06-23.18m: J85°, pl, he				
	23.25	SANDSTONE - very low then low to medium strength, slightly weathered, unbroken, light grey-brown, medium grained sandstone						23.2m: J45°, pl, ro, cly 23.39m: B0°, pl, ro, cly, fe	C	100	82	PL(A) = 0.1
-4	24											PL(A) = 0.2
-5	25											PL(A) = 0.3
-6	26							26.46m: B10°, pl, ro, cly, fe	C	100	100	PL(A) = 0.3
	26.5	Bore discontinued at 26.5m										
-7	27											
-8	28											
-9	29											
-10												

RIG: Scout 2 **DRILLER:** GT **LOGGED:** PO/JEH/SI **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 20.3m; NMLC-Coring to 26.5m

WATER OBSERVATIONS: Free groundwater observed at 3.0m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 17.8 AHD
EASTING: 334362
NORTHING: 6246408
DIP/AZIMUTH: 90°/--

BORE No: 128
PROJECT No: 73743.02
DATE: 1/2/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
17	0.15	CONCRETE										
		FILLING - light grey, medium to coarse sand filling with some fine to medium sandstone gravel, moist							A			
	0.65	SAND - loose, dark brown, medium to coarse sand, moist							A			
16	1								A			
									S			2,3,4 N = 7
	2											
	2.0	SAND - medium dense, yellow, medium to coarse sand, moist										
15									S			3,4,7 N = 11
	3											
14	4					▼						
		- becomes saturated							S			3,6,6 N = 12
13	5											
									S			5,4,6 N = 10
12	6											
11	7								S			6,6,7 N = 13
10	8											
	8.5	SAND - loose, grey, medium to coarse sand							S			2,4,4 N = 8
9	9											
8												

RIG: Scout 2 **DRILLER:** SY **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 14.3m; NMLC-Coring to 22.7m

WATER OBSERVATIONS: Free groundwater observed at 4.2m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 17.8 AHD
EASTING: 334362
NORTHING: 6246408
DIP/AZIMUTH: 90°/--

BORE No: 128
PROJECT No: 73743.02
DATE: 1/2/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SAND - loose, grey, medium to coarse sand *(continued)*										
		10.0m: becoming medium dense							S			3,4,7 N = 11
	11											
									S			3,8,11 N = 19
	12											
	12.8	SANDY CLAY - very stiff, grey-yellow, sandy clay										
	13								S			4,9,17 N = 26
								Note: Unless otherwise stated, all other defects are 0°- 5°, pl, ro, cbs st				
	14											
	14.1	SANDSTONE - extremely low strength, extremely weathered, grey-yellow sandstone										
	14.3	SANDSTONE - very low and medium strength, highly to moderately weathered, slightly fractured and unbroken, grey-yellow, fine to medium grained sandstone with ironstone bands										PL(A) = 0.1
	15							15m: Cs, 700mm	C	100	70	
												PL(A) = 0.4
	15.9	SANDSTONE - medium strength, highly to moderately weathered, slightly fractured, fine to medium grained sandstone with clay bands						15.87m: Cs, 30mm				PL(A) = 0.4
	16											
	17							17.1m: Cs, 100mm				
	17.2	SANDSTONE - medium strength, slightly weathered, slightly fractured, light grey and brown, medium to coarse grained sandstone with some clay bands						17.62m: J45°, pl, ro, cbs, st				PL(A) = 0.7
	18								C	100	92	PL(A) = 0.4
	19											
		20.0m: very low strength zone						19.85m: J30°, pl, ro, cly	C	100	85	PL(A) = 0.5

RIG: Scout 2 **DRILLER:** SY **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 14.3m; NMLC-Coring to 22.7m

WATER OBSERVATIONS: Free groundwater observed at 4.2m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 17.8 AHD
EASTING: 334362
NORTHING: 6246408
DIP/AZIMUTH: 90°/--

BORE No: 128
PROJECT No: 73743.02
DATE: 1/2/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-3	21	SANDSTONE - medium strength, slightly weathered, slightly fractured, light grey and brown, medium to coarse grained sandstone with some clay bands *(continued)*						20.13m: J0°- 30°, un, ro, fe st 20.45m: Cs, 100mm				PL(A) = 0.4
-4	21.0	SANDSTONE - low strength, fresh, slightly fractured and unbroken, light grey, medium to coarse grained sandstone with some carbonaceous laminations							C	100	85	PL(A) = 0.2
	22											PL(A) = 0.2
-5	22.7	Bore discontinued at 22.7m						22.62m: J70°- 90°, un, ro, cln				
	23											
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											
-12												

RIG: Scout 2 **DRILLER:** SY **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 14.3m; NMLC-Coring to 22.7m

WATER OBSERVATIONS: Free groundwater observed at 4.2m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334443
NORTHING: 6246389
DIP/AZIMUTH: 90°/--

BORE No: 130
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.15	CONCRETE							A			
	0.3	FILLING - dark grey, fine to coarse sand and fine to coarse gravel, moist							A			
		FILLING - brown, medium to coarse sandy clay with some fine sandstone gravel, moist							A			
17	1.4								S			2,5,8 N = 13
		FILLING - dark grey, medium to coarse sand with some fine sandstone gravel, moist										
16	2.5								S			4,8,9 N = 17
	2.95	SAND - medium dense, brown, fine to medium sand, moist										
15		SAND - medium dense, white and brown to dark brown, fine sand										
		3.8m: becoming wet				▼			S			4,7,8 N = 15
14												
13									S			2,7,5 N = 12
12												
11		7.0-7.45m: slightly silty, brown							S			8,13,13 N = 26
10	8.0	SAND - dense, light grey-brown, fine to medium grained sand							S			12,21,25 N = 46
9	10.0											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN/PO **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 20.5m; NMLC-Coring to 29.1m

WATER OBSERVATIONS: Free groundwater observed at 3.8m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334443
NORTHING: 6246389
DIP/AZIMUTH: 90°/--

BORE No: 130
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault				
		PEAT - firm to stiff, dark brown to black, peaty clay							S			10,6,3 N = 9
	11											
									S			3,4,4 N = 8
	12											
	13 13.0	SAND - very dense, brown, fine sand							S			13,24,25/100mm refusal
	14											
		14.5-14.6m: as above, mottled white and brown							S			25/100mm refusal
	15											
	16 16.0	CLAY - firm, dark grey-black clay							S			3,3,4 N = 7
	16.45	SANDY CLAY - stiff, pale grey-white, fine to coarse sandy clay										
	17											
									S			3,3,5 N = 8
	18											
	19	19.0-19.45m: very stiff							S			5,9,10 N = 19

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN/PO **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 20.5m; NMLC-Coring to 29.1m

WATER OBSERVATIONS: Free groundwater observed at 3.8m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334443
NORTHING: 6246389
DIP/AZIMUTH: 90°/--

BORE No: 130
PROJECT No: 73743.02
DATE: 3/2/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2	20.5	SANDY CLAY - stiff, pale grey-white, fine to coarse sandy clay *(continued)*						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	20.65	SANDSTONE - very low strength, light grey, fine to medium grained sandstone							S			25/150mm refusal
-3	21	SANDSTONE - very low strength, highly weathered, fractured and slightly fractured, grey-brown, medium to coarse sandstone with some extremely low strength bands (possible weathered dyke)						20.8m: Cs, 20mm 20.99m: Cs, 10mm 21.17-22.15m: J (x3) 40°- 45°, pl, sm, cln 21.82m: J45°, pl, sm, cly 22.15m: Cs, 150mm	C	100	41	PL(A) = 0.1
-4	22.4	SANDSTONE - medium and high strength, moderately weathered, fractured, red and grey-brown, medium to coarse sandstone with ironstone bands and some extremely low and very low strength sandstone bands						22.49m: Cs, 10mm 22.56m: J45°- 80°, st, ro, fe st 22.8m: Cs, 30mm 22.83m: fg, 70mm 22.83 &23.64m: J80°- 90°, cu, ro, cln 23.0-23.46m: J45°- 90°, un, ro, fe st 23.42m: Cs, 40mm 23.86-23.96m: J45°- 90°, cu, ro, cly 23.96m: CORE LOSS: 40mm 24.0-24.06m: J0°- 90°, un, ro, cln 24.32m: Cs, 110mm 24.43-24.56m: J90°, pl, ro, cly				PL(A) = 0.4
-5	24								C	97	84	
-6	24.0											PL(A) = 0.2
-7	25							24.53, 24.78m: J30°- 45°, cu, ro, cln 24.78m: Cs, 50mm 25.15-25.46m: J75°- 90°, pl, partially he 25.46m: Ds, 30mm 25.5-25.8m: J (x3) pl, ro, cly 26m: Ds, 50mm 26.05m: CORE LOSS: 450mm 26.6m: B10°, fe st 26.73-28.85m: J60°- 90°, co, ro, cln 26.85m: Cs, 200mm 27.05-27.2m: J60°- 90°, cu, ro, cln 27.13m: B5°, cbs, st 27.18m: J45°, pl, ro, cln 27.31-27.38m: J60°, pl, ro, cln 27.51-23.56m: J30°- 45°, cu, ro, cly 27.66-28.1m: J30°- 45°, pl, ro, cln 28.1m: Cs, 300mm 28.37m: J45°, pl, ro, cln 28.45m: Cs, 30mm				PL(A) = 1.2
-8	26											
	26.05	SANDSTONE - medium strength, slightly weathered, slightly fractured, red and brown, medium to coarse sandstone with some ironstone bands							C	76	44	
-9	26.5											PL(A) = 0.9
	27											
-10	27.0	SANDSTONE - medium strength, fresh, fractured and slightly fractured, yellow-brown, medium to coarse sandstone with extremely low strength bands										PL(A) = 0.9
	28								C	100	70	
-11	29											PL(A) = 0.6
	29.06	Bore discontinued at 29.06m										

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN/PO **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 20.5m; NMLC-Coring to 29.1m

WATER OBSERVATIONS: Free groundwater observed at 3.8m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.4 AHD
EASTING: 334270
NORTHING: 6246547
DIP/AZIMUTH: 90°/--

BORE No: 131
PROJECT No: 73743.02
DATE: 17 - 18/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.2	FILLING - roadbase gravel and sand filling							A			
		FILLING - poorly compacted, light grey to dark grey, fine to medium sand filling with some roadbase gravel and building rubble							A			
17	1								A			
									S			1,2,2 N = 4
16	2											
									S			1,1,1 N = 2
15	3											
						▼						
14	4								S			3,6,6 N = 12
	4.1	FILLING - variably compacted, brown, gravelly (brick, roadbase) sand filling, wet										
13	5											
									S			13,7,8 N = 15
12	6											
	6.0	SAND - very dense, light grey-brown, fine to medium sand										
11	7								S			12,20,25 N = 45
10	8											
									S			25,32/150mm refusal
9	9											
	9.8	ORGANIC CLAY - see next page										

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JN/SI **CASING:** HW to 5.5m; HQ to 17.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 17.5m; NMLC-Coring to 23.55m

WATER OBSERVATIONS: Free groundwater observed at 3.9m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.4 AHD
EASTING: 334270
NORTHING: 6246547
DIP/AZIMUTH: 90°/--

BORE No: 131
PROJECT No: 73743.02
DATE: 17 - 18/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
8		ORGANIC CLAY - very soft, dark grey clay with some fine sand *(continued)*							S			0,0,0 N = 0
7	11 11.0	SAND - very dense, light grey-brown, fine to medium sand							S			35/150mm refusal
6	12											
	12.5	CLAY - stiff then very stiff, light grey and mottled brown clay, slightly silty with a trace of fine sand										
5	13								S			2,6,9 N = 15
4	14											
	15								S			5,5,8 N = 13
3	16											
2		16.5m: becoming sandy clay						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			6,10,17 N = 27
1	17											
	17.3	SANDSTONE - very low strength, light brown to red-brown, fine to medium sandstone										
	17.5	SANDSTONE - medium to high and high strength, slightly weathered, slightly fractured, yellow-brown, medium to coarse grained sandstone						17.73-17.92m: B10°, pl, ro, cly 18.12m: Cs, 30mm 18.65m: B10°, pl, ro, cly	C	100	99	PL(A) = 1 PL(A) = 1.1
0	18											
	19 19.0	SANDSTONE - very low strength, highly weathered, slightly fractured, brown, fine to medium grained sandstone						19.31m: Cs, 20mm 19.5m: fg, 30mm				
-1	19.5	SANDSTONE - see next page										PL(A) = 0.4

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JN/SI **CASING:** HW to 5.5m; HQ to 17.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 17.5m; NMLC-Coring to 23.55m

WATER OBSERVATIONS: Free groundwater observed at 3.9m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.4 AHD
EASTING: 334270
NORTHING: 6246547
DIP/AZIMUTH: 90°/--

BORE No: 131
PROJECT No: 73743.02
DATE: 17 - 18/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2		SANDSTONE - medium and high strength, fresh, slightly fractured and unbroken, light grey-medium to coarse grained sandstone *(continued)*						20.11m: Cs, 10mm	C	100	99	
-3	21											PL(A) = 0.6
-4	22							>>	C	100	99	PL(A) = 1.4
-5	23											PL(A) = 1.7
	23.55	Bore discontinued at 23.55m										PL(A) = 0.8
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JN/SI **CASING:** HW to 5.5m; HQ to 17.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 17.5m; NMLC-Coring to 23.55m

WATER OBSERVATIONS: Free groundwater observed at 3.9m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334308
NORTHING: 6246548
DIP/AZIMUTH: 90°/--

BORE No: 132
PROJECT No: 73743.02
DATE: 25/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.14	CONCRETE							A			
		FILLING - dark grey, sandy gravel filling with some clay and silt, damp							A			
	0.8	FILLING - poorly compacted, dark grey, silty, medium to coarse sand filling with some fine to medium sandstone gravel, damp to moist							A			
17	1								S			1,1,1 N = 2
	2	2.0m: becoming wet				▼						
16	2.5	SILTY CLAY - very soft, dark grey, silty clay with some fine to medium sandstone gravel and a trace of sea shell fragments, wet							S			1,0,0 N = 0
15	3											
	4								S			3,5,8 N = 13
14	4.4	SAND - medium dense, brown, medium to coarse sand with a trace of fine sandstone gravel, saturated										
13	5											
		5.6-6.8m: becomes light brown							S			5,9,9 N = 18
12	6											
		6.8-8.5m: becomes very dense, dark brown										
	7								S			25/100mm refusal
11	8											
		8.5-10.4m: becomes dense, light brown							S			11,18,24 N = 42
10	9											
9												

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.14m; Solid flight auger (TC-bit) to 5.5m; Rotary to 15.7m; NMLC-Coring to 22.7m

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334308
NORTHING: 6246548
DIP/AZIMUTH: 90°/--

BORE No: 132
PROJECT No: 73743.02
DATE: 25/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SAND - *(continued)*							S			10,8,4 N = 12
	10.4	SANDY CLAY - stiff, light and dark grey, medium to coarse sandy clay, saturated										
	11.3	CLAYEY SAND - very dense, light grey, medium to coarse clayey sand, saturated							S			8,16,25/50mm refusal
	12.8	SILTY CLAY - stiff, grey, silty clay with medium to coarse sand, saturated							S			3,5,8 N = 13
		14.5-15.7m: becomes grey mottled red with trace of medium to coarse sand, saturated						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			3,6,9 N = 15
	15.7	CLAY - hard, grey clay, slightly silty with ironstone bands and some medium to coarse sand										~~pp >600~~
									C	100	0	pp >600 pp >600 PL(A) = 0.3
	17.05	SANDSTONE - very low strength, highly weathered, fractured to slightly fractured, grey and red, medium to coarse grained sandstone with extremely low and very low strength, extremely weathered bands							C	100	45	
	18.8	SANDSTONE - low to medium and low strength, moderately weathered, slightly fractured, grey-red, fine to medium grained sandstone						19.08m: B0°- 5°, pl, ro, fe st 19.14m: B0°- 5°, pl, ro, cly 19.71m: Cs, 20mm	C	100	100	PL(A) = 0.3

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.14m; Solid flight auger (TC-bit) to 5.5m; Rotary to 15.7m; NMLC-Coring to 22.7m

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334308
NORTHING: 6246548
DIP/AZIMUTH: 90°/--

BORE No: 132
PROJECT No: 73743.02
DATE: 25/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2		SANDSTONE - *(continued)*						20.09m: Cs, 80mm 20.23m: Cs, 30mm				PL(A) = 0.2
	20.5	SANDSTONE - medium to high and high strength, fresh, slightly fractured then unbroken, grey, medium to coarse grained sandstone with carbonaceous laminations							C	100	100	
-3	21											PL(A) = 1.2
	22											
-4	22.7											PL(A) = 1
		Bore discontinued at 22.7m										
-5	23											
	24											
-6	25											
-7	26											
-8	27											
-9	28											
-10	29											
-11												

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.14m; Solid flight auger (TC-bit) to 5.5m; Rotary to 15.7m; NMLC-Coring to 22.7m

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING: 334345
NORTHING: 6246511
DIP/AZIMUTH: 90°/--

BORE No: 133
PROJECT No: 73743.02
DATE: 18 - 19/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.15	CONCRETE										
		FILLING - poorly compacted, dark grey-brown, fine to medium sand filling with some glass							A			
									A			
1									A			
									S			3,3,2 N = 5
17												
2	2.0	SAND - medium dense, light grey-brown, fine to medium sand, moist										
									S			2,4,5 N = 9
16												
3												
15												
4		4.1m: becoming wet				▼			S			8,12,18 N = 30
14												
5												
13												
									S			6,8,16 N = 24
6												
12												
7	6.9	CLAYEY SAND - loose, dark grey-brown, fine to medium clayey sand with some organic matter							S			5,5,3 N = 8
	7.1	SAND with some CLAY - dense, light grey-brown, fine sand with some clay										
11												
8												
10									S			6,14,25 N = 39
9												
	9.25	SANDY CLAY - firm, dark grey-brown, fine sandy clay with some organic matter, low plasticity										
9												

RIG: Explorer **DRILLER:** JS **LOGGED:** JEH/SI **CASING:** HQ to 21.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 21.5m; NMLC-Coring to 27.5m

WATER OBSERVATIONS: Free groundwater observed at 4.1m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING: 334345
NORTHING: 6246511
DIP/AZIMUTH: 90°/--

BORE No: 133
PROJECT No: 73743.02
DATE: 18 - 19/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	10.1	CLAYEY SAND - very dense, dark brown-brown, fine sand with some clay							S S			4,3,3 N = 6
									S			11,23,25/90mm refusal
	12.9	SANDY CLAY - very stiff, dark grey-grey, fine sandy clay, high plasticity							S			12,9,8 N = 17
	14.5	CLAY - stiff, grey mottled red, clay with some fine sand							S			3,4,7 N = 11
		15.9m: becoming very stiff, medium plasticity							S			6,11,13 N = 24
	16.5	CLAY - very stiff, grey mottled brown-orange clay, medium plasticity							S			5,9,15 N = 24
									S			7,11,16 N = 27

RIG: Explorer **DRILLER:** JS **LOGGED:** JEH/SI **CASING:** HQ to 21.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 21.5m; NMLC-Coring to 27.5m

WATER OBSERVATIONS: Free groundwater observed at 4.1m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING: 334345
NORTHING: 6246511
DIP/AZIMUTH: 90°/--

BORE No: 133
PROJECT No: 73743.02
DATE: 18 - 19/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CLAY - *(continued)*										
-2	20.4	SANDSTONE - extremely low strength, light grey, fine grained sandstone						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			6,12,16 N = 28
	21											
-3	21.5	SANDSTONE - medium strength, highly weathered, slightly fractured, medium to coarse grained sandstone						21.55m: J60°, fe, ti 21.67m: B0°, cly, 10mm 21.8m: J45°, ti 21.92m: J50°, pl, ro, fe				PL(A) = 0.7
	22											
-4	22.0	SANDSTONE - high strength, moderately weathered then fresh, slightly fractured and unbroken, medium to coarse grained sandstone										PL(A) = 2.4
	23								C	100	97	
-5												PL(A) = 1.9
	24											
-6								24.3 & 24.75m: B (x2) 15°, cly vn, ti				PL(A) = 1.5
	25											
-7												PL(A) = 2.3
	26								C	100	100	
-8		26.4-26.5m: medium strength carbonaceous sandstone						26.4m: B0°, cly co, 3mm				PL(A) = 0.7
	27	26.75-27.35m: fine grained sandstone						26.85m: J80°, un, ro, cln				PL(A) = 2.1
-9	27.5	Bore discontinued at 27.5m						27.3m: B10°, cbs co				
	28											
-10												
	29											
-11												

RIG: Explorer **DRILLER:** JS **LOGGED:** JEH/SI **CASING:** HQ to 21.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 21.5m; NMLC-Coring to 27.5m

WATER OBSERVATIONS: Free groundwater observed at 4.1m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334279
NORTHING: 6246532
DIP/AZIMUTH: 90°/--

BORE No: 134
PROJECT No: 73743.02
DATE: 21/12/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.18	CONCRETE							A			
		FILLING - poorly compacted, dark grey, medium to coarse sand filling with roadbase gravel, timber and brick fragments							A			
17	1								A			
									S			1,1,1 N = 2
	1.8	FILLING - poorly compacted, dark grey, sandy clay filling with some gravel (roadbase, building rubble etc), wet										
16	2								S			1,0,1 N = 1
	3					▼						
15	4								S			3,5,2 N = 7
	4.9	SAND - medium dense then dense, light grey-brown, fine to medium sand										
14	5											
13									S			28,12,14 N = 26
	6											
12	7								S			15,23,17 N = 40
11	8											
10		8.5m: dense silty sand							S			3,16,27 N = 43
	9											
9	9.8											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 5.5m; HQ to 18.0m

TYPE OF BORING: Diatube to 0.18m; Solid flight auger (TC-bit) to 5.5m; Rotary to 18.0m; NMLC-Coring to 24.05m

WATER OBSERVATIONS: Free groundwater observed at 3.2m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334279
NORTHING: 6246532
DIP/AZIMUTH: 90°/--

BORE No: 134
PROJECT No: 73743.02
DATE: 21/12/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
8		ORGANIC SANDY CLAY - very soft, dark grey to black, fine, organic sandy clay *(continued)*							S			0,0,1 N = 1
	10.8	SAND - very dense, light brown, fine to medium sand with some clay										
7	11								S			40/150mm refusal
6	12											
	12.7	CLAY - stiff then very stiff, light grey mottled brown clay, slightly silty										
5	13								S			2,5,7 N = 12
4	14											
									S			6,9,13 N = 22
3	15											
2	16								S			4,10,14 N = 24
	16.5	SANDY CLAY - very stiff to hard, light grey-brown, fine sandy clay										
1	17							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	17.65	SANDSTONE - very low strength, light grey-brown, fine to medium grained sandstone							S			6,20/100mm refusal
0	18 18.0	SANDSTONE - low strength, extremely to highly weathered, slightly fractured, light grey, medium to coarse grained sandstone with extremely low and very low strength bands						18m: Cs, 40mm 18.55m: Cs, 650mm	C	100	62	PL(A) = 0.2
	19											
-1	19.2	LAMINITE - very low strength, highly weathered, unbroken, dark grey siltstone with grey, fine to medium sandstone laminae										PL(A) = 0.1
	19.5											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 5.5m; HQ to 18.0m

TYPE OF BORING: Diatube to 0.18m; Solid flight auger (TC-bit) to 5.5m; Rotary to 18.0m; NMLC-Coring to 24.05m

WATER OBSERVATIONS: Free groundwater observed at 3.2m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334279
NORTHING: 6246532
DIP/AZIMUTH: 90°/--

BORE No: 134
PROJECT No: 73743.02
DATE: 21/12/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2		SANDSTONE - low to medium strength, slightly weathered, fractured to slightly fractured, grey, fine to medium grained sandstone with some very low strength bands and carbonaceous laminations *(continued)*						20.6 & 20.7m: J30°- 45°, pl, ro, cly 20.84m: B5°, Cs, 5mm	C	100	62	PL(A) = 0.3
	21											
-3								21.6m: Cs, 50mm				
	22	21.9-23.4m: becomes medium strength, fresh, unbroken										PL(A) = 0.8
-4									C	100	100	PL(A) = 1.1
	23											
-5	23.4	LAMINITE - high strength, fresh, unbroken, dark grey siltstone with fine to medium grained sandstone laminae										PL(A) = 2
	23.7											
	24											
-6	24.07	SANDSTONE - high strength, fresh, unbroken, brown, medium to coarse grained sandstone										PL(A) = 1.8
		Bore discontinued at 24.07m										
	25											
-7												
	26											
-8												
	27											
-9												
	28											
-10												
	29											
-11												

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 5.5m; HQ to 18.0m

TYPE OF BORING: Diatube to 0.18m; Solid flight auger (TC-bit) to 5.5m; Rotary to 18.0m; NMLC-Coring to 24.05m

WATER OBSERVATIONS: Free groundwater observed at 3.2m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.1 AHD
EASTING: 334257
NORTHING: 6246525
DIP/AZIMUTH: 90°/--

BORE No: 135
PROJECT No: 73743.02
DATE: 16/12/2015
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.12	CONCRETE							A			
		FILLING - poorly compacted, light brown, sand filling with some crushed sandstone gravel, damp							A			
		0.4m - becoming brown with some roadbase gravel							A			
17	1	1.0m - with some igneous rock gravel with trace of ceramic and trace of metal, moist							S			5,2,2 N = 4
16	2					▼						
	2.75	PEATY CLAY - very soft, dark grey to black, peaty clay, wet							S			2,1,1 N = 2
15	3											
	3.2	SAND - medium dense grey, brown fine to medium grained sand, slightly silty, moist										
		3.80m - becoming grey-brown silty sand							S			4,7,9 N = 16
14	4											
13	5								S			10,12,17 N = 29
12	6											
11	7								S			25,15,11 N = 26
	7.7	SAND - dense to very dense brown, fine to medium grained sand										
10	8								S			16,20,25 N = 45
9	9											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JS/SI **CASING:** HW 5.5-15.2m; HQ15.2-21.25m

TYPE OF BORING: Solid flight anger (TC bit) to 5.5m; Rotary to 16.2m; NMLC-Coring to 21.25m

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.1 AHD
EASTING: 334257
NORTHING: 6246525
DIP/AZIMUTH: 90°/--

BORE No: 135
PROJECT No: 73743.02
DATE: 16/12/2015
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SAND - dense to very dense brown, fine to medium grained sand *(continued)*							S			10,17,25 N = 42
	11											
	12								S			26,32 refusal
	12.1	CLAY - stiff, grey mottled orange brown clay, moist										
	13								S			2,5,8 N = 13
	14											
		14.3m - becoming very stiff						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			1,6,9 N = 15
	15											
	15.0	SANDSTONE - very low strength, grey brown, fine to medium grained sandstone										
	15.2	SANDSTONE - medium strength, moderately weathered then fresh, slightly fractured and unbroken, fine to medium grained sandstone										PL(A) = 0.7
	16							15.83m: B0°- 5°, cly				PL(A) = 0.7
												PL(A) = 0.4
								16.47m: B0°- 5°, cly	C	100	100	PL(A) = 1.1
	17											
								>>				PL(A) = 0.5
	18											PL(A) = 0.4
								18.6m: J85°- 90°, pl, ro, cln				
	19							18.95m: Cs, 10mm	C	100	100	PL(A) = 0.8
	19.6	SANDSTONE *(see next page)*										

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JS/SI **CASING:** HW 5.5-15.2m; HQ15.2-21.25m

TYPE OF BORING: Solid flight anger (TC bit) to 5.5m; Rotary to 16.2m; NMLC-Coring to 21.25m

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.1 AHD
EASTING: 334257
NORTHING: 6246525
DIP/AZIMUTH: 90°/--

BORE No: 135
PROJECT No: 73743.02
DATE: 16/12/2015
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2		SANDSTONE - high strength, slightly fractured to unbroken, fresh, fine to medium sandstone *(continued)*						20.14m: Cs, 5mm				PL(A) = 1.3
									C	100	100	
-3	21							21.1m: B0°- 5°, cly				PL(A) = 1.4
	21.25	Bore discontinued at 21.25m										
-4	22											
-5	23											
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JS/SI **CASING:** HW 5.5-15.2m; HQ15.2-21.25m

TYPE OF BORING: Solid flight anger (TC bit) to 5.5m; Rotary to 16.2m; NMLC-Coring to 21.25m

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334289
NORTHING: 6246512
DIP/AZIMUTH: 90°/--

BORE No: 136
PROJECT No: 73743.02
DATE: 14/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.13	CONCRETE							A			
		FILLING - poorly compacted, dark brown, gravelly, medium to coarse sand							A			
	1								A			
									S			1,1,0 N = 1
17	2											
16									S			1,0,0 N = 0
	3					▼						
15	4	4.0m: becomes saturated							S			1,2,5 N = 7
14	4.3	SAND - loose, yellow-brown, medium to coarse sand, saturated										
	5											
13		5.4-6.8m: becomes light grey							S			2,1,3 N = 4
12	6											
	6.8	SAND - very dense, dark grey, medium to coarse sand							S			8,12,25/100mm refusal
11	7											
	8											
10	8.2	CLAYEY SAND - medium dense, grey, medium to coarse clayey sand							S			8,3,23 N = 26
	8.9	SAND - dense, light grey, medium to coarse sand										
9	9											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 15.8m; NMLC-Coring to 21.8m

WATER OBSERVATIONS: Free groundwater observed at 3.0m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334289
NORTHING: 6246512
DIP/AZIMUTH: 90°/--

BORE No: 136
PROJECT No: 73743.02
DATE: 14/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault				
		SAND - dense, light grey, medium to coarse sand *(continued)*							S			18,22,20 N = 42
	11											
		11.5m: becoming very dense							S			25 refusal
	12											
	12.8	SILTY CLAY - very stiff, grey silty clay										
	13								S			2,4,5 N = 9
	14											
		14.5m: becomes very stiff							S			5,9,10 N = 19
	15							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	15.8	CLAY - hard, grey mottled red clay										pp >600
	16											pp >600
												pp >600
	16.5	SANDSTONE - very low strength, highly weathered, fractured and slightly fractured, grey, medium to coarse grained sandstone with some extremely low strength bands						16.7m: J45°, pl, ro, cly				PL(A) = 0.1
	17							16.9m: J45°, pl, ro, cln 16.92m: Cs, 80mm 17.18m: Cs, 20mm 17.31m: Cs, 150mm	C	100	0	
												PL(A) = 0.1
	18											
												PL(A) = 0.1
								18.67m: Cs, 330m				
	19	19.0 SANDSTONE - medium strength, moderately weathered, fractured, grey and red, medium to coarse sandstone with some extremely low strength bands						18.9m: B5°, pl, ro, fe st 19.14m: B0°, pl, ro, fe st 19.27m: Cs, 10mm 19.31m: Cs, 20mm 19.34m: B5°, pl, ro, cly 19.59m: B0°, pl, ro, Cs, 5mm	C	100	97	PL(A) = 0.7
	19.92											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 15.8m; NMLC-Coring to 21.8m

WATER OBSERVATIONS: Free groundwater observed at 3.0m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334289
NORTHING: 6246512
DIP/AZIMUTH: 90°/--

BORE No: 136
PROJECT No: 73743.02
DATE: 14/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2	21	SANDSTONE - medium strength, fresh, fractured to slightly fractured, grey, medium to coarse grained sandstone with a trace of extremely low strength bands *(continued)* 21.12-21.8m: becomes high strength						19.86m: J0°- 45°, cu, ro, cly 19.91m: Cs, 10mm 20.08m: B0°, pl, ro, fe st 20.19m: J30°, pl, ro, cly 20.4m: Cs, 30mm 20.4-20.7m: J70°, pl, ro, cln 20.9m: Cs, 10mm 21.1m: Cs, 10mm	C	100	97	PL(A) = 0.4 PL(A) = 1.3
-3	21.8	Bore discontinued at 21.8m										
-4	22											
-5	23											
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 15.8m; NMLC-Coring to 21.8m

WATER OBSERVATIONS: Free groundwater observed at 3.0m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334322
NORTHING: 6246499
DIP/AZIMUTH: 90°/--

BORE No: 137
PROJECT No: 73743.02
DATE: 15 - 18/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.15	CONCRETE							A			
		FILLING - dark brown, fine to medium sand with some gravel							A			
	0.7	FILLING - light to medium brown, fine sand filling										
17	1.0	FILLING - light brown to brown, fine sand with some gravel							A			
									S			2,3,3 N = 6
	1.8	SANDY CLAY - very loose, brown to dark grey, fine to medium sand with some silt and some organic matter										
16									S			1,0,1 N = 1
	2.8	SAND - medium dense, light brown to brown-grey, fine to medium sand, damp to wet										
15						▼			S			4,9,14 N = 23
14												
13									S			6,9,10 N = 19
12												
11									S			8,14,13 N = 27
10	8.1	CLAYEY SAND - medium dense, brown to grey, fine to medium clayey sand										
									S			20,11,4 N = 15
9	9.5	SAND - very dense, light brown to brown, fine sand										

RIG: Scout 2 **DRILLER:** WG **LOGGED:** AT **CASING:** HW to 5.8m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.8m; Rotary to 15.8m; NMLC-Coring to 24.05m

WATER OBSERVATIONS: Free groundwater observed at 4.3m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334322
NORTHING: 6246499
DIP/AZIMUTH: 90°/--

BORE No: 137
PROJECT No: 73743.02
DATE: 15 - 18/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SAND - very dense, light brown to brown, fine sand *(continued)*						B - Bedding J - Joint S - Shear F - Fault	S			24,25/50mm refusal
	10.9	PEATY SAND - very dense, dark grey-brown, fine sand with some peat/charcoal										
	13.35	SAND - medium dense, light brown-grey, fine sand							S			25,15,9 N = 24
	14.0	SILTY CLAY - stiff to very stiff, red-brown mottled grey, silty clay with a trace of ironstone gravel						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			3,6 refusal
	15.8	SANDSTONE - very low strength, highly weathered, slightly fractured, grey, fine grained sandstone										
	17.0	SANDSTONE - low strength, highly weathered, slightly fractured, grey, ironstained, fine grained sandstone							C	92	81	PL(A) = 0.2
	19.84								C	100	91	

Degree of Weathering: EW, HW, MW, SW, FS, FR
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00

RIG: Scout 2 **DRILLER:** WG **LOGGED:** AT **CASING:** HW to 5.8m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.8m; Rotary to 15.8m; NMLC-Coring to 24.05m

WATER OBSERVATIONS: Free groundwater observed at 4.3m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334322
NORTHING: 6246499
DIP/AZIMUTH: 90°/--

BORE No: 137
PROJECT No: 73743.02
DATE: 15 - 18/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2	21	SANDSTONE - low and medium strength, highly weathered, slightly fractured, light grey, medium grained sandstone with ironstone bands *(continued)*						20.19m: B5°, pl, ro 20.6m: B0°, pl, ro, cly 20.74m: J45°, pl, ro, cln	C	100	91	PL(A) = 0.8 PL(A) = 0.1
-3	21.19	SANDSTONE - medium strength, slightly weathered, slightly fractured, light grey, medium grained sandstone						21.16m: B5°, pl, ro, cly (10mm) 21.43m: B5°, pl, ro, cln				PL(A) = 0.3 PL(A) = 0.5
-4	21.77 22	SANDSTONE - high strength, fresh, slightly fractured, light grey, medium grained sandstone						21.64m: B0°, pl, ro, cly, 10mm 21.64-21.76m: J70°, un, ro, cln 21.76m: B5°, pl, ro, cly vn	C	100	92	PL(A) = 1.3
-5	23							23.51m: B0°, pl, ro, cly vn				PL(A) = 1.1
	24 24.09	Bore discontinued at 24.09m										
-6	25											
-7	26											
-8	27											
-9	28											
-10	29											
-11												

Degree of Weathering: EW, HW, MW, SW, FS, FR
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00

RIG: Scout 2 **DRILLER:** WG **LOGGED:** AT **CASING:** HW to 5.8m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.8m; Rotary to 15.8m; NMLC-Coring to 24.05m

WATER OBSERVATIONS: Free groundwater observed at 4.3m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.1 AHD
EASTING: 334245
NORTHING: 6246502
DIP/AZIMUTH: 90°/--

BORE No: 138
PROJECT No: 73743.02
DATE: 18/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.12	CONCRETE							A			
		FILLING - grey to grey-brown, gravelly (roadbase, rubble) sand filling with glass and brick fragments							A			
17	1								A			
									S			2,2,2 N = 4
16	2											
	2.8	SAND - medium dense, grey-brown sand, wet							S			4,5,8 N = 13
15	3					▼						
14	4								S			3,7,14 N = 21
13	5											
		5.5m: becoming dense to very dense							S			15,15,16 N = 31
12	6											
11	7								S			23,30/150mm refusal
	7.9	PEATY CLAY - very soft, dark grey, peaty clay with some sand										
10	8											
	8.3	SAND - medium dense, light grey-brown, fine to medium sand							S			22,15,10 N = 25
9	9											
		10.0m: becomes very dense										

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JN/SI **CASING:** HQ to 3.5m; HW to 16.0m

TYPE OF BORING: Diatube to 0.12m; Solid flight auger (TC-bit) to 3.5m; Rotary to 16.0m; NMLC-Coring to 22.1m

WATER OBSERVATIONS: Free groundwater observed at 3.5m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.1 AHD
EASTING: 334245
NORTHING: 6246502
DIP/AZIMUTH: 90°/--

BORE No: 138
PROJECT No: 73743.02
DATE: 18/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
8		SAND - medium dense, light grey-brown, fine to medium sand *(continued)*							S			16,25,30/100mm refusal
7	11											
	11.3	CLAY - stiff, light grey clay, slightly silty, moist							S			0,5,5 N = 10
6	12											
	12.8	SANDY CLAY - very stiff, grey-brown, fine to medium sandy clay, moist							S			0,6,10 N = 16
5	13											
4	14											
	14.6	SANDSTONE - very low strength, light grey-brown, fine to medium grained sandstone							S			70,20/150mm refusal
3	15											
	16 16.0	SANDSTONE - high strength, slightly weathered, slightly fractured, red-grey-orange, medium to coarse sandstone with ironstaining										PL(A) = 2
	16.43 16.56							16.43m: CORE LOSS: 130mm				
2		SANDSTONE - medium to high and high strength, fresh, fractured to slightly fractured, light grey, medium to coarse grained sandstone with some carbonaceous laminations and trace of extremely low strength bands							C	96	99	
1	17											PL(A) = 1.3
	18											PL(A) = 1
0	19											PL(A) = 0.7
-1									C	100	92	
	19.6	LAMINITE - low strength, highly weathered and fresh, fractured, grey,										
	19.85											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JN/SI **CASING:** HQ to 3.5m; HW to 16.0m

TYPE OF BORING: Diatube to 0.12m; Solid flight auger (TC-bit) to 3.5m; Rotary to 16.0m; NMLC-Coring to 22.1m

WATER OBSERVATIONS: Free groundwater observed at 3.5m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.1 AHD
EASTING: 334245
NORTHING: 6246502
DIP/AZIMUTH: 90°/--

BORE No: 138
PROJECT No: 73743.02
DATE: 18/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2	20.26	medium to coarse grained sandstone with dark grey siltstone laminations										
-3	21.0	SANDSTONE - medium to high and high strength, fresh, slightly fractured, light grey, medium to coarse grained sandstone with some carbonaceous laminations and extremely low and very low strength bands *(continued)*							C	100	92	PL(A) = 1.7
-4	22.1	SANDSTONE - medium to high strength, fresh, slightly fractured, light grey, fine to medium grained sandstone										PL(A) = 0.9
		SANDSTONE - medium strength, fresh, unbroken, light grey, medium to coarse grained sandstone										
		Bore discontinued at 22.1m										
-5	23											
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JN/SI **CASING:** HQ to 3.5m; HW to 16.0m

TYPE OF BORING: Diatube to 0.12m; Solid flight auger (TC-bit) to 3.5m; Rotary to 16.0m; NMLC-Coring to 22.1m

WATER OBSERVATIONS: Free groundwater observed at 3.5m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334274
NORTHING: 6246513
DIP/AZIMUTH: 90°/--

BORE No: 139
PROJECT No: 73743.02
DATE: 14/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.13	CONCRETE							A			
	0.3	FILLING - poorly compacted, dark grey, medium to coarse sand filling with roadbase gravel, moist							A			
18		FILLING - poorly compacted, dark grey, fine sandy clay filling with some metallic wire, wet							A			
	1								S			1,1,1 N = 2
17												
	2											
16		2.7m: becoming wet				▼			S			1,0,0 N = 0
	3											
15												
	4								S			1,0,1 N = 1
14												
	4.8	SAND - medium dense, light brown, fine to medium grained sand, slightly silty, wet										
	5											
13									S			2,9,13 N = 22
	6											
12												
	6.8	PEATY SAND - medium dense, dark grey, fine grained, peaty sand										
	7								S			11,25/100mm refusal
	7.25	SAND - dense to very dense, light grey-brown, fine to medium sand										
11												
	8											
10									S			8,26,25/100mm refusal
	9											
9												

RIG: Scout 2 **DRILLER:** WG **LOGGED:** SI **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 14.3m; NMLC-Coring to 22.7m

WATER OBSERVATIONS: Free groundwater observed at 2.7m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334274
NORTHING: 6246513
DIP/AZIMUTH: 90°/--

BORE No: 139
PROJECT No: 73743.02
DATE: 14/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SAND - dense to very dense, light grey-brown, fine to medium sand *(continued)*							S			10,25,17 N = 42
	11											
									S			12,25/100mm refusal
	12											
	12.4	CLAY - stiff, grey clay with a trace of fine sand, moist										
	13											
								Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			2,3,6 N = 9
	14											
	14.0	SANDSTONE - extremely low strength, light grey-brown, fine grained sandstone										
	14.3	SANDSTONE - medium and medium to high strength, highly to moderately weathered, slightly fractured, brown to red-brown, medium grained sandstone										PL(A) = 0.1
	15							14.9m: B10°, fe, cly, 10mm 15.15m: J35°, un, ro, fe				PL(A) = 0.1
								15.62-15.89m: B10°, fe, cly	C	100	10	
	16							16.12m: J60°, pl, ro, cln				
								16.42-17.95m: B (x8) 10°- 15°, cly vn, fe, ti				PL(A) = 0.8
	17											PL(A) = 1.1
	18											
	18.2	SANDSTONE - very low strength, highly to moderately weathered, slightly fractured, light grey to grey, fine to medium grained sandstone						18.22-18.25m: cly	C	100	55	PL(A) = 0.1
	19							18.8-18.83m: cbs, cly				
								19.23m: B0°, fe				PL(A) = 0.1
	19.75							19.76 & 20.48m: B 5°, cbs co, 1mm	C	100	100	

RIG: Scout 2 **DRILLER:** WG **LOGGED:** SI **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 14.3m; NMLC-Coring to 22.7m

WATER OBSERVATIONS: Free groundwater observed at 2.7m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334274
NORTHING: 6246513
DIP/AZIMUTH: 90°/--

BORE No: 139
PROJECT No: 73743.02
DATE: 14/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2	21	SANDSTONE - high strength, fresh, slightly fractured and unbroken, light grey, medium grained sandstone *(continued)*										PL(A) = 1.1
-3	22								C	100	100	PL(A) = 1.8
-4	22.7							22.5m: B5°, cly co, 2mm				PL(A) = 1.4
		Bore discontinued at 22.7m										
-5	23											
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** SI **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 14.3m; NMLC-Coring to 22.7m

WATER OBSERVATIONS: Free groundwater observed at 2.7m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334319
NORTHING: 6246477
DIP/AZIMUTH: 90°/--

BORE No: 140
PROJECT No: 73743.02
DATE: 15/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.13	CONCRETE							A			
		FILLING - dark grey, fine to medium grained sand filling with some gravel and silt and traces of glass/tiles							A			
	0.9								A			
17	1	FILLING - poorly compacted, brown to dark brown, fine grained sand filling							S			3,3,4 N = 7
	2											
16	2.4	PEATY SAND - very loose, brown to dark grey, fine peaty sand with some organic matter and charcoal, moist							S			2,1,0 N = 1
	2.7											
15	2.95	SAND - very loose, brown to dark brown, fine sand with some organic clay, damp										
	3	SAND - medium dense, brown to dark brown, fine sand, moist										
14	4	4.2m: becoming wet				▼			S			3,9,12 N = 21
	5											
13									S			3,5,9 N = 14
	6											
12	7								S			8,12,13 N = 25
11												
	8											
10	8.5	CLAYEY SAND - very dense, grey-brown, fine sand							S			15,15,30/100mm refusal
	9											
9	10.0											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** AT/SI **CASING:** HW to 5.5m; HQ to 17.55m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.55m; NMLC-Coring to 23.75m

WATER OBSERVATIONS: Free groundwater observed at 4.2m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334319
NORTHING: 6246477
DIP/AZIMUTH: 90°/--

BORE No: 140
PROJECT No: 73743.02
DATE: 15/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SAND - medium dense, brown to dark brown, fine sand, slightly silty							S			20,10,6 N = 16
	10.45	SAND - very dense, light brown to brown, fine sand										
	11											
									S			28,35 refusal
	12											
	12.9	CLAY - firm, grey to dark grey clay							S			0,0,6 N = 6
	13.45	CLAY - stiff, light grey mottled orange-brown clay										
	14											
									S			0,0,9 N = 9
	14.95	CLAY - very stiff, light grey mottled brown clay										
	15											
	16								S			8,12,14 N = 26
	16.45	CLAYEY SAND - very dense, light brown mottled red brown, clayey sand						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	17											
	17.55	SANDSTONE - low to medium and medium strength, highly to moderately weathered, slightly fractured, light brown to red-brown, fine to medium grained sandstone with some very low strength bands							S			20/50mm refusal PL(A) = 0.8
	18							17.87m: B10°, cly co, fe				
								18.6m: B10°, cly co, 3mm	C	100	81	PL(A) = 0.3
	19							19.08m: B5°, fe				
												PL(A) = 0.4
	20.0							19.8-20.5m: B (x5) 5°, fe				

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** AT/SI **CASING:** HW to 5.5m; HQ to 17.55m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.55m; NMLC-Coring to 23.75m

WATER OBSERVATIONS: Free groundwater observed at 4.2m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334319
NORTHING: 6246477
DIP/AZIMUTH: 90°/--

BORE No: 140
PROJECT No: 73743.02
DATE: 15/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2	21	SANDSTONE - medium strength, slightly weathered, slightly fractured, light grey-brown, fine to medium grained sandstone with some carbonaceous laminations						20.29m: B0°, fe, cly, 5mm 20.82m: B5°, fe, cly co 21.15m: J70°, un, ro, cln	C	100	81	PL(A) = 0.4 PL(A) = 0.7
-3	21.6											
	22	SANDSTONE - high strength, slightly fractured, light grey, medium grained sandstone						21.63 & 21.73m: B (x2) 5°, cly co, 2mm	C	100	98	PL(A) = 1.7
-4								22.65 & 22.7m: B0°, cly co				
-5	23							23.55m: B10°, cly vn, ti				PL(A) = 1.9
	23.77	Bore discontinued at 23.77m										
-6	24											
	25											
-7												
	26											
-8												
	27											
-9												
	28											
-10												
	29											
-11												

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** AT/SI **CASING:** HW to 5.5m; HQ to 17.55m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.55m; NMLC-Coring to 23.75m

WATER OBSERVATIONS: Free groundwater observed at 4.2m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334327
NORTHING: 6246472
DIP/AZIMUTH: 90°/--

BORE No: 141
PROJECT No: 73743.02
DATE: 18 - 19/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		FILLING - dark grey, gravelly clayey sand filling										
	1.0	SAND - loose, pale grey-brown, fine to medium sand, moist							S			3,3,3 N = 6
		2.5m: slightly silty							S			0,2,3 N = 5
	4.0	SAND - medium dense, pale grey to white, fine to medium sand sand, wet				▼			S			5,7,10 N = 17
									S			2,4,9 N = 13
									S			8,8,10 N = 18
									S			6,6,10 N = 16
	10.0											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JH/JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.5m; NMLC-Coring to 23.65m

WATER OBSERVATIONS: Free groundwater observed at 3.9m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334327
NORTHING: 6246472
DIP/AZIMUTH: 90°/--

BORE No: 141
PROJECT No: 73743.02
DATE: 18 - 19/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault				
		SAND - dense, pale grey to grey, fine to medium sand							S			18,20,20 N = 40
		11.5m: very dense							S			40 refusal
	13.0	SILTY CLAY - very soft, grey to dark grey-brown clay							S			0,0,0 N = 0
	14.5	SANDY SILTY CLAY - stiff, pale grey mottled orange-yellow sandy silty clay							S			0,4,8 N = 12
	15.0	SILTY CLAY - stiff, pale grey mottled orange-yellow, silty clay with a trace of sand										
	16.0	SANDY SILTY CLAY - very stiff, pale grey mottled red-brown, sandy silty clay						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			17,12,14 N = 26
	17.5	SANDSTONE - low to medium and medium strength, moderately weathered, slightly fractured, light grey and red, medium to coarse grained sandstone with some extremely weathered, very low strength bands						18.07m: Cs, 250mm 18.62m: Cs, 50mm 19.5m: Cs, 20mm 19.8m: Cs, 50mm	C	100	92	PL(A) = 0.6 PL(A) = 0.3 PL(A) = 0.4

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JH/JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.5m; NMLC-Coring to 23.65m

WATER OBSERVATIONS: Free groundwater observed at 3.9m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334327
NORTHING: 6246472
DIP/AZIMUTH: 90°/--

BORE No: 141
PROJECT No: 73743.02
DATE: 18 - 19/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2	20.08	LAMINITE - low to medium strength, slightly weathered, slightly fractured, light grey, fine to medium grained sandstone with some dark grey siltstone laminations						20.08m: B0°- 5°, pl, ro, fe st 20.44m: Cs, 130mm	C	100	92	PL(A) = 0.3
	20.57	SANDSTONE - medium to high strength, fresh, slightly fractured to unbroken, light grey, medium to coarse grained sandstone with some very low strength bands						21m: Cs, 20mm 21.4m: J30°, pl, ro, cln 21.49m: Cs, 10mm				PL(A) = 1
-3	21							21.9m: Cs, 60mm	C	100	97	PL(A) = 1
-4	22											
-5	23							22.98m: Cs, 10mm				PL(A) = 1.4
	23.65	Bore discontinued at 23.65m										
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

Degree of Weathering: EW HW MW SW FS FR
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** JH/JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.13m; Solid flight auger (TC-bit) to 5.5m; Rotary to 17.5m; NMLC-Coring to 23.65m

WATER OBSERVATIONS: Free groundwater observed at 3.9m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334259
NORTHING: 6246486
DIP/AZIMUTH: 90°/--

BORE No: 142
PROJECT No: 73743.02
DATE: 11/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.14	CONCRETE SLAB							A			
18		FILLING - dark grey, fine to coarse sand filling with some silt and fine to coarse sandstone gravel, damp							A			
	1	- with a trace of steel, glass, brick and asbestos fragments below 0.4m							A			
									S			4,9,6 N = 15
17	2											
	2.3	FILLING - dark grey, fine to coarse sand with some clay and some fine sandstone gravel, wet				▼			S			2,1,1 N = 2
16	3											
15	4								S			4,10,14 N = 24
	4.3	SAND - medium dense to dense, grey and light brown, medium sand, wet										
14	5											
13									S			12,20,25 N = 45
	6											
12												
	7								S			12,17,18 N = 35
11												
	8											
	8.0	PEATY SAND - medium dense, dark brown, peaty, fine sand with some silt										
10									S			7,11,15 N = 26
	9											
9												

RIG: Scout 2 **DRILLER:** WG **LOGGED:** MP **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.14m; Solid flight auger (TC-bit) to 5.5m; Rotary to 14.5m; NMLC-Coring to 21.5m

WATER OBSERVATIONS: Free groundwater observed at 2.3m whilst augering

REMARKS: Asbestos fragments observed in filling below 0.4m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334259
NORTHING: 6246486
DIP/AZIMUTH: 90°/--

BORE No: 142
PROJECT No: 73743.02
DATE: 11/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault				
		PEATY SAND - medium dense, dark brown, peaty, fine sand with some silt *(continued)*							S			20,35,25/100mm refusal
	11.5	CLAY - stiff, light grey clay							S			10,5,5 N = 10
		- becoming very stiff and red-brown mottled below 12.7m							S			6,8,12 N = 20
	14.5	SANDSTONE - low strength, highly weathered, unbroken, grey and red, fine to medium grained sandstone with some extremely weathered, extremely low strength bands						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	C	100	98	PL(A) = 0.5
	16.3	SANDSTONE - high strength, slightly weathered, unbroken, grey and red, medium to coarse grained sandstone with ironstone bands						16.15m: Cs, 50mm				PL(A) = 1.1
	17.35	SANDSTONE - medium and medium to high strength, fresh, slightly fractured and unbroken, grey, medium to coarse sandstone with carbonaceous laminations						17.41m: J30°, pl, ro, fe st 17.5m: B0°, pl, ro, fe st 18.23m: B0°, pl, cly 18.51m: J30°, pl, ro, cln 19.75m: J70°- 90°, un, ro, cln	C	100	100	PL(A) = 0.5 PL(A) = 0.5 PL(A) = 1

RIG: Scout 2 **DRILLER:** WG **LOGGED:** MP **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.14m; Solid flight auger (TC-bit) to 5.5m; Rotary to 14.5m; NMLC-Coring to 21.5m

WATER OBSERVATIONS: Free groundwater observed at 2.3m whilst augering

REMARKS: Asbestos fragments observed in filling below 0.4m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.5 AHD
EASTING: 334259
NORTHING: 6246486
DIP/AZIMUTH: 90°/--

BORE No: 142
PROJECT No: 73743.02
DATE: 11/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2		SANDSTONE - medium and medium to high strength, fresh, slightly fractured and unbroken, grey, medium to coarse sandstone with carbonaceous laminations *(continued)*							C	100	100	PL(A) = 0.5
	20.85											
-3	21	SANDSTONE - high strength, fresh, unbroken, grey, medium to coarse grained sandstone										PL(A) = 2
	21.49	Bore discontinued at 21.49m										
-4	22											
-5	23											
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** MP **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.14m; Solid flight auger (TC-bit) to 5.5m; Rotary to 14.5m; NMLC-Coring to 21.5m

WATER OBSERVATIONS: Free groundwater observed at 2.3m whilst augering

REMARKS: Asbestos fragments observed in filling below 0.4m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.2 AHD
EASTING: 334295
NORTHING: 6246465
DIP/AZIMUTH: 90°/--

BORE No: 143
PROJECT No: 73743.02
DATE: 8/1/2015
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Type	Core Rec. %	RQD %	Test Results & Comments
18	0.3	FILLING - red-brown and grey, medium to coarse sand with some clay and some fine to coarse sandstone and igneous gravel, damp	A			
	0.5	CONCRETE SLAB	A			
17	1	FILLING - grey, fine to coarse sand with some sandstone gravel and a trace of brick and asbestos fragments. - becoming slightly clayey below 0.8m	A			
	1.8	FILLING - dark grey, silty, fine to medium sand with some sandstone gravel, wet	S			2,2,2 N = 4
16	2		S			1,2,3 N = 5
15	3					
14	4		S			6,9,17 N = 26
	4.3	SAND - medium dense, grey then light brown, medium sand, wet				
13	5		S			6,12,13 N = 25
12	6					
11	7		S			11,13,11 N = 24
10	8					
	8.0	SILTY SAND - medium dense to dense, dark grey, fine to medium silty sand	S			9,15,15 N = 30
9	9					

RIG: Scout 2 **DRILLER:** WG **LOGGED:** MP/SI **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 14.2m; NMLC-Coring to 21.3m

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS: Asbestos fragments observed in filling below 0.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.2 AHD
EASTING: 334295
NORTHING: 6246465
DIP/AZIMUTH: 90°/--

BORE No: 143
PROJECT No: 73743.02
DATE: 8/1/2015
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
8	10.2	SILTY SAND *(continued)*										
		SAND - very dense, grey, medium sand							S			16,25,26 N = 51
7	11											
	11.7	CLAY - very stiff, grey clay with some sand							S			23,14,9 N = 23
6	12	- becoming less sandy and red-brown mottled below 12.7m										
5	13							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping at 0° - 5°	S			5,6,12 N = 18
	14											
4	14.2	SANDSTONE - very low strength, highly weathered, light grey-brown to red-brown, fine to medium grained sandstone with some medium strength ironcemented sandstone bands							C	100	20	PL(A) = 0.1 PL(A) = 0.4
3	15											
2	16							16.06m: J, 70°, cu, ro, cln 16.23m: B, 5°, Cs, 40mm 16.33m: Cs, 80mm 16.37m: Cs, 30mm				PL(A) = 0.5
	16.5	SANDSTONE - medium strength, highly weathered, slightly fractured, red brown, medium grained sandstone										PL(A) = 0.5
1	17							17.04m: B, 5°, Cs, 5mm 17.17m: Cs, 180mm	C	98	50	
	17.16	SANDSTONE - very low strength, highly weathered, slightly fractured, light grey and pale red, fine to medium grained sandstone with some medium strength ironcemented bands						17.39m: Cs, 300mm				PL(A) = 0.3
0	18							17.85m: Cs, 10mm 18.11m: Cs, 50mm 18.23m: Cs, 110mm				
	18.39							18.34m: CORE LOSS: 50mm 18.39m: Cs, 50mm 18.5m: Cs, 20mm 18.84m: Cs, 80mm 18.99m: Cs, 10mm 19.07m: J, 30°, pl, ro, cln 19.1m: J, 30°, pl, ro, cln 19.28m: Cs, 40mm 19.4m: Cs, 10mm				PL(A) = 0.1
-1	19								C	100	80	
	19.6	SANDSTONE - description next page										PL(A) = 0.1

RIG: Scout 2 **DRILLER:** WG **LOGGED:** MP/SI **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 14.2m; NMLC-Coring to 21.3m

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS: Asbestos fragments observed in filling below 0.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 18.2 AHD
EASTING: 334295
NORTHING: 6246465
DIP/AZIMUTH: 90°/--

BORE No: 143
PROJECT No: 73743.02
DATE: 8/1/2015
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2		SANDSTONE - low then medium strength, slightly weathered, slightly fractured, light grey, fine to medium grain sandstone with carbonaceous laminations *(continued)*						20.04m: Cs, 10mm 20.34m: B, 5°, cbs, st, Cs, 40mm 20.6m: Cs, 80mm	C	100	80	PL(A) = 0.2
-3	21											PL(A) = 0.5
	21.3	Bore discontinued at 21.3m										
-4	22											
-5	23											
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** MP/SI **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 14.2m; NMLC-Coring to 21.3m

WATER OBSERVATIONS: Free groundwater observed at 2.0m whilst augering

REMARKS: Asbestos fragments observed in filling below 0.5m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 19.0 AHD
EASTING: 334266
NORTHING: 6246467
DIP/AZIMUTH: 90°/--

BORE No: 144
PROJECT No: 73743.02
DATE: 15/1/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Type	Core Rec. %	RQD %	Test Results & Comments
19	0.15	CONCRETE		A			
		FILLING - grey, silty, medium to coarse sand filling, damp		A			
18	1			A			
				S			1,3,3 N = 6
17	2						
				S			1,1,2 N = 3
16	3						
	3.4	FILLING - dark grey, silty, medium to coarse sand with a trace of fine to medium sandstone gravel, wet					
15	4			S			1,1,1 N = 2
	4.0	SAND - very loose, dark brown, medium to coarse sand, saturated (possible filling)					
14	5						
	5.0	SAND - medium dense, grey-brown, fine to medium sand, saturated		S			5,11,17 N = 28
13	6						
12	7			S			9,16,19 N = 35
	7.2	SAND - dense, brown, medium to coarse sand					
11	8						
				S			11,25,15 N = 40
10	9						
	10.0						

Degree of Weathering: EW, HW, MW, SW, FS, FR
Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High
Water: ▼
Fracture Spacing (m): 0.01, 0.05, 0.10, 0.50, 1.00
Discontinuities: B - Bedding, J - Joint, S - Shear, F - Fault
Sampling & In Situ Testing: Type, Core Rec. %, RQD %, Test Results & Comments

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 13.5m; NMLC-Coring to 21.10m

WATER OBSERVATIONS: Free groundwater observed at 2.7m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 19.0 AHD
EASTING: 334266
NORTHING: 6246467
DIP/AZIMUTH: 90°/--

BORE No: 144
PROJECT No: 73743.02
DATE: 15/1/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
9		SAND - very dense, light grey, medium to coarse sand							S			11,25,25/100mm refusal
8	11											
7	12								S			18,25/100mm refusal
6	12.4	CLAYEY SAND - medium dense, light grey, clayey sand						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	13								S			3,8,13 N = 21
5	13.5	CLAY - hard, grey, silty clay with ironstone bands and some fine to medium sand							C	100	0	pp >600
4	14											
3	15											
2	16								C	100	45	
1	16.8	SANDSTONE - very low strength, highly weathered, slightly fractured, orange and light grey, medium to coarse grained sandstone										PL(A) = 0.6
	17							17.35m: J30°, pl, ro, fe st				
	17.07	SANDSTONE - medium then medium to high strength, moderately weathered, fractured to slightly fractured, light grey, medium to coarse grained sandstone with ironstone bands						17.85m: J45°, pl, ro, cln 17.98m: J80°- 90°, un, ro, cln				
0	18											PL(A) = 1
	18.5	SANDSTONE - low strength with some medium to high strength bands, slightly weathered, slightly fractured, light grey, fine to medium grained sandstone with carbonaceous laminations and ironstone bands						18.58m: B0°- 10°, pl, ro, fe st 18.77-18.87m: J60°, pl, ro, cly 18.85m: B5°, pl, ro, cbs st 19.44m: Cs, 10mm	C	100	99	PL(A) = 0.2
	19											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 13.5m; NMLC-Coring to 21.10m

WATER OBSERVATIONS: Free groundwater observed at 2.7m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 19.0 AHD
EASTING: 334266
NORTHING: 6246467
DIP/AZIMUTH: 90°/--

BORE No: 144
PROJECT No: 73743.02
DATE: 15/1/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-1												
		20.0-20.95m: becomes low to medium strength, fresh, unbroken, with some carbonaceous laminations						20m: Cs, 30mm	C	100	99	PL(A) = 0.3
-2	21	20.95										
		SANDSTONE - low strength, fresh, unbroken, light grey, medium to coarse grained sandstone										PL(A) = 0.2
	21.1	Bore discontinued at 21.1m										
-3	22											
-4	23											
-5	24											
-6	25											
-7	26											
-8	27											
-9	28											
-10	29											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JN **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 13.5m; NMLC-Coring to 21.10m

WATER OBSERVATIONS: Free groundwater observed at 2.7m whilst augering

REMARKS: Standpipe installed to 12.0m (screen 3.0-12.0m; gravel 2.5-12.0m; bentonite 1.0-1.2m; backfill to GL with Gatic cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 19.1 AHD
EASTING: 334294
NORTHING: 6246436
DIP/AZIMUTH: 90°/--

BORE No: 145
PROJECT No: 73743.02
DATE: 12/1/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
19	0.11	CONCRETE							A			
	0.2	FILLING - poorly compacted, grey-brown, fine to medium sand							A			
	0.33	CONCRETE										
18	1	FILLING - variably compacted, grey to dark grey, fine to medium sand filling with some crushed sandstone and roadbase gravel							S			5,10,12 N = 22
17	2					▼			S			1,3,2 N = 5
16	3											
	3.8	CLAYEY SAND - loose, dark grey, fine to medium clayey sand with traces of organic matter, wet							S			2,2,5 N = 7
15	4											
14	5											
	5.3	SAND - dense, light grey to brown, fine to medium sand							S			10,14,16 N = 30
13	6											
12	7	7.0m: becoming medium dense							S			5,13,10 N = 23
	7.5	SAND - dense, dark brown, fine to medium sand										
11	8											
	8.5	SAND - dense, dark grey, fine to medium sand with some clay							S			6,15,17 N = 32
10	9											

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JEH **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.33m; Solid flight auger auger (TC-bit) to 5.5m; Rotary drilling to 13.4m; NMLC-Coring to 19.7m

WATER OBSERVATIONS: Free groundwater observed at 2.7m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Gunyama Park Aquatic and Recreation Centre
LOCATION: Joynton Ave, Zetland

SURFACE LEVEL: 19.1 AHD
EASTING: 334294
NORTHING: 6246436
DIP/AZIMUTH: 90°/--

BORE No: 145
PROJECT No: 73743.02
DATE: 12/1/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		B - Bedding J - Joint S - Shear F - Fault	EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00					
9		SAND - dense, dark grey, fine to medium sand with some clay *(continued)*							S			2,12,18 N = 30
8	11											
	11.4	SAND - very dense, light grey, fine to medium sand, wet							S			13,30/100mm refusal
7	12											
	12.5	SANDY CLAY - hard, grey mottled red and yellow, fine sandy clay						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
6	13								S			4,11,25/100mm refusal
	13.3	SANDSTONE - extremely low strength, grey mottled red, fine grained sandstone										
	13.4	IRONSTONE - medium and medium to high strength, moderately weathered, fractured, red ironstone with orange and grey, medium to coarse grained sandstone and extremely low and very low strength bands						13.4-13.44m: J80°, pl, ro, fe, st 13.45m: Cs, 150mm 13.55m: J45°, un, ro, fe, st 13.67m: J60°- 90°, un, ro, fe st 13.87m: Cs, 20mm 14.07-14.12m: J45°, pl, cly 14.22m: Cs, 40mm	C	93	61	PL(A) = 0.8 PL(A) = 0.8
5	14											
	14.88							14.3m: Cs, 100mm 14.43m: Cs, 170mm 14.6-14.73m: J0°- 90°, st, ro, fe st 14.78m: CORE LOSS: 100mm 14.96m: Cs, 40mm 15.08 & 15.2m: B0°- 5°, pl, cly 15.25m: J45°, pl, cly 15.63m: Cs, 150mm 15.84m: Cs, 20mm	C	100	82	PL(A) = 1 PL(A) = 0.4
4	15											
	16.0	SANDSTONE - medium strength, slightly weathered, slightly fractured, grey, medium to coarse sandstone with carbonaceous laminations and ironstone banding										
3	16											
	16.7	SANDSTONE - medium strength, fresh, unbroken, grey, medium to coarse grained sandstone with some carbonaceous laminations and a trace of ironstone banding										PL(A) = 0.4
2	17											
	18.0	SANDSTONE - medium strength, fresh, unbroken, grey, fine to medium grained sandstone						18.38m: Cs, 40mm	C	100	98	PL(A) = 0.8
1	18											
	19											PL(A) = 0.8
0	19.7	Bore discontinued at 19.7m										

RIG: Scout 2 **DRILLER:** WG **LOGGED:** JEH **CASING:** HW to 5.5m

TYPE OF BORING: Diatube to 0.33m; Solid flight auger auger (TC-bit) to 5.5m; Rotary drilling to 13.4m; NMLC-Coring to 19.7m

WATER OBSERVATIONS: Free groundwater observed at 2.7m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

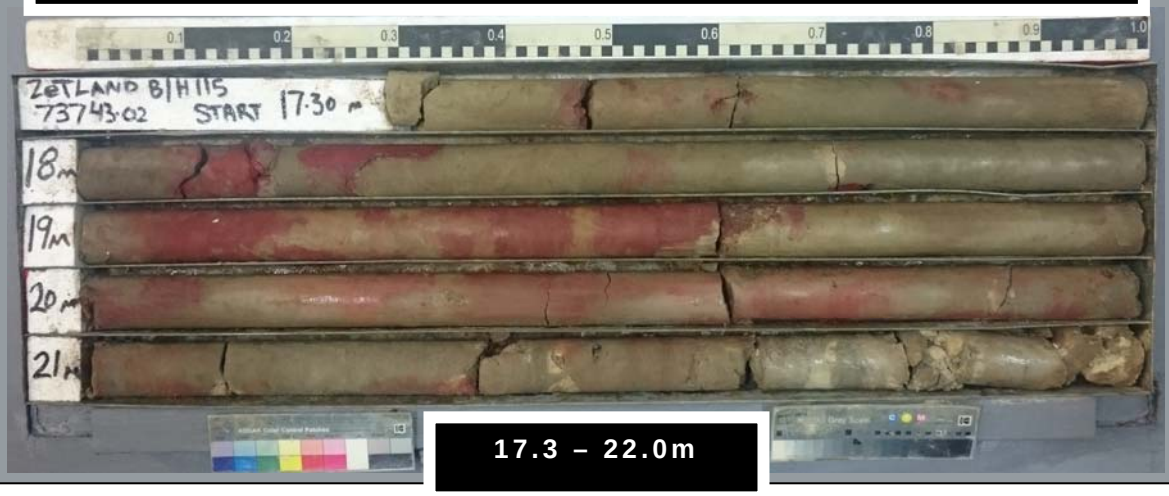
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 115 PROJECT 73743.02 JAN 2016



17.3 – 22.0m

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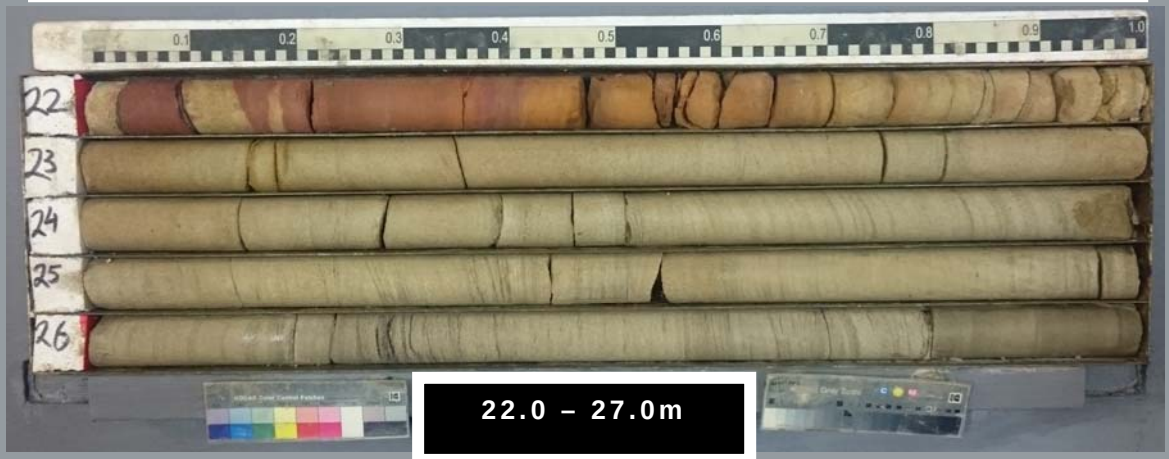
GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 115 PROJECT 73743.02 JAN 2016



22.0 – 27.0m

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GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 115 PROJECT 73743.02 JAN 2016



27.0 – 28.6m

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GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 118 PROJECT 73743.02 FEB 2016



21.8 – 26.0m

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GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 118 PROJECT 73743.02 FEB 2016



26.0 – 28.1m

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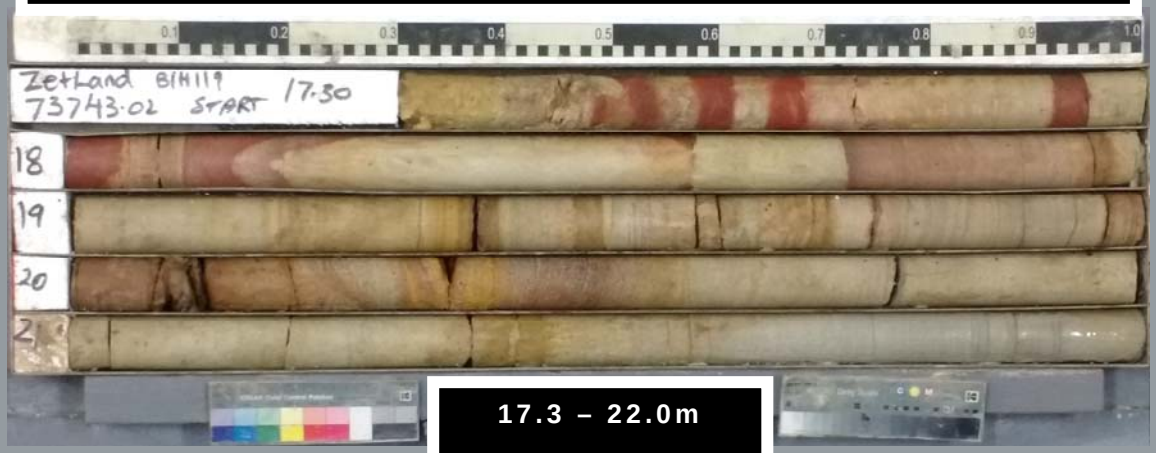
GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 119 PROJECT 73743.02 JAN 2016



17.3 – 22.0m

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GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 119 PROJECT 73743.02 JAN 2016



22.0 – 24.2m

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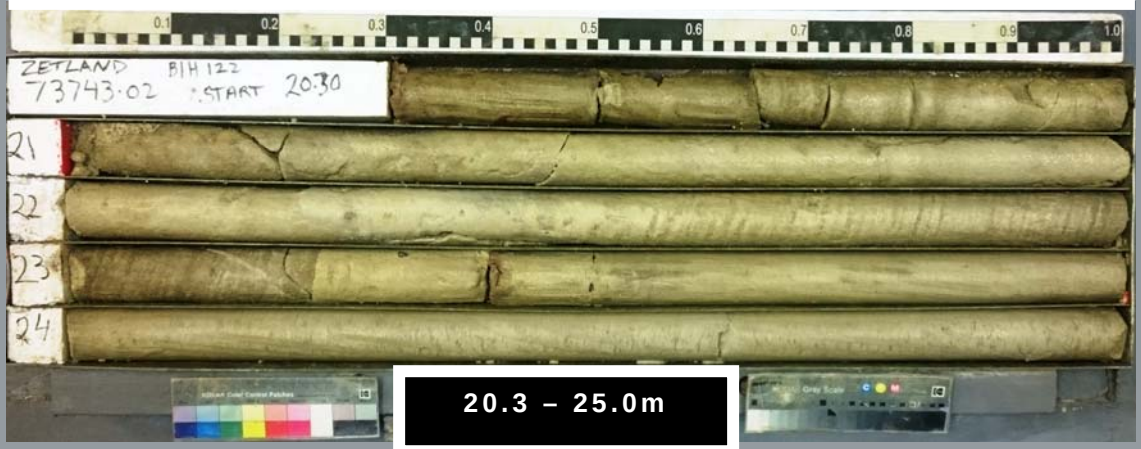
GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 122 PROJECT 73743.02 FEB 2016

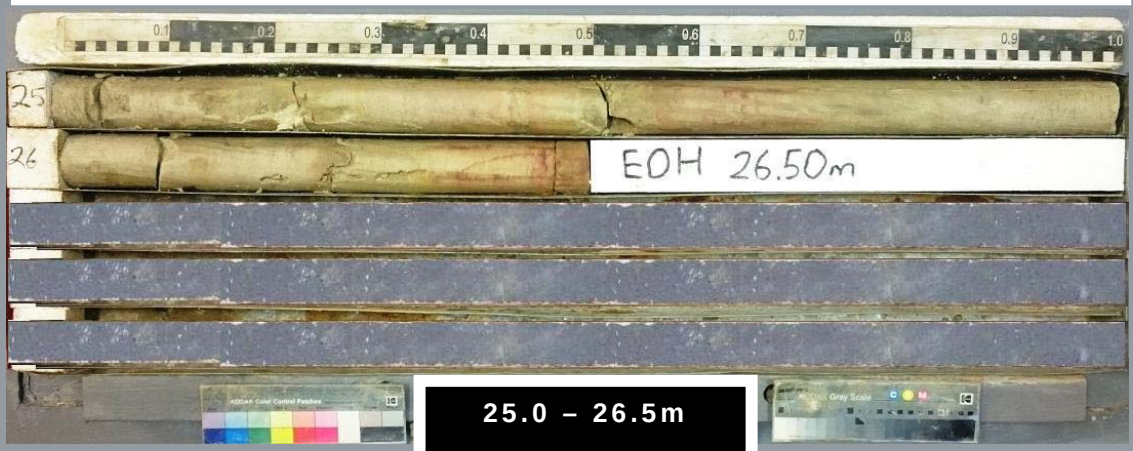


20.3 – 25.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 122 PROJECT 73743.02 FEB 2016



25.0 – 26.5m

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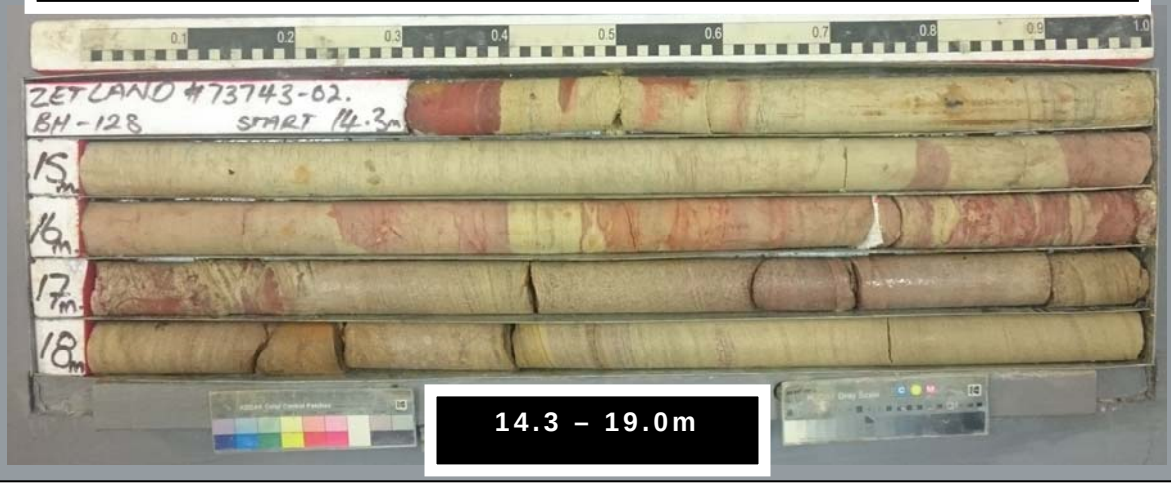
GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 128 PROJECT 73743.02 FEB 2016

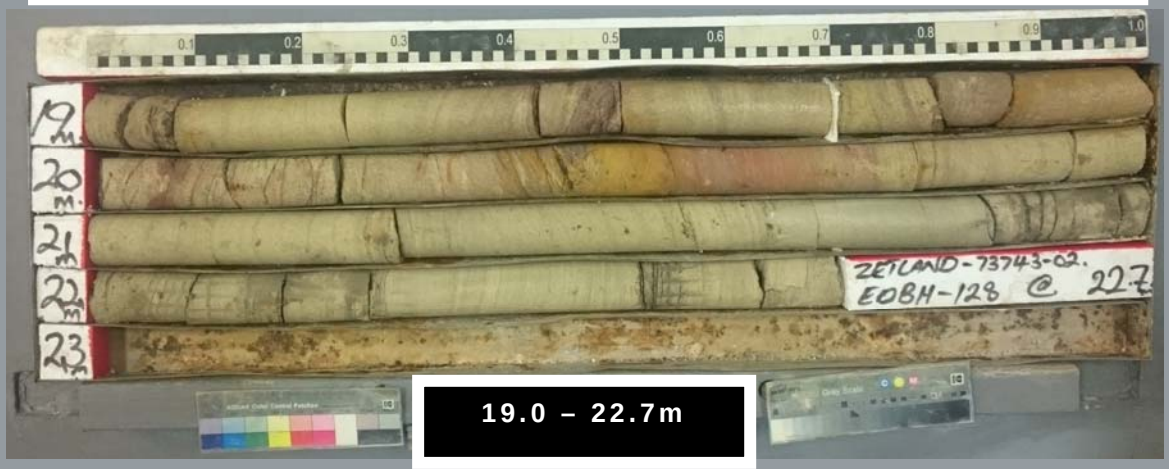


14.3 – 19.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 128 PROJECT 73743.02 FEB 2016

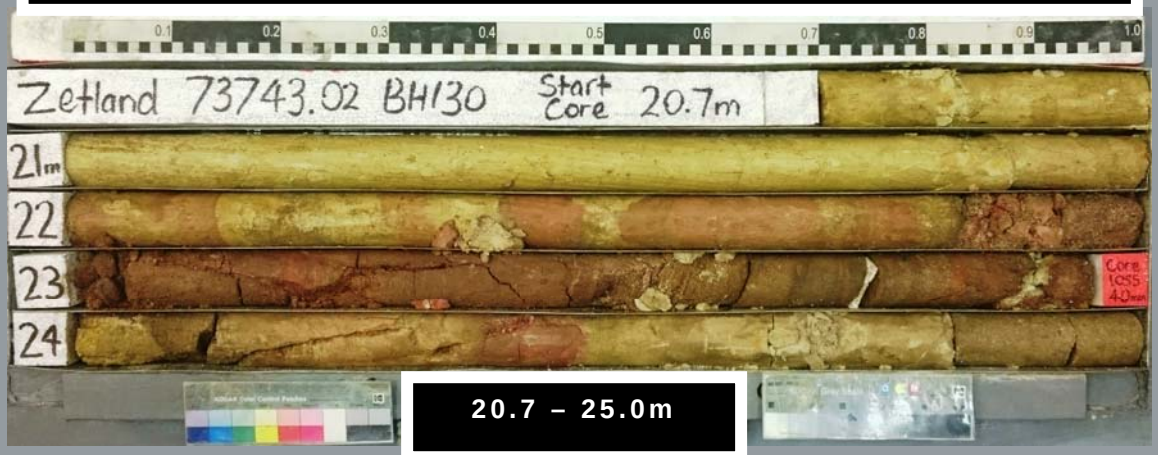


19.0 – 22.7m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 130 PROJECT 73743.02 FEB 2016



20.7 – 25.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 130 PROJECT 73743.02 FEB 2016

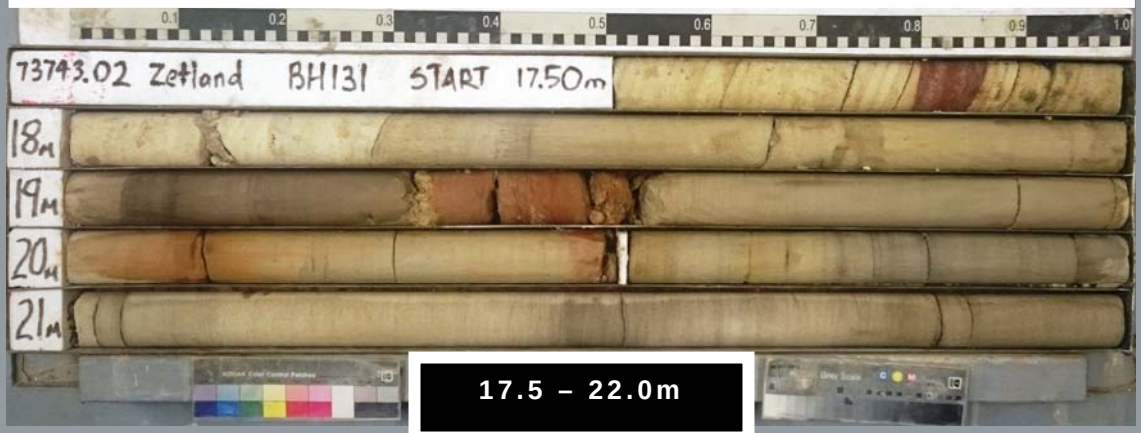


25.0 – 29.06m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 131 PROJECT 73743.02 JAN 2016

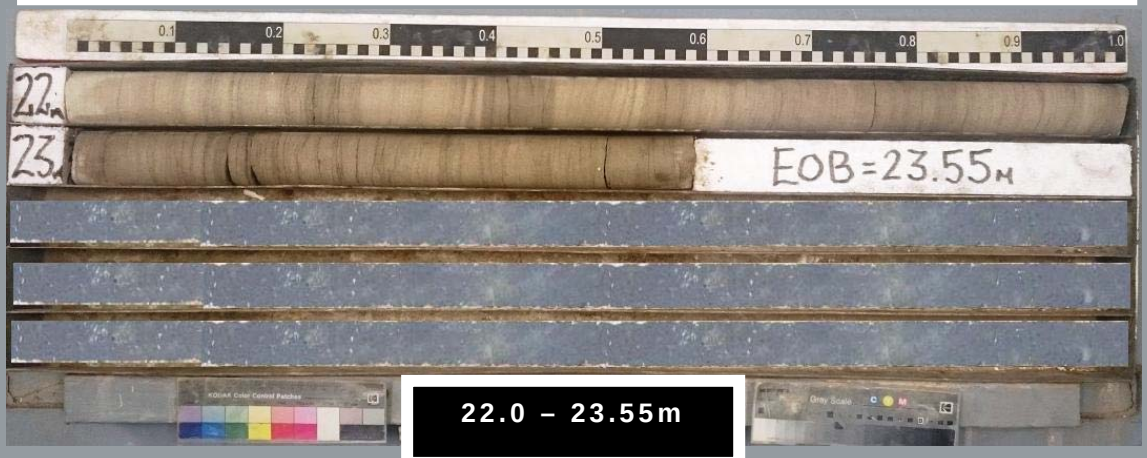


17.5 – 22.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 131 PROJECT 73743.02 JAN 2016



22.0 – 23.55m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 132 PROJECT 73743.02 JAN 2016

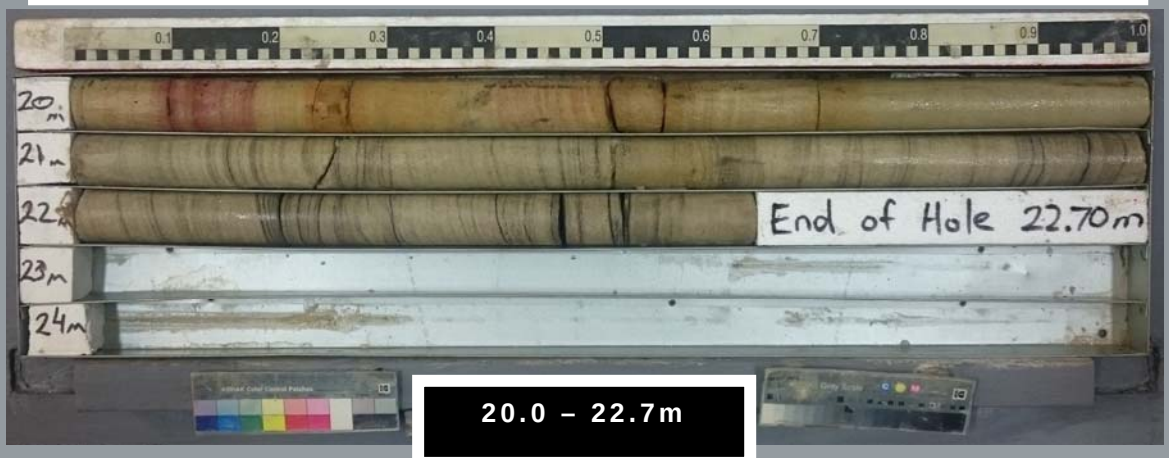


15.7 – 20.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 132 PROJECT 73743.02 JAN 2016

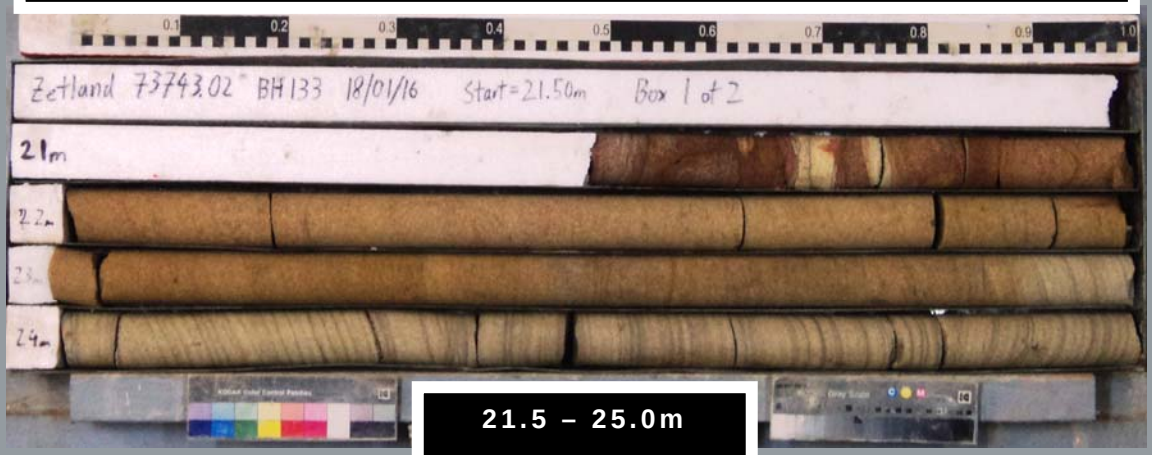


20.0 – 22.7m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 133 PROJECT 73743.02 JAN 2016

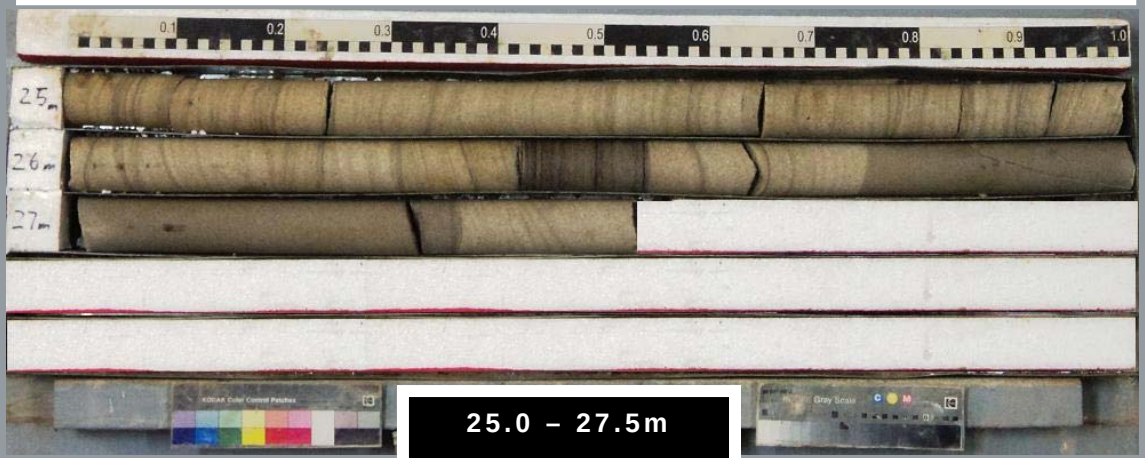


21.5 – 25.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 133 PROJECT 73743.02 JAN 2016



25.0 – 27.5m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 134 PROJECT 73743.02 DEC 2015

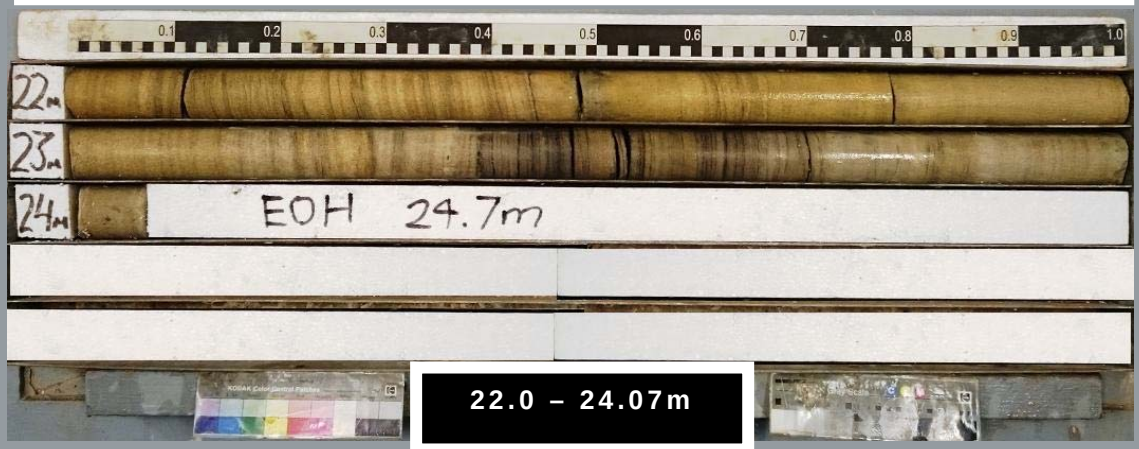


18.0 – 22.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 134 PROJECT 73743.02 DEC 2015

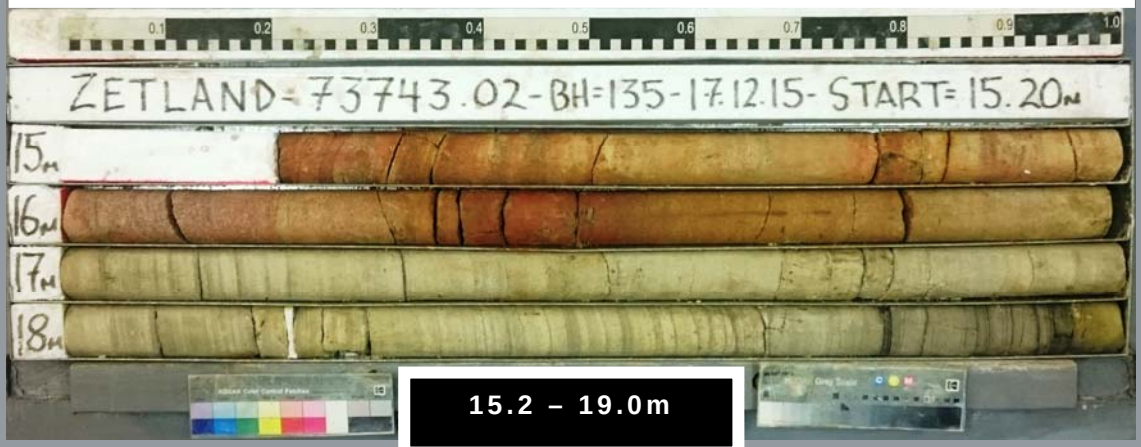


22.0 – 24.07m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 135 PROJECT 73743.02 DEC 2015

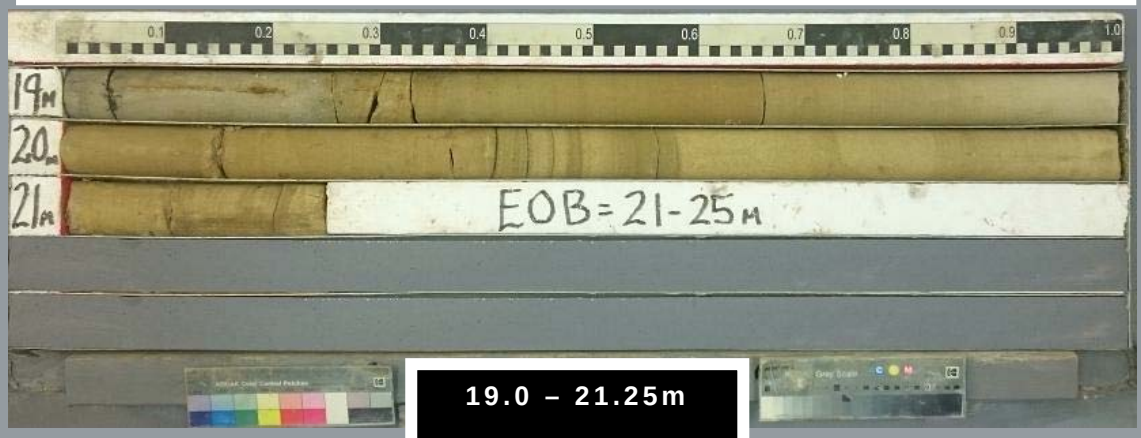


15.2 – 19.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 135 PROJECT 73743.02 DEC 2015

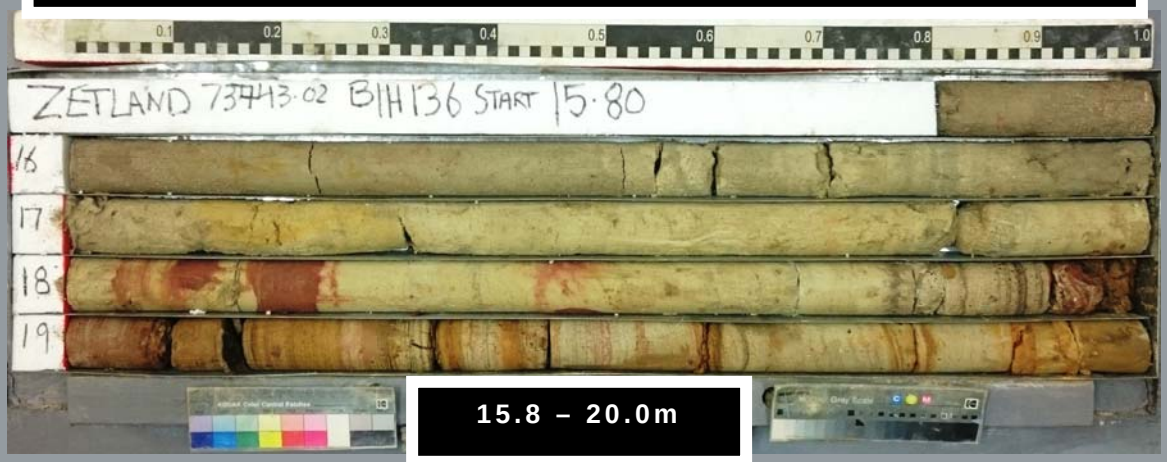


19.0 – 21.25m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 136 PROJECT 73743.02 JAN 2016

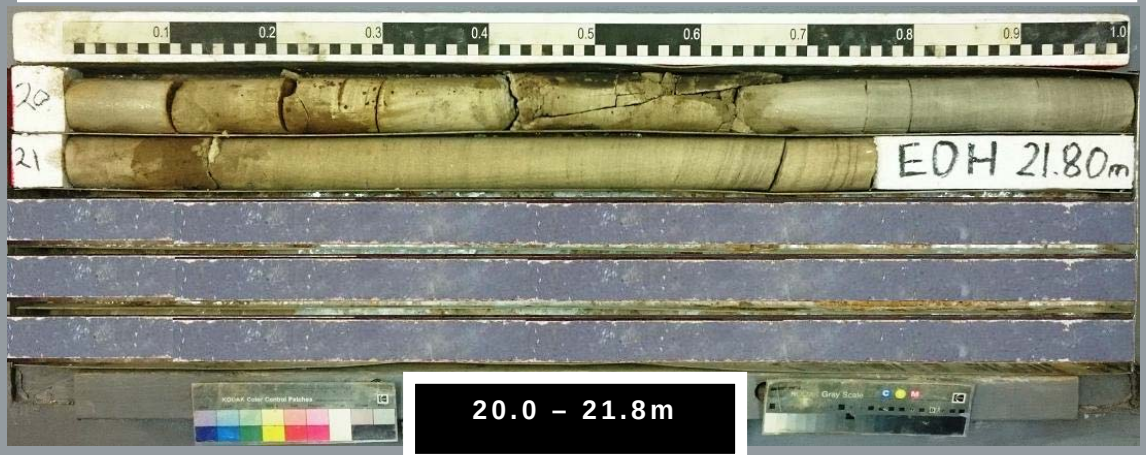


15.8 – 20.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 136 PROJECT 73743.02 JAN 2016



20.0 – 21.8m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 137 PROJECT 73743.02 JAN 2016

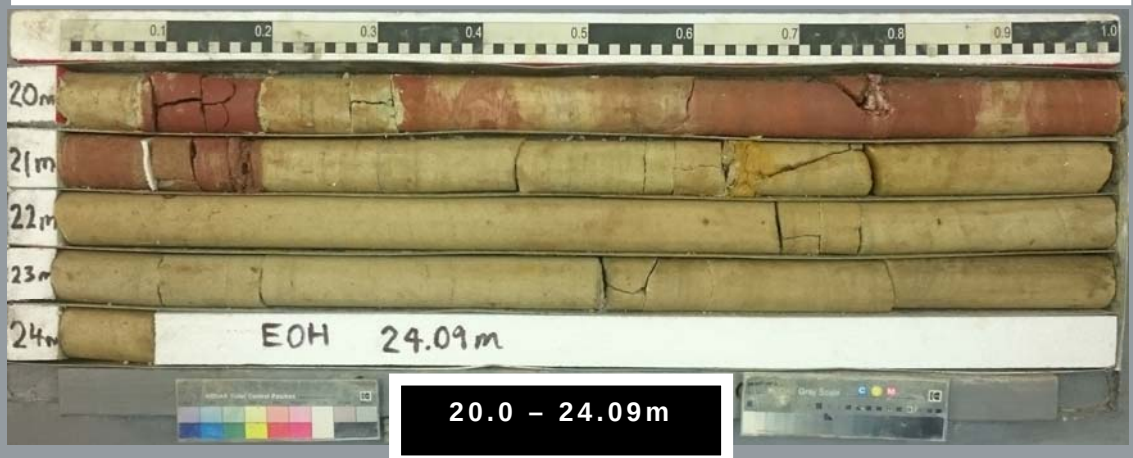


15.8 – 20.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 137 PROJECT 73743.02 JAN 2016



20.0 – 24.09m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 138 PROJECT 73743.02 JAN 2016



16.0 – 20.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 138 PROJECT 73743.02 JAN 2016

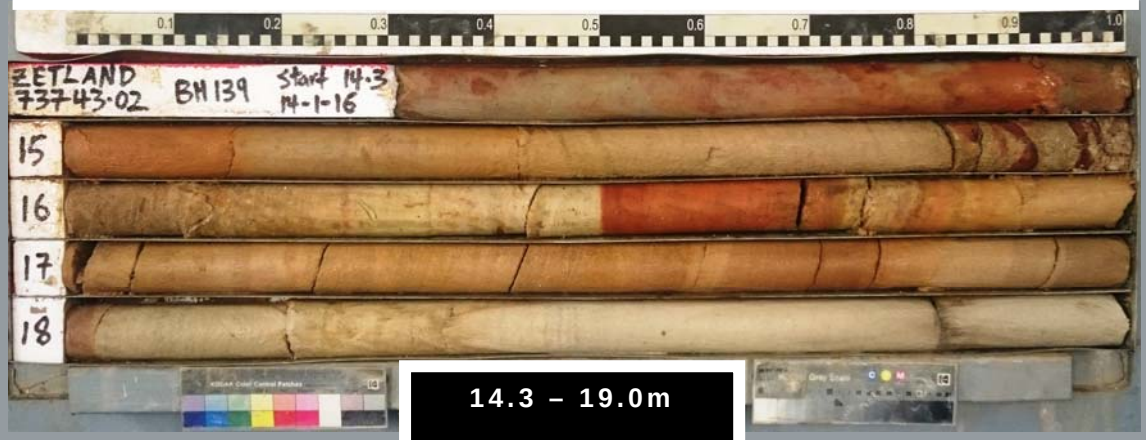


20.0 – 22.1m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 139 PROJECT 73743.02 JAN 2016



14.3 – 19.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 139 PROJECT 73743.02 JAN 2016



19.0 – 22.7m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 140 PROJECT 73743.02 JAN 2016

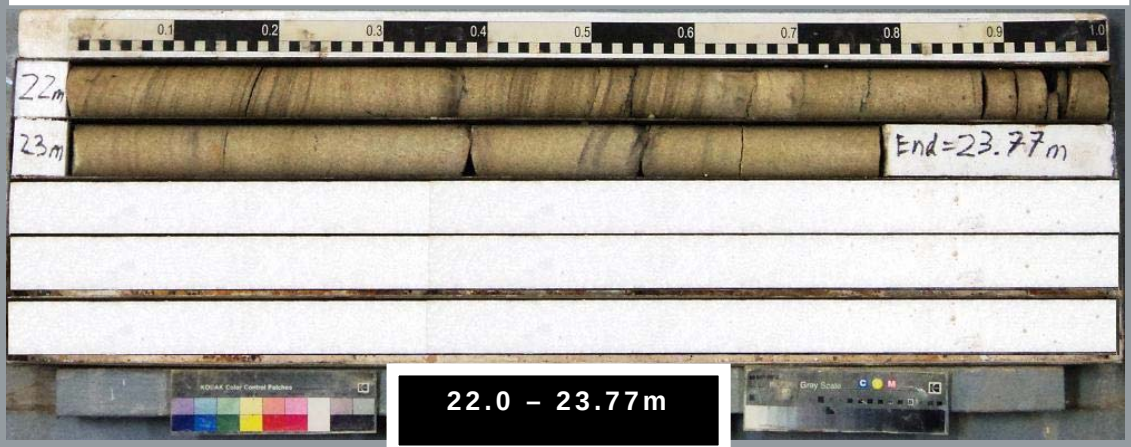


17.55 – 22.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 140 PROJECT 73743.02 JAN 2016



22.0 – 23.77m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 141 PROJECT 73743.02 JAN 2016

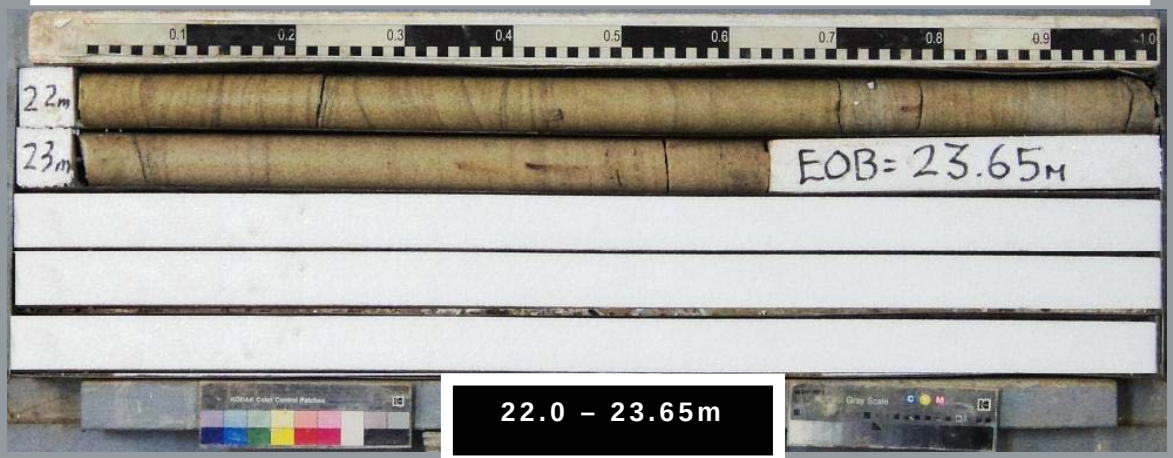


17.5 – 22.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 141 PROJECT 73743.02 JAN 2016

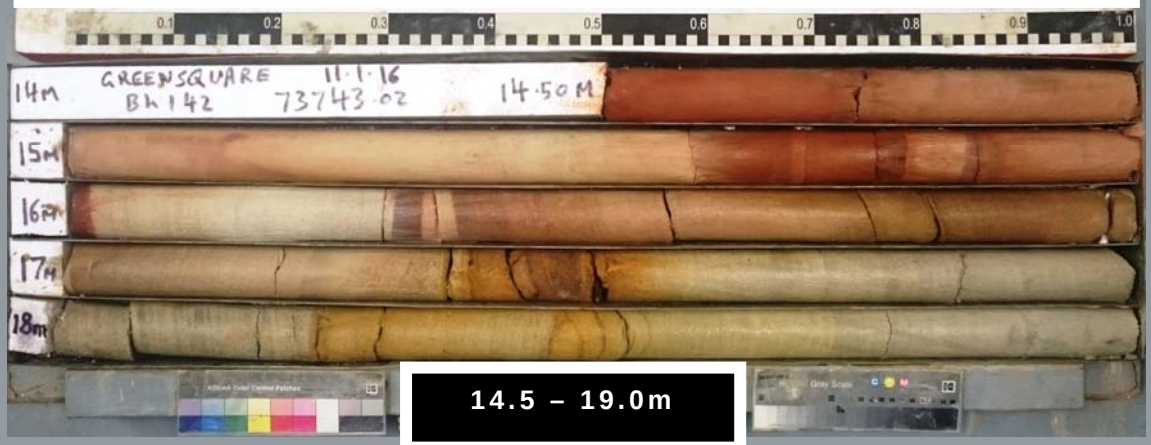


22.0 – 23.65m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 142 PROJECT 73743.02 JAN 2016



14.5 – 19.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 142 PROJECT 73743.02 JAN 2016

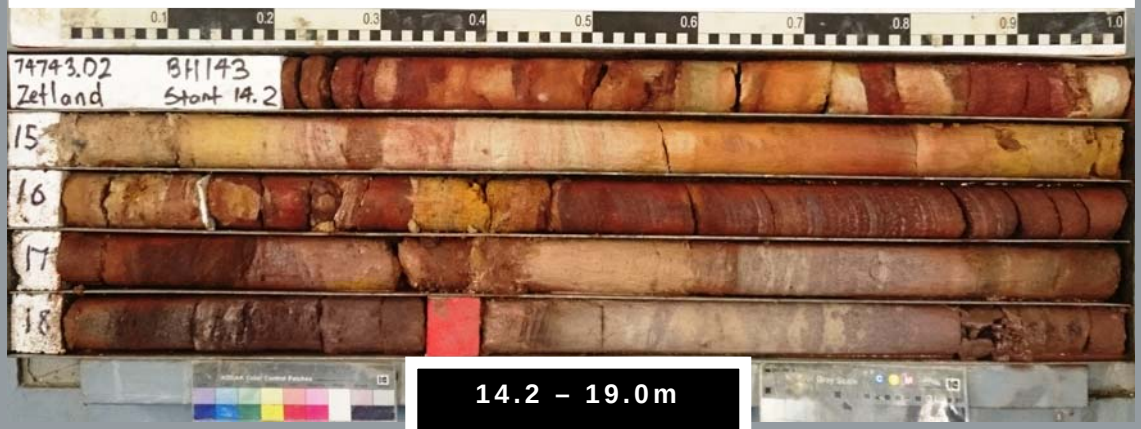


19.0 – 21.49m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 143 PROJECT 73743.02 JAN 2016



14.2 – 19.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 143 PROJECT 73743.02 JAN 2016

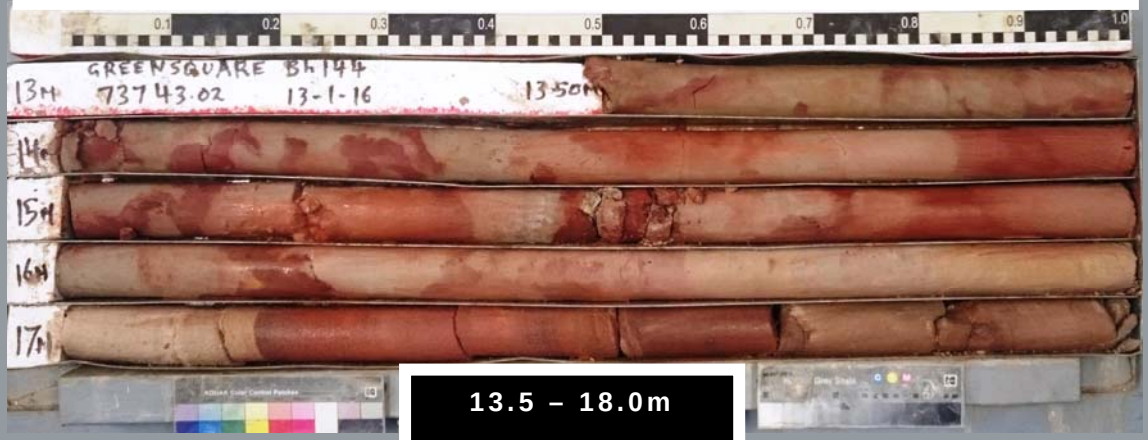


19.0 – 21.3m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 144 PROJECT 73743.02 JAN 2016



13.5 – 18.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 144 PROJECT 73743.02 JAN 2016

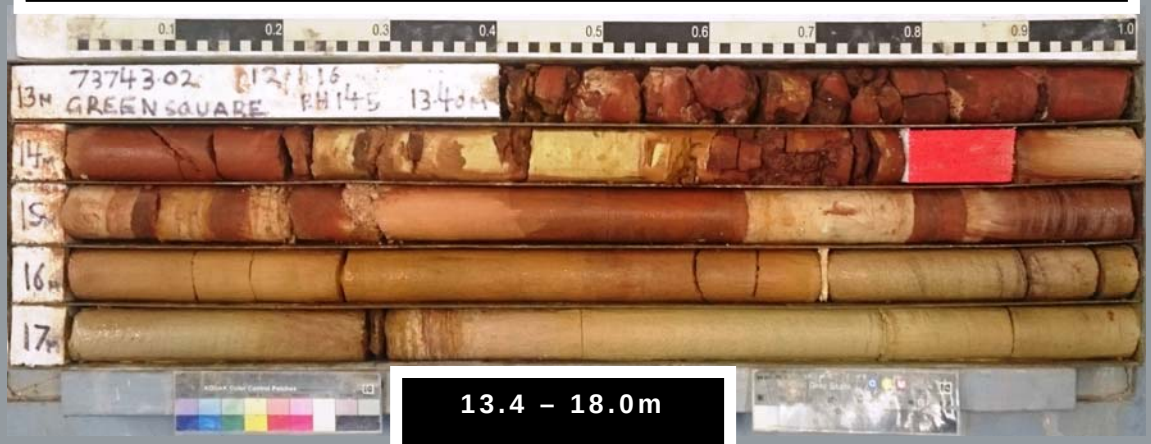


18.0 – 21.1m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 145 PROJECT 73743.02 JAN 2016



13.4 – 18.0m

DOUGLAS PARTNERS PTY LTD

GUNYAMA PARK/GS AQUATIC CENTRE – ZETLAND

BORE 145 PROJECT 73743.02 JAN 2016



18.0 – 19.7m

Appendix D

Results of Previous Field Work

CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.4

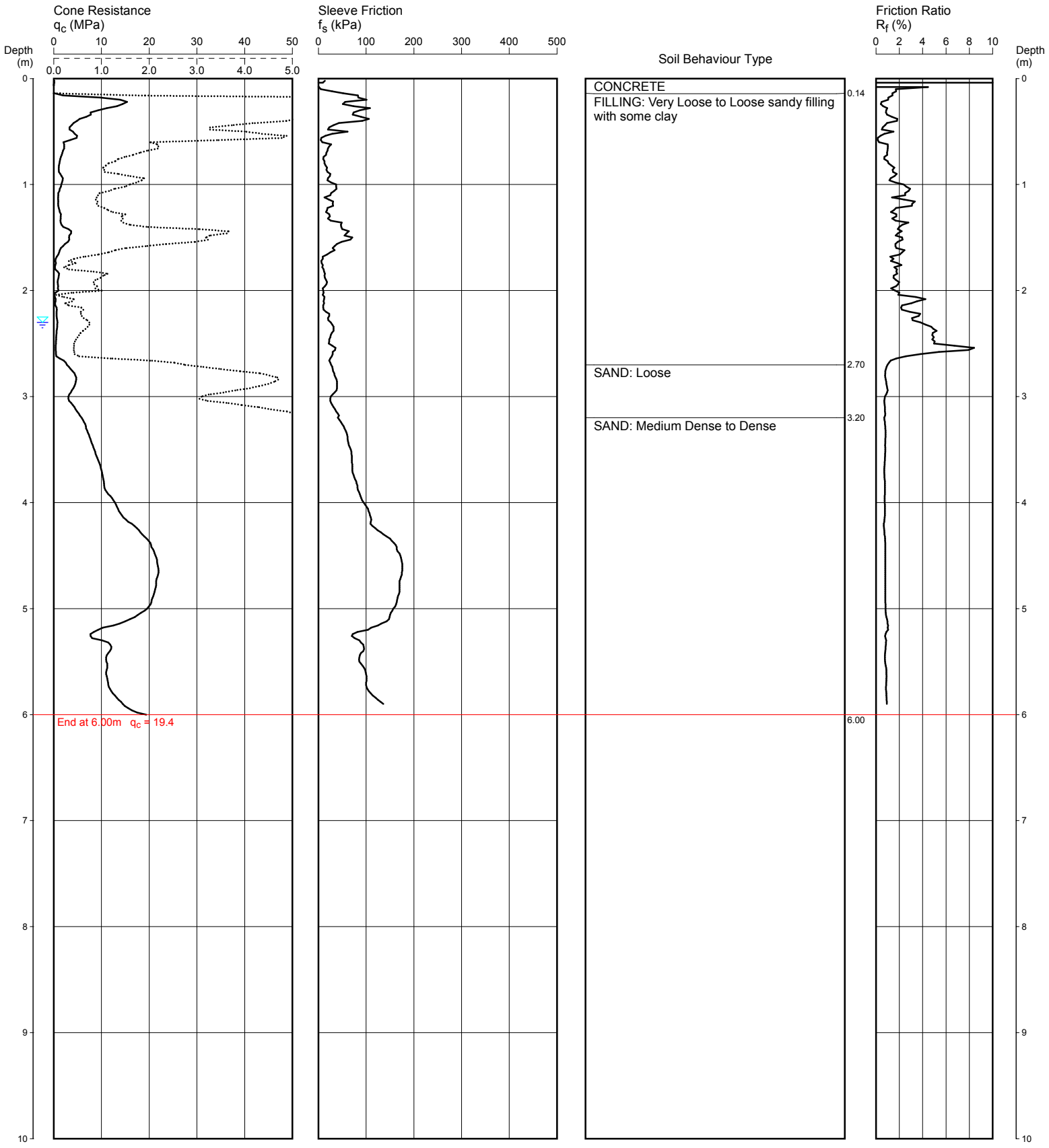
COORDINATES:

CPT1

Page 1 of 1

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.14 m DEPTH
HOLE COLLAPSE AT 2.3 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.30m depth (assumed)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT1.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.6

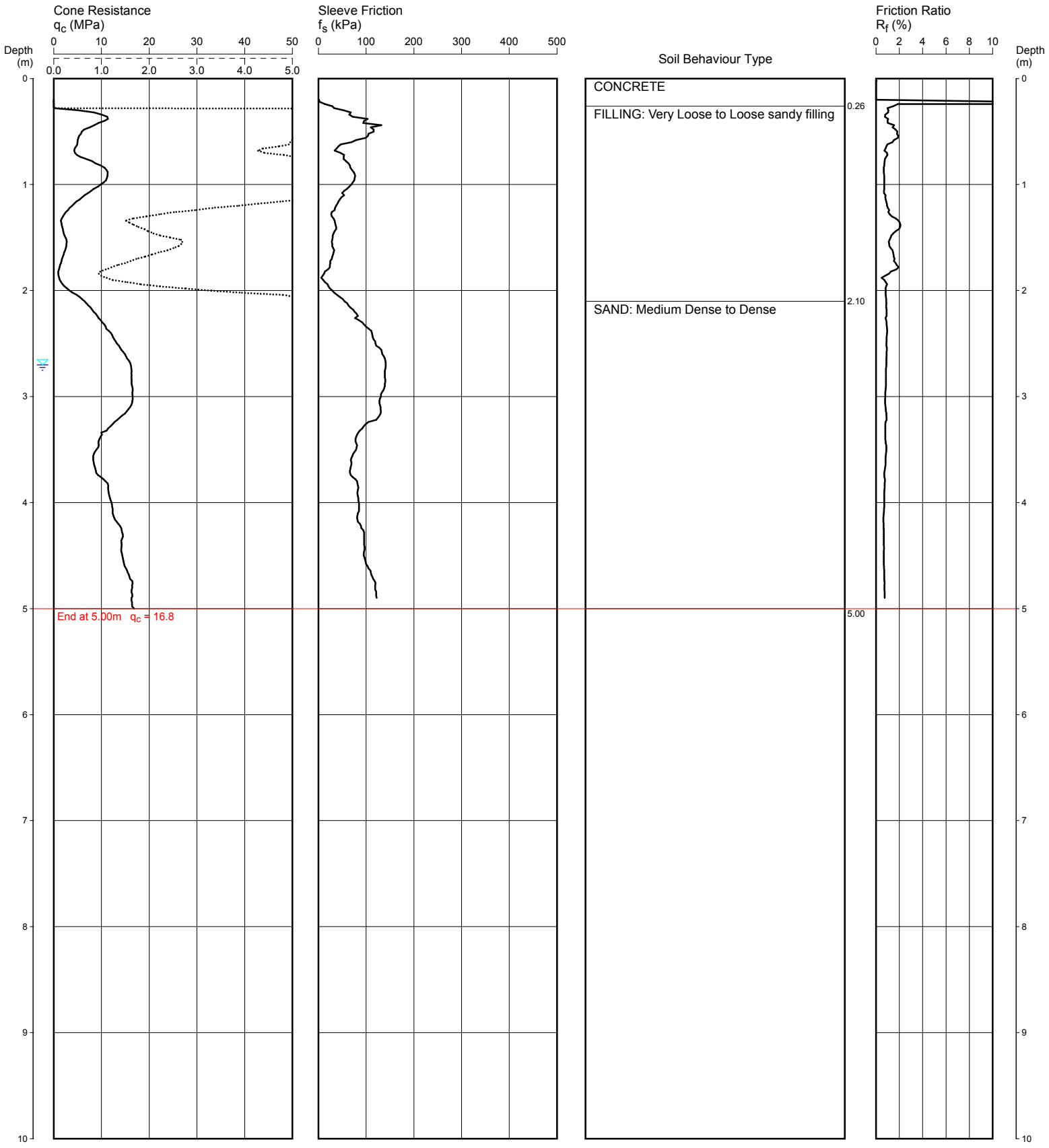
COORDINATES:

CPT2

Page 1 of 1

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.26 m DEPTH
HOLE COLLAPSE AT 2.65 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.70m depth (assumed)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT2.CP5

Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

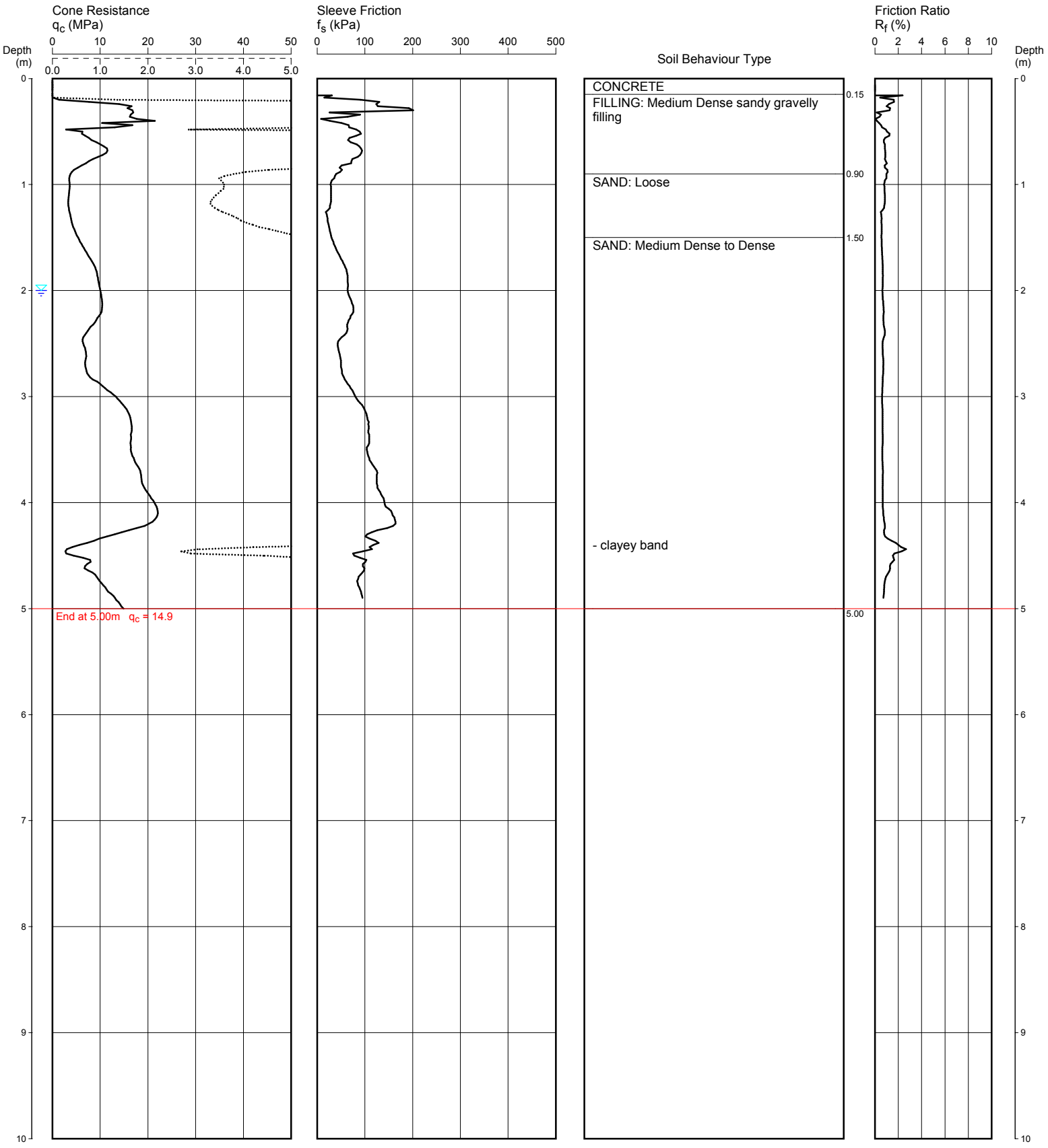
REDUCED LEVEL: 18.4

COORDINATES:

CPT3

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.15 m DEPTH
HOLE COLLAPSE AT 1.95 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.00m depth (assumed)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT3.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.3

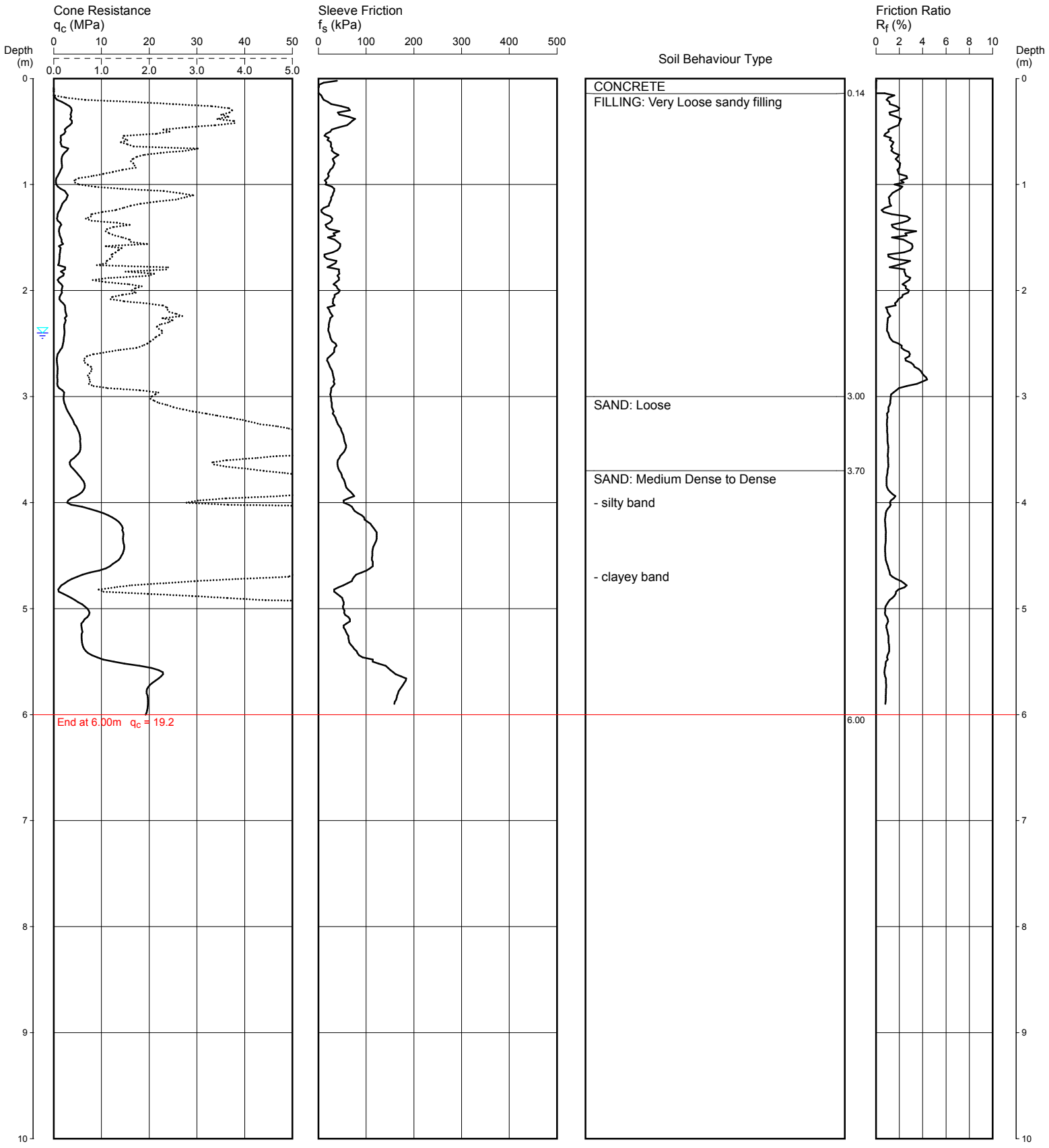
COORDINATES:

CPT4

Page 1 of 1

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.14 m DEPTH
HOLE COLLAPSE AT 2.4 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.40m depth (assumed)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT4.CP5

Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.5

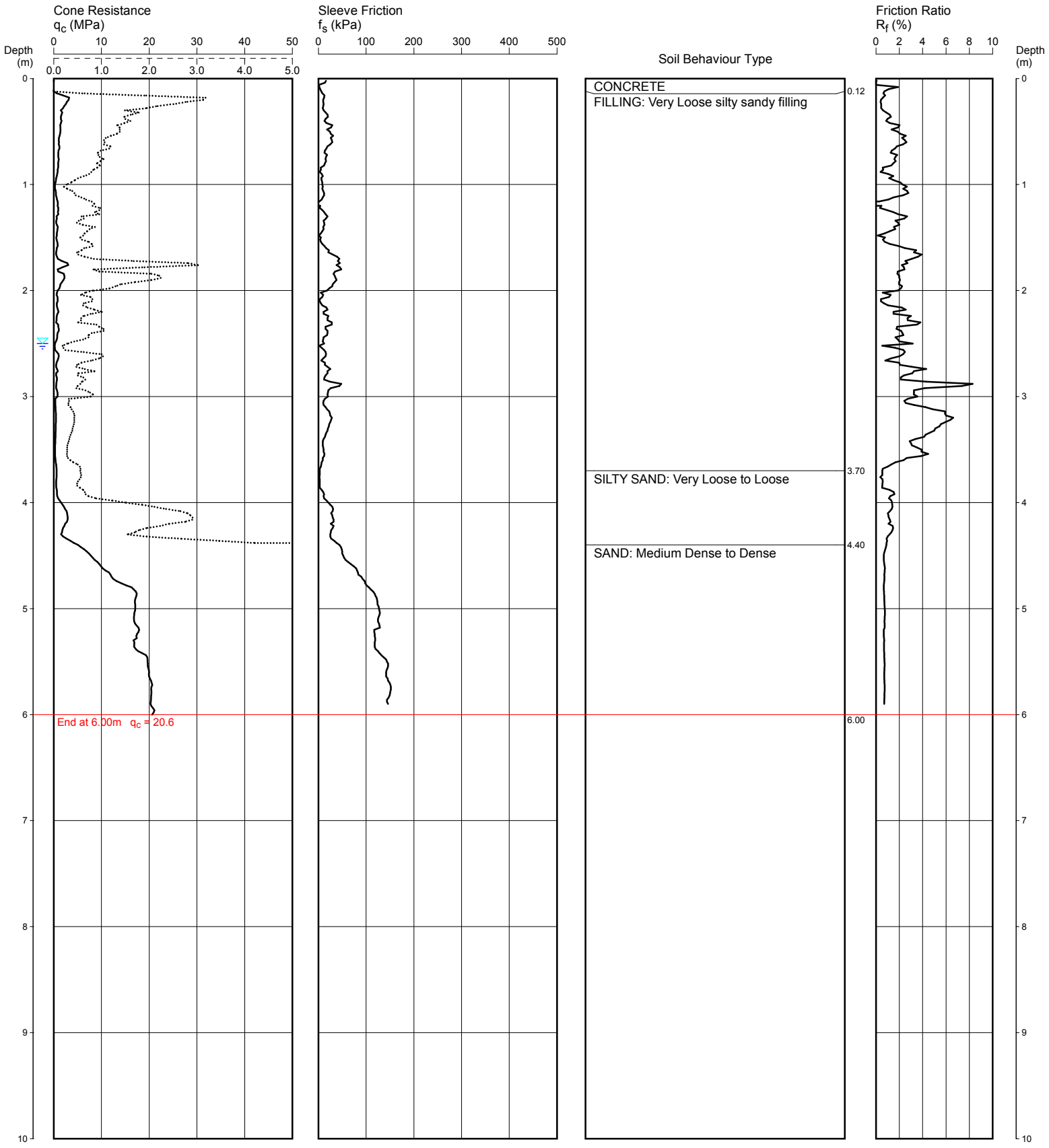
COORDINATES:

CPT5

Page 1 of 1

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.12 m DEPTH
GROUNDWATER OBSERVED AT 2.5 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.50m depth (measured)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT5.CP5

Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.5

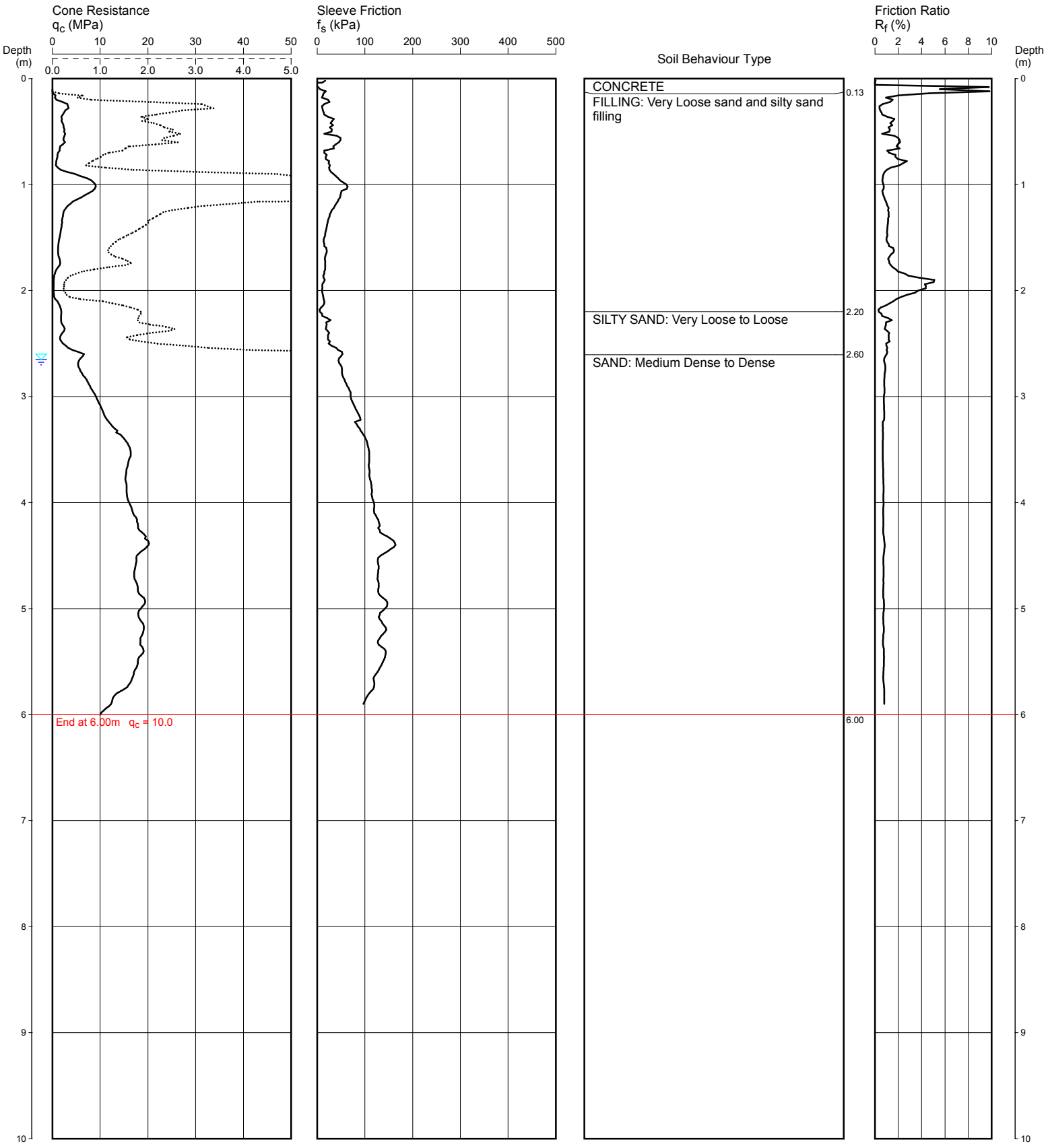
COORDINATES:

CPT6

Page 1 of 1

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.13 m DEPTH
GROUNDWATER OBSERVED AT 2.65 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.65m depth (measured)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT6.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

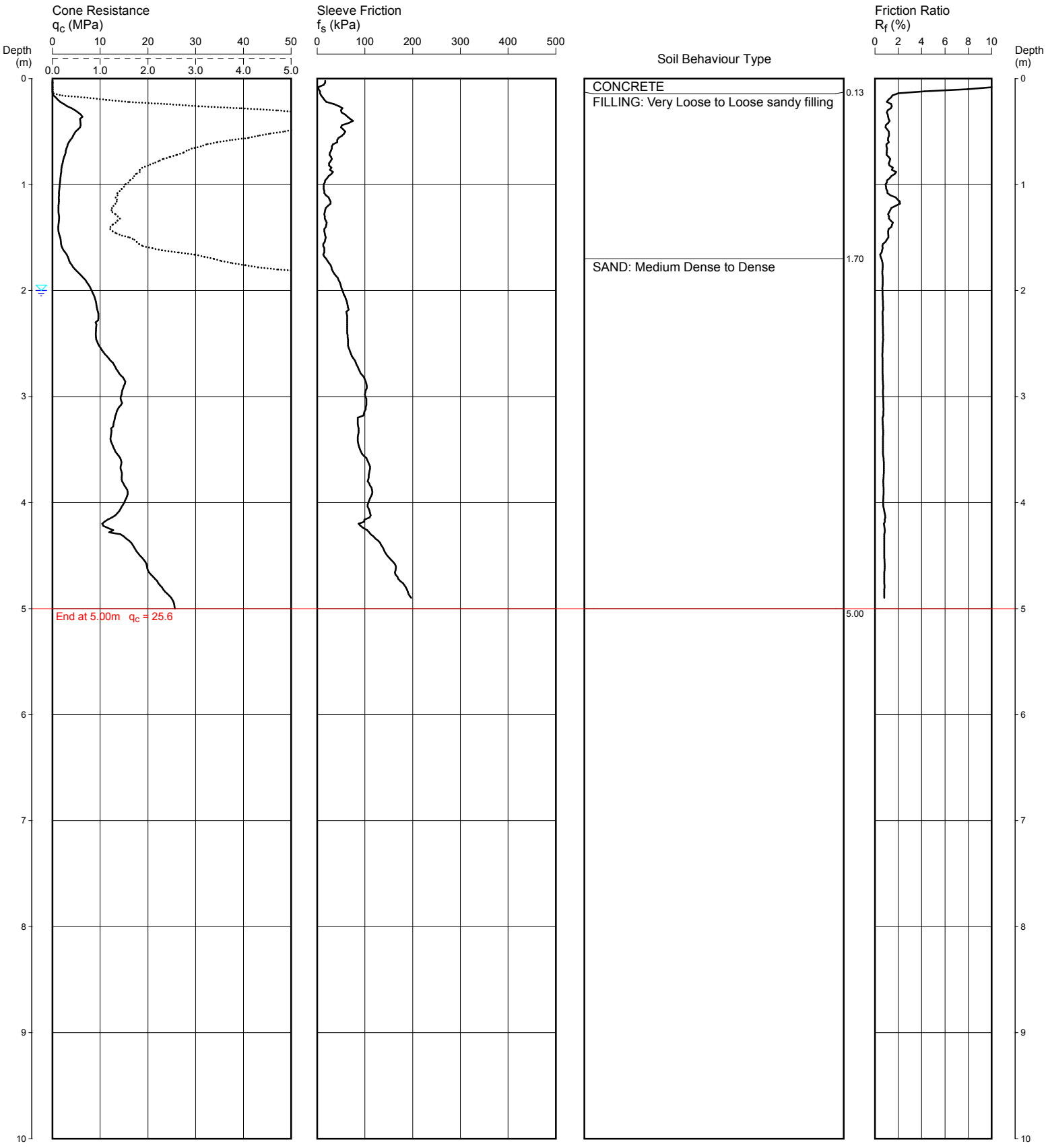
REDUCED LEVEL: 18.4

COORDINATES:

CPT7

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.13 m DEPTH
HOLE COLLAPSE AT 2.0 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.00m depth (assumed)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT7.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

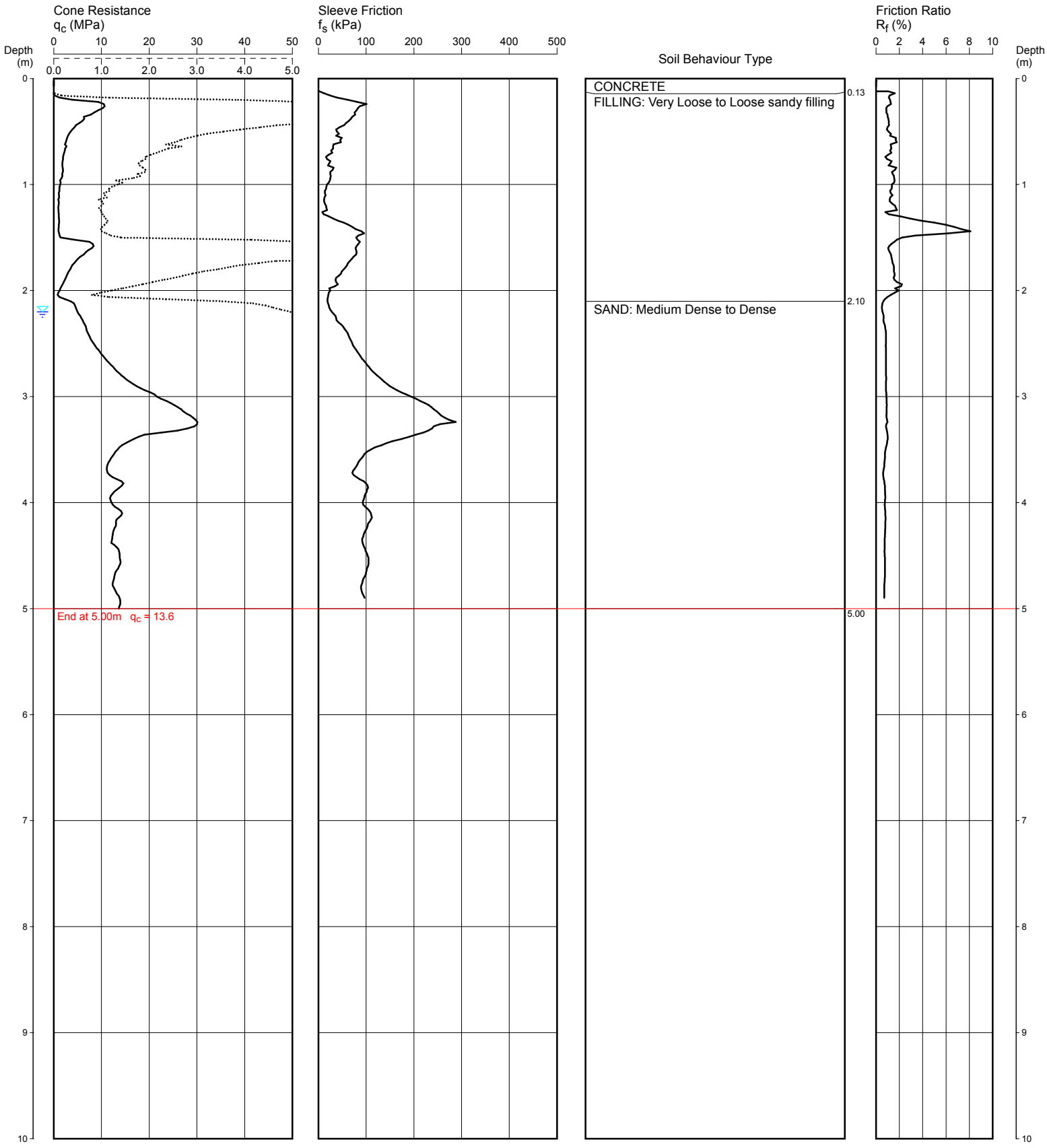
REDUCED LEVEL: 18.5

COORDINATES:

CPT8

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.13 m DEPTH
HOLE COLLAPSE AT 2.2 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.20m depth (assumed)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT8.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.7

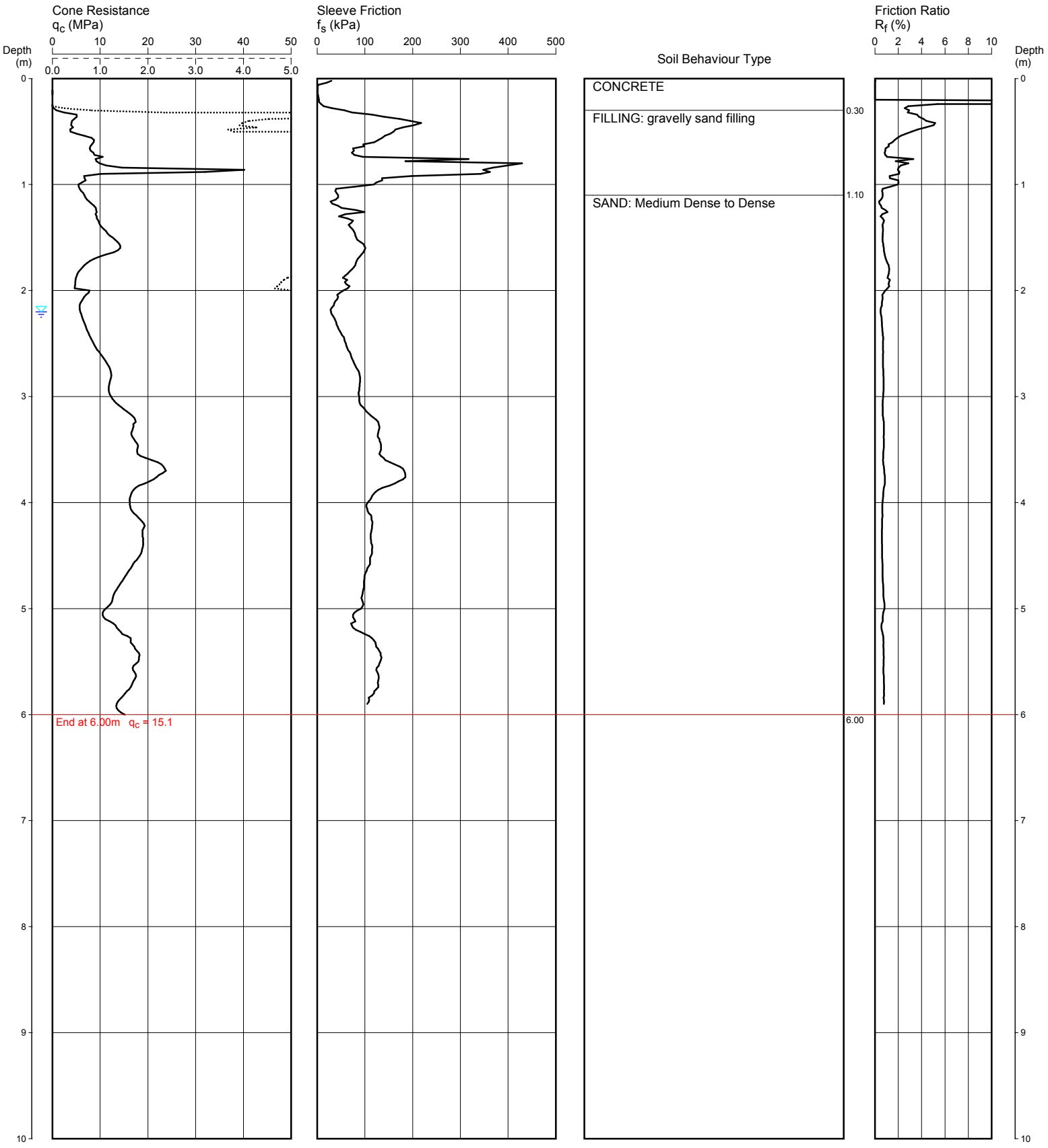
COORDINATES:

CPT9

Page 1 of 1

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.3 m DEPTH
HOLE COLLAPSE AT 2.2 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.20m depth (assumed)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT9.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 18.7

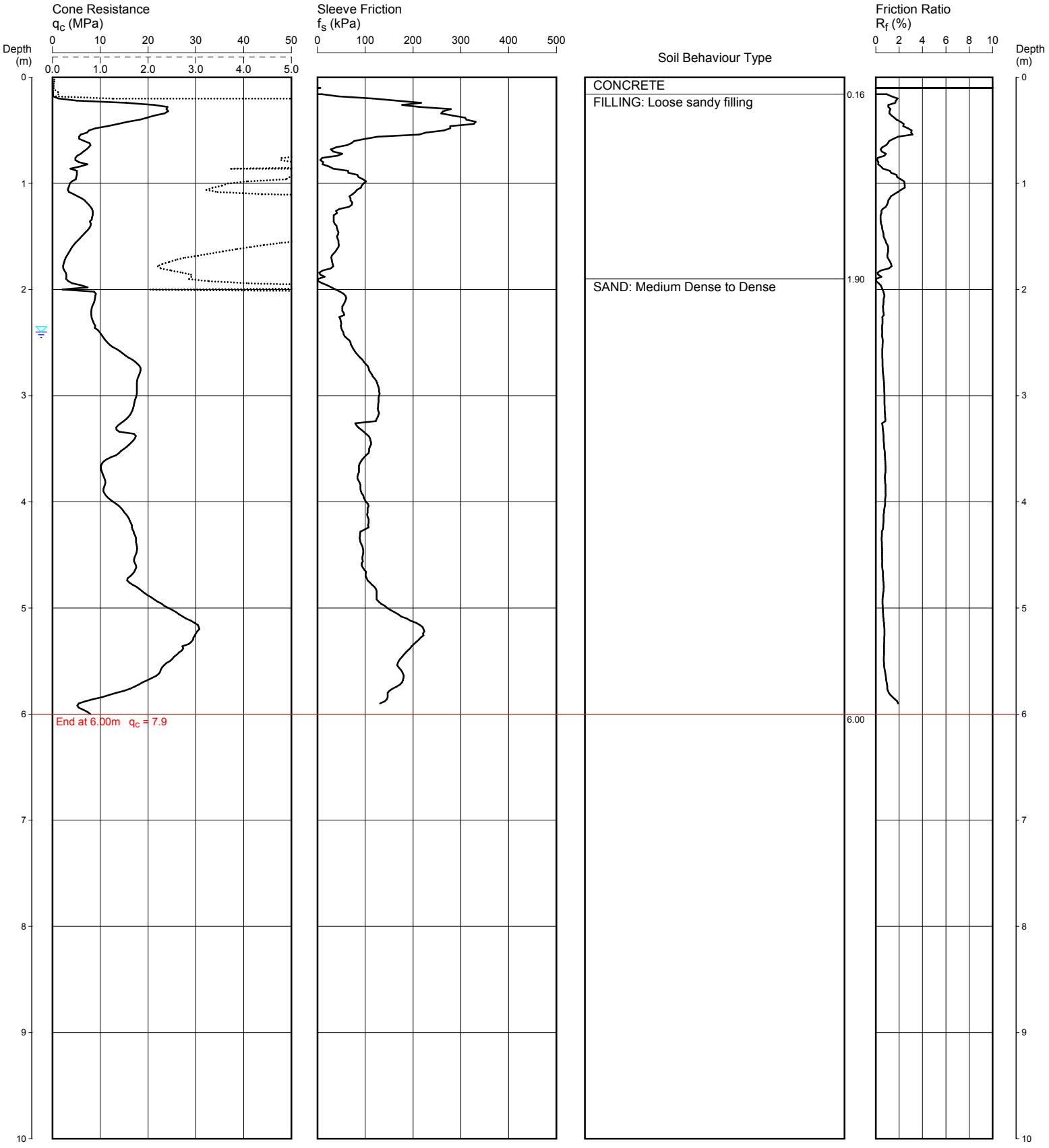
COORDINATES:

CPT10

Page 1 of 1

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.16 m DEPTH
HOLE COLLAPSE AT 2.4 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.40m depth (assumed)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT10.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 19.0

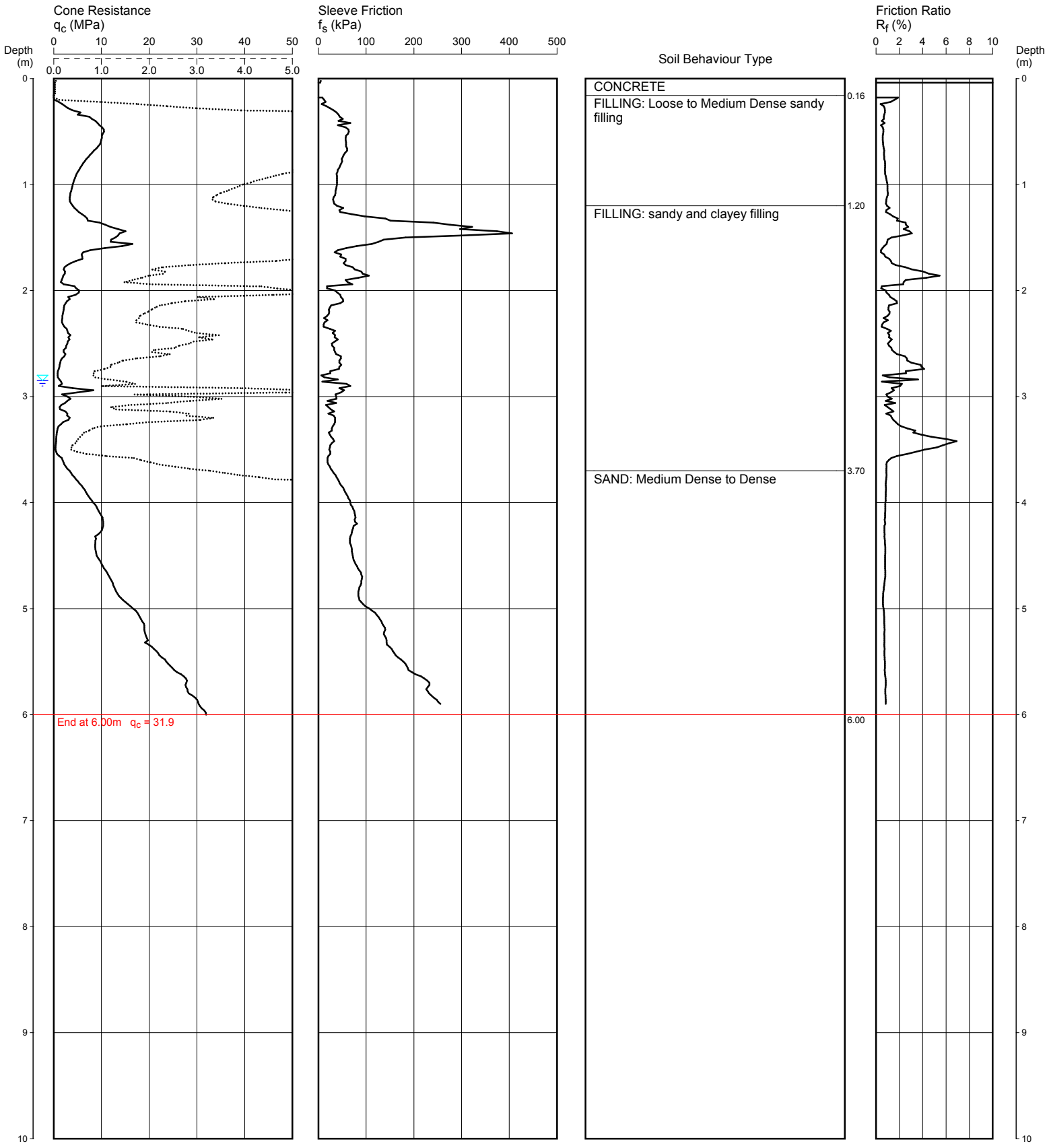
COORDINATES:

CPT11

Page 1 of 1

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.16 m DEPTH
GROUNDWATER OBSERVED AT 2.85 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 2.85m depth (measured)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT11.CP5

Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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CONE PENETRATION TEST

CLIENT: CITY OF SYDNEY COUNCIL

PROJECT: GREEN SQUARE HEALTH AND RECREATION CENTRE

LOCATION: JOYNTON AVENUE, ZETLAND

REDUCED LEVEL: 17.7

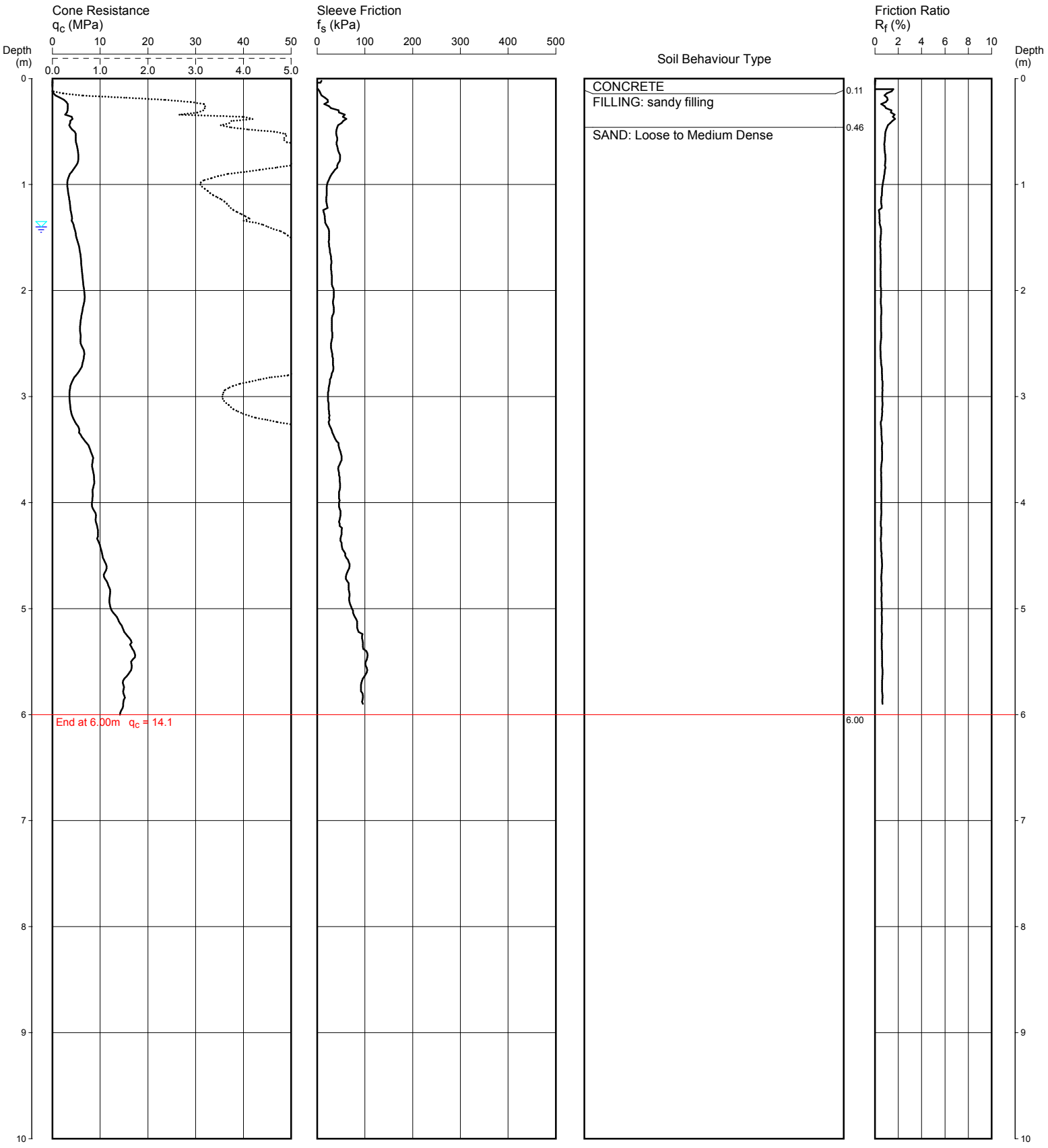
COORDINATES:

CPT12

Page 1 of 1

DATE 16/1/2014

PROJECT No: 73743



REMARKS: CONCRETE SLAB TO 0.11 m DEPTH
HOLE COLLAPSE AT 1.4 m DEPTH AFTER WITHDRAWAL OF RODS

Water depth after test: 1.40m depth (assumed)

File: P:\73743 ZETLAND, Green Square Health & Rec PMO\Field\CPT\CPT12.CP5
Cone ID: 120631 **Type:** I-CFXY-10

ConePlot Version 5.9.2

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BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 73743
DATE: 17 - 18/12/2013
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.15	CONCRETE										
		FILLING - variably compacted, light grey-brown then grey, gravelly sand filling, moist							A			
17	1								A S			7,9,13 N = 22
16	2											
		2.8m: becoming wet				▼			S			2,1,0 N = 1
15	3											
14	4	SAND - loose then medium dense, light grey, fine to medium grained sand							S			2,1,5 N = 6
13	5											
12	6								S			10,13,13 N = 26
11	7								S			7,12,12 N = 24
10	8											
		8.5m: becoming medium dense to dense sand							S			10,15,15 N = 30
9	9											
	9.8	SAND - see next page										

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 4.0m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 4.0m; Rotary to 14.5m; NMLC-Coring to 20.1m

WATER OBSERVATIONS: Free groundwater observed at 2.8m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 73743
DATE: 17 - 18/12/2013
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SAND - dense to very dense, light grey-brown, fine to medium grained, slightly silty sand *(continued)*							S			16,30,25/50mm refusal
	11											
	11.8	CLAYEY SAND - dense, light grey, fine grained clayey sand							S			30,25,26 N = 51
	12											
	12.6	SANDY CLAY - hard, light brown and red-brown, fine grained sandy clay with some ironstone gravel										
	13								S			12,26,15 N = 41
	13.8	SANDSTONE - extremely low to very low strength, light grey and red-brown, fine grained sandstone						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	14											
	14.5	SANDSTONE - very low strength, highly weathered, slightly fractured, light grey-brown and red-brown, fine grained sandstone with some high strength ironstone bands						14.58m: B0°, fe, cly, 5mm 14.7m: CORE LOSS: 450mm 15.15-15.76m: Ds	C	68	0	PL(A) = 1.2
	15											
	15.15											
	15.8	SANDSTONE - medium strength, highly weathered, slightly fractured, red-brown, medium grained sandstone						15.76m: B0°, cly 15.91m: B0°, fe 16.13m: B0°, fe, cly, 20mm 16.33-16.68m: B (x3) 10°, fe				PL(A) = 0.9 PL(A) = 0.4
	16											
	16.8	SANDSTONE - low to medium strength, moderately weathered then fresh, slightly fractured, light grey-brown then light grey, medium grained sandstone with some carbonaceous laminations 17.6-18.0m: very low strength band						17.17m: B0°, fe, Ds, 30mm 17.7m: B5°, fe	C	100	80	PL(A) = 0.3
	17											
	18							18.2 & 18.44m: B10°, cly vn 18.62m: J45°, pl, ro, cln				PL(A) = 0.3
	18.9	SANDSTONE - high strength, fresh, unbroken, light grey, medium grained sandstone							C	100	100	
	19											PL(A) = 1.8

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 4.0m
TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 4.0m; Rotary to 14.5m; NMLC-Coring to 20.1m
WATER OBSERVATIONS: Free groundwater observed at 2.8m whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 73743
DATE: 17 - 18/12/2013
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	20.1	Bore discontinued at 20.1m - target depth reached										

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 4.0m
TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 4.0m; Rotary to 14.5m; NMLC-Coring to 20.1m
WATER OBSERVATIONS: Free groundwater observed at 2.8m whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 73743
DATE: 18 - 19/12/2013
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.15	CONCRETE										
		FILLING - grey, fine to medium grained sand and crushed sandstone filling, humid							A			
	0.8	FILLING - moderately compacted, light grey and red-brown, sandy clay and crushed sandstone filling, moist							A			
17	1								S			3,6,16 N = 22
	1.6	SILTY SAND - grey then light brown, fine grained silty sand, moist										
16	2											
	2.1	SAND - loose to medium dense, light grey, fine to medium grained sand, moist										
		2.6m: becoming wet				▼			S			3,4,6 N = 10
15	3											
14	4								S			4,8,12 N = 20
	5.0	SAND - dense, light grey-brown, fine grained, slightly silty sand, wet										
13	5								S			9,14,21 N = 35
		5.8m: dark grey, peaty sandy clay										
12	6											
11	7								S			18,31,25/100mm refusal
10	8											
	8.8	SANDY CLAY - very stiff then hard, light grey-brown, fine grained sandy clay with a trace of ironstone gravel							S			23,17,19 N = 36
9	9											

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 5.5m; HQ to 12.0m
TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 13.0m; NMLC-Coring to 20.8m
WATER OBSERVATIONS: Free groundwater observed at 2.6m whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 73743
DATE: 18 - 19/12/2013
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
8		SANDY CLAY - very stiff then hard, light grey-brown, fine grained sandy clay with a trace of ironstone gravel *(continued)*							S			3,7,12 N = 19
7	11											
		11.5m: becoming hard							S			11,14,20 N = 34
6	12							Note: Unless otherwise stated, rock is fractured along rough planar bedding, dipping 0°- 10°				
	12.5	SANDSTONE - very low strength, light grey and red-brown, fine grained sandstone with ironstone bands							S			25,25/50mm refusal
5	13 13.0	SANDSTONE - very low and low strength, highly weathered, slightly fractured and unbroken, light brown and red-brown, fine grained sandstone						13.12m: J50°, un, ro, cly	C	100	38	PL(A) = 0.1 PL(A) = 0.2
4	14											
	15							14.98m: B5°, fe, cly, 5mm 15.15m: B5°, fe, cly, 10mm 15.17-15.25m: fg, fe				
3	15.2	SANDSTONE - low to medium strength, highly to moderately weathered, unbroken, light grey-brown, medium grained sandstone										PL(A) = 0.3
2	16											
	16.35	SANDSTONE - low and medium strength, highly to moderately weathered then fresh stained, slightly fractured, light grey-brown, medium grained sandstone						16.25-16.88m: B (x6) 5°, fe, cly	C	100	92	PL(A) = 0.7
1	17							17.2m: B0°, cly, 5mm				
	17.65	SANDSTONE - high strength, fresh stained then fresh, slightly fractured, light grey, medium grained sandstone						17.66-18.7m: B (x5) 10°, fe, cly vn				PL(A) = 1.2
0	18											PL(A) = 2.2
	19							19.08 & 19.57m: B0°, cly co, 1-5mm	C	100	100	PL(A) = 1.5
-1												

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 5.5m; HQ to 12.0m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 13.0m; NMLC-Coring to 20.8m

WATER OBSERVATIONS: Free groundwater observed at 2.6m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 73743
DATE: 18 - 19/12/2013
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
-2		SANDSTONE - high strength, fresh stained then fresh, slightly fractured, light grey, medium grained sandstone *(continued)*						20.35m: B0°, cbs co, 1mm	C	100	100	PL(A) = 1.6
	20.8	Bore discontinued at 20.8m - target depth reached										
-3	21											
-4	22											
-5	23											
-6	24											
-7	25											
-8	26											
-9	27											
-10	28											
-11	29											

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 5.5m; HQ to 12.0m

TYPE OF BORING: Diatube to 0.15m; Solid flight auger (TC-bit) to 5.5m; Rotary to 13.0m; NMLC-Coring to 20.8m

WATER OBSERVATIONS: Free groundwater observed at 2.6m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 73743
DATE: 19/12/2013
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18		FILLING - poorly compacted, light grey to grey, fine grained sand filling with some roadbase gravel, humid							A			
17	1								A			1,1,0 N = 1
									S			
16	2 2.0	FILLING - poorly compacted, dark grey, sandy silty clay filling with some concrete gravel and glass fragments, wet							S			1,0,0 N = 0
15	3					▼						
14	4								S			0,2,3 N = 5
	4.5	SAND - medium dense then dense, light grey and grey, fine grained sand, slightly silty, wet										
13	5											
		5.8m: peaty clayey sand							S			4,8,9 N = 17
12	6											
11	7								S			7,12,18 N = 30
10	8											
		8.5m: becoming dense sand							S			10,22,28 N = 50
9	9											
	9.9											

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 5.5m; HQ to 13.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 16.15m; NMLC-Coring to 21.15m

WATER OBSERVATIONS: Free groundwater observed at 3.8m whilst augering

REMARKS: Standpipe installed to 9.0m (Screen 6.0-9.0m; Gravel 5.5-9.0m; Bentonite 5.3-5.5m; Backfill to GL with Gatic Cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 73743
DATE: 19/12/2013
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
8		PEATY CLAY - stiff, dark grey, peaty clay with some fine grained sand *(continued)*							S			4,5,4 N = 9
7	11 11.0	CLAYEY SAND - very dense, light grey, fine to medium grained clayey sand							S			22,30/100mm refusal
6	12 12.3	CLAY - very stiff, light grey to grey, slightly silty clay, with a trace of ironstone gravel							S			4,6,11 N = 17
5	13											
4	14								S			4,9,11 N = 20
3	15							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
2	16 16.0 16.15	SANDSTONE - very low strength, light grey-brown, fine to medium grained sandstone							S			9,30/30mm refusal
1	17	SANDSTONE - high strength, moderately weathered, slightly fractured, light grey-brown, medium to coarse grained sandstone						16.28m: B20°, cly vn 16.55-16.79m: B (x3) 10°, cly vn, ti 16.96m: B5°, cly, 5mm	C	100	81	PL(A) = 1.3
0	17.65 18	SANDSTONE - very low then medium strength, highly to moderately weathered then fresh, slightly fractured, light grey and red-brown, medium grained sandstone						17.42m: B5°, cly co, 1mm 17.65-17.95m: Ds				PL(A) = 1.3
-1	19							18.57 & 18.87m: B5°, cly, 5mm, fe 19.25 & 19.26m: B0°, fe, cly, 10mm	C	100	98	PL(A) = 0.6 PL(A) = 0.7

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 5.5m; HQ to 13.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 16.15m; NMLC-Coring to 21.15m

WATER OBSERVATIONS: Free groundwater observed at 3.8m whilst augering

REMARKS: Standpipe installed to 9.0m (Screen 6.0-9.0m; Gravel 5.5-9.0m; Bentonite 5.3-5.5m; Backfill to GL with Gatic Cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 73743
DATE: 19/12/2013
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDSTONE *(continued)*										
	20.65	SANDSTONE - high strength, fresh, slightly fractured, light grey, medium grained sandstone						20.63 & 20.66m: B5°, cly co, 2-5mm 20.97m: B0°, cbs co, 1mm	C	100	98	PL(A) = 0.8 PL(A) = 1.3
	21.15	Bore discontinued at 21.15m - target depth reached										

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** HW to 5.5m; HQ to 13.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 16.15m; NMLC-Coring to 21.15m

WATER OBSERVATIONS: Free groundwater observed at 3.8m whilst augering

REMARKS: Standpipe installed to 9.0m (Screen 6.0-9.0m; Gravel 5.5-9.0m; Bentonite 5.3-5.5m; Backfill to GL with Gatic Cover)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 19.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 73743
DATE: 19/12/2013
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
19	0.15	CONCRETE										
		FILLING - poorly compacted, grey, clayey sand and roadbase gravel filling with a trace of building rubble, moist							A			
									A			
18	1								A			
	1.2	SAND - loose, dark grey-brown, fine grained sand, slightly silty, moist (possible filling)							S			1,2,2 N = 4
17	2											
	2.2	SAND - medium dense, light grey, fine to medium grained sand, moist							S			6,9,10 N = 19
16	3	3.2m: becoming wet				▼						
15	4								S			4,6,11 N = 17
14	5											
									S			2,8,9 N = 17
13	6											
12	7								S			0,1,3 N = 4
	7.0	PEATY CLAY - soft to firm, dark grey, peaty clay										
11	8								S			5,9,12 N = 21
	8.0	CLAYEY SAND - medium dense, light grey-brown, fine grained clayey sand										
10	9											

RIG: DT 100 **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 3.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 14.8m; NMLC-Coring to 19.96m

WATER OBSERVATIONS: Free groundwater observed at 3.2m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 19.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 73743
DATE: 19/12/2013
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
9	10.1	PEATY SANDY CLAY - stiff, dark grey, fine grained peaty sandy clay							S			3,4,6 N = 10
8	11											
	11.4	CLAYEY SAND - very dense, light grey, fine grained clayey sand							S			20,25/90mm refusal
7	12											
	12.5	CLAY - firm to stiff, light grey clay										
6	13								S			1,3,4 N = 7
								Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
5	14											
	14.1	SANDSTONE - extremely low to very low strength, light grey-brown, fine to medium grained sandstone										
	14.5	SANDSTONE - medium strength, highly to moderately weathered, slightly fractured, brown, medium grained sandstone						14.8 & 15.32m: B10°, cly vn 15.72-16.37m: B (x4) 0°-5°, cly, 5mm	C	100	94	PL(A) = 0.5 PL(A) = 0.6
4	15											
	16											
	16.2	SANDSTONE - medium strength, highly to moderately then slightly weathered, slightly fractured, light grey and brown, medium grained sandstone. Some very low to low strength bands						16.56 & 16.93m: B5°, fe 17.06m: B0°, fe, cly, 10mm 17.2 & 17.35m: J70°, cu, ro, fe 17.65m: B0°, fe & J85°, pl, ro, cly 17.95m: B0°, fe, cly, 5mm 18.3m: B0°, fe, cly & J85°, pl, ro, cln 18.58-19.72m: B0°, cly, 5mm	C	100	63	PL(A) = 0.6 PL(A) = 0.4 PL(A) = 0.8
3	17											
	17.6	SANDSTONE - very low to low strength, slightly weathered, slightly fractured, light grey, fine grained sandstone with some carbonaceous laminations										
2	18											
	18.3	SANDSTONE - medium then high strength, slightly weathered then fresh, slightly fractured and unbroken, light grey-brown then light grey, medium grained sandstone										
1	19								C	100	99	PL(A) = 1.8
0	19.96	Bore discontinued at 19.96m										

RIG: DT 100- target depth reached **DRILLER:** SS **LOGGED:** SI **CASING:** HW to 3.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 5.5m; Rotary to 14.8m; NMLC-Coring to 19.96m

WATER OBSERVATIONS: Free groundwater observed at 3.2m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: City of Sydney Council
PROJECT: Green Square Health & Recreation Centre
LOCATION: Joynton Avenue, Zetland

SURFACE LEVEL: 18.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 73743
DATE: 20/12/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
18	0.05	ASPHALT										
	0.3	CONCRETE										
		FILLING - variably compacted, grey to dark grey, silty sand and roadbase gravel filling, moist							A			
1									A			
									S			1,2,3 N = 5
17												
2	2.1	SAND - medium dense, light grey-brown, fine to medium grained sand, moist										
16						▼			S			4,6,9 N = 15
		2.8m: becoming wet										
3												
15												
4									S			3,6,8 N = 14
14												
5	5.0	Bore discontinued at 5.0m - target depth reached										
13												
6												
12												
7												
11												
8												
10												
9												
9												

RIG: Scout 2 **DRILLER:** LC **LOGGED:** SI **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 5.0m

WATER OBSERVATIONS: Free groundwater observed at 2.8m whilst augering

REMARKS: Standpipe installed to 5.0m (Screen 2.0-5.0m; Gravel 1.5-5.0m; Bentonite 1.2-1.5m; Backfill to GL with Gatic Cover)

SAMPLING & IN SITU TESTING LEGEND

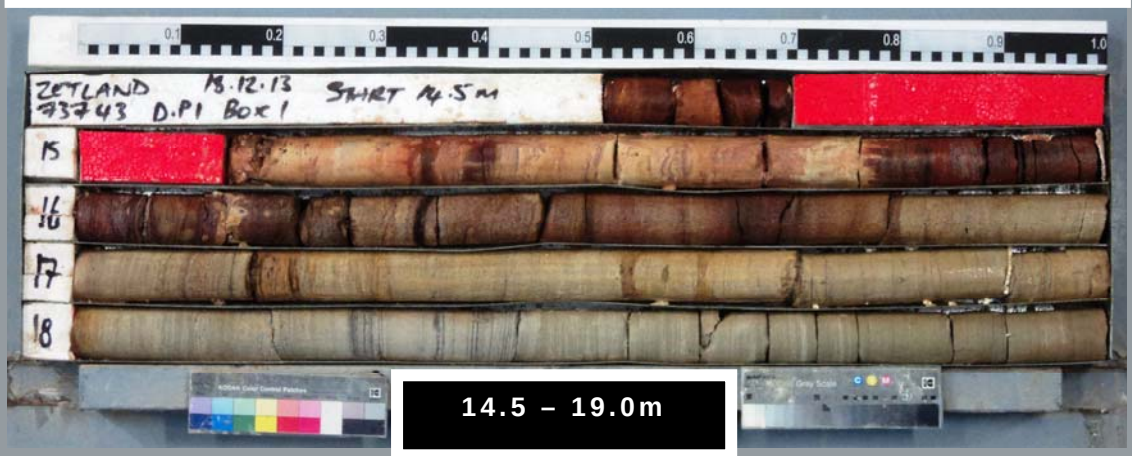
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE HEALTH & RECREATION CENTRE - ZETLAND

BORE BH1 PROJECT 73743 DEC 2013

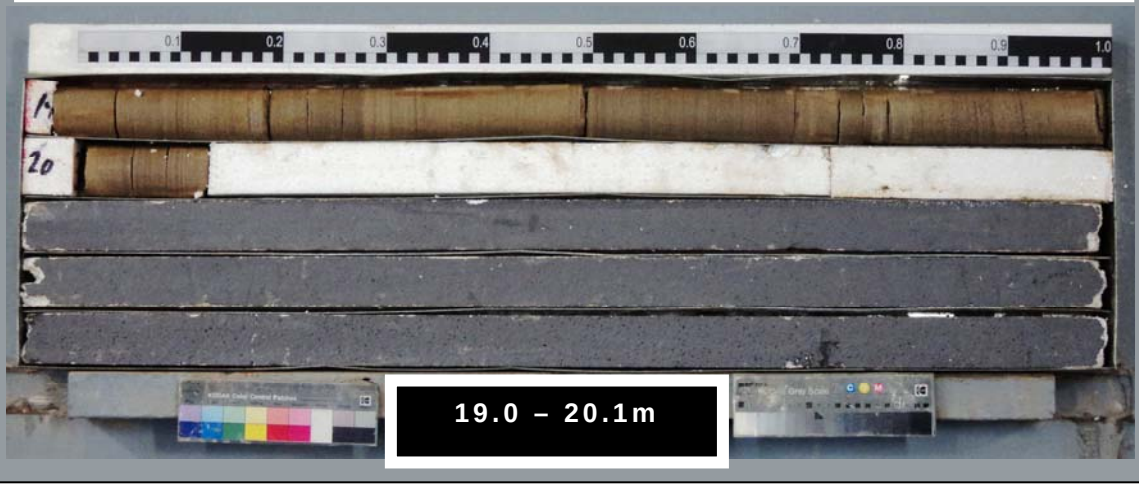


14.5 – 19.0m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE HEALTH & RECREATION CENTRE - ZETLAND

BORE BH1 PROJECT 73743 DEC 2013



19.0 – 20.1m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE HEALTH & RECREATION CENTRE - ZETLAND

BORE BH2 PROJECT 73743 DEC 2013

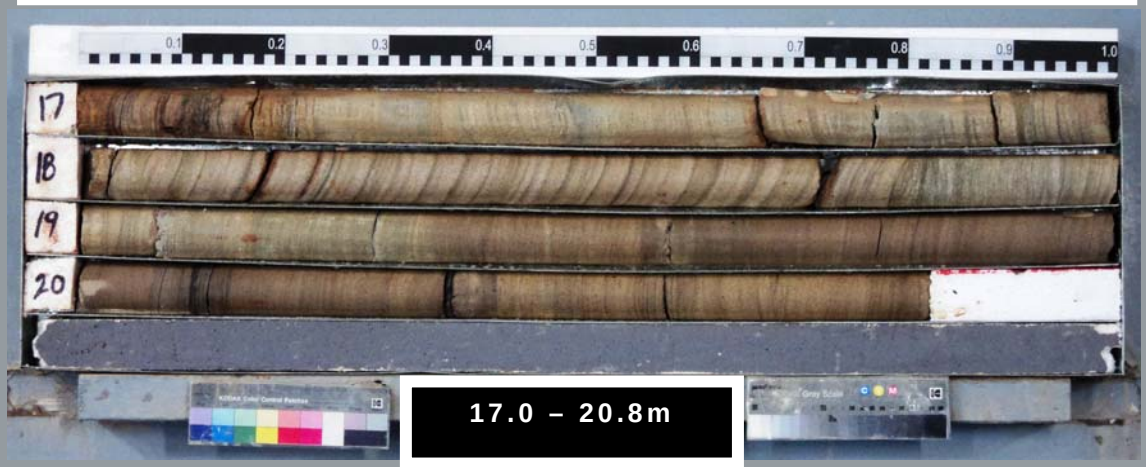


13.0 – 17.0m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE HEALTH & RECREATION CENTRE - ZETLAND

BORE BH2 PROJECT 73743 DEC 2013

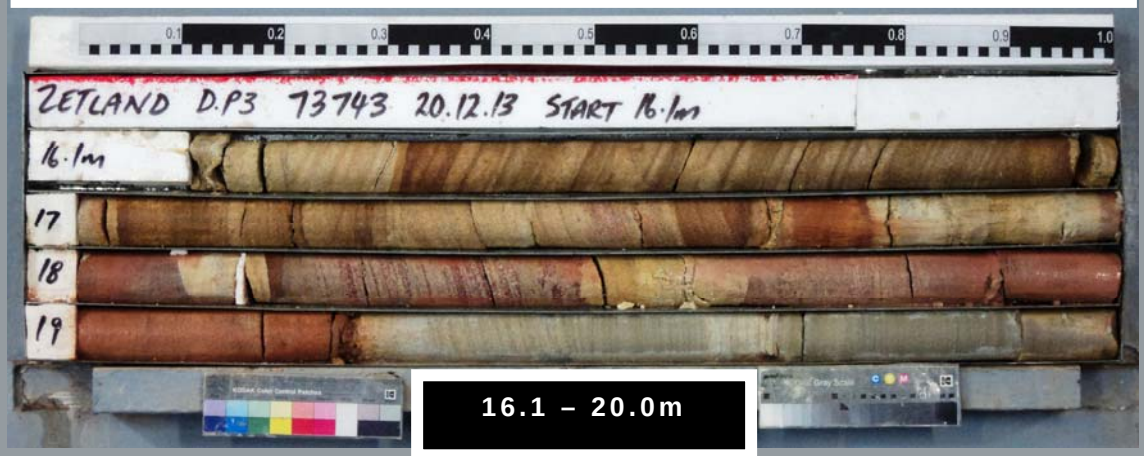


17.0 – 20.8m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE HEALTH & RECREATION CENTRE - ZETLAND

BORE BH3 PROJECT 73743 DEC 2013

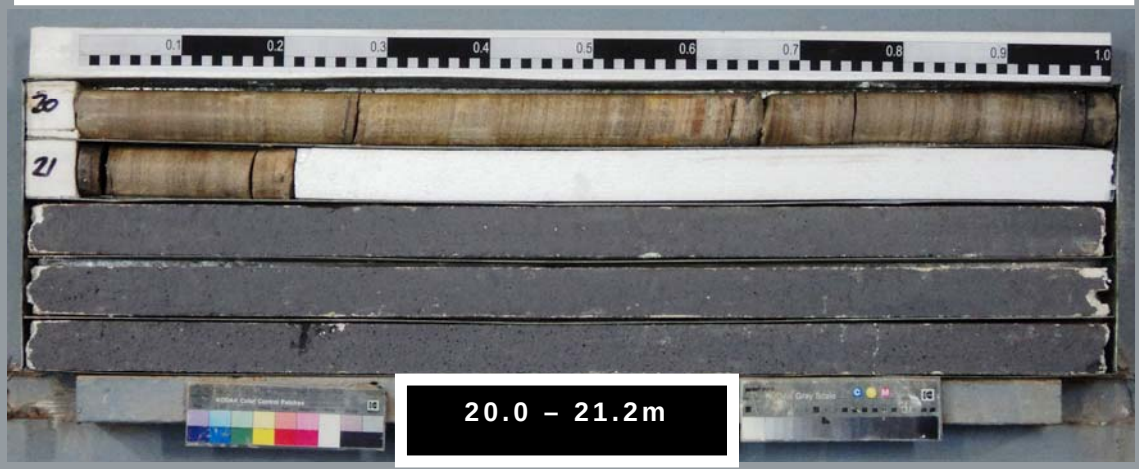


16.1 – 20.0m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE HEALTH & RECREATION CENTRE - ZETLAND

BORE BH3 PROJECT 73743 DEC 2013

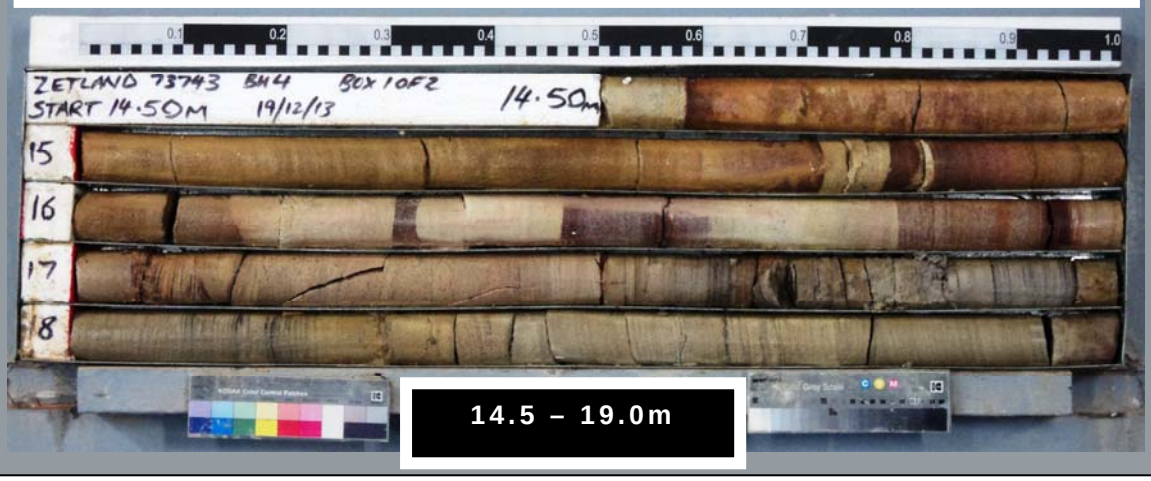


20.0 – 21.2m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE HEALTH & RECREATION CENTRE - ZETLAND

BORE BH4 PROJECT 73743 DEC 2013

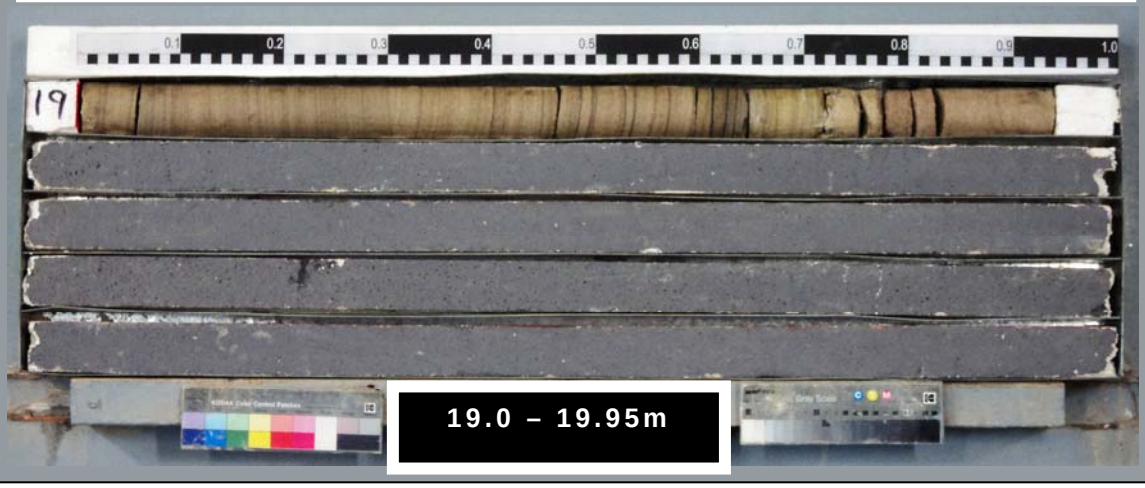


14.5 – 19.0m

DOUGLAS PARTNERS PTY LTD

GREEN SQUARE HEALTH & RECREATION CENTRE - ZETLAND

BORE BH4 PROJECT 73743 DEC 2013



19.0 – 19.95m

Appendix E

Laboratory Test Results

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 105873

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Peter Oitmaa

Sample log in details:

Your Reference:	**73743, Green Square HRC**
No. of samples:	4 Soils
Date samples received / completed instructions received	28/02/14 / 28/02/14

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	3/03/14 / 3/03/14
Date of Preliminary Report:	not issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

Miscellaneous Inorg - soil					
Our Reference:	UNITS	105873-1	105873-2	105873-3	105873-4
Your Reference	----------	BH1	BH2	BH3	BH4
Depth	----------	2.5-2.95	5.5-5.95	8.5-8.95	10-10.45
Date Sampled		17/12/2013	18/12/2013	19/12/2013	19/12/2013
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	03/03/2014	03/03/2014	03/03/2014	03/03/2014
Date analysed	-	03/03/2014	03/03/2014	03/03/2014	03/03/2014
pH 1:5 soil:water	pH Units	8.2	6.2	6.0	4.7
Electrical Conductivity 1:5 soil:water	µS/cm	250	150	38	120
Chloride, Cl 1:5 soil:water	mg/kg	20	20	10	20
Sulphate, SO4 1:5 soil:water	mg/kg	250	180	28	170

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 22nd ED, 4500-H+.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 22nd ED, 4110 -B.

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			03/03/2014	105873-1	03/03/2014 || 03/03/2014	LCS-1	03/03/2014
Date analysed	-			03/03/2014	105873-1	03/03/2014 || 03/03/2014	LCS-1	03/03/2014
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	105873-1	8.2 || 8.2 || RPD: 0	LCS-1	100%
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	105873-1	250 || 250 || RPD: 0	LCS-1	105%
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	105873-1	20 || 20 || RPD: 0	LCS-1	98%
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	105873-1	250 || 260 || RPD: 4	LCS-1	100%

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	105873-2	03/03/2014
Date analysed	-	[NT]	[NT]	105873-2	03/03/2014
pH 1:5 soil:water	pH Units	[NT]	[NT]	[NR]	[NR]
Electrical Conductivity 1:5 soil:water	µS/cm	[NT]	[NT]	[NR]	[NR]
Chloride, Cl 1:5 soil:water	mg/kg	[NT]	[NT]	105873-2	85%
Sulphate, SO4 1:5 soil:water	mg/kg	[NT]	[NT]	105873-2	91%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Management Plan

City of Sydney
Town Hall House
456 Kent Street
Sydney NSW 2000

Gunyama Park Aquatic and Recreation Centre (GPARC)



City Operations
June 2016
Revision 6.0

Sydney2030/Green/Global/Connected
city of villages

CITY OF SYDNEY 2030

Certification

This plan has been prepared and reviewed by the City of Sydney Council as prescribed below.

Document	Gunyama Park Aquatic and Recreation Centre (GPARC) Management Plan
Date	11 December 2015
TRIM	2015/660152
Prepared by	Collette Holland

Revision History

Revision	Revision Date	Details	Authorised	
			Name and Position	Signature
1.0	11.12.15	Issued to Gary Barnett for input	Collette Holland, Aquatic & Leisure Services Manager	Collette Holland
2.0	14.12.15	Issued for City Projects input	Collette Holland, Aquatic & Leisure Services Manager	Collette Holland
3.0	29.02.16	General revisions	Collette Holland, Aquatic & Leisure Services Manager	Collette Holland
4.0	15.04.16	General revisions – 70% DA	Collette Holland, Aquatic & Leisure Services Manager	Collette Holland
4.0	04.05.16	Issued to Steve Tyler for information	Collette Holland, Aquatic & Leisure Services Manager	Collette Holland
5.0	11.05.16	General revisions and update of Sections 4.2 and 4.3 in response to feedback from City Projects	Collette Holland, Aquatic & Leisure Services Manager	Collette Holland
6.0	09.06.16	Update to Section 3.5 Occupancy	Collette Holland, Aquatic & Leisure Services Manager	Collette Holland

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1. Introduction

This Management Plan ("the Plan") has been prepared by the City of Sydney ("the City") in support of the proposed Gunyama Park Aquatic and Recreation Centre ("the Centre") development which is proposed to be lodged with the Council of the City in May 2016. The sporting field, park and aquatic leisure centre design was developed based on a national design competition which the City held to achieve design excellence and maximum creativity for this key recreational precinct. It is currently being implemented by the City and Andrew Burges Architects with Grimshaw and T.C.L, was awarded the design competition.

1.1 Background

The park and Centre site sits within the proposed Epsom Park precinct, a 19 hectare area within the Green Square Urban Renewal Area. It is one of the fastest growing neighbourhoods in the city. The 278 hectare precinct includes Zetland and Beaconsfield, and parts of Rosebery, Waterloo and Alexandria and will eventually be home to 48,000 residents and the workplace for 22,000 people. Many of these residents will be living in vertical villages, either in the new town centre next to the station or in other new precincts such as Epsom Park, Lachlan Precinct and Victoria Park. It is vital that Green Square's residents, workers and visitors have open spaces in which to meet and gather, to play and exercise. The park and Centre will complement the library, the plaza, other new parks, and the creative community hub on the former hospital site in creating a vibrant and active neighbourhood.

1.2 Vision

The City of Sydney's vision for the precinct is to provide an all-inclusive physical activity hub. This will combine a precinct recreation park with a state-of-the-art aquatic leisure centre with the overriding aim of enhancing the health, fitness and recreational needs of the large and diverse local community of residents and workers in and around Green Square. As part of the City's network of aquatic leisure centres the Centre will contribute to the vision of Sustainable Sydney 2030 and the Social Sustainability Strategy by providing a vibrant multigenerational leisure space that satisfies the needs for programs, watertainment and social interaction.

The Centre will be efficient and sustainable and will cater for local people who want to maintain their health and wellbeing, learn valuable water safety life skills and local families who want to experience a fun day together in a joyful and stimulating environment which will encourage active lifestyles.

1.3 What is a management plan?

It is a document that outlines how land or a particular use of land is to be managed and operated in a safe and efficient manner. It is also a requirement with a development application for particular uses and events that are proposed within the City of Sydney Local Government Area. The Plan commonly addresses the following key matters:

- Permitted uses;
- Occupancy numbers;
- Hours of operation;
- Safety and security;
- Noise;
- Responsible service of alcohol;
- Waste management; and
- Access and movement.

Note this Management does not fulfill the requirements for the preparation of a Plan of Management under *the NSW Local Government Act 1993* (LG Act) for community land.

1.4 Purpose of this Plan

The purpose of the Plan is to inform Centre management to ensure the safe and successful use of the Centre including the context of the development within a residential area. The Plan is required to list the conditions of use that are a result of Development Consent.

1.5 Copies of consents, management plan and hazardous materials register

A current copy of the development consent for the operation of the Centre and the Plan is kept on display on-site and made available to Police or Council Officers or Special Investigator on request. A complete copy of the consent is appended to this Plan. A Hazardous Materials register is kept on-sit and updated by contractors or Centre management when required.

1.6 Review of this Plan

The Plan will be reviewed by the City regularly in order that it remains fit-for-purpose and also consistent with community values and changing circumstances.

Consideration will be given to changes in the nature of particular uses that occur during the operations of this Plan, any unforeseen impacts that have affected the amenity of the area or have been the basis for substantiated complaints made to Council.

2. Building use at Gunyama Park Aquatic and Recreation Centre

2.1 Permitted uses

The City's aquatic leisure network contributes to developing and supporting physically active and healthy communities. The focus is on meeting the needs of the diverse range and age of users and encouraging lifelong participation - active in the pool for life. The age range of users' spans from 3 months to 80+ years and the vision for the Centre reflects this.

In designing the spaces and layouts the following have been important considerations:

- Social inclusion;
- Sports development;
- Creative swimming;
- Healthy agenda, healthy living;
- Inclusive building;
- Community groups;
- Outreach; and
- Events.

The needs of users are many and varied and can be grouped into the following categories:

- Families;
- Children, in various age ranges/cohorts;
- Training;
- Education;
- Schools;
- Leisure;
- Health and rehabilitation;
- People with disabilities and/or injuries;
- Social competitors;
- Casual users;
- Visitors;
- Spectators;
- Event officials;
- Community groups; and
- Sporting associations.

The scale and intensity of the various activities will be limited by occupancy numbers, water space availability and hours of operation.

There are three modes under which people engage in activities as follows:

- **Drop in/casual** – where individuals and families decide to come and swim on a case by case basis;

- **Program** – where users pre-commit, through a registration process, to a series of uses that typically involve some instruction or leadership and happen at a predetermined time;

- **Rental/hire** – where a group rents the space and then controls the users and use.

The above categories of services are typically accommodated as summarised below:

	Modes of operation		
Categories of services	**Drop in / casual**	**Program**	**Rental / Hire**
Recreational and leisure swimming	■		
Education		■	■
Fitness swimming	■	■	■
Sport training		■	■
Events		■	■
Health and rehabilitation	■	■	■
Leadership training		■	■
Fitness	■	■	

2.2 Programs and services

Activities, including but not limited to the following, will take place in key spaces:

Lobby/foyer area – welcoming and attractive environment for social interaction and relaxation in an open area and space for personal devices offering free Wi-Fi. Retail area will sell items such as apparel and sporting goods. A single change room will be available. The area will also provide space to accommodate overflow from the café, secondary area for membership enquiries and sales, learn to swim registration etc. The foyer includes lift and stair access to the fitness centre on the level above past controlled access gates;

Meeting Rooms – for use internally as well as for external hire. Space will also function for membership sales enquiries and registration, café functions etc;

Indoor 25m 8 lane teaching/program pool (with moveable floor) – primarily for delivering learn to swim program but will also accommodate other warm water activities including shallow/deep aquasize classes, deep water running/walking, junior squads as well as water polo training and school carnivals;

Hydrotherapy pool – dedicated pool designed to AS3979-1993 for Hydrotherapy Pools with ancillary support services. This provides the opportunity for the pool to be used for medically based therapeutic programs as well as a range of external and centre run non-therapy based programs, including learn to swim babies classes, gentle exercise and sports recovery;

Leisure/aqua water play space – fun play pool of variable water depths and elements including water sprays, geyser, slide/s and places for parents to watch and play with their children as well as accommodating water familiarisation;

Outdoor 50m/recreation pool – flexible space with flip up boom at 25 metres and spectator seating to cater for a variety of programs and activities all year, including:

- lap swimming, squad training, swimming club race nights and club championships, corporate challenges, swimming carnivals; bi/triathlons;
- Aquatic sports may include canoeing scuba diving lessons, synchronised swimming, water polo training, underwater hockey;
- Educational programs will include learn to swim, water safety, schools, swimming competency training and certification, pool lifeguard courses, coaching courses etc;
- Free play activities will occur in the free form recreational water area at the shallow end of the pool. It is anticipated that this will operate on a seasonal basis ie September to April, but may increase to all year operation depending on demand;
- The 50m pool will also have a strong 'leisure' focus that includes inflatables, water basketball, water volleyball, peddle bikes, aquatic climbing wall, dive in movies, zoom balls, floatables; school holiday activities, family fun days, theme days, family and end of year events;
- General public use will be guaranteed at all times.

Multi-space fitness centre – located on the first floor where users engage in a range of activities including weight training on various machines and also using free weights, cardio training on treadmill and rowers, functional training;

Fitness studios/function rooms – flexible climate controlled rooms for a range of classes such as cross training, core-fitness, yoga, pilates, senior exercise, cardio boxing and meditation. They can also double as VIP or function rooms in conjunction with events held in the Centre eg member breakfasts, meetings, staff workshops, championship/club night presentations or for external hire for social gatherings, product launches and information sessions, Christmas parties, corporate or industry training and functions;

Wellness – complementary and alternative therapies for example physiotherapy, remedial, sports and relaxation massage, nutrition and naturopathy;

Crèche/multipurpose space – space for parents whilst using the Centre that will cater for up to 30 children from 6 weeks to 5 years. This space will function as a multipurpose area for other activities ie birthday parties, vacation care, training and children's programs when not in use as a crèche;

Café – food and beverage service to customers from front of house and a kiosk outlet accessible from the outside pool concourse; and

Public toilets for the café and general public.

3. Management and use

Overall management and supervision of the Centre will be in accordance with relevant best practice, various Australian Standards, applicable legislation, Council's own policies and procedures and operating procedures for the Centre. Management of the Centre is yet to be determined, however it is anticipated it will be managed under a Management Agreement by a professional organisation and industry leader appointed through a competitive tender process. Procedures will prescribe all arrangements pertaining to the Centre's use, maintenance and operations, including but not be limited to responsibilities of the City and the operator, maintenance obligations, insurances, Priority of Use guidelines (see Section 3.6) to be complied with, customer service and performance management.

Centre management will ensure the Centre provides an array of regular programs, plays host to community organisations, schools and clubs and associations who seek to hire facilities on a regular and casual basis and serve as a venue for school holiday activities, community celebrations and events.

The management principles for the Centre will include:

- A market driven approach to maximise use either through venue hire to groups or by programming initiated or conducted by Centre management, in accordance with Priority of Use Policy that will preclude one user group or activity dominating space in any activity area;
- Devise programs that optimise family time together and social capital building;
- Maximised commercial viability and Centre operational performance results in minimal or no cost to Council for its recurrent and refurbishment costs;
- Community has the opportunity to participate in a range of quality activities regardless of social disadvantage or disability;
- Services provided are complementary to programs and services provided by Council at other facilities; and
- Engagement with all necessary stakeholders to promote a shared ownership of community development in the use of the Centre.

3.1 Staffing

The Centre will be managed during all operating hours by staff specifically skilled, qualified and experienced in facility management, maintenance and programming and community development. These staff will work shifts, spread over the hours below (See Section 3.2). On average there will be between 25-35 staff in the building at one time, depending on activity. An indicative staffing complement would include:

- Administration staff;
- Customer service Manager and staff;
- Café manager and staff;
- Fitness Manager and program staff;
- Operations Manager;
- Operations coordinator;
- Lifeguards and Duty Manager/s;
- Swim coaches and instructors;
- Membership consultants;
- Crèche coordinator and staff; and
- Centre Manager.

3.2 Hours of operation

The Centre will be available to operate 7 days a week each day of the year with the exception of Good Friday and Christmas Day. Earlier closure or later opening may be agreed to by the City over the Christmas/New Year period and Anzac Day and customers will be advised in advance.

The hours of the Centre are still to be finalised but will be reflective of the operating hours in the endorsed Business Case and for contemporary and comparable aquatic leisure centres. The following outlines the proposed spread of hours.

Aquatic Leisure Centre (including fitness area) - indoor and outdoor (all year)

Staff setting up and closing:

- Monday to Friday 5.00am – 11.30pm
- Saturday, Sunday and Public Holidays 5.30am – 9.30pm

Customers using the building:

- Monday to Friday (indoor) 5.30am – 11.00pm
- Monday to Friday (outdoor) 5.30am – 10.00pm
- Saturday, Sunday and Public Holidays 6.00am – 9.00pm

Café – indoor and kiosk (all year)

Staff setting up and closing:

- Monday to Friday 6.00am – 11.30pm *
- Saturday, Sunday and Public Holidays 6.30am – 9.30pm *

*subject to external operator or Centre management

Customers using the building:

- Monday to Friday 6.30am – 10.00pm
- Saturday, Sunday and Public Holidays 7.00am – 8.00pm

3.3 General Access

Entry and exit access will be controlled through the lobby/foyer to securely direct participants, spectators and visitors to permitted areas with the Centre. This will ensure safety, security and operational monitoring of numbers through electronic access gates controlled via a point of sale system.

A secondary electronically controlled entry point off the 50 metre pool concourse to assist entry for large groups. Spectators when events being held and school groups and competitors will be directed to use this entry to avoid congestion through the lobby/foyer.

The carparking ticket validation machine will be located past the controlled entry gates.

3.4 Fitness centre access

Council will not be competing with the 24-hour fitness market and will staff the fitness centre providing a high level of customer service contributing to safe and vibrant community hubs. It will operate to the same hours as the overall Centre.

3.5 Occupancy

Attendance projections have been estimated in the order of 577,000 for year one increasing to 712,000 by year 10 (as per updated Business Case 2016).

The maximum number of persons within the Centre at any one time shall not exceed 2100.

The following levels have been established in the different areas:

- Aquatic Centre Ground Floor (excluding crèche/shared use room) = 1640
- Fitness Centre Level 1 = 380 (general operation and event mode), with access to centre toilets for event mode as required
- Café/ Kiosk (Internal and External) = 100 (general operation) and 200 (event mode), with access to centre toilets for event mode as required

- Crèche/ Shared Use Room = 25 (general operation) and 30 (event mode), with access to centre toilets for event mode as required

The following sign, in letters not less than 25mm in height must be fixed (and maintained at all times) inside the main entrance/s to the premises:

Maximum Number of Persons Permitted Maximum Capacity 2100 persons

Monitoring of occupancy levels is the responsibility of centre management. Centre management will:

- Monitor occupancy numbers for safety purposes;
- Record customer numbers for reporting purposes through a leisure management and access control system;
- Monitor the behaviour of customers entering and exiting the Centre.

City representatives will have access to the Centre at all times for the purpose of inspection and may impose restrictions on usage numbers in the interest of the public's safety.

3.6 Exclusivity and restrictions

Subject to payment of the required entry fee as prescribed by Council all areas of the Centre will be available to the public when it is open on a non-exclusive basis, except where there is an event and prior consent is granted by Council for the activity and/or pre-existing agreements exist.

Public access to the Centre is restricted outside of approved opening hours for safety and security of infrastructure. The Centre is fenced to prevent unauthorised entry and vandalism to the site in addition to the security system outlined in Security Management Plan.

3.7 Food and beverages

The Centre will provide a service to both internal and external markets and create a strong connection with the adjoining park. The café will consist of provision of self-service and staff assisted service snacks, refreshments and light meals (hot and cold) and non-alcoholic/alcoholic beverages.

Some on site preparation will be required. The Centre will be able to provide food prepared off site or on site in a conventional manner and allow for reconstitution or immediate serving of these meals. Catering of any on site functions will be coordinated through the café. This can range from a birthday party of 30 children, venue hire for a small meeting of 10, through to a corporate product launch for 100. The Centre has regular hirers and casual hirers or local businesses will be potential clients.

Café service includes from chairs and tables indoors as well as under the outside undercover area. There is also seating provided from the walk up 'kiosk' window accessible from the outdoor pool concourse and room in the foyer for lounges, tables and chairs for service. Mobile carts will also serve the outdoor pool during peak summer periods or events.

Service will be available during operational hours that will be defined in consultation with the City. Vending machines will be provided to cater for periods outside of these hours or peak loads.

The product range will be provided in accordance with relevant health requirements.

The café can operate *On Premises Licence* (please see section 3.17 Behaviour of Customers and Responsible Service of Alcohol).

There is team sport training and competition on the outside sportsfield. Some of these clubs have access to external canteen facilities that are used to raise funds. Centre management will not undertake services that directly compete and impact on the fundraising of those clubs.

Food vans will not be permitted to operate within the immediate precinct of the Centre or park.

3.8 Children's crèche/multipurpose room

The crèche will offer an on-site short term child minding service to parents and guardians making use of the facilities inside the Centre, primarily during peak usage times only. It is not a child care centre for parents to leave their child in care and undertake activities outside or away from the Centre. Parents and guardians will be able to place their child(ren) in the crèche while they are on site for a maximum two (2) hour period any single day.

3.9 Retail space

Small retail operations will be established within the foyer/lobby area to offer consumable items and a selected range of leisure and fitness apparel. This is an important element of securing secondary spend in a facility of this type. Stock items are likely to include sweat bands for head and wrist, socks, soap and shampoo, towels, goggles, flippers, sunscreen etc as well as some product relevant to the fitness centre.

3.10 Commercial tenancy spaces

To increase the attraction and appeal of the Centre the potential to offer a select number of allied health and wellness opportunities will be considered as part of developing the management framework. Subject to identifying suitable accommodation space, these tenancies will either be offered through direct engagement of staff or on a commercial license basis to provide ancillary services to customers in disciplines such as medical/sports medicine, physiotherapist, naturopath and nutritionist, massage etc.

3.11 Amenity of neighbourhood and noise

Managing noise levels is an important part of the City's commitment to providing a liveable, supportive environment for all. This is especially important to the Centre that is in close proximity to nearby residential apartment towers.

The City of Sydney will endeavour to ensure that the purpose and use of the Centre is communicated broadly to residents and neighbours from its inception, and Centre management will take a proactive approach to engage with the residents and surrounding facilities. This will include regular communication with these stakeholders about activities occurring in the Centre.

The activities to be conducted in the various areas of the Centre will from time to time, give rise to moderate to high levels of sound, particularly the outdoor pool. The principle noise source will be general noise associated with use of the pool activities (water basketball), instructors, coaches, spectator noise for carnivals (applause, shouting, cheering) etc and in some cases the noise of game or activity control devices ie water polo training. Special equipment noise may be generated through use eg for control over games times. Such equipment may include hooters, sirens, and bells etc generating very high levels of noise.

Restrictions will be placed on when the use of noise generating equipment or game control devices or activities in the outdoor pool area (with the exception of during an emergency). This is expected to be limited to:

Weekdays (NDST)

- Not before 7.00am and not after 9.00pm

Saturday, Sunday and Public Holidays

- Not before 8.00am and not after 8.00pm

Weekdays (DST)

- Not before 7.00am and not after 10.00pm

Saturday, Sunday and Public Holidays

- Not before 8.00am and not after 9.00pm

Loud amplified music will be played in the fitness studios during classes. Background music is likely to be played within the fitness centre.

With the exception of night cleaning contractors the premises will be vacated by no later than 30 minutes after the scheduled closing time. This will include the exit of staff and customers and will include any special events including bump out and cleaning.

All staff, customers and contractors will be instructed to be quiet when leaving the Centre. Signage will be displayed to remind and/or inform customers to be quiet when exiting.

Centre management will ensure that the daily operation complies with all noise conditions as outlined in the DA consent. Any complaints from neighbours will be resolved as soon as possible and registered and reported to the City for monitoring purposes.

3.12 Noise general

[WILL BE UPDATED WHEN CONDITIONS SET]

3.13 Speakers or noise outside

Speakers installed in the outdoor pool area will be used for a range of purposes on a daily basis including key operational purposes, public service announcements and emergency purposes. They will also include the playing of background music during nominated events ie school holiday activities, announcements during school carnivals, swimming club meets and race nights as well as announcement of upcoming daily activities. Speakers are placed so as to not direct the noise towards the adjacent residential premises.

3.14 Accessibility

It is recognized that there is a diverse community with specific requirements that will be using the Centre and the design caters for all age ranges, genders, vulnerable groups and differing levels of disability.

The design measures included will make the Centre more accessible to people with a disability and more user-friendly for everyone. The following operational considerations and provisions will be accommodated:

Furniture – appropriate colour scheme and style to ensure unhindered access and use and to optimise the use of the Centre.

Changing Places facility – people with profound and multiple learning disabilities, as well as spinal injuries, spina bifida, motor neurone disease, multiple sclerosis or an acquired brain injury, often need extra facilities to allow them to use the toilets comfortably. A ‘changing places’ facility will be directly accessible to the general public and for users of the hydrotherapy pool. Gantry will connect the change rooms and hydrotherapy pool.

Recharge point for electric mobility devices and equipment – the Centre will become recognised ‘recharge point’ as part of Council’s partnership with Recharge Scheme Australia. The position will be prominent within the lobby area of the Centre.

Fitness centre – will include a range of fitness equipment accredited as suitable for use by non-able bodied users. Programming of classes can be adapted to those with special needs.

Lockers – designated lockers with electronic access in lower tiers will be designated to promote user friendliness for wheel chair users.

Staff awareness and training - ongoing disability awareness training and staff induction programme for disability awareness will be included in the Management Agreement with Centre management.

Communications – a range of methods and different formats will be implemented to disseminate information and detail about what facilities are available. These may include braille, large print or web-based.

Assistance dogs – trained dogs will be permitted in the Centre. Centre management will have a policy on assistance dogs included in its operational manual.

Community noticeboard/s – the 'zone of common reach' for people who are standing or in wheelchair.

LED display boards – will be provided to both indoor and outdoor areas as part of a comprehensive signage strategy to provide key information.

3.15 Gunyama Park community and sporting event bookings

Administration and management of the sportsfield for organised use will be undertaken by Centre management in accordance with the Gunyama Park Management Plan.

3.16 Security

The City of Sydney as owner of the building, will install a security system within the Centre for protection of the property and management of access to areas within the Centre in accordance with the Security Management Plan.

3.17 Behaviour of customers and the responsible service and sale of alcohol policy

Responsible serving of alcohol is vital for legal, health and community reasons. Centre management will uphold all regulations and recommendations in the sale and serving of alcohol and in accordance with the New South Wales Office of Liquor, Gaming & Racing On-Premises Licence for a Restaurant. This licence will permit alcohol to be sold or consumed on a daily basis with or ancillary to another product or services that is sold, supplied or provided to people on the premises. This will include the café and also be served in conjunction with events such as corporate training days, product launches and Christmas parties.

Regulations adhered to:

Centre management shall comply with the measures for responsible service and sale of alcohol set out hereunder.

The following operational policies for the responsible service of alcohol shall apply.

1. Centre management shall adopt and promote the "New South Wales Liquor Industry Code of Practice for Responsible Promotion of Alcohol Products";
2. Signage will be displayed at the front of the premises that shows the name of the premises, the type of liquor licence held, either the business or activity carried out on the premises or the kind of premises and the name of the licensee;

3. Centre management shall maintain a register, containing copies of certificates showing the satisfactory completions of Responsible Service of Alcohol courses undertaken by the licensee (if not run directly by them), managers and all staff required to complete such a course. That register shall be made available for inspection on request from a NSW Police officer or special inspector;
4. Centre management shall not engage in any liquor promotion that is likely to promote irresponsible service of liquor;
5. Centre management shall not serve any alcoholic beverage to any person who is intoxicated;
6. No person under the age of 18 years shall be served any alcoholic beverage. Production of photographic identification will be required where age is an issue. The only acceptable proof of age identification shall be:
    - Photo current driver's license;
    - Proof of age card (RTA);
7. The official "Intoxication" sign and "Proof of Age" poster shall be prominently displayed throughout the café; and
8. Food must be available whenever liquor is consumed in the designated area/s.

House Policy

Centre management will be required to adopt the following House Policy, which provides a framework for Responsible Service of Alcohol:

1. “Proof of Age’ to be provided on request in order to prevent underage drinking;
2. Persons who are intoxicated will be refused access to the premises;
3. Intoxication signs are to be displayed at the premises and will be referred to in order to support a responsible attitude and requirements of legislation;
4. Any customer at the premises considered intoxicated will be denied services;
5. Centre management will educate its staff and customers as a part of their duty of care to ensure that they understand the implications and abide by the responsible service of alcohol policy;
6. Free drinking water will be available for customers at all times; and
7. Promotion of non-alcoholic beverages, low alcohol beers and food.

3.18 Management of liquor

Centre management will not allow the removal of liquor from the café premises in either open or closed containers. All alcohol purchased or brought into the Centre is to be consumed on the premises in the designated and licenced area. Signage must be clearly displayed at all times that prohibit taking liquor beyond this outside designated area adjacent to the café.

3.19 Green travel plan

A Green Travel Plan (“GTP”) will be developed for the precinct targeting both staff and visitors. It will include a statement of objectives, targets and measures. The objective will be to ‘maximise opportunities for visitors and staff to travel by means other than by sole occupancy car’.

The GTP will contain various measures to encourage and promote sustainable travel. The adoption of the GTP by Centre management will be key to ensuring implementation and further development of the plan. These requirements will be incorporated into the Management Agreement with the operator.

4 Maintenance and presentation

4.1 Maintenance

Depending on the management option selected, the City and Centre Management will share maintenance of the building including all planned and reactive maintenance. Responsibility will be determined in accordance with a matrix to be developed in consultation with the City's Property unit.

4.2 Deliveries and servicing

Café, merchandise and general deliveries will predominantly be made via either entry from Zetland Avenue. Deliveries are relatively frequent and delivery vehicles will use the designated loading zone on Zetland Avenue.

Plant room deliveries will be predominantly water treatment chemicals. Deliveries are relatively frequent and can be managed at convenient times and will use the designated loading bay on Rose Valley Way. An intercom and video screen link and automatic door release for contractors will provide discrete and controlled access.

Plant and equipment deliveries and/or building maintenance work requiring very large vehicles will be comparatively rare and will be subject to specifically agreed traffic management plans, as required.

4.3 Food and waste management

The City has a waste reduction policy which applies to all City facilities which includes reduction of waste to landfill, recycling and e-waste. Targets for the Centre will be set and reviewed in consultation with the City's Sustainability team.

All waste generated from the Centre will be the responsibility of Centre management. Waste collection services will be provided by approved licensed contractors in accordance with the Waste Management Plan. Collection of waste will be via the waste collection bay accessible via the through site link. Days of collection are yet to be advised. Written evidence will be held on site at all times of a valid and current contractor with a licensed contractor for waste and recycling collection and disposal.

4.4 Presentation

Centre management will undertake the daily cleaning of the Centre, through a combination of staff and a planned cleaning contract. Removal of external defacing of the building such as graffiti will be the responsibility of Centre management. All horticultural elements will be maintained by the City parks maintenance team.

CITY OF SYDNEY

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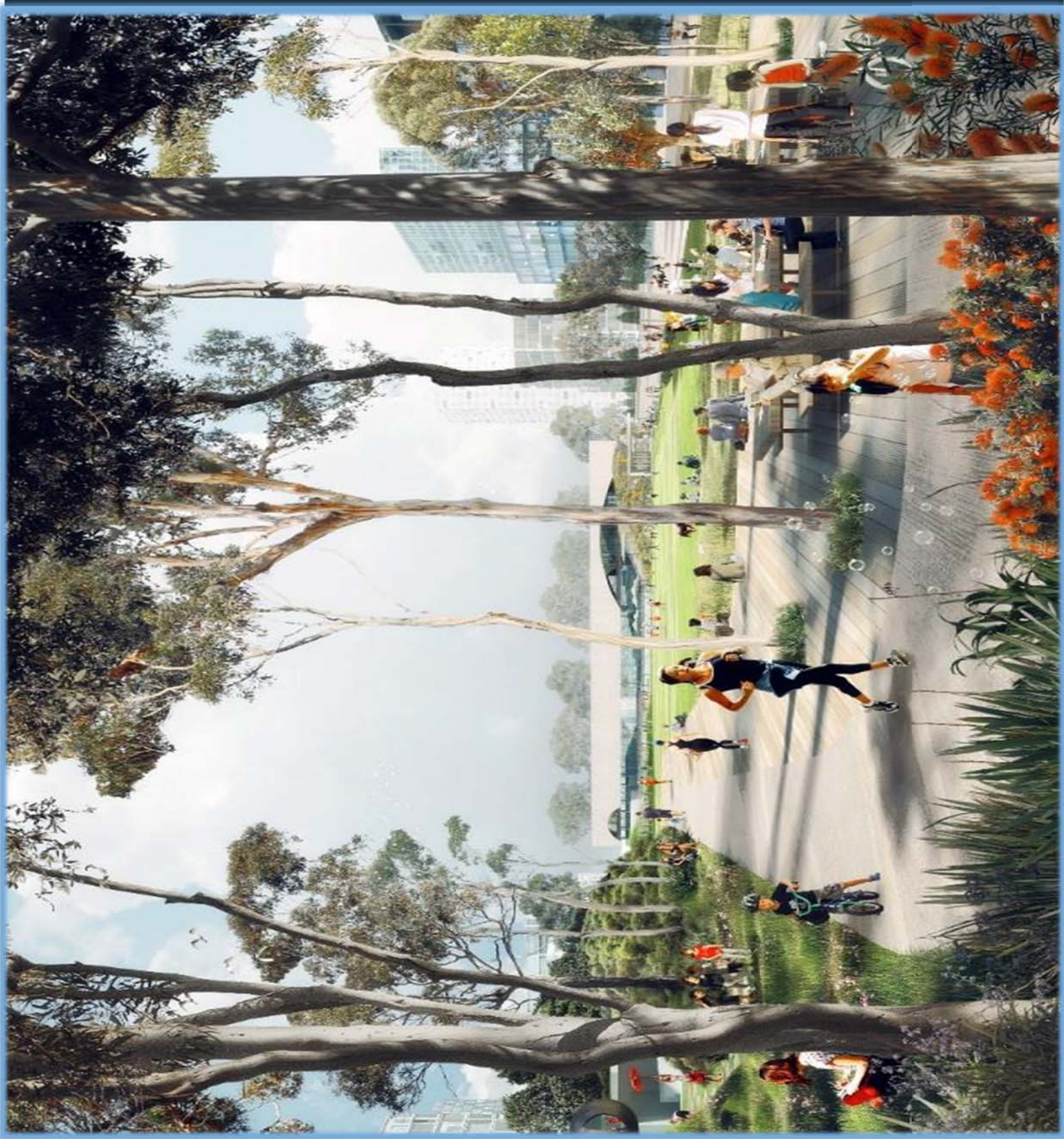
city of villages

Gunyama Park

Managament Plan



Management Plan – Gunyama Park

Introduction

The City is committed to providing a quality, inclusive, safe, inviting and well-maintained parks efficiently and sustainably managed for the benefit of the entire community. Gunyama Park comprising of a 1.8 Ha parkland and a 1 Ha controlled access aquatic and fitness centre, will provide for the diverse recreational needs of the local and wider community of residents, workers, businesses, students and visitors.

Key features of the park include:

- an multipurpose synthetic sports-field with lighting;
- a playground and skate facilities;
- picnic and BBQ facilities;
- public toilets; and
- supporting infrastructure including paths, steps, ramps, seating, bicycle racks, water bubblers, shade and shelter.
- Horticultural landscape elements including: grass lawns, garden beds, park and street trees, raingardens and a roof-garden

Management Objectives

Management goals and objectives are to:

- provide a safe, inclusive, accessible and engaging urban environment with a diverse range of sporting and recreational opportunity for people of all genders, ages and ability;
- manage and maintain the park and its facilities in accordance with best practice principles of ecologically sustainable development, including maximising opportunities for resource conservation, reuse and recycling, and in accordance with the Generic Parks and Open
- Space Plan and Plan of Management and the Gumyana Park Master Plan.
- protect and enhance the natural and built environment and maximise opportunities for ecological habitat;
- promote community awareness, involvement and equitable use of the park and its facilities;
- integrate the objectives of the 2030 Sustainable Sydney strategy and relevant council policies including: Corporate Environmental Management Plan; Urban Ecology Strategic Action Plan; Access and Inclusion Policy (currently in draft) / Disability Action Plan;

Maintenance Objectives

Maintenance objectives are to:

- Ensure entrances, pathways, park assets and facilities are safe, well presented, clean, inviting and accessible at all times to meet the high expectations of the community;
- Keep park assets and facilities in good working order, fit for use, litter-free, graffiti free and free of slip, trip and fall hazards;
- Minimize water, energy, resource and pesticide use and maximise opportunities for reuse and recycling;
- Conserve and enhance opportunities for urban ecological habitat

Responsibilities

Asset/Facility	Division / Business Unit (Team)
Aquatic Recreation Facility	
Client/Asset owner	City Projects & Property/City Property
Facility Manager	City Operations/City Greening & Leisure (Aquatics & Leisure)
Facility Operator	City Operations/City Greening & Leisure – (to be appointed through procurement process)
Building maintenance	City Properties; Service Delivery – Brookfield Johnson Control
Pool Plant & Equipment maintenance	City Operations/City Greening & Leisure – (to be appointed through procurement process)
Gumyana Park	
Client/Asset Owner	City Operations/City Greening and Leisure
Park maintenance	City Operations/City Greening and Leisure (Parks Maintenance)
Sportsfield bookings	City Operations/City Greening & Leisure – (to be appointed through procurement process)
Sportsfield maintenance	City Operations/City Greening and Leisure (Parks Services & Assets)
Building maintenance	City Properties; Service Delivery – Brookfield Johnson Control
Compliance Monitoring and Enforcement	City Operations/City Rangers; Security and Safety

Work Health & Safety

Staff and contractors are required to undertake their activities in accordance with the City's Workplace Health and Safety Management System. Safe Working Method Statements and Risk Assessments for all maintenance tasks.

Parks Maintenance Manager, Maintenance Supervisor and Contract Coordinators are responsible for the induction of staff and contractors and undertaking periodic audits of the Safety Management System including the issuing of Corrective Action Notices as required.

Public Safety

The park and its facilities have been designed to meet all applicable safety standards and CPTED principles have been incorporated into the design. Periodic audits of assets and facilities will ensure that they continue to perform and function in a safe manner and in accordance to standards and design intent.

Park perimeter and entrances are illuminated at all times after dark from the street lighting and supplemented by park lighting along the main pedestrian thoroughfares.

Sight lines into the park will be maintained through regular monitoring and management of vegetation as required.

Facilities and equipment will be periodically inspected to ensure continued integrity of structures, facilities and equipment.

Routine daily inspections of the playground, sports-field and paths will remove identified hazards and foreign material.

Park toilets designed and built to incorporate CPTED principles, will be operational seven days per week during daylight hours, or to meet period of high demand in the evenings (for example coinciding with sports-field usage). Contaminated sharps containers will be placed in each toilet facility and regularly inspected and serviced in accordance to observed demand.

Park and facility signage will include council contact details to report issues for follow-up.

Vehicle Access – Vehicular access to the park is restricted authorised council and contractor vehicles (and noted on park signage)

Asset Management

Periodic asset inspections will be undertaken to monitor and record the condition of all park and recreation assets by park asset inspectors. Valuation of assets will be undertaken on an annual basis by park asset inspectors.

Missing or damaged equipment will be promptly made safe, repaired or replaced with equivalent assets and/or OEM parts, where available.
Defaced and dirty elements will be promptly cleaned to ensure they continue to meet their design intent and the needs and expectations of visitors and users.

Environmental Management

The City is a carbon neutral council - 100% of our greenhouse gas emissions are offset.

The City has committed to water and energy reduction targets based on 2006 baseline data and its performance towards these goals, through water saving and energy saving policies and action plans is monitored, and publicly reported.

City Greening and Leisure are committed to reducing resource consumption and maximising opportunities for resource conservation, reuse and recycling in its maintenance activities for parks and open spaces. The primary source of irrigation for Gunyama Park will be harvested storm/rain-water– collected, treated and reused. An irrigation management system will program and record water consumption, which will be regularly reported. Park and sports-field lighting will utilise LED lighting and programmed illumination to minimize energy consumption.
Litter and waste deposited in the park rubbish bins is collected and recycled at alternate waste treatment facilities. Green waste is collected, removed from site and composted for reuse.

Pesticide use will be minimised and the City is committed to using the lowest toxicity pesticides required. Hand-weeding is employed within and around playgrounds. Park visitors and local stakeholders are informed about pesticide application in accordance with the City's Pesticide Use Notification Plan.

The City's Urban Ecology Plan identifies opportunity for habitat conservation and creation and flora and fauna surveys are periodically undertaken within the City's parks. The tree and plant palette at Gunyama Park maximises the use of native species.

Community and Sporting Events

The City is committed to ensure that our public open spaces are vibrant, well-used and meet the needs of the community. The City's neighbourhood parks from time to time host a diverse range of community events including cultural, sport, recreation events and community markets for the benefit of the local and wider community. Events and organised activities within Gunyama Park will require approval of the City and requests will be assessed on their merits taking the needs of residents and park visitors into account. Park signage will state that events require approval of council.

Organised use of the sports field will require a formal booking. Management and access to the field will take into account the carrying capacity of the facility to ensure that the resource is used in a responsible and sustainable manner. Administration and management of the sports-field will be undertaken by the operator of the adjacent Gunyama Park Aquatic and Recreation Centre.

Limited informal low-impact use will be permitted when the field is not in use for organised sport. Signage will clearly indicate when the field is available for low-impact informal use and when it is closed for maintenance.

Rates for formal use of the sports-field will be set annually by Council at a market rate (comparable with the charges of neighbouring councils and agencies for similar facilities) and published in the annual Council budget report – Fees and Charges document.

The field will be available for booked use from 8am until 10pm Monday to Sunday including public holidays. The field will be illuminated at sunset to cater to formal booked use until 10.30pm. The field design will include provision for the later installation of low-height perimeter fencing if required to control access and field use.

Line marking of the field will, as a minimum, include boundary markings with a centre line to allow for flexible multi-purpose use. Boundary markings will also be provided to allow placement of cones for small sided games and junior play. This may change if the Expression of Interest process to allocate field usage indicates further line marking is needed.

Fitness service providers will be entitled to conduct group fitness training within the park (but not the sports-field) in accordance with the provisions of the City's Group Fitness Training Code of Conduct (or other adopted applicable policies). Use of the park fitness equipment by training groups will be permitted providing that such use does not exclude access for others.

Electric barbecues are available for use in the park and are available for community use without a booking. The barbecues will be on a timer and cease operating at 10pm. Barbecue lighting will also turn off at this time.

Public Toilets and Changerooms

Toilets will be managed by the City Property and Projects division through their contracted service provider (currently Brookfield Johnson Controls). Toilets will be opened at dawn and closed around sunset seven days per week and cleaned daily, twice per day on weekends and school holidays by the toilet cleaning subcontractor. Servicing will be increased to meet demand if required. Operational hours and contact information to report issues is provided on the facility signage. The subcontractor will inspect the operation and condition of the toilets and report damage, graffiti or vandalism to the service provider for prompt repair. Contaminated sharps containers located within each toilet will be regularly monitored and emptied by the City's contracted syringe management contractor.

The sports field changerooms will be open for sports and park bookings.

Dog Management

The City recognises the prevalence of dog ownership and the necessity for local off-leash parks for the welfare of dogs and their owners. The City of Sydney Companion Animals Policy aims to provide equitable access to a mix of on-leash and off-leash parks in consultation with the community. The leash designation of new parks and open spaces within the Green Square precinct will be determined by Council following a process of community consultation.

The City will install dog-tidy bags and drinking water for dogs at popular dog walking areas including all off-leash parks. Dog tidy-bags will be checked and replenished daily or as required depending on visitation and demand. After use, dog-tidy bags are placed in the general waste collection bins for disposal as general waste.

Under the Companion Animals Act NSW, owners are responsible to pick-up after their pets when using public spaces. City Rangers patrol the City's parks on a regular basis monitoring compliance and educating owners about their responsibilities. Parks maintenance and street cleansing staff will remove and dispose of uncollected faeces through their regular scheduled litter picking, cleaning and cleansing processes.

Park signage will include responsible dog management messages and contact details to report issues.

Park Maintenance

General park and horticultural maintenance will be undertaken by a combination of the City's in-house parks operations staff and specialist contract staff depending on the tasks required to be undertaken. The park will be maintained to a high standard in accordance with the City's Parks and Open Space Maintenance Specification for iconic parks. Arboricultural maintenance will be undertaken with technical guidance and advice provided by the Urban Forest Manager. Tree condition audits will be undertaken on a regular basis and their condition recorded in the City's Tree Management System.

Playground and fitness equipment maintenance will be undertaken by the park maintenance team with quarterly asset condition and safety audits undertaken by the City's contracted service provider.

Asset types, maintenance tasks and frequencies are outlined in the table below:

Asset	Objective	Tasks	Frequency	Notes
Signage Community Notice Board	Presents well - intact, clean, legible	Check integrity and condition of signage; Replace missing, defective or damaged parts; Clean and remove graffiti and foreign materials daily as required. Remove old notices from notice board	Weekly Weekly	
Public Art	Intact, well presented	Check condition of public art works and remove foreign matter including fly-posters and graffiti Undertake annual asset condition audits	Monthly Annual	Graffiti removed by graffiti contractor Public art contractor
Public Toilets		Daily opening and closing of toilets	Daily	

Asset	Objective	Tasks	Frequency	Notes
	Present well, clean, hygienic and inviting to use.	Cleaning twice per day Check condition and operation of all appurtenances, fixtures and fittings Report issues for prompt repair List and maintain listing on National Public Toilet Map	 Annual	Contract and subcontract managed by City Property.
Litter Bins Dog-tidy bag dispenser Litter Removal Litter Picking	Park and open space is litter-free, clean and well presented at all times.	Check litter bins for capacity (no more than ¾ full) , empty litter bin Clean litter bin surfaces to ensure they are inviting to use Repair/replace damaged bin components. Check and replace consumables Sweeping/blowing of park paths and surfaces, remove and dispose of litter (inorganic and organic), foreign objects. Waste management and litter removal within aquatic facility perimeter managed by facility operator.	Daily As required As required Daily Daily	
BBQs	Present well – intact, operational, clean	Check operation and cleanliness of BBQ; Clean facility and ensure cooking plate is free from foreign materials, food waste, stains.	Daily	
Park furniture Picnic Tables	Presents well – intact, clean, free of foreign objects Operational and in good condition	Check integrity and condition of tables, remove foreign materials and clean as required. Apply wood preserver, varnish/paint/oil as required	Weekly As required	

Asset	Objective	Tasks	Frequency	Notes
Park seating; benches, bleachers				
Park Lighting	Operational and in good condition	Check operation of lighting and replace luminaires as required	Monthly	
		Adjust timing to reflect daylight saving	Daylight Saving	
	Free from fly-posters and graffiti	Remove fly-posters and clean residue	As required	
Sports floodlighting	Operational, in good condition and available when field is in use.	Check operation of floodlights and replace luminaires as required; check automated timing controls and adjust as required.	Monthly	
Fences, gates, retaining and boundary structures	Present well, free from hazards and in good condition.	Check integrity and condition and operation of structures and replace damage or defective elements as required.	Quarterly	
Park paths	Ensure paths are free of hazards, foreign matter and in good structural condition.	Remove hazards and foreign matter, sweep and dispose of litter and foreign matter (organic and inorganic)	Daily	Weed eradication on perimeter paths by contractor
		Weed eradication	As required	
Playground Play Equipment Fitness Stations Skate Facility	Hazard free, safe, clean	Check apparatus, soft-fall, nature play area, skate facility, fitness trail/apparatus and surrounds for presence of hazards – remove repair as required.	Daily	

Asset	Objective	Tasks	Frequency	Notes
		Check structural condition and integrity and compliance of play and fitness apparatus with applicable standards	Quarterly	Playground equipment maintenance contract
Irrigation System Sprinklers Sprays Drip Control system, valves, filters and pumps	Operational and intact	Check operation of park irrigation system to ensure it is in good condition and continues to operate to designed specifications. Clean/adjust/repair/replace appurtenances as required.	Monthly	Irrigations system maintenance contract
Drainage System (grates, storm water, pipe drains pollutant traps0	Operational and clean	Visual check of drainage components for damage or blockage to ensure it continues to operate as designed. Remove foreign matter and blockages as required.	Monthly and after heavy rain or storms	
Shade structures and shelters	Present well in good condition	Visual check of structures, sweep/clean surfaces and remove foreign material Check asset condition and valuation. Repaint/condition as required	Daily	Graffiti removal by contractor
Raingardens	Present well and operational	Remove foreign materials (organic and inorganic) Replant and replace/condition soil and aggregate as required.	Monthly	

Asset	Objective	Tasks	Frequency	Notes
Green Roof	Healthy and well presented	Prune, fertilise, replant vegetation as required Check operation of irrigation system.	Weekly	Working at heights protocols
Synthetic Sports field	Intact, clean and well presented	Visual check of field and removal of foreign matter, dirt and stains. Grooming of field and topping up infill material Deep clean, lifting and levelling of infill Cleansing to remove stains and growths to ensure public health Monitor and regulate and use of the field	Daily Fortnightly (3-4 hours) 2-3 times per year As required Daily	As per manufacturer specifications Specialist maintenance contractor for grooming and deep clean Facility operator
Natural grass lawns	Healthy and well-presented	Mow grass to maintain desired height of cut. Remove clippings and dispose off-site or recycle. Edging and brush-cutting Remove foreign matter and weeds as required. Apply fertiliser, compaction relief, scarify and top dress as required. Visual check of irrigation system.	Fortnightly summer; monthly winter Annual - biannual As required	Turf improvement plan.
Garden Beds	Healthy, well-presented operating as designed.	Horticultural maintenance –inspect and keep plants in healthy condition free from disease, damage and deadwood.	Weekly check	

Asset	Objective	Tasks	Frequency	Notes
		Pruning according to species requirements and maintain sight lines at entrances and keep vegetation from encroaching on travel paths. Fertilize plants according to species / seasonal requirements Keep garden beds free from foreign materials, inorganic and organic litter. Top-up mulch and soil profile as required. Vermin and pest-control measures as required.	Seasonal in-fill planting and mulching	
Hedges and climbers	Healthy well-presented and reflecting design intent.	Prune hedges / climbers to maintain design intent and healthy growth Remove dead, diseased or damaged growth as required by species.	As required	
Trees		Arboricultural maintenance – inspect and keep trees in healthy condition free of deadwood & disease. Maintain pedestrian clearance (crown raising, removal of suckers as required). Corrective pruning as required to remove weak growth and damage and to maintain pedestrian access and to preserve significant views. Condition / SULE assessment and records maintained on asset management data base. Pest-control measures as required.	As required and checks after storm damage. Assessed annually	

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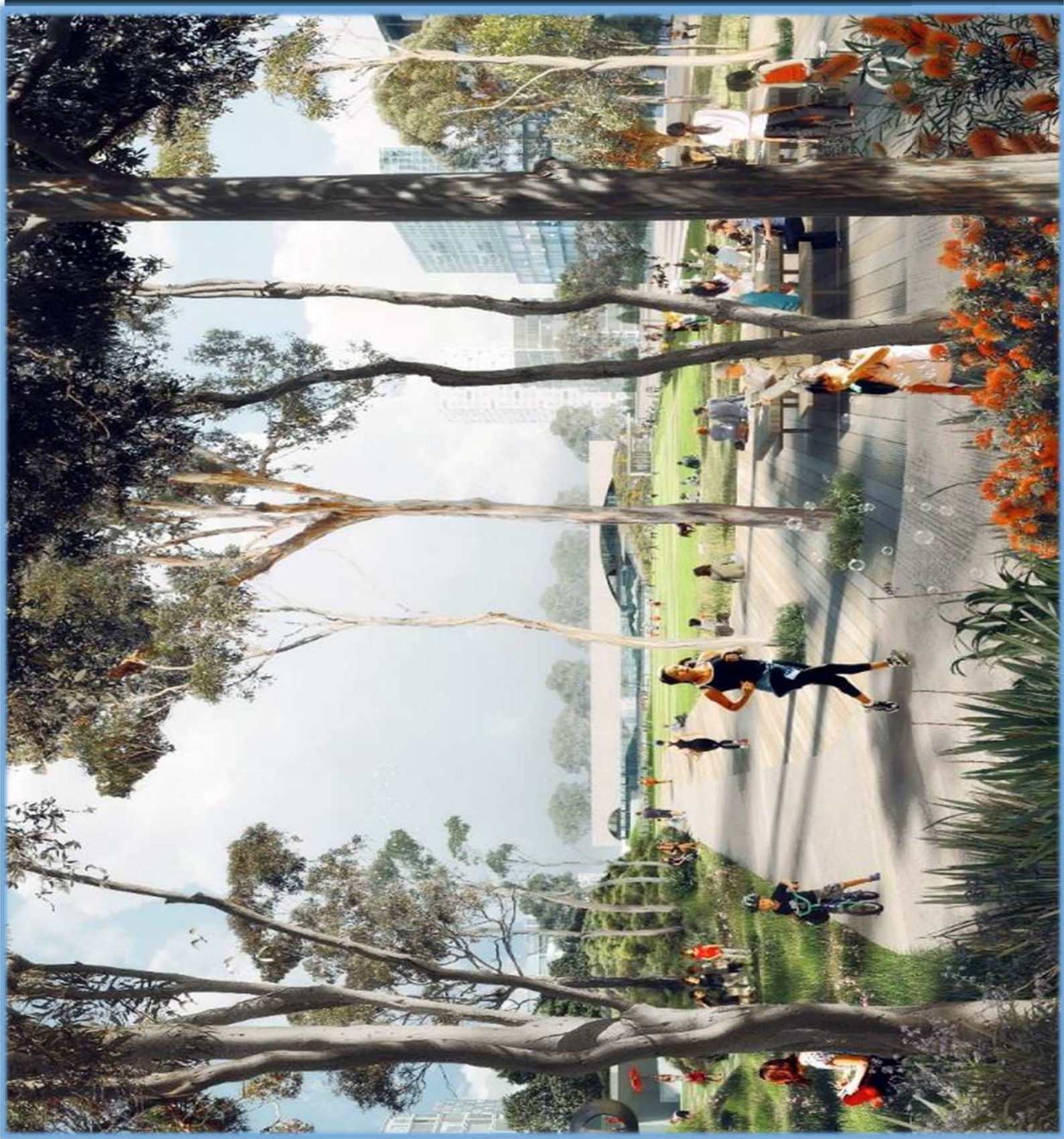
city of villages

Gunyama Park

Managament Plan



Management Plan – Gunyama Park

Introduction

The City is committed to providing a quality, inclusive, safe, inviting and well-maintained parks efficiently and sustainably managed for the benefit of the entire community. Gunyama Park comprising of a 1.8 Ha parkland and a 1 Ha controlled access aquatic and fitness centre, will provide for the diverse recreational needs of the local and wider community of residents, workers, businesses, students and visitors.

Key features of the park include:

- an multipurpose synthetic sports-field with lighting;
- a playground and skate facilities;
- picnic and BBQ facilities;
- public toilets; and
- supporting infrastructure including paths, steps, ramps, seating, bicycle racks, water bubblers, shade and shelter.
- Horticultural landscape elements including: grass lawns, garden beds, park and street trees, raingardens and a roof-garden

Management Objectives

Management goals and objectives are to:

- provide a safe, inclusive, accessible and engaging urban environment with a diverse range of sporting and recreational opportunity for people of all genders, ages and ability;
- manage and maintain the park and its facilities in accordance with best practice principles of ecologically sustainable development, including maximising opportunities for resource conservation, reuse and recycling, and in accordance with the Generic Parks and Open
- Space Plan and Plan of Management and the Gumyana Park Master Plan.
- protect and enhance the natural and built environment and maximise opportunities for ecological habitat;
- promote community awareness, involvement and equitable use of the park and its facilities;
- integrate the objectives of the 2030 Sustainable Sydney strategy and relevant council policies including: Corporate Environmental Management Plan; Urban Ecology Strategic Action Plan; Access and Inclusion Policy (currently in draft) / Disability Action Plan;

Maintenance Objectives

Maintenance objectives are to:

- Ensure entrances, pathways, park assets and facilities are safe, well presented, clean, inviting and accessible at all times to meet the high expectations of the community;
- Keep park assets and facilities in good working order, fit for use, litter-free, graffiti free and free of slip, trip and fall hazards;
- Minimize water, energy, resource and pesticide use and maximise opportunities for reuse and recycling;
- Conserve and enhance opportunities for urban ecological habitat

Responsibilities

Asset/Facility	Division / Business Unit (Team)
Aquatic Recreation Facility	
Client/Asset owner	City Projects & Property/City Property
Facility Manager	City Operations/City Greening & Leisure (Aquatics & Leisure)
Facility Operator	City Operations/City Greening & Leisure – (to be appointed through procurement process)
Building maintenance	City Properties; Service Delivery – Brookfield Johnson Control
Pool Plant & Equipment maintenance	City Operations/City Greening & Leisure – (to be appointed through procurement process)
Gumyana Park	
Client/Asset Owner	City Operations/City Greening and Leisure
Park maintenance	City Operations/City Greening and Leisure (Parks Maintenance)
Sportsfield bookings	City Operations/City Greening & Leisure – (to be appointed through procurement process)
Sportsfield maintenance	City Operations/City Greening and Leisure (Parks Services & Assets)
Building maintenance	City Properties; Service Delivery – Brookfield Johnson Control
Compliance Monitoring and Enforcement	City Operations/City Rangers; Security and Safety

Work Health & Safety

Staff and contractors are required to undertake their activities in accordance with the City's Workplace Health and Safety Management System. Safe Working Method Statements and Risk Assessments for all maintenance tasks.

Parks Maintenance Manager, Maintenance Supervisor and Contract Coordinators are responsible for the induction of staff and contractors and undertaking periodic audits of the Safety Management System including the issuing of Corrective Action Notices as required.

Public Safety

The park and its facilities have been designed to meet all applicable safety standards and CPTED principles have been incorporated into the design. Periodic audits of assets and facilities will ensure that they continue to perform and function in a safe manner and in accordance to standards and design intent.

Park perimeter and entrances are illuminated at all times after dark from the street lighting and supplemented by park lighting along the main pedestrian thoroughfares.

Sight lines into the park will be maintained through regular monitoring and management of vegetation as required.

Facilities and equipment will be periodically inspected to ensure continued integrity of structures, facilities and equipment.

Routine daily inspections of the playground, sports-field and paths will remove identified hazards and foreign material.

Park toilets designed and built to incorporate CPTED principles, will be operational seven days per week during daylight hours, or to meet period of high demand in the evenings (for example coinciding with sports-field usage). Contaminated sharps containers will be placed in each toilet facility and regularly inspected and serviced in accordance to observed demand.

Park and facility signage will include council contact details to report issues for follow-up.

Vehicle Access – Vehicular access to the park is restricted authorised council and contractor vehicles (and noted on park signage)

Asset Management

Periodic asset inspections will be undertaken to monitor and record the condition of all park and recreation assets by park asset inspectors. Valuation of assets will be undertaken on an annual basis by park asset inspectors.

Missing or damaged equipment will be promptly made safe, repaired or replaced with equivalent assets and/or OEM parts, where available.
Defaced and dirty elements will be promptly cleaned to ensure they continue to meet their design intent and the needs and expectations of visitors and users.

Environmental Management

The City is a carbon neutral council - 100% of our greenhouse gas emissions are offset.

The City has committed to water and energy reduction targets based on 2006 baseline data and its performance towards these goals, through water saving and energy saving policies and action plans is monitored, and publicly reported.

City Greening and Leisure are committed to reducing resource consumption and maximising opportunities for resource conservation, reuse and recycling in its maintenance activities for parks and open spaces. The primary source of irrigation for Gunyama Park will be harvested storm/rain-water– collected, treated and reused. An irrigation management system will program and record water consumption, which will be regularly reported. Park and sports-field lighting will utilise LED lighting and programmed illumination to minimize energy consumption.
Litter and waste deposited in the park rubbish bins is collected and recycled at alternate waste treatment facilities. Green waste is collected, removed from site and composted for reuse.

Pesticide use will be minimised and the City is committed to using the lowest toxicity pesticides required. Hand-weeding is employed within and around playgrounds. Park visitors and local stakeholders are informed about pesticide application in accordance with the City's Pesticide Use Notification Plan.

The City's Urban Ecology Plan identifies opportunity for habitat conservation and creation and flora and fauna surveys are periodically undertaken within the City's parks. The tree and plant palette at Gunyama Park maximises the use of native species.

Community and Sporting Events

The City is committed to ensure that our public open spaces are vibrant, well-used and meet the needs of the community. The City's neighbourhood parks from time to time host a diverse range of community events including cultural, sport, recreation events and community markets for the benefit of the local and wider community. Events and organised activities within Gunyama Park will require approval of the City and requests will be assessed on their merits taking the needs of residents and park visitors into account. Park signage will state that events require approval of council.

Organised use of the sports field will require a formal booking. Management and access to the field will take into account the carrying capacity of the facility to ensure that the resource is used in a responsible and sustainable manner. Administration and management of the sports-field will be undertaken by the operator of the adjacent Gunyama Park Aquatic and Recreation Centre.

Limited informal low-impact use will be permitted when the field is not in use for organised sport. Signage will clearly indicate when the field is available for low-impact informal use and when it is closed for maintenance.

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The field will be available for booked use from 8am until 10pm Monday to Sunday including public holidays. The field will be illuminated at sunset to cater to formal booked use until 10.30pm. The field design will include provision for the later installation of low-height perimeter fencing if required to control access and field use.

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Playground and fitness equipment maintenance will be undertaken by the park maintenance team with quarterly asset condition and safety audits undertaken by the City's contracted service provider.

Asset types, maintenance tasks and frequencies are outlined in the table below:

Asset	Objective	Tasks	Frequency	Notes
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Public Art	Intact, well presented	Check condition of public art works and remove foreign matter including fly-posters and graffiti Undertake annual asset condition audits	Monthly Annual	Graffiti removed by graffiti contractor Public art contractor
Public Toilets		Daily opening and closing of toilets	Daily	

Asset	Objective	Tasks	Frequency	Notes
	Present well, clean, hygienic and inviting to use.	Cleaning twice per day Check condition and operation of all appurtenances, fixtures and fittings Report issues for prompt repair List and maintain listing on National Public Toilet Map	 Annual	Contract and subcontract managed by City Property.
Litter Bins Dog-tidy bag dispenser Litter Removal Litter Picking	Park and open space is litter-free, clean and well presented at all times.	Check litter bins for capacity (no more than ¾ full) , empty litter bin Clean litter bin surfaces to ensure they are inviting to use Repair/replace damaged bin components. Check and replace consumables Sweeping/blowing of park paths and surfaces, remove and dispose of litter (inorganic and organic), foreign objects. Waste management and litter removal within aquatic facility perimeter managed by facility operator.	Daily As required As required Daily Daily	
BBQs	Present well – intact, operational, clean	Check operation and cleanliness of BBQ; Clean facility and ensure cooking plate is free from foreign materials, food waste, stains.	Daily	
Park furniture Picnic Tables	Presents well – intact, clean, free of foreign objects Operational and in good condition	Check integrity and condition of tables, remove foreign materials and clean as required. Apply wood preserver, varnish/paint/oil as required	Weekly As required	

Asset	Objective	Tasks	Frequency	Notes
Park seating; benches, bleachers				
Park Lighting	Operational and in good condition	Check operation of lighting and replace luminaires as required	Monthly	
		Adjust timing to reflect daylight saving	Daylight Saving	
	Free from fly-posters and graffiti	Remove fly-posters and clean residue	As required	
Sports floodlighting	Operational, in good condition and available when field is in use.	Check operation of floodlights and replace luminaires as required; check automated timing controls and adjust as required.	Monthly	
Fences, gates, retaining and boundary structures	Present well, free from hazards and in good condition.	Check integrity and condition and operation of structures and replace damage or defective elements as required.	Quarterly	
Park paths	Ensure paths are free of hazards, foreign matter and in good structural condition.	Remove hazards and foreign matter, sweep and dispose of litter and foreign matter (organic and inorganic)	Daily	Weed eradication on perimeter paths by contractor
		Weed eradication	As required	
Playground Play Equipment Fitness Stations Skate Facility	Hazard free, safe, clean	Check apparatus, soft-fall, nature play area, skate facility, fitness trail/apparatus and surrounds for presence of hazards – remove repair as required.	Daily	

Asset	Objective	Tasks	Frequency	Notes
		Check structural condition and integrity and compliance of play and fitness apparatus with applicable standards	Quarterly	Playground equipment maintenance contract
Irrigation System Sprinklers Sprays Drip Control system, valves, filters and pumps	Operational and intact	Check operation of park irrigation system to ensure it is in good condition and continues to operate to designed specifications. Clean/adjust/repair/replace appurtenances as required.	Monthly	Irrigations system maintenance contract
Drainage System (grates, storm water, pipe drains pollutant traps0	Operational and clean	Visual check of drainage components for damage or blockage to ensure it continues to operate as designed. Remove foreign matter and blockages as required.	Monthly and after heavy rain or storms	
Shade structures and shelters	Present well in good condition	Visual check of structures, sweep/clean surfaces and remove foreign material Check asset condition and valuation. Repaint/condition as required	Daily	Graffiti removal by contractor
Raingardens	Present well and operational	Remove foreign materials (organic and inorganic) Replant and replace/condition soil and aggregate as required.	Monthly	

Asset	Objective	Tasks	Frequency	Notes
Green Roof	Healthy and well presented	Prune, fertilise, replant vegetation as required Check operation of irrigation system.	Weekly	Working at heights protocols
Synthetic Sports field	Intact, clean and well presented	Visual check of field and removal of foreign matter, dirt and stains. Grooming of field and topping up infill material Deep clean, lifting and levelling of infill Cleansing to remove stains and growths to ensure public health Monitor and regulate and use of the field	Daily Fortnightly (3-4 hours) 2-3 times per year As required Daily	As per manufacturer specifications Specialist maintenance contractor for grooming and deep clean Facility operator
Natural grass lawns	Healthy and well-presented	Mow grass to maintain desired height of cut. Remove clippings and dispose off-site or recycle. Edging and brush-cutting Remove foreign matter and weeds as required. Apply fertiliser, compaction relief, scarify and top dress as required. Visual check of irrigation system.	Fortnightly summer; monthly winter Annual - biannual As required	Turf improvement plan.
Garden Beds	Healthy, well-presented operating as designed.	Horticultural maintenance –inspect and keep plants in healthy condition free from disease, damage and deadwood.	Weekly check	

Asset	Objective	Tasks	Frequency	Notes
		Pruning according to species requirements and maintain sight lines at entrances and keep vegetation from encroaching on travel paths. Fertilize plants according to species / seasonal requirements Keep garden beds free from foreign materials, inorganic and organic litter. Top-up mulch and soil profile as required. Vermin and pest-control measures as required.	Seasonal in-fill planting and mulching	
Hedges and climbers	Healthy well-presented and reflecting design intent.	Prune hedges / climbers to maintain design intent and healthy growth Remove dead, diseased or damaged growth as required by species.	As required	
Trees		Arboricultural maintenance – inspect and keep trees in healthy condition free of deadwood & disease. Maintain pedestrian clearance (crown raising, removal of suckers as required). Corrective pruning as required to remove weak growth and damage and to maintain pedestrian access and to preserve significant views. Condition / SULE assessment and records maintained on asset management data base. Pest-control measures as required.	As required and checks after storm damage. Assessed annually	

City of Sydney / ABA + Grimshaw + TCL
Gunyama Park Aquatic and Recreation Centre (GPARC)
132-140 Joynton Avenue Zetland NSW 2017

Signage Strategy for External Signage – DA Issue

13 June 2016

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City of Sydney / ABA + Grimshaw + TCL
Gunyama Park Aquatic and Recreation Centre (GPARC)
Signage Strategy for External Signage – DA Issue

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GPARC Signage Strategy

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—Signage Masterplans
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—City of Sydney Community Facilities and External Identification Signage
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Appendix 1
City of Sydney Community Facilities Signage Style Guide, December 2014 – Key Signtypes (Extract)

Appendix 2
City of Sydney Parks Signage System Regulation Signage User Manual, 28 October 2011 – Key Signtypes (Extract)

GPARC Signage Strategy

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Signage and wayfinding strategy

Signage is located at key decision making points allowing users and visitors to understand where the various facilities are and make the right journey decisions to their various destinations. This assists with the successful function of the Gunyama Park Aquatic and Recreation Centre environment and the enjoyment and positive experience of the facilities for people of all ages.

Overview

Gunyama Park Aquatic and Recreation Centre (GPARC) is located on the corner of Joynton Avenue and the new Zetland Avenue (132-140 Joynton Avenue Zetland NSW 2017). The two main entrances are set back from the new Zetland Avenue and the centre can be accessed by walking, cycling, bus, rail, and car.

The building's iconic architecture is likely to become a strong identifier within the urban landscape, easily recognisable to the local community and visitors alike.

Signage will support building identification. The key address to the street will be at Zetland Ave as the new main street for the area, and the corner of Joynton Avenue for visitors approaching from the west.

Building identification signage is proposed at the level one building facade, supported by pedestrian level signage at key site and building entry points. Refer signage masterplans and elevations.

User-centered approach

The strategic approach is placing the user at the centre of the wayfinding system. This sets the precedence and frame of reference for a user-focused wayfinding strategy and signage system. The system will be simple to use and easy to understand, making the use of the facilities and the journey experience fulfilling, purposeful and enjoyable.

Putting the needs of users first requires that we appreciate the number of different kinds of journey requirements from local visitors, tourists, groups, staff and service workers. The signage approach works with these core requirements:

—know where to look for wayfinding information when they need it

—understand the way in which the information is communicated

—obtain the information they want quickly, intuitively and without fuss.

What are the key user requirements

For the wayfinding system to work, it must be able to support the movement needs of all. Understanding how different groups navigate and what type of information they need forms a fundamental part of wayfinding.

What users are looking for

For successful signage design, user needs are identified, given a hierarchy of importance, and translated into the information requirements for each destination or purpose. Not all information needs are based on destination. On many occasions we know what we want but not where to find it. The signage and wayfinding needs to be flexible enough to allow for this. We have used this premise as a basis for the locations and hierarchy of signage.

Progressive disclosure

The signage approach and the wayfinding system is also built around the principle of 'progressive disclosure', providing enough information at the right time along a journey, sufficient to give users confidence they are on the right path or can find something when they need to.

Wayfinding decision making points

Enabling users to make the right decision at the right time is critical to the successful function of an environment. Unfamiliar journeys are stressful; having the right information at the right time helps the understanding of the journey providing confidence, and supporting safety, inclusivity, accessibility, and efficiency to create a positive visitor experience.

This means providing information at the right time in the right location. The principles applied are:

—signage to key destinations and amenities

—signage located at key decision points, entries, exits and destinations

—signage has clear views and sight lines where possible

—signage to be positioned to suit user requirements – pedestrian, accessible and varying ages groups

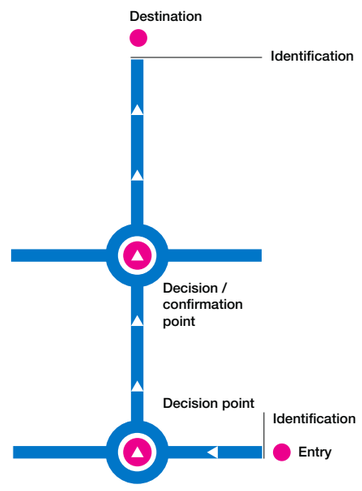
—accessible signage to be positioned in accordance with Australian Standards

—critical signage is illuminated externally or internally.

Wayfinding system components

A typical wayfinding system is built around a core family or hierarchy of signage elements. Identification signage, totems/pillars, map totems, flag signs, pole mounted signs, wall mounted signs, interpretative signs and destination markers can all be used to make up a comprehensive signage system. In the design process, we develop a hierarchy of signage elements to suit the user and information requirements.

Principles of circulation and identification at key decision making points



Extrablack

Signage and wayfinding strategy

The signage will be clear, simple and consistent and express the visual language of the classic Australian beach pool vernacular style creating ‘a very Sydney pool’.

Signage system approach and signage elements

Signage elements are drawn from the City of Sydney Community Facilities Signage Style Guide, December 2014 and the City of Sydney Parks Regulation Signage User Manual 28 October 2011 and additional signage developed by the City to extend this system.

Park, park amenities and sports field signage

Signage elements masterplanned are from the City of Sydney ‘s Parks Regulation Signage User Manual 28 October 2011 and additional signage developed by the City to extend this system. Park signage is located at key decision making points in accordance with guidelines in the Parks Signage User Manual. Refer signage masterplans.

Aquatic and recreation centre signage

Signage elements masterplanned are from the The City of Sydney’s Community Facilities Signage System – some external signage elements from the system are used at entry points, fulfilling the aim of the guidelines to unify the display of public information at the entry points to City of Sydney facilities. Refer signage masterplans and elevations.

City of Sydney branding

The City of Sydney brand will be consistently applied across the site utilising both the City of Sydney’s Community Facilities Signage Style Guide and the City of Sydney Parks Regulation Signage User Manual. The style guide recommends a range of signtypes available to identify a facility and provide user recognition of the centre ownership and services provided by the City of Sydney.

Core City of Sydney brand elements such as the brand mark (roundel), the colour palette and the typeface (Swiss), will be expressed consistently for all operational signage.

External signage elements and locations are consistent with the Community Facilities Signage Style Guide where practical, depending on landscape and architecture.

GPARC signage and wayfinding

In addition to the two City of Sydney signage systems, some custom signage is currently being designed by Extrablack in collaboration with Andrew Burges Architects, Grimshaw + TCL project teams and the City of Sydney project team.

Primary external site/building identification (placemaking) signage will be a site specific response and respond to the architecture, building identification and wayfinding requirements.

This signage, including the GPARC external primary identification building signage, is at concept stage utilising the building architectural approach and materials and colour palettes.

Custom signage will refer to the overall City of Sydney identity but also respond to the design and purpose of the facilities, giving it a unique identity and personality.

External signage is indicated on the External Signage Masterplans and Elevations.

GPARC primary building identification

The primary external building identification signage will respond to the building facade material palette. Signage will be either applied to or integrated with the facade cladding material. Main entry identification signage will be visible from the street and located in response to the entry orientation and circulation requirements.Materials will be robust in response to the environment and the public nature of the building.

Zones for external identification signage have been identified on elevations.

GPARC Environmental/Ecological and Interpretation Signage

The City of Sydney’s Parks signage will be used for site-specific historic interpretive information.

Design approach

The primary issues considered during the design process are:

Colour
Where colour is used for the graphics and signage within the GPARC building, the colours are drawn from a palette developed for GPARC. Other colours are as specified in the City of Sydney’s Community Facilities Signage Style Guide and Parks Regulation Signage User Manual.

Form
Sign forms are taken from the architectural language and are integrated into the built form wherever possible.

Scale
Signage scale is a response to the required viewing distance for each sign.

Materials
Robust materials have been proposed wherever the signage is exposed, in order to withstand vandalism as far as possible, and minimise maintenance costs.

Accessibility
Where accessible facilities are provided, braille and tactile signage will be documented as part of the door signage.

Signage and wayfinding strategy

Wayfinding and circulation

Site and park wayfinding is primarily focused on the building, with the building acting as an landmark, allowing for easy orientation and location. Pathways and landscape features identify circulation routes to the building and facilities.

Park

Park signage is located at key decision-making points as set out in the City of Sydney Parks Regulation Signage User Manual.

Key entry points and facilities/amenities within the park are also identified using City of Sydney Parks Regulation Signage User Manual.

Aquatic and Recreation Centre

Signage located at key entry points to the Aquatic and Recreation Centre building use the City of Sydney Community Facilities Signage System.

External building signage such as plant rooms are identified with panels taken from the Aquatic and Recreation Centre signage system. The signs will identify rooms such as Plant, Deliveries etc. where required.

Signage Locations

There is a consistent methodology for the placement of signage and operational information within the building and park.

The location of regulatory information is typically stipulated in standards and codes, however, our approach for operational signage when it is not governed by Australian Standards or The City of Sydney's signage manuals is to apply the signage on common datums where possible to improve the visual aesthetic and remove the distraction of random signage placement. This improves user communication and creates a safer environment.

Accessible signage to be positioned in accordance with Australian Standards.

Messaging

Signage wil provide clear and legible messaging conforming to the necessary accessibility regulations as set out in the City of Sydney's Parks Signage User Manual and Brand Manuals.

Design and graphic set out

Signage graphics will conform to the City of Sydney Brand Guidelines and corporate typeface 'Swiss'. Graphics will be set out in a comparable manner as required to give a clear indication of facility, function, regulations or as required to relevant Australian Standards including typeface (font), spacing, use of title case and sans-serif font, colour, contrast and message position to the viewer.

A GPARC 'placemaking brand' typeface may be used for large scale identification of the building supported by the City of Sydney font for functional messaging.

Regulatory/statutory signage

Signage will conform to current Australian Standards, and BCA/ DDA code requirements. A consistent application, and thoughtful alignment of signage will provide a structured approach to the display of the information and contribute to a less visually cluttered environment.

There are a number of 'off-the-shelf' signs available; we will consider the use of these as required. However, these are mainly designed for low cost application or back of house use and are basic in their appearance.

Accessible signage to be positioned in accordance with Australian Standards.

Plant room regulatory signage

Plant room regulatory signage will be standard 'off-the-shelf' signs suitable for purpose and environmental conditions. For example 'HAZCHEM' signage displayed at key entry points. Specific operational signage ia required to be supplied by plant/equipment suppliers.

Safety signage

No climbing on fence signs

Safety signage is proposed at key points for example 'no climbing on grassed roof area' to discourage people walking up the grass/landscape berms.

Sign construction and materiality

Materials will be robust in response to the environment and the public nature of the building.

_Materials will conform with existing City of Sydney Guidelines

_Signage materiality to suit environmental conditions, and consistency of signage materials selected in conjunction with the architectural palette

_Signage will use low-reflective materials, surfaces and coatings where applicable to minimise glare and conform to luminance contrast requirements

_Material performance in relation to maintenance requirements and longevity of materials.

Parks and Amenities building signage

Construction and fabrication as indicated in the City of Sydney's Parks Regulation Signage User Manual.

Community Facilities signage

Construction and fabrication as indicated in the Community Facilities Signage Style Guide.

GPARC building statutory signage

External statutory sign panels will be fabricated from a robust substrate panel. Graphics will be either engraved and filled or mask and sprayed with a clear anti-graffiti spray coating. Signs will be concealed fixed to wall or door elements as required.

Performance standards

Signage specified will conform to current codes and standards, not limited to:

_BCA, Australian Standards relevant to signage including AS1428, accessibility and DDA requirements
_WH&S compliance.

Illumination and light levels (at locations where signage will be installed) will conform to AS1680.

Signage strategy statement

All project signage for the park and public domain, and external building signage will be in accordance with the City's standard guidelines and templates where applicable.

All aquatic regulatory signage will be in accordance with the Aquatic Industry Guidelines and Standards.

Recommendations

_The City of Sydney's Community Facilities Signage System – key external signage elements from the system are used at entry points fulfilling the aim of the guidelines to unify the display of public information at the entry points to City of Sydney facilities.

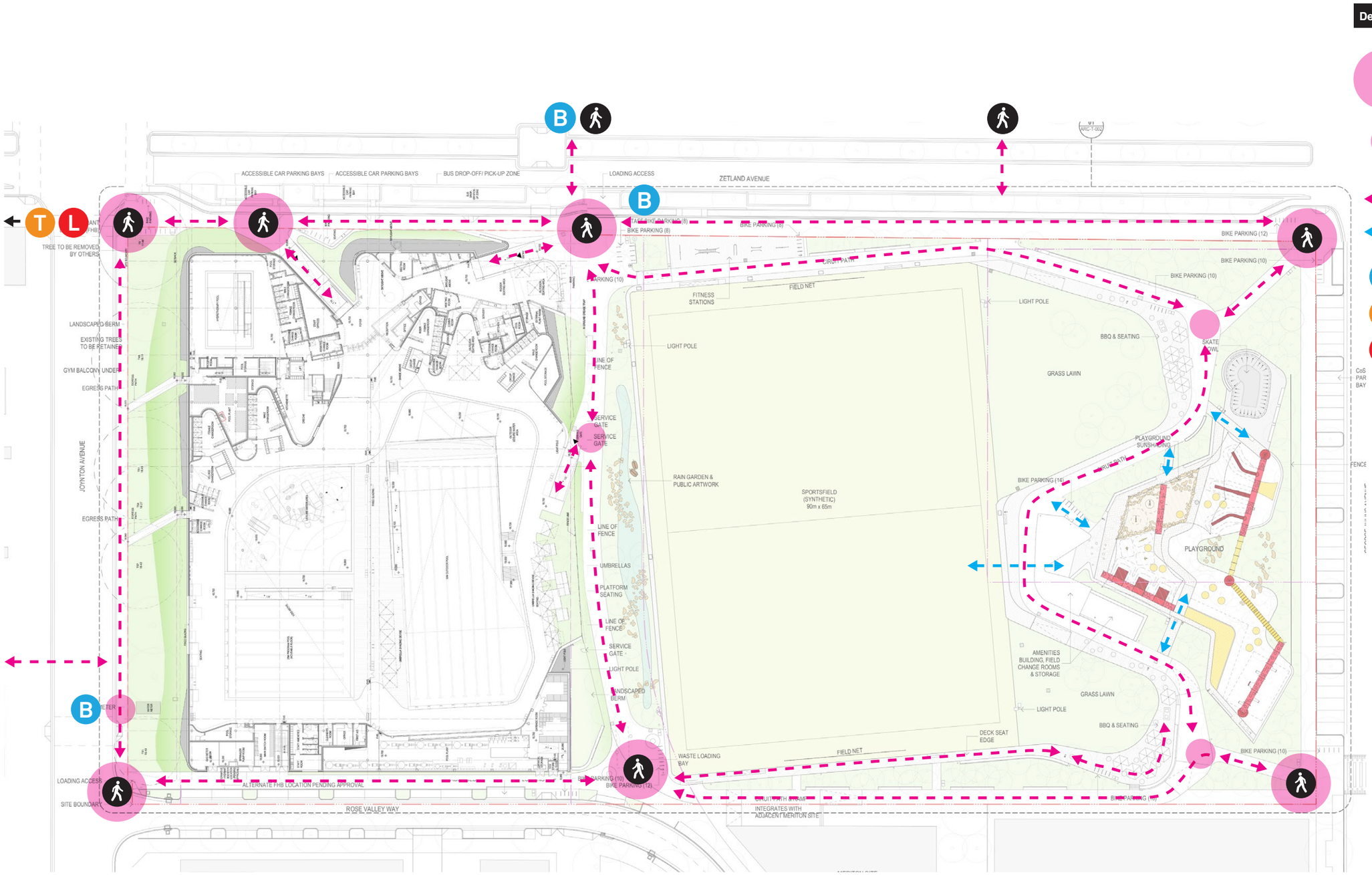
_The City of Sydney's Parks Regulation Signage System – signtypes as set out in the Guidelines throughout the park and public domain.

_External building identification (placemaking) signage as a site specific response to express the 'identity' of the Gunyama Park Aquatic and Recreation Centre.

Core references

City of Sydney's Corporate Identity Guidelines and Logo Guide, July 2012
City of Sydney's Aquatic Branding Design Guidelines, 2012
City of Sydney's Park Signage and Technical Manual, 2011
Bicycle Network Directional Signage Design Guidelines and Appendix A, 2010
City of Sydney's Community Facilities Signage Style Guide, December 2014
Royal Life Saving and aquatic industry guidelines and signage standards (primarily for internal signage).

Circulation and decision making points



Decision making points

- Primary decision making point
- Secondary decision making point
- Primary route
- Secondary route
- Bus drop off / pick up
- Train
- Light Rail (future)

01 Plan – Circulation
Scale: NTS

Route by choice – aim to encourage journey along Rose Valley Way and Overland flow path

GPARC External Signage Masterplanning
Park and Building

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Signtypes

The following signtypes are used across the attached drawings. Where a sign type identifier doesn't appear in the existing systems we have applied a temporary code.

The City of Sydney Community Facilities Signage Style Guide, December 2014

CoS Community Facilities Signage

- BR.1 **Brand Roundel** wall mounted – Illuminated
- BR.2 **Brand Roundel** wall mounted – Solid
- BI.2 **Building Identification + Promotional** freestanding – Illuminated
- BI.3 **Building Identification Plinth** freestanding
- BI.4 **Building Identification** wall mounted graphics direct to building
- SA.2 **Site Arrival Identification** front door – wall mounted
- SA.6 **Site Arrival Identification** front door – glass mounted vinyl

The City of Sydney Parks Regulation Signage User Manual 28 October 2011

CoS Parks Signage System

- S1 **Primary Regulation/Identification** freestanding pole
- S2 **Secondary Regulation/Identification** freestanding – large *Includes 'Good day' in Gadigal*
- S3 **Local Specific Regulation/Identification** large/small wall mount
- S4 **Local Specific Regulation/Identification** freestanding
- S5 **Toilet Identification** wall mount
- S6 **Primary Regulation/Identification** wall mount
- S7 **Secondary Regulation/Identification** wall mount
- S10 **Community Noticeboard**
- S12 **Freestanding Fitness Equipment Signage**

GPARC signage

In addition to the City of Sydney signage systems, some custom signage is currently being designed by Extrablack in collaboration with Andrew Burges Architects, Grimshaw + TCL project teams and the City of Sydney.

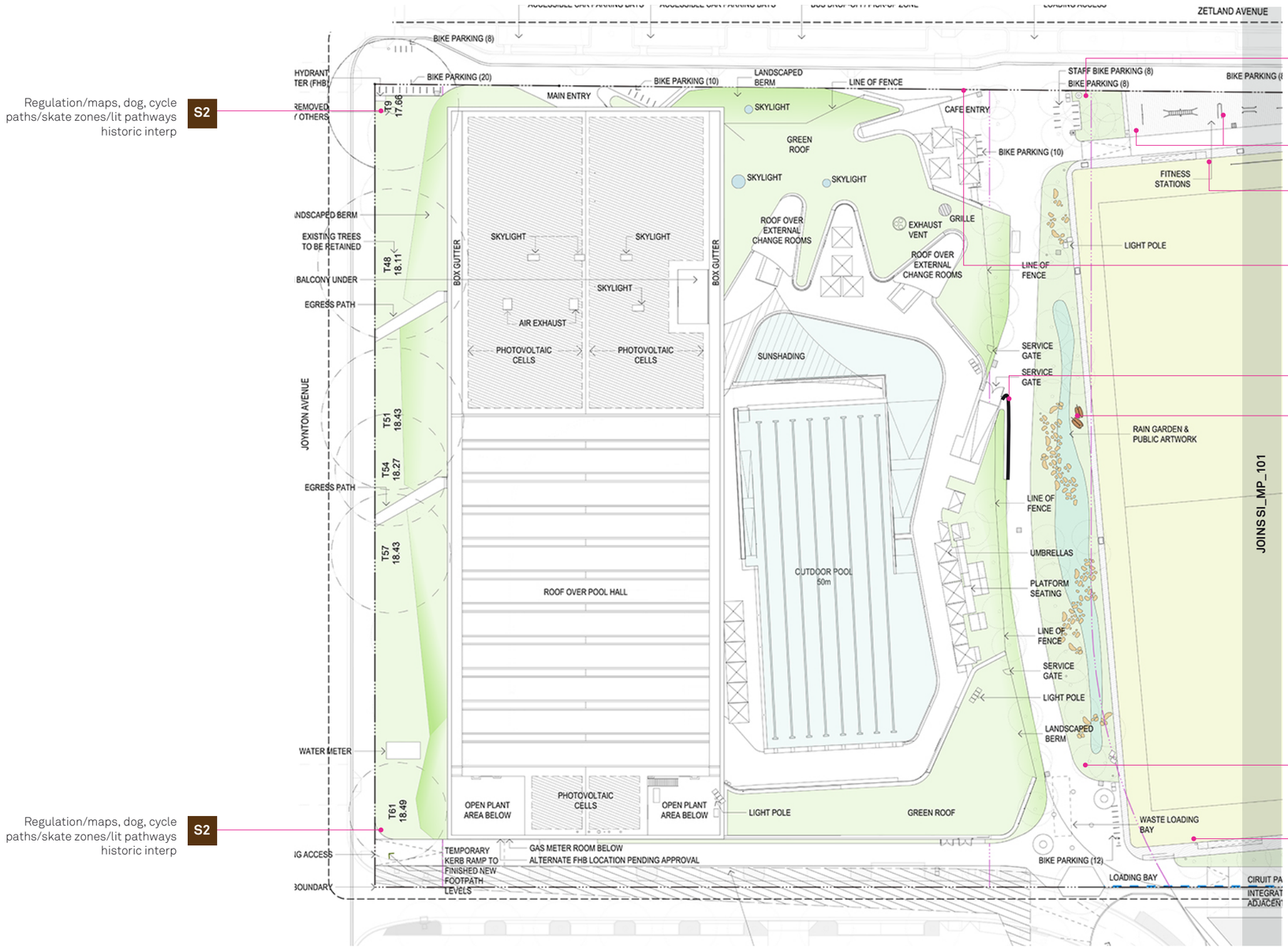
GPARC Sign types

- S1 **Building Identification – GPARC** facade – high level wall mounted
- S2 **Building Identification – GPARC** entry – low level wall mounted
- S3 **Lord Mayor's Opening Plaque** wall mounted
- S4 **Cafe Identification** facade/wall mounted
- S5 **Operational** wall/glass mounted
- S6 **Wayfinding/Directional** wall mounted/suspended
- S7 **Facility Identification – Pool** wall mounted
- S8 **Facility Identification – Internal** wall mounted
- S9 **Room Identification – Internal** wall mounted
- S10 **Toilets & Amenities** wall mounted
- S11 **Pool/RLSS Signage** wall/floor/object mounted
- S12 **Statutory & Regulatory Signage** wall mounted
- S13 **Back of House – External** wall/door mounted
- S14 **Back of House – Internal** wall/door mounted
- S15 **Changeable & Variable Signage** wall mounted

Site specific signage

- IN **Interpretive – historic & public art** as part of object
- EC **Ecological** freestanding / object mounted
- SZ **Skateable Moments** object mounted icon

MP Signage Masterplan – Park Signage



Regulation/maps, dog, cycle paths/skate zones/lit pathways historic interp — **S2**

S2 Regulation/maps, dog, cycle paths/skate zones/lit pathways historic interp

S12 Freestanding Fitness Equipment signage

S4 Synthetic field regulation
Field booking changeable panel if field is closed, operational info.
Dog regulatory

S10 Community Noticeboard

S5_02 Operational signage

IN Interpretive public art

S2 Regulation/maps, dog, cycle paths/skate zones/lit pathways historic interp

S4 Synthetic field regulation
Field booking changeable panel if field is closed, operational info
Dog regulatory

Regulation/maps, dog, cycle paths/skate zones/lit pathways historic interp — **S2**

01 Plan – Signage masterplan – Part 1 of 2
Scale: NTS

CoS Parks Signage System

S1 **Primary Regulation/Identification**
freestanding pole

S2 **Secondary Regulation/Identification**
freestanding – large
Includes 'Welcome' in Gadigal

S3 **Local Specific Regulation/Identification**
large/small wall mount

S4 **Local Specific Regulation/Identification**
freestanding

S5 **Toilet Identification**
wall mount

S6 **Primary Regulation/Identification**
wall mount

S7 **Secondary Regulation/Identification**
wall mount

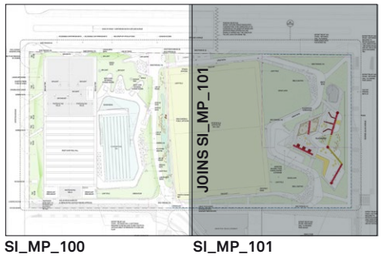
S10 **Community Noticeboard**
freestanding community noticeboard currently under design by CoS

S12 **Freestanding Fitness Equipment Signage**

Site specific signage

IN **Interpretive – historic & public art**
object

EC **Ecological**
freestanding / object mounted



SI_MP_100 SI_MP_101

Plan area 1 of 2

Issued for DA

Revisions

01	201015	For Review
02	050416	For Review
03	150416	70% DA Review
04	250516	100% DA Issue

Client GRIMSHAW / CITY OF SYDNEY 2030

Scale As shown at A3

Project
Gunyama Park Aquatic and Recreation Centre (GPARC), Zetland Ave, Zetland 2017

Drawing title
Signage Masterplan – Park Partial Plan 1 of 2

Drawn RP | **Checked** KM

Date 111015 | **Job number** ABA001

Drawing number
SI_MP_100

Sign type MP | **Revision** 04 | **Sheet size** A3

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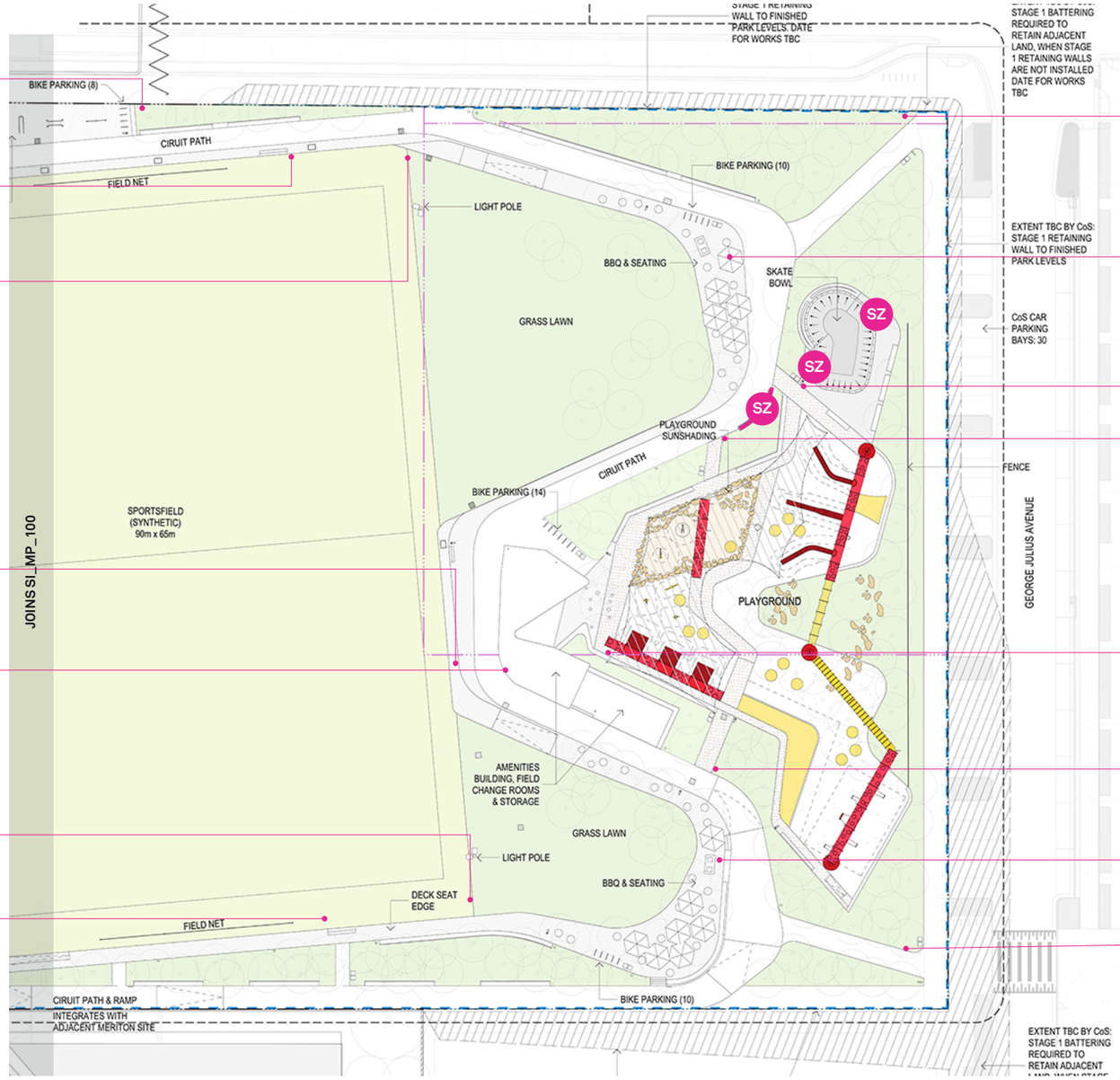
MP Signage Masterplan – Park Signage



Regulation/maps, dog, cycle paths/skate zones/lit pathways historic interp **S2**

Synthetic field regulation Field booking changeable panel if field is closed, operational info Dog regulatory **S4**

Synthetic field regulation Field booking changeable panel if field is closed, operational info Dog regulatory **S4**

Synthetic field regulation Field booking changeable panel if field is closed, operational info Dog regulatory **S4**

Freestanding sports field noticeboard **S10**

Synthetic field regulation Field booking changeable panel if field is closed, operational info S5 Dog regulatory **S4**

Synthetic field regulation Field booking changeable panel if field is closed, operational info Dog regulatory **S4**

S2 Regulation/maps, dog, cycle paths/skate zones/lit pathways historic interp

S4 BBQ facilities freestanding

S4 Skate bowl identification/regulation

S4 Playground identification/regulation

S4 Playground identification/regulation Entry to amenities area from playing field

S4 Playground identification/regulation

S4 BBQ facilities freestanding

S2 Regulation/maps, dog, cycle paths/skate zones/lit pathways historic interp

CoS Parks Signage System

S1 **Primary Regulation/Identification**
freestanding pole

S2 **Secondary Regulation/Identification**
freestanding – large
Includes 'Welcome' in Gadigal

S3 **Local Specific Regulation/Identification**
large/small wall mount

S4 **Local Specific Regulation/Identification**
freestanding

S5 **Toilet Identification**
wall mount

S6 **Primary Regulation/Identification**
wall mount

S7 **Secondary Regulation/Identification**
wall mount

S8 **Changeable/Facility Identification**
Freestanding/wall mount

S10 **Community Noticeboard**
freestanding community noticeboard currently under design by CoS

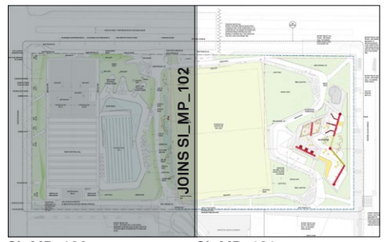
S12 **Freestanding Fitness Equipment Signage**

Site specific signage

IN **Interpretive – historic & public art**
object

EC **Ecological**
freestanding / object mounted

SZ **Skateable Moments**
object mounted icon



SI_MP_100 SI_MP_101

Plan area 2 of 2

01 Plan – Signage masterplan – Part 2 of 2
Scale: NTS

Issued for DA

Revisions

01	050416	For Review
02	150416	70% DA Review
03	250516	100% DA Issue

Client
GRIMSHAW
CITY OF SYDNEY 2030

Scale As shown at A3

Project
Gunyama Park Aquatic and Recreation Centre (GPARC), Zetland Ave, Zetland 2017

Drawing title
Signage Masterplan – Park Partial Plan 2 of 2

Drawn RP **Checked** KM

Date 210316 **Job number** ABA001

Drawing number
SI_MP_101

Sign type MP **Revision** 03 **Sheet size** A3

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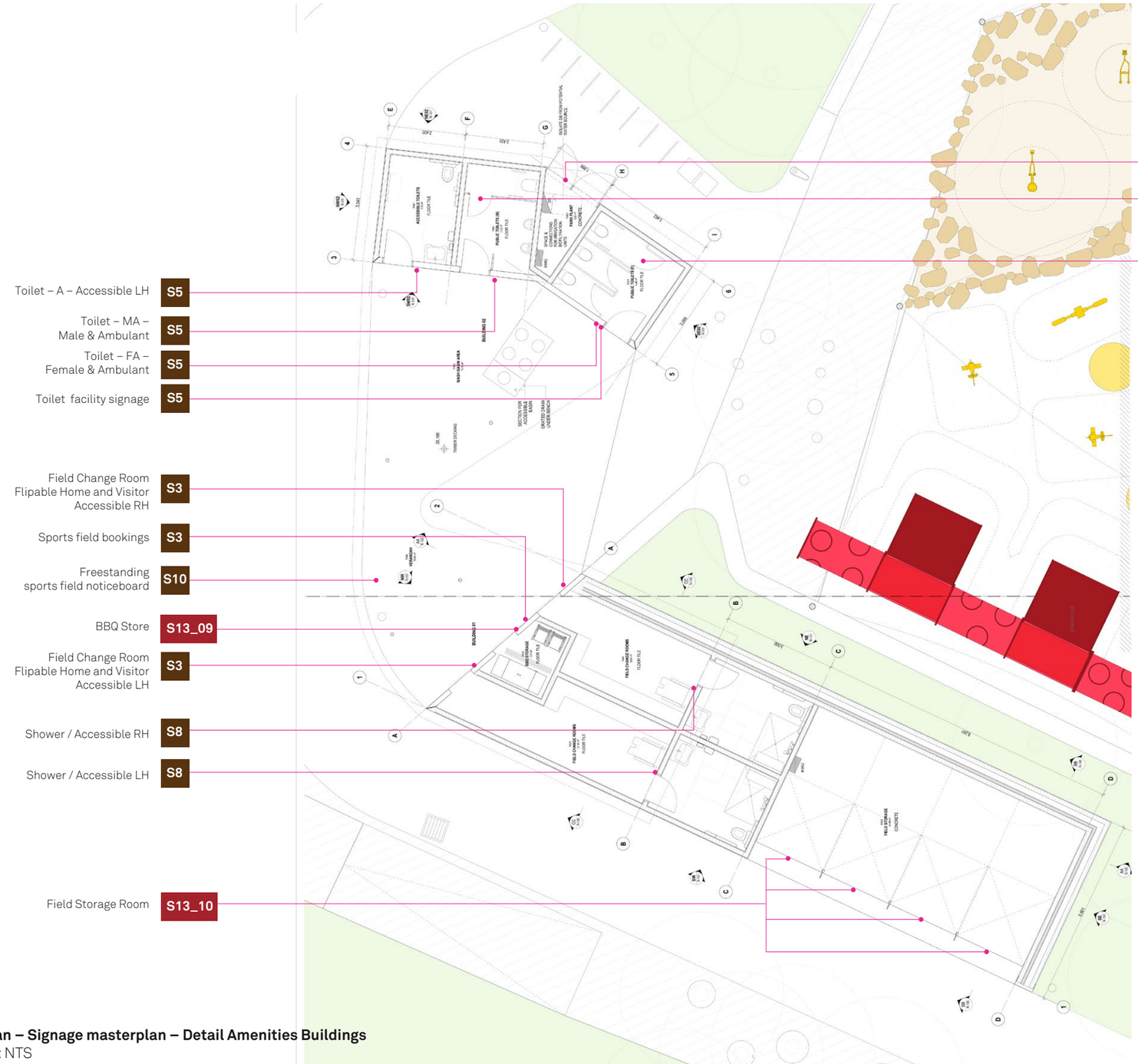
MP Signage Masterplan – Park Signage – Amenities Building



01 Plan – Signage masterplan – Detail Amenities Buildings
Scale: NTS

CoS Parks Signage System

- **S1** **Primary Regulation/Identification** freestanding pole
- **S2** **Secondary Regulation/Identification** freestanding – large *Includes 'Welcome' in Gadigal*
- **S3** **Local Specific Regulation/Identification** large/small wall mount
- **S4** **Local Specific Regulation/Identification** freestanding
- **S5** **Toilet Identification** wall mount
- **S6** **Primary Regulation/Identification** wall mount
- **S7** **Secondary Regulation/Identification** wall mount
- **S8** **Changeable/Facility Identification** Freestanding/wall mount
- **S10** **Community Noticeboard** freestanding community noticeboard currently under design by CoS

Site specific signage

- **IN** **Interpretive – historic & public art** object
- **EC** **Ecological** freestanding / object mounted
- **SZ** **Skateable Moments** object mounted icon

GPARC Sign types

- **S10** **Toilets & Amenities** wall mounted
- **S12** **Statutory & Regulatory Signage** wall mounted
- **S13** **Back of House – External** wall/door mounted



Detail plan area (shown as white)

Issued for DA

Revisions

01	050416	For Review
02	150416	70% DA Review
03	250516	100% DA Issue

Client GRIMSHAW / CITY OF SYDNEY

Scale As shown at A3

Project
Gunyama Park Aquatic and Recreation Centre (GPARC), Zetland Ave, Zetland 2017

Drawing title
Signage Masterplan – Detail Plan Park Amenities Building

Drawn RP | **Checked** KM

Date 210316 | **Job number** ABA001

Drawing number
SI_MP_102

Sign type MP | **Revision** 03 | **Sheet size** A3

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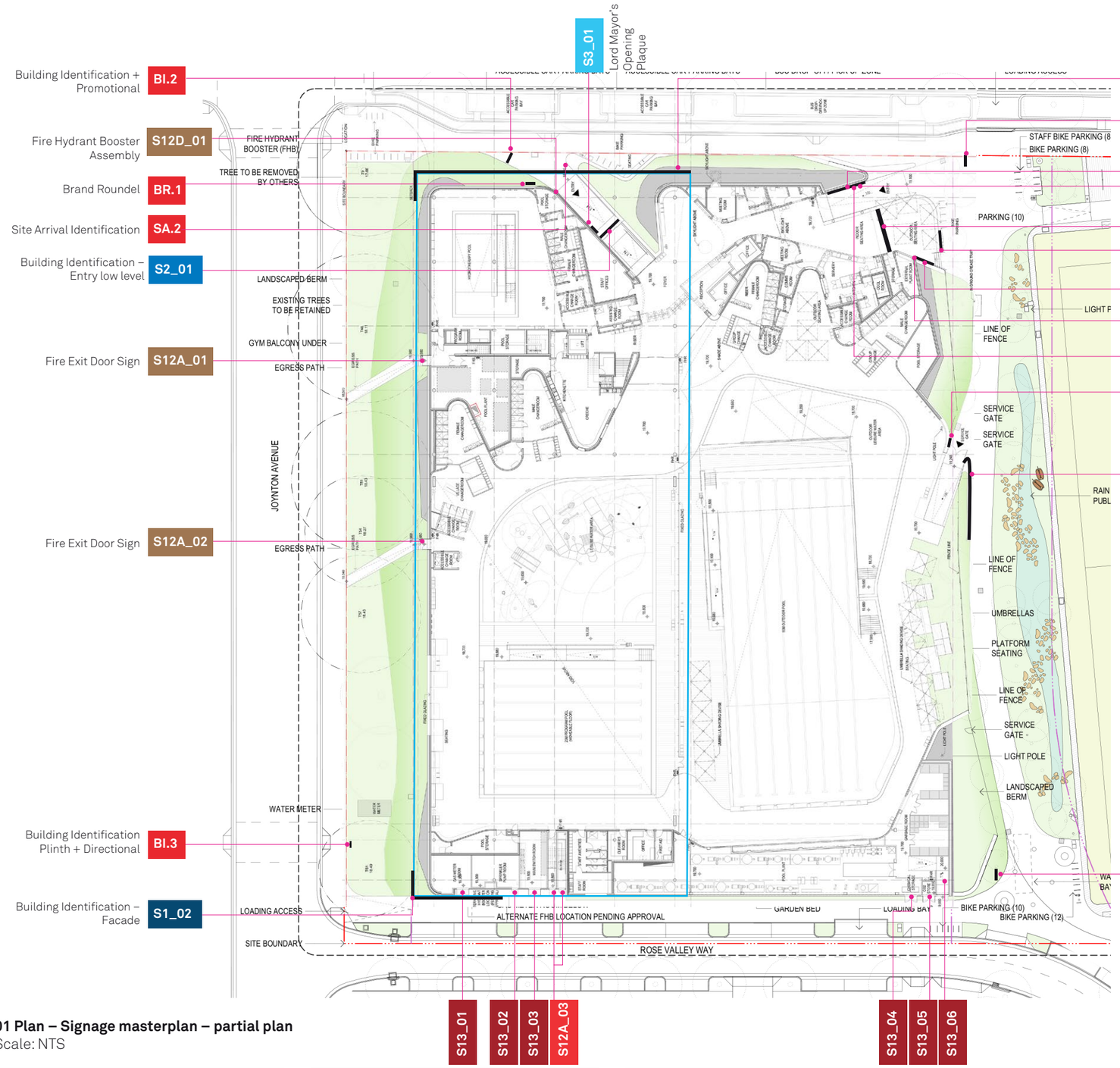
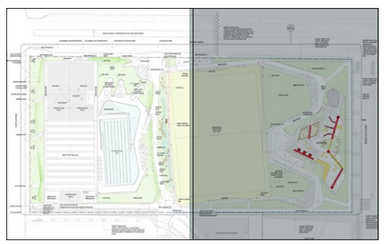
MP Signage Masterplan – City of Sydney Community Facilities & External Identification Signage



01 Plan – Signage masterplan – partial plan
Scale: NTS



Plan area

CoS Community Facilities Signage

- **BR.1** Brand Roundel – wall mounted – Illuminated
- **BR.2** Brand Roundel – wall mounted – Solid
- **BI.2** Building Identification + Promotional – freestanding – Illuminated
- **BI.3** Building Identification Plinth – freestanding
- **BI.4** Building Identification – wall mounted graphics direct to building
- **SA.2** Site Arrival Identification – front door – wall mounted
- **SA.6** Site Arrival Identification – front door – glass mounted vinyl

GPARC Sign types

- **S1** Building Identification – GPARC – facade – high level wall mounted
- **S2** Building Identification – GPARC – entry – low level wall mounted
- **S3** Lord Mayor's Opening Plaque – wall mounted
- **S4** Cafe Identification – facade/wall mounted
- **S5** Operational – wall/glass mounted
- **S6** Wayfinding/Directional – wall mounted/suspended
- **S7** Facility Identification – Pool – wall mounted
- **S8** Facility Identification – Internal – wall mounted
- **S9** Room Identification – Internal – wall mounted
- **S10** Toilets & Amenities – wall mounted
- **S11** Pool/RLSS Signage – wall/floor/object mounted
- **S12** Statutory & Regulatory Signage – wall mounted
- **S13** Back of House – External – wall/door mounted
- **S14** Back of House – Internal – wall/door mounted
- **S15** Changeable & Variable Signage – wall mounted

Site specific signage

- **IN** Interpretive – historic & public art – object
- **EC** Ecological – freestanding / object mounted
- **SZ** Skateable Moments – object mounted icon

Issued for DA

Revisions

01	050416	For Review
02	150416	70% DA Review
03	250516	100% DA Issue

Client ABA GRIMSHAW; CITY OF SYDNEY 2030

Scale As shown at A3

Project
Gunyama Park Aquatic and Recreation Centre (GPARC), Zetland Ave, Zetland 2017

Drawing title
Signage Masterplan – Partial plan

Drawn RP | **Checked** KM

Date 210316 | **Job number** ABA001

Drawing number
SI_MP_103

Sign type MP | **Revision** 3 | **Sheet size** A3

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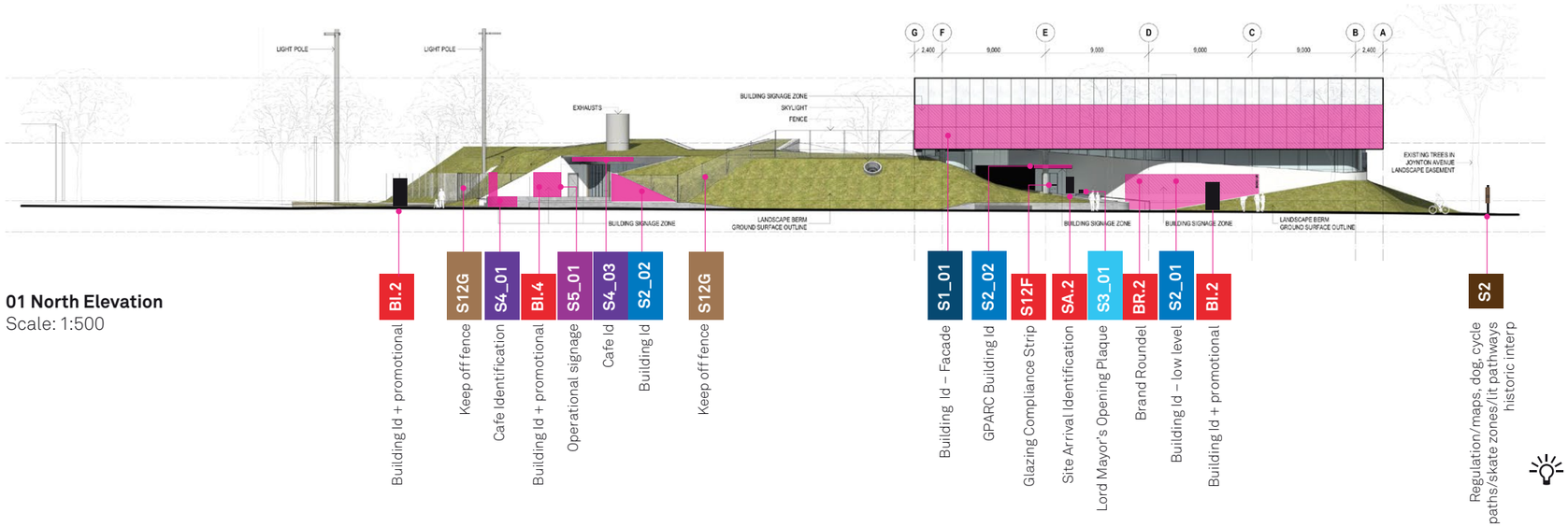
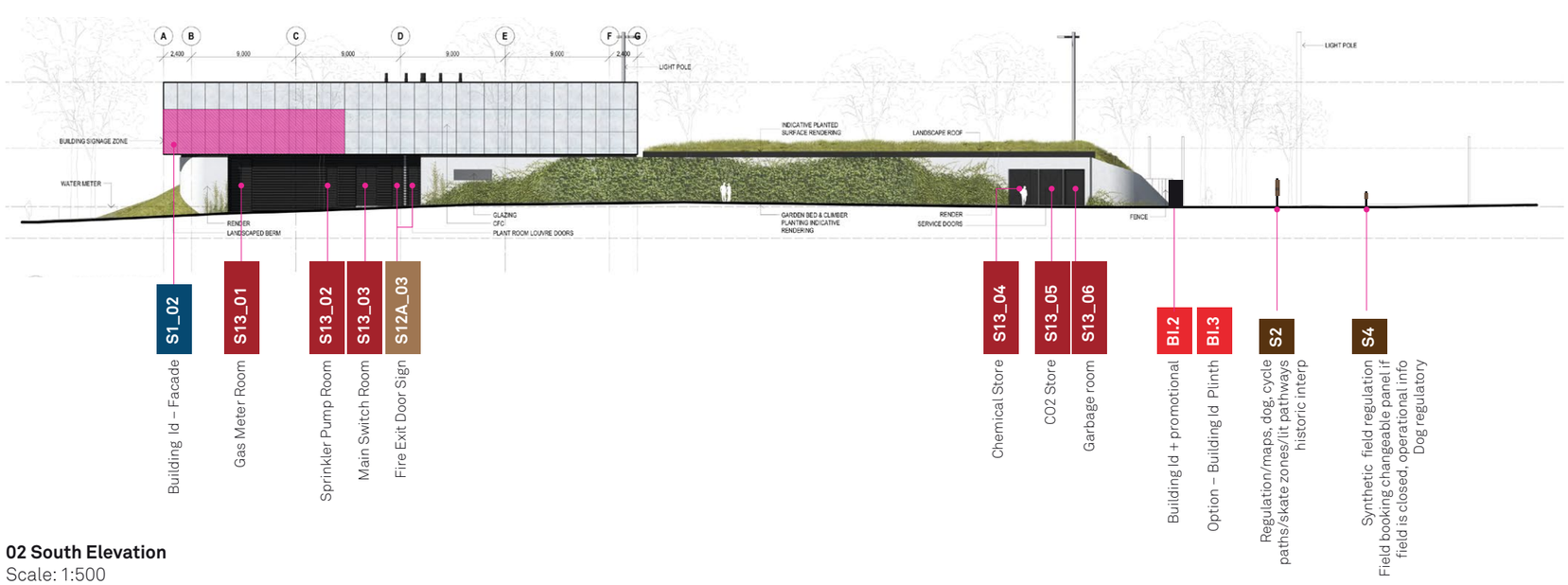
EL Signage Elevations – GPARC Building



01 North Elevation
Scale: 1:500



02 South Elevation
Scale: 1:500

CoS Parks Signage System

- **S1** Primary Regulation/Identification – freestanding pole
- **S2** Secondary Regulation/Identification – freestanding – large. *Includes 'Welcome' in Gadigal*
- **S3** Local Specific Regulation/Identification – large/small wall mount
- **S4** Local Specific Regulation/Identification – freestanding
- **S5** Toilet Identification – wall mount
- **S6** Primary Regulation/Identification – wall mount
- **S7** Secondary Regulation/Identification – wall mount
- **S10** Community Noticeboard – freestanding community noticeboard currently under design by CoS
- **S12** Freestanding fitness equipment signage

CoS Community Facilities Signage

- **BR.1** Brand Roundel – wall mounted – Illuminated
- **BR.2** Brand Roundel – wall mounted – Solid
- **BI.2** Building Identification + Promotional – freestanding – Illuminated
- **BI.3** Building Identification Plinth – freestanding
- **BI.4** Building Identification – wall mounted graphics direct to building
- **SA.2** Site Arrival Identification – front door – wall mounted
- **SA.6** Site Arrival Identification – front door – glass mounted vinyl

GPARC Sign types

- **S1** Building Identification – GPARC – facade – high level wall mounted
- **S2** Building Identification – GPARC – entry – low level wall mounted
- **S3** Lord Mayor's Opening Plaque – wall mounted
- **S4** Cafe Identification – facade/wall mounted
- **S5** Operational – wall/glazing mounted
- **S6** Wayfinding/Directional – wall mounted/suspended
- **S7** Facility Identification – Pool – wall mounted
- **S8** Facility Identification – Internal – wall mounted
- **S9** Room Identification – Internal – wall mounted
- **S10** Toilets & Amenities – wall mounted
- **S11** Pool/RLSS Signage – wall/floor/object mounted
- **S12** Statutory & Regulatory Signage – wall mounted
- **S13** Back of House – External – wall/door mounted
- **S14** Back of House – Internal – wall/door mounted
- **S15** Changeable & Variable Signage – wall mounted

Site specific signage

- **IN** Interpretive – historic & public art – object
- **EC** Ecological – freestanding / object mounted
- **SZ** Skateable Moments – object mounted icon

Proposed signage zone

Issued for DA

Revisions

01	070416	For Review
02	150416	70% DA Review
03	250516	100% DA Issue

Client GRIMSHAW / CITY OF SYDNEY

Scale As shown at A3

Project
Gunyama Park Aquatic and Recreation Centre (GPARC), Zetland Ave, Zetland 2017

Drawing title
Signage Elevations – GPARC_Buildings

Drawn RP | **Checked** KM

Date	Job number
210316	ABA001

Drawing number
SI_EL_150

Sign type EL | **Revision** 03 | **Sheet size** A3

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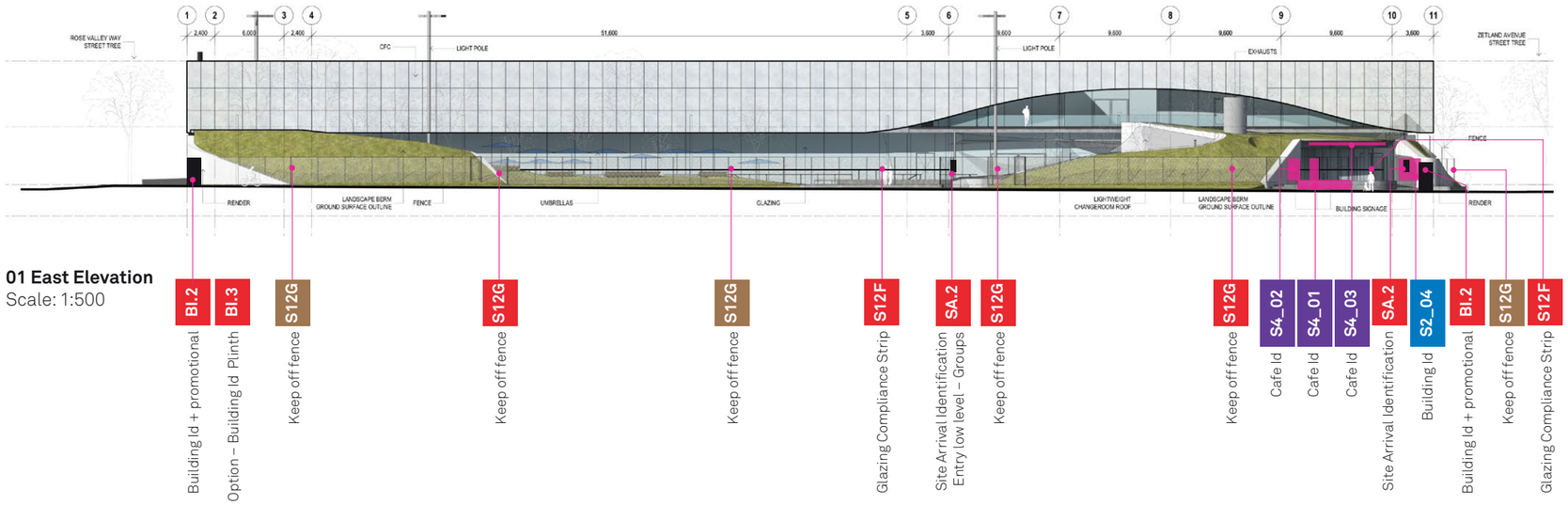
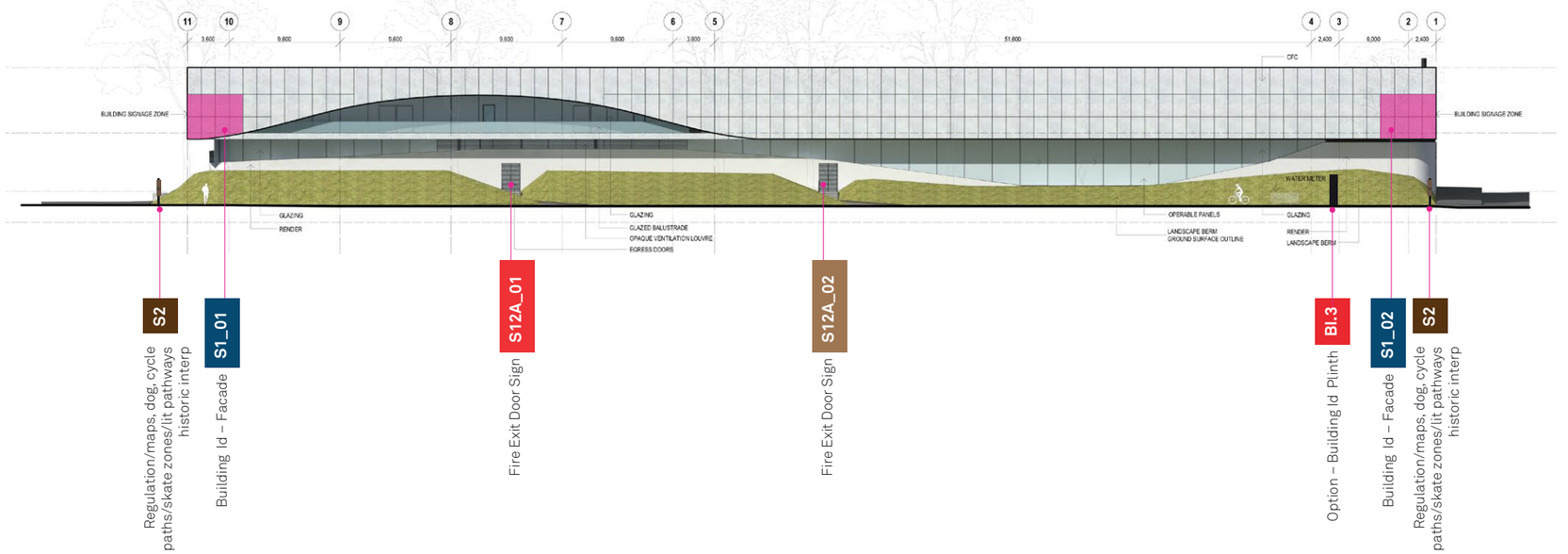
EL Signage Elevations – GPARC Building



01 East Elevation
Scale: 1:500



02 West Elevation
Scale: 1:500

CoS Parks Signage System

- **S1** Primary Regulation/Identification – freestanding pole
- **S2** Secondary Regulation/Identification – freestanding – large. *Includes 'Welcome' in Gadigal*
- **S3** Local Specific Regulation/Identification – large/small wall mount
- **S4** Local Specific Regulation/Identification – freestanding
- **S5** Toilet Identification – wall mount
- **S6** Primary Regulation/Identification – wall mount
- **S7** Secondary Regulation/Identification – wall mount
- **S10** Community Noticeboard – freestanding community noticeboard currently under design by CoS
- **S12** Freestanding fitness equipment signage

CoS Community Facilities Signage

- **BR.1** Brand Roundel – wall mounted – Illuminated
- **BR.2** Brand Roundel – wall mounted – Solid
- **BI.2** Building Identification + Promotional – freestanding – Illuminated
- **BI.3** Building Identification Plinth – freestanding
- **BI.4** Building Identification – wall mounted graphics direct to building
- **SA.2** Site Arrival Identification – front door – wall mounted
- **SA.6** Site Arrival Identification – front door – glass mounted vinyl

GPARC Sign types

- **S1** Building Identification – GPARC – facade – high level wall mounted
- **S2** Building Identification – GPARC – entry – low level wall mounted
- **S3** Lord Mayor's Opening Plaque – wall mounted
- **S4** Cafe Identification – facade/wall mounted
- **S5** Operational – wall/glazing mounted
- **S6** Wayfinding/Directional – wall mounted/suspended
- **S7** Facility Identification – Pool – wall mounted
- **S8** Facility Identification – Internal – wall mounted
- **S9** Room Identification – Internal – wall mounted
- **S10** Toilets & Amenities – wall mounted
- **S11** Pool/RLSS Signage – wall/floor/object mounted
- **S12** Statutory & Regulatory Signage – wall mounted
- **S13** Back of House – External – wall/door mounted
- **S14** Back of House – Internal – wall/door mounted
- **S15** Changeable & Variable Signage – wall mounted

Site specific signage

- **IN** Interpretive – historic & public art – object
- **EC** Ecological – freestanding / object mounted
- **SZ** Skateable Moments – object mounted icon

Proposed signage zone

Issued for DA

Revisions

01	070416	For Review
02	150416	70% DA Review
03	250516	100% DA Issue

Client GRIMSHAW / CITY OF SYDNEY

Scale As shown at A3

Project
Gunyama Park Aquatic and Recreation Centre (GPARC), Zetland Ave, Zetland 2017

Drawing title
Signage Elevations – GPARC_Buildings

Drawn RP | **Checked** KM

Date	Job number
210316	ABA001

Drawing number
SI_EL_151

Sign type EL | **Revision** 03 | **Sheet size** A3

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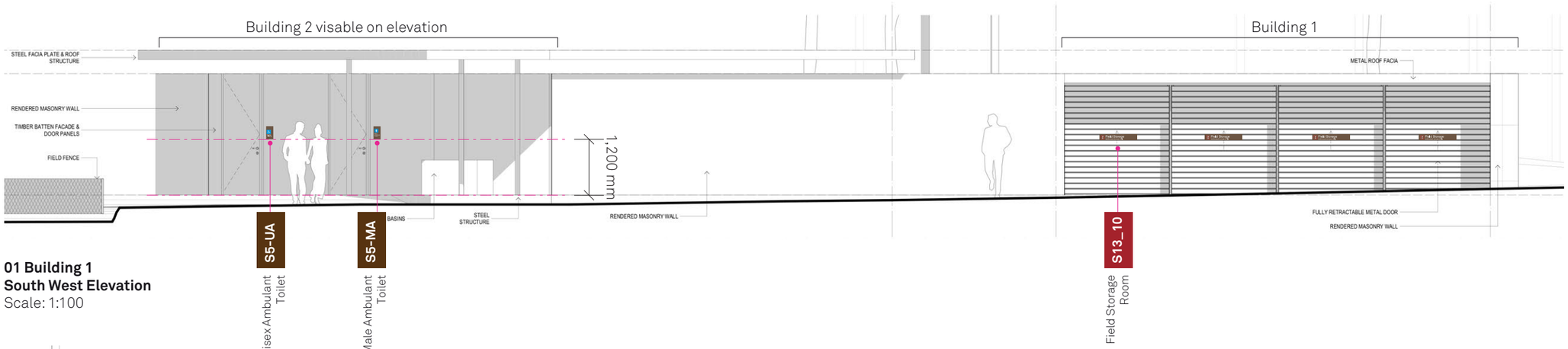
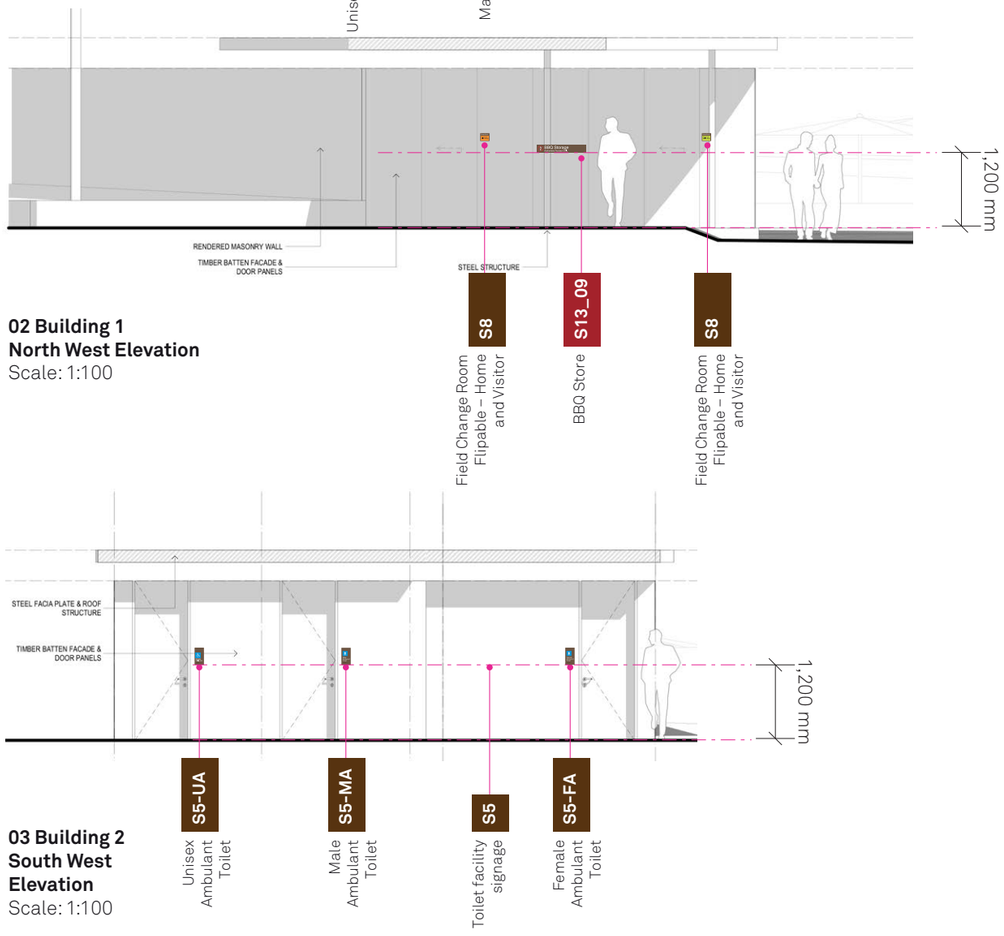
EL Signage Elevations – Amenities Buildings



01 Building 1
South West Elevation
Scale: 1:100



02 Building 1
North West Elevation
Scale: 1:100

03 Building 2
South West Elevation
Scale: 1:100



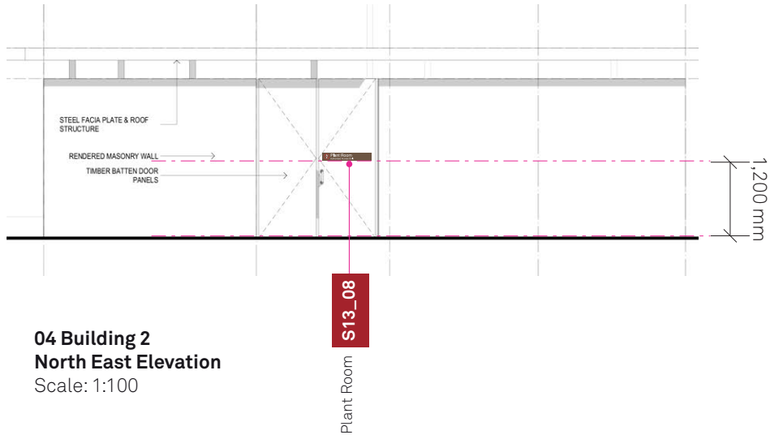
05 Detail – Typical
S5G UA + S
Scale: 1:10



06 Detail –
S8 Changeable Operational sign
Scale: 1:10



07 Detail – Typical
S13 Room sign
Scale: 1:20



04 Building 2
North East Elevation
Scale: 1:100

CoS Parks Signage System

- **S1** **Primary Regulation/Identification** freestanding pole
- **S2** **Secondary Regulation/Identification** freestanding – large *Includes 'Welcome' in Gadigal*
- **S3** **Local Specific Regulation/Identification** large/small wall mount
- **S4** **Local Specific Regulation/Identification** freestanding
- **S5** **Toilet Identification** wall mount
- **S6** **Primary Regulation/Identification** wall mount
- **S7** **Secondary Regulation/Identification** wall mount
- **S10** **Community Noticeboard** freestanding community noticeboard currently under design by CoS
- **S12** **Freestanding fitness equipment signage**

Site specific signage

- **IN** **Interpretive – historic & public art** object
- **EC** **Ecological** freestanding / object mounted
- **SZ** **Skateable Moments** object mounted icon

Proposed signage zone

GPARC Sign types

- **S10** **Toilets & Amenities** wall mounted
- **S12** **Statutory & Regulatory Signage** wall mounted
- **S13** **Back of House – External** wall/door mounted

Issued for Review

Revisions

01	070416	For Review
02	150416	70% DA Review
03	250516	100% DA Issue

Client
GRIMSHAW
CITY OF SYDNEY 2030

Scale As shown at A3

Project
Gunyama Park Aquatic and Recreation Centre (GPARC), Zetland Ave, Zetland 2017

Drawing title
Signage Elevations – GPARC_Amentities Buildings

Drawn RP | **Checked** KM

Date 210316 | **Job number** ABA001

Drawing number
SI_EL_152

Sign type EL | **Revision** 03 | **Sheet size** A3

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Appendix 1

City of Sydney Community Facilities Signage Style Guide December 2014

Key Signtypes (Extract)

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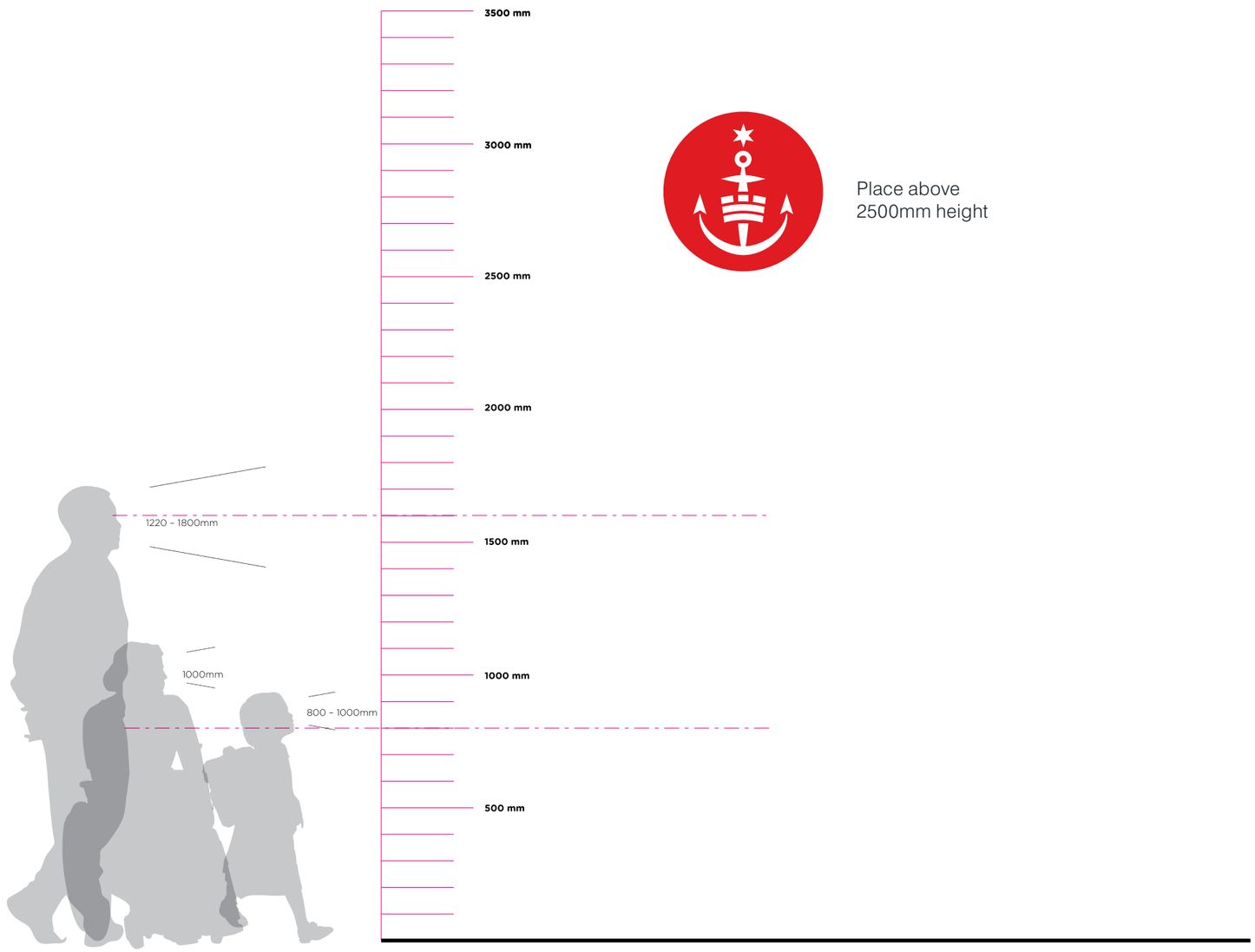
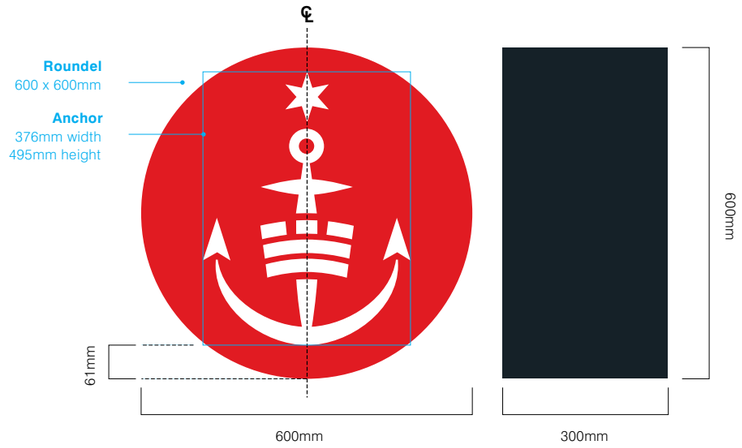
City of Sydney Community Facilities Signage

BR.1 Illuminated roundel – building mounted



Place above
2500mm height



01 Front elevation
BR.1 Illuminated roundel
Scale 1:20

Refer: City of Sydney Community Facilities Signage
Style Guide December 2014_pp57

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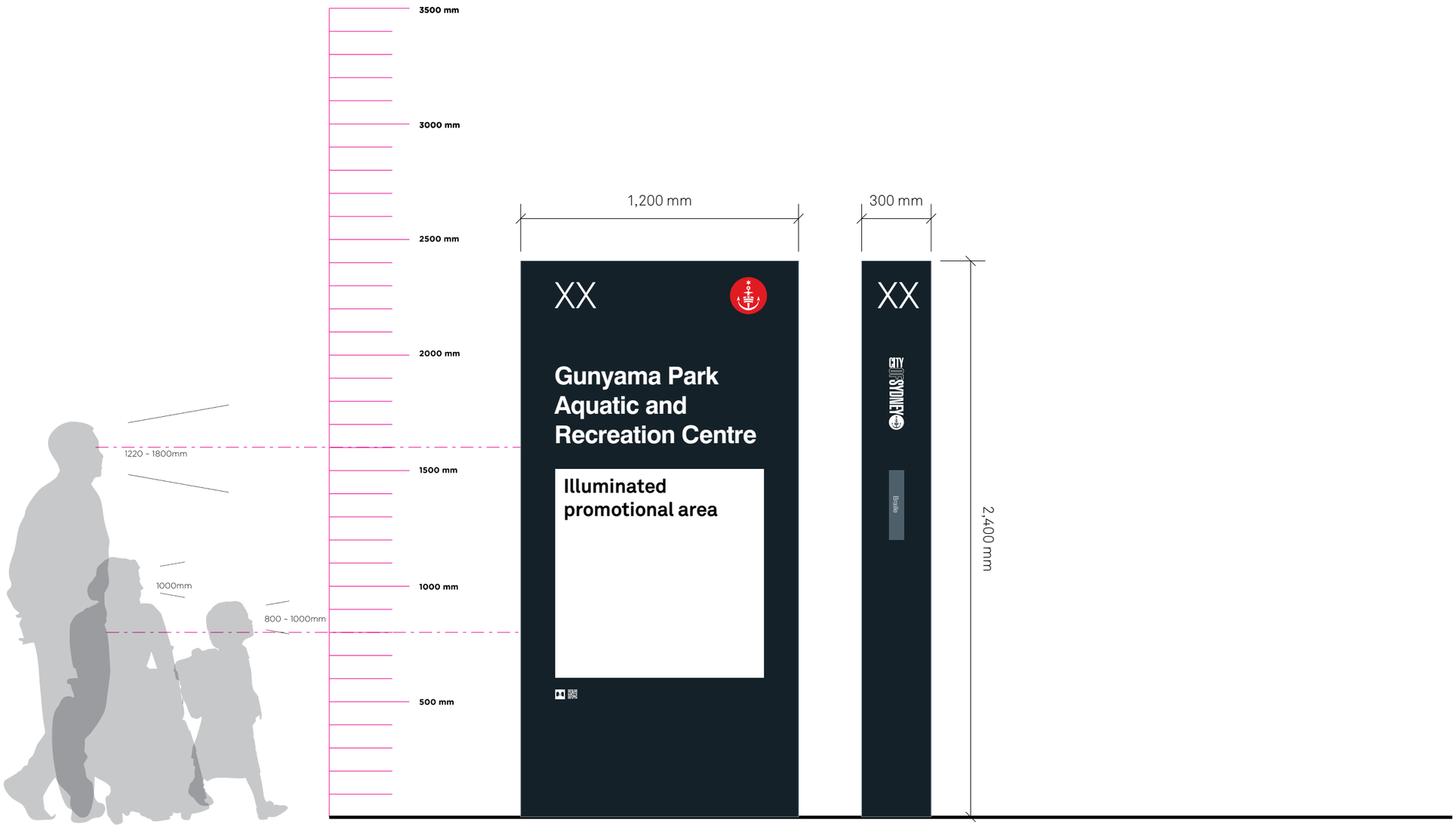
City of Sydney Community Facilities Signage

B1.2 – Large freestanding sign with promotional area



01 Front elevation
B1.2 Large freestanding sign with promotional area
Scale 1:20

02 Side elevation

Please note information shown on sign is indicative only

Refer: City of Sydney Community Facilities Signage Style Guide December 2014_pp64

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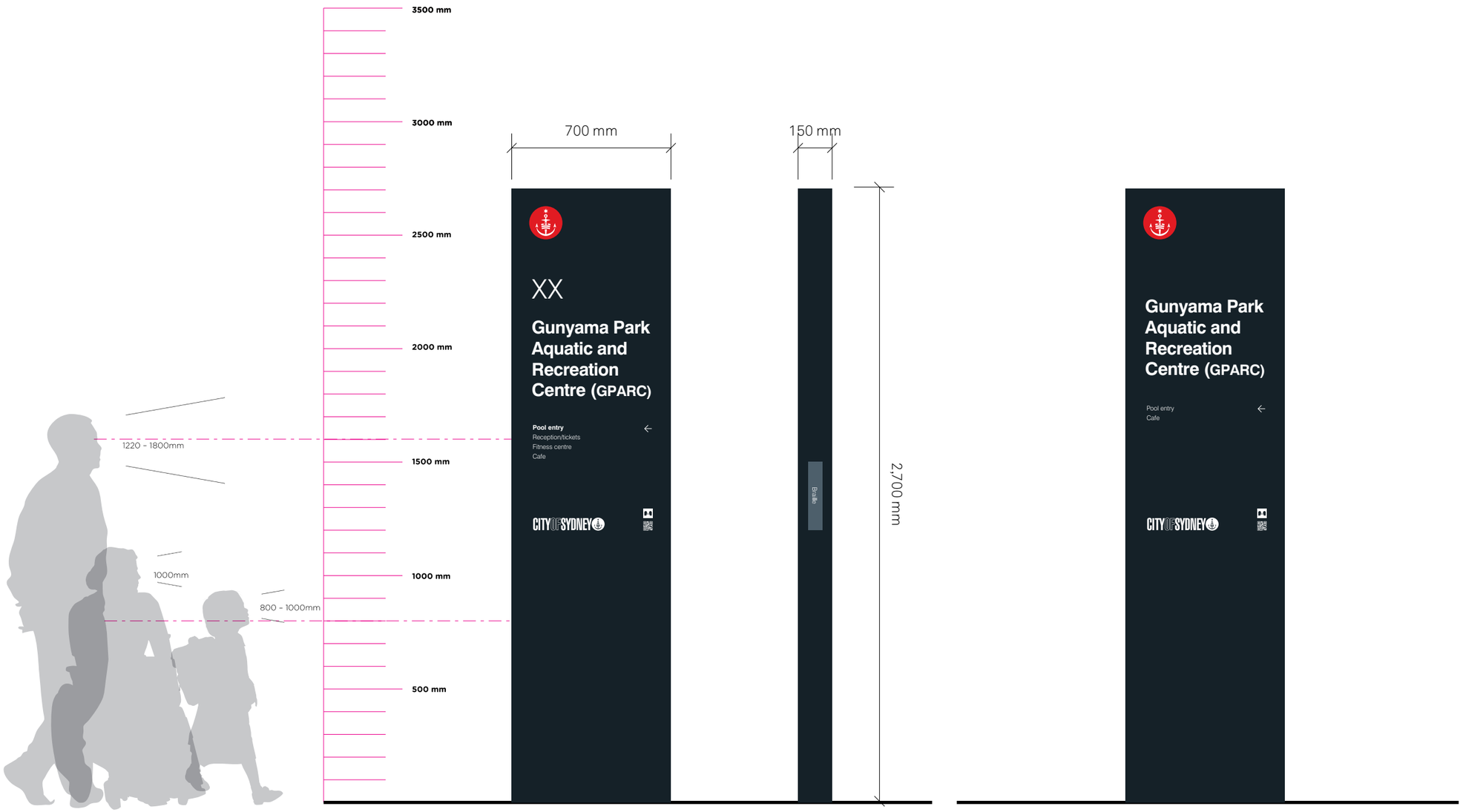
City of Sydney Community Facilities Signage

B1.3 – Building identification plinth



01 Front elevation
B1.3 Building identfication plinth
Directional to entry
Scale 1:20

02 Side elevation

03 Front elevation
B1.3 Building identfication plinth
Directional to entry
Scale 1:20

Please note information shown on sign is indicative only

Refer: City of Sydney Community Facilities Signage Style Guide December 2014_pp66

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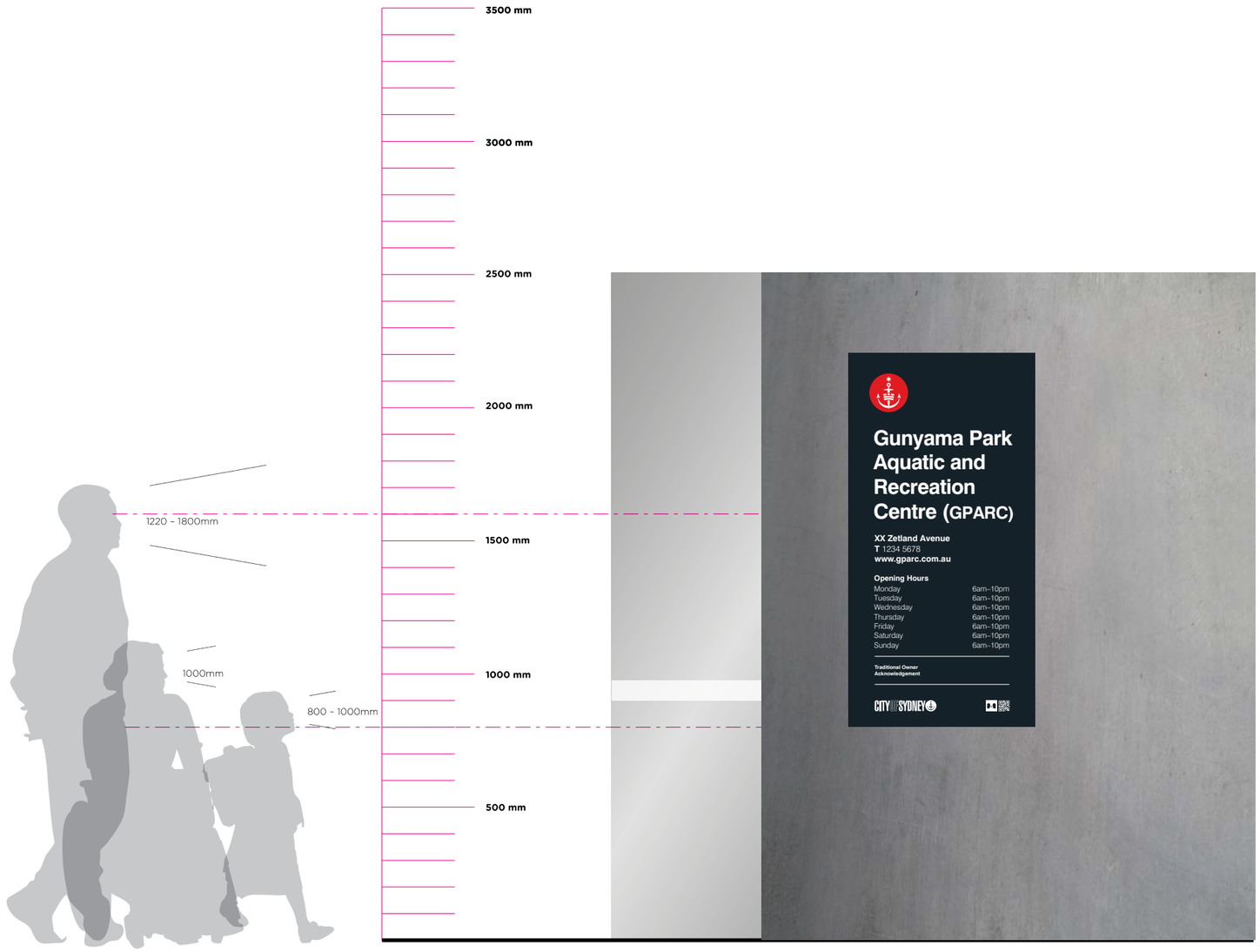
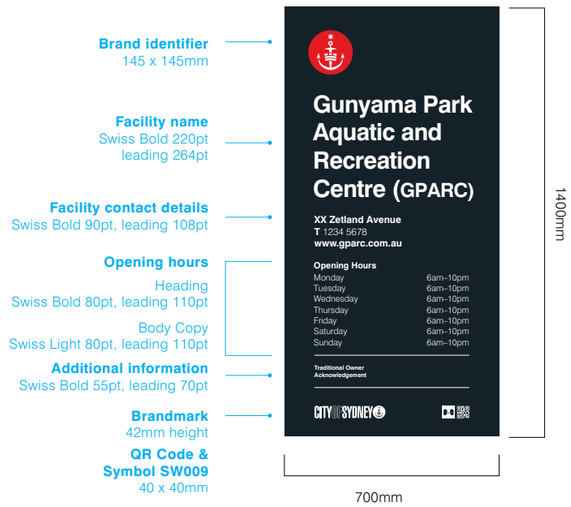
City of Sydney Community Facilities Signage

SA.2 – Wall mounted boxed vitreous enamel





01 Front elevation
SA.2 Wall mounted boxed vitreous enamel
Scale 1:20

Please note information shown on sign is indicative only

Refer: City of Sydney Community Facilities Signage Style Guide December 2014_pp74

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Appendix 2

City of Sydney Parks Signage System Regulation Signage User Manual, 28 October 2011

Key Signtypes (Extract)

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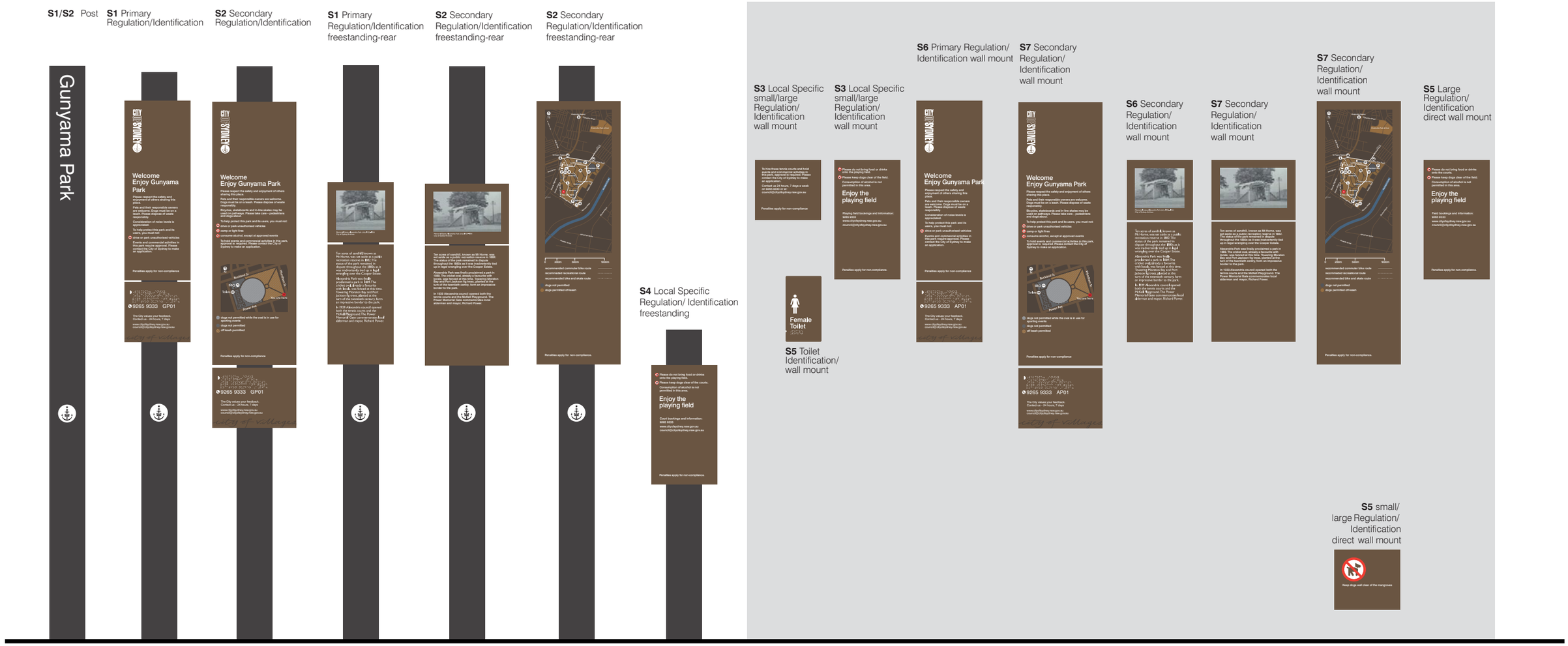
The City of Sydney's Parks signage system
Overview of sign family / signtypes



Refer: Park Signage User Manual_City of Sydney_28Oct11_pp5

Please note information shown on signage is indicative only

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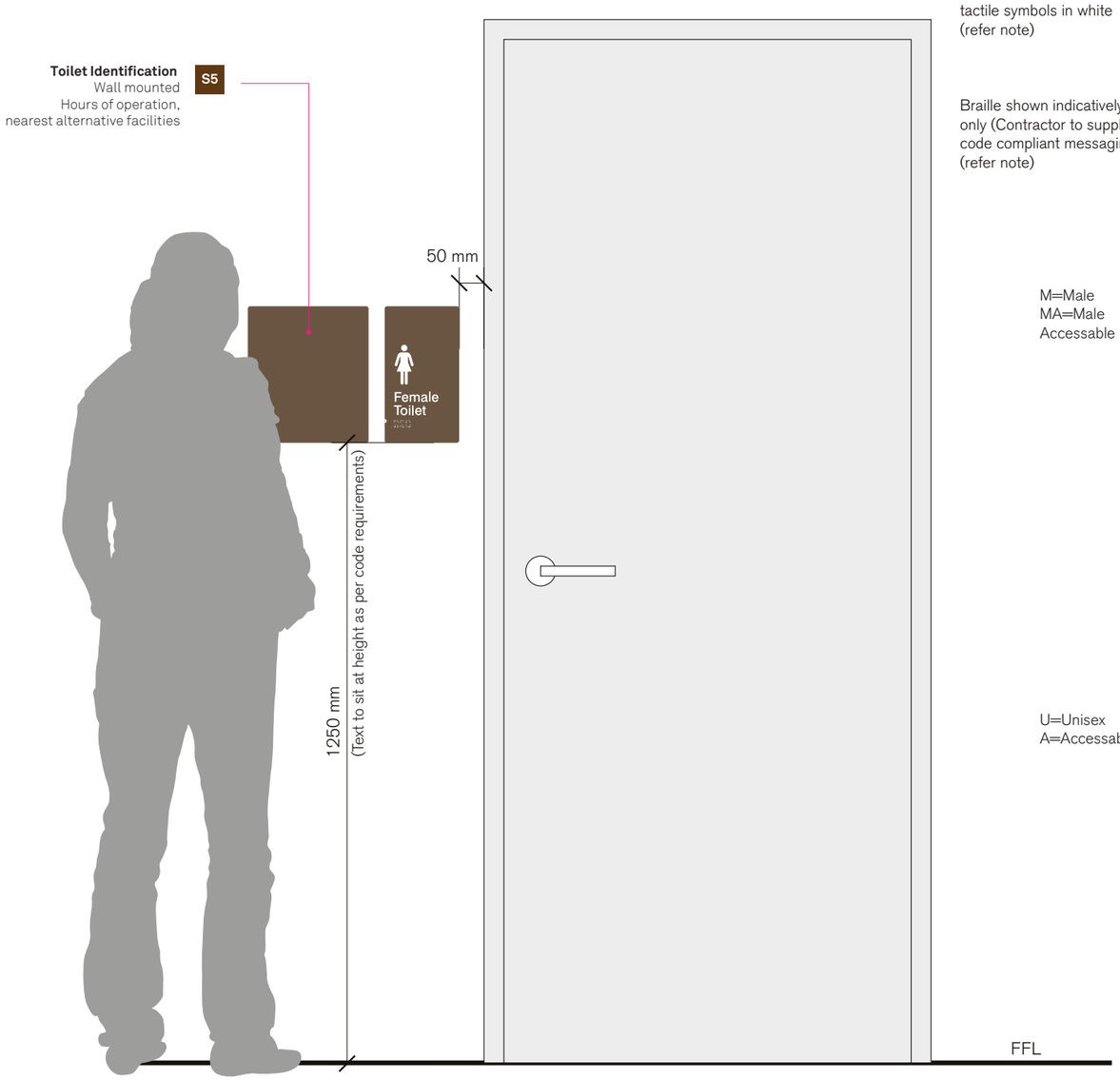
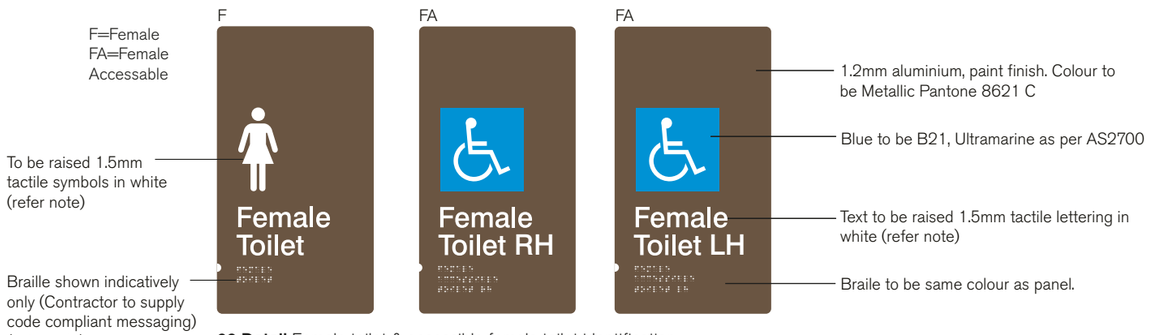
The City of Sydney's Parks signage system
Overview of sign family / signtypes

Note:
As per BCA standards, tactile characters and symbols must have rounded edges. Sign panel edges to be slightly rounded.
Entire sign panel, including braille and tactile to be fully encapsulated.
Powdercoat finish of sign to be matt or low sheen.
Braille must be Grade 1 Braille in accordance with the criteria set out by the Australian Braille Authority.



01 Elevation Amenity identification
Scale 1:10



02 Detail Female toilet & accessible female toilet identification
Scale 1:5



03 Detail Male toilet & accessible male toilet identification
Scale 1:5



04 Detail Unisex toilet & accessible unisex toilet identification
Scale 1:5

CoS Parks Signage System

S5 **Toilet Identification**
wall mount

Toilet signage messaging includes the gender designation pictograms, braille and tactile messaging; the name of facility (i.e. Gunyama Park Toilet); operating hours (daylight hours); contact information (City of Sydney) and the nearest alternative toilet if closed – as recommended in the City's Public Toilet Strategy.

Refer: Park Signage Tech Manual_City of Sydney_Frost_28 Oct11_pp52

Please note information shown on signage is indicative only

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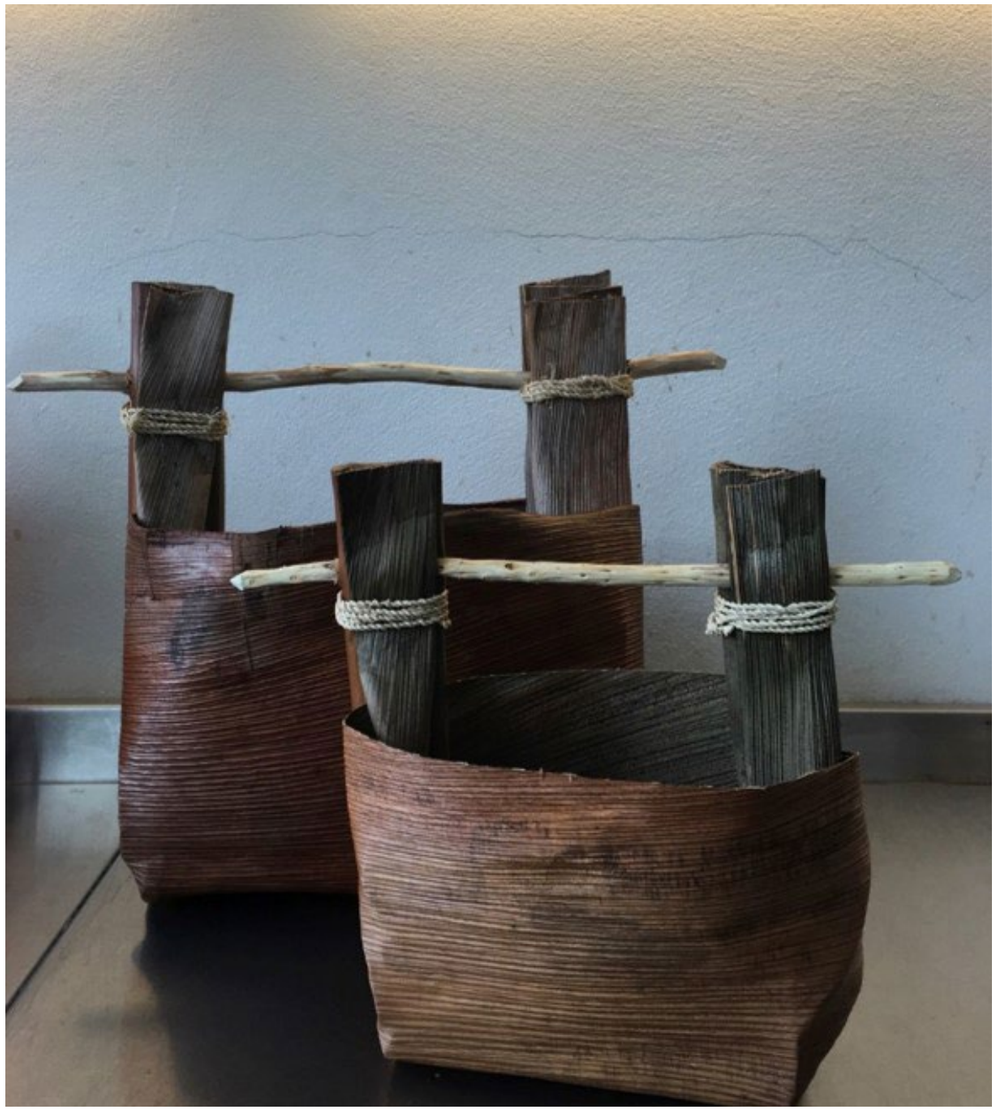
PUBLIC ART STRATEGY STATEMENT

FOR DEVELOPMENT APPLICATION

C16113 GUNYAMA PARK AQUATIC AND RECREATION CENTRE

JONATHAN JONES WITH ANDREW BURGES ARCHITECTS + GRIMSHAW + TCL

09.05.2016



CONTENTS

1.0 INTRODUCTION

2.0 PUBLIC ART PROPOSAL

2.1 BACKGROUND

2.2 SALTWATER/ FRESHWATER DIALOGUE - BANGALA

2.3 PUBLIC ART LOCATION

2.4 LOCATION ON SITE PLAN

1.0 INTRODUCTION

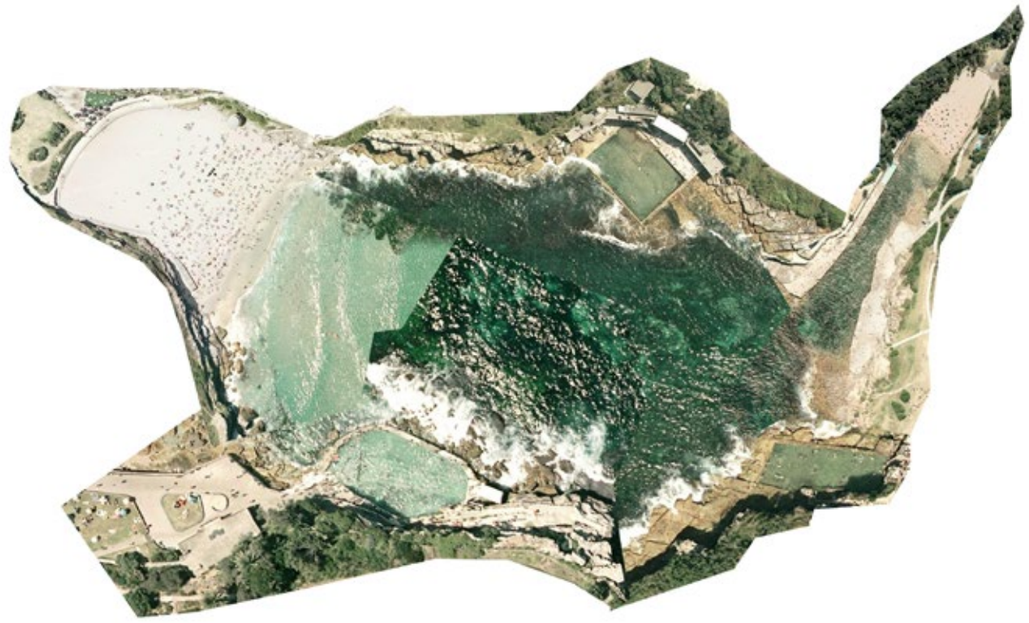
This statement describes the public art integration with Gunyama Park Aquatic and Recreation Centre to enhance and reinforce the key design concepts from the winning competition scheme proposed by Andrew Burges Architects together with Grimshaw and TCL. Along with a large team of consultants, artist Jonathan Jones formed part of the succesful team for fhe competition.
The public art strategy has been developed on the basis of several objectives, including the competition requirements for public art integration with the project, the competition design concepts and engagement with the specificity and history of the site, the artist's portfolio and strong links to indigenous culture, and a process of collaboration within the design team as well as consultation with The Public Art Advisory Panel.

COMPETITION REQUIREMENTS FOR PUBLIC ART
City of Sydney supports public art as a key element in the success of Green Square and its community, and therefore public art shall be an integral part of the design for the project and the precinct as a whole. It is envisaged by the City of Sydney that entrants will pursue a holistic artistic and creative approach to the design of the park and aquatic centre as per the adopted Green Square Public Art Strategy 2012 and Implementation Plan.
It is expected that a public artist will form an integral part of the team and that the artist will truly collaborate with the project team to integrate their concept into the overall park and aquatic centre design. It will be important that the artist's work is not an 'add-on' to the architectural and landscape design vision.
Design proposals must consider the integration of public art as an essential requirement. Deliver appropriate opportunities to integrate function with interpretation, such as revealing an environmental process, echoing past forms or referencing vernacular materials. In doing so, this project will develop proposals for cultural overlays, retention and interpretation of elements and public art. Public art proposals are to address the complexities of the brief, emerging design strategies and respond to the relationship with the existing and proposed physical and cultural site, its context and functions. The public art will consider long term maintenance and be designed to reduce any adverse effect on the environment during its life cycle and construction. This project is intended to be a true collaboration of urban design, architecture, landscape architecture and public art.

ARTIST'S PORTFOLIO
The portfolio of artist Jonathan Jones shows a great range of site-specific art installations closely linked to the history and traditional cultures of the specific locality. His artworks draw on an extensive knowledge based in Aboriginal ancestry and developed through years of research of the traditional owners of this land and their cultural use of place, which has been a key focus throughout his career. The same methodology has been applied to the public art strategy for Gunyama Park Aquatic and Recreation Centre to allow the public artwork to develop out of and in close relationship with the heritage of the site and the design concepts of the competition scheme.

COMPETITION DESIGN CONCEPTS
Based on the ABA Grimshaw competition concept of grafting the beach into the urban pool experience, Jonathan Jones suggested another layer of interpretation in the duality between saltwater and freshwater environments; the typology of saltwater pools which are introduced into a site previously immersed in the wetland landscapes of the Botany freshwater swamps. With a landscaped ground plane extending across the full footprint of the site as proposed in the competition scheme, the overland flow path running through the site at the junction of aquatic and recreation centre and park seems an obvious location for a sculptural artwork engaging the dialogue between saltwater and freshwater environments. The introduction of sculptures with references to water in the overland flow path will enhance the unifying concept of water and wetland that binds building and park in a continuous landscape.

COLLABORATION AND CONSULTATION
The proposed public art strategy has grown from a close collaboration between artist, architect and landscape architect initiated at competition stage. The development of the public art proposal has included continuous consultation and collaboration with Aboriginal elders and heritage consultants, and the detail and siting of the artwork has been developed in collaboration with civil and hydraulic engineers.
Consultations with the Public Art Advisory Panel held on May 5th 2015, 27th of October 2015, and 22nd of March 2016 have provided valuable feedback into the further development of the public art strategy. At the latest presentation on 22nd of March 2016, the Panel expressed their support of the developed artwork and its location within the site, with a recommendation that the artist speak to a casting specialist to obtain technical knowledge and expertise to inform the artwork. The artist is currently working together with a casting specialist and manufacturer to design casting moulds from threedimensional scans of a water carrier, which will be created in collboration with Aboriginal elder Aunty Julie Freeman.





2.0 PUBLIC ART PROPOSAL

2.1 BACKGROUND

This proposal has developed out of research into local history, with the aim to acknowledge the site's traditional owners, the Gadigal people of the Eora Nation, who have been living in this region for thousands of generations and whose presence and cultural traditions are the foundation of Sydney.

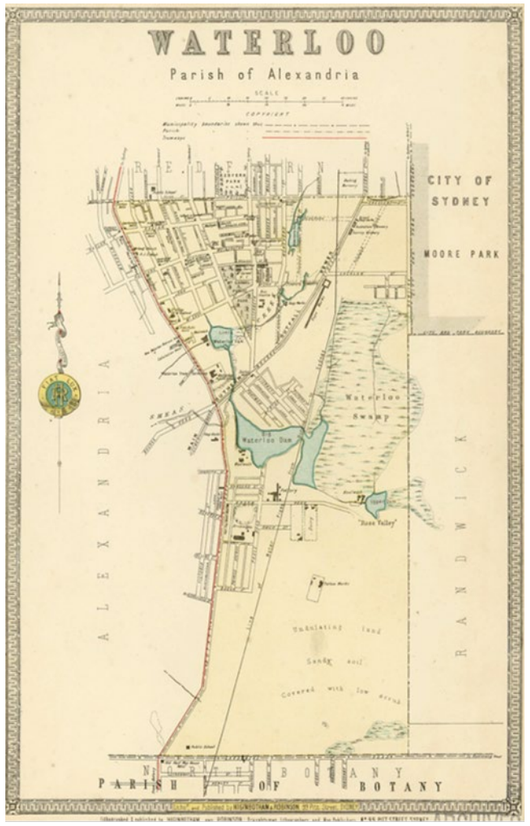
Water, along with the memory of water, has continued to define the Green Square area and is an important way of understanding place. The site and its surroundings continue to be an important resource for the local Aboriginal community who knew this area as a series of sand dunes and swamps that led into the present-day Cooks River and ultimately into Kamay (Botany Bay). The high part of the country would have been covered in heath and scrub, Freshwater creeks would have been the main geographical feature of the area and the lifeblood of the wetlands.
Many parts of the wetlands were drained in the early 1900s to make way for water-reliant industries. but the site retains its aquatic memory with large drainage systems still passing under the site.
Today, Gunyama Park Aquatic and Recreation Centre is continuing this history, linking back to the traditional landscape and returning the site to a place of water and recreation.

With the Green Square re-development, the site is returning to a place of residence. This future will be embedded into the region's history, and the proposed site-specific artwork for Gunyama Park Aquatic and Recreation Centre draw on Gadigal histories of residence and help sculpt the new identity. To achieve this, the proposed artistic vision works with local Aboriginal knowledge, engaging with local traditional owners, historical information and technology, to create an artwork that will contribute to defining the site and creating a sense of place.

The engagement of community is occuring by working with key elder and knowledge holder Aunty Julie Freeman to ensure that the project has local relevance and becomes an important part of the landscape and fabric of the community. Aunty Julie is a Gorawarl Jerrawongarla traditional owner for south Sydney and the South Coast of New South Wales with ties to the communities of La Perouse and Wreck Bay. She is a recognised artist, cultural leader and storyteller, with strong knowledge relating to the region's environmental system.
Artist Jonathan Jones is a member of the Wiradjuri and Kamilaroi nations, and is based in Sydney. He creates site-specific installations and interventions to explore Indigenous practices, relationships and ideas.
Aunty Julie and artist Jonathan have exhibited and worked together for a number of years.

The artwork concept has been conceived by Aunty Julie Freeman, whose knowledge of making bangala is driving the project, and Jonathan Jones. Artist, architect, landscape architect, heritage consultant and civil and hydraulic engineers have all worked together to develop the artwork and its siting.

The artwork proposal received endorsement from Uncle Charles (Chicka) Madden and the Metropolitan Local Aboriginal Land Council. Aunty Julie will continue to manage relevant protocols with Jonathan.
The Public Art Advisory Panel have provided valuable feedback and also support the artwork project.



01



02

01. (PREVIOUSPAGE) SYDNEY OCEAN POOLS COLLAGE FROM COMPETITION ENTRY

02. (PREVIOUS PAGE) ONE OF THE LAST COASTAL WETLANDS IN THE SYDNEY REGION, TOWRA LAGOON IN KURNELL ON THE SOUTH SIDE OF KAMAY (BOTANY BAY) IS CURRENTLY UNDERGOING RESTORATION. THE SITE PROVIDES A GOOD EXAMPLE OF THE TYPE OF ENVIRONMENTS ONCE EXPERIENCED IN THE SOUTHERN WATERLOO REGION WHERE THE WETLANDS ENCOUNTERED BRACKISH WATER.

01. HISTORIC MAP OF WATERLOO SWAMP

02. AUNTY JULIE FREEMAN

2.2 SALTWATER/ FRESHWATER DIALOGUE - BANGALA

Understanding the way different types of waters mix on the site has become the central point of artistic investigation. As outlined in further detail in the heritage reports, the site has a mixed history of water: traditionally, with the region being an important site of fresh and bitter waters; followed by the industrialisation of the site's waters with the establishment of manufacturing; and now the current competition concept for Gunyama Park Aquatic and Recreation Centre of siting Sydney's iconic coastal saltwater pools within this freshwater environment.

The creation of site-specific sculptures is an important way of interpreting the heritage of the site and celebrating its water histories, knowledge and memory. The iconic bangala, or Eora bark vessel used for carrying fresh water, has become the symbol for understanding the site and the complex water narrative it contains. The bangala embodies how both fresh and salt water can operate together, while referencing the aquatic centre as a container of water. The bangala, or Eora water vessels, of the proposed artwork will acknowledge the traditional owners and how their cultural use of the site continues to inform the present and future.

Bangala are often made from the base of a palm frond folded into position or from bark drawn together at the ends, both fastened with a stick and string to create a watertight carrier. These vessels were an important way of containing and maintaining fresh water in the coastal environments and were shared up and down the coast.
Today a number of key traditional owners continue to hold the knowledge for how to make bangala, including Aunty Julie Freeman.

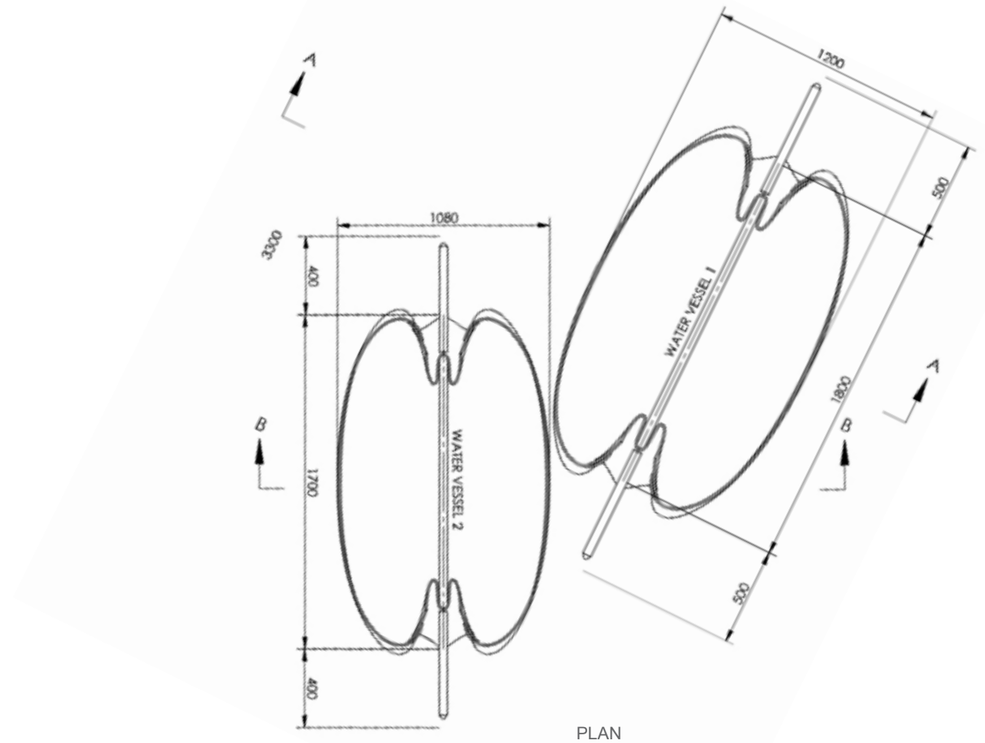
Through a series of workshops between Aunty Julie and Jonathan Jones, bangala are being created using the base of a palm frond, along with an oak handle and twined string. Once a suitable form has been selected, this will be scanned and 3D-modelled to be detailed and scaled up. The form will then be made in foam in three dimensions to be cast in bronze. The cast will capture the texture of the palm frond, the detail of the twine and the grain of the handle. In addition, twine and handle may be worked to achieve different patinas or tonal qualities, or the twine may be made out of wire. The handles will be cast as separate items and dropped into place.

Bronze is a material that will tarnish with age to appear like the natural material it is representing in this work, and is also a material that can be cast. Bronze is also a durable material that has a long history of usage for public art and is easily repaired and maintained. It can be used as a water feature as it can handle chemical treatments.

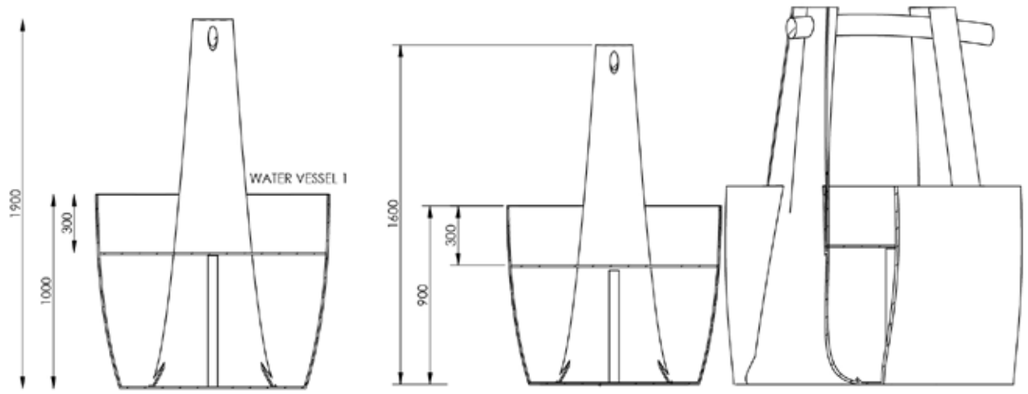
The two bronze bangala respond directly to the two large bodies of water within the aquatic centre, one slightly larger than the other. Placed together as a pair, they will be approximately 2 metres tall by 2 metres wide (refer drawings for exact measurements).

These oversized bronze bangala will become water features, with filtration ensuring cleanliness to Australian Standards. A false base will limit water depth to manage weight concerns, limit the size of water filtration equipment and minimise the energy required to service the water features.

As water features the bronze bangala sculptures will appear to be like freshwater springs, filling to the rim and spilling over into the landscape, and reminding people of the site's history. They will speak of the enduring presence of Eora culture within the landscape, the dichotomy of the architectural salt water within a freshwater environment, the importance of water, and the site's ongoing aquatic usage.



PLAN



SECTION A-A

SECTION B-B

2.3 PUBLIC ARTWORK LOCATION

In coordination with the architect, landscape architect, and civil engineer, the artwork has been integrated into the park landscape. As if left in the landscape by tradtional owners, the bronze bangala will be set amongst sandstone stepping stones within the riparian landscape zone along the overland flow path that will run through the site. Rushes will grow around them at the border of the rain garden, where water will be contained for some time after rainfall before it seeps into the ground and gets filtered for re-use. The bangala water features will appear as a part of this system.

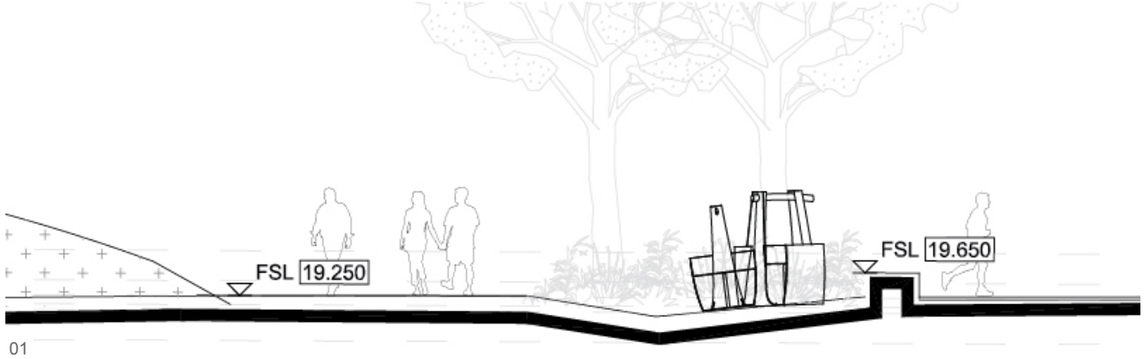
The sculptures will be sited in a prominent position opposite the secondary group entry into the aquatic recreation centre so it can be viewed from the outdoor pool and main recreational park areas, whilst also being positioned as an element to be discovered on journeys through the park via the promenade walkway. This location along the overland flow path has been appoved by the flood modeller, ensuring the sculptures would not become an obstruction to the overland water flows in a flood event.

The artwork is intended to be self-explanatory, however some description of the artwork may be integrated into park signage. Lighting will illuminate the artwork at night time.

01. SITE SECTION THROUGH BANGALA SCULPTURES

02. PHOTOMONTAGE INDICATING SITING OF BANGALA SCULPTURES

03. RUSHES IN RIPARIAN LANDSCAPE ZONE ALONG OVERLAND FLOW PATH



01

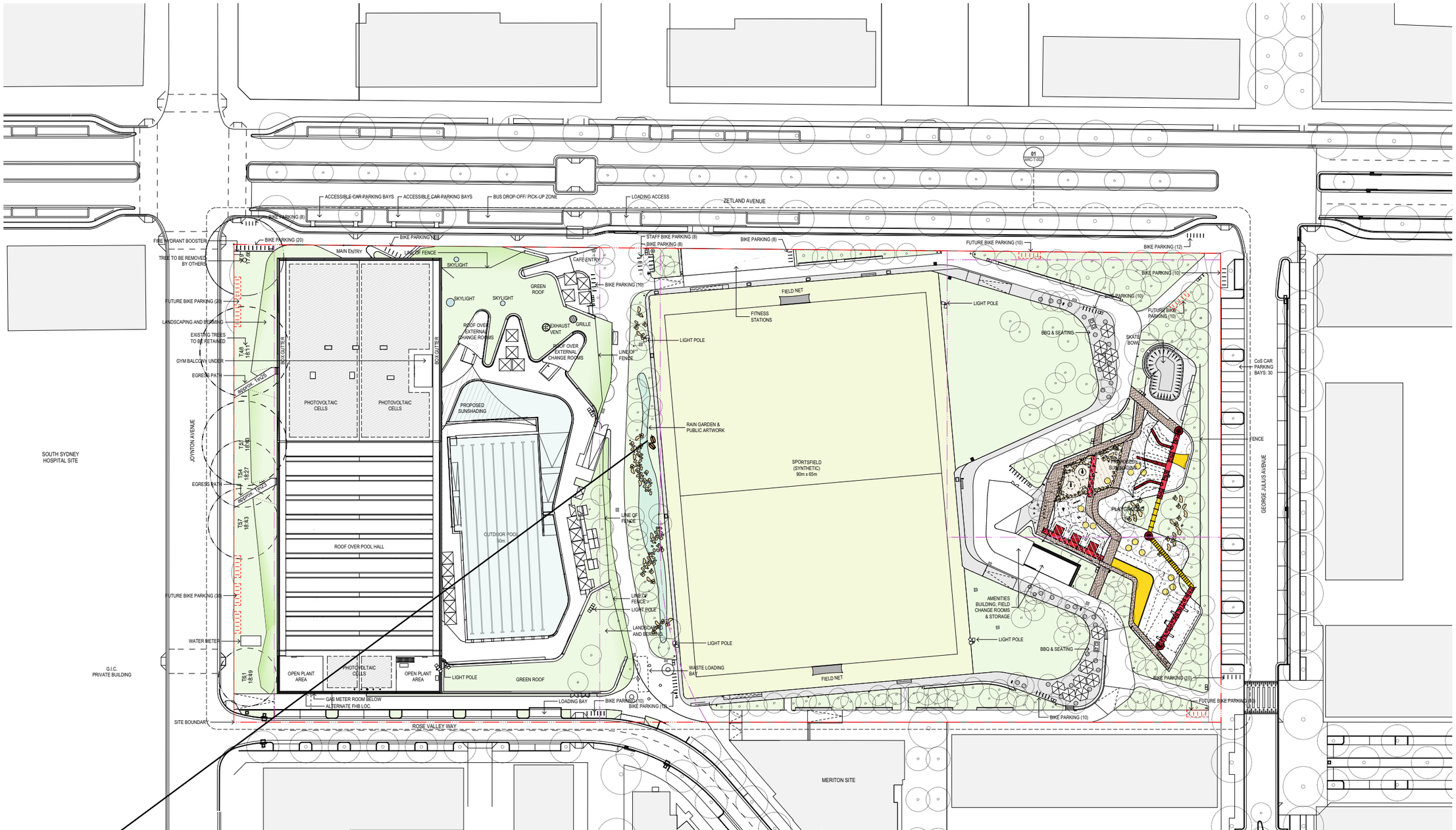


03



02

2.4 LOCATION ON SITE PLAN



BANGALA SCULPTURES
IN RIPARIAN LANDSCAPE
AND RAIN GARDEN SETTING
ALONG THE OVERLAND FLOW PATH



Gunyama Park Aquatic and Recreation Centre Transport Assessment

Client //	City of Sydney
Office //	NSW
Reference //	15S1006100
Date //	09/06/16

Gunyama Park Aquatic and Recreation Centre

Transport Assessment

Issue: B 09/06/16

Client: City of Sydney
Reference: 15S1006100
GTA Consultants Office: NSW

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	07/06/16	Final	Darnell Cordova, Rhys Hazell	Rhys Hazell	Brett Maynard	Brett Maynard
B	09/06/16	Final – Modified area schedules	Darnell Cordova, Rhys Hazell	Rhys Hazell	Brett Maynard	

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1. Introduction

1.1 Background

City of Sydney is finalising the design for a proposal to redevelop land located at 132-140 Joynton Avenue, Zetland in to a new aquatic leisure centre and park (Project Number – C16113). The site, to be known as Gunyama Park Aquatic and Recreation Centre (GPARC) is located within the Epsom Park Precinct in Zetland which forms part of the broader Green Square development area.

This Transport Assessment has been completed for Andrew Burges Architects (ABA) and Grimshaw Architects, on behalf of City of Sydney.

The key GPARC facilities include the following:

- 50m heated outdoor pool and leisure pool
- 25m indoor program pool
- indoor leisure pool
- hydrotherapy pool
- crèche
- café
- health and fitness centre and outdoor fitness station
- outdoor synthetic multipurpose sports field
- outdoor playground with skate facilities
- park boardwalk, terraces and seating
- native planting and landscaping.

1.2 Purpose of this Report

This report sets out an assessment of the anticipated transport implications of the facility, including consideration of the following:

i existing pedestrian and bicycle facilities within the vicinity of the subject site
ii existing public transport facilities and services within the vicinity of the subject site
iii existing on-street parking conditions
iv existing traffic conditions surrounding the site (referencing previous traffic modelling studies)
v pedestrian and bicycle requirements
vi suitability of pedestrian and cyclist facilities
vii suitability of the proposed site access arrangements
viii suitability of the proposed parking arrangements
ix service vehicle requirements
x the transport impact of the proposal on the surrounding road network (referencing previous studies).

1.3 References

In preparing this report, reference has been made to the following:

- inspections of the site and its surrounds
- City of Sydney Development Control Plan (DCP) 2012
- City of Sydney Local Environmental Plan (LEP) 2012
- Green Square Urban Renewal Area Transport Management and Accessibility Plan (TMAP), 2012 Update Volume 2: Main Report, Parsons Brinckerhoff
- Green Square Town Centre – Essential Infrastructure and Public Doman, 2031 Traffic Modelling Synopsis, AECOM, July 2014
- Green Square Town Centre Parking and Traffic Study, Bitzios Consulting, January 2012
- Gunyama Park and Green Square Aquatic Centre Access Assessment Report Preliminary Design, BCA Logic, June 2015
- GPARC Population Study Input, @leisure, July 2015
- Transport Report for Green Square Town Centre Essential Infrastructure, Colston Budd Hunt & Kafes, July 2012
- Traffic and Car Parking Advice prepared by GTA Consultants, dated 20 December 2012
- Newcastle Regional Aquatic & Leisure Centre (Lambton) Site Feasibility & Masterplan
- Warringah Aquatic Centre – Site Development Strategy prepared by Strategic Leisure Group, March 2013
- Australian Standard/ New Zealand Standard, Parking Facilities, Part 1: Off-Street Car Parking AS/NZS 2890.1:2004
- Australian Standard, Parking Facilities, Part 2: Off-Street Commercial Vehicle Facilities AS 2890.2:2002
- Australian Standard / New Zealand Standard, Parking Facilities, Part 6: Off-Street Parking for People with Disabilities AS/NZS 2890.6:2009
- 100% Design Development drawings prepared by ABA+G.
- other documents and data as referenced in this report.

2. Traffic and Transport Context

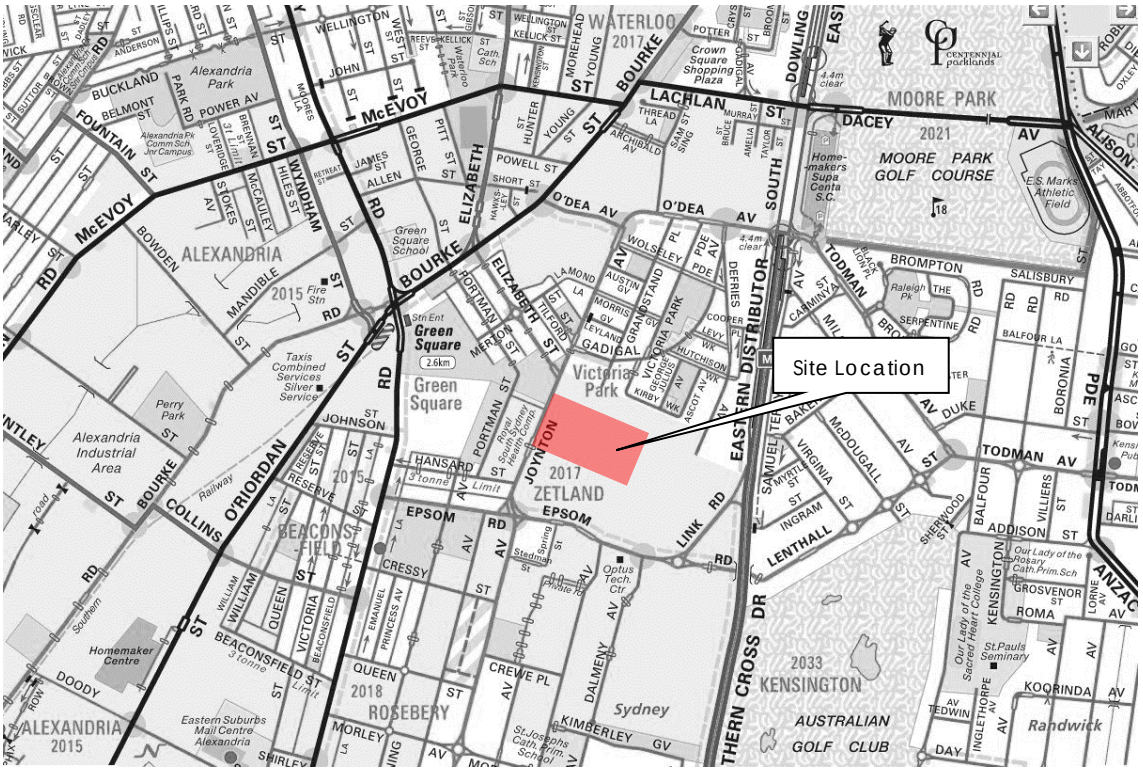
2.1 Existing Conditions

The site is located at 132-140 Joynton Avenue, Zetland and currently has a single street frontage of 155m to Joynton Avenue along its western boundary. The site currently has a land use classification of B4 Mixed Use and has largely been cleared of permanent structure. Temporary buildings and worker parking associated with the Green Square Stormwater Drain Project is currently occupying the majority of the site area.

The surrounding properties currently include a mix of industrial and commercial land uses with an increasing amount of medium and high density residential properties. The area is subject to several precinct studies with the onset of residential and mixed use developments being implemented in accordance with the Green Square development area.

The location of the site and its surrounding environs is shown in Figure 2.1 with the Epsom Park Precinct illustrated in Figure 2.2.

Figure 2.1: Subject Site and Its Environs



Basemap source: Sydway

Figure 2.2: Epsom Park Precinct Public Domain



Source: Epsom Park Precinct Public Domain Concept Design, City of Sydney, Rev. A, 23.10.15

2.2 Precedent and Benchmarking Study

Several transport related studies have been completed for the immediate area and several surrounding precincts, as detailed in Table 2.1. Select studies are particularly relevant to the transport related objectives of Gunyama Park Aquatic and Recreation Centre (GPARC), specifically those that assess future traffic implications, regional and local level road upgrade needs together with provision for future public transport services.

Table 2.1: Transport Related Studies

Document	Author	Date/Year	Traffic Surveys	Traffic Generation	Purpose
Green Square Town Centre (GSTC) Parking and Traffic Study	Bitzios Consulting	January 2012	Yes	Yes	Parking and traffic study of the GSTC and appropriate measures to address increase in traffic volumes.
Epsom Park Precinct Traffic Generation Study	City of Sydney	2014	No	Yes	Compare existing and future traffic generation of the site and determine future traffic impacts.
Population Study Input	@leisure Planners	July 2015	No	No	Estimate and model the population of activity areas within the GPARC precinct.
Green Square Town Centre – Essential Infrastructure and Public Domain – 2031 Traffic Modelling Synopsis	AECOM	July 2014	No	Yes	Determine the future traffic impacts of the GSTC development in surrounding road networks
Gunyama Park and Green Square Aquatic Centre Access Assessment Report – Preliminary Design	BCA Logic	May 2016	No	No	Assess and comment on the relevant access requirements for persons with a disability and identify any issues relating to non-compliance.
Transport Report for Green Square Town Centre Essential Infrastructure	Colston Budd Hunt & Kafes	July 2012	No	Yes	Traffic and parking implications of the essential road infrastructure works for the Green Square Town Centre to support the development application

2.3 Transport Context

GPARC is located within the Epsom Park Precinct in Zetland which forms part of the broader Green Square development area. The site is planned to be highly accessible by walking, cycling and public transport services with limited car parking, which is generally in accordance with the City of Sydney's Green Square development objectives. Future surrounding land uses will predominantly consist of high density residential with ground floor retail/ commercial uses, with Green Square Town Centre (GSTC) located to the west, which will further support reduced reliance on private vehicle transport.

The site is located approximately 950m (or 12 minute) walk from Green Square Railway Station with high frequency bus services currently provided along Joynton Avenue that link the local area with the CBD and beyond. Planned sustainable transportation in the area includes the Eastern Transit Corridor (ETC), a high capacity transport corridor which will initially be serviced by buses and eventually light rail, to connect Green Square with Sydney CBD. This corridor is planned to make use of Zetland Avenue along the site's northern boundary.

A network of dedicated pedestrian routes are proposed, which will in-turn connect with the broader area and recognises the site's importance as a pedestrian destination and asset for local residents. The proposed cycling routes will also link the site with the surrounding established network and those planned as part of the broader Green Square development area. These facilities address the objectives of City of Sydney's Cycling Strategy and Action Plan.

Sustainable Sydney 2030

When planning for the future transport requirements of key public facilities, it is appropriate to reference the transport objectives of Sustainable Sydney 2030.

The development of bold and decisive transport options is key to building on Sydney's global city status and facilitating the anticipated significant growth in population and employment between 2006 and 2036, while also realising the negative impacts of bus, traffic and pedestrian congestion on the City. Providing people with faster and more efficient transport options has proven to be the most effective way to combat congestion, whether it be via heavy rail expansion, provision of light rail, expanded dedicated bus lanes, safe cycleways and walking routes.

Green Square is one of two key development areas (the other being Barangaroo), with the need to ensure a high level of connectivity by a range of transport modes considered of prime importance. The City has been working with both State and Federal Governments to protect a corridor to ensure the medium-term delivery of light rail to better link the area with the City, in combination with improved cycling and cross-regional bus networks. The light rail corridor would use Zetland Avenue along the GPARC northern boundary, noting that implementation would remove on-street parking currently accommodated within the central median.

The key transport related actions relevant to Green Square include the following:

- encouraging active transport
- integrating transport and land use
- managing street, parking and vehicles
- enhancing public transport.

2.4 Existing Travel Modes

The Census *Journey to Work* (JTW) data 2011 is regarded as the most robust picture of existing travel patterns to/ from Green Square. The smallest geographical area for which JTW data is available is a Travel Zone (TZ). JTW data was analysed for the broader Green Square catchment, to better understand the current travel patterns for people who live in the area.

The analysed Green Square catchment is shown in Figure 2.3.

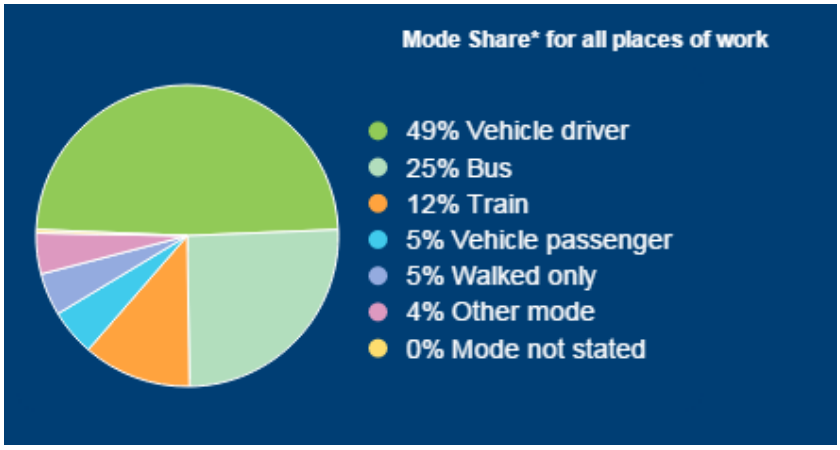
Figure 2.3: 2011 Census Data Journey to Work Data (TZ 280 and TZ 278)



Basemap Source: Bureau of Transport Statistics

The 2011 JTW data indicates that 1,832 people lived in the Green Square region located immediately north of the site. Of those travelling to work on a daily basis, 54% (906) commuted by car (as driver or passenger) and 37% (625) commuted via bus or train. These statistics are summarised in Figure 2.4.

Figure 2.4: 2011 JTW – Employed Residents Commuting from TZ 280 and TZ 278



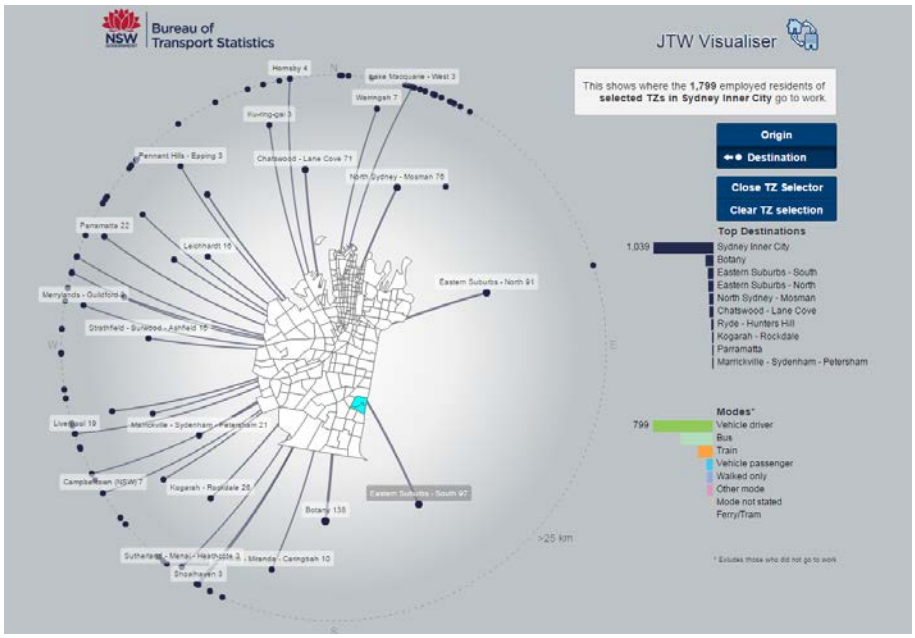
Basemap Source: Bureau of Transport Statistics

The JTW data also states the most common places of work for the 1,799 employed Green Square residents, with the primary destinations including:

- Sydney Inner City (57%)
- Botany (8%)
- Eastern Suburbs - South (5%)
- Eastern Suburbs - North (5%)
- Northern Sydney - Mosman (4%).

Figure 2.5 shows where the employed residents in the selected Travel Zones (see Figure 2.3) work. In total, 49% travel to work by car (as driver or passenger) with 35% using public transport (bus, train).

Figure 2.5: Place of Work for Employed Residents in selected Travel Zones, 2011



Basemap source: Bureau of Transport Statistics

It is also worth noting that of the 220 people who work in the selected Travel Zones, 79% either drive a car or are a passenger in a car, with 13% travelling by bus or train.

Given the age of the most recent census data (last census being 2011) it is anticipated that the mode shift to active travel modes (walking and cycling) and public transport would have increased and now be higher than the census data indicates. The subject site is well placed to support future growth of active and public transport modes, particularly with the anticipated high density residential growth and public transport improvements anticipated in the area over the next few years.

2.5 Existing Road Network

Joynton Avenue

Joynton Avenue is a collector road which has historically functioned as the main north-south link through the area. It is a two-way road which is predominantly configured with one traffic lane and one parking lane in each direction. Kerbside parking is generally permitted on both sides of the road with specific areas of no stopping.

Joynton Avenue carries approximately 24,000 vehicles per day in the vicinity of the site and currently serves as the primary north-south route through the local and regional areas.

Epsom Road

Epsom Road is a collector road aligned in a west-east direction and located south of the site. It is a two-way road with one traffic lane and one parking lane in each direction. Wide traffic lanes (approximately 4m) readily allow for heavy vehicle movements. Epsom Road links Botany Road

to the west with Lenthall Street to the east (under the M1) and further convenient connections with Todman Avenue and Anzac Parade further to the east.

Epsom Road carries approximately 12,000 vehicles per day in the vicinity of the site.

Hansard Street

Hansard Street is a local road that travels west from Joynton Avenue south of the site and connects with Botany Road further to the west. It is a two-way road with a mix of parallel and angled kerbside parking along both sides.

All the roads in the vicinity are subject to a 50km/h speed zone, except Hansard Street and Elizabeth Street (to the north-west) which are subject to 40km/h limits. The site is well located with respect to the surrounding local and arterial roads providing convenient local and regional access. Traffic distribution would be direct and uncomplicated with minimal incentive for use of lower order roads.

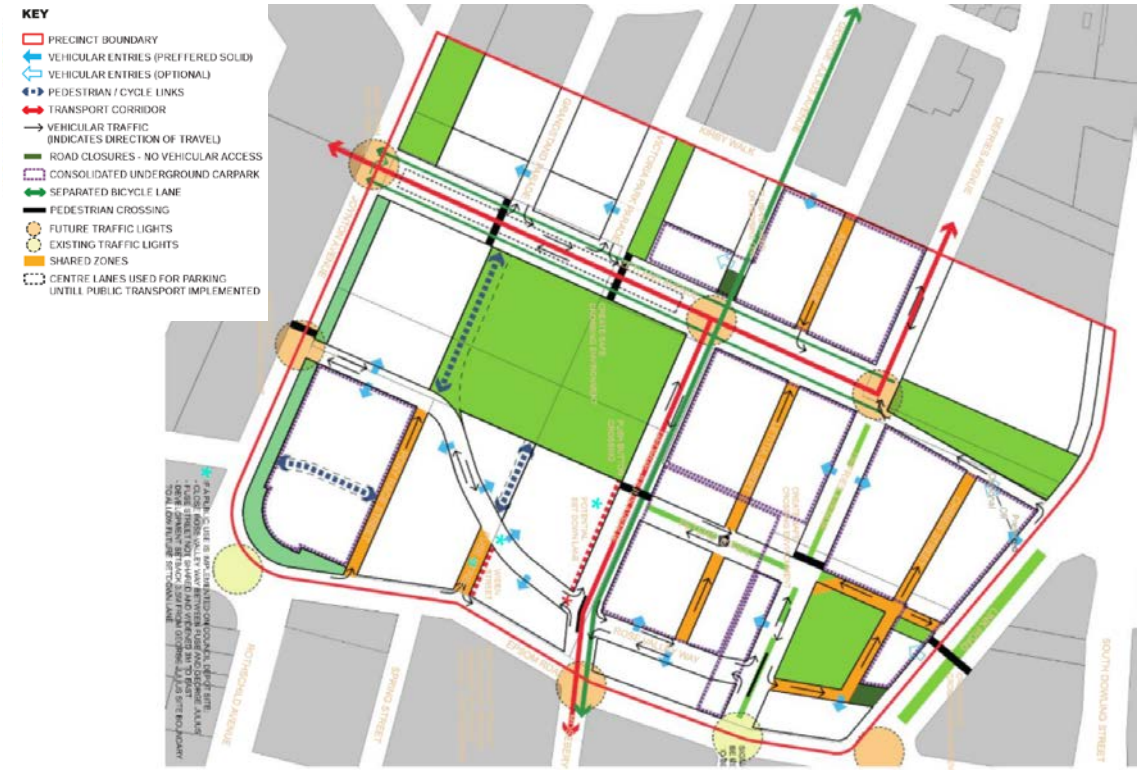
2.5.1 Surrounding Intersections

The following intersections currently exist in the vicinity of the site:

- Joynton Avenue/ Epsom Road/ Rothschild Avenue (signalised)
- Joynton Avenue/ Hansard Street (priority controlled)
- Joynton Avenue/ Elizabeth Street (priority controlled).

Given the planned modifications to the road network associated with the Green Square development area, the existing road network is somewhat unrepresentative of future conditions. With this in mind, Figure 2.6 intends to illustrate the key roads in the immediate vicinity of GPARC with the key traffic routes, future intersections and turning locations evident.

Figure 2.6: Epsom Park Precinct Access and Circulation



Source: City of Sydney, Public Domain Urban Framework, Epsom Precinct – Access and Circulation, 08.04.15, Rev. D

Based on the above, the future key precinct intersections will include:

- Joynton Avenue/ Zetland Avenue (signalised)
- Zetland Avenue/ George Julius Avenue(signalised)
- Joynton Avenue/ Rose Valley Way (priority controlled)
- George Julius Avenue/ Rose Valley Way (priority controlled).
- Epsom Road/ George Julius Avenue (signalised)
- Epsom Road/ Joynton Avenue.

2.6 Traffic Volumes

Existing traffic volumes for the adjacent Green Square Town Centre development area are contained in the *Green Square Town Centre Parking and Traffic Study* prepared by Bitzios (2013).

City of Sydney also completed turning movement counts at all site access locations along Joynton Avenue, Epsom Road and Link Road in June 2014 as part of the *Epsom Park Precinct Traffic Generation Study*.

The results concluded that the site (Epsom Park Precinct) generated a total of 585 vehicle movements during the weekday AM peak hour, 452 during the weekday PM and 276 on a Saturday.

2.7 Future Road Network

Zetland Avenue

Zetland Avenue is planned to provide the main west-east link through the Epsom Park Precinct and along the northern boundary of GPARC. It is also proposed to serve as the key public transport corridor with future light rail also planned over the medium term. A light rail stop is also proposed east of GPARC and east of the intersection with George Julius Avenue. It will also serve as a bus corridor and links well with GSTC further to the west (and Green Square Railway Station).

Parallel parking is proposed along both sides of the road and within the central median until a time when the light rail will occupy the central median.

It is understood that full construction of Zetland Avenue will not be complete at the time of GPARC opening with planning for this to include turnaround facilities.

George Julius Avenue

George Julius Avenue will provide a key north-south link along the eastern boundary of Gunyama Park. It will be a key future traffic route through Epsom Park Precinct linking Epsom Road with Zetland Avenue and Defries Avenue further to the north.

90-degree parking is proposed along the western side and parallel parking along the eastern side adjacent to Gunyama Park. The key intersections along the length of George Julius Avenue will be signalised on account of the anticipated future traffic volumes.

Rose Valley Way

Rose Valley Way travels along the southern boundary of the Aquatic Centre and deviates further south around future mixed use development along the southern alignment of Gunyama Park. When complete, it will link Joynton Avenue in the west with George Julius Avenue in the east at priority controlled intersections. It will also serve as a key access road to surrounding residential developments.

Full construction of Rose Valley Way will not be completed prior to the opening of GPARC. In the interim, the Rose Valley Way footpath south of GPARC will be used as a shared zone, with dedicated service vehicles access also permitted.

2.8 Traffic Assessment

A series of modelling assessments have been completed as part of the planning for GSTC and the Epsom Park Precinct. With this in mind, the following assessment highlights the outcomes of the base Paramics modelling as it relates to specific locations key to GPARC and other assessments/ assumptions etc:

- The Bitzios report determined that the intersection of Joynton Avenue/ Epsom Road operates at Level of Service (LoS) A/B in the weekday AM peak and LoS F in the weekday PM peak.
- The AECOM report completed future 2031 modelling with the intersection of Zetland Avenue/ Joynton Avenue expected to operate at LoS D in the weekday AM peak and LoS C in the PM peak. Overall, the report concluded that the GSTC road network will likely be at capacity in future years due to the development of the GSTC, Epsom Park Precinct and other precincts. However, revised model inputs and amendments to traffic signal phasing as a result of RMS consultation resulted in agreed and acceptable intersection operation.
- The City of Sydney report included turning movement counts in June 2014 for all site accesses along the site frontage streets. The existing peak period was found to be between 6.30am and 9.30am and 3:00pm and 6:00pm weekdays and 12:00pm to 1:00pm on Saturdays. The existing site generates 585 vehicles in the AM peak, 452 vehicles in the PM peak and 276 vehicles on Saturdays.
- The City of Sydney report also concluded that GPARC would generate low traffic volumes; 15 vehicle trips in the AM peak and 30 vehicle trips in the PM peak.

2.9 Existing Parking Review

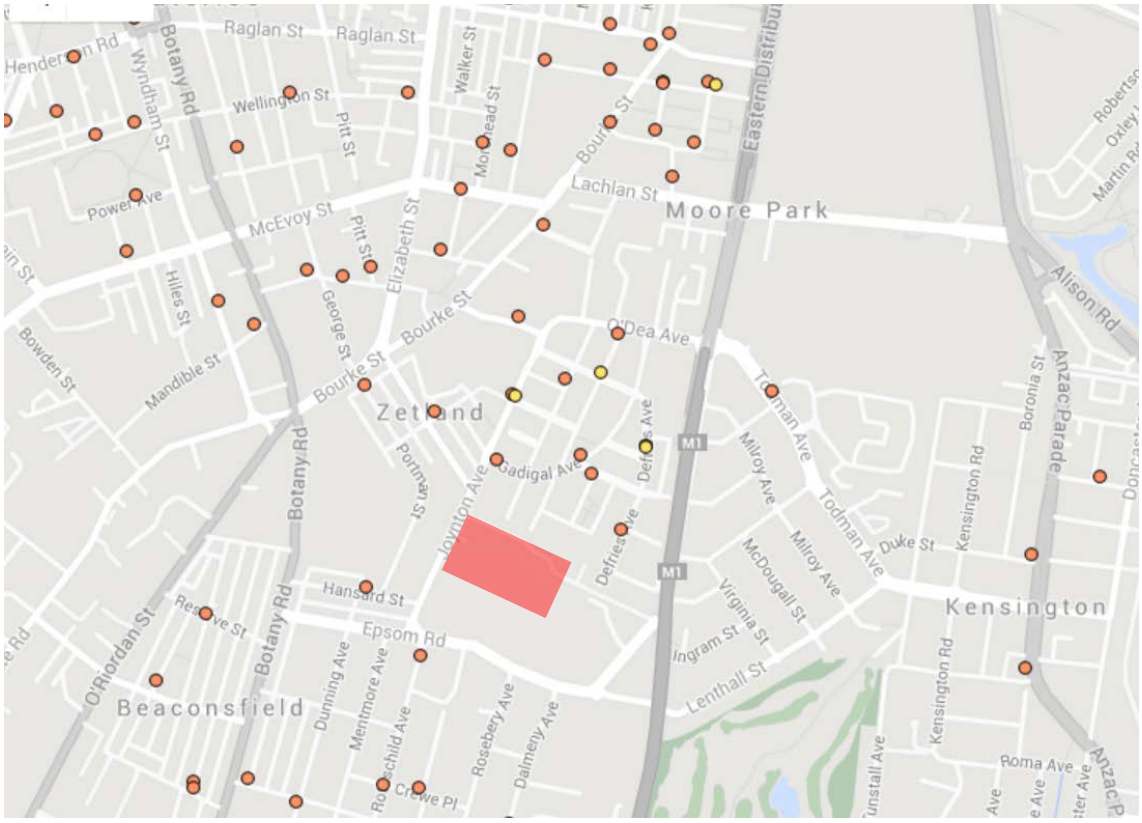
An existing signage plan has been prepared for Joynton Avenue, Hansard Street, Chester Lane, Elizabeth Street and Grandstand Parade and is included as Appendix B. The total existing on-street car parking supply for this study area is 138 spaces with a real mix of restricted parking (1P through to 4P) and unrestricted parking.

2.10 Local Car Sharing Initiatives

The site is already well located to car share facilities with several GoGet spaces located within a short walking distance. Those within the vicinity of the area are illustrated in Figure 2.7.

The redevelopment of the Green Square area will obviously bring about significant change to the level of car share spaces available both on-street and, increasingly likely, within the various residential developments surrounding GPARC.

Figure 2.7: Car Share Locations



Source: http://www.cityofsydney.nsw.gov.au/live/residents/car-sharing (accessed May 2016)

The above shows that the site is readily accessible with several currently available car share spaces located within the vicinity.

3. Development Proposal

3.1 Project Overview

The key facilities of the GPARC project will incorporate the following:

- 50m heated outdoor pool and leisure pool
- 25m indoor program pool
- indoor leisure pool
- hydrotherapy pool
- crèche
- café
- health and fitness centre and outdoor fitness station
- outdoor synthetic multipurpose sports field
- outdoor playground with skate facilities
- park boardwalk, terraces and seating
- native planting and landscaping.

The GPARC site will not incorporate off-street parking given the level of existing and planned future accessibility via public transport, walking and cycling, as well as its proximity to future high density residential living. This approach will be supported by a Green Travel Plan and an ongoing monitoring program and is in accordance with City of Sydney's Green Square development objectives.

Parking demand will also be facilitated by provision of on-street parking and associated management (e.g. 'park and swim') in the vicinity, including 30 angled spaces along the western alignment of George Julius Avenue fronting Gunyama Park.

Aquatic Centre

The Accommodation Schedule indicates the aquatic centre will have a total floor area of 7,107 sq.m internal area and 2,409 sq.m external area, comprised of the following facilities:

- Front of House – 978 sq.m (internal), 158 sq.m (external)
- Administration – 175 sq.m (internal), 6 sq.m (external)
- Aquatic Centre – 3,691 sq.m (internal), 2,285 sq.m (external)
- Health and Fitness Centre – 1,479 sq.m (internal)
- Back of House – 667 sq.m (internal).

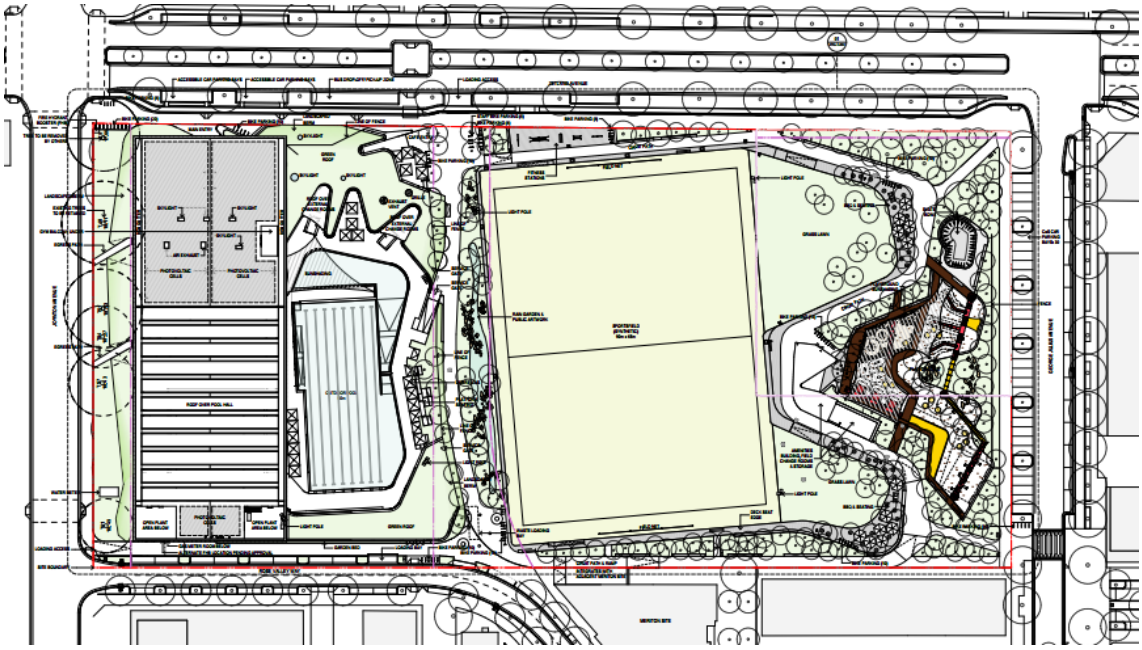
Park/ Sports Field

The Park and Public Domain Accommodation Schedule indicates the park and sports field area will have total floor areas as follows:

- Multi-purpose Field – 5,850-7,400 (external)
- Playspace – 1,500 sq.m (external)
- Park Amenities – 112 sq.m.

An extract of the site layout plan is shown in Figure 3.1.

Figure 3.1: Site Plan



Source: Site Plan, ABA Grimshaw, ARC-DA-011, Rev. A, 25/05/16

3.2 Schedule of Areas

Table 3.1 summarises the subject site facilities and sizes.

Table 3.1: GPARC Schedule of Areas

Facility	Use	Size
Aquatic Centre		
Entry/ Reception	Office	44sq.m plus part of foyer
Cafe/ Kiosk	Food and Drink premises	306sq.m [1]
Crèche	Child care centre	128sq.m
Management Offices/ Meeting Rooms	Office	174sq.m
Leisure Water Area	Pool	510sq.m (indoor)
25m Program Pool	Pool	540sq.m (8 lanes)
50m Outdoor Pool	Pool	1,150sq.m (8 lanes)
Stadium seating	Place of Assembly	110sq.m (allow 100-200 seats)
Hydrotherapy (pool)	Health consulting rooms and medical centre	366sq.m (1 program room)
Weights, Cardio, Spin Room	Gym	1,478sq.m
Back of House Plant Rooms, Garbage Room	Ancillary Uses	667sq.m
Gunyama Park		
Multi-purpose sports facility and park area	Recreation	5,850 sq.m (65m x 90m field) + park area

[1] Number of seats not specified

[2] Floor area based on ABA + Grimshaw plan (Rev D, 31/05/16)

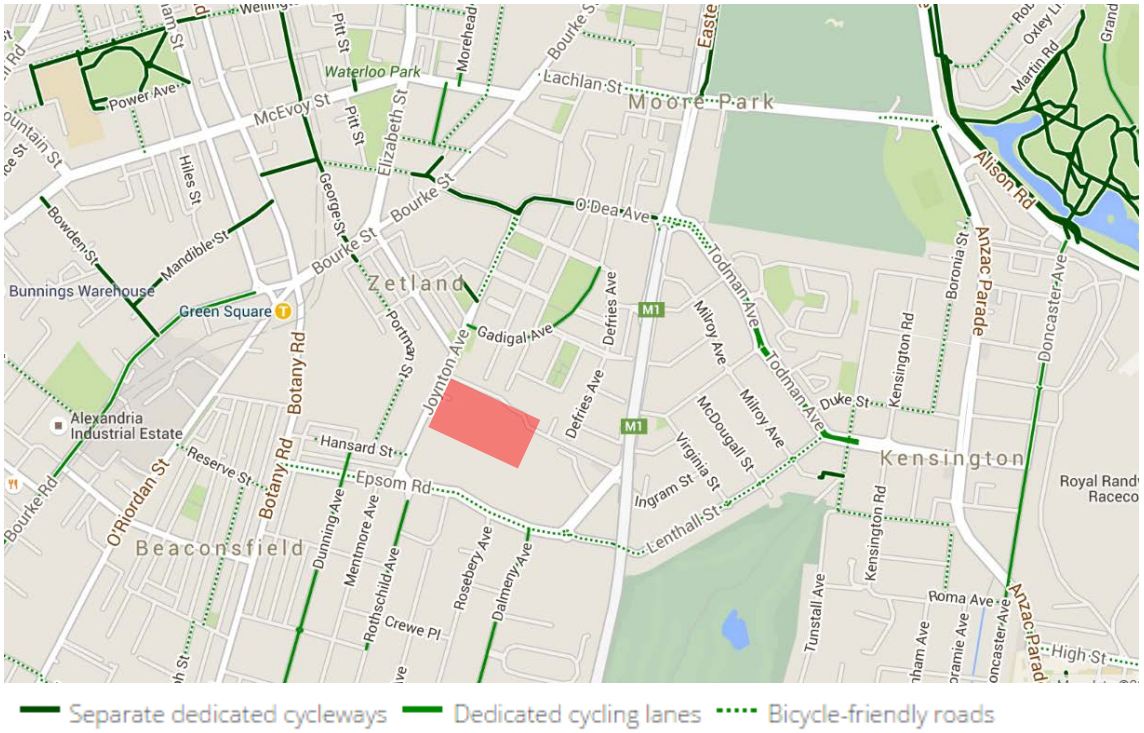
4. Sustainable Transport Infrastructure

4.1 Existing Walking and Cycling Facilities

The streets surrounding the subject site all have some footpath provision, generally with sealed footpaths provided on both sides of the carriageway. These footpaths provide a relatively connected pedestrian network within the local area surrounding the subject site. Signalised intersections in the vicinity of the subject site provide pedestrian crossing facilities. With future development near the subject site it is understood walking routes and crossing opportunities will be improved and strengthened as part of the surrounding development.

No on street bicycle facilities currently exist on the roads immediately adjacent the subject site, although there are several on street bicycle lanes providing some connectivity to the south, including Dunning Avenue and Dalmeny Avenue. Figure 4.1 shows the existing cycling infrastructure within the vicinity of the subject site. With future development in the surrounding area it is anticipated cycling facilities will be upgraded with connectivity strengthened to support reduced car use in the area.

Figure 4.1: Existing Cycling Infrastructure



Source: http://www.sydneycycleways.net/map/ (accessed May 2016)

Furthermore children under the age of 12 (and accompanying adult) can cycle on the footpath (unless otherwise signed) in NSW. The existing footpaths within the vicinity of the site are currently able to be used by children cycling to/ from GPARC and within the local area.

4.2 Bicycle End of Trip Facilities

Bicycle end of trip facilities will include the following:

- bicycle parking for general public and for private (staff) users
- bicycle repair stations
- end-of-trip facilities including showers and lockers for both public and private (staff) users
- convenient, well-lit pedestrian links.

When planning sustainable transport options careful consideration needs to be given to factors that may affect the level of use. For example, the implicit provision for walkers and cyclists include:

- security and safety
- visibility
- shelter
- convenience
- signage.

The site plans show extensive bicycle parking within and around GPARC as part of the development. The facilities are understood to be inverted U-loops which are appropriate for short term use consistent with recreational land uses. Of the total 130 bicycle racks, 64 (49%) are located in good proximity to the Aquatic Centre front entrance. The remainder are evenly spread around Gunyama Park. In addition, 8 dedicated staff bicycle racks are conveniently located close to the front entrance to ensure their needs are also catered for.

Future provision has also been made for an additional 70 bicycle racks, with 40 (57%) of these located along the Joynton Avenue frontage and the remainder in the north-west corner, close to George Julius Avenue.

The provision will ensure viable sustainable transport modes are not only accommodated but able to be easily promoted, with convenience to play a significant role in ensuring new residents to the precinct move away from private vehicles as their primary mode of transport.

4.3 Future Walking and Cycling Network

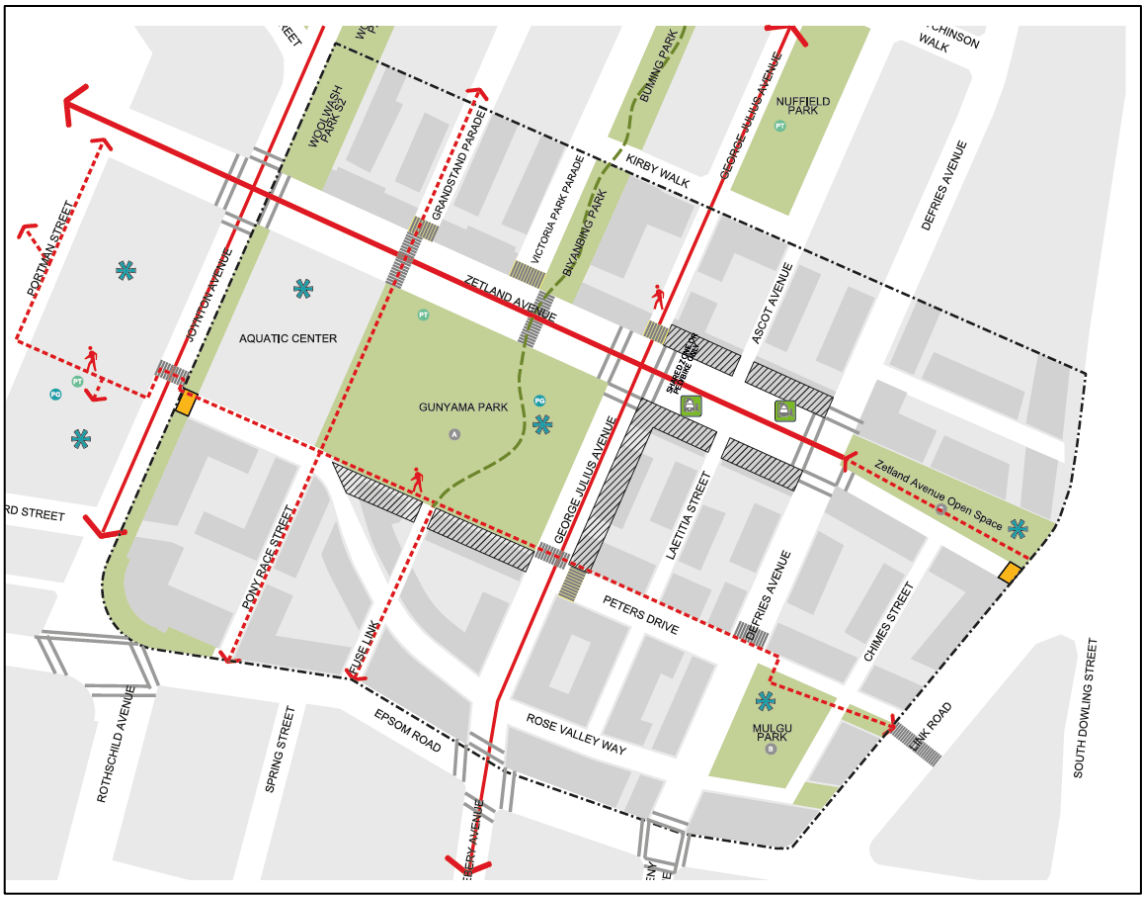
GPARC and the broader precinct is a brownfield site with the whole area currently undergoing extensive redevelopment. As part of that redevelopment pedestrian and cyclist facilities will be strengthened, which is essential to achieving the desired change in mode shift from private vehicle to more active modes of transport. This should support the localised high density residential catchment that will be developed over the next 10 to 15 years that should generally not need to drive within the local area to access a wide range of facilities.

Pedestrian paths will generally be provided along both sides of the road in the surrounding streets, connecting GPARC users with the broader Green Square development area. Primary pedestrian paths along Joynton Avenue and George Julius Avenue will connect to the Zetland Avenue main entrance. A dedicated path will also travel in a north-south direction between Aquatic Centre and Gunyama Park to ensure permeability throughout and to allow for overland flow requirements.

Pedestrian facilities, including marked pedestrian crossings will improve pedestrian safety in the area and allow pedestrians to easily move between and around the precinct, as illustrated by Figure 4.2.

The proposed shared paths discussed further below will also improve pedestrian access to the subject site and surrounding areas.

Figure 4.2: Public Spaces and Pedestrian Desire Lines



Source: City of Sydney Epsom Park Urban Framework Plans Rev D (April 2015)

Surrounding streets which facilitate recreational and leisure cycling include Dalmeny Avenue, Dunning Avenue, Bourke Road and Bourke Street. It is also understood that a cycle lane infrastructure is currently in the design stage for a high quality link between Green Square and Randwick which may be attractive to GPARC users. As the precinct continues to develop, appropriate cycling infrastructure should be accommodated.

Part of City of Sydney's Cycle Strategy and Action Plan 2007-2017 (2007) is to develop the Green Square area in to a fully permeable, safe environment for the residents, workers and visitors to move safely.

More recent new cycleways planned for Green Square Town Centre include:

- Zetland Avenue between Paul Street and Victoria Park Parade: 420m long separated one-way cycleway on each side of the road to connect GPARC with GSTC and community facilities.
- Geddes Avenue between Botany Road and Portman Street: 275m long separated bidirectional cycleway (construction to commence June 2016).
- Portman Street between Portman Lane and Hansard Street: 350m separated bidirectional cycleway.

Providing these cycling links will substantially improve bicycle access to the site from the existing routes and support the vision for increased cycling activity to the site while ensuring a high level of cyclist amenity.

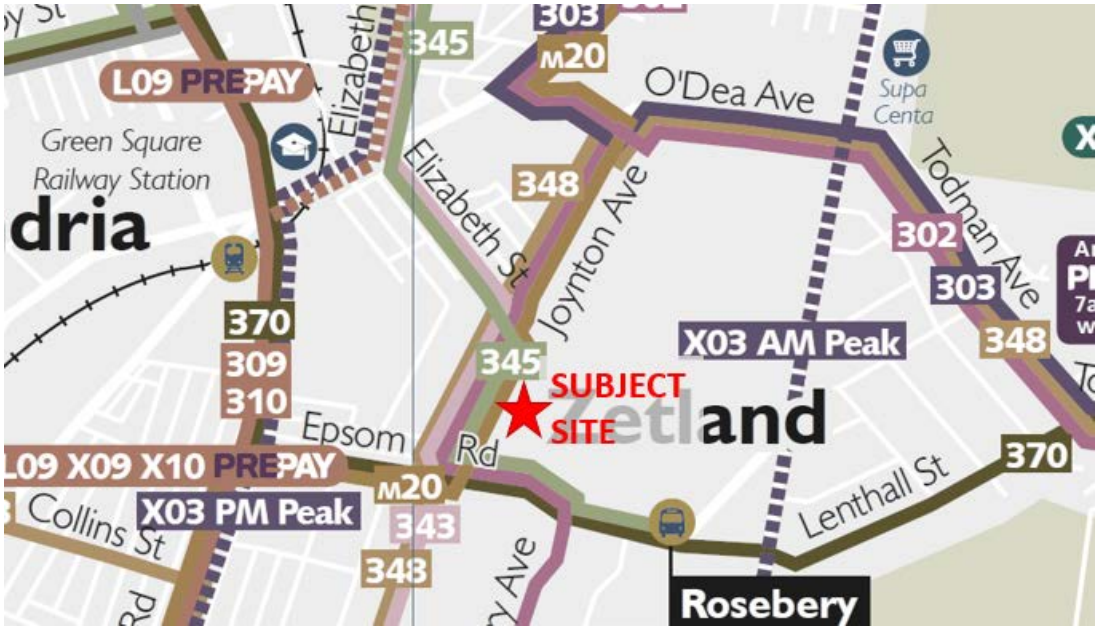
4.4 Public Transport

4.4.1 Buses

Existing Services

As illustrated in Figure 4.3, it is evident that there are several existing bus routes in close vicinity to the site, mostly travelling along Joynton Avenue immediately to the west, as well as Epsom Road to the south.

Figure 4.3: Existing Bus Services



Source: Sydney Buses region guide for eastern region (SMBSC 9), www.transportnsw.info

A bus stop for northbound buses is located opposite the site on Joynton Avenue with the southbound bus stop located approximately 120 metres to the south. These bus stops are serviced by the following bus routes:

- 301 Eastgardens - Sydney
- 343 Daceyville - Chatswood
- M20 Botany – Gore Hill
- 348 Wolli Creek - Bondi Junction.

The above routes combine to provide high frequency services at the Joynton Avenue bus stop, with the wait time between buses generally up to 5 minutes during the day and less during the peak hours.

The two Epsom Road bus stops are also each within approximately 300m of the site. Bus route 370 Coogee – Leichhardt is the key east-west route through the area and in combination, these stops generally have a 5 to 20-minute wait between buses throughout the day.

The frequency of each route is summarised Table 4.1.

Table 4.1: Existing Bus Routes

Bus Route	Headway Weekday	Operating Hours
301	<10 minutes (peak) 20-30 minutes (off peak)	06:13 – 23:28
343	5-10 minutes (peak) 10-20 minutes (off peak)	04:24 – 00:09
348	30 minute	06:18 – 19:42
M20	10 minutes (peak) 15 minutes (off peak)	06:38 – 20:21
370	10 minutes (peak) 20 minutes (off peak)	05:42 – 20:54

Source: Transport NSW

The services these bus routes provide and their regularity will allow for easy bus access to the site from initial opening and able to support the objectives of limited private vehicle travel.

To support the existing public transport routes, the walking routes to and from public transport services (i.e. bus stops and train stations) should be of good quality and provide for passive security through design, particularly on walking routes to public transport that would be in use at night (e.g. lighting).

Future Provision

In addition to the existing bus routes along Joynton Avenue and Epsom Road, there are proposed bus routes which will also service the GPARC site. It is understood from City of Sydney's Epsom Park Urban Framework Plan (Rev D) that short term potential bus routes will operate along Zetland Avenue as part of the Eastern Transit Corridor (ETC) initiatives. The bus services will provide links to the Green Square Town Centre, Transport Place and other key locations in the Green Square development area within the local context. From a broader perspective, the bus services will provide links to several key generators including Sydney CBD, Mascot and Bondi Junction.

Transport for NSW has outlined its intentions to provide two alternative bus routes travelling through the GSTC site. These bus services will provide links to areas including the CBD, Gore Hill, Mascot, Coogee, Leichhardt, Bondi Junction, Wolli Creek and the University of New South Wales (UNSW). Bus services will operate at a frequency of about one bus every 6 minutes during peak periods. With relation to the site, these buses will travel in a north-south direction along Joynton Avenue, directly west of the site.

4.4.2 Heavy Rail

The GPARC site is currently an approximate 950m (or 12 minute) walk from Green Square Railway Station. The T2 Airport Line provides a convenient link to Central Station and other CBD stations, as well as to the domestic and international airport terminals. Ongoing connections to all Sydney Trains and NSW TrainLink rail networks are achievable via Central station.

The Green Square Railway Station provides trains at a frequency of every 2 to 5 minutes across peak periods and during the day. Weekend services are also reasonably frequent, although there is some irregularity in service patterns with wait times varying between 2 and 15 minutes. The two directions of service operate at 5 to 10 minute headways and span 04:45am to 00:15am (following day). The regularity of train services at the Green Square Station will assist with convenient train access to the site and wider precinct, to support the objectives of limited private vehicle transport.

Notwithstanding, the current walking route to/ from Green Square Railway Station represents a detour which will be resolved as part of the ongoing Green Square/ Epsom Park development. When the Green Square Town Centre is developed, the direct pedestrian link will represent a travel distance saving of approximately 300m, and well within the broadly recognised 800m walking distance (approximate 10-minute walk) for access to a railway station.

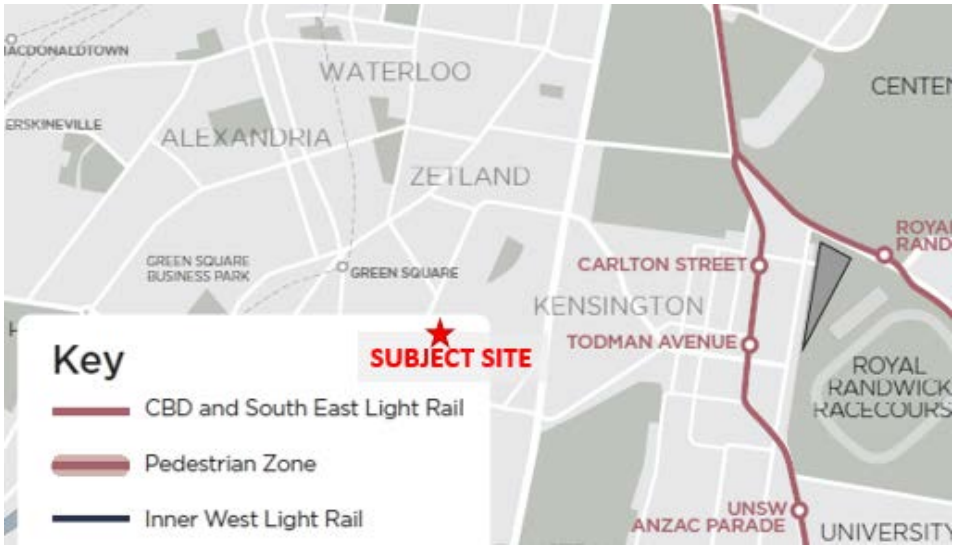
4.4.3 Light Rail

CBD and South East Light Rail

The proposed CBD South East light rail line (shown in Figure 4.4) will provide additional public transport options within the vicinity of the site. The proposed route and stop locations are shown in Figure 4.5.

The Todman Avenue stop is expected to provide the closest stop to the site, although it will be further from the site than the existing Green Square Railway Station.

Figure 4.4: CBD and South East Light Rail



Source: Transport for NSW CBD and South East Light Rail Route Map (December 2015)

Zetland Avenue

The ETC was previously proposed as a bus rapid transit system to operate along Zetland Avenue and connect the surrounding area to the Sydney CBD. Within the site's neighbourhood, the ETC was to connect GPARC to key destinations in the area such as Transport Place, Green Square Town Centre and various plazas. This has now been superseded by light rail proposals.

In Infrastructure Australia's latest plan, the light rail project to Green Square has been designated a high priority initiative with a probable timescale of 5-10 years. The City of Sydney is proposing an indicative Green Square Light Rail alignment as shown in Figure 4.5.

A future light rail stop is also being considered along Zetland Avenue in close proximity to the GPARC site.

Figure 4.5: Green Square Light Rail



Source: Infrastructure Australia

4.5 Green Travel Plan

A Green Travel Plan (GTP) and Transport Access Guide (TAG) is a package of measures aimed at promoting and encouraging sustainable travel and reducing reliance on the private car. The GTP is designed to support and promote active and sustainable alternatives instead of typical private car usage, that is, single occupancy or short distance trips. The GTP seeks to support mode shift to healthier, more active and sustainable travel.

A separate GPARC GTP has been prepared and indicates:

- measures which encourage reduced car use (disincentives or 'sticks')
- measures which encourage or support sustainable travel (also known as Active Transport), reduce the need to travel or make travelling more efficient (incentives or 'carrots').

The GTP promotes the use of transport, other than the private car, for choice of travel to and from GPARC, which is more sustainable and environmentally friendly. Ultimately however, visitors shall determine their most suitable means of transport.

The GTP will benefit from the walkable and bikeable precinct that is envisaged and the high level of public transport accessibility intended to be readily available to and from the precinct. The GTP will:

- advise the wider travel choices to staff and visitors
- help staff/ visitors identify transport means which will result in them being healthier, fitter and more productive
- aim to reduce congestion and provide easily identifiable transport means, improving relations with neighbours and enabling deliveries and essential journeys to move more freely.

Encouraging staff to use public transport could also incorporate elements such as transit pass subsidy to discourage staff from driving to and from the centre.

5. Car Parking

5.1 Proposed Development

The GPARC site will not be providing any dedicated on-site parking for general visitor use.

While the excessive costs of basement car parking located beneath a complex pool structure contributed to this decision, there is a prevailing desire to remain consistent with the broader precinct planning intent and limit the use of private vehicles by provision of both active and sustainable transport modes, together with implementation of a range of incentive programs.

The provision of no parking is generally intended to reduce the incentive to travel by car, and the future growth of the local area will increase the local population catchment significantly, allowing more patrons to walk or cycle to GPARC.

As such, any patrons who chose to drive to the centre will be required to park on-street in the surrounding local street network, which will largely be time restricted parking (e.g. 2P). Parking demand will be addressed through a parking management scheme, including appropriate priced meter/ ticket parking and discounts/ reimbursement for aquatic centre users, and a Green Travel Plan. An additional 30 parking spaces would also be provided along George Julius Avenue.

5.2 Other Facilities

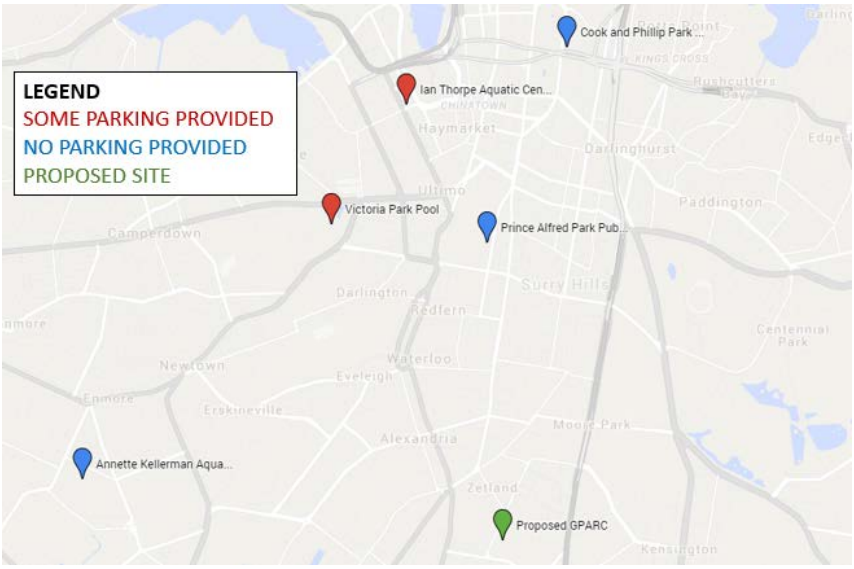
GTA has considered similar facilities for their empirical car parking impact to consider the potential impact of parking on street, and the appropriateness of providing no on-site parking.

There are several aquatic facilities located within Sydney that do not include off street vehicle parking provision, including:

- Annette Kellerman Aquatic Centre
- Prince Alfred Park Pool
- Cook and Philip Park Aquatic and Fitness Centre (Domain car park opposite).

The above facilities are shown on Figure 5.1, along with other nearby pool facilities for which some information on parking is available. This map shows that the Annette Kellerman Aquatic Centre is of comparative location (proximity to the CBD and other nearby pools) to the subject site.

Figure 5.1: Existing Pools within Vicinity of the Site



It is understood Victoria Park Pool provides 'limited' free 2-hour parking, although the exact quantity is not known. Ian Thorpe Aquatic Centre is understood to provide 99 on-site car parking spaces.

Discussions with Belgravia Leisure provided GTA with a general understanding of pool patronage numbers and operation. In regard to the existing Annette Kellerman Aquatic Centre, the following was noted:

- The Aquatic Centre is permitted to have 650 patrons on the premises at any one time.
- Patronage limits are determined from the volume capacity of the pools, with the Royal Life Saving Society providing standards/ guidance.
- During school aged children swimming lessons there could be up to 10 instructors in charge of 5 pupils each.
- Peak periods generally occur in the early weekday evenings (after school) and on weekends.
- No on-site car parking is provided.

5.3 Empirical Car Parking Assessment

Outputs from the GPARC Population Study commissioned by City of Sydney were used to develop parking estimates for the proposed development. As inputs and assumptions for this assessment, the following is noted:

- Existing journey-to-work mode split (ABS, 2011) for Victoria Park (immediately to the north of Epsom Park Precinct) is approximately 55% car driver and passenger, with more than 50% of local residents working within the City of Sydney LGA.
- The Green Square Transport Management and Accessibility Plan (TMAP) sets car-based mode share targets (work trips) for the broader Green Square area at 39% for residents and 58% for workers (combined target of 50%). This rises to 54% when accounting for both work and non-work trips, implying that greater car use is expected for non-work trips, which would include trips to GPARC (either as specific trips or linked trips).

- The TMAP targets represent a relatively significant mode shift from existing travel patterns, noting that additional public transport and active travel initiatives would support such a mode shift.
- Residents within 400-500m of GPARC could be expected to walk to the facility (when not visiting as part of a broader car-based linked trip). However, given that the above mode share percentages are an average for the local population, the likely mode share for patrons outside this immediate catchment would need to be recalculated should the overall catchment be broken up in this manner. There is insufficient data to estimate this with any reliability.
- Given that the GPARC resident catchment is approximately 138,000 people and the worker catchment is approximately 13,500 people, it is appropriate to adopt a residential mode split for assessing travel to the facility.
- GPARC patrons during the AM and PM peak periods would have a significant proportion of professionals travelling alone. As such a vehicle occupancy of 1.5 persons per car has been assumed.

On the above basis, a 39% car driver and passenger mode split has been adopted for assessing potential parking demand, noting that initial parking demand could be higher but offset by lower short-term patronage and alternative transport mode access prior to full occupation of surrounding developments and future development and enhancement of public transport, cycling and walking networks.

Table 5.1 has been prepared on the basis of PM peak time user numbers sourced from GPARC Population Study supplementary data and the assumptions of a 39% car-based mode share and an average vehicle occupancy of 1.5 persons. Two scenarios have been presented; direct use of the PM peak population estimates and a scaled estimate that is considered to be more reflective of typical weekday PM peak activity (particularly acknowledging that gym facilities would typically not operate at maximum capacity). The resultant estimate of a demand for 105 parking spaces is comparable with the weekday PM peak period estimate of 104 parking spaces in Table 5.1.

Table 5.1: PM Peak Period Parking Demand Estimates based on Population

Activity Area	Peak Time (1700-1900) Estimated Total Capacity*	GTA Typical PM Peak Patronage Estimate	PM Peak Maximum Parking Requirement	GTA Typical PM Peak Parking Requirement Estimate
Indoor Leisure Water	50	40	13	10
Outdoor Leisure Water	30	25	8	7
Indoor 25m Pool	64	64	17	17
Outdoor 50m Pool	120	120	31	31
Hydrotherapy Pool	24	15	6	4
Gym, cardio room, dry fitness studio	160	100	42	26
Spin room	30	20	8	5
Weights room	30	20	8	5
TOTAL	**508 pax***	**404 pax****	**132 spaces**	**105 spaces**

* Assumed to represent the likely maximum number of patrons using the facility at any one time (Source: @ Leisure Population Study Input, Supporting Document, 28/07/15).
** GTA typical PM peak period patronage estimate total of 404 patrons is comparable with 402 patrons identified for the 5-7pm period (based on @ Leisure Year 1 estimates) in the Green Square Aquatic Centre – User Projections (City Aquatics, 30/07/15).

The above indicates some 100-130 vehicles could attempt to park near the subject site based on this analysis. It is anticipated that this level of demand could be reflective of the operation of the site following initial opening.

With longer term local high density residential development and the wider public transport, walking and cycling network improvements the local catchment of the aquatic centre will increase and the parking demand would be expected to reduce.

5.4 Precinct Wide Parking Assessment

To consider the impacts of the potential car parking demand a precinct wide parking assessment has been conducted.

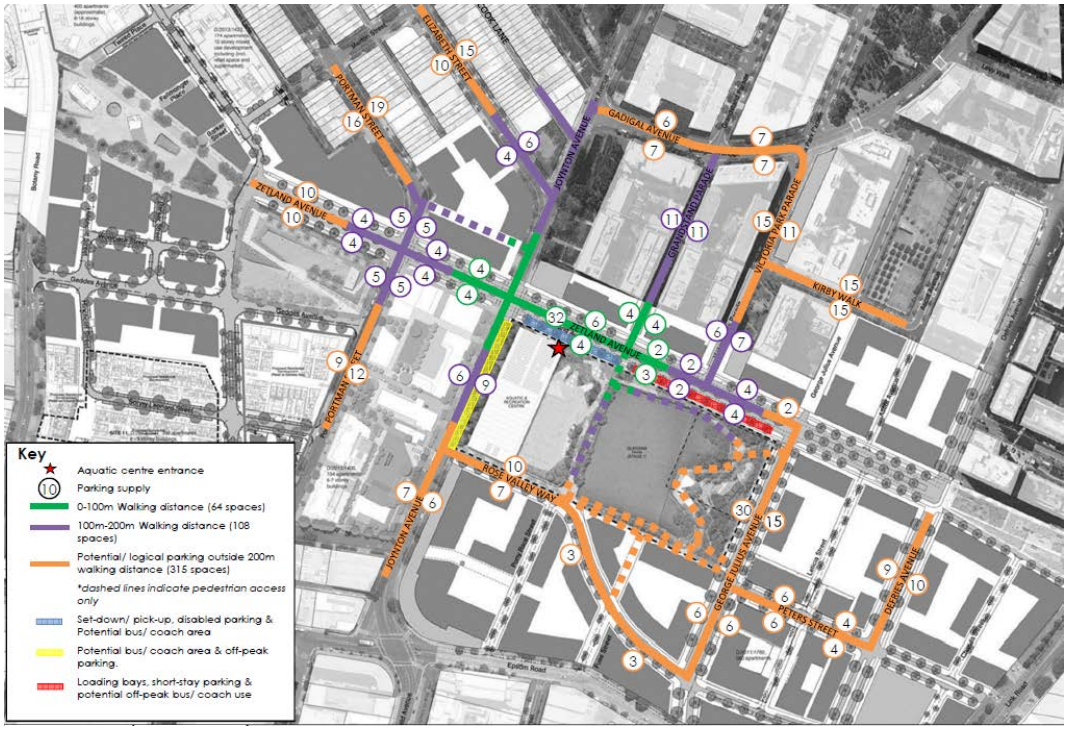
The future roads adjacent to GPARC, including Zetland Avenue, George Julius Avenue and Rose Valley Way would be able to support approximately 36 on-street non-dedicated car spaces along the site frontages as part of the Epsom Park Precinct public domain.

Following a detailed options assessment and analysis throughout, agreement has been reached to provide expanded on-street parking provision along the frontage streets. The assessment confirmed that the parking supply would be increased to approximately 50 spaces, mostly through the use of 90-degree parking along George Julius Avenue (noting the traffic and road safety impacts of such 90-degree parking, including setback requirements).

While it is recognised that the entire Epsom Park Precinct will include approximately 215 time restricted on-street non-dedicated parking spaces, demand and competition for such parking is anticipated to be high. This considers several factors though is mostly attributable to the surrounding likely future land uses (including anticipated ground floor retail and other parking demand generators) and proximity of available parking for the Aquatic Centre.

With this in mind, Figure 5.2 has been prepared to assess the theoretical supply of on-street parking that would be within a logical walking distance of the Aquatic Centre entrance. A larger version of this figure is included as Appendix C. The area of influence includes the Epsom Park Precinct, Green Square Town Centre and other local areas and assumes that there would be no other land uses generating parking demand in competition with GPARC.

Figure 5.2: Potential Future Parking Catchment Map



The following is a summary of key information from the potential future parking catchment map:

- There will be approximately 60 parking spaces available within 100m walking distance from the Aquatic Centre entrance.
- There will be approximately 105 parking spaces available between 100m-200m walking distance from the Aquatic Centre entrance.
- There is potential for approximately 315 spaces outside a 200m walk from the Aquatic Centre entrance for visitors to park.
- A set-down/ pick-up area and 4 accessible parking spaces will be provided along Zetland Avenue close to the Aquatic Centre entrance.

5.5 Adequacy of On Street Parking Supply

Based on the above, there would be between 150 and 175 on-street spaces within a 200m walk of the Aquatic Centre entrance that would theoretically be available for visitors to park. This increases to between 215 and 240 spaces within a 225m walk, and is variable depending on the time of day, extent of future planned Joynton Avenue clearways, bus/ coach areas and provision of set-down/ pick-up areas.

With the decision made to ultimately provide no on-site parking and thereby rely on the on-street parking within the surrounding precinct, a range of incentive programs and detailed implementation strategy will be key to the functionality of GPARC and the precinct generally.

Future land uses (including residential, retail, commercial and other parking demand generators) will likely create some competition for on-street parking, and will also increase the local catchment that can walk or cycle to GPARC and the potential for linked trips (e.g. parents dropping kids at lessons and then doing the shopping). The future development of the area will also strengthen existing walking and cycling connections, as well as public transport links.

Similar to the Annette Kellerman Aquatic Centre the proposed GPARC will advertise the train, bus, bicycle and walking routes to the site and facilities to the site instead of advertising parking. In the short term there will be some impact on nearby on street parking, but as the area develops into a higher density region the reliance on vehicular transport will shift to adopt more sustainable transport methods and the impact on the surrounding streets car parking due to the GPARC will reduce.

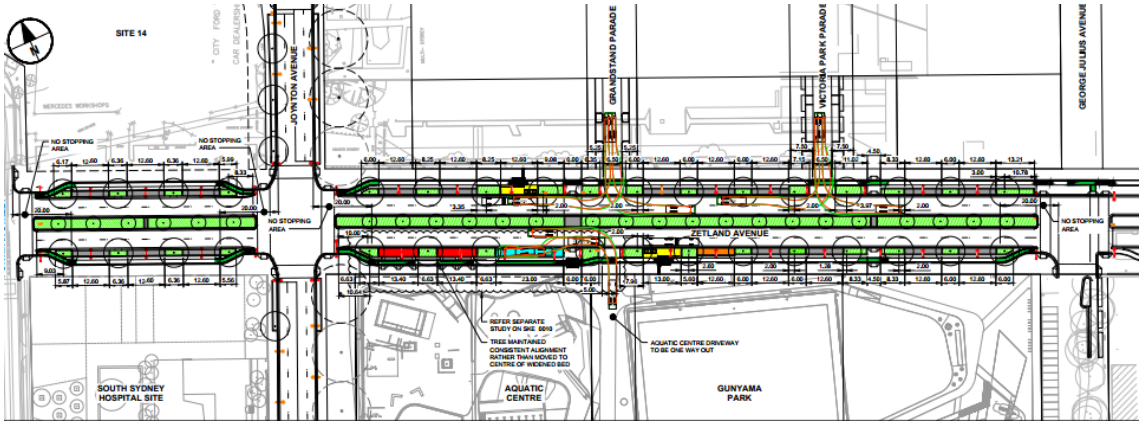
5.6 Other Considerations

The role of Zetland Avenue as the primary frontage street will be key to the way the site is accessed. With this in mind, the following provision will be made in close vicinity to the Aquatic Centre entrance:

- separated cycle path
- set-down/ pick-up area/ coach set-down
- in-lane bus stop
- accessible parking
- loading zone.

The Zetland Avenue layout is illustrated in Figure 5.3.

Figure 5.3: Zetland Avenue Proposed Layout



Source: Zetland Avenue East Ultimate Layout, AECOM, 60300384-SKE-02-04-G-0006, Rev. 1, 07.03.16

Rose Valley Way also plays an important role in terms of broader precinct accessibility and will provide a loading bay, indented parking bays for the general public and loading/ service vehicle access.

The number of accessible spaces may be influenced by the extent of hydrotherapy pool activity, and will likely require monitoring and potentially additional detailed investigation.

These areas connect well with the surrounding expansive public domain and formalised pedestrian facilities along Zetland Avenue, and adjacent to the primary Aquatic Centre entrance.

The 90-degree on-street parking along George Julius Avenue provides additional on-street parking spaces, though creates a long walking distance for visitors to access the Aquatic Centre entrance and is therefore most likely to be used for access to Gunyama Park. This option will also impact the safety of surrounding roads as it creates more vehicular activity on-street as cars pull in and out of parking spots. The final design and setback from the adjacent traffic lanes will also

require detailed design analysis and consideration by City of Sydney to ensure a safe environment for all future users, based on anticipated future traffic volumes.

A parking management system including a metered 'Park and Swim' scheme will also be adopted in order to allow effective use of specific parking spots in the vicinity by visitors to GPARC. The concept is modelled off North Sydney Council's Olympic Pool in Milsons Point, an area that also experiences high demand for on-street parking. The parking fees are in the order of $8.00 per hour with a full refund available for pool users via an automated facility internal to the site, for a two-hour stay. It will be important for such a scheme to be implemented with an appropriate pricing strategy and to be monitored to ensure use by Aquatic Centre visitors and not the general public.

Appropriate signage indicating parking restrictions, accessible parking, loading zones and set-down/ pick-up zones should be incorporated and clearly delineated.

6. Service Vehicles

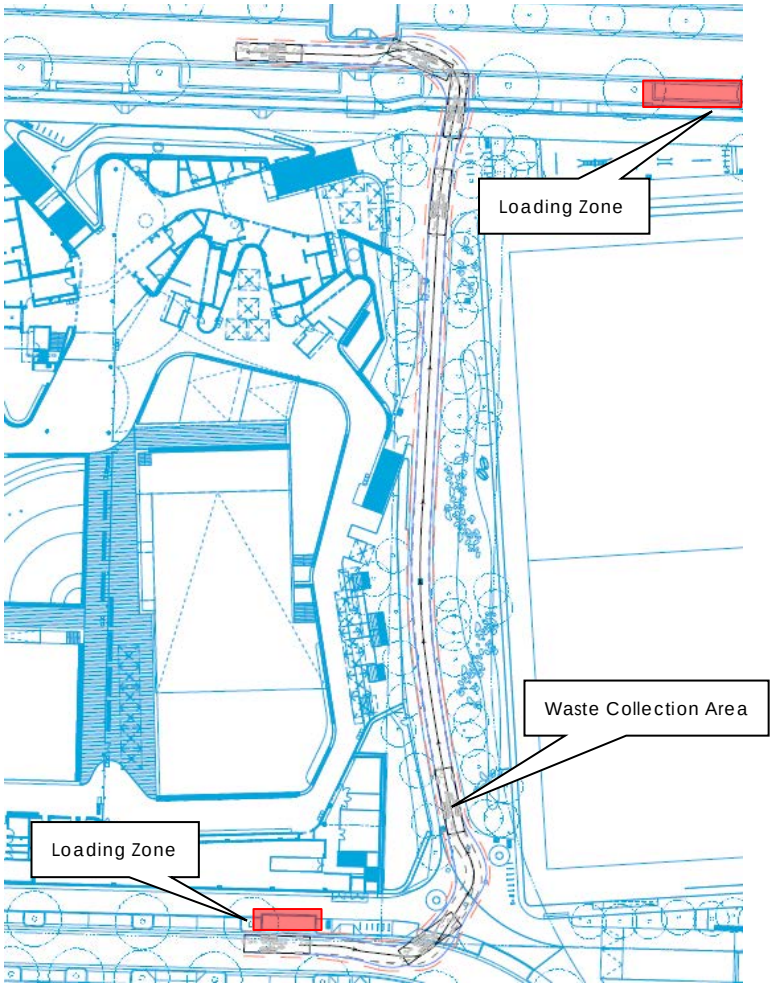
The detailed design includes provision for service vehicles and garbage trucks to access a drive-thru area for the purposes of servicing the site. This design will ensure that all service vehicles are able to have dedicated access at all times of the day and is both efficient and non-intrusive to visitors.

Dedicated driveway crossovers have been provided along Zetland Avenue and Rose Valley Way to ensure a high level of accessibility and links with the logical approach and departure routes. On-street loading bays to the north (close to the main entrance and café) and south (close to pool plant areas) will also ensure that servicing the aquatic centre is easily achievable.

This reduces the design related impact of the site servicing needs while being able to maintain appropriate access. Garbage collection and specific GPARC loading needs (if required) would all be achievable along this corridor. Swept paths of the standard City of Sydney garbage truck and Australian Standard 6.4m small rigid trucks have been completed in various key locations to ensure appropriate design and confirm access.

The service and maintenance vehicle, together with garbage truck access and facilities are broadly highlighted in Figure 6.1.

Figure 6.1: Anticipated Service Vehicle Access and Loading Areas



7. Traffic Impact Assessment

7.1 Traffic Impact

AECOM (2014) completed future traffic modelling for GSTC taking into account future surrounding developments that included the Epsom Park Precinct. With respect to traffic generation, AECOM assessed the GPARC site as 'community' land uses and adopted a commercial development traffic generation rate. The adopted traffic generation rate had a reduction factor applied (to account for GSTC location and proposed reduced parking provisions) and when considering the indicative site floor area quoted, represents approximately 65 vehicle trips during the road network PM peak hour.

City of Sydney (2014) estimated the traffic generation of the GPARC site based on a series of mode split assumptions and traffic generated by the Ian Thorpe Aquatic Centre and the Cook + Phillip Park Aquatic and Leisure Centre, summarised as follows:

- 50% of visitors would be locals residing in the immediate surrounding precincts and 50% from the outer Green Square area
- all local visitors to travel by non-car modes
- 60% of visitors from the outer area to be by non-car modes (based on the Parsons Brinckerhoff Green Square TMAP (2012)
- average of 2 people per car
- less than 20% of daily visits occurring in any peak hour.

The City of Sydney report concluded that GPARC would generate low traffic volumes; 15 vehicle trips in the AM peak and 30 vehicle trips in the PM peak.

Assessment by GTA (2014 and 2015) identified a PM peak parking demand of just over 100 spaces. A turnover of 1-2 vehicle movements per parking space during the PM peak hour would result in a traffic generation of 100-200 vehicle trips, noting that this did not specifically account for any set-down/ pick-up activity. This could be considered reflective of opening conditions in which the catchment will be large and prior to firmly establishing the associated transport improvements.

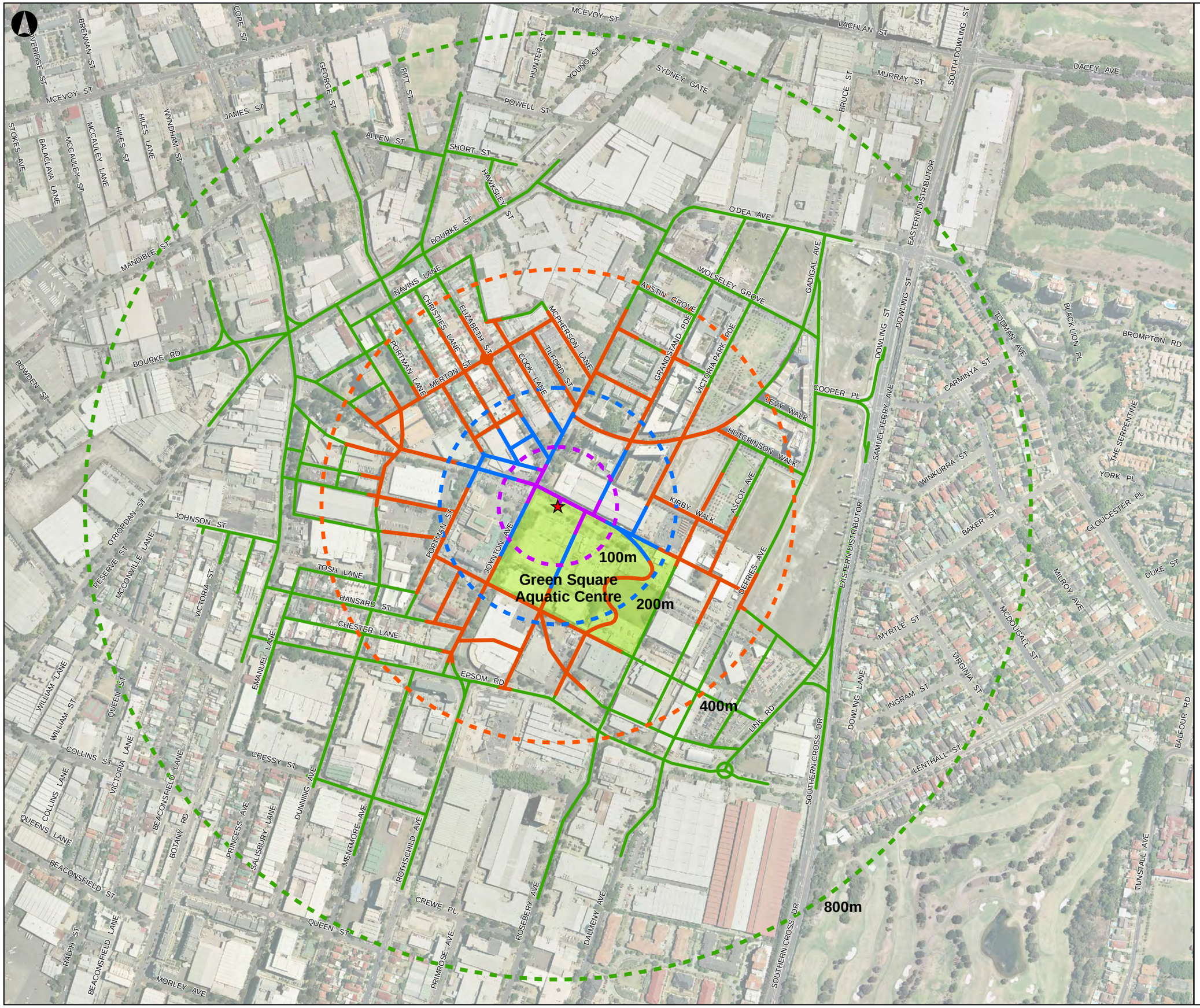
While it is also recognised that close to 5,000 new dwellings are currently planned to be occupied by the time GPARC opens in 2019, the longer term scenario will see the surrounding residential areas develop much further and result in a significant proportion of users arriving from the local area. Given this, the percentage of corresponding vehicle trips will decrease.

Given the site will not provide off-street parking, all site specific traffic will be associated with the on-street car parking spaces. The AECOM report has detailed the impact of some 65 trips during the PM peak hour and would be more aligned with future travel modes, where increased use of active/ sustainable travel would lessen traffic associated with the site.

The AECOM report indicates that in 2031 the future Joynton Avenue/ Zetland Avenue intersection will operate close to capacity in peak periods. A staged intersection upgrade may be undertaken in the future. GTA notes this is with the realisation of other traffic generating uses within the Epsom Park Precinct, and will not be solely due to the contribution of the GPARC site, which will in fact lessen in traffic impact by 2031 due to anticipated travel mode shift.

Appendix A

Existing Walking Catchment Map



Legend

- Green Square Aquatic Centre
- Access
- 100m Catchment (1.25 minute walk)
- 200m Catchment (2.5 minute walk)
- 400m Catchment (5 minute walk)
- 800m Catchment (4 minute cycling)

Issue	Date	By	Chkd	Appd
P1	22-07-15	BLL	RMH	BDM

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Client
ABA + GRIMSHAW

Job Title
Green Square Aquatic Centre

Drawing Title
Catchment Map

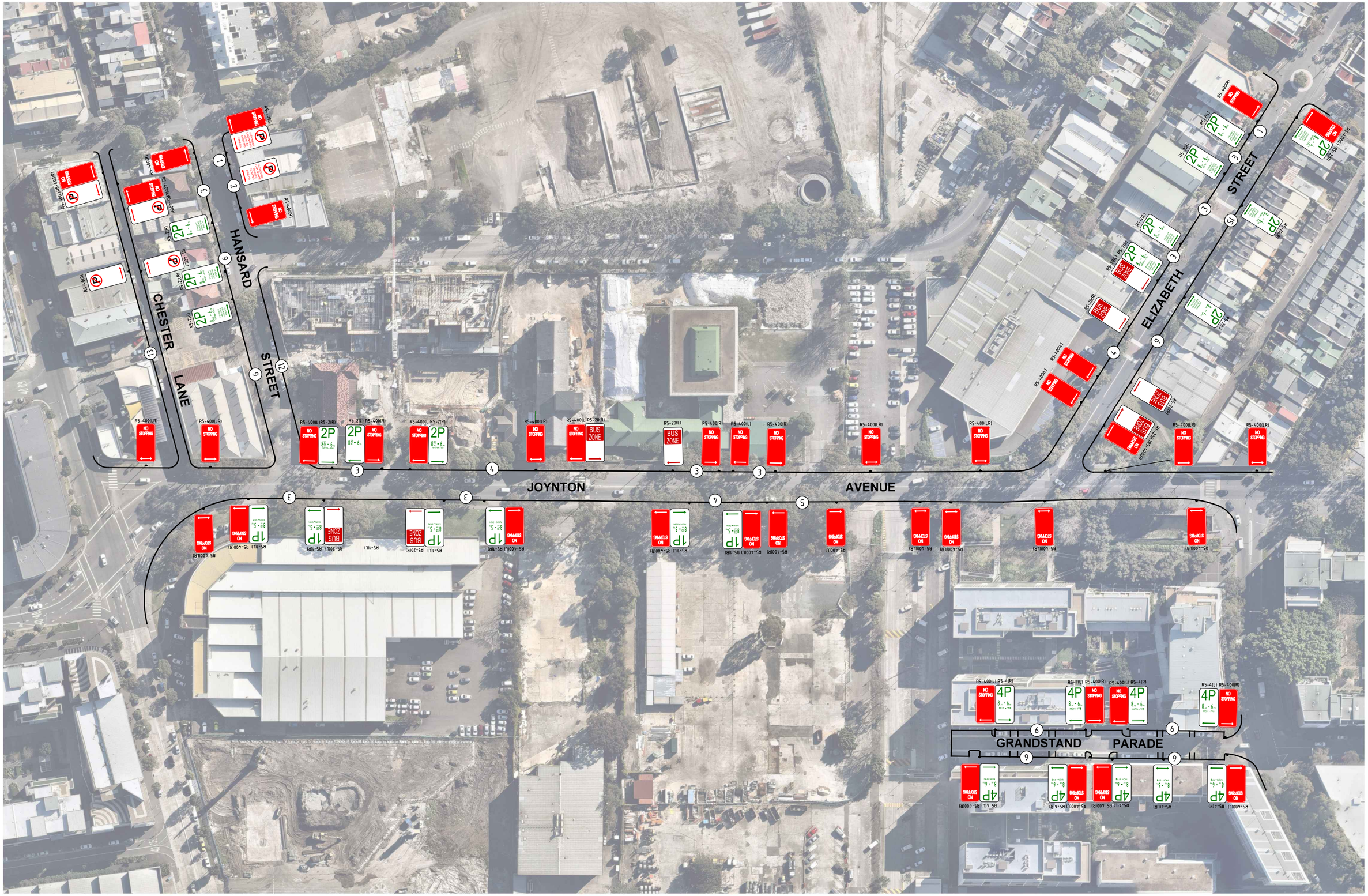
Scale at A3
1:6,000

Drawing Status
Preliminary

Job No	Drawing No	Issue
15S1006100	001	P1

Appendix B

Existing Signage Plan



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PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY
SUBJECT TO CHANGE WITHOUT NOTIFICATION

GREEN SQUARE AQUATIC CENTRE

EXISTING SIGNAGE PLAN

DATE: 22.07.2015
SCALE: 1:1500@A3 (0, 15, 30, 45)
APPROVED: RMH
DRAWING NO.: 15S1006100-02-01-P1
SHEET: 01 OF 01

PLOTTED BY : barryli
ON 23/07/2015 AT 5:18:12 PM 15S1006100-02-P1.dgn

Appendix C

Parking Catchment Map



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Canberra 02 6263 9400
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Gunyama Park & Green Square
Aquatic Centre Parking Catchment Map

DATE:
08.06.16

DRAWING NO.
15S1006100-03

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Gunyama Park Aquatic and Recreation Centre

132-140 Joynton Avenue, Zetland

Green Travel Plan

Client // City of Sydney
Office // NSW
Reference // 15S1006100
Date // 08/06/16

Gunyama Park Aquatic and Recreation Centre

132-140 Joynton Avenue, Zetland

Green Travel Plan

Issue: A 08/06/16

Client: City of Sydney
Reference: 15S1006100
GTA Consultants Office: NSW

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	08/06/16	Final	Hilary Papps, Paul Froggatt, Lydia Kairl	Rhys Hazell	Brett Maynard	

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A: Transport Access Guide

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1. Introduction

1.1 Background

The following Green Travel Plan has been prepared for Andrew Burges Architects on behalf of the City of Sydney in relation to the development of the Gunyama Park Aquatic and Recreation Centre (GPARC) located on Joynton Avenue, Zetland.

Transport is a necessary part of life, derived from the activities undertaken at varying spatial locations. As such, the mode of transport taken will affect sustainability outcomes including greenhouse gas emissions, population health levels and social participation rates. These outcomes then affect the prosperity and liveability of the immediate site, surrounding suburbs and the Council of the City of Sydney.

By implementing a Green Travel Plan, GPARC visitors and employees can be informed about and be incentivised to use sustainable travel options to access the site and the broader Green Square precinct.

1.2 Subject Site

GPARC is located within the Epsom Park Precinct in Zetland which forms part of the broader Green Square development area. The site and much of the surrounding area has previously been industrial in nature, and is part of a wider area redevelopment that will provide an increasing amount of medium and high density residential properties and a substantial increase in the local residential population.

New road and public transport networks are proposed as part of the Green Square development. Networks of local pedestrian routes and cycling routes and facilities will be provided to connect within the redevelopment area. Dedicated cycle infrastructure will be provided on Zetland Avenue, Portman St and the East-West Relief Route. Signalised crossings and a highly permeable street layout will ensure safe and convenient pedestrian access from Zetland, Waterloo and Rosebery. On street pick up and drop off areas as well as service zones will be provided.

Public transport access to the area will also be upgraded in the future, including improved bus and train services. The centre will be served by high-frequency bus routes on Joynton Avenue and Epsom Road, and rail at Green Square station.

The location of the subject site, surrounding environs and existing transport networks is shown in Figure 1.1 under existing arrangements with future road hierarchy shown in Figure 1.2.

Figure 1.1: Subject Site and Its Environs

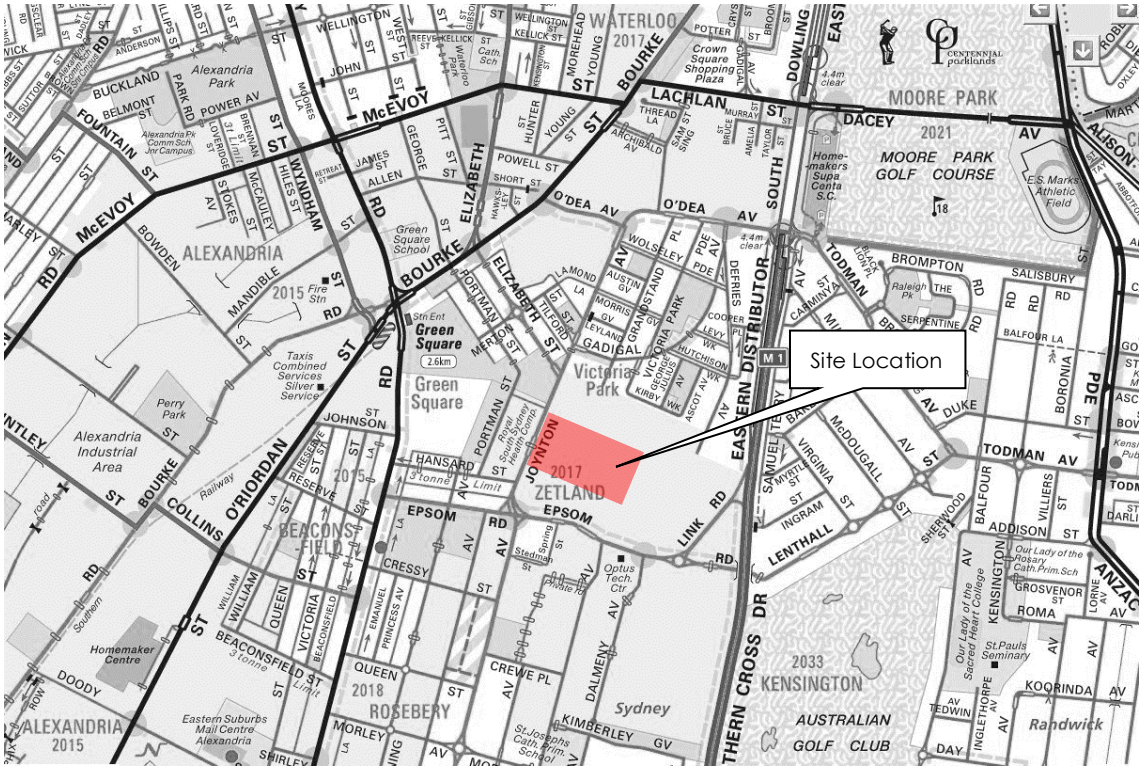
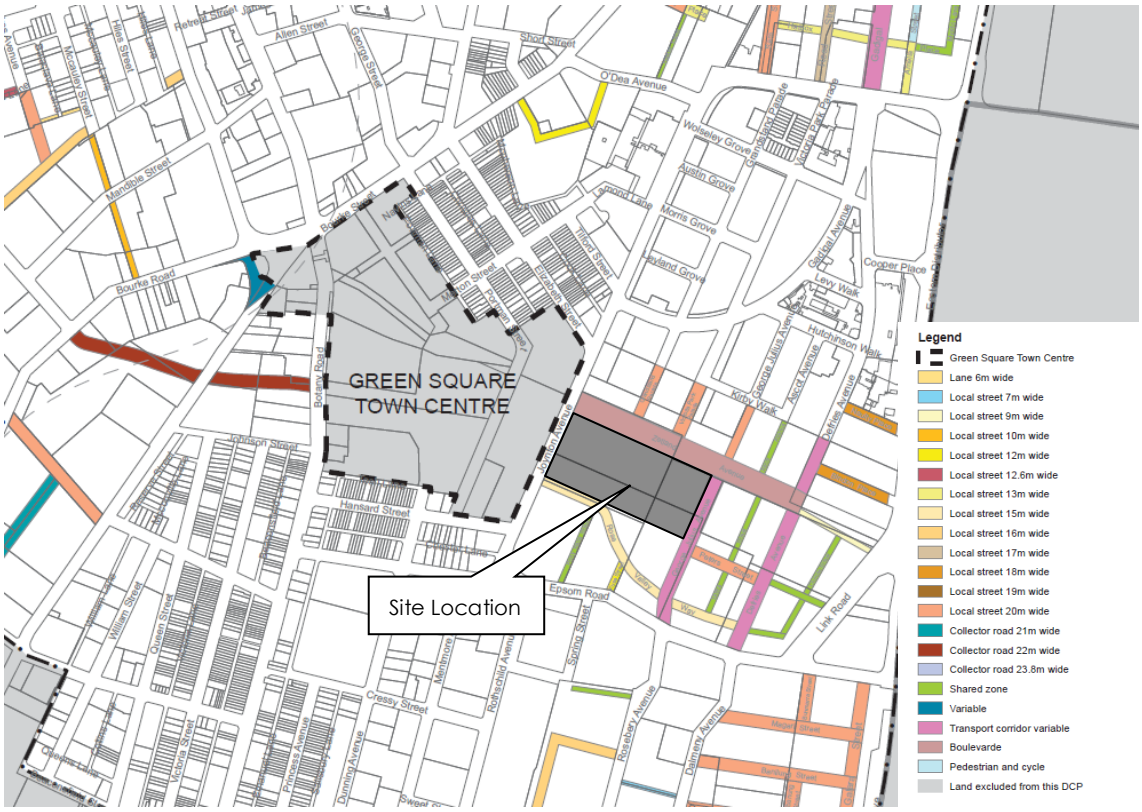


Figure 1.2: Green Square Street Hierarchy and Layout



Source: Sydney DCP 2012 Figure 5.35 Green Square – Street Hierarchy and Layout

1.3 Proposed Development

The key GPARC facilities include the following:

- 50m heated outdoor pool and leisure pool
- 25m indoor program pool
- indoor leisure pool
- hydrotherapy pool
- crèche
- café
- health and fitness centre and outdoor fitness station
- outdoor synthetic multipurpose sports field
- outdoor playground with skate facilities
- park boardwalk, terraces and seating
- native planting and landscaping.

The development does not propose any on-site car parking in accordance with City of Sydney's LEP 2012 which identifies that car parking should be ancillary to other development and should seek to minimise the amount of vehicular traffic generated by a development. Parking demand will be addressed by the provision of 30 car spaces along George Julius Avenue as part of a separate project, and on-street parking management including a metered 'Park and Swim' scheme.

2. Travel Planning Context

2.1 Travel Plan Drivers

Local, state and national policies provide strategic frameworks that establish the objectives and principles in support of sustainable transport practises and choices. Promoting sustainable transport (such as walking, cycling and public transport) is important for a wide range of reasons, such as:

- Socially connected, liveable communities – places where people walk, cycle and use public transport are likely to perform better on a range of social indicators.
- Healthy, active communities – there is a strong link between active transport and health and less sedentary lifestyles.
- Transport efficiency – increased use of sustainable transport (such as mass transit) has environmental and economic benefits through reduced greenhouse emissions and reduced space required for vehicle movement and storage.
- Access for all members of the community – a large number of people in the community don't or can't drive, and the provision of attractive and viable alternative means of transport is a key factor in whether a community is affected by transport disadvantage.
- Safety – Increased participation in sustainable and active transport can improve safety and perceptions of safety.
- Giving people a greater transport choice in a quality built environment can improve social connections, access to employment and equity.

2.2 What is a Travel Plan?

Travel planning is used in a number of jurisdictions around Australia. City of Sydney provides guidance on Travel Plans as follows:

> *"A travel plan is a package of site-specific measures implemented to promote and maximise the use of more sustainable modes of travel. Typically, travel plans support walking, cycling, public transport and car sharing, which are encouraged via a range of actions, promotional campaigns and incentives.*
>
> *Travel plans are concerned with more than just the installation of facilities such as bike racks and end-of-trip facilities. A travel plan should be considered as a site management tool which incentivises people to make more sustainable transport choices.*
>
> *Developments can enjoy many benefits as a result of an effective travel plan – parking needs and costs are reduced, staff and residents are healthier and therefore take fewer sick days, and strain on local transport networks is reduced.*
>
> *Developing a travel plan is not a one-off task. It involves ongoing implementation, monitoring and review – a travel plan should be a 'living document'. Nominating an individual or a team to oversee the implementation of a travel plan is a crucial component of success, as is gaining support from senior management, strata management or other relevant governing body.*
>
> *Travel plans can be developed and implemented for a range of development types, including workplaces, residential developments, destinations (such as tourist attractions), schools and educational campuses."*

Source: City of Sydney website (site accessed January 2016)

Measures that are typically included in travel plans encompass site design, improvements to off-site access, facilities reducing the need to travel, public transport improvements, parking management and raising awareness of more sustainable travel options.

2.3 Purpose of this Travel Plan

This Green Travel Plan comprises actions and strategies aimed at encouraging walking, cycling, public transport and carpooling for travel, and a shift away from the reliance on private vehicle travel, and in particular single occupancy vehicle travel.

The introduction of this Green Travel Plan will:

- advise the wider travel choices to visitors and staff
- help visitors and staff identify transport means which will result in them being healthier, fitter and more productive
- provide equitable access so there is no disadvantage to those without access to a car
- aim to reduce congestion, enabling deliveries and essential journeys to move more freely
- provide easily identifiable transport access options and minimising parking demand pressures to improve relations with neighbouring land uses.

It is the intention therefore that this Green Travel Plan will encourage sustainable transport means which could result in the following benefits:

- higher mode share targets
- greenhouse gas emission reductions and smaller carbon footprints
- healthy living
- greater social equity, social participation and lower social exclusion
- improve knowledge and contribute to learning.

The Green Travel Plan is supported by a Transport Access Guide (TAG) that provides a summary of all travel options to GPARC. This can be updated as the surrounding transport networks develop as part of the broader precinct redevelopment. The TAG is included as Appendix A.

2.4 Relevant Transport Policy

The following council policies have been referenced in preparing this travel plan.

- City of Sydney Development Control Plan (DCP) 2012
- City of Sydney Local Environmental Plan (LEP) 2012
- City of Sydney Cycle Plan and Access Strategy.

3. Transport Infrastructure

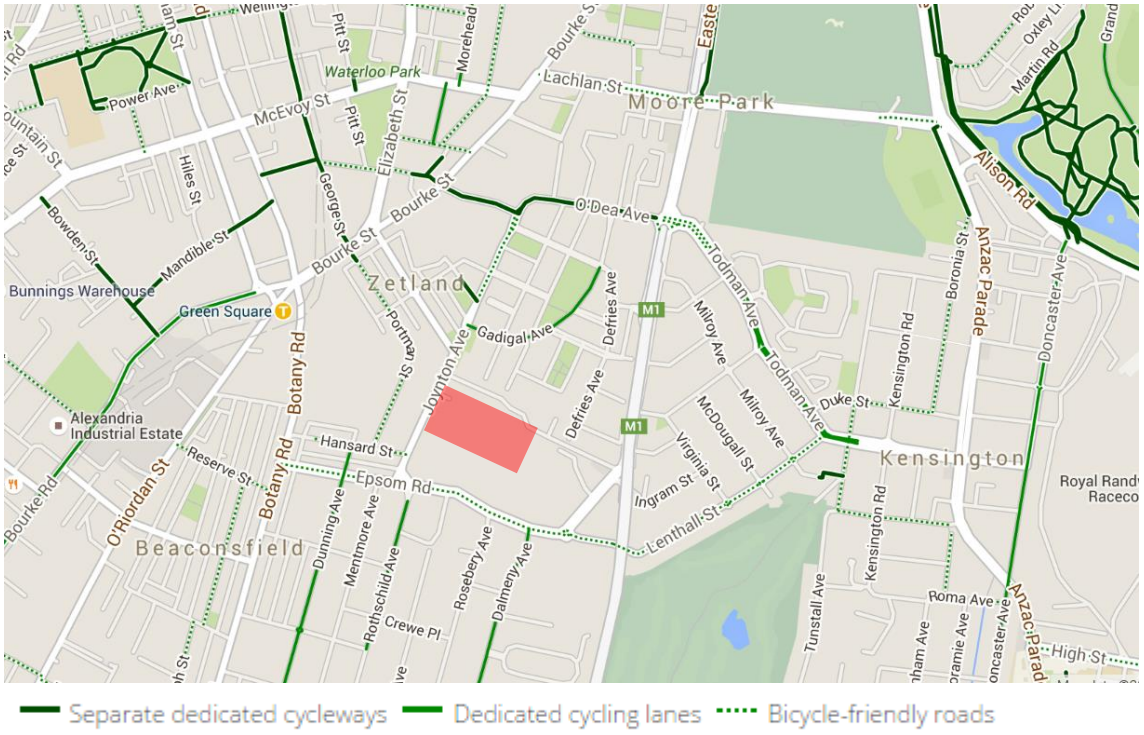
3.1 Existing Walking and Cycling Facilities

The streets surrounding the subject site all have some footpath provision, generally with sealed footpaths provided on both sides of the carriageway. These footpaths provide a relatively connected pedestrian network within the local area surrounding the subject site. Signalised crossings and a highly permeable street layout will ensure safe and convenient pedestrian access from Zetland, Waterloo and Rosebery.

No on-street bicycle facilities currently exist on the roads immediately adjacent the subject site, although there are several on-street bicycle lanes providing some connectivity to the south, including Dunning Avenue and Dalmeny Avenue. Figure 3.1 shows the existing cycling infrastructure within the vicinity of the subject site.

With future development in the surrounding areas, cycling facilities will be upgraded with dedicated cycle infrastructure on Zetland Avenue, Portman Street and the East-West Relief Route to support reduced car use.

Figure 3.1: Existing Cycling Infrastructure



Source: http://www.sydneycycleways.net/map/ (accessed May 2016)

It is also worth noting that children under the age of 12 (and an accompanying adult) can cycle on the footpath (unless otherwise signed) in NSW. The existing footpaths within the vicinity of the subject site are able to be used by children cycling and the adult accompanying them.

3.2 Future Development

GPARC and the broader precinct is a brownfield site with the whole area currently undergoing extensive redevelopment. This redevelopment has, and will continue to create a high density residential catchment over the next 10 to 15 years. The proposed development and supporting infrastructure should mean that residents do not generally need to drive within the local area to access a wide range of facilities.

The indicative residential population forecasts that will be within 500m of the site are:

- 2015 9,796
- 2020 29,668
- 2025 34,010.

3.3 Future Walking and Cycling Network

3.3.1 Pedestrian Footpaths

As part of the proposed redevelopment, pedestrian and cyclist facilities will be strengthened, which is essential to achieving the desired change in mode shift from private vehicle to more active modes of transport.

Pedestrian paths will be provided along both sides of the surrounding streets, connecting GPARC users with the broader Green Square development area. Primary pedestrian paths along Joynton Avenue and George Julius Avenue will connect to the Zetland Avenue main entrance. A dedicated path on the GPARC site will travel in a north-south direction across the site between the aquatic and recreation centre and the main parklands to ensure permeability throughout.

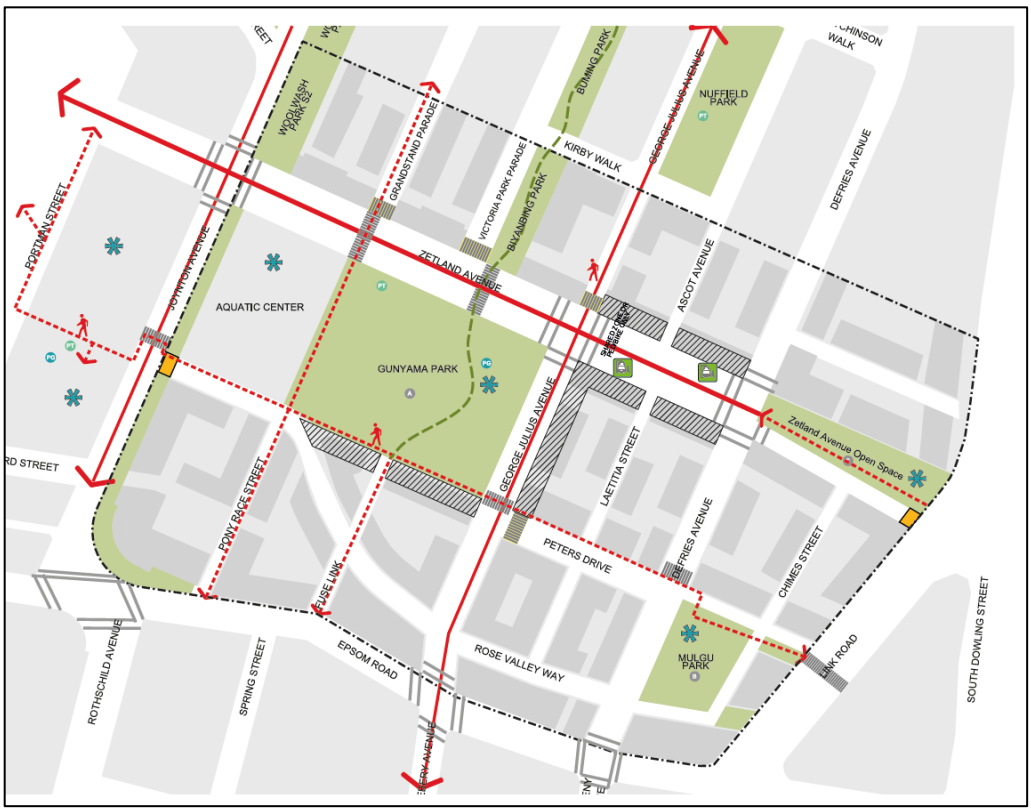
Pedestrian facilities, including marked pedestrian crossings will improve pedestrian safety in the area and allow pedestrians to easily move between and around the precinct. Signalised crossings and a highly permeable street layout will ensure safe and convenient pedestrian access from Zetland, Waterloo and Rosebery.

To support existing and future public transport routes, the walking routes to and from public transport services (i.e. bus stops and train stations) are to be of good quality and provide for passive security through design, particularly on walking routes to public transport that would be in use at night (e.g. lighting).

The proposed shared paths, discussed further below as part of the bicycle networks, will also form part of the pedestrian access to the GPARC site and surrounding areas.

The proposed local networks are illustrated by Figure 3.2.

Figure 3.2: Public Spaces and Pedestrian Desire Lines



Source: City of Sydney Epsom Park Urban Framework Plans Rev D (April 2015)

3.3.2 Bicycle Networks

The surrounding streets which facilitate cycling include Dalmeny Avenue, Dunning Avenue, Bourke Road and Bourke Street. In addition, cycle lane infrastructure is currently in the design stage for a high quality link between Green Square and Randwick which may be attractive to GPARC users. Dedicated cycle infrastructure has also been identified for Zetland Avenue, Portman St and the East-West Relief Route. As the precinct continues to develop, further cycling infrastructure can be anticipated to respond to demand.

Part of City of Sydney's Cycle Strategy and Action Plan 2007-2017 (2007) is to develop the Green Square area in to a fully permeable, safe environment for the high numbers of residents, workers and visitors to move safely.

More recent new cycleways planned for Green Square Town Centre include:

- Zetland Avenue between Paul Street and Victoria Park Parade: 420m long separated one-way cycleway on each side of the road to connect GPARC with GSTC and community facilities.
- Geddes Avenue between Botany Road and Portman Street: 275m long separated bidirectional cycleway (construction to commence June 2016).
- Portman Street between Portman Lane and Hansard Street: 350m separated bidirectional cycleway.

Providing these cycling links will substantially improve bicycle access to the site from the existing routes and support the vision for increased cycling activity to the site while ensuring a high level of cyclist amenity.

The cycling networks are illustrated as part of the transport and access plan detailed in Figure 3.3.

Figure 3.3: Transport and Access Map



Source: City of Sydney Epsom Park Urban Framework Plans, Rev D (8/04/15)

3.3.3 Bicycle Parking

The proposed development will provide 130 bicycle parking spaces across the site for use by patrons of the GPARC. The facilities will be inverted U-loops which are appropriate for short term parking consistent with recreational land uses. 8 secure bicycle parking spaces will also be provided for dedicated staff use.

Once operating, regular monitoring of the availability of bicycle parking for staff and visitors will need to be undertaken via occupancy surveys and/ or 'spot checks'. Adaptive measures will need to be considered should the bicycle demand regularly exceed the supply. There is the potential for a further 70 bicycle parking spaces to be formally provided across the site for any additional future demand. Monitoring of the initial 130 bicycle parking spaces on a regular weekly or monthly basis is essential to understand whether the additional bicycle parking provision needs to be implemented should cycling trips to the site increase.

Due to the nature of the site's proposed use, dedicated end-of-trip facilities will not be required for visitors as this will be integrated into the purpose of their visit. End of trip facilities will be made available for staff, including shower and change room amenities, bicycle parking and storage opportunities.

3.4 Public Transport

3.4.1 Buses

Existing Services

Figure 3.4 shows the subject site in relation to the existing public transport routes in its vicinity. As shown on Figure 3.4 several bus routes pass along Joynton Avenue immediately adjacent the site, as well as Epsom Road to the south.

This map shows the current public transport arrangements close to the site. This map is expected to be superseded quickly with the proposed changes and will be replaced by maps contained and regularly updated in the TAG, displayed on site or available through websites and travel information apps.

Figure 3.4: Subject Site Public Transport Access



Source: Sydney Buses region guide for eastern region www.sydneybuses.info/routes/Region_guide_East-2015.pdf (site visited June 2016)

A bus stop for northbound buses is located immediately opposite the site on the west side of Joynton Avenue. The southbound bus stop is located approximately 120m to the south on the eastern side of Joynton Avenue. These bus stops are serviced by the following bus routes:

- 301 Eastgardens – Sydney
- 343 Daceyville – Chatswood
- M20 Botany – Artarmon
- 348 Wolli Creek – Bondi Junction.

The two Epsom Road bus stops are also each within approximately 300m of the site with bus route 370 Coogee – Leichhardt being the key east-west route through the area.

The frequency of each route is summarised in Table 3.1.

Table 3.1: Bus Routes

Bus Route	Headway Weekday	Span
301	<10 minutes (peak) 20-30 minutes (off peak)	06:13 – 23:28
343	5-10 minutes (peak) 10-20 minutes (off peak)	04:24 – 00:09
348	30 minutes	06:18 – 19:42
M20	10 minutes (peak) 15 minutes (off peak)	06:38 – 20:21
370	10 minutes (peak) 20 minutes (off peak)	05:42 – 21:06

Source: Transport for NSW

The combined frequencies of the above routes that service the Joynton Avenue stops will provide a very high frequency service to key local destinations. For each individual service, the wait time between buses along Joynton Avenue is generally in the order of 5 minutes during the peak periods and 10 minutes during the day. The Epsom Road stops generally have 10 minute frequencies during the peak hours and a 20-minute wait between buses during the day. These frequency levels and service coverage should allow many potential staff and visitors easy access to the GPARC site without the need for a car.

Routes 343 and 370 currently provide services for the anticipated early morning sessions (starting at 5.30am) at the aquatic centre, with the evening period also well serviced by the majority of routes. Other services may extend operating hours in the future as the level of travel demand in the precinct increases.

Future Provision

In addition to the existing bus routes along Joynton Avenue and Epsom Road, there are proposed bus routes which will also service the GPARC site. It is understood from City of Sydney's Epsom Park Urban Framework Plan (Rev D) that short term potential bus routes will operate along Zetland Avenue as part of the early stages of Eastern Transit Corridor (ETC) initiatives prior to conversion to light rail. The bus services will provide links to the Green Square Town Centre, Transport Place and other key locations in the Green Square development area within the local context. From a broader perspective, the bus services will provide links to several key generators including Sydney CBD, Mascot and Bondi Junction.

Transport for NSW has outlined its intentions to provide two additional bus routes travelling through the Green Square precinct close to the GPARC site. These bus services will provide links to areas including the CBD, Gore Hill, Mascot, Coogee, Leichhardt, Bondi Junction, Wolli Creek and the University of New South Wales (UNSW). Bus services will operate at a frequency of about one bus every 6 minutes during peak periods. These buses are expected to travel in a north-south direction along Joynton Avenue, directly west of the site.

3.4.2 Heavy Rail

The GPARC site is currently an approximate 950m (12 minutes) walk from Green Square Railway Station. The T2 Airport Line provides a convenient link to Central Station and other CBD stations, as well as to the domestic and international airport terminals. Ongoing connections to all Sydney Trains and NSW TrainLink rail networks are achievable via Central Station.

The Green Square Railway Station provides trains at a frequency of every 2 to 5 minutes across peak periods and during the day. Weekend services are also reasonably frequent, although there is some irregularity in service patterns with wait times varying between 2 and 15 minutes. The

two directions of service operate at 5 to 10 minute headways and span 04:45am to 00:15am (following day). The regularity of train services at the Green Square Station will assist with convenient train access to the site and wider precinct, to support the objectives of limited private vehicle transport.

Whilst the current walking route of 950m between Green Square Railway Station and the GPARC site represents a detour, this will be resolved as part of the ongoing Green Square/ Epsom Park development. When the Green Square Town Centre is developed, the direct pedestrian link will provide an easy and pleasant walk within a highly pedestrian friendly environment. The revised route will also achieve a travel distance saving of approximately 300m, meaning the GPARC site will be well within the 800m walking distance considered acceptable for access to a railway station.

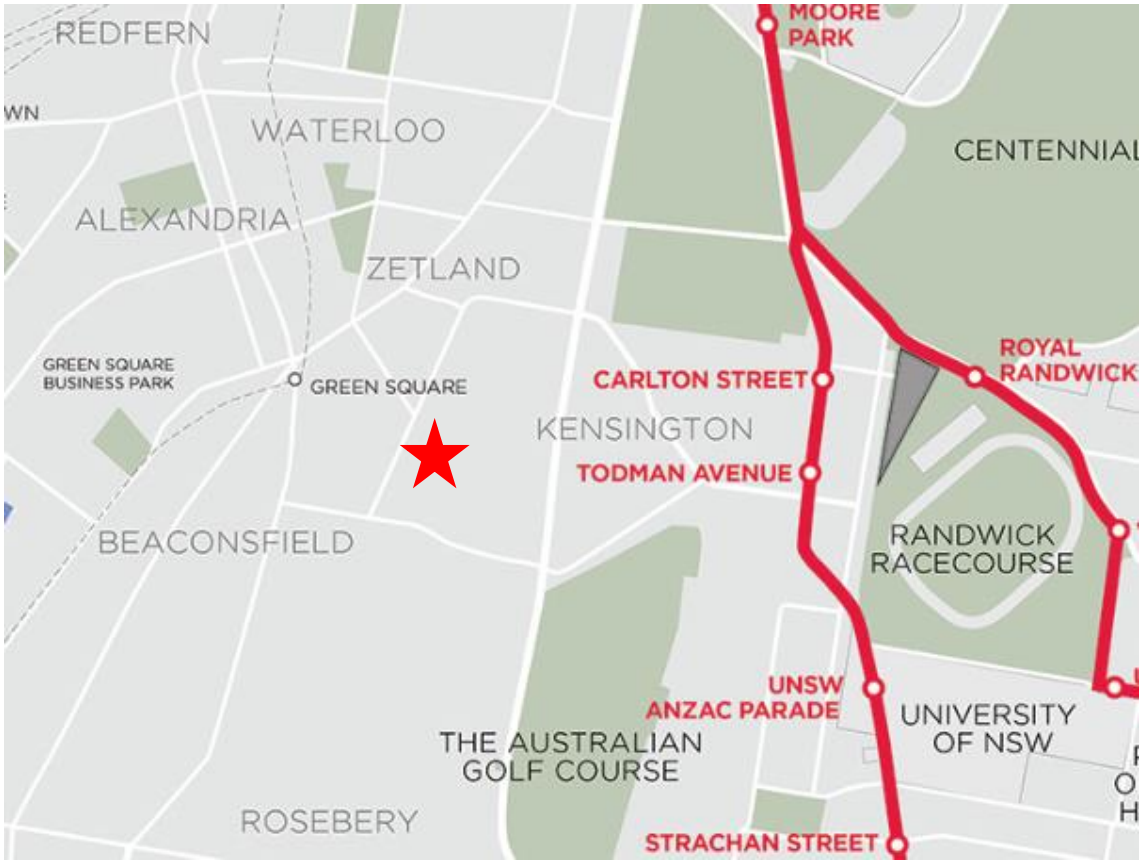
3.4.3 Light Rail

CBD and South East Light Rail

The proposed CBD South East light rail line (shown in Figure 3.5) will provide additional public transport options within the wider catchment of the site. The proposed route and stop locations are shown in Figure 3.6.

The Todman Avenue stop is expected to provide the closest stop to the site. It will however be further from the site than the existing Green Square Railway Station, at around 1.3km (20-minute walk) and is therefore expected to provide only limited access improvements for the GPARC site.

Figure 3.5: CBD and South East Light Rail



Source: CBD and South East Light Rail Route Map www.sydneylightrail.transport.nsw.gov.au/information/maps (site visited June 2016)

Zetland Avenue

The ETC planning includes a bus rapid transit system to operate along Zetland Avenue and connect the surrounding area to the Sydney CBD. Within the site's neighbourhood, the ETC is planned to connect GPARC to key destinations in the area such as Transport Place, Green Square Town Centre and various plazas. Further assessments will determine transport mode, with light rail proposals now a key consideration.

In Infrastructure Australia's latest plan, the light rail project to Green Square has been designated a high priority initiative with a probable timescale of 5-10 years. The City of Sydney is proposing an indicative Green Square Light Rail alignment as shown in Figure 3.6.

A future light rail stop is also being considered along Zetland Avenue in close proximity to the GPARC site.

Figure 3.6: Green Square Light Rail



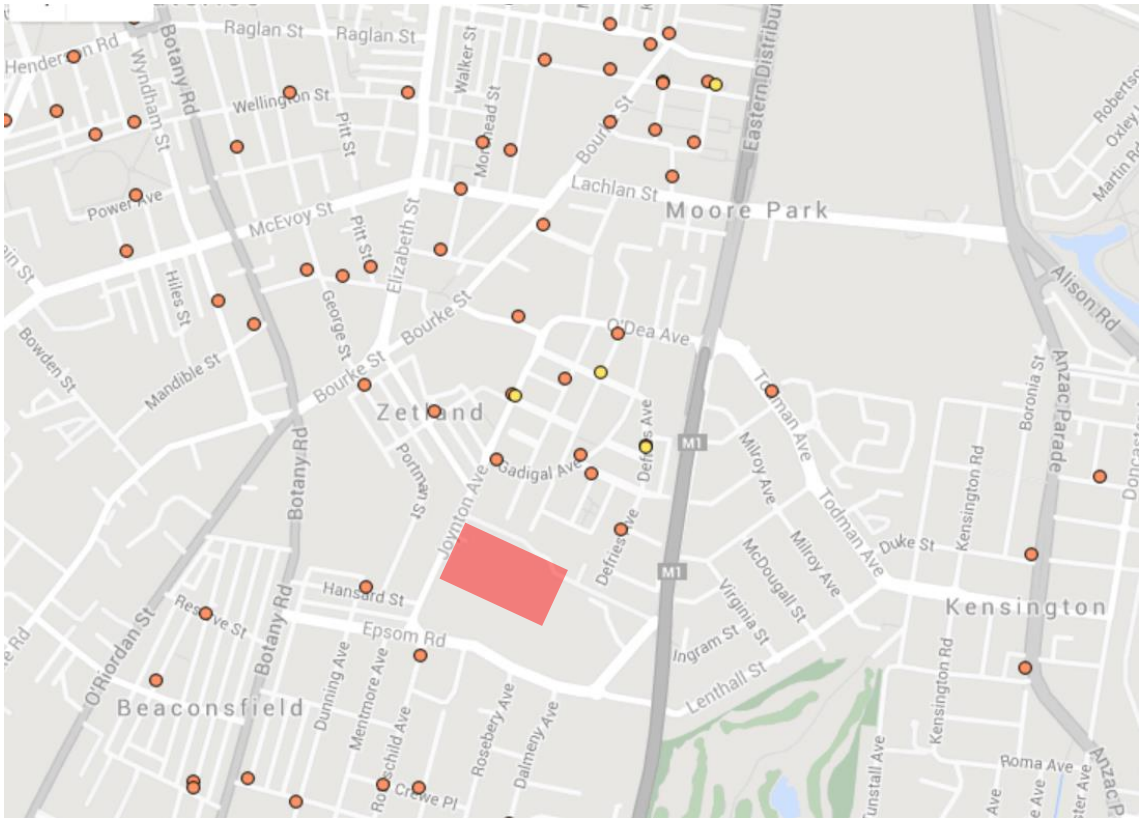
Source: Infrastructure Australia

3.5 Local Car Sharing Initiatives

The site is already well located to car share facilities, with several car share pods available within the vicinity, as illustrated in Figure 3.7. The closest pods are currently located on Gadigal Avenue and Defries Avenue around 150m and 300m from the GPARC site respectively.

The redevelopment of the Green Square area is likely to bring about significant change to the level of car share spaces available both on-street and, increasingly likely, within the various residential developments surrounding GPARC. Given GPARC is to be a trip destination rather than a trip generator, car share vehicles available for use within the visitor catchment is important to ensuring ready access. While car trips are not an obvious mode share target, use of such schemes is becoming increasingly important in high density living.

Figure 3.7: Car Share Locations



Source: http://www.cityofsydney.nsw.gov.au/live/residents/car-sharing (site visited May 2016)

3.6 Parking Provision

A review of publicly available car parking in the vicinity of the site indicates that current supply is limited and demand remains high in an area that continues to cater for the surrounding commercial buildings while also accommodating temporary demands from a range of construction workers. The Green Square precinct is however planned to redevelop quickly, with high density residential apartments changing the transport demand profile and historical demand for parking.

It is envisaged that the new road network will provide paid on-street car parking with time restrictions. The number of on-street car spaces, time restrictions and price are currently unknown.

GPARC will feature no on-site car parking for employees or visitors in accordance with the objectives of the Sydney LEP 2012. 30 parking spaces primarily intended for GPARC visitors will be provided along George Julius Avenue as part of another project. This limited parking supply highlights the importance of communicating the initiatives outlined in this plan to staff and visitors to GPARC and the wider precinct to make use of alternative and sustainable transport modes.

4. Existing Travel Characteristics

4.1 Baseline Travel Data

In order to set specific, measureable, achievable and realistic transport mode split targets, it is important to first have a good understanding of the initial trends of transport use for employees and visitors to the GPARC.

Given the GPARC is a new build, existing travel data is not yet available in order to establish baseline mode splits.

It is recommended that once the development is operating, a 'baseline survey' be carried out of staff and visitors to the site to 'ground truth' the transport mode spilt. This could be conducted once travel activity has settled and is operating normally (approximately 3-6 months after occupation). A survey form could be handed to visitors when they pay entry fees, made available within the entrance area or promoted online. Hard copy forms can be returned via a box near the main entrance and exit. A simple verbal survey could be conducted for those visitors paying entry fees, with staff recording the response (similar to when paying for some services, particularly in the tourism industry; employees request patron postcodes etc).

Existing members travel habits could also easily be captured via information gathered as they swipe in through the turnstiles.

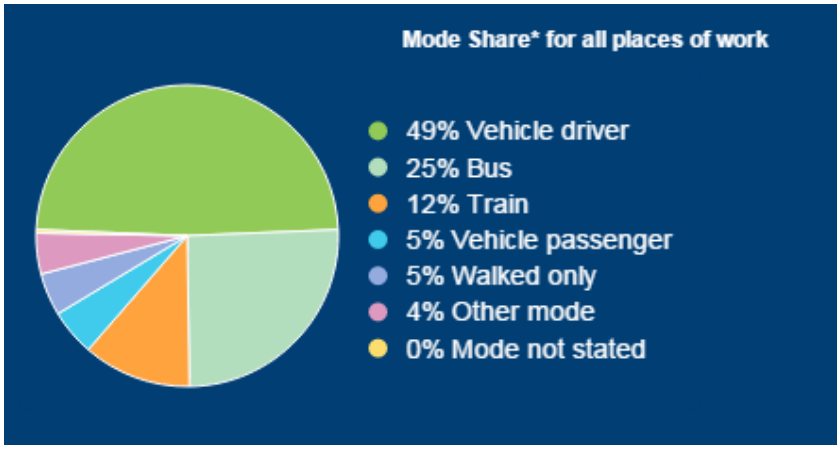
4.2 Benchmarking

In advance of identifying travel modes to the GPARC site, census travel to work data provides the most reliable source for understanding current travel patterns. This does have limitations in that it would only reference staff travel and the most recent census data from 2011 will be unlikely to reflect the recent development changes in the Green Square precinct. This section should therefore be updated, initially to 2016 census data as it becomes available and then to site specific data following GPARC opening.

The 2011 Census *Journey to Work* (JTW) data has been analysed for the broader Green Square catchment to better understand the current travel patterns for people who live in the area.

The JTW data indicates that 1,832 people lived in the Green Square region in 2011. Of those travelling to work on a daily basis, 49% (822) drive to work and 12% (196) commute via train, with 4% (74) using other public transport modes. These statistics are summarised in Figure 4.1.

Figure 4.1: 2011 JTW – Employed Residents Commuting from TZ 280 and TZ 278



Basemap source: Bureau of Transport Statistics

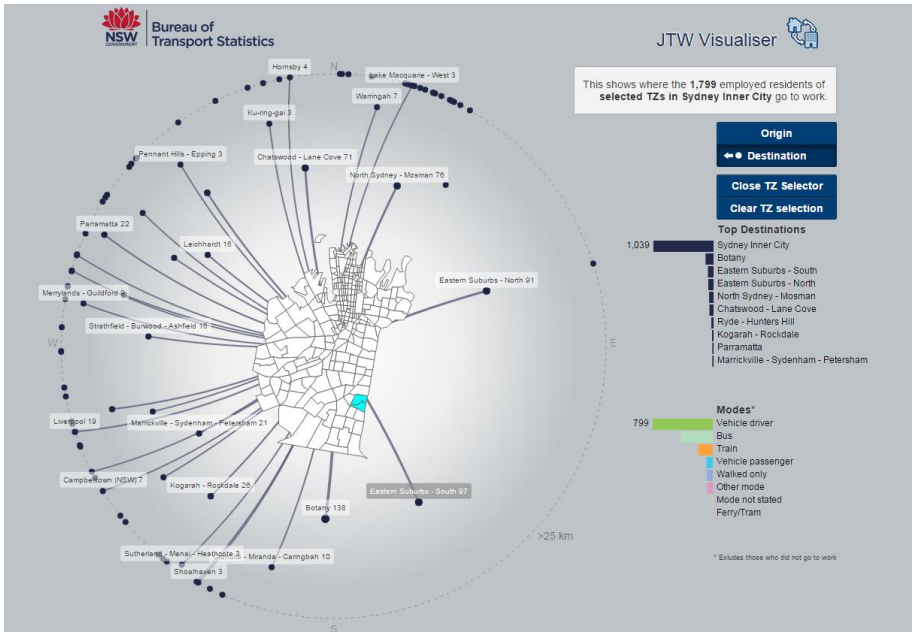
The JTW data also indicates the most common work places for Green Square residents, with the primary destinations including:

- Sydney Inner City (57%)
- Botany (8%)
- Eastern Suburbs - South (5%)
- Eastern Suburbs - North (5%)
- Northern Sydney - Mosman (4%).

It is worth noting that 213 people work in the Green Square area, with 54% either driving or being a passenger in a car, and 12% travelling by train.

The data indicates that a total of 1,799 employed residents were living in the selected Travel Zones with 58% working in the area referred to as Sydney Inner City. Figure 4.2 shows where the employed residents in the travel zone go to work. In total, 49% travel to work by car (as driver or passenger) with 35% using public transport (bus, train).

Figure 4.2: Place of Work for Employed Residents in selected Travel Zones, 2011



Basemap source: Bureau of Transport Statistics

5. Opportunities

In considering the implementation of a travel plan, it is key to ensure that the prevailing conditions and opportunities are conducive to encouraging travel behaviour change. Having regard to the preceding discussions, a summary of the identified opportunities that will support the GPARC Travel Plan are set out as follows:

- The site is in a central location to the wider development area, providing opportunities for local accessibility by a high number of residents.
- As part of the precinct redevelopment, transport networks will be developed with high quality active travel and public transport access in mind.
- The City of Sydney Public Domain strategies that are being implemented across the precinct demonstrate a commitment to sustainable transport opportunities (e.g. pedestrian connections, cycleways, etc.).
- As many of the residents will be new to the immediate area, they will not have established travel patterns, such that the quality active travel and public transport infrastructure proposed can encourage sustainable travel patterns to be normalised.
- The site is located immediately next to or within close proximity to public transport services, including existing frequent bus services and a train line, with further enhancements to bus services and two light rail lines proposed.
- Limited car parking will be available close to the site and the available on-street parking is likely to be paid parking with time restrictions. Clear information on travel options to the GPARC centre will be essential to avoid perceived travel difficulties becoming a disincentive to staff and visitors.
- The development will provide a large number of bicycle parking spaces across the site for staff and visitors and adaptive measures taken in the future to increase the provision if demand exceeds supply.
- Given the nature of the GPARC, it is likely that most visitors and staff are generally active and therefore there is scope to encourage people to consider alternative modes of transport.
- The bicycle parking facilities at GPARC will support use of the proposed cycling network around the site and wider precinct.
- Bicycle end of trip facilities will provide an integral part of the trip purpose for the majority of visitors to GPARC and will be readily available to staff.
- Construction of Zetland Avenue to the north, other new nearby road networks and the Gunyama Park perimeter path will further strengthen walking, cycling and public transport options.
- Enabling pedestrians and cyclists to connect to existing roads and paths surrounding the site to complete their journeys as desired.
- The availability of nearby car sharing locations is expected to reduce car ownership, whilst still allowing for necessary trips. The use a car share option will ensure more consideration of the need for car travel and is likely to reduce unnecessary car based trips.

6. Mode Share Targets

6.1 Target Setting

Mode split targets are an important part of a Travel Plan, as they:

- Refer to an existing mode split as a baseline.
- Articulate a target mode split to serve as a reference point, post occupation. These targets are the goal to be achieved through subsequent Travel Plan 'Actions' (as outlined in Section 7).
- Enable the progress of the Travel Plan to be monitored and reviewed.

Ideally, targets follow the SMART principles approach of being Specific, Measurable, Achievable, Relevant and Time-based:

- **Specific** – specific end result or action (e.g. increase by 50%)
- **Measurable** – must be a way to record and show progress
- **Achievable** – not too aspirational, but not too easy
- **Relevant** – something that can be controlled or influenced
- **Time-based** – a target date or milestone to keep goals on track

6.2 GPARC Targets

Based on benchmarked mode splits presented in Section 4, and given both the high quality active transport infrastructure and public transport service quality, relatively high mode split targets can be placed on the GPARC site.

At this stage, mode split targets have been set as shown in Table 6.1. These targets have been identified against the existing baseline mode splits presented in the previous section of this report. The targets reflect that the census Journey to Work information is not directly applicable for recreational travel, is now somewhat aged and does not reflect the recent and ongoing changes in the precinct. Beyond these considerations, factors including local residential catchment, demographics of pool user groups and potential for linked trips need to be considered when directly comparing the baseline and 2020 targets.

Table 6.1: Travel Mode Targets for 2020

Transport	Baseline Mode Split Estimate	2020 Target Mode Split
Car (Driver)	49%	30%
Vehicle Passenger	5%	5%
Bus/Light Rail	25%	25%
Train	12%	10%
Walk Only	5%	20%
Other mode (incl. cycling)	4%	10%

The initial mode share targets have been considered and recognise that up to 2020 there will still be a significant amount of development taking place and that the full walking, cycling and public transport networks will not be in place. A methodology for driving the shift towards the 2020 mode split targets is set out in the following 'Actions' section of the Travel Plan.

Over the first two to three years of operation of GPARC and the Travel Plan, progress towards the initial targets will need be monitored and updated annually to ensure longer term targets can be established.

7. Monitoring Tasks and Responsibilities

7.1 Travel Plan Monitoring

In order for this Travel Plan to be effective, it must be reviewed on a regular basis to ensure that the objectives are being met and that strategies and actions are having their intended impact on car use and transport choices for staff and visitors of the site.

A travel survey should be completed following initial occupation (recommended to be around three months) to establish a baseline of travel behaviour to the site. This baseline can then be used as a measure against which future changes to mode share can be assessed.

Future monitoring and review of the Travel Plan would subsequently be completed by undertaking additional travel mode surveys of staff and visitors. The future surveys are recommended to be completed every 12 months, although once travel patterns in the precinct have been established, the frequency of surveys can be determined by the Travel Plan Co-ordinator in consultation with other relevant parties.

The key information that the surveys should seek to identify include:

- Nature and frequency of visits to GPARC
- Where staff live or visitors travel from to access GPARC
- Travel mode on a regular or occasional basis
- Travel time to GPARC
- Reasons for choosing travel mode.

The survey could either be completed in hard copy format, made available within the entrance area of GPARC, or as an online survey advertised on site and via e-mail promotional information.

The results of these surveys should be used to assess changes in mode split and any potential adaptive measures that should be included in the Travel Plan. The survey can also be used as a means of providing feedback to City of Sydney and Transport for NSW on transport issues in the area. Staff and visitors can also be encouraged to provide regular feedback to the relevant authorities on any transport related matters, such as footpath and cycleway conditions, public transport services and street lighting.

7.2 Responsibility

7.2.1 Travel Plan Co-ordinator

Overall responsibility and specific roles for the implementation, monitoring and management of the Travel Plan will be provided by the City of Sydney as the owner of the facility.

A Travel Plan Coordinator should be nominated to oversee the implementation and continued development of the initiatives set out within the Travel Plan. The Travel Plan Coordinator's role should include:

- Managing and implementing the Travel Plan.
- Seeking to set up a Travel Plan Steering Group or local working group.
- Being the first point of contact for all users of the site.
- Communication and engagement with all parties/stakeholders.

- Setting up Specific User Group meetings, meetings with the local authorities, and public transport operators.
- Prepare and/or distribute maps and travel information to visitors and staff.
- Promoting the Travel Plan to the outside community through public meetings.
- Implementing promotional days and events.
- Organising the travel facility audits and surveys of visitors and staff.
- Initiate and organise personalised travel planning sessions for new staff as required.
- Producing all questionnaires, promotional and informative material.
- Maintenance of community notice boards.

The Travel Plan Co-ordinator for the site would typically be a member of staff of the occupier (in this case the GPARC operator) of the facility. However, in this instance, given the relationship between the owner and operator of GPARC, the Travel Plan Coordinator will be a Council staff member. To support the wider precinct, this person may have a similar role across the precinct to oversee and take the lead role in delivering precinct wide Travel Plan objectives. In this case there would need to be a staff representative from the GPARC operator who provides the day to day contact for the site.

The Co-ordinator role would not need to be the staff member's only role, but it is important that they are allocated sufficient time to the Travel Plan to ensure that it can be meaningfully implemented and monitored, particularly in the early stages of occupation.

7.2.2 Precinct Wide Groups

A Working Group could be convened to assist the Travel Plan Coordinator in the implementation of preferred actions. The Working Group would comprise representatives of the GPARC and Council (and potentially select community representatives), and would be led by the Travel Plan Coordinator who would facilitate Working Group meetings and take responsibility for monitoring and reviewing the Travel Plan document. The Working Group potentially could be for the whole precinct.

The primary aims of the Working Group would include:

- review Travel Plan initiatives and determine a program for implementation
- oversee completion of post occupancy surveys and follow up actions arising from these
- provide feedback on activities and initiatives such as carpooling databases
- update transport orientated targets in line with post occupancy surveys
- assist Travel Plan coordinator to promote activities and disseminate information
- advocate for sustainable transport modes among employees and visitors.

The Working Group would be responsible for the Travel Plan remaining a "live" document, with it being amended as necessary to reflect changes in the precinct, and agreeing future actions and mode split targets.

8. Actions

8.1 Background

This section sets out Travel Plan 'Actions' that will need to be completed during the development, initial occupation and ongoing operation of the GPARC site. The actions include the provision of physical infrastructure, incentive measures, education initiatives and other recommendations as a way of promoting and encouraging sustainable transport use. These actions are aimed at achieving the target mode splits identified in Section 6 and have been categorised in the following tables by timeframe.

The actions cover the start-up/ occupation stage, post opening stage and ongoing annual actions. The actions will therefore apply across the City of Sydney, both as the owner and developer of the facility, and the operator.

The following timeframes have been adopted:

- Short Term Actions: 0-1 years
- Future Actions: 1-3 years
- Annual: some actions should be implemented in the short term, and reviewed or conducted annually thereafter.

Actions contained within this Travel Plan should be reviewed and updated annually as progress is made and the surrounding development progresses.

8.2 Short Term Actions

Table 8.1 outlines the short term actions that should be addressed during the final construction phase, initial occupation and within one year of occupation to ensure that the relevant infrastructure is implemented and to address any immediate concerns.

Table 8.1: Short Term Actions

Action	Responsible	Timeframe	Checklist
Provide staff lockers and bicycle parking for dedicated staff use.	City of Sydney	Prior to Occupation	
Consider the installation of a publically available bike maintenance station near bike parking.	City of Sydney	Prior to Occupation	
Ensure there are showers and change room facilities accessible by all staff.	City of Sydney	Prior to Occupation	
Ensure bicycle parking is clearly visible or provide signage to direct visitors to cycle bays.	City of Sydney	Prior to Occupation	
Ensure that suitable pram and wheelchair/mobility scooter storage is available to enable any visitor to access the site conveniently on foot if they choose and without relying on storage in a car.	City of Sydney	Prior to Occupation	
Develop or utilise an existing precinct walking map documenting local walking routes including times and distances, to local facilities, such as shops and public transport stops. Initial data will be provided as a Transport Access Guide (TAG) to be uploaded to the GPARC website and staff intranet or a printed copy brochure available within entrance lobby and staff areas.	City of Sydney	Upon Occupation	
Develop or utilise an existing precinct bicycle map documenting local cycling routes for travel to and from GPARC connecting with nearby cycling routes. Initial data will be provided as a Transport Access Guide (TAG) to be uploaded to the GPARC website and staff intranet or a printed copy brochure available within entrance lobby and staff areas. Utilise www.sydneycycleways.net/map/ cycling maps.	City of Sydney	Upon Occupation	
Develop or utilise an existing map of local vicinity bus and train stops and wider connections documenting the location of nearby public transport stops and services. Initial data will be provided as a Transport Access Guide (TAG) to be uploaded to the GPARC website and staff intranet or a printed copy brochure available within the entrance lobby and staff areas. Utilise http://tp.transportnsw.info journey planner.	City of Sydney	Upon Occupation	
Consider providing all new staff with an Opal card with $30 free travel pre-loaded. This will assist in reducing the barriers to public transport use, particularly for infrequent users and allowing blended travel.	City of Sydney	Upon Occupation	
Supply and maintain a workplace bicycle toolkit consisting of puncture repair equipment, a bike pump, a spare lock and lights.	GPARC Operator	Upon Occupation	
Supply information/maps with green travel options as part of visitor membership/ staff induction kit.	GPARC Operator	Upon Occupation	
All promotional material for GPARC to provide clear details on how to access the site on foot, by bicycle and on public transport ahead of vehicle and parking information.	City of Sydney	Upon Occupation	
Place information on the work intranet with links to appropriate external websites e.g. Transport NSW, Opal Customer Care.	GPARC Operator	1 month	
Consider providing assistance to staff as required to identify their travel options (personalised travel planning).	GPARC Operator	1 month	
Conduct an initial travel survey of staff and visitors.	City of Sydney	3 months	
Seek to enter an agreement with a local bicycle retailer for discounted servicing of staff bikes and other incentives.	GPARC Operator	1 year	

8.3 Future Actions

Table 8.2 outlines actions that should be completed or established following the first year of occupation to ensure that the GTP continues to meet its objectives, particularly in promoting travel by active modes.

Table 8.2: Future Actions

Action	Responsible	Timeframe	Checklist
Seek to provide a screen for live public transport feed so visitors can see when the next bus/train is scheduled, including details on network delays and disruptions. Potentially utilising http://tp.transportnsw.info/ "next departures" information.	City of Sydney	1-2 years	
Work with the GPARC operator and other precinct occupiers to seek to establish a precinct wide Bicycle Users Group (BUG). BUGs are formed by people who want to work together to improve facilities for cyclists and encourage cycling. Such a group could consider affiliation with other BUG groups that may be established as part of the overall Green Square development.	City of Sydney	3 years	
Consider the development of a 'bike buddy' scheme for inexperienced cyclists, within the GPARC site and potentially as part of a precinct wide scheme.	City of Sydney/ GPARC Operator	3 years	
Seek to establish a GPARC staff account for access to local car share for use on any essential GPARC travel that can't be undertaken by other modes	GPARC Operator	3 years	
Consider providing an on-site bicycle maintenance service (either as a special one-day event or on a regular basis).	City of Sydney	3 years	
Subject to on site bicycle parking demand, seek to establish a bike hire hub based at GPARC.	City of Sydney	3 years	
Encourage staff to take part in local cycling and other community health/active events to support staff inclusion, morale and promote cycling (and other activities) for health benefits.	GPARC Operator	3 years	

8.4 Annual and Ongoing Actions

Table 8.3 outlines the actions that should be established within the initial year of occupation of the site and continue on at least an annual basis.

Table 8.3: Annual Actions

Action	Responsible	Timeframe	Checklist
Update precinct walking, cycling and public transport maps and information as the surrounding precinct evolves.	City of Sydney	Annually or on major changes	
Encourage staff to take part in national walk and cycle to work days.	GPARC Operator	Annually	
Seek to implement TravelSmart Get to Work days encouraging staff to come by alternative modes of transport if mode split targets are not being achieved.	GPARC Operator	Annually	
Monitor and review bicycle parking demand over time, and if demand regularly exceeds supply, take adaptive measures to provide more bicycle parking and locker space.	City of Sydney/ GPARC Operator	Ongoing	
Consider providing all new staff with an Opal card with $30 free travel pre-loaded. This will assist in reducing the barriers to public transport use, particularly for staff unfamiliar with public transport networks.	City of Sydney/ GPARC Operator	Ongoing	
Consider providing assistance to new staff as part of their induction to identify their travel options (personalised travel planning).	GPARC Operator	Ongoing	
Consider options for discounted entry to those who walk/cycle and/or discounted membership to local residents (within precinct who would be expected to walk).	City of Sydney/ GPARC Operator	Ongoing	

Appendix A

Transport Access Guide

Gunyama Park Aquatic and Recreation Centre (GPARC) occupies the block bounded by Joynton Avenue, Zetland Avenue, George Julius Avenue and Rose Valley Way in Zetland. It is conveniently located, directly east of the Green Square Town Centre.

Walking: GPARC is no more than a 5 minute walk from the nearest bus stops, Green Square Town Centre and various parks. Established pedestrian walkways and crossing facilities provide visitors with a safe walking route to/from GPARC.

By Bicycle: Two one-way cycling routes run along Zetland Avenue, taking cyclists to key facilities including the Green Square Town Centre and various parks in the area. These cycling routes connect well with the broader area cycling network to provide links to several key attractors, including Sydney CBD.

By Bus: GPARC is within a 3 minute walking distance from frequent Sydney bus services that stop along Joynton Avenue. These services provide links to the surrounding local area, regional key destinations and Sydney CBD. The services operate frequently during both peak and off-peak times.

More detail on bus services provided overleaf.

By Train: Green Square Station is located approximately 500 metres, or a 6 minute walk west of GPARC. This station services the T2 Airport Line that provides links to the Sydney CBD and Sydney Airport.

More detail on train services provided overleaf.

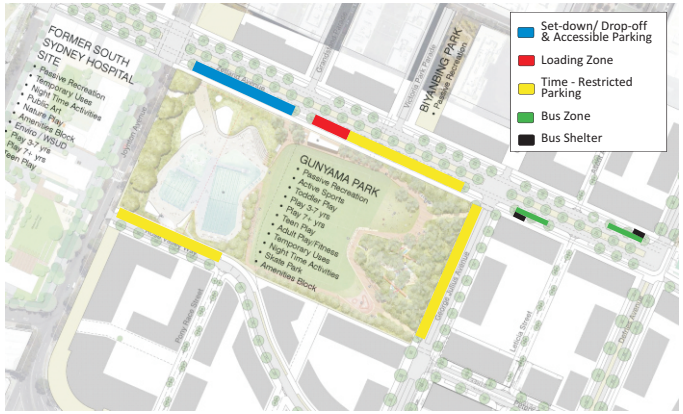
By Car: A set-down/pick-up zone is available near the main entrance along Zetland Avenue. There are 68 on-street time-restricted car spaces along the site frontage streets. The broader area provides a total of 200 on-street parking spaces.

Mobility Parking: Marked accessible parking spaces are available along Zetland Avenue adjacent to the primary entrance.

Opal Cards: Opal cards are available for purchase online (www.opal.com.au) or at selected local newsagencies and service stations. Use Opal cards for access to the public transport network.

By Light Rail (Future): Zetland Avenue is proposed to accommodate a future Eastern Transit Corridor light rail service that will provide links to the Sydney CBD.

For further public transport information go to www.transportnsw.info or call 131 500



LOGO

Gunyama Park Aquatic & Recreation Centre

OPENING HOURS
AQUATIC CENTRE
x:xxam to x:xxpm Monday to Friday
x:xxam to x:xxpm Saturday
x:xxam to x:xxpm Sunday and Public Holidays

Contact Gunyama Park Aquatic Centre
XX Zetland Avenue, Green Square NSW 2015
p (02) xxx xxx f (02) xxx xxx
e xxx@xxxxxx.com.au

city of villages

LOGO

Gunyama Park Aquatic & Recreation Centre

Transport Access Guide

DRAFT

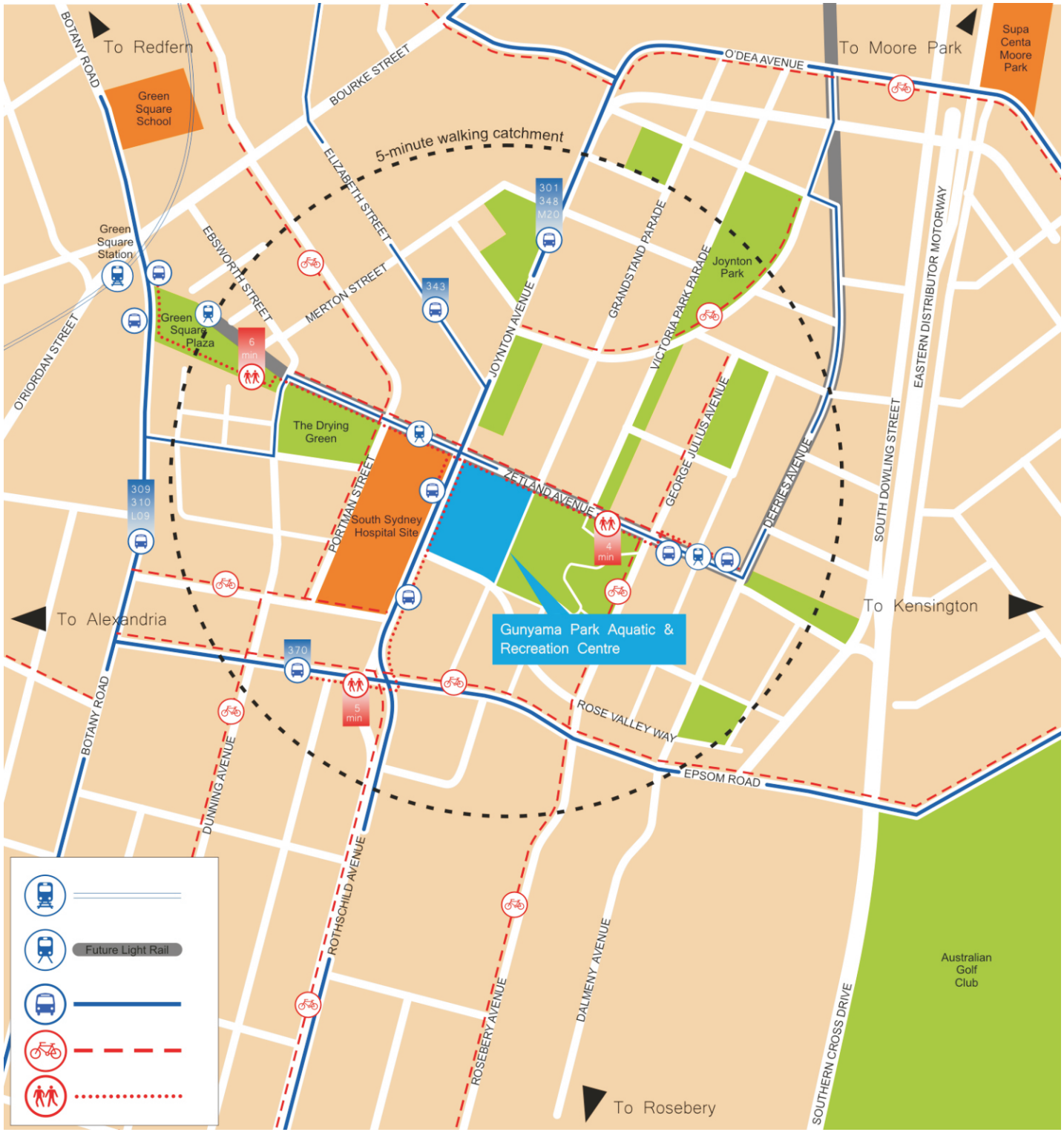
How to get to Gunyama Park Aquatic & Recreation Centre

CITY OF SYDNEY 2030

BUS ROUTE (local origins & destinations)		FREQUENCY OF SERVICE (approximate)
301	City to Eastgardens via Surry Hills, Zetland & Mascot	Mon-Fri between 06:13-23:28 Mon-Fri less than 10 mins (peaks) Mon-Fri every 20-30 mins (daytime) Mon-Fri every 10-30 mins (after 7pm) Weekends every 30 mins
343	Chatswood to Kingsford via North Sydney, City & Zetland	Mon-Fri between 04:24-00:09 Mon-Fri every 5-10 mins (peaks) Mon-Fri every 10-20 mins (daytime) Mon-Fri every 20-30 mins (after 7pm) Weekends every 30 mins
348	Bondi Junction to Wolli Creek via Randwick Jn, UNSW & Alexandria	Mon-Fri between 06:18-19:42 Mon-Fri every 30 mins (peaks) Mon-Fri every 30 mins (daytime) Mon-Fri every 30 mins (after 7pm) Weekends every 30 mins
370	Coogee to Leichhardt via UNSW, Newtown & Glebe	Mon-Fri between 05:42-21:06 Mon-Fri every 10 mins (peaks) Mon-Fri every 20 mins (daytime) Mon-Fri every 20 mins (after 7pm) Weekends every 30-60 mins
M20	Gore Hill to Botany via North Sydney, City, Victoria Park	Mon-Fri between 06:38-20:21 Mon-Fri every 10 mins (peaks) Mon-Fri every 15 mins (daytime) Mon-Fri every 10-20 mins (after 7pm) Weekends every 20 mins

TRAIN LINE (local origins & destinations)		FREQUENCY OF SERVICE (approximate)
T2 Airport Line	City to Macarthur via Airport	Mon-Fri between 04:45-00:15 Mon-Fri every 2-5 mins Weekends every 2-15 mins

For further public transport information go to www.transportnsw.info or call 131 500



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U:\02 CURRENT PROJECTS\C150202 - Green Square\Civil Drawings\C150202 C0x 100DD.dwg

LEGEND

- SEDIMENT BUND & BARRIER OR SIMILAR APPROVED DEVICE
- OVERLAND DRAIN
- SITE GRADE
- RETAINIG WALL

Levels Table			
No.	Min. Level	Max. Level	Colour
1	-1.533	0.000	
2	0.000	0.500	
3	0.500	1.500	
4	1.500	2.500	
5	2.500	3.330	

CUT / FILL

PROVIDE PROTECTION TO SITE OUTFALL LOCATION (TYP)

ZETLAND AVENUE IS ONLY BEING PARTIALLY CONSTRUCTED DURING THE GPARC CONSTRUCTION PHASE (APPRIOX HALF WAY ALONG THE GPARC SITE)

SITE OUTFALL LOCATION (BEING CONSTRUCTED BY DG ALLIANCE)

FUTURE BUILDING LOCATION TO BE PROTECTED FROM WATER INGRESS DURING CONSTRUCTION.
CONTRACTOR TO FOLLOW THE PROCEDURES OUTLINED IN THE GEOTECH REPORT AND THE REMEDIAL ACTION PLAN.

FYI - JOYNTON AVENUE LEVELS WILL BE RAISED APPROXIMATELY 1m TO REMOVE TRAPPED LOW POINT PRIOR TO THE CONSTRUCTION OF GPARC (WORKS SCHEDULED BETWEEN APRIL 2017 - NOV 2018)

AQUATIC CENTRE BUILDING

REFER TO ARBORIST REPORT FOR TREE PROTECTION MEASURES FOR RETAINED TREES ALONG THIS BOUNDARY

FUTURE PLAYING FIELD LOCATION TO BE PROTECTED FROM WATER INGRESS DURING CONSTRUCTION.
CONTRACTOR TO FOLLOW THE PROCEDURES OUTLINED IN THE GEOTECH REPORT AND THE REMEDIAL ACTION PLAN.

PLAYGROUND/PARK AREA (REFER TO LANDSCAPE PLANS FOR LEVELS & DETAILS)

PROVIDE EXTERNAL FLOOD RETARDATION BASIN OUTLET AS PER HYDROPLAN RECOMMENDATION TO PROTECT SITE DURING SITE WORKS PHASE.

ALL BUILDINGS TO BE DEMOLISHED ON THE CURRENT CITY OF SYDNEY EPSOM RD DEPOT, 94-104 EPSOM RD, ZETLAND. TO PROTECT GPARC SITE DURING CONSTRUCTION, THE MAIN OVERLAND FLOW ROUTE FOR FLOOD WATER IS TO BE TEMPORARILY DIVERTED TO RETARDING BASIN AT 94-104 EPSOM RD.

GEORGE JULIUS AVENUE WILL BE CONSTRUCTED AFTER THE GPARC DEVELOPMENT

STAGE 1 INDICATIVE RETAINING WALL & BATTERING - REQUIRED TO RETAIN LAND TO NEW FOOTPATH LEVELS & DIRECT STORMWATER TO OVERLAND FLOW

STAGE 1 EXTENT OF ROSE VALLEY WAY

STAGE 1 INDICATIVE BATTERING REQUIRED TO RETAIN ADJACENT LAND

STAGE 1 INDICATIVE RETAINING WALL TO FINISHED PARK LEVELS

GENERAL NOTES

1. THE CONTRACTOR WILL BE RESPONSIBLE FOR THE CONTROL OF SOILS, POLLUTION FROM SEDIMENT AND CONSTRUCTION WASTE DURING THE LAND DISTURBANCE ACTIVITIES AND DURING THE CONSTRUCTION OF THE SITE WORKS.

2. THE CONTRACTOR MUST PREPARE A DETAILED SWMP AND HAVE THIS APPROVED BY COUNCIL PRIOR TO COMMENCEMENT ON SITE.

3. THE CONTRACTOR MUST PUT IN PLACE MEASURES THAT CONTROL STORMWATER FLOWS ONTO, THROUGH AND FROM THE SITE.

4. TREE PROTECTION MEASURES TO BE PUT IN PLACE PRIOR TO ANY WORKS BEING UNDERTAKEN. PROTECT MATURE TREES RETAINED ALONG JOYNTON AVENUE BOUNDARY (REFER TO THE ARBORIST REPORT).

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REVISIONS

No	DATE	AMENDMENTS	AUT.
P1	17.05.16	100% DD FOR INFORMATION	VR
P2	30.05.16	MINOR AMENDMENTS TO DD DRAWINGS SET	DF

CLIENT: CITY OF SYDNEY

ARCHITECTS: GRIMSHAW

LANDSCAPE: ASPECT T.C.L

CONSULTANT: CJ ARMS & ASSOCIATES

PROJECT: GPARC
GUNYAMA PARK AQUATIC AND RECREATION CENTRE
132-140 JOYNTON AVE, ZETLAND NSW 2017

DRAWING: CIVIL SITEWORKS EROSION & SEDIMENT CONTROL PLAN

DRAWING STATUS: PRELIMINARY

PROJECT STATUS: DESIGN DEVELOPMENT

SCALE	A1 1:500
DESIGN	PP/BW
DRAWN	BW/WB/DF
DATE	28.07.15
PROJECT NUMBER	C150202
DRAWING & REV.	CV-007 A P2

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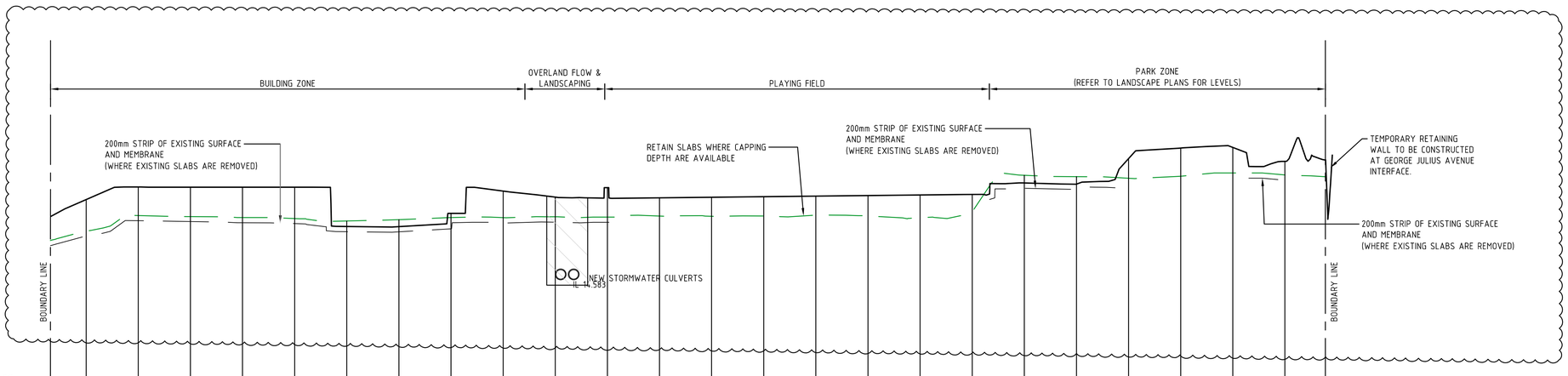
P2	04.05.16	MINOR AMENDMENTS TO DD DRAWINGS SET	DF
P3	17.05.16	MINOR AMENDMENTS TO DD DRAWINGS SET	DF



DATUM R.L. 12.00

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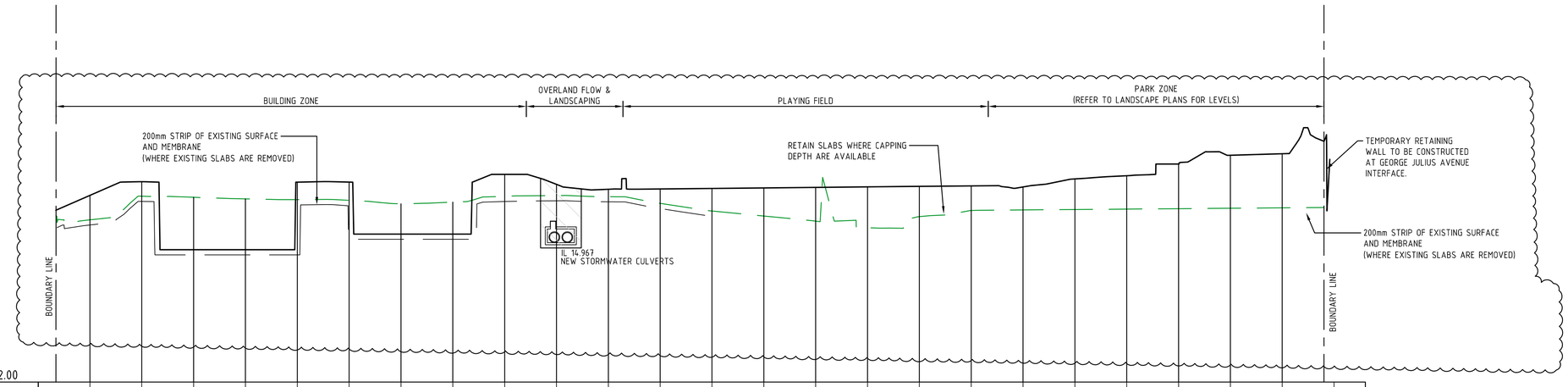
DESIGN LEVEL		19.23	19.71	19.70	19.70	19.70	18.20	18.19	18.70	19.55	19.32	19.69	19.29	19.32	19.34	19.36	19.38	19.40	19.43	19.87	19.82	20.80	21.21	21.23	20.70		
EXISTING LEVEL		18.02	18.62	18.58	18.54	18.50	18.41	18.46	18.54	18.54	18.57	18.56	18.60	18.59	18.60	18.63	18.60	18.53	18.76	20.16	20.11	20.05	20.12	20.25	20.17		
CHAINAGE		10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	150.00	160.00	170.00	180.00	190.00	200.00	210.00	220.00	230.00	240.00	250.00	256.02

LONGITUDINAL SECTION C
SCALES: HORIZONAL 1:200 VERTICAL 1:40



DATUM R.L. 12.00

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DESIGN LEVEL		19.19	19.72	17.10	17.10	19.70	19.71	17.70	17.70	20.00	19.62	19.43	19.44	19.46	19.48	19.50	19.52	19.54	19.56	19.52	19.82	19.95	20.40	20.74	20.79		
EXISTING LEVEL		18.25	19.16	19.12	19.06	19.03	19.00	18.87	18.93	19.16	19.18	19.14	18.88	18.59	18.40	18.20	17.95	18.37	18.61	18.63	18.65	18.66	18.68	18.69	18.71		
CHAINAGE		10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	150.00	160.00	170.00	180.00	190.00	200.00	210.00	220.00	230.00	240.00	250.00	256.02

LONGITUDINAL SECTION D
SCALES: HORIZONAL 1:200 VERTICAL 1:40

PLEASE NOTE:
AS PER RAP RECOMMENDATION
WHERE POSSIBLE THE EXISTING CONCRETE SLAB ARE TO BE RETAINED

CLIENT CITY OF SYDNEY
ARCHITECTS GRIMSHAW
LANDSCAPE ASPECT T.C.L
CONSULTANT CJ ARMS & ASSOCIATES

PROJECT GPARC
GUNYAMA PARK AQUATIC AND RECREATION CENTRE
132-140 JOYNTON AVE, ZETLAND NSW 2017

DRAWING CIVIL SITEWORKS
SITE CROSS SECTIONS
SHEET 2

DRAWING STATUS PRELIMINARY
PROJECT STATUS DESIGN DEVELOPMENT

SCALE A1 1:500
DESIGN PP/BW
DRAWN BW/WB
DATE 28.07.15

PROJECT NUMBER C150202
DRAWING & REV. CV-301 P3

NOTES:

1. FOR VEGETATION REMOVAL REFER TO LANDSCAPE ARCHITECTURAL DRAWINGS.
2. ALL RETAINED TREE TO BE PROTECTION AS PER AS 4970-2009.
3. ALL INTERNAL FENCING TO BE REMOVED.
4. CUT, SEAL AND REMOVE ALL EXISTING INCOMING SERVICES TO ALL LOTS, INCLUDING GAS, ELECTRICITY, COMMUNICATIONS, WATER AND SEWER.
5. RETURN ALL UTILITY METERS TO THE RELEVANT AUTHORITIES AND OBTAIN RECEIPTS FOR THEIR RETURN.
6. ALL EXISTING PAVEMENTS AND SLABS BEING REMOVED ARE TO BE CRUSHED ONSITE AND STOCKPILED FOR RE-USE AS FILL AS COMPACTED GRANULAR MATERIAL IN BULK EARTHWORKS.
7. CONTRACTOR TO REFER TO THE GEOTECHNICAL REPORT AND THE REMEDIAL ACTION PLAN FOR DETAILS AND PROCEDURES RELATING TO DEMOLITION, STOCKPILING AND MATERIALS MANAGEMENT.

LEGEND

- EXISTING SLAB REMOVED BY THIS PROJECT
- SLAB ASSUMED REMOVED AS PART OF 'DG ALLIANCE' PROJECT
- EXISTING SERVICE TO BE REMOVED

ELECTRICAL CABLES TO BE REMOVED IN THIS AREA. REFER TO CARDNO EXISTING SERVICES DRAWINGS FOR EXTENT OF WORKS (FROM WEST PROPERTY BOUNDARY TO NORTH PROPERTY BOUNDARY ONLY). NOTE CABLES WILL BE CUT AND CAPPED AT THE PROPERTY BOUNDARIES UNDER A SEPARATE ASP1 CONTRACT.

EXISTING SEWER MANHOLE TO BE PROTECTION DURING DEMOLITION

SITE BOUNDARY (RED)

EXISTING STORMWATER CULVERT TO BE REMOVED UNDER THE NEW BUILDING AS PART OF THE DEMOLITION CONTRACT. PIPEWORK TO BE CUT, SEALED AND ALL DECOMMISSIONED PIPEWORK TO BE REMOVED. BACKFILL TRENCHES AS PER GEOTECHNICAL ENGINEER REQUIREMENTS AND RAP' REQUIREMENTS.

FUTURE STORMWATER DETENTION TANK
(SIZE OF TANK REQUIRED TO BE CONFIRMED WITH SYDNEY WATER)

EXISTING SEWER MANHOLE TO BE CAPPED AND BURIED (SUBJECT TO SYDNEY WATER ACCEPTANCE

FUTURE AQUATIC CENTRE BUILDING

THIS AREA IS TO BE EXCAVATED (CUT). EXISTING ASPHALT & SUBGRADE TO BE CRUSHED AND STOCKPILED FOR RE-USE AS FUTURE FILL.

FOR VEGETATION REMOVAL REFER TO LANDSCAPE ARCHITECTURAL DRAWINGS. ALL RETAINED TREE TO BE PROTECTION AS PER AS 4970-2009.

EXISTING WATER MAIN TO BE REMOVED AS PART OF THE DEMOLITION CONTRACT. PIPEWORK TO BE CUT, SEALED AND ALL DECOMMISSIONED PIPEWORK TO BE REMOVED.
BACKFILL TRENCHES AS PER GEOTECHNICAL ENGINEER REQUIREMENTS AND RAP' REQUIREMENTS.

THIS BUILDING HAS BEEN DEMOLISHED BY DG ALLIANCE. DEMOLITION OF BUILDING SLAB TO BE INCLUDED IN GPARC WORKS AFTER ALL SERVICES PIPES HAVE BEEN DISCONNECTED AND DECOMMISSIONED.

EXISTING SEWER MANHOLE TO BE PROTECTION DURING DEMOLITION

EXISTING COUNCIL DEPOT SITE & BUILDINGS TO BE DEMOLISHED AS PART OF THESE CONTRACT WORKS.

REMOVE ELECTRICAL CABLES IN THIS AREA FROM SUBSTATION TO WEST PROPERTY BOUNDARY ONLY. REFER TO CARDNO EXISTING SERVICES DRAWINGS FOR EXTENT OF WORKS. NOTE CABLES WILL BE CUT AND CAPPED AT THE PROPERTY BOUNDARY UNDER A SEPARATE ASP1 CONTRACT.

ZETLAND AVENUE
JOYNTON AVENUE
GEORGE JULIUS AVENUE (FUTURE)
ROSE VALLEY WAY
SECTION A
SECTION B
SECTION C
SECTION D
SECTION E
97.495

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PRELIMINARY DRAWING FOR INFORMATION ONLY

CLIENT: CITY OF SYDNEY

ARCHITECTS: GRIMSHAW

LANDSCAPE: ASPECT T.C.L

CONSULTANT: CJ ARMS & ASSOCIATES

PROJECT: GPRC
GUNYAMA PARK AND RECREATION CENTRE
132 JOYNTON AVE, ZETLAND NSW 2017

DRAWING: CIVIL SITEWORKS DEMOLITION PLAN

DRAWING STATUS: PRELIMINARY

PROJECT STATUS: DESIGN DEVELOPMENT

SCALE	A1 1:500
DESIGN	PP/BW
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DATE	28.07.15
PROJECT NUMBER	C150202
DRAWING & REV.	CV-005 P4

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Green Square Aquatic and Recreation Centre
Proposed Cogeneration Plant Installation
Statement of Environmental Effects.

Cogeneration Plant Installation Overview

Design and construct a 200 to 260 kWe (electrical output) cogeneration unit in the main plant room of the Green Square Aquatic and Recreation Centre (GPARC); connect the installation to the Centre's electrical reticulation system in manner that allows the power to be used locally or at other facilities connected to the South Sydney Hospital (SSH) private wire; control the cogeneration power production in conjunction with the roof-top photovoltaic installation and any other embedded generation, so the conditions of the private wire - Ausgrid connection agreement are complied with; and integrate the hot water service produced by the cogeneration unit with other pool, space and domestic hot water heating services in the GPARC.

Key Environmental Effects

The main *potential* environment effects of a cogeneration installation are:

1. Visual Impacts
2. Noise and vibration
3. Air quality effects
4. Carbon Abatement

The extent to which these impacts apply to the GSAC are discussed below along with potential mitigation measures and proposed Development Consent conditions. Beforehand, a general description of cogeneration technology will be presented; then an outline of the benefits or motivation for cogeneration; followed by a more specific description of the proposal for the GPARC.

Cogeneration Technology

Cogeneration is the simultaneous production of two energy services, usually electricity and heat (manifested as hot water). A variety of machines can be used for cogeneration, such as gas turbines or piston (reciprocating) engines. The machines can also use a variety of fuels; petrol, diesel, natural gas or biogas gas and even pulverised coal dust.

The machine proposed for the GSAC is a natural gas fuel reciprocating engine. Natural gas engines are typically diesel engines converted to run on natural gas. The cogeneration engine directly drives a gen-set which produces electricity. Electricity output can varied to match demand by ramping the machine up or down (giving it more or less fuel).

Heat production by the cogeneration machine can be understood by reference to a standard car engine. Some of the heat produced by a car during fuel combustion is absorbed by the engine block, transferred to a water jacket and then dissipated to the atmosphere via the radiator (see Figure 1). On cold days heat is also diverted to the internal cabin heater. Heat also leaves the engine via the hot exhaust gases. Heat is also directly radiated off the exhaust system and the

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engine – that is why the engine compartment gets warm and heat shields are often needed between exhaust system components and the vehicle underbody.

With a cogeneration system the jacket water is used via a heat exchanger to provide energy services - pool or space heating, hot water for laundries etc. Much of the exhaust heat can also be captured, turned into hot water and put to good use. Heat directly radiating off engine, gen-set and exhaust is usually lost but this typically amounts to less than 10% of the heat produced.

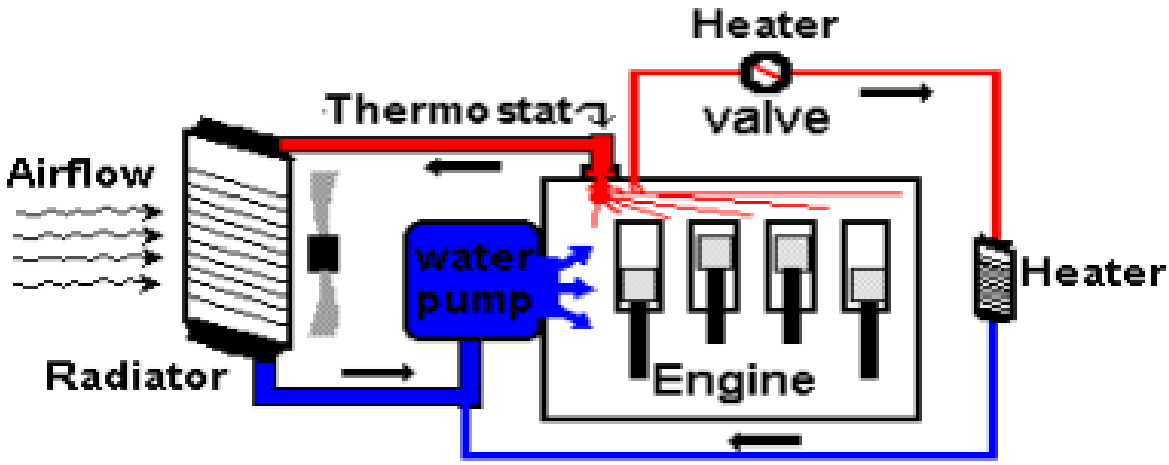

Figure 1: **Motor Vehicle - Reciprocating Engine Jacket Heat Transfer System**
(on cold days some heat is diverted to the internal cabin heater – RHS of diagram).

Just like some cars, cogeneration units may also have turbochargers that compress the air fed to the engine. This allows more fuel to be used and hence more power produced from a given sized engine. The act of compressing the air generates heat (like a bicycle pump) that can also be captured (from a device known as the aftercooler) and used for low temperature services such a pre-heating domestic hot water for showers. This increases the overall energy efficiency of a cogeneration system.

Benefits of Cogeneration

The principle benefits of cogeneration are energy efficiency and carbon abatement when compared with more conventional ways of generating heat and power.

The most common way to produce grid electricity is via coal fired boilers and steam turbine plant and, in some circumstances hydro-electric schemes and nuclear power (not in Australia). These days natural gas turbines also play an important role and progressively renewable energy sources, such as wind and solar are becoming important.

With coal fired boiler and steam turbine plant, coal is burnt to produce steam. Steam is used to drive a turbine – generator system. This system is typical around 40% efficient and produces large amounts of waste heat. Only in rare cases is this heat used – for district heating of buildings, for heating greenhouses or (rarely) aquaculture (e.g. prawn farms). Usually there is no

local use for this heat (and it is impractical to transport it) so the heat is dissipated to the atmosphere via cooling towers (see Figure 2).

The most efficient, commercially proven, form of fossil fuel power generation is natural gas combined cycle. With this technology a natural gas turbine drives a gen-set. Some of the heat in the hot turbine exhaust is captured and turned into steam. This in turn is used to drive a small steam turbine gen-set combination to produce more electricity. The overall efficiency of this configuration can be a bit over 50%. Unused heat is again discharged to the atmosphere.



Figure 2: **Cooling Towers for a Coal Fired Power Station**
(the white clouds consist of moisture condensing as air exits the cooling towers)

With cogeneration systems the waste heat is used directly on-site. Unlike the natural gas combined cycle approach, waste heat is not partially converted to electricity with attendant losses. More than 85% of the natural gas input to a cogeneration system can be converted into useful energy services. In a practical setting, due to mismatches from time to time in the supply and demand for heat, the average energy efficiency is typically around 80% (see Figure 3 below). This translates into a substantial advantage in terms of carbon emissions.

Cogeneration can reduce carbon emissions by up to 50% compared with coal fired steam turbine power systems and by up to 30% compared with natural gas combined cycle power generation. Even a rigorous analysis of obtaining power from the grid and hot water from a gas boiler (or electric heat pump) and comparing this with heat and power from cogeneration, comes up with similar levels of carbon abatement.

When a cogeneration systems is retrofitted to a facility there is usually less import of grid electricity to the facility but slightly more gas consumption. As noted above, the net result is a substantial carbon abatement, but in the right circumstances there also be significant

commercial benefits as well. Depending on the electricity and gas tariffs, there may be a net savings in operating costs. If the capital cost of the retrofit (or new building installation) is not too great then can also be a net lifecycle cost savings.

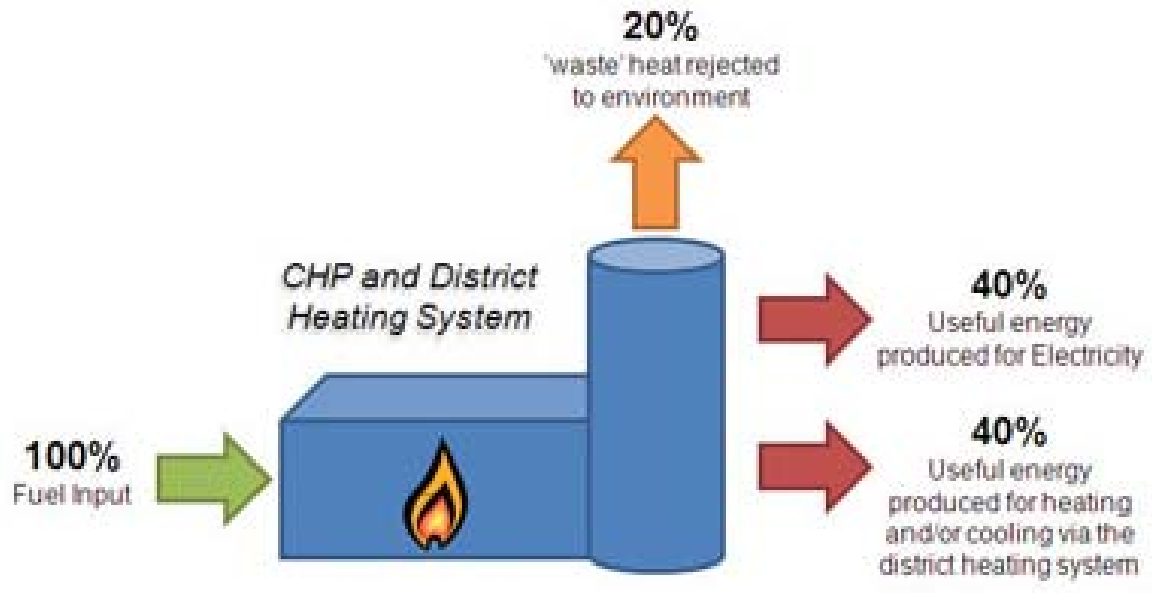

Figure 3: **Typical Cogeneration Efficiencies**
(the heat and power production balance depends on actual system configuration)

Green Square Aquatic and Recreation Centre Cogeneration System

The cogeneration engine proposed for the GPARC is sized in the range 200 to 260kWe. Engines in this size range correspond to large truck or bus engines rated at 270 to 360 horsepower. Engine displacement is typically around 12 litres. The number of cylinders can vary from 6 to 12.

The engine will come as a packaged unit. Typically the engine, generator and jacket heat exchanger, will be in an acoustic a container (see Figure 4). The overall dimensions of the packaged unit are typically 4 metres long, 1.5 metres wide and around 3 metres tall (excluding exhaust stack).



Figure 4: **Packaged Cogeneration Unit - Side Covers Removed**

The cogeneration packages unit and its ancillary equipment such as the dump radiator (covered shortly) also need clearances to allow access for maintenance. Figure 5 below shows the typical plan layout for a 230 kWe installation. At the GPARC the heat rejection or dump radiator will most likely be located on the roof above the plantroom.

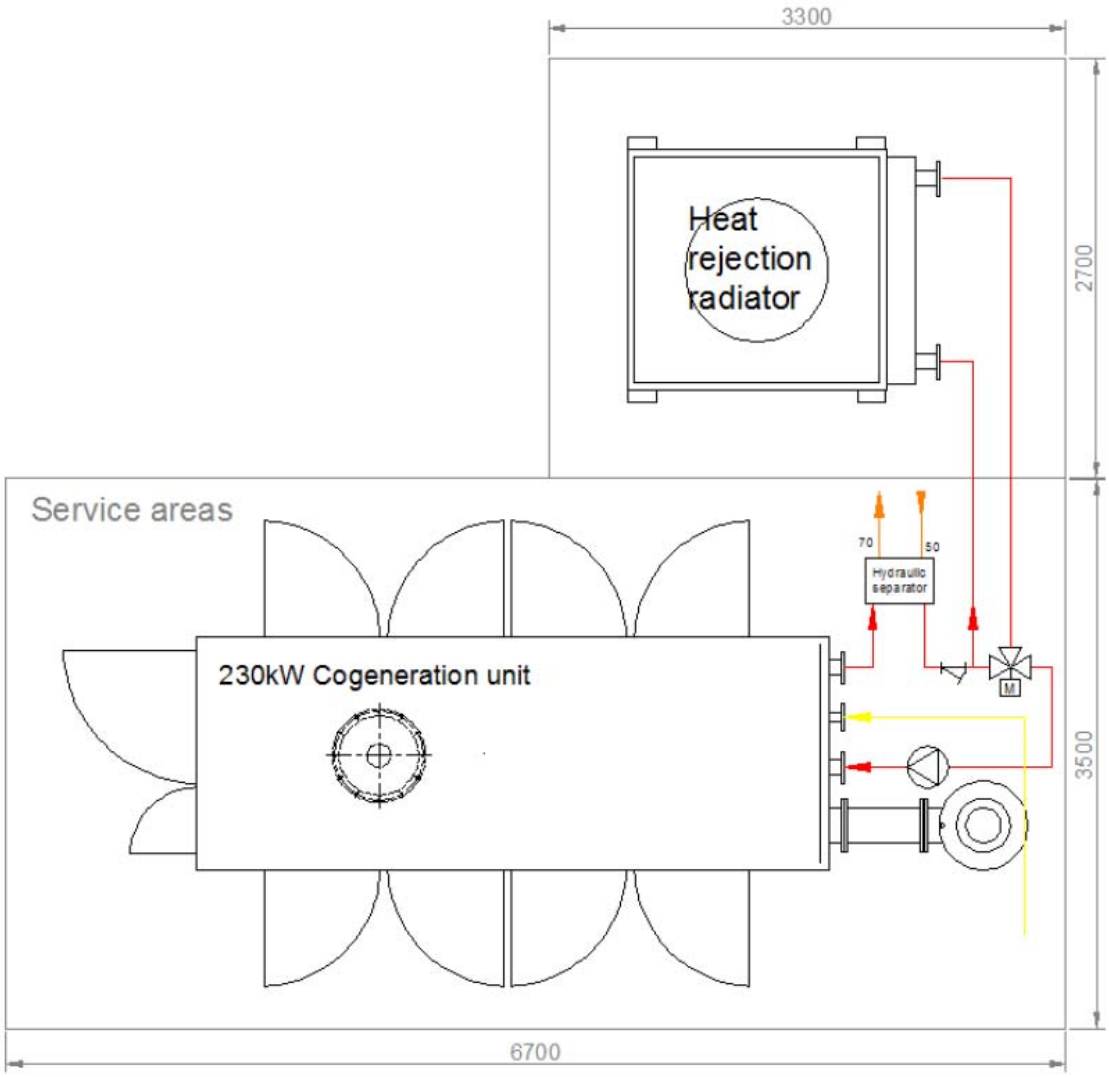

Figure 5: **Typical Plant Layout - 230 kWe Cogeneration Installation**
(Dimensions are in mm)

The exhaust heat exchanger and the exhaust silencer(s) are usually separate bolt on units. The engine container will have an air intake with a silencer or acoustically treated louvers to provide engine ventilation. The package is supported on isolation mounts to mitigate vibration.

The cogeneration unit will be located in its own plant room within the GPARC building. The plant room will be fully enclosed but will have sufficient ventilation to provide combustion air for the cogeneration machine and gas boiler(s), and to meet the requirements of any air handling units and personnel in the space.

The engine's exhaust will pass through a heat recovery unit and one or more silencers located within the plant room. The exhaust will pass through the roof and discharge above the building with sufficient clearance from any air intakes or openings in the building envelope. The part of

the exhaust visible above the roof is typically 150mm in diameter and fabricated from stainless steel.

To manage heat supply and demand imbalances a dump radiator is used. This is typically fabricated from powder coated sheet metal enclosure with a fined metal radiator core and one or more electric fan motors. For the GPARC it will be a roof mounted low profile unit. Dump radiators can also be installed in roof wells so that they do not protrude above the roofline; or placed behind balustraded areas to reduce their visibility.

Electrical cables from the gen-set connect to the building Main Switch Board (MSB). Full compliance with Australian-New Zealand Standards ensures electrical safety. A connection agreement with Ausgrid will take care of wider grid safety and performance (power quality) issues.

Heat is transferred from the cogeneration unit to the building's hot water loop via a heat exchanger(s). In common with other plant that use water as an energy transfer medium (e.g. air conditioning chillers and cooling towers), the cogeneration water system will be chemically treated to avoid corrosion and biological growth. None of the cogeneration water circulation will be in contact with, or at risk of cross-contaminating potable water.

Engine oil capacity varies with engine size, but for machines in the 200 to 260 kWe range the volume is normally around 20 litres. Packaged cogeneration units are usually supplied with on-board oil pans or bunds. Oil spill kits are normally provided in close proximity to the machines to deal with the any mishap during oil changes.

The plant room will have a gas detector to provide an alarm in the event of gas leakage. The machine will also shut-down in the event of low gas pressure. The gas-fire safety record of cogeneration machines is as good as that for natural gas boilers, a ubiquitous piece of technology. A large percentage of the State Transit Authority Sydney Buses fleet is powered by compressed natural gas. Natural gas cogeneration is a well-established and safe technology.

Potential Environmental Effects

As mentioned previously, the main *potential* environment effects of a cogeneration installation are:

1. Visual Impacts
2. Noise and vibration
3. Air quality effects
4. Carbon Abatement

Each of these are discussed below.

a) Visual Impact

As mentioned above, the cogeneration unit will be fully housed inside its own plant room within the GPARC building and consequently not visible to facility clients or passers-by. The only externally visibly units will be the exhaust stack and the dump radiator.

The exhaust stack will be a 150mm diameter (more or less) stainless steel pipe with a rain cowl/shield on top. The height of the cowl above the roof depends on its position with respect to the roof ridge or high point, the disposition of adjacent roof top

equipment and the location of air intakes or windows. For a near flat roof, like that above the plant room, the cowl should be no higher than 1.5 metre above the roof.

The exhaust will be set back from the roof edge and consequently it is unlikely to be visible from ground level close to the building. Furthermore, it will be possible to architecturally integrate the exhaust and cowl into the building design from the outset as opposed to having to retrofit it to an existing building.

A dump radiator will also be installed on the roof. Dump radiators come in two general configurations; low profile, large footprint, multiple fan units and small footprint tall units with only one or two fans (the latter is shown in Figure 5 above). Radiators can be installed in roof wells so that they do not protrude above the roofline; or placed behind balustraded areas to reduce their visibility.

A small footprint tall unit for the GPARC sized engine would be about 1500 mm square by about 1750 mm tall (an example is shown in Figure 5 above). A low profile unit would be about 750 mm high. Its footprint would be around 2500 mm by 1000 mm (an example is shown in Figure 6 below). The radiator would be located back from the building edge which reduces visibility from the ground. The final choice of radiator style, location and need for any aesthetic treatment would be made in conjunction with the GPARC architectural requirements with the aim of not detracting from the visual amenity of the building.



Figure 6: Low Profile Dump Radiator

b) Noise and Vibration

As mentioned earlier, the cogeneration machine will come as a packaged unit with an acoustic enclosure and be installed in the main plant room on isolation mounts. Standard cogeneration acoustic treatment results in around 80 dB (A) noise levels, but the packaged unit for the GPARC will be treated with additional insulation to achieve less than 75 dB(A) at 1 metre. This is mainly for the benefit of technicians working in the plant room as no discernible noise will emanate from the plant room to building occupants or outside passers-by. A noise level of 75 dB (A) is louder than normal speech and about the same level as the sound of a vacuum cleaner at one metre.

Sound emanating from roofs can carry. The cogeneration exhaust system will have one or two silencers, depending on make and model, and a heat recovery module which also attenuates sound. The sound at rooftop level will be less than 65 dB and not discernible to building occupants or street level passers-by.

In addition to the plant and equipment specifications that will apply, the cogeneration contractor will also be required to demonstrate that consideration has been given to and, where appropriate, the installation will comply with:

- The NSW Industrial Noise Policy
- Australian/New Zealand Standard 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors (AS2107)
- Australian Standard 2670.2-1990: Evaluation of human exposure to whole-body vibration continuous and shock induced vibration in buildings (1 to 80Hz) (AS2670)
- Department of Environment and Conservation's *Assessing Vibration – A Technical Guideline, 2006.*

c) Air Quality Effects

Stack Emissions

The volume or flow rate of exhaust gases leaving the cogeneration exhaust stack is similar to that leaving the flue of a 500 to 600 kW boiler. The gas profile is also similar except that oxides of nitrogen (NOx) can be more prevalent. Typically exhaust parameters for a 200kWe turbocharged cogeneration unit with catalytic converter are presented in the Table 1 below:

Table 1: Typical Exhaust Characteristics - 200kWe Cogeneration Unit (turbocharged)

Exhaust Gas Species	Quantity	Units
NOx	250	mg/Nm^3
CO	300	mg/Nm^3
NMHC	75	mg/Nm^3
CH_2O Formaldehyde	40	mg/Nm^3
Dust Particles	20	mg/Nm^3
SO_2	35	mg/Nm^3
Exhaust Flow Rates 100% Duty		
Exhaust Mass Flow Rate (dry)	1,000	kg/hr
Exhaust Volume Flow Rate (dry)	800	Nm^3/h
Exhaust Temperature ex manifold	500	^oC
Exhaust Temperature ex cowl*	120	^oC

* Lower temperatures possible with condensing heat recovery modules

The main potential emissions impact from the GPARC cogeneration unit is its contribution to the level of NOx emissions in the Sydney basin airshed. NOx is implicated in the creation of photochemical smog and is known to have other deleterious health effects. NOx levels in the Sydney airshed have been falling overall but the proportion due to industrial sources, including cogeneration, has been rising and at an accelerated rate since 2003. Figure 7 shows the actual and forecast NOx levels up to 2016. A similar set of forecasts has been made for the Illawarra basin airshed.

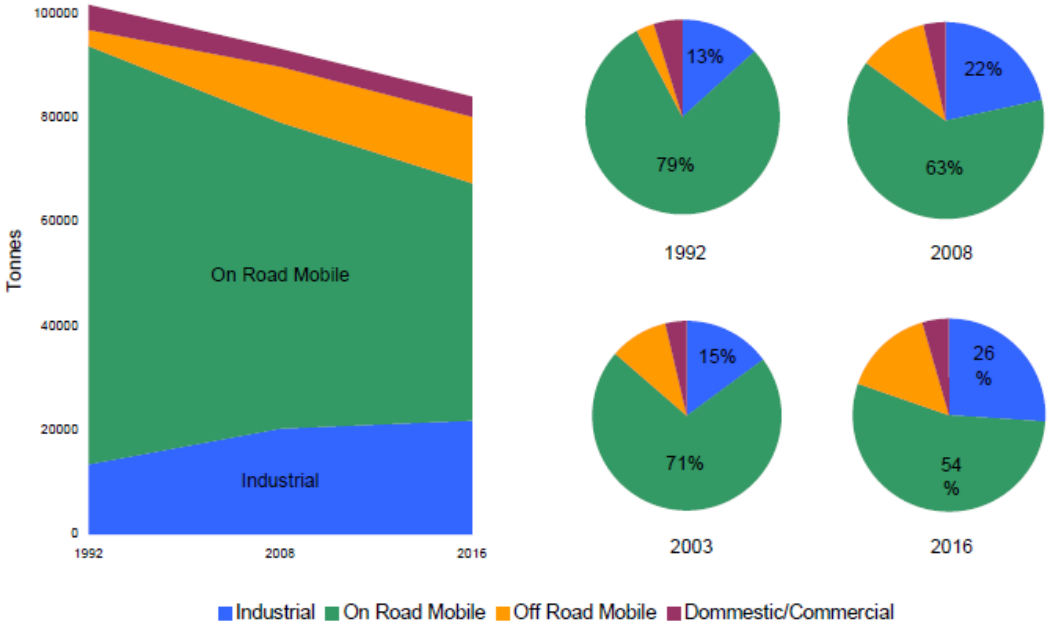

Figure 7: Sydney Annual NOx Emissions - Actual and Forecast
(Office of Environment and Heritage)

Based on the forecasts, the Office of Environment and Heritage decided to issue an *Interim OEH Nitrogen Oxide Policy for Cogeneration in Sydney and the Illawarra*. Among other things this policy calls for cogeneration proposals in Sydney and the Illawarra to either be NOx neutral or be required to achieve Best Available Technique (BAT) emission performance. Subsequently the Office of Environment and Heritage published guidance on what was consider to be BAT for small cogeneration installations (Table 2 below).

The gas flow rate for a 200 to 260 kWe cogeneration unit operating at 100% load will be between 50 and 70 Nm^3 per hour equivalent to a burn rate of 500 to 700 kW of gas. These gas flow/consumption rates are equate to between 0.5 and 0.75MJ/second, that is less than the 7 MJ/s threshold for the table above. In other words the table applies to the cogeneration unit envisaged for the GSAC.

Table 2: **NOx BAT Emission Standard for Natural Gas Fired Reciprocating Engine Burn Capacity <7 MJ/s of Fuel** (Office of Environment and Heritage).

Activity or plant	Air impurity	Region	Emission standard mg/m³ *
Any natural gas fired stationary reciprocating internal combustion engine	Nitrogen dioxide (NO_2) or nitric oxide (NO) or both, as NO_2 equivalent	Sydney and Wollongong Metropolitan Area# and Wollondilly Local Government Area	250

The gas flow rate for a 200 to 260 kWe cogeneration unit operating at 100% load will be between 50 and 70 Nm^3 per hour equivalent to a burn rate of 500 to 700 kW of gas. These gas flow/consumption rates are equate to between 0.5 and 0.75MJ/second, that is less than the 7 MJ/s threshold for the table above. In other words the table applies to the cogeneration unit envisaged for the GPARC.

While the *Interim OEH Nitrogen Oxide Policy for Cogeneration in Sydney and the Illawarra* is not underpinned by regulation, the City of Sydney is committed to supporting efforts to mitigate NOx emissions and requires that all its cogeneration installations achieve or better the BAT standard. Accordingly, the GPARC cogeneration installation will be required to have NOx emissions stack equal or less than 250 mg/Nm^3. Furthermore the ability of the unit installed at the GPARC to achieve this standard will be confirmed by emissions testing during plant commissioning.

Large cogeneration units sometimes have NOx scrubbing equipment (which uses urea to absorb NOx) fitted to comply with NOX emission standards. While appropriate for large installations, this technology creates a set of management and potential secondary environmental impacts when applied to small installations. A survey of engine suppliers in Australia has confirmed that the 250 mg/M^3 NOx standard can be achieved by engine retuning and/or the fitting of catalytic converters. There are no major downsides to these approaches when applied to small cogeneration machines, and consequently the GPARC installation will use these instead of scrubbing technology

Receiver Air Quality

Complying with the Office of Environment and Heritage *Interim OEH Nitrogen Oxide Policy for Cogeneration in Sydney and the Illawarra* is an appropriate means to mitigate the main concern regarding airshed air quality impacts. Local impacts can be dealt with in one of two ways. Common to both approaches is the requirement that stack emissions must comply with all relevant EPA regulations. Air quality modelling is then often undertaken for large installations (greater than 1 MW). A different approach is

adopted in NSW, including the Sydney Basin, for small scale cogeneration proposals such as that proposed for the GSAC.

As mentioned earlier, there are truck and buses with similar (or larger) sized diesel engines on the streets to that proposed for the GPARC. Furthermore a 200 to 260 kWe unit is at the bottom end of the cogeneration size scale and is more akin to a small boiler installation. For these reasons the most common way of dealing with potential localised air quality problems is to apply the flue requirements in the Building Code of Australia and the relevant State gas regulations/codes to the cogeneration exhaust.

These codes/rules ensure adequate clearances from windows, air intakes and other openings in a building's envelope. The codes/rules also cover stack heights in relation to the location of roof high points to ensure adequate dispersion of the exhaust plume. In the case of the GSAC, the roof is large and relatively flat. Good dispersion will occur before any exhaust gases reach the building eaves. Wind velocity increases with height. The height of the roof will further facilitate the dispersion of the exhaust.

As stack emissions will comply with all relevant EPA regulations (and the interim policy on NOx) and flue location and height will fully comply with the BCA/State gas regulations, there does not appear to be any need for additional or special requirements under a DA.

d) Carbon Abatement

Carbon dioxide is a greenhouse gas. There are policies at the City of Sydney, the Australian Commonwealth and international levels to abate carbon emissions to mitigate climate change. As explained in the section above on the *Benefits of Cogeneration*, cogeneration provides a positive environmental effect through abating carbon emissions when compared with producing the same amount of heat from boilers (or heat pumps) and power from fossil fuel based power stations.

Consultants for the City of Sydney analysed the forecast heat and power demand profiles for the GPARC and calculated the carbon abatement for different sized cogeneration units. For a 230 kWe machine the consultant estimated the abatement at around 1300 tonnes per annum. This was based on 24/7 operation.

Continuous operation of a cogeneration machine may lead to the maximum carbon abatement, but the cost of abatement is also a consideration. The City's own studies have shown that the abatement cost is lower if the machine is only run on a 15/7 basis where the run time corresponds to the peak period for electricity tariffs. That is when the electricity produced by cogeneration has the highest commercial value. It also tends to correspond to the period when the Aquatic Centre will have the greatest demand for energy. This means that the utilisation factor for the cogeneration unit will tend to be high and little of the heat produced will be sent to the dump radiator due to supply- demand imbalances.

The difference between 15/7 and 24/7 is not a straight scaling exercise due to the greater utilisation with 15/7 operation. It is estimated that the carbon abatement for

15/7 operation will be close to 900 tonnes. The exact engine size and the final operating regime for the GSAC cogeneration unit has not been settled yet but it can be confidently predicted that the level of carbon abatement will between 800 and 1500 tonnes per annum.

This level of abatement is quite significant. For comparison, a photovoltaic installation of between 500 to 1000 kWp on the GPARC would be needed to achieve similar levels of abatement – but an installation beyond around 150 kWp is impractical due to lack of roof space. This illustrates the major role that a cogeneration installation will play in the carbon abatement strategy for the GSAC.

Potential DA Conditions

This section coverS proposed Development Consent conditions covering the GPARC cogeneration installation:

Machine Size

The cogeneration installation shall use a natural gas fuelled reciprocating engine and have an electrical generation capacity no greater than 260 kW**e.**

Visual Impacts

No conditions proposed. The engine, gen-set, electrical board and heat exchangers will be installed in a plant room. The only external visible feature will be the exhaust and the dump radiator. These will be integrated into the architectural design of the building.

Noise and Vibration

a) The cogeneration installation design shall to take into account the following:

- The NSW Industrial Noise Policy
- Australian/New Zealand Standard 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors (AS2107)
- Australian Standard 2670.2-1990: Evaluation of human exposure to whole-body vibration Continuous and shock induced vibration in buildings (1 to 80Hz) (AS2670)
- Department of Environment and Conservation's *Assessing Vibration – A Technical Guideline, 2006.*

b) The engine and gen-set after acoustic treatment including installation of an enclosure shall have a noise level not exceeding 75dB (A) at 1 metre.

Air Quality

a) The exhaust stack emissions shall comply with the EPA regulations for cogeneration equipment of the size proposed.
b) NOx exhaust emissions shall comply with the Office of Environment and Heritage *Interim OEH Nitrogen Oxide Policy for Cogeneration in Sydney and the Illawarra* and not exceed 250 mg/NM^3.

c) The composition of the cogeneration unit exhaust gas, that is the amount in mg/NM^3, shall be confirmed by testing during commissioning.
d) The plan location and height of the cogeneration exhaust stack shall comply with the relevant requirements in the Building Code of Australia and the NSW State Government gas regulations, as if the cogeneration installation was a boiler installation with the same natural gas consumption rate.



Chris Collins
Manager Green Infrastructure Implementation
Green Infrastructure

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Green Square Aquatic and Recreation Centre
Proposed Photovoltaic Installation
Statement of Environmental Effects

Photovoltaic Installation Overview

Design and construct a circa 150 kWp photovoltaic installation (PV) on the roof of the Green Square Aquatic and Recreation Centre (GPARC); connect the installation to the Centre's electrical reticulation system in A manner that allows the power to be used locally or at other facilities connected to the South Sydney Hospital (SSH) private wire; and control the PV production in conjunction with other embedded generation so the conditions of the private wire - Ausgrid connection agreement are complied with.

Key Environmental Effects

The key potential environment effects of the proposed installation are:

1. Visual Impacts
2. Public Safety
3. Glare or Sunstrike
4. Carbon Abatement

Visual Impacts

General

The PV installation, including its roof access system will have a low profile on the roof of the GPARC and likely not be visible or be barely visible from street level. Measures will also be taken to enhance the aesthetics of the installation as seen from any future nearby tall buildings, or from the air.

Panel Location, Type, Tilt and Orientation.

Panel orientation should be between NNE and NNW. To facilitate self-cleaning and minimise architectural impact the panels should have a tilt between 10 and 20 degrees.

PV panels vary between manufacturers in physical size and output. Typically the sizes vary from around 1600 mm by 1000mm (250-260W) and 2000 mm and 1000 mm (300-310W). The smaller panels are commonly used in household installations and the larger panels are more applicable to institution/facility use such as at the GPARC. Panel thickness varies from around 35 mm for the smaller panels to 40 mm for the larger ones.

PV panels typically have aluminium perimeter frames. Tilt frames to support the panels typically consist of aluminium extruded beams, cross beams and legs, aluminium frame clamps and stainless steel fasteners. Care will be taken to avoid the use of dissimilar metals (in terms of electrolysis) which can lead to corrosion and discoloration of the roof and tilt frame components.

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In order to facilitate aerial photography aesthetics, the arrays will consist, as far as practical, of solid straight edge blocks. Gaps or gap tooth edges will be avoided. Regular sawtooth edges may be acceptable. Where stringing arrangements make this difficult to achieve, non-connected panels may be used as infill.

All panels should be the same size, model and (hence) manufacturer and be from the same production batch. Panels are typically blue to dark blue in colour, but shades of red, brown, green and grey are also available. All panels should be the same colour and reflectivity.

Ancillary Installations and Equipment

The intent is to install a roof access system, consisting of catwalks, anchor rails and points, to facilitate inspection and maintenance of the PV installation (and the building roof and façade). Electrical cable trays will also be placed across the roof. One or more relatively small electrical boards (PV combiner boards) may also be required on the roof. All other plant and equipment (such as inverters and PV supply boards) will be located inside the building.

The performance of PV panels can be seriously affected by panel shading even if it is transitory. Consequently all ancillary installation and equipment will be designed to have a low profile. Some items, such DC combiner board(s) will be set back from the roof edge to facilitate maintenance. The result will be PV related ancillary elements not visible or barely visible from street level.

Public Safety

Public safety will be assured by designing and constructing the installation in accordance with all relevant standards and codes; building to a high standard; mitigating major operational risks; and providing a roof access system to facilitate inspections and ongoing maintenance.

Australian Standards

There are a range of AS/NZS covering the design and installation of PV systems. Design and installation will be in accordance with all relevant Australian Standards, in particular AS/NZS 5033:2012 and all normative documents referenced by this standard.

Structural integrity

This system can come under major stress and vibration during storm events. All connections will be designed and correctly installed to avoid coming loose. A means of quickly inspecting the PV installation after major storms will also be installed – please refer to the roof access section.

PV panels typically have aluminium perimeter frames. Tilt frames to support the panels typically consist of aluminium extruded beams, cross beams and legs, aluminium frame clamps and stainless steel fasteners. Galvanised iron, while seemingly suitable for tilt frames, will be avoided as using dissimilar metals can lead to accelerated corrosion of the frames, fasteners and the roof.

Lightning Protection System

Action will be taken to ensure that damage from lightning to the PV installation and to the GPARC building or its electrical reticulation, as a consequence of the PV installation, is mitigated.

The PV contractor will assess whether the lightning protection system (LPS) proposed for the GPARC building adequately protects the PV array as required under AS5033:2012, or if the PV array can be incorporated into the proposed building LPS and hence gain protection.

Roof Access

A roof access system will be installed to provide for emergency inspection of the rooftop PV installation (for example after major storms), as well as for general maintenance needs

The system will consist of access hatches, catwalk, balustrades, anchor points and rail attachment systems. As mentioned above under visual impacts these elements will be designed to have a low profile and/ or be set back from the building edge.

The roof access system and its documentation will fully comply with the relevant codes and standards as well as being fit for its PV installation purpose. Having an effective access system means that the PV installation can be maintained in a safe working state.

Glare and Sunstrike

This information is provided for completeness as glare and sunstrike (glare affecting road users) is not expected to be an issue with this PV proposal. It is more likely to arise with an at grade PV installation, especially when wet, or with highly reflective windows and atrium glazing.

The sun continually changes its path across the sky during the year. As a result any reflection and associated glare will be a transitory effect. The main concern is to avoid, if possible, sun strike affecting road users. The elevated position of the proposed PV installation means it will not generally reflect sunlight towards any roads. There is a theoretical possibility of very infrequent, short duration, weak reflection towards the ground as the sun sets in mid-summer.

The table below shows the sun angles for the winter and summer solstice at Sydney. Times are local time (AEST –winter and AEDT – summer)

Sydney: Sun Altitude

Date	08.00	12.00	18.00
21 June 2016	10°	33°	Ex Sunset
21 Dec. 2016	38°	80°	12°

Sydney: Sun Azimuth

Date	08.00	12.00	18.00
21 June 2016	53°	359°	Ex Sunset
21 Dec. 2016	95°	352°	249°

The low rising eastern sun will tend to reflect to sites to the west of the GPARC. The SSH site is adjacent and to the west of the GPARC. Most buildings are low rise and will be unaffected by reflected sunlight. There is a block of medium height affordable housing located in the SW corner of the SSH site, but its distance and direction with respect to the GPARC means reflected light rays will pass over it. The low setting winter western sun will reflect to the east towards Gunyama Park. Reflected rays will pass over the Park.

The worst time for reflected light in terms of a ground level viewer, will occur when the midsummer setting sun strikes wet panels. The sun will be low in the sky and well south of west. Light will be reflected toward the ground to the NE of the GSAC site. The effect, however, will be rare, transitory and limited to a few minutes on a handful of days. The low angle means the sun will be very weak at this time of day. Furthermore, only a fraction of the panels will be engaged in reflecting light off the roof and geometry dictates that the viewer will need to be a considerable distance from the GSAC to see the reflection. In short, no practical glare or sunstrike impact will occur.

Carbon Abatement

Carbon dioxide is a greenhouse gas. There are policies at the City of Sydney, the Australian Commonwealth and international levels to abate carbon emissions to mitigate climate change.

On average the PV installation will generate around 250,000 kWh per annum of renewable energy all of which will be used in the GPARC or the SSH site buildings connected to the Aquatic Centre. A coal fired power station would emit around 250 tonnes of carbon per annum to produce the same amount of electricity. There are negligible emissions associated with the operation and maintenance of PV systems. On this basis the proposed PV installation can be said to abate the 250 tonnes per annum of carbon emissions.

Both a coal fired power station and the proposed PV installation have embodied energy – fossil fuels used in the course of their construction.

It is difficult to arrive at definitive numbers for embodied energy in PV production and installation because production technology is constantly improving and the fossil fuel intensity of various manufacturing operations depends on production scale and production location. The upper range for the carbon footprint of PV manufacture, transport and installation seems to be around 100gm per kWh produced. This figure is based on manufacture in a carbon intensive economy, long transport distances to the final location and installation in countries with sub-optimal solar resources.

The embodied energy in the construction and maintenance of a coal fired power station is also difficult to generalise. The upper limit seems to be around 50 gm per kWh produced. Any difference between the embodied energy of PV systems and coal fired power station is likely to be relatively small and not affect the significant carbon abatement advantage of PV power generation. On a worse-case scenario the carbon abatement attributable to a PV system versus a coal power station might be reduced by less than 5%. if embodied energy is considered.



Chris Collins
Manager Green Infrastructure Implementation
Green Infrastructure

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Registered* Quantity Surveyor's Detailed Cost Report

[Development cost in excess of $3,000,000.00]

* A member of the Australian Institute of Quantity Surveyors or the Royal Institute of Chartered Surveyors

DEVELOPMENT APPLICATION or **CONSTRUCTION CERTIFICATE [Section 61]**	☒ / ☐	**REFERENCE:**	
		DATE:	15/06/2016

APPLICANT'S NAME	City of Sydney	**DEVELOPMENT NAME**	Gunyama Park Aquatic & Recreation Centre
APPLICANT'S ADDRESS	456 Kent St, Town Hall House	**DEVELOPMENT ADDRESS**	130 & 132-140 Joynton Avenue
	Sydney NSW 2000 Australia		Zetland NSW 2017

OCCUPIER'S NAME City of Sydney

DESCRIPTION OF WORKS Construction of a new Aquatic Centre comprising indoor and outdoors pools, including gym facilities.
Works will also comprise a new park with synthetic multipurpose field, park amenities and Playscape

TOTAL DEVELOPMENT COST	$	87,162,396	GROSS FLOOR AREA (Commercial)	m²	7,290
TOTAL CONSTRUCTION COST	$	69,498,408	GROSS FLOOR AREA (Residential)	m²	
TOTAL GST	$	7,893,862	Total GST Cost		
TOTAL SITE AREA	m²	28,693	GROSS FLOOR AREA) (Retail)	m²	
TOTAL GROSS FLOOR AREA	m²	7,290	GROSS FLOOR AREA (Parking)	m²	
			NUMBER OF PARKING SPACES	no	
PROFESSIONAL FEES	%	14%	of construction cost		
	%	11%	of development cost		
DEMOLITION & SITE PREPARATION	$	3,148,656	total construction cost		
	$	110	/m² of site area		
EXCAVATION	$	2,755,000	total construction cost		
	$	96	/m² of site area		
CONSTRUCTION Commercial	$	63,594,752	total construction cost		
	$	8,724	/m² of commercial area		
CONSTRUCTION Residential	$		total construction cost		
	$		/m² of residential area		
CONSTRUCTION Retail	$		total construction cost		
	$		/m² of retail area		
FITOUT Commercial	$		total construction cost		
	$		/m² of commercial area		
FITOUT Residential	$		total construction cost		
	$		/m² of residential area		
FITOUT Retail	$		total construction cost		
	$		/m² of retail area		
CARPARK	$		total construction cost		
	$		/m² of parking area		
	$		per space		

We certify that we have:

- Inspected the plans the subject of the application for development consent or construction certificate
- Prepared and attach an **elemental estimate** generally prepared in accordance with the Australian Cost Management Manuals from the Australian Institute of Quantity Surveyors.
- Calculated the development costs in accordance with Schedule 2.3 of the Central Sydney Contributions Plan 2013: "Cost of Development - Estimation" and at current prices.
- Included GST in the caclulation of development cost
- Measured Gross Floor Areas in accordance with the Method of Measurement of Building Areas in the AIQS Cost Management Manual Volume 1, Appendix A2

Prepared by (name of organisation): Turner & Townsend

Signed:

Name: Brendan McDermott

Position and Qualifications: Senior Cost Manager - BSc (Hons) MRICS

Date: 15-Jun-16

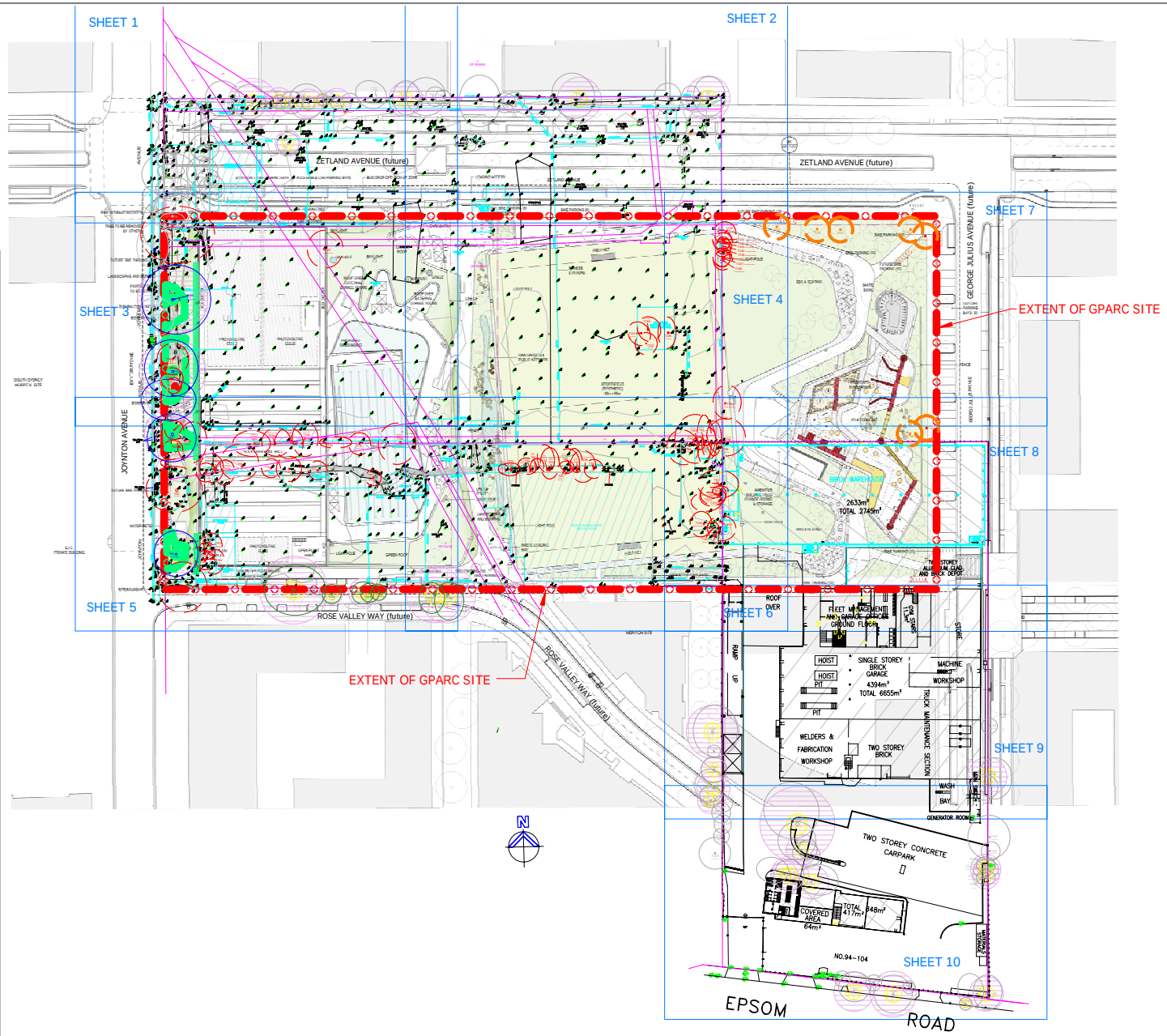
CITY OF SYDNEY

GUNYAMA PARK AQUATIC & RECREATION CENTRE

JOYTON AVE, ZETLAND

ELEMENTAL COST ESTIMATE

Element	GFA	Unit	Rate / m2	Total (ex GST)
Demolition	7,290	m2	301.16	2,195,456
Site Preparation & Excavation	7,290	m2	541.06	3,944,347
Substructure	7,290	m2	1,055.40	7,693,876
Columns	7,290	m2	29.94	218,258
Upper Floors	7,290	m2	127.19	927,238
Staircases	7,290	m2	70.62	514,834
Roof	7,290	m2	672.27	4,900,879
External Walls/ Facade	7,290	m2	437.40	3,188,613
External Doors/Windows	7,290	m2	20.00	145,808
Internal Walls	7,290	m2	204.70	1,492,290
Internal Doors	7,290	m2	12.83	93,548
Wall Finishes	7,290	m2	133.04	969,894
Floor Finishes	7,290	m2	381.03	2,777,705
Ceiling Finishes	7,290	m2	172.89	1,260,334
Fitments	7,290	m2	214.59	1,564,347
Special Equipment	7,290	m2	584.27	4,259,320
Hydraulic Services	7,290	m2	263.64	1,921,929
Mechanical Services	7,290	m2	452.74	3,300,498
Fire Protection	7,290	m2	75.22	548,368
Electric Light And Power	7,290	m2	429.17	3,128,664
Transportation Systems	7,290	m2	21.40	156,000
Roads, Footpaths & Paved Areas	7,290	m2	132.86	968,583
Boundary Walls, Fencing And Gates	7,290	m2	79.92	582,608
Landscaping & Improvements	7,290	m2	807.89	5,889,531
External Stormwater Drainage	7,290	m2	233.44	1,701,778
External Hydraulics	7,290	m2	53.47	389,828
External Electric Light And Power	7,290	m2	206.20	1,503,207
Builders Work In Connection With Services	7,290	m2	42.23	307,840
Special Provisions	7,290	m2	362.36	2,641,600
Preliminaries & Margin	7,290	m2	1,414.43	10,311,226
Total Construction Cost				**69,498,408**
Fees & Charges				
Professional Fees				9,440,208
Authority Fees & Charges				329,919
Toal Development Costs (Excl Gst)				**79,268,535**



LEGEND

- Tree to be retained and protected in accordance with Tree Protection Measures (Section 10)
- Tree to be removed in accordance with Section 10.12
- Tree to be pruned in accordance with Section 10.10
- Tree to be removed in accordance with Section 10.12. To be assessed following transfer of ownership to City of Sydney. Refer to TCL Dwg No. ARC-T-DA-003
- Existing buildings & structures to be demolished. Demolition works within TPZ's to be undertaken in accordance with Section 10.5
- New Building works. All excavations for building foundations within TPZ's to be undertaken in accordance with Section 10.6
- Structural Root Zone (SRZ)
- Tree Protection Zone (TPZ) [refer Section 7]
- Excavations in these areas for footings and services to be undertaken in accordance with Section 10.6
- Tree Protection Fence to be erected in accordance with Section 10.3
- Erect any required temporary scaffolding in these areas in accordance with Section 10.13
- Install trunk protection in accordance with Section 10.4

APPENDIX 6
TREE PROTECTION PLAN

GUNYAMA PARK AQUATIC & RECREATION CENTRE
132-140 Joynton Road and
94-104 Epsom Road, ZETLAND, NSW

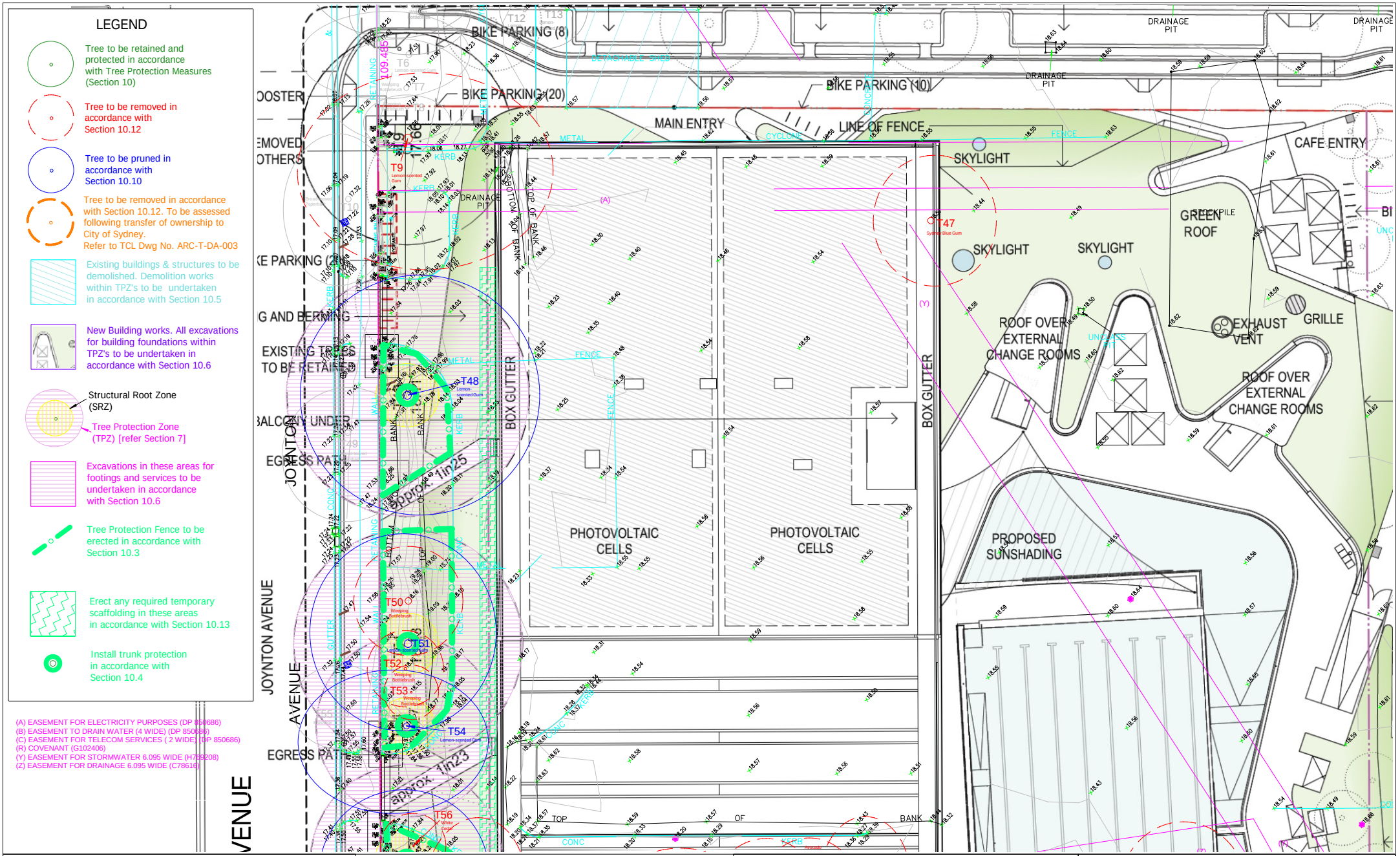
Earthscape Horticultural Services
Arboricultural and Horticultural Consultants
PO Box 364
BEROWRA NSW 2081
Ph: 02 9456 4787
Fax: 02 9456 5757 e: earthscape@iinet.net.au

Based on the Survey Drawing
prepared by Cardno Hard & Forester
Dwg Ref No. 11678500 dated 05/03/2014
and
Site Plan prepared by TCL
Dwg. No ARC-DA-011
dated 22/04/16

DWG No. T16-050902

KEY PLAN

DATE: 23/05/2016



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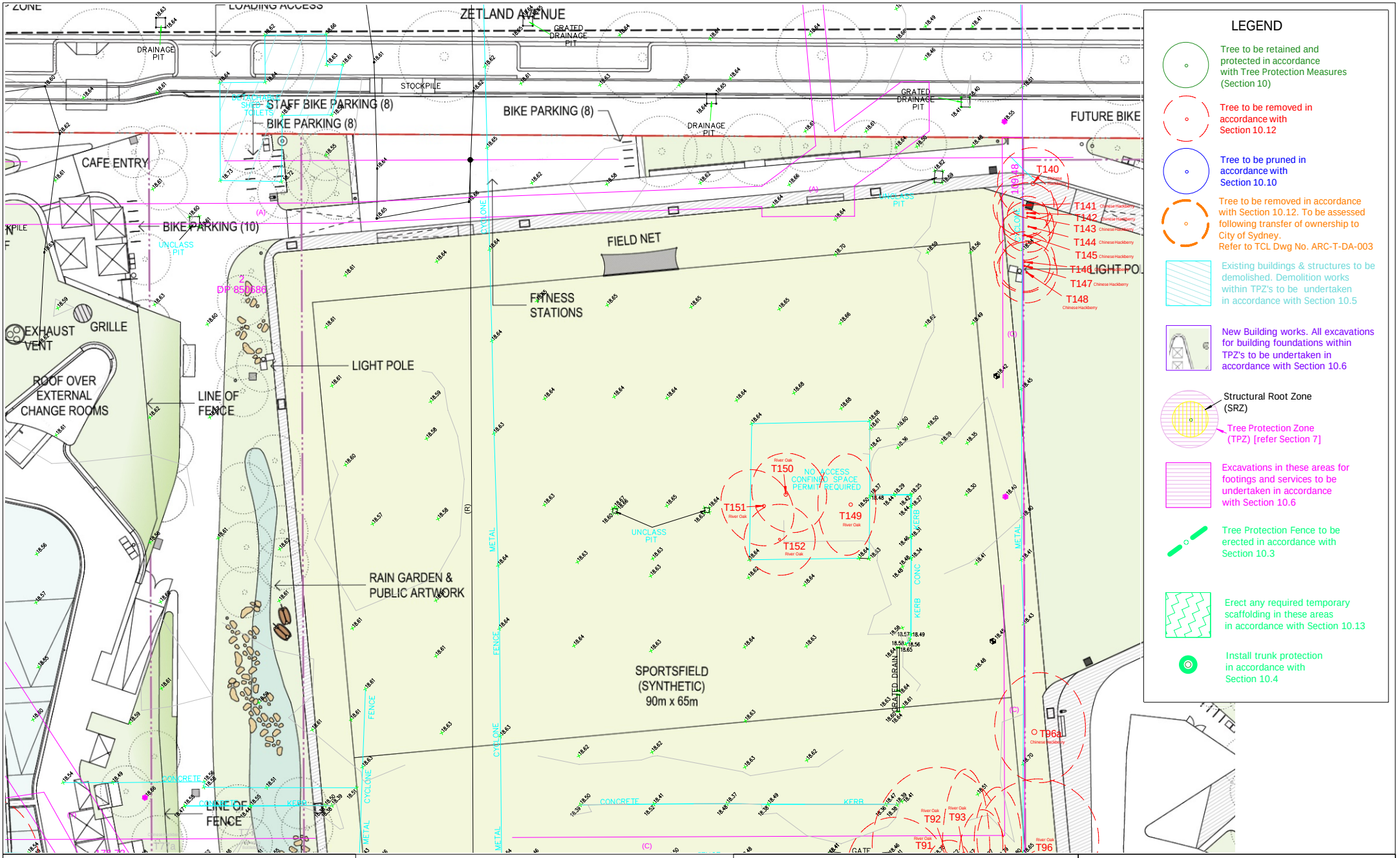
SHEET 3

DATE: 23/05/2016



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94-104 Epsom Road, ZETLAND, NSW

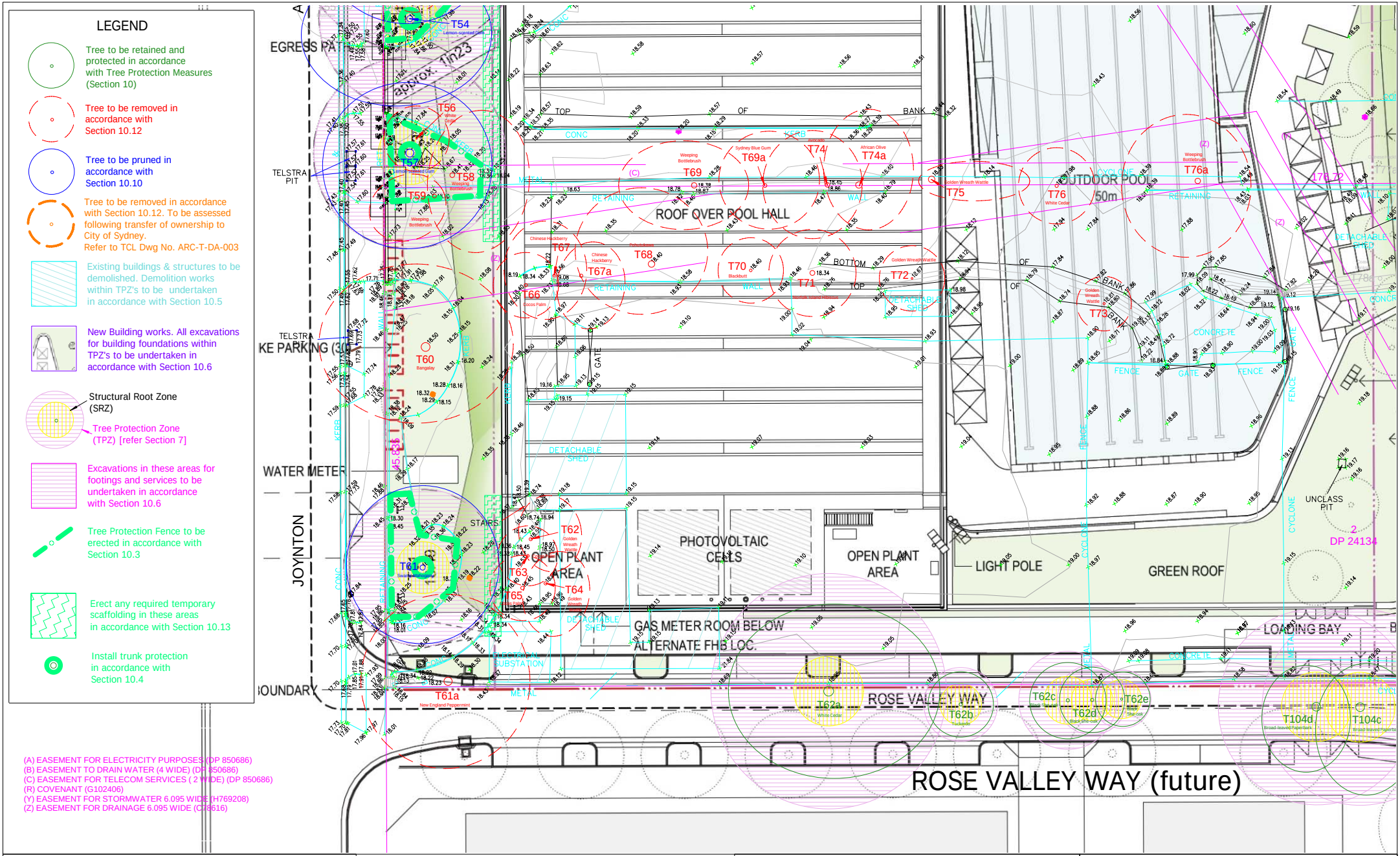
Earthscape Horticultural Services
Arboricultural and Horticultural Consultants
PO Box 364
BEROWRA NSW 2081
Ph: 02 9456 4787
Fax: 02 9456 5757 e: earthscape@iinet.net.au

Based on the Survey Drawing
prepared by Cardno Hard & Forester
Dwg Ref No. 11678500 dated 05/03/2014
and
Site Plan prepared by TCL
Dwg. No ARC-DA-011
dated 22/04/16

DWG No. T16-050902

SHEET 4

DATE: 23/05/2016



APPENDIX 6
TREE PROTECTION PLAN

GUNYAMA PARK AQUATIC & RECREATION CENTRE
132-140 Joynton Road and
94-104 Epsom Road, ZETLAND, NSW

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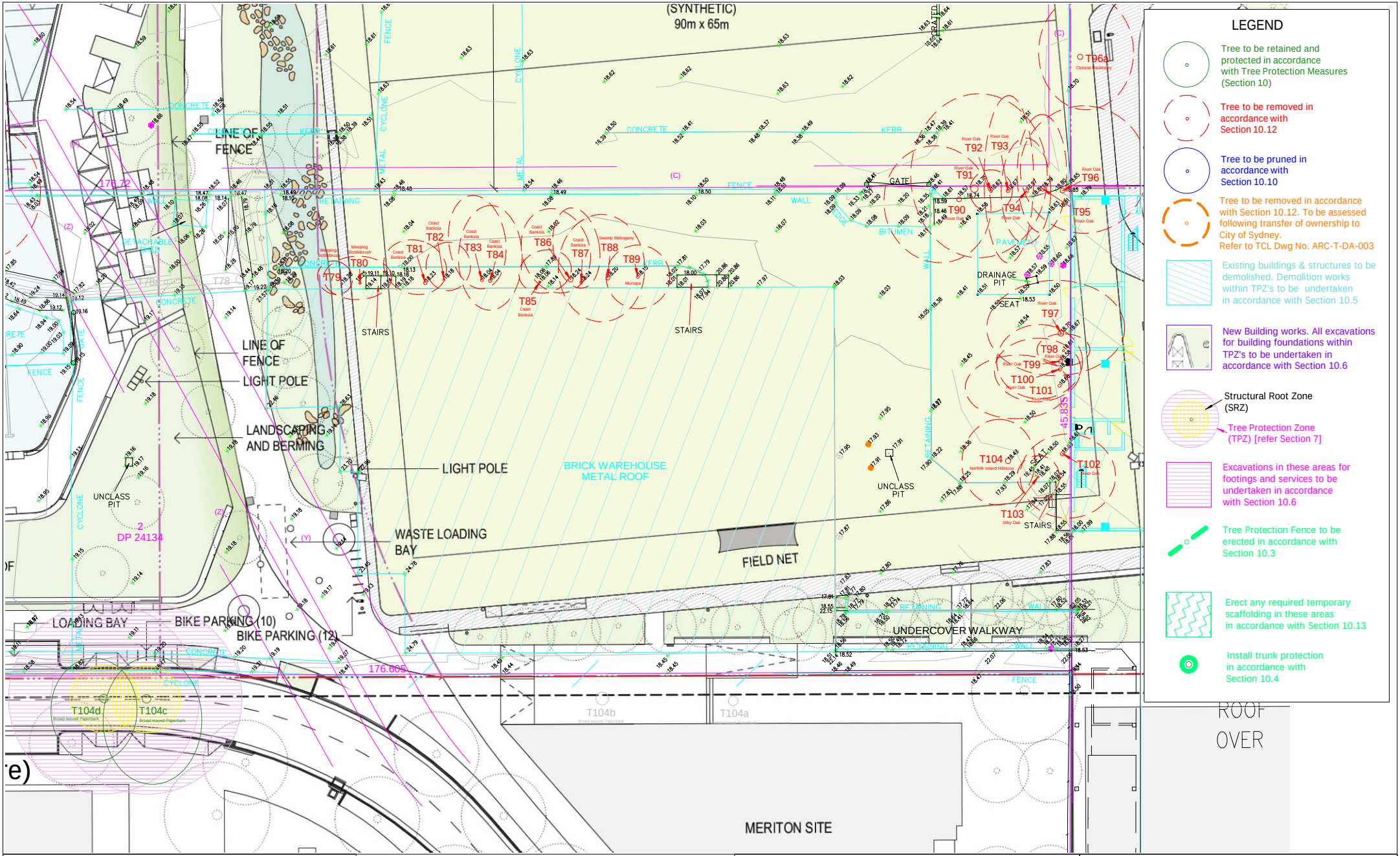
DWG No. T16-050902

SHEET 5

DATE: 23/05/2016



LEGEND

- Tree to be retained and protected in accordance with Tree Protection Measures (Section 10)
- Tree to be removed in accordance with Section 10.12
- Tree to be pruned in accordance with Section 10.10
- Tree to be removed in accordance with Section 10.12. To be assessed following transfer of ownership to City of Sydney. Refer to TCL Dwg No. ARC-T-DA-003
- Existing buildings & structures to be demolished. Demolition works within TPZ's to be undertaken in accordance with Section 10.5
- New Building works. All excavations for building foundations within TPZ's to be undertaken in accordance with Section 10.6
- Structural Root Zone (SRZ)
- Tree Protection Zone (TPZ) [refer Section 7]
- Excavations in these areas for footings and services to be undertaken in accordance with Section 10.6
- Tree Protection Fence to be erected in accordance with Section 10.3
- Erect any required temporary scaffolding in these areas in accordance with Section 10.13
- Install trunk protection in accordance with Section 10.4

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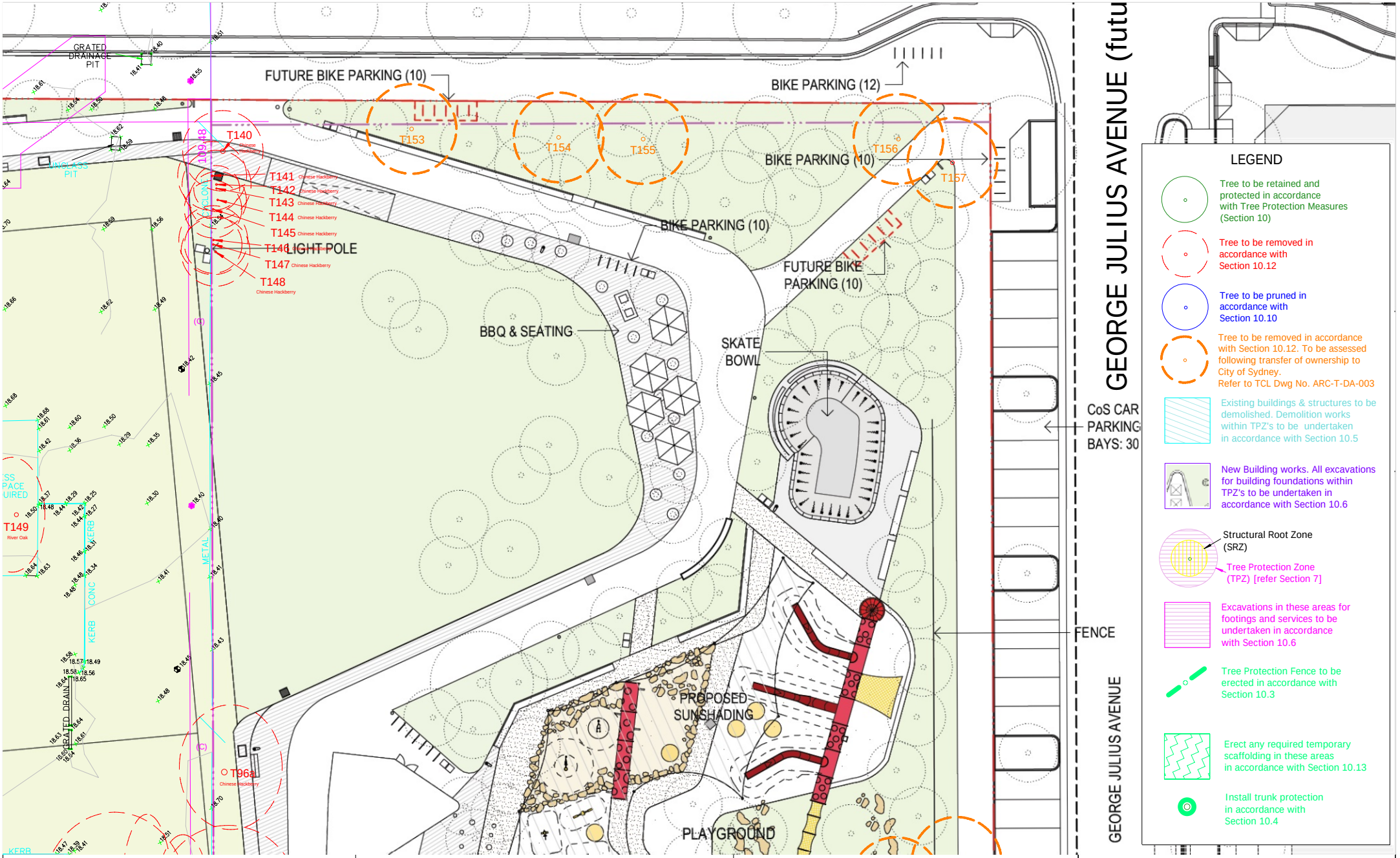
SHEET 6

DATE: 23/05/2016



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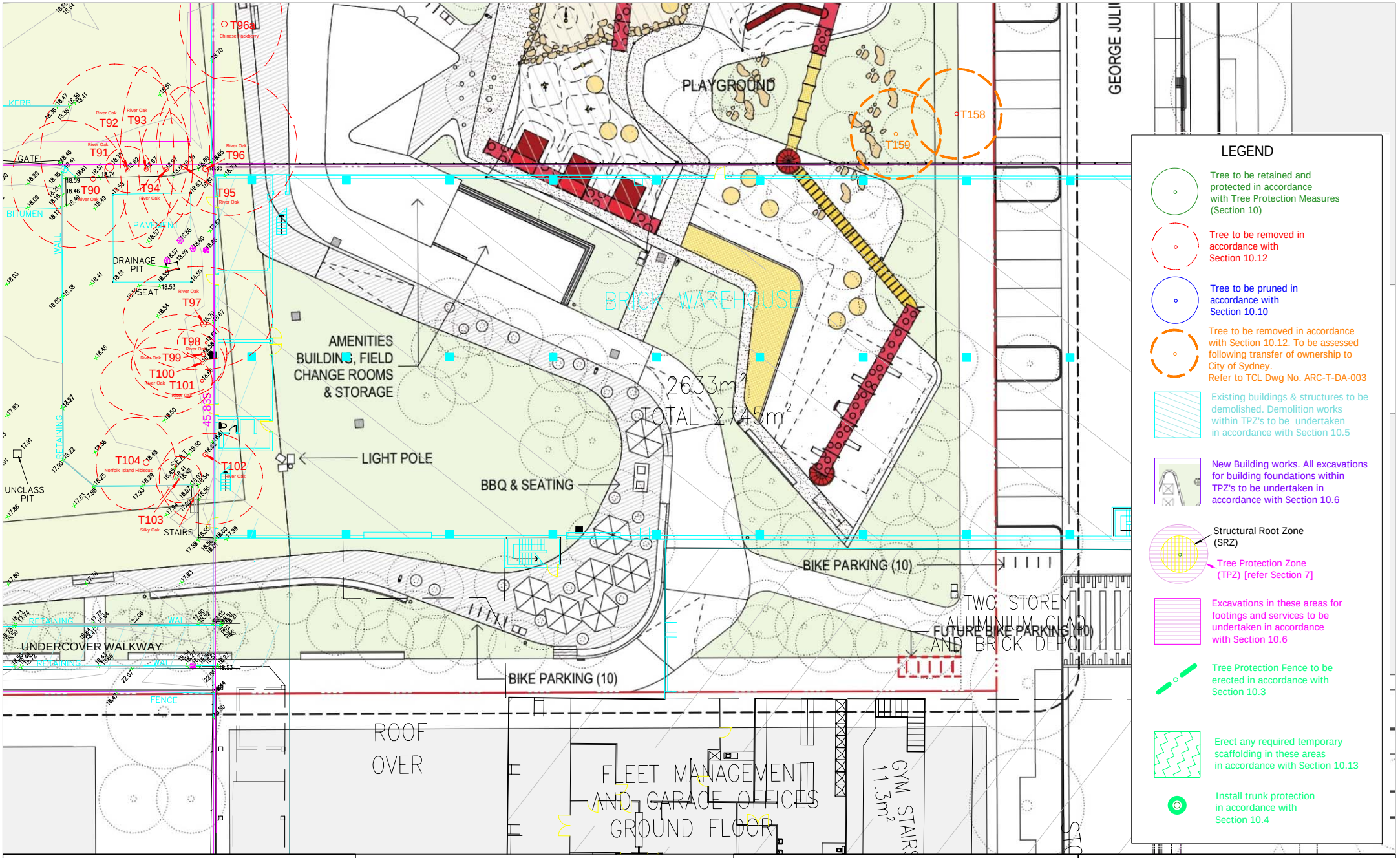
DWG No. T16-050902

SHEET 7

DATE: 23/05/2016



APPENDIX 6
TREE PROTECTION PLAN

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Dwg. No ARC-DA-011
dated 22/04/16

DWG No. T16-050902

SHEET 8

DATE: 23/05/2016

DESIGN ADVISORY PANEL

AGENDA – MEETING of 28 April 2015, 9:00am–1.20pm

FINANCE ROOM, TOWN HALL

ATTENDEES	APOLOGIES
DESIGN ADVISORY PANEL	
Ken Maher (Chair)	Kerry Clare
Maria Atkinson	
Richard Johnson	
Elizabeth-Ann McGregor	
Peter Mould	
Peter Poulet (first part of meeting)	
James Weirick	
CITY OF SYDNEY	
Graham Jahn, Director City Planning, Development & Transport Bridget Smyth, City Design Pauline Chan, City Design Katharine Young, City Design Michael Harvey, City Design John Vu, City Design Alexander Carlise, City Design Chris Thomas, City Projects Adam Fowler, City Projects Elizabeth Sandoval, City Projects	Bill Mackay, City Planning Rebecca Thompson, City Planning Nicola Reeve, City Planning Natasha Ridler, City Planning David McNamara, City Planning Tony Smith, City Planning Cindy Ch'ng, City Planning Emma Brookes, City Planning Julie Prentice, Office of the Lord Mayor April McCabe, Office of the Lord Mayor Suzanne Sackar, Councillor Support
DESIGN COMPETITION JURY (Gunyama Park & Green Square Aquatic Centre item only)	
Carey Lyon, Chair Camilla Block Greg Holman Richard Johnson	Gini Lee (apologies)

1. **Declarations of Interest**
   Richard Johnson, Ken Maher, Peter Mould and Bridget Smyth declared interests in the AMP Quay Quarter. Refer to Advice Sheet 15/2015

2. **Adoption of the previous minutes**
   The previous minutes were endorsed.

3. **Hyde Park Pool of Remembrance**
   City Projects requested the Panel's input on establishing a panel of experts to advise on tree species selection for the Pool of Remembrance upgrade. The Panel recommended that a small group of experts be assembled, recommending Peter Emmett together with 2 members of DAP (recommended Richard Johnson and James Weirick), with input provided from Council's arborists.

4. **Epsom Park Public Domain**
   See Advice Sheet 12/2015

5. **Gunyama Park and Green Square Aquatic Centre**
   See Advice Sheet 13/2015

6. **37-41 Bayswater Road Darlinghurst**
   See Advice Sheet 14/2015

7. **AMP Quay Quarter**
   See Advice Sheet 15/2015

8. **130-134 Elizabeth Street Sydney**
   See Advice Sheet 16/2015

9. **Other business**
   The Panel requested that the MLC Centre DA be presented at a future meeting, following the engagement of a Panel subcommittee at pre-DA stage. Graham Jahn agreed that the MLC proposal would be presented back to the panel.



Ken Maher, Chair

CITY OF SYDNEY **ADVICE SHEET NO: 13/2015**

DESIGN ADVISORY PANEL

Project	**Gunyama Park and Green Square Aquatic Centre**
Review Date	28 April 2015
Designer	Grimshaw/TCL
Panel Present	Ken Maher (Chair) Peter Mould Richard Johnson Elizabeth Ann McGregor James Weirick Maria Atkinson
Design Competition Jury Present	Carey Lyon Camilla Block Greg Holman Richard Johnson
COI Declaration	NIL
Council Officer	Elizabeth Sandoval
Advice	The Panel noted their support for the process of the competition jury and design panel jointly reviewing the project. The Panel and Jury were presented with an update on the progress of the project, and jointly made the following comments: • Recommended finding ways to maintain the non-rectilinear form of the pool and the strong relationship between the geometry of the landscape and built/pool forms. This is particularly an issue for the arrival area of the pool. • Recommended revisiting the northern boardwalk area around the pool, which has become compressed by expansion of functional areas (hydrotherapy, café and toilets). • Noted that the extent of building on the western side of the pool has been reduced to create more transparency through the landscape into the pool. The Panel and Jury questioned the significance of that transparency, in the context of the resulting geometric implications for the pool and circulation areas. • Noted that the original diagonal entry allowed a view across the pool and park, unifying the two elements. This was considered to be a central characteristic of the competition winning scheme. The Panel and Jury recommended that this visual continuity and connection be reinstated and developed further with the new entry location. • Questioned how the expanding functional areas can be convincingly enclosed in a landscape berm with a floating roof. Noted that the geometric relationship between building

	elements, landscape and pool geometry needs greater consideration through the next stage of design. • Commended the original boardwalk design noting that the undulating boardwalk had a strong and beautiful relationship to the landscape and the rhythm of breathing associated with swimming. Recommended that this undulation of the boardwalk be recovered through design development. • Strongly supports the proposed use of timber in the design. • Questioned the need for a kiosk located on the boulevard, given the revised location of the café is closer to the kiosk. • Questioned the need for a synthetic surface to the sports field, noting that it detracts from the competition scheme where the field geometry was totally integrated in the bigger park space. Noted the need to resolve the edge condition between the field and the surrounding park lawn.

DESIGN ADVISORY PANEL

MINUTES – MEETING of 14 July 2015, 9:00am–1.00pm

FINANCE ROOM, TOWN HALL

ATTENDEES	APOLOGIES
DESIGN ADVISORY PANEL	
Ken Maher	Peter Poulet
Maria Atkinson	
Kerry Clare	
Richard Johnson	
Elizabeth-Ann MacGregor	
James Weirick	
Peter Mould	
CITY OF SYDNEY	
Clover Moore, Lord Mayor Graham Jahn, Director City Planning, Development & Transport Bridget Smyth, City Design Michael Harvey, City Design Katharine Young, City Design Laurie Johnson, City Design Adam Fowler, City Projects Elizabeth Sandoval, City Projects Kawai Yeung, City Projects	Vanessa Aziz, Planning Assessments Russell Hand, Planning Assessments David McNamara, Planning Assessments

1. **Declarations of Interest**
   Ken Maher declared an interest in Item 5, refer to advice sheet 26/2015.

2. **Adoption of the previous minutes**
   The previous minutes were endorsed.

3. **Gunyama Park and Green Square Aquatic Centre**
   See Advice Sheet 24/2015

4. **Hyde Park South Cafe**
   See Advice Sheet 25/2015

5. **City North Streetscapes and Spaces Concept Design**
   See Advice Sheet 26/2015

6. **148-160 King Street Sydney**
   See Advice Sheet 27/2015

7. **Site 9B Green Square Town Centre, 105-115 Portman Street Zetland**
   See Advice Sheet 28/2015

8. **Other business**
   The Panel requested an update on the AMP Precinct and MLC Centre Development Applications. It was noted that these items will be on the agenda for the August DAP meeting.

   The Panel Chair requested that future meeting agendas be circulated to the Chair further in advance to allow review and discussion with the City team prior to circulation to the panel.

Ken Maher
Chair

CITY OF SYDNEY **ADVICE SHEET NO: 24/2015**

DESIGN ADVISORY PANEL

Project	**Gunyama Park and Green Square Aquatic Centre**
Review Date	14 July 2015
Designer	Andrew Burges Architects, Grimshaw and TCL
Panel Present	Ken Maher (Chair) Peter Mould Richard Johnson James Weirick Maria Atkinson Elizabeth Ann McGregor Kerry Clare
COI Declaration	Richard Johnson noted that he is part of the design competition jury. It was agreed by the Panel this is not a conflict of interest.
Council Officer	Elizabeth Sandoval
Advice	The Panel were presented with the schematic design development and responses to previous DAP advice. The Panel noted that the scheme is now an improvement on the competition scheme and expressed confidence in the ongoing resolution of design issues. The Panel commented and recommended the following: • The Panel noted that previous comments have been comprehensively addressed and commended the enrichment of the scheme presented. • The Panel strongly supported the concept of the sunken field and edging detail, noting the improved interface this provided between the landscape and architectural elements. • The Panel recommended that detail of the interface between the park/field and pool area continue to be further developed in line with the competition scheme. • The Panel suggested the option of moving the playing field slightly to the west could alleviate pinch points, allow for improved landscape integration and improve the field levels. The Panel noted the land ownership constraints and recommended that this option be developed as a confidential alternate scheme. • The Panel raised public safety concerns regarding the proposed corridor location for the public toilet. • The Panel suggested that the café design be developed to allow the café to serve outside the pool as well as inside, noting the design challenge to retain the expression of a berm and achieve café functionality, transparency and access. Moving the pool to the west (as recommended above) may alleviate this challenge. • The Panel supported the concept of the change rooms and

	hydrotherapy pool being carved out of the berm. The Panel endorsed recent comments provided by the design competition jury (Attached). The Panel noted a need to engage in more detail with engineering issues, and requested that the next presentation include a presentation by the project's engineers, and in particular the prevention of condensation. The Panel requested that sections through the building be included in the material for the next presentation.

GREEN SQUARE COMPETITION - GUNYAMA PARK & AQUATIC CENTRE

Competition Jury Report on progress presentation by ABA Grimshaw Architects

Overview

The Jury has reviewed the design team presentation documents as provided by the City of Sydney on 1 July, and provide the following comments for consideration by ABA Grimshaw and the Design Advisory Panel.

In summary, the Jury positively supports the key revisions to the design, and appreciates the architectural team being responsive to comments provided at the previous review on 28th April 2015.

The Jury provides the following specific comments to assist the team with the ongoing development prior to the next milestone presentation in September 2015.

Revised Berm geometry

The Jury supports the revisions to the berms, particularly in relation to the revised planning arrangements. We would note, however, that the height and steepness of the middle berm (housing the waiting and public toilets on Zetland Avenue) is quite steep and might need further consideration i.e. if the berm is too vertical it may feel more like a wall, and therefore a barrier.

Meeting entry sequence

The Jury fully supports the reintroduction of the diagonal entry and vista through to the pool and the Park. The proposal to provide more access from the Park circulation systems along Zetland Avenue, including the location of the cafe, is also strongly supported – and adds to the intrinsic quality of the scheme, in fully integrating the park and pool facilities.

The jury notes that the Park building (change and storage shed) needs to be more fully addressed in response to these changes, and appears to be somewhat under developed at this stage.

Planning Layout

The jury, as noted above, fully supports the reintroduction of a more organic or ‘landscape’ quality to the planning of the functional areas. However it is unclear, from the plans submitted, what the current thinking is around the glass wall separating the internal and external pool environments (it can be implied but needs more detailed design review). For example, ideally in benign conditions it would be possible to open the interior entirely to the east and the outdoor pools, so that the use of the concourse between the pools follows the model of the board walks to the beach/ocean pool boardwalks referenced in the design.

There is still some concerns about the narrowness of the concourse at the shallow end of the 50m lap pool, particularly given that it is accessed from the western side, and more consideration might be given to this issue.

Structure, Arches and Roof

The jury appreciates being provided with the multiple options in relation to the structure, arches and roof, however we have no strong opinion one way or the other on the architectural form. We would support the design teams own preferences in a way that maintains the original integrity of the design, but adjusts it to meet the current revised planning layouts.

The jury also supports the use of the ETFE and LVL roof structures, and are aware of multiple other projects in Australia where this has been proven to be a high quality, durable, and cost effective solution. The jury, however, recommends that issues with respect to condensation be investigated.

Gunyama Park

The jury supports the introduction of the hybrid concrete and timber parallel paths, as a way of mitigating the maintenance issues raised at the previous review. It also has the potential to articulate high traffic areas distinct from waiting and resting spaces – an approach which appears implicit in the concept sketches (plans and sections) provided.

However, the Jury would be interested to see that this does not impact on the consistency of the spatial flow along the boardwalk, particularly when timber/concrete/timber is introduced. We would support an approach that is not unnecessarily intricate, or narrows the walk usability for crowds.

On the same issue, it's unclear whether there is an intention to float boulder/stones into the concrete path edges, as well as loose stone edging conditions, and we would request the design team review this with respect to creating potential tripping hazards.

Some further information regarding the grading options around the Park would be appreciated at the next review, particularly ones which confirm wheelchair accessibility. Similarly, it might be appropriate in the public areas if the steps have some consistency in terms of riser and tread, perhaps with a lower riser and wider tread in the landscaped areas.

Sports Field Size Options

It is difficult for the Jury to comment on these options in any detail, given they are balancing a range of technical and commercial issues with which we are not fully familiar. However in broad terms the Jury would support the Preferred Option (Sport field Location Option 03).

However we note that an option for a 50m by 82m Sports field is also provided, and if this is supportable by the City of Sydney from an operational point of view, then clearly this would be the most preferable option, given that it provides more generous threshold spaces between the perimeter circulation and sports field itself.

The report also refers to a 1 metre high perimeter fence around the sports field which is, in the Jury's view, a significant new addition to the design. The Jury would <u>not</u> support this proposal, as a key reason for the selection of the ABA Grimshaw scheme as the preferred design was its open, integrated, and accessible connections between the formal sportsfield, the park and landscape, and the building itself. A perimeter fence would set up a significant, and in our view unacceptable, barrier to open community space.

We would, of course, be pleased to discuss any of these items with the City of Sydney, and we look forward to an opportunity to a further review the developed scheme in September 2015.

Yours faithfully

Carey Lyon (Jury Chair)
On behalf of fellow jurors: ***Richard Johnson, Greg Holman, Camilla Block and Gini Lee***

DESIGN ADVISORY PANEL

MINUTES – MEETING of 15 September 2015, 9:00am–12.30pm

FINANCE ROOM, TOWN HALL

ATTENDEES	APOLOGIES
DESIGN ADVISORY PANEL	
Ken Maher (Chair)	Elizabeth-Ann MacGregor
Maria Atkinson	Richard Johnson
Kerry Clare	Peter Poulet
Peter Mould	
James Weirick	
CITY OF SYDNEY	
Clover Moore, Lord Mayor Kim Woodbury, Chief Operations Officer Graham Jahn, Director City Planning, Development & Transport Bridget Smyth, City Design Pauline Chan, City Design Laurie Johnson, City Design John Vu, City Design Elizabeth Sandoval, City Projects Kawai Yeung, City Projects Chris McBride, City Projects Gynt Drinan, City Projects Michael Mackinnon, City Projects Sarah Scott, City Projects Stephen Merchant, City Projects	Tony Smith, Planning Assessments Chris Corradi, Planning Assessments Simon Ip, Planning Assessments Christopher Ashworth, Planning Assessments Emma Brooks, Planning Assessments Sabrina Philips, Green Square Unit

1. Declaration of Interest

NA

2. Adoption of the previous minutes

The previous minutes were endorsed.

3. 542-544 George Street, Sydney

Advice Sheet 36/2015

4. 105-115 Portman Street, Zetland

Advice Sheet 37/2015

5. Gunyama Park and Green Square Aquatic Centre Design
Advice Sheet 38/2015

6. Drying Green Park, Amenities Block
Advice Sheet 39/2015

7. Hyde Park South Cafe
Advice Sheet 40/2015

8. Green Square Library and Plaza
The Panel requested an update on the progress of the Green Square Library and Plaza. The Panel were interested in the progress of the design and for the responses and design resolution to the previously raised issues. The Panel also noted that it is very important that the project is underpinned by an appropriate procurement method and that all mechanisms and processes are in place to ensure a good quality design outcome. A project of this significance warrants the involvement of preeminent experts and builders with a commitment to design excellence. It was suggested that a member of the Panel could serve as an advisor to the tender assessment.



Ken Maher
22 September 2015

CITY OF SYDNEY **ADVICE SHEET NO: 38/2015**

DESIGN ADVISORY PANEL

Project	**Gunyama Park and Green Square Aquatic Centre**
Review Date	15 September 2015
Panel Present	Ken Maher (Chair) Maria Atkinson Kerry Clare Peter Mould James Weirick
Design Competition Jury Present	Carey Lyon Camilla Block Greg Holman
COI Declaration	NA
Designer	Andrew Burges Architects, Grimshaw and TCL
Council Officer	Elizabeth Sandoval
Advice	The Panel and the Jury were presented with an update of the schematic design development. The designers and project team were commended for the ongoing resolution of design issues and thorough analysis. The Panel and the Jury jointly made the following comments and recommendations; Park • The removal of the stage 2 boundary and the subsequent shift in the position of the field is a positive move. • The strategy to omit fencing and encourage passive and active uses in the synthetic field is supported. • A consistent paving material and treatment on the surrounding footpath of the site is supported. • A study into the desired future ecology should be conducted to inform the design and planting strategy. • In the original scheme, the circuit path design possessed a language of an undulating and meandering path. The current iteration is more monotonous in form and width. The Panel and Jury recommended that the original language and 'magic' be reintroduced into the design. • The sparseness of the open space of the playing field and natural grass areas contained by their hard edges could be softened with the introduction of trees and/or planting within the natural grass areas. This may help to regain the relaxedness and informality of the original design. • Whilst accepting that there are practical and technical constraints in the development of the design, the Panel and Jury were concerned that the current iteration of the Park appears to have been driven by the geometry of the field.

	The fluidity of form in the original design needs to be retained and the proposal to have custom designed forms for the playground to help achieve that end is supported. • There were concerns over the limited access points into the field and the potential for the proposed precast concrete edge to become a barrier. The Panel and Jury suggested further investigations into the introduction of ramps to the remaining two corners of the field. Further to this, it was noted that the planted berm which is the interface between the pool and the park should be permeable and should not become a visual barrier between the two. • Further investigation into how the park and field amenities along Zetland Ave can be more consistent with the language of the rest of the site. Pool Building • The importance of natural light in the Pool was noted and the next phase should include studies into the nature of the space and the moments of light and shade in the building. • The overall approach to the planning is supported, however there were practical concerns about the progression and sequence of how users will move through the space and how that affects the experience of the place. The example of having to move through wet floors to get to the change rooms upon arrival was cited. The wet and dry circulation and travel paths could be defined through slight level changes to avoid potential conflicts. • The relationship between the change rooms and the crèche and the visibility and sightlines need to be reviewed. • Whilst the evolution of the elevations is generally supported, there was a concern that the southern façade was the least resolved. In the design development, there should be investigations into that façade and its address to Rose Valley Way. • In the next stage, the Panel and Jury requested that the project to presented back with studies into materiality, the junction between materials and the relationship between the build form and the landscape berm. The Panel and Jury further noted that the Park and Pool design should read as a whole and not as separate elements. The proposed integration of the artwork into the raingarden is also supported.

DESIGN ADVISORY PANEL

MINUTES – MEETING of 8 March 2016, 9:00am–1.00pm

FINANCE ROOM, TOWN HALL

DESIGN ADVISORY PANEL	
ATTENDEES	APOLOGIES
Ken Maher (Chair)	Elizabeth-Ann MacGregor
Kerry Clare	Peter Poulet
James Weirick	
Peter Mould	
Richard Johnson	

CITY OF SYDNEY	
Clover Moore, Lord Mayor	Andrew Rees, Planning Assessments
Graham Jahn, Director City Planning,	Nicola Reeve, Planning Assessments
Development & Transport	Ben Chamie, Planning Assessments
Bridget Smyth, Design Director	David White, City Renewal
Pauline Chan, City Design	Tony Smith, Urban Design and Heritage
Laurie Johnson, City Design	Ben Pechey, Strategic Planning and Urban Design
Michael Harvey, City Design	Johnathon Carle, Strategic Planning and Urban Design
Nick McCarthy, City Design	Jesse McNicoll, Strategic Planning and Urban Design
John Vu, City Design	Emma Brooks, Landscape Assessment Officer
Alexander Carlile, City Design	Nicola Reeve, Planning Assessments
Emma Cosgrove, City Design	McCabe, Office of The Lord Mayor
Chris Thomas, City Projects	Julie Prentice, Office of The Lord Mayor
Elizabeth Sandoval, City Projects	Julie Lawson, Councillor Support
Wendy James, City Projects	
Stephen Merchant, City Projects	

1. **Declaration of Interest**
   201 Elizabeth Street - Richard Johnson noted his involvement with the upgrade of the Anzac Memorial at Hyde Park
   The Landscape Code – Peter Mould noted that his daughter works for Oculus and is part of the project team working on The Landscape Code

   It was determined that the above noted are not conflicts of interest.

2. **Adoption of the previous minutes**
   The previous minutes were endorsed.

3. **Maria Atkinson's resignation**
   Maria's resignation from the Panel to commence her appointment as Central District Commissioner at the Greater Sydney Commission was noted. The Panel would like to thank Maria for her valuable input over the years, particularly for her expertise in sustainability which has been so critical in reviewing some of the major developments and projects for the City. The Panel noted the importance for nominees with similar expertise as Maria be considered for the vacant position. The Panel members also agreed on the importance of gender balance as a factor in the consideration of nominees.

4. **Gunyama Park and Green Square Aquatic Centre**
   Advice Sheet 6/2016

5. **904 Bourke Street Park, Zetland**
   Advice Sheet 7/2016

6. **Wimbo Park Preliminary Concept Design**
   Advice Sheet 8/2016

7. **201 Elizabeth Street, Sydney**
   Advice Sheet 9/2016

8. **The Landscape Code**
   Advice Sheet 10/2016

9. **2-32 Junction Street, Forest Lodge**
   Advice Sheet 11/2016

10. **Other matters for noting**
    The Lord Mayor requested for an extraordinary Panel meeting in the coming weeks on the overall impact of light rail in Surry Hills including a review of the concept design for Wimbo Park, the Devonshire light rail corridor and the associated pocket parks to be delivered by the ALTRAC light rail consortium.



Ken Maher

CITY OF SYDNEY **ADVICE SHEET NO: 06/2016**

DESIGN ADVISORY PANEL

Project	**Gunyama Park Aquatic and Recreation Centre (GPARC)**
Review Date	08 March 2016
Panel Present	Ken Maher (Chair) Kerry Clare Richard Johnson Peter Mould James Weirick
COI Declaration	NA
Designer	Andrew Burges Architects, T.C.L.
Council Officer	Elizabeth Sandoval
Advice	The Panel was presented with an update on the schematic design for the Park and the Aquatic and Recreation Centre. The Panel commended the project team on the progress of the concept design noting that the design refinements have further improved the strong competition scheme. The Panel noted support for; • A unified design for the entire site with the background work in place to establish timely 'site handover' for implementation. • The integration of the park amenities into the site and the integration of the Park and the Building, and the surrounding landscape. • The coherence in the proposed choice of material and colour palette for the Park and Building elements. • The resolution of a defined edge detail between synthetic sports field and natural grass. The Panel further noted the and recommended the following; • With regards to the options for the fence, the Panel's preference is for it to be receding and not overt, noting its visibility from the street. The Panel recommends that the fence does not detract from the other strong elements of the design. Safety issues in regard to access to banks will also need resolution. • The Rose Valley Way façade needs further design articulation to move it away from being a 'blank wall', the Panel suggested softening the façade through green walls and overhanging plants from the green roof. • An analysis of the proposed shade structures with the anticipated wind and rain conditions, to confirm the provision of adequate weather protection.

CITY OF SYDNEY **ADVICE SHEET NO: 57.3b/2015**

PUBLIC ART ADVISORY PANEL

Project	**Gunyama Park & Green Square Aquatic Centre Public Art, Public Art Strategy**
Review Date	Tuesday 5 May 2015
Panel Present	Felicity Fenner (Chair) Judith Blackall Richard Johnson Anne Loxley
COI Declaration	NA
Council Officer	Elizabeth Sandoval, Snr Design Manager (Architectural)
Advice	The Panel was particularly impressed by Jonathan's research into Joseph Banks' private collection and Aunty Julie's responses to the cuttings. The Panel appreciated the challenge of symbolism and concurred that the proposed concrete patterning/stencilling is less successful as an approach as it seems to create a 'faux' interpretation equivalent to the feel of a billboard. They felt that the integrated approach taken to the introduction of aggregate into the concrete, working with the lighting design and the planting was a more powerful outcome. The Panel made the following recommendations: • Investigate a more collaborative process with the architects, integrating all the elements currently being researched to create a sublime fully integrated singular work or a series of works. • The team are encouraged to introduce art as a way of reinforcing the experiential quality of the Gunyama Park and Aquatic Centre scheme, which is specifically Sydney. The salt water/fresh water duality provides an interesting currency and source of tension. • Further investigation, particularly how to capture the building, Sydney's coastal pools and stories • Community consultation • Documentation of this process, capturing the development of the project • The Panel requested the above be considered and the proposal return to the Panel

CITY OF SYDNEY **ADVICE SHEET NO: 61.2a/2015**

PUBLIC ART ADVISORY PANEL

Project	**Gunyama Park and Green Square Aquatic Centre Public Art Update**
Review Date	Tuesday 27 October 2015
Panel Present	Leon Paroissien (Chair) Judith Blackall Felicity Fenner Anne Loxley
COI Declaration	NA
Council Officer	Elizabeth Sandoval, Senior Design Manager (Architecture) City Projects
Advice	The Panel commended the artist on his research to date and support the direction taken and concepts. The Panel looks forward to seeing how the preliminary proposals (plantings and water carriers) develop with input from the Landscape Architects (TCL) and further investigation into materiality and scale of the water carriers. The Panel made the following recommendations: • That the delivery and materiality of the water carriers must be given careful consideration, ensuring their ability to hold water. The Panel recommended that further testing and consultation should include: o The investigation of non-metallic, organic materials, and o The analysis of scale and the number of elements in the landscape • That TCL Landscape Architects work closely with the artist to explore a full range of planting options on site and more generally in the overall integration of the artwork. The Panel expressed concerned that the art budget may limit multiple approaches and expressed its support for the artist refining and focusing the scope should he consider that necessary.

CITY OF SYDNEY **ADVICE SHEET NO: 64.2e/2016**

PUBLIC ART ADVISORY PANEL

Project	**Gunyama Park & Aquatic Centre Public Art**
Review Date	Tuesday 22 March 2016
Panel Present	Leon Paroissien (Chair) Judith Blackall Felicity Fenner Lisa Havilah Anne Loxley
COI Declaration	NA
Council Officer	Elizabeth Sandoval, Senior Design Manager, Architectural
Advice	The Panel was presented with an update on the current research and development into the proposed public art work by the artist as part of the Gunyama Park and Aquatic Centre. The Panel were pleased with recent investigations and endorsed the artist's preference for location 02.

Intended for

City of Sydney

Prepared by

Ramboll Environ Australia Pty Ltd

Date

June 2016

Project Number

AS121697

Audit Number

MP 35_1

INTERIM AUDIT ADVICE GREEN SQUARE AQUATIC CENTRE AND GUNYAMA PARK

RAMBOLL ENVIRON

RAMBOLL ENVIRON

15 June 2016 Our Ref: AS121697

City of Sydney
Attn: Russell Kosko
Town Hall House
456 Kent Street
Sydney NSW 2000

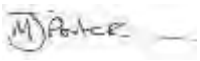
Dear Russell

Re: Interim Audit Advice - Green Square Aquatic Centre and Gunyama Park

As a NSW EPA Environment Protection Authority (EPA) accredited Contaminated Sites Auditor, I am conducting an audit in relation to the subject site. This initial review has been undertaken to determine if the site can be made suitable for the proposed use.

Thank you for giving me the opportunity to conduct this Audit. Please call me on 9954 8113 if you have any questions.

Yours faithfully,
Ramboll Environ Australia Pty Ltd



Melissa Porter
EPA Accredited Site Auditor 0803

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List of Abbreviations

ACM	Asbestos Containing Material
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
BaP	Benzo(a)pyrene
BGL	below ground level
BTEX	Benzene, Toluene, Ethylbenzene & Xylenes (Monocyclic Aromatic Hydrocarbons)
CEC	Cation Exchange Capacity
CLM Act	NSW Contaminated Land Management Act 1997
CN	Cyanide (total or free)
Council	City of Sydney Council
CT	Certificate of Title
DA	Development Application
DP	Deposited Plan
DQO	Data Quality Objective
EMP	Environmental Management Plan
EPA	Environment Protection Authority (NSW)
ESA	Environmental Site Assessment report
FFL	Final finished level
GME	Groundwater Monitoring Event
GSC	Green Square Consortium
GSTC	Green Square Town Centre
HIL	Health Investigation Level
HSL	Health Screening Level
ha	Hectare
km	Kilometres
LOR	Limit of Reporting
m	Metres
Mercury	Inorganic mercury unless noted otherwise
Metals	As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Ni: Nickel, Pb: Lead, Zn: Zinc, Hg: Mercury
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
mbgl	Metres below ground level
ML	Management Limits (NEPM, 2013)
MTP	Material Tracking Plan
µg/L	Micrograms per Litre
NATA	National Association of Testing Authorities
NC	Not Calculated
ND	Not Detected
ng/L	Nanograms per Litre
NEHF	National Environmental Health Forum
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
n	Number of Samples
OCPs	Organochlorine Pesticides
OEH	Office of Environment and Heritage
OH&S	Occupational Health & Safety
OPPs	Organophosphorus Pesticides
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PFCs	Perfluorinated Compounds
pH	a measure of acidity, hydrogen ion activity
PID	Photoionisation Detector
ppm	Parts Per Million
PQL	Practical Quantitation Limit
PSH	Phase Separated Hydrocarbon

QA/QC	Quality Assurance/Quality Control
RAP	Remediation Action Plan
REMP	Remediation Environmental Management Plan
RPD	Relative Percent Difference
SAQP	Sampling Analysis and Quality Plan
SAR	Site Audit Report
SAS	Site Audit Statement
SGMP	Soil and Groundwater Management Plan
SILs	Soil Investigation Levels
SVOCs	Semi Volatile Organic Compounds
SWL	Standing Water Level
TCLP	Toxicity Characteristic Leaching Procedure
TPHs	Total Petroleum Hydrocarbons
TV	Trigger Value
UCL	Upper Confidence Limit
UFP	Unexpected Finds Protocol
VHCs	Volatile Halogenated Hydrocarbons
UST	Underground Storage Tank
VENM	virgin excavated natural material
VOCs	Volatile Organic Compounds
WHSP	Work Health and Safety Management Plan
-	On tables is "not calculated", "no criteria" or "not applicable

"

1 Introduction

A site Audit is being conducted in relation to the property to be developed as the Green Square Aquatic Centre and Gunyama Park at 130 – 140 Joynton Avenue and 94 to 116 Epson Road, Zetland, NSW and known in this report as 'the site'. This Interim Audit Advice (IAA) has been prepared to provide an initial independent review of the suitability and appropriateness of a Remediation Action Plan (RAP).

Details of the Audit are:

Requested by:	Bernard Jeffery on behalf of City of Sydney
Request/Commencement Date:	6 February 2014
Auditor:	Melissa Porter
Accreditation No.:	0803

The scope of the Audit included:

- Review of the following reports:
  - 'Site Investigation, 132 – 138 and 140-144 Joynton Avenue and 94-104 Epsom Road, Zetland, NSW' dated 2002 by HLA-Envirosciences Pty Ltd (now AECOM).
  - 'Phase 2 Environmental Site Assessment, 132 – 138 Joynton Avenue and 140-144 Epsom Road, Zetland, NSW' dated 30 May 2008 by AECOM.
  - 'Strategic Site Remediation Report: 132 – 138 and 140-144 Joynton Avenue, Zetland, NSW' dated 9 June 2009 by AECOM.
  - 'Material Reuse Options Study – Green Square Aquatic Centre, 132-138 Joynton Avenue, Zetland, NSW' dated 30 April 2014 by AECOM.
  - 'Report on Geotechnical Investigation. Green Square Health and Recreation Centre, Joynton Avenue, Zetland' dated May 2014 by Douglas Partners Pty Ltd (Douglas).
  - 'Remedial Action Plan. Gunyama Park & Green Square Aquatic Centre - Zetland, NSW' (drafts issued between April and June 2016) dated 15 June 2016 by AECOM. This report is inclusive of Additional Site Investigations undertaken by AECOM in 2015 (AECOM 2015) as an Appendix. This RAP supersedes the RAP prepared 18 June 2014.
- Site visit on 11 April 2016
- Discussions with City of Sydney, and with AECOM who prepared the RAP.

Previous investigations were undertaken over the former Lincon site (north-east corner) as detailed below:

- 'Phase 1 Contamination Assessment, 106-116 Epsom Road, Zetland NSW' by WSP Environment & Energy (WSP, 2011a) dated May 2011.

- ‘Limited Phase 2 Contamination and Geotechnical Assessment, 106-116 Epsom Road, Zetland NSW’ by WSP dated October 2011
- ‘Phase 1 Contamination Assessment (summarised in WSP reports)’ by Douglas Partners dated 2009.
- ‘Preliminary Contamination Assessment (summarised in WSP reports)’ by Douglas Partners dated 1995.

These investigations have not been relied on as investigations undertaken by AECOM (as detailed in an appendix to the RAP) supersede these. AECOM note that they were unaware of the presence of the reports until ‘during the completion’ of their report. The summary of the previous reports provided by AECOM (2015) confirms that the current findings are consistent with those previously found.

2 Site Details

2.1 Location

The site location is shown on Attachment 1, Appendix A.

The site details are as follows:

Street address:	130 – 140 Joynton Avenue, Zetland, NSW and 94-116 Epsom Road, Zetland, NSW
Identifier:	As shown as Attachment 1, Appendix A. 130 Joynton Avenue Small section of Lot 1 DP 850686 (Ausgrid site) 132-138 Joynton Avenue Part of Lot 2 DP 850686 140 Joynton Avenue Lot 100 DP 1200645 Part of 94-104 Epsom Road Part of Lot 101 DP 1200645 (Council depot site) 106-116 Epsom Road Part of Lot 1 DP 830870 (Lincon Development site, north east corner of the Site)
Local Government:	City of Sydney Council
Site Area:	approximately 2.87 ha

The site forms part of a much larger transformation project of the Green Square Precinct.

The western, southern and eastern boundaries are well defined by existing fence lines.

The northern boundary is not well defined in the field as it is unfenced and set back approximately 45 m from the current fence line due to provision of land to be developed as Zetland Avenue. Zetland Avenue is not within the Audit boundary. The investigations undertaken in 2002 and 2008 extended beyond the current northern boundary.

2.2 Zoning

The current zoning of the site is SP2 Community Facility.

2.2 Surrounding Land Uses

The Site is located within a predominantly commercial/industrial area with some residential land uses. The Site is currently surrounded by the following land uses as noted by AECOM:

- North: A narrow strip that is part of the former Zetland Ausgrid Depot, followed by high density residential apartments and open space. The Ausgrid Depot was notified under Section 60 of the *Contaminated Land Management Act* (1997) (CLM Act) however regulation was not required by EPA and much of that property has since been developed as residential apartments.
- South: Car dealership and service centre, a Meriton residential construction site, City of Sydney Depot and a warehouse are located along the southern boundary of the Site followed by Epsom Road. The property known as 94-92 Epsom Road has been notified

to the EPA as a contaminated site under Section 60 of the *Contaminated Land Management Act* (1997) (CLM Act). The register notes that the site is under assessment. The property is owned by Goodrick Control Systems. The nature of the contamination is not clear and the property is located to the south and down-gradient of the site.

- East: Car dealerships and service centres, followed by Link Road and Southern Cross Drive.
- West: Joynton Avenue followed by Green Square Community Hall, high density residential apartments and future development site for a childcare centre and park.

The Auditor considers that there is a potential for contamination associated with the adjacent land uses as discussed further in Section 3 and 4.

The nearest surface water receptor is Sheas Creek located approximately 1.2 km to the west that drains to Alexandra Canal.

The Auditor notes that these are consistent with general observations during the site inspection.

2.3 Site Condition

The site is relatively flat with a slight slope to the west (in the west) and to the south (in the east). The surrounding land slopes to the west towards Alexandra Canal.

At the time of the Auditor's site visit on 11 April 2016:

- Most buildings had been demolished and the concrete pads remained. Previous site uses including landscaping depot and scaffold storage yard, had ceased. The north-east (former Ausgrid depot and former Lincon site) were still being used for car parking.

- The DG Alliance, inclusive of the City of Sydney, Sydney Water and the contractor, had commenced construction of the trunk drainage stormwater corridor. Large pre-cast concrete pipes were being stored across the north-west section of the site on concrete slabs. A large excavation, to facilitate directional drilling, was still exposed immediately to the north of the site and adjacent to Joynton Avenue. Fill containing construction rubble was evident in the sub-soil material. Material sourced from the approximate 10 m pit was stockpiled on-site. No major inclusions or odours were noted over the surface on initial inspection by the Auditor of the stockpile.

- The building at the south-east corner was yet to be demolished and paving was still in place adjacent to the building to the south. The paving was covered in leaf litter. A number of groundwater wells were located to the west of this area thought to be part of the dewatering works for the DG Alliance.

- The western boundary is defined by a low brick wall along Joynton Avenue behind which is a landscaped corridor of large trees.

- Material suspected of containing asbestos containing material excavated during installation of the trunk drainage was observed to be stored temporarily, prior to proposed off-site disposal, over concrete in the north-east corner of the site.

2.4 Proposed Development

It is understood that the site is to be redeveloped for recreational mixed uses as the Aquatic Centre facility (recreation mixed use) and as Gunyama Park (recreational open space) (Attachment 2, Appendix A), as follows:

- A Landscaped Easement is proposed along the entire western boundary with a width of approximately 10 m The current established trees and current site levels will be retained to prevent adverse impacts to the trees and shallow root systems.

- The Aquatic Centre in the western section will include four swimming pools and pool balance tanks to be excavated to a maximum depth of 1.2 m below the current ground level. The Aquatic Centre building is to be supported by piles and raised approximately 1.2 m above the current ground levels. There will be a step down to the Landscaped Easement to the west. The Aquatic Centre Building is to be inclusive of a small crèche that is to be located on the ground floor in the northwest corner.

- Realignment of the Green Square stormwater main by the DG Alliance within the easement located directly to the east of the Aquatic Centre building. These works are currently underway. The Auditor notes that once the trunk drainage is installed, there would be no opportunity for direct contact with soil as access would be via man holes at the surface that lead directly to the internal structure. The Auditor notes that as on-site soil was used to back fill to the surface, further separate consideration was not required.

- Gunyama Park in the eastern section will include a synthetic sports field, landscaped setback areas around the sports field and extended into the recreational open space at the eastern end of the site and a small amenities building. AECOM indicate that the final details are subject to further design and development.

- No new roadway areas are proposed within the site as part of the proposed development works.

- The existing concrete slabs will be retained where possible as part of the development works. The concrete slabs below the proposed aquatic centre building will be removed.

Further details of the proposed development are considered in Section 11.

The most sensitive exposure scenario of ‘recreational open space’ (soil) or ‘commercial/ industrial’ (vapours from groundwater) have been referred to.

3 Site History

HLA (2002) provided a site history based on some aerial photographs and Certificates of Title and is summarised below. WSP (2011) also undertook internet search, review of historical titles, aerial photographs, a site interview (anecdotal), WorkCover Dangerous Good record search and Council Records for the former Lincon site (north-east) (these were summarised by AECOM 2016).

3.1 Site History Summary

The general area was a former wetland that was drained and filled for redevelopment of a large racecourse in 1913. The site formed the south-east corner of the track. The track was used as an 'ordinance unit and military camp for WWII' between 1939 and 1945. No infrastructure was noted over the site on the 1943 aerial photograph.

From 1954, the north-western section of the site was owned by James N Kirby Holdings Pty Ltd (10 years) with site uses including manufacture of household appliances. From 1964, the north-western half of the site was used by Sydney County Council as a works depot for council. No details on activities provided.

From 1951, the south-east and north-east of the site was purchased by Nuffield Limited with site uses including 'a large industrial facility producing motor vehicles'. It is noted that that the facility was located off-site to the north and that the section over this site remained vacant. The site was sold three years after this purchase. From 1952 the south-west of the site was owned by government (transport) and used as a road works depot.

From 1952/1955 the southern properties and the property to the north-west were purchased by the 'Olympic Tyre and Rubber Company' for the manufacture of tyres. These sites were sold between 1968 (north-west) and 1980 (south).

From 1980, the southern properties were owned by various companies associated with print including Fairfax that leased the site. No details on activities provided. From 1989 until present, the south-west section was purchased by City of South Sydney (now City of Sydney Council) and used as a Council works depot. The remainder was purchased in 1998. USTs removed (prior 2002) and buildings demolished (damaged in 1999 hailstorm event) and replaced with portable buildings or used for the storage of vehicles and landscape wastes. (east). Permanent buildings were retained in the west.

From 1968, the property to the north-west was sold to D.C.L (nature not known) which was followed by additional filling over the next 2 or so years prior to use as a recreational areas and car park use. Use still current.

3.2 Surrounding Site History Summary

The wetland was drained to the north-west, north and north-east and infilled. The surrounding areas were redeveloped and mainly used for manufacturing including car manufacture (north), car parts (south), textiles (west) and depots (south). The property to the north was also used for car manufacture from 1961 to 1975. The site was then used as a Naval Store until the factories were demolished in 1999. AECOM note that groundwater

impacted by chlorinated solvents was remediated. It was also indicated that the adjacent site was reclaimed with landfilling waste. The site was then used as an Ausgrid electrical depot.

3.3 Historic Remedial Work

HLA notes that a UST was removed at the northern boundary. No other information was provided and one borehole (BH05) was excavated nearby.

HLA notes that two USTs (diesel and petrol) and a bowser (staining still present on concrete during HLA investigation) were located at the southern boundary that had been previously removed. No other information was provided. HLA (2002) noted that 'no known environmental testing was conducted during the UST removal process'. Additional works are proposed to confirm that the removal of the USTs was adequately validated as discussed in Section 11.

3.4 Auditors Opinion

Filling has occurred at the site and although there will be some uncertainties regarding fill quality, in the Auditors opinion, this has been compensated for by soil sampling, consistent observations and results. This is discussed further in Section 6.

In the Auditor's opinion, the site history provides an indication of past activities however the details regarding the location and specific nature of the site activities (fuel storage, industrial processes) are lacking. Further assessment of the sampling density and analysis (Section 6), the proposed development and remedial works (Section 11) and proposed additional investigations (Section 11) has been undertaken to confirm whether these have or will compensate for the deficiencies in the site history.

4 Contaminants Of Concern

AECOM (RAP 2016) provided a table of the areas, activities and contaminants of concern. These are presented in Table 4.1. These were not clearly presented in the earlier reports provided by the consultants.

Table 4.1: Contaminants of Potential Concern

Area	Activity	Contaminants of concern
All	Uncontrolled spoil disposal in the 1990s (i.e. filling) and in north-east between 1950s and 1970.	Heavy metals, TRH, BTEX, PAHs, asbestos, OCPs, OPPs, PCBs and industrial solvents (SVOCs and VOCs).
North-East	Use of ash on racetrack surface and racecourse construction and operation.	PAHs, OCPs and OPPs.
South-east	Not listed in Areas and Contaminants of Concern as the former industrial facility was located to the north and the south-east corner of the Site remained vacant during that time.	None considered in RAP.
North-West	Industrial manufacturing of refrigerators and appliances. The potential contaminants include solvents such as chlorofluorocarbons. The Auditor notes that degreasing operations, painting, assembly line and bulk storage are also possible. The nature of storage is not known i.e. bunds/spills/locations, outdoor ASTs covered, pipelines etc.	Metals, TRH, BTEX, cyanide and industrial solvents (SVOCs and VOCs) and perfluorinated compounds (PFCs). The Auditor considers that specific contaminants could include chlorinated hydrocarbons and metals.
All	Unknown fuel storage and dispensing The Auditor notes that wash-bays and workshops could also be potential areas of concern.	Lead, TRH, BTEX and PAHs.
South-west	Known fuel storage and dispensing	
All	Ordnance storage or use during WWII	'There are no UXO reported on the Department of Defence website'.
Up-gradient	Industrial manufacturing, electrical substations, car servicing centres/mechanics and filled land	Industrial solvents (SVOCs and VOCs) and PCBs. The Auditor notes that this specifically includes VHCs.
All	The Auditor also notes that the use of pesticides under concrete slabs could also be of concern.	OCPs/OPPs

TRH: Total Recoverable Hydrocarbons
BTEX: Benzene, Toluene, Ethyl benzene, Xylene
PAH: Polycyclic Aromatic Hydrocarbons
OCPs: Organochlorine Pesticides
OPPs: Organophosphorus Pesticides
SVOCs: Semi-volatile Organic Compounds
VOCs: Volatile Organic Compounds
VHCs: Volatile Halogenated Hydrocarbons
PCBs: Polychlorinated biphenyl's
UXO: Unexploded ordnance
PFCs: Perfluorinated Chemicals

4.1 Auditor's Opinion

The contaminants of concern listed by AECOM are consistent with the site history, however the analyte list used during the investigation essentially did not include OPPs, OCPs, PCBs, SVOCs, VOCs or PFOS (including VHCs) (only two samples in soil submitted for PCBs and VOCs and four samples for OCPs) for soil. The analyte list used did not include OPPs, PCBs, SVOCs and PFOS for groundwater. Further assessment of the sampling density and analysis (Section 6), the proposed development and remedial works (Section 11) and proposed additional investigations (Section 11) has been undertaken to confirm whether these have or will compensate for the deficiencies in the analytical testing.

The site was not investigated for UXOs and there was no evidence during the intrusive investigations or geotechnical investigations. An unexpected finds protocol is outlined and only limited excavations are proposed to facilitate construction of the pools and reshaping for landscaping purposes. The Auditor considers that no further works are required with respect to UXOs.

5 Stratigraphy and Hydrogeology

Following a review of the reports provided, a summary of the site stratigraphy and hydrogeology was compiled as follows.

5.1 Stratigraphy

Fill extends across the Site that appears to have been placed prior to 1910 and contains waste with slag, ash and metal. The material filled the former Waterloo swamp and dam that was located within and surrounding the Site. The fill is deepest in the west near Joynton Avenue and shallowest in the south east of the Site. The Lincon Development site was filled with a mound of material between the mid-1950s and 1961 that sits above the pre 1910 fill. The 1960s fill consists of soil mixed with demolition and tyre waste. A conceptual cross section provided by AECOM of the stratigraphy is provided as Attachment 3, Appendix A.

The sub-surface profile of the site is summarised in Table 5.1.

Table 5.1: Stratigraphy

Depth (mbgl)	Subsurface Profile
West (west of BH212)	
0.0 – 0.4	Fill: Road base gravels underlying pavements
0.4 – 3.0 (depth increases to the west with fill as shallow as 0.2 m to the east)	Fill: Gravelly silty sand with rubbish including slag (metallic orange slag and metal grey), ceramics, metal, big pieces of zinc, wood, nails, wire, ash, brick and rubber.
3 m +	Sand Peat and plant fibres noted at depths ranging from 2 to 4.5 m depth of limited thickness (maximum 0.3m).
East	
0.0 – 1.2	Fill: Road base gravels underlying pavements followed by fill consisting of sand, gravel and clay with demolition type waste (brick and concrete) to 1 - 2 m bgl. The demolition type fill was underlain by fill similar to the fill in the western part of the Site, but with lower proportions of slag, ash and metals.
1.2 +	Sand

mbgl – metres below ground level

The borehole logs prepared by AECOM (2008 and 2015) have been considered. The Auditor notes that although less detail was provided in HLA (2002) that the logs are generally consistent with those logged by AECOM. The geotechnical bores by Douglas Partners indicate that sandstone was encountered at approximately 12m to 14 m depth.

The Auditor considers that the depth of fill and underlying stratigraphy have been adequately characterised.

5.2 Hydrogeology

Groundwater occurs in fill and sands at a depth between about 1.4 and 5.2 m below ground surface. The groundwater flow direction is ‘expected to be’ to the west towards the greater proposed Green Square Town Centre. The inferred groundwater flow is towards the dewatering area to the west (see below).

The Auditor notes that these levels and flow direction and generally consistent with those observed within the general area. Given this, the placement of the wells and the topography of the site, the estimate of the flow direction is considered adequate for the purposes of the Audit.

In 2015, AECOM observed that groundwater levels were 1 to 1.5 m lower than those observed during investigations in 2008 across the site. This is likely due to temporary dewatering works currently occurring to the west to northwest of the Site on the Green Square Town Centre construction site (on the opposite side of Joynton Avenue) and possibly related to the current Mirvac basement excavation/construction works to the south of the Site.

Groundwater in the Botany Sands aquifer has been widely used historically, and it is reported that there are approximately 15 registered bores within 1.5km. The Auditor notes that the site is located within Zone 2 of the Botany Groundwater Management Zone where groundwater use is banned for domestic uses. The nearest groundwater receptor is likely to be Alexandra Canal to the south west of the site.

In the Auditor’s opinion, the subsurface conditions are generally well characterised.

6 Evaluation of Quality Assurance and Quality Control

The Auditor has assessed the overall quality of the data by review of the information presented in the referenced reports, supplemented by field observations. The Auditor's assessment follows in Tables 6.1 and 6.2.

Table 6.2: QA/QC – Sampling and Analysis Methodology Assessment

Sampling and Analysis Plan and Sampling Methodology	Auditor Comments
Sampling Pattern, Density and Locations	Fill (including Lincon): The overall sample density, locations and patterns are considered adequate given consistency of field observations and nature of contaminants encountered in the fill and given remedial works are proposed (see Section 11). Historic Uses (Soil): Concrete slabs have been retained across the site and the site history indicates that activities include storage of fuels, paints, solvents, oils at some point over most of the site and more specific uses in the north-west (with activities possibly including degreasing, electro-painting, assembly lines). Given this, the lack of any specific details and non-testing of some of the contaminants of concern, the minimum sampling density (sampling spacing of 25 to 30 m apart) is considered inadequate without further consideration of the proposed development, proposed remedial works and groundwater results. Historic Uses (Groundwater): In total 11 wells are located across the site with a spacing of approximately 25 m. Seven of these wells are located at the western and south-west boundary, the inferred down-gradient position. Gross contamination was not encountered in groundwater which compensates to some extent for limited site history and minimum soil sampling density. However, the Auditor notes that groundwater was not tested for all contaminants of concern. Given the the historic industrial use, limited historic details, possible use of degreasers and as only the minimum sampling density in soil (limited sampling for chlorinated hydrocarbons) was implemented, further vapour sampling is proposed to confirm that vapours are not of concern (Section 11). A former UST that was removed in the south-west, a former concrete footing at the southern boundary and other concrete slabs (pesticides) were not targeted for sampling.
Sample Depths	The depths are considered adequate to target the fill material.
Well construction	Screen depths and lengths and the well construction materials are considered adequate to characterise the overall groundwater characteristics.
Sample Collection Method	Solid flight, hollow flight augers and hand augers for soil and groundwater samples were collected using disposable bailers. These methods may have led to some loss of volatiles however are consistent across the two investigations. Further consideration of volatiles is proposed (Section 11).
Decontamination Procedures	The sampling equipment and decontamination procedures employed

Table 6.2: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor Comments**
	are considered to be sufficient to limit cross-contamination.
Sample handling and containers	Samples were placed into preserved and prepared jars and chilled during storage and transport to the laboratory. Metals were field filtered.
Chain of Custody	Completed chain of custody forms were provided.
Detailed description of field screening protocols including calibration	Field screening for odours, visual indications and volatiles (PID in ziplock bags) is considered to be adequate.
Sampling Logs	Soils logs provided adequate details i.e. sample depth, PID readings and lithology.

Table 6.3: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor Comments**
Field quality control samples	Field quality control samples were undertaken.
Field quality control results	Field quality control samples results indicate that the data is appropriate for use in the assessment.
NATA registered laboratory and NATA endorsed methods	The laboratory certificates provided are NATA stamped.
Analytical methods and holding times	Laboratory methods are indicated on laboratory certificates. They are typically in-house methods.
Practical Quantitation Limits (PQLs)	The PQLs are considered to be sufficiently low to assess risk. This is discussed further in Section 9 with regard to groundwater sampling.
Laboratory quality control samples	Laboratory quality control samples were included in laboratory reports.
Laboratory quality control results	The laboratory quality control samples results indicate that the data is appropriate for use in the assessment.
Data Quality Objectives and Data Evaluation (completeness, comparability, representativeness, precision, accuracy)	DQOs were set by the various consultants and data validation was undertaken. The consultants concluded that the overall quality of the analytical data produced is acceptable.

In considering the data as a whole the Auditor concludes that:

- While data is likely to be representative the use of augers may have led to a loss of volatiles.
- The minimum sample density implemented for soil sampling does not compensate for data gaps in the operational site history i.e. point sources. Further works are proposed

as discussed in Section 11 with regard to former USTs, potential impacts to groundwater and soil vapour.

- There is a high degree of confidence that data is comparable for each sampling and analytical event.
- The primary laboratory provided sufficient information to conclude that data is of sufficient precision.
- The data is likely to be accurate.

In considering the data as a whole the Auditor concludes that the data is likely to be reliable and useable for the purpose of remediation planning where further investigations are proposed to confirm the data gaps (Section 11).

7 Environmental Quality Criteria

The Auditor has assessed **soil** data provided by AECOM (2002, 2008 and 2016) in reference to criteria from National Environmental Protection Council (NEPC) *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as Amended 2013 (NEPM, 2013).

Based on the proposed development and remedial strategy of cap and contain (Section 11), the Tier 1 (screening) criteria for 'commercial/industrial' or 'recreational open space' setting were referred to.

- Human Health .
  - Health Based Investigation Levels (HIL C) to provide an indication of the nature of the fill and precautions required should the material be disturbed.
  - Soil Health Screening Levels (HSL D) for Vapour Intrusion. HSL D are more conservative than HSL C and given the presence of a basement below the crèche, this is considered adequate. The most conservative criteria were adopted i.e. assumed depth to source < 1 m and sand.
  - CRC CARE (2011) Direct Contact (HSL C and intrusive maintenance worker)
  - Asbestos Health Screening Levels (HSL C).
- Management Limits (Residential/Open Space) assuming coarse soil.
- Aesthetics. The Auditor has considered the need for remediation based on the 'aesthetic' contamination as outlined in the NEPM (2013).

Given the proposed cap and contain strategy, assessment of the terrestrial ecological risks was not undertaken. The majority of the site will be sealed with concrete or a synthetic playing field and the remainder landscaped with an imported growing medium.

The Auditor has assessed the **groundwater** data provided by AECOM in reference to Tier 1 (screening) criteria for 'commercial/industrial' from the following:

- Human Health Assessment
  - NEPM (2013) Groundwater Health Screening Levels (HSL D) for vapour intrusion (sand, 2 to <4 m)
  - WHO (2008) Drinking water guidelines where HSLs are not applicable
  - USEPA RSL (on-line) Residential Tap Water Criteria for use where HSLs are not applicable
- Ecological Assessment
  - Groundwater Investigation Levels (GILs) listed in NEPM (2013) for protection of aquatic ecosystems referenced in ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Trigger values (TVs) provided are concentrations that, if exceeded, indicate a potential environmental problem at the point of use and 'trigger' further investigation. The marine water criteria were adopted.

AECOM note that 'groundwater is not beneficially used on the Site (currently and no plans in the future) or in the Region'. Given this and as groundwater in the Botany Sands aquifer has been widely used historically, groundwater is currently banned for domestic uses and as there is a reticulated water supply for the area, the Auditor agrees that specific consideration of other environmental values is not required.

The environmental quality criteria adopted in the RAP are consistent with the guidance listed above with the exception of:

- Aesthetics as not specifically discussed and should be considered as per NEPM (2013)

Other considerations during validation of the remedial works are discussed in Section 11 including imported material and verification of capping works.

The Auditor notes that imported fill would be assessed in relation to attributes expected of virgin excavated natural material (VENM). The NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste* classifies VENM as *"…natural material (such as clay, gravel, sand, soil or rock fines):*

- 'that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities
- 'that does not contain sulphidic ores or soils, or any other waste, and includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved from time to time by a notice in the NSW Government Gazette."

On this basis, the Auditor considers that for soil to be classified as VENM, the following criteria generally apply:

- Organic compounds (including petroleum hydrocarbons, PAHs, OCPs, PCBs, Phenols) should be less than the LORs.
- Inorganic compounds should be consistent with background concentrations.

8 Evaluation of Soil Analytical Results

Investigations were undertaken by HLA (2002) and AECOM (2008) over the site inclusive of the former Council Depot (Lot 5 DP 235181). The current site only extends over part of that larger investigation area. Only data within the current site boundaries has been considered as shown on Attachment 4, Appendix A.

Additional investigations were undertaken by AECOM (2016) within the site boundaries, including the Lincon site. All data obtained within the site boundaries is summarised in Table 8.1. Given the cap and contain remedial strategy, this review provides an overview of the conditions that may be encountered during future excavations and the protective measures that may be required.

Table 8.1: Soil Analytical Results – Summary Table (mg/kg)*

Analyte	n	Detections	Maximum (2nd highest)	n > Human Health Screening Criteria (NEPM, 2013)
Asbestos	52	3	NA	3
Lead	77	73	4150 (1550)	14
Arsenic	78	38	20	0
Cadmium	78	13	4	0
Chromium (III+VI)	78	63	134	0
Copper	78	62	1290	0
Mercury	78	48	4	0
Nickel	78	57	105	0
Zinc	78	71	3240	0
Benzene	64	0	ND	0
Ethylbenzene	64	0	ND	0
Toluene	64	1	0.2	0
Xylene Total	64	1	1	0
F1 minus BTEX (C6-C10)	64	1	32	0
F2-NAPHTHALENE	64	2	100 (75)	0
C16-C34	64	26	4500 (2200)	0
C34-C40	64	24	2350 (540)	0
Naphthalene	66	9	4	0
PAHs (Sum of total)	66	42	1431	3
Benzo(a)pyrene TEQ	66	42	141	29

Table 8.1: Soil Analytical Results – Summary Table (mg/kg)*				
OCPs	4	0	ND	0
PCBs (Sum of total)	4	0	ND	0
Chlorinated Hydrocarbons	2	0	ND	0
Other VOCs	2	0	ND	0

n number of samples
- No criteria available/used
(number) the next highest number if the maximum is well above the other results

A significant amount of fill containing rubbish (deepest in the west) located across the site is characterised by polycyclic aromatic hydrocarbons (PAHs), metals such as elevated lead, copper and zinc. Areas in association with former fuel storage reported some detection of long chain petroleum hydrocarbons . These impacts are generally distributed as follows:

- The rubbish fill reported elevated concentrations of metals, specifically lead, copper and zinc. The most elevated concentrations were reported in fill in the north-west section of the site and in the south-east (north-east corner of Lincon). The most elevated concentrations were reported in fill at the northern boundary with fill reporting the presence of metal inclusions (lead at 4150 mg/kg at BH201 (1-1.1m) and copper at 1290 mg/kg and 1240 mg/kg in nearby samples BH200 (1-1.1m) and BH14 (0.8-.1m), respectively).
- Fill extending into groundwater at the western boundary was not submitted for analysis so it is assumed that the elevated concentrations extend to depth at the western boundary associated with fill ‘with scrap metal inclusions’. Fill currently extends approximately 0.5 to 1m into groundwater (noting that following cessation of groundwater dewatering in the area that this may increase to 2 to 2.5 m of fill within the groundwater. Further discussion on the risk to groundwater is provided in Section 9.
- Elevated concentrations of total PAHs and benzo(a)pyrene were associated with the fill containing rubbish with some elevated concentrations detected along the western boundary. Further remediation to limit contact with the aesthetically unsuitable material characterised by elevated PAHs and metals is detailed in Section 11.
- Benzene and toluene, PCBs, OCPs, chlorinated hydrocarbons and VOCs were not reported above the PQLs consistent with the relatively low PID readings reported. Only a limited number of samples were submitted for analysis.

  An elevated PID reading of 465 ppm and odours were noted in silty sand fill in the upper 0.4 m at the southern boundary (BH107) to the east of BH106 discussed below. This sample was not submitted for TPH analysis however TPH was not reported above the PQLs at 1.8 m in the same location. This section of the site will be located under the Rose Street footpath and risk from volatiles is considered to be low.
- The longer-chain petroleum hydrocarbons (> C16) were reported in association with rubbish fill and elevated PAH concentrations along the western boundary. The concentrations are less than the Management Limits or screening criteria for direct contact.

- The most elevated concentrations of total PAHs (1431 mg/kg) and total petroleum hydrocarbons (TPH > C15 reported at 6850 mg/kg) were reported in sandy fill with shiny black gravel and chemical odours. The fill was encountered at a depth of 2 to 3m and the material and magnitude of impact are inconsistent with those reported over the remainder of the site. The underlying natural sandy clay also reported organic chemical odour and plant fibres. Given these results and current and future depth of groundwater to levels above that depth, further delineation and remediation is proposed as detailed in Section 11.
- No visual observations of asbestos were made. Asbestos was reported in approximately 6% of samples submitted for analysis with descriptions included ‘loose bundle of friable asbestos fibres’ or ‘one fragment of friable asbestos fibre’. AECOM (Addendum) noted that ‘the asbestos is expected to be randomly distributed amongst the fill and the management of the material will be addressed in the RAP’.
- It is understood that while most of the concrete slabs will be retained, that concrete slabs under the aquatic centre will be removed.

While some further investigations are required with regard to petroleum infrastructure and following the removal of slabs and buildings (Section 11) and there are inherent uncertainties associated with the extensive filling of the site, the Auditor considers that the investigations conducted were sufficient to show that there is unlikely to be any gross contamination that would preclude the proposed development.

The Auditor considers that soil has been characterised sufficiently such that a plan of remediation could be prepared. A RAP has been prepared to address the presence of the fill material and proposes further investigations to confirm data gaps (Section 11).

9 Evaluation of Groundwater Analytical Results

Groundwater samples were collected from the original 11 wells installed by HLA (2002) in 2008. These wells are positioned to confirm up-gradient conditions (four wells located off-site along the northern boundary), down-gradient conditions (western and southern boundary) and down-gradient of a former UST. All results have been considered in Table 9.1 and groundwater contours are shown as Attachment 5, Appendix A.

An additional 6 wells were installed in 2016 by AECOM over the former Lincon site and further down-gradient. Two of the wells were dry as the wells were not extended deep enough (at the up-gradient location and the north-west corner). The Auditor considers that given the results and positions of the other wells, that the number of wells remaining are adequate to provide an indication of the distribution of contamination in the groundwater.

The analytical results are summarised below in Table 9.1.

Table 9.1: Evaluation of Groundwater Analytical Results – Aquatic Ecosystems - Summary Table (μg/L)

	AECOM (2008)			AECOM (2016)		
Analyte	**Detects (n = 11)**	**Maximum**	**n > adopted ecological criteria**	**Detects (n = 4)**	**Maximum**	**n > adopted ecological criteria**
Lead	4	4	0	2	8	0
Arsenic	9	6	**1**	2	8	0
Cadmium	1	0.2	0	0	<PQL	0
Total Chromium	0	<PQL	0	1	2	0
Copper	6	26	**2**	0	<PQL	0
Mercury (inorganic)	0	<PQL	0	0	<PQL	0
Nickel	7	7	0	1	2	0
Zinc	9	167	**9**	4	10	0
Benzo(a)pyrene*	1	2	**1**	2	2.3	**2**
Anthracene*	2	6 (2)	**2**	2	1.4	**2**
Naphthalene*	3	20	0	0	<PQL	0
Phenanthrene*	3	24 (3)	**3**	2	4.8	**2**
Fluoranthene*	1	11 (<PQL)	**1**	2	4.7	**2**
F1 (C6-C10) – BTEX	1	96	-	1	130	-
F2 (C10-C16) – Naphthalene*	3	150	-	0	<PQL	-
C16-C34*	3	1160	-	2	1360	-
C34 – C40*	2	180	-	2	270	-

Table 9.1: Evaluation of Groundwater Analytical Results – Aquatic Ecosystems - Summary Table (μg/L)

	AECOM (2008)			AECOM (2016)		
Analyte	**Detects (n = 11)**	**Maximum**	**n > adopted ecological criteria**	**Detects (n = 4)**	**Maximum**	**n > adopted ecological criteria**
Benzene	1	231	0	0	<PQL	0
Toluene	0	<PQL	0	0	<PQL	0
Ethylbenzene	1	202	0	0	<PQL	0
Xylene	1	31	0	0	<PQL	0
TCE	1	7	-	1	97	-
Cis 1, 2 dichloroethene	2	45 (8)	0	1	31	0
Vinyl Chloride	0	<PQL	0	0	<PQL	0
Other VOCs (VHCs only 2016)	0	<PQL	0	0	<PQL	0

- – No Guideline
<PQL – Not detected above the PQLs
* Individual PAHs PQLs of 0.5 and 1 μg/L were above the trigger values.

Table 9.2: Evaluation of Groundwater Analytical Results – Human Health Vapour Intrusion - Summary Table (μg/L)

	AECOM (2008)			AECOM (2016)		
Analyte	**Detects (n = 11)**	**Maximum**	**n > adopted human health criteria**	**Detects (n = 4)**	**Maximum**	**n > adopted human health criteria**
Naphthalene	3	20	0	0	<PQL	0
F1 (C6-C10) – BTEX*	1	96	0	1	130	0
F2 (C10-C16) – Naphthalene*	3	150	NL	0	<PQL	NL
Benzene	1	231	0	0	<PQL	0
Toluene	0	<PQL	NL	0	<PQL	NL
Ethylbenzene	1	202	NL	0	<PQL	NL
Xylene	1	31	NL	0	<PQL	NL
TCE	1	7	See Table 9.3	1	97	See Table 9.3
Cis 1, 2 dichloroethene	2	45 (8)		1	31	
Vinyl Chloride	0	<PQL		0	<PQL	
Other VOCs (VHCs only 2016)	0	<PQL	0	0	<PQL	0

- – No Guideline
<PQL – Not detected above the PQLs
NL – Not limiting

Metals, including copper, lead and zinc were reported in groundwater above the PQLs in 2008. Recently installed wells in the near vicinity of those installed in 2008 reported much reduced concentrations during the 2015 sampling round with most concentrations below the PQLs. Those concentrations of zinc and to a lesser extent copper that exceeded the ecological trigger values in 2008 did not exceed the criteria in 2015.

As the fill is characterised by elevated concentrations of metals, the fill cannot be discounted as the source of the initial concentrations of metals in groundwater. However the relatively low concentrations and current non-detects are consistent with the likely low leachability of these metals.

PAHs are not particularly elevated in groundwater across the site consistent with the expected relatively low solubility of PAHs, the currently sealed surfaces that limit surface water infiltration through the material and the extensive time (over 100 years) that the fill has been in place.

Elevated concentrations of PAHs, including naphthalene, and TPH above the PQLs in groundwater were reported in association with a distinct fill type at the southern boundary reporting elevated concentrations of PAHs and TPHs (fill is located below the water table at BH106). Further delineation and remedial works are proposed as discussed in Section 11.

Petroleum impacts to groundwater were reported to the north off-site likely due to a former UST and at the southern boundary immediately down-gradient of former USTs (said to have been removed).

Groundwater to the north-east (off-site) indicated a potential off-site source of volatile petroleum hydrocarbons including naphthalene, benzene, ethylbenzene and xylene reported at low concentrations in 2008 below the adopted human health screening criteria. These petroleum hydrocarbons were not reported above the PQLs on-site down-gradient in 2008 and 2016.

TCE and cis 1,2 DCE, a breakdown product of TCE, were encountered at low concentrations towards the centre of the site and further down-gradient at the south-western corner during the 2002, 2008 and 2016 investigations.

To assess the potential risk to human health for the proposed Aquatic Building, the maximum groundwater concentrations (2008 and 2016) for volatile chlorinated hydrocarbons (as there are no HSLs) have been referenced against the drinking water guidelines. Those that exceed the drinking water guidelines warrant further consideration for potential health risks. This comparison is presented in Table 9.3.

Table 9.3: Maximum Groundwater Concentrations Compared to Drinking Water Guidelines (mg/L)

Chemical of Concern in Groundwater	Maximum Concentration (mg/L)	Drinking Water Guidelines (mg/L)
Cis1,2-dichloroethene	**0.045**	0.05 [1]
Trichloroethene	**0.097**	0.0049 [2]
Vinyl chloride	**< 0.05**	0.0003

Values in **bold text** and in shaded cells exceed the adopted screening criteria
1. WHO (2008)
2. USEPA RSL Tap Water
0.041 – value exceeds drinking water guideline

Based on the Auditor's review of the groundwater data compared to the drinking water guidelines, TCE (and potentially vinyl chloride) were identified as potential chemicals of concern from a vapour intrusion perspective.

The site history indicated that a former Defence Navy Supply Centre, previously located to the north of the site, was remediated for chlorinated solvents in groundwater. No further information was provided on that source or the remediation works. AECOM (2008) had identified that degreasers may have been used in the former workshops with volatile halogenated compounds (VHCs) such as trichloroethylene (TCE) identified as contaminants of concern. Further groundwater sampling is proposed to confirm the maximum VHC concentrations as discussed in Section 11.

Groundwater is located below the depth to which trenches and services would normally be excavated. Volatile petroleum contaminants were only detected in two wells at low concentrations towards the up-gradient boundary. Management of groundwater during the proposed development works is discussed in Section 11. The results (other than VHCs) obtained were similar to those obtained in 2002 by HLA and indicate that groundwater at the site has been sufficiently characterised for the purposes of the Audit. If groundwater were to be used for beneficial uses i.e. irrigation or water features, further assessment would be required to assess suitability for those uses.

10 Evaluation of Conceptual Site Model

A conceptual site model (CSM) is a representation of the source, pathway and receptor linkages at a site. AECOM present a conceptual site model in the RAP which is summarised in Table 10.1.

A cross-section prepared by AECOM of the site is presented in Attachment 3 in Appendix A.

Table 10.1: Review of the Conceptual Site Model

Element of CSM	Consultant	Auditor Opinion
Contaminant source and mechanism	Metals (mainly lead, nickel and zinc), PAHs, TRH and asbestos due to uncontrolled historical fill, including ash, slag and demolition waste. Off-site sources (north) of chlorinated hydrocarbons 'potentially related to the former Defence Navy Supply Centre' anecdotally indicated to have been subject to remedial works.	Past industrial uses on-site should be considered as a potential source of chlorinated hydrocarbons and TRH. Further sampling is proposed to confirm that vapours are not of concern for the proposed development. Former plating works (if undertaken) would also have been a source of metals, cyanide and PFCs. No evidence of historic remedial works to the north off-site have been provided. Further groundwater sampling is proposed for chlorinated hydrocarbons followed by a quantitative risk assessment. Depending on the magnitude/consistency of those works, further evidence of up-gradient remedial works may be required. The PQL for vinyl chloride was reported above the screening criteria and along with other breakdown products, should be considered as a contaminant of concern. It is possible that OCPs were applied prior to placement of the slabs. As surface sampling for OCPs under the slabs was not undertaken the potential source has not been accounted for (discussed below).
Affected media	Soil – Metals (mainly lead, nickel and zinc), PAHs, TRH and asbestos. Groundwater – 'no significant' petroleum impact and chlorinated hydrocarbon concentrations considered low. Soil vapour – not specifically discussed. Quantitative risk assessment on current	Given the consistency of results, the nature of fill and the proposed remedial works, the nature and extent of fill is considered to be sufficiently known. Soil may be impacted by VHC and TRH. Soil immediately under concrete slabs may be impacted by OCPs. Groundwater may be impacted by PFCs. As concentrations of VHCs in groundwater exceed conservative screening criteria and as soil not adequately investigated, soil vapour may include VHCs. As details on site history are lacking, as only the

Table 10.1: Review of the Conceptual Site Model		
Element of CSM	**Consultant**	**Auditor Opinion**
	results not yet completed.	minimum sampling density in soil was reached and spacing of groundwater wells, and chlorinated hydrocarbons detected in groundwater, further investigations are required to confirm that the site is not a source of VHC contamination.
Receptor identification	Long term human receptors include recreational users of recreational open space and the aquatic centre and intrusive workers. Potential environmental receptors include Alexandra Canal from off-site migration of impacted groundwater and Gunyama Park.	Intrusive workers particularly include contractors engaged for intrusive landscaping works in open space recreational areas, including adjacent to Joynton Avenue. Ecological receptors to impacted soil are located specifically in the upper 2m of the recreational open space that includes the area adjacent to Joynton Avenue and other open space areas.
Exposure pathways	Dermal and Ingestion (soil) Inhalation (vapour)	Exposure pathways identified although qualified with the proposed remedial works and assumptions on concentrations based on current works.
Presence of preferential pathways for contaminant movement	Leaching to groundwater from fill Migration of vapour from groundwater.	Migration of vapour from residual undetected soil is not discussed however is a potential migration pathway for unidentified contamination. Migration of vapour from groundwater was ruled out by AECOM due to 'relatively low concentrations', distance of detection from the proposed building. The Auditor notes that confirmation of site history, commensurate further monitoring and a quantitative risk assessment would be required to confirm the magnitude of the concentrations and risk of impacted vapours migrating into the proposed development. This assessment should consider the subsurface structures, services and sensitive uses in the building.
Evaluation of data gaps	RAP notes that proposed groundwater works are proposed. Additional soil validation under the building footprints and former UST location are also proposed in the body of	The CSM does not identify these other key data gaps (these are however contemplated in other sections of the RAP: – Undetected impacts to soil (volatiles and OCPs under concrete slabs) and other underground storage tanks from historic activities due to limited site history information. Further works are required to confirm there is no risk from volatiles in the

Table 10.1: Review of the Conceptual Site Model		
Element of CSM	**Consultant**	**Auditor Opinion**
	the RAP.	proposed indoor areas. – The thickness of OCP impacted soil is likely to be limited. As long as the slabs are retained in place, the Auditor considers that the OCP uncertainty can be managed as per the proposed remedial works (Section 11). Intrusive sampling at the southern boundary should include OCPs in soil directly under the slab (proposed in RAP). Where concrete slabs are removed, the underlying surface soil should be tested for OCPs. – Extent and magnitude of impacts to groundwater (chlorinated hydrocarbon, including vinyl chloride). Further groundwater sampling is proposed as discussed in Section 11.

The conceptual model presented by AECOM is consistent with the results obtained to date suggesting that fill is mainly impacted by PAHs, metals, asbestos and TRH and that groundwater is characterised by detections of volatile chlorinated hydrocarbons potentially sourced from off-site.

Given the deficiencies in the site history review, it is not clear whether undetected contamination remains due to site activities including OCP impacts to soil under concrete slabs and TRH and chlorinated impacts to soil and groundwater (magnitude and nature). Further confirmation is required and further sampling is proposed as discussed in Section 11.

11 Evaluation of Remediation Action Plan

Following the investigation works it was identified that remedial works would be required to ensure that the site can be made suitable for the proposed uses.

The known contamination issues that require remediation include:

- Contact with fill material which is characterised by elevated concentrations of PAHs, metals, asbestos and TRH.
- Fill with particularly elevated concentrations of PAHs and TRH located below the groundwater table at the southern boundary.

The potential contamination issues that require further consideration include:

- Inhalation of vapours from soil or groundwater from previous site uses particularly chlorinated hydrocarbons however also petroleum hydrocarbons.
- Sub-slab impacts from spraying of OCPs under the slabs.
- Residual impacts associated with former USTs at the south-east boundary.

A cap and contain remedial strategy is proposed in conjunction with the site re-development works as follows:

- To facilitate construction of the swimming pools and balance tanks, impacted fill will be excavated and stockpiled for assessment prior to re-use under the raised Aquatic Building concrete slabs (cap). Services will be placed into the cap material. The Auditor notes that all fill should be considered to be impacted unless demonstrated otherwise.
- The Landscaped Easement (width of approximately 10 m) will be retained along the western boundary and subject to specific cap and contain requirements to allow retention of the established trees. No fences are proposed between the landscaped easement and Joynton Avenue.
- The construction of the synthetic sports field over the centre of the site provides a barrier (cap) layer.
- Landscaped setback areas around the perimeter of the sports field (width of approximately 1 m) and the recreational open space over the eastern section of the site require a cap and contain strategy commensurate with the depths of plantings and surface treatments.
- The finished levels of the park are such that no batters are expected in the long term adjacent to Zetland Avenue, proposed Rose Street, George Julius Avenue or Joynton Avenue. Prior to road works along Joynton Avenue and new Zetland Road (being raised), the RAP notes that temporary retaining walls will be required i.e. raising offsite areas with suitable material by up to 400mm forming low profile batter slopes around the edge of the Site. The Auditor notes that if landscaping is proposed on any of the batters that an adequate depth of capping should be implemented as per the RAP.

- There is a step down from the Aquatic Building to the Landscaped Easement to the west. The RAP notes that 'the thickness of capping material may be increased locally to provide suitable batter slopes'. The Auditor notes that these works are required.

The proposed remedial works (Table 11.1), validation works (Table 11.2) and an evaluation of the RAP by comparison with the checklist included in 'Guidelines for Consultants Reporting on Contaminated Sites' (Table 11.3) are provided below.

Table 11.1: AECOM RAP – Remediation Works Proposed

Element	Remediation Works Proposed	Auditor's Comments
Separation Layer	**Landscaped Easement:** Excavation of impacted fill overlying the tree roots to the extent practicable by hand, installation of bright coloured marker material and cover with minimum 200mm layer of mulch. **Aquatic Building:** Concrete slabs **Synthetic Sports Field:** 300 mm (minimum) crushed rock (drainage layer) and at least 150 mm of capping overlying marker material (an impermeable liner). **Recreational Open Space:** Shallow plantings: minimum 500 mm capping depth Deep plantings: 1.5 m depth Gunyama Park beneath other open space areas (including the stormwater main easement): 500 mm (minimum). **Marker Layer:** All capping features will be underlain by a marker material i.e. a light coloured knitted HDPE constructed to a density greater than 300 grams per square metre (or equivalent). **Underground service corridors:** services placed within capping (minimum 850 mm capping depth from surface). If services are installed at greater depths, the depth of the cap and marker layer will be extended 'appropriately'. **Drainage:** Infiltration is expected to be reduced due to the following: - Sealed surfaces of the Aquatic Building (concrete slab) - Drainage layer of the synthetic sports field (crushed rock underlain by impermeable liner) - Reduction of leaks due to stormwater upgrade - Surface runoff from Gunyama Park and the synthetic sports field to pits with connection to the new stormwater drain. The RAP notes that capping would not be required in areas of the Site where the material is natural	Please note that bright coloured marker layer will need to be ordered well in advance of project. The Aquatic Building concrete slab forms a separation layer and is required to be maintained as part of the cap and contain strategy. The separation layer in the parkland areas (other than trees) is a minimum 500 mm capping and appears to include all areas i.e. softfall, granite, turf, sandstone mulch, etc.

Table 11.1: AECOM RAP – Remediation Works Proposed		
Element	**Remediation Works Proposed**	**Auditor's Comments**
	and uncontaminated or if there is a minimum of 2 m of validated clean material.	
Unexpected Finds and Building Footprints	**Unexpected Finds**: Most slabs will be retained, however if removed, soil will be inspected (based on visual and olfactory observations and field screening of soil samples using a PID. This includes for asbestos. RAP provides some examples of potential unexpected finds and notes that separate stockpiling and validation would be required. **Building Footprint**: Retention of the concrete slab is proposed. Further sampling is proposed as discussed in Table 11.2.	**Building Footprint**: See Table 11.2.
Delineation of USTs	HLA notes that a UST was removed from beyond the northern boundary. No other information was provided and one borehole (BH05) was excavated nearby. HLA note that two USTs (diesel and petrol) and a bowser were located at the southern boundary and had been previously removed. No other information was provided. Two further boreholes are proposed. A contingency for remediation is not provided.	Further comment is provided in Table 11.2. If petroleum hydrocarbon impacts are encountered such that remediation is required, the RAP should be updated.
Delineation and Potential Remediation (BH106)	Following delineation works, if remedial works are required, the RAP proposes excavation and further stockpile characterisation i.e. leachate testing for lead and BaP (method not specified) and visual assessment to confirm whether the material is disposed off-site (subject to further waste classification) or retained on-site (i.e., not specified however Auditor notes that the volatility and leachability of the material will need to be assessed in consideration of the proposed emplacement area). AECOM note that the material would be placed above the depth of groundwater. BH106 excavation to be reinstated with re-used fill to the required levels .	Further comment is provided on the additional delineation works in Table 11.2.
Validation	Capping: Visual validation of placement of the marker layer and capping. Photographs of the emplacement of the marker layer will be provided. Survey data following installation of the marker layer and capping materials (including a survey of thickness and extent of separation layer). Soil sampling and analysis to validate remedial excavations and to validate material to be used as capping material i.e. material sourced from on-site as capping and growing media and imported material (topsoil, VENM, ENM). Confirmation of maximum groundwater concentrations of VHCs is	Sampling of VENM and ENM should be commensurate with the adequacy of documentation on the source of the material. Survey data should also include boundary conditions.

Table 11.1: AECOM RAP – Remediation Works Proposed		
Element	**Remediation Works Proposed**	**Auditor's Comments**
	also proposed. The details are discussed in Table 11.2.	
Materials Management	The RAP notes that A Material Tracking Plan (MTP) is to be prepared to manage the reuse of material. An outline of the details is provided in the RAP including the need for procedures to confirm material quality to enable re-use. Material will require to be environmentally characterised prior to movement. Material would be disposed off-site in accordance with *NSW EPA (2014) Waste Classification Guidelines Part 1: Classifying Waste.* Off-site waste disposal - 1 per 100 m^3 following inspection to confirm material is relatively homogenous, if heterogeneous a greater density of sampling would be undertaken. The RAP notes that asbestos was encountered. An Asbestos Management Plan will be prepared and implemented during intrusive works.	Asbestos-containing materials are not to be used above the marker layer.
Long Term Environmental Management Plan	A long term EMP will be prepared following the completion of the validation report. The RAP notes that the EMP is required to ensure that the cap is retained and that intrusive works are adequately informed.	The Auditor notes that an EMP is required where a separation layer is required to prevent access to the underlying material.

The details of the proposed sampling and analysis to characterise material to be used within the separation layer, unexpected finds and data gaps are provided in Table 11.2.

Table 11.2: AECOM RAP - Proposed Sampling Works		
Area	**Sampling and Analysis**	**Auditor Comments**
USTs	Two additional boreholes proposed.	The Auditor notes that the extent of the excavation is not known and that two boreholes are unlikely to provide sufficient evidence that the base and walls were adequately chased out and validated. Recommend use of test pits/trenches, good visual and olfactory observations confirming the location/extent and PID screening.
BH106 and BH105	3 delineation boreholes approximately 10m from BH106 with samples to be collected at 0.1m and every 0.5m thereafter in fill and at	Samples should also be submitted for TPH. The triggers for whether

Table 11.2: AECOM RAP - Proposed Sampling Works		
Area	**Sampling and Analysis**	**Auditor Comments**
	1.0m intervals in natural. Samples will be submitted for PAHs, VHCs and OCPs Soil sampling will be undertaken within natural materials to an approximate maximum depth of 5.0 m below ground level (plus PID screening). AECOM will then determine the need for remediation. Groundwater (MW106) will be sampled and analysed for PAHs	remediation is required are not specifically discussed. The results will be reported to the Auditor (letter report) prior to implementation of the RAP for endorsement. The Auditor notes that the risk to groundwater needs to be considered.
Groundwater VHC concentrations	Additional groundwater sampling would be undertaken from 6 existing wells (VHCs with a detection limit of 0.3 ug/L for vinyl chloride), prior to implementation of the RAP (mid-2016) and preferably once the dewatering works in the local area have ceased, and the Site's groundwater level has returned to stabilised levels. If VHC concentrations in groundwater exceed the US EPA Region 9 screening criteria, a quantitative assessment will be undertaken to assess the risk from volatiles to receptors within the Aquatic Centre. The GME report and risk assessment (if required) will be provided to the Site Auditor for endorsement. Samples will also be submitted for SVOCs and PFCs.	The Auditor will refer to screening criteria in Section 7. Groundwater will need to be submitted for OCP analysis.
Building Footprints	Building Footprints: Only one concrete slab remains that was not previously investigated through intrusive investigations. Two additional boreholes proposed.	Boreholes are proposed. Test pits would be preferred. Samples from directly under the concrete slab (upper 0.15 m) in these two boreholes are required to be submitted for OCP analysis.
Vapour	Soil vapour pins would be targeted (6 locations) beneath future occupied areas within the footprint of the Aquatic Centre building (excluding outdoor areas and future pool excavations).Integrity testing, use of canisters, US EPA TO-15 Method for chlorinated hydrocarbons and screening against NEPM and US EPA Region IX Screening Levels proposed. Permanent gases and VOCs would also be screened with portable instruments. Results will be provided to the Auditor for endorsement. Depending on the results, further assessment may be warranted.	Sufficient as a screen where the unexpected finds protocol is implemented during the pool excavations.

Table 11.2: AECOM RAP - Proposed Sampling Works		
Area	**Sampling and Analysis**	**Auditor Comments**
Re-use of On-Site Material as Unexpected Finds – Beneath the cap and within 2 m of the surface of Gunyama Park	1 per 70 m3, submitted for total lead, petroleum hydrocarbons including BTEX and PAHs and asbestos as well as inspections during stockpiling with visual observations and PID screening. The validation samples will also be tested to assess the leachability of lead and benzo(a)pyrene. Material which is found to be aesthetically dissimilar to the fill materials exposed in general will be assessed as per protocols for unexpected finds. Malodorous materials shall be analysed for VOCs (in addition to the CoPCs discussed above). Inspected during placement under the cap.	
Imported: General Capping Material including growing media	VENM Quarry product – homogenous, VENM certificate with supporting test data and visual confirmation that the material is free of contamination as imported to the site. VENM (non-quarry), ENM or 'any other suitable material which has been appropriately validated' including mulch, recycled concrete, crushed rock, topsoil or other imported material prior to importation as follows: - Site inspection of the source site - One sample per 70m^3 will be collected and analysed or a minimum of 3 samples per source at the source site (may be decreased depending on quantity from same source and the initial laboratory analytical results to be determined in consultation with the NSW EPA Accredited Site Auditor) - Metals, PAHs and phenols, TPH/BTEX, OPPs, OCPs, PCBs; and asbestos. - Visual confirmation that the material is free from contamination as it is imported to the Site.	The Auditor notes that commensurate documentation and testing will be required depending on the source and documentation provided.
Proposed QA/QC – Sampling	AECOM notes that data quality indicators (DQIs) would need to be considered. A stockpile register would be provided and a summary of the remedial works. Details of proposed sample handling and containers were provided including transport under chain of custody.	Predetermined DQIs will need to be discussed with regard to the five category areas. Actions required if the data do not meet the expected objectives should also be outlined prior to the remedial works.
Proposed QA/QC – Laboratory	NATA accredited laboratories would be used, with appropriate methods and LORs. AECOM provide a discussion of data quality	These should ensure that the overall quality of the analytical data produced is acceptable.

Table 11.2: AECOM RAP - Proposed Sampling Works		
Area	**Sampling and Analysis**	**Auditor Comments**
	indicators (DQIs).	

Table 11.3: AECOM RAP - Evaluation of Key Elements		
Remedial Action Plan	**Comments**	**Auditor Comments**
Remedial Goal	The goal is to ensure that the remedial works in conjunction with the planned development ensure the protection of human health and the environment.	Adequate
Discussion of the extent of remediation / management required.	Not specifically discussed	Given the proposed treatments outlined in the RAP it is understood that the extent of cap and contain is the whole site.
Remedial Options and Preferred Option	The RAP considers that given the low level of risk of PAH impacts, practicalities of excavating large volumes of fill (dewatering and shoring works) renders excavation an unsustainable approach with respect to the balance between resource consumption (associated with dewatering of the groundwater, excavation, spoil management and off-site disposal) and the prospective benefit to improving groundwater quality migrating from the Site.	A 'Remediation Options Assessment Matrix' was not provided. The Auditor notes that the options were adequately considered.
Long-term engineering security of works, integrity of the cap i.e. risk of the erection of structures on the capped area, minimisation of the potential for leachate formation and/or volatilisation and/or off-site migration.	The overall scale of redevelopment for the Aquatic Building and Guyana Park will ensure the long term engineering security. The drainage features will also minimise future infiltration through the fill and into groundwater. The fill has been in place for over 100 years and the risk of further leaching into groundwater in contact with the fill (limited to the lower 1m of material really at the western end) is considered to be low.	The risk of volatiles will be further assessed during additional groundwater and soil vapour sampling. Adequate to address known contamination in fill.
Long Term Environmental Management Plan (LT EMP)	A brief outline of the likely key elements of the EMP roles and responsibilities for implementing the EMP including site inductions, is provided. The SMP will be included in the Site's Environmental Management System.	The final long term EMP will need to be commensurate with the remedial works conducted.

Table 11.3: AECOM RAP - Evaluation of Key Elements		
Remedial Action Plan	**Comments**	**Auditor Comments**
Interim Site Management Plan (before remediation)	Not discussed. The site is currently occupied and managed by the DG Alliance for installation of the stormwater pipes.	Adequate.
Site Management Plan and Contingency Plans to Respond to Site Incidents.	A Remediation Environmental Management Plan (REMP) is to be prepared by the remediation contractor. An outline of the required elements and procedures was provided in the RAP.	The REMP should be reviewed and endorsed by an environmental consultant and provided to City of Sydney or their nominated representative prior to commencement of remediation works.
Occupational Health and Safety	A Work Health and Safety Management Plan (WHSP) is to be prepared by the remediation contractor. The RAP notes that asbestos identification and removal would need to be undertaken in accordance with NSW Work Health and Safety Act and Regulation and Codes of Practice by Safe Work Australia.	The Auditor notes that that once the WHSP is developed, that it should be revised if there are unexpected finds during remediation and construction.
Unexpected Finds Protocol (UFP)	An Unexpected Finds Protocol (UFP) to be followed if unexpected potentially hazardous substances are encountered, is included in the RAP. The procedure essentially requires cease work, fencing, inspection and appropriate sampling and analysis by consultant and remediation if required following discussion with the Auditor and validation.	Adequate
Licence and Approvals	Environmental management of the site and remedial works will need to be undertaken in accordance with City of Sydney (2004) Contaminated Land Development Control Plan (2004). This requires that waste be minimised. All waste material will be classified in accordance with the POEO Act with tracking of the transport and disposal of the waste.	Adequate
Contacts/ Community Relations	RAP notes that signage at the main gate will include after-hours contact details.	A community relations plan should be included in the REMP.

Overall, based on a review of the site history, the groundwater and soil results against relevant guidelines and consideration of the overall investigations completed , it is the Auditor's opinion that:

- Future excavations are likely to intercept fill contaminated with PAHs, metals, petroleum hydrocarbons and asbestos. The RAP outlines a process that the Auditor

considers adequate to limit access to these materials in terms of human health and phytotoxicity.

- Further investigation of soil and groundwater are proposed prior to the remedial works to confirm that volatiles and emerging contaminants (PFOS) are not of concern. If necessary, the Auditor considers that the vapour intrusion risks could be managed on-site by conventional methods, such as a vapour barrier.
- Following further inspections and investigations during some earthworks to facilitate pool excavation, there is a risk that unexpected finds i.e. drums, may be encountered or that petroleum hydrocarbon impacted material will be encountered in association with the former infrastructure. The RAP outlines the Unexpected Finds Protocol (UFP) which is considered adequate to manage this risk. A GPR survey will also be undertaken.

The Auditor notes that the investigations required should be undertaken before implementation of the RAP. There is a risk that additional investigations will reveal previously unknown issues that require additional remediation or management. The RAP or a Remedial Works Plan would need to be updated prior to implementation.

12 Conclusions and Recommendations

AECOM (2016) conclude that 'upon successful implementation of the preferred remediation strategy described by this RAP and in conjunction with the proposed development works, the Site will have been made suitable for the proposed Aquatic Centre facility (recreation mixed use) and Gunyama Park (recreational open space) and will ultimately result in improved groundwater quality migrating from the Site'.

The Auditor considers that if the works proposed by AECOM are implemented in consideration of comments provided in Section 11, the proposed remedial and additional investigation works should confirm that the site is suitable for the proposed use as an Aquatic Centre facility (recreation mixed use) and as Gunyama Park (recreational open space).

Following completion of the proposed further assessment, preparation of a report indicating whether any changes to the Remedial Action Plan is required. If further remedial works are required, the Remedial Action Plan would need to be updated.

Confirmation that the site is suitable will rely on successful validation of the remedial works. A Site Audit Report (SAR) and Section A Site Audit Statement (SAS) are required at the completion of remedial works and review of the validation documentation.

Additional investigation work, that should be conducted prior to the commencement of site development and in consideration of comments made in Table 11.2, with updating of the RAP as necessary, are:

- Southern Boundary: Intrusive investigations in the former location of the USTs, around BH106/BH105 and through the retained former concrete slab.
- Aquatic Building: Installation of soil vapour pins into the current concrete slab external to the proposed pool excavations considering the future location of the crèche.
- Entire Site: Additional groundwater sampling from the existing groundwater wells.

At the completion of the investigations, a Section B Site Audit Statement and Site Audit Reports could be prepared if necessary.

13 Other Relevant Information

Consistent with the NSW EPA requirement for staged 'signoff' of sites that are subject of progressive assessment, remediation and validation, I advise that:

- This advice letter does not constitute a SAR or SAS.
- At completion of the remediation and validation I will provide a SAS and supporting documentation.
- This interim advice will be documented in the SAR.

This Audit and preparation of the IAA was completed on the behalf of City of Sydney to provide an initial independent review of the suitability and appropriateness of a RAP

This IAA may not be suitable for other uses. AECOM included limitations in their reports. The Audit must also be subject to those limitations. The Auditor has prepared this document in good faith, but is unable to provide certification outside of areas over which the Auditor had some control or is reasonably able to check.

The Auditor has relied on the documents referenced in Section 1 of the IAA in preparing the Auditors' opinion. If the Auditor is unable to rely on any of those documents, the conclusions of this IAA could change.

It is not possible in an IAA report to present all data which could be of interest to all readers of this report. Readers are referred to the referenced reports for further data. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect to, their situation.

Appendix A: Attachments

Attachment 1: Site Location and Lot Numbers
Attachment 2: Proposed Development – General Arrangement Plan
Attachment 3: Cross-Section
Attachment 4: Investigation Locations
Attachment 5: Groundwater Flow Direction Plans

Attachment 1: Site Location and Lot Numbers



Site area details:

Total project site area - 28,693 m²

Total Stage 1 - 23,900 m²
Total Stage 2 - 4,793 m²

Stage 1 land parcel areas:

- 132-138 Joynton Ave, Zetland, Lot 2 DP 850686 - 12,688 m²
- 140 Joynton Ave, Zetland, Lot 100 DP 1200645 - 8098 m²
- 94-104 Epsom Road, Zetland, Lot 101 DP 1200645 - 3114 m²

Stage 2 land parcel areas:

- 106-116 Epsom Rd, Zetland, Lot 1 DP 830870 - 4664 m²
- 130 Joynton Avenue, Zetland, Lot 1 DP 850686 - 129 m²

IMPORTANT NOTE:
This plan is prepared for City of Sydney from a combination of field survey and existing records for the purpose of alignment identification and should not be used for any other purpose.

REVISION	DATE	DESCRIPTION	12D REF	APPROVED
05	26.04.2016	LOT AND DP NUMBERS UPDATED, IMAGE UPDATED	117244AA	AL
04	13.04.2016	LANDSCAPED AREAS REMOVED, DIMENSIONS ADDED	117244AA	AL
03	31.08.2015	LANDSCAPED AREAS ADDED	117244AA	AL
02	12.12.2014	NORTHERN PROJECT BOUNDARY ORIENTATION ADDED	117244AA	AL
01	3.12.2014	PROJECT AREAS INCLUDED	117244AA	AL
00	18.11.2014	ORIGINAL ISSUE	117244AA	AL

SCALE:
HORZ. 1:1000
CONTOUR INTERVAL:
A1

HORIZONTAL ORIGIN
COORD. SYSTEM: MGA
MARK ADOPTED: PM 59537
COORDINATES:
E 334 292.991
N 6 246 690.999
VERTICAL DATUM

Cardno Hard&Forester
Shaping the Future
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SURVEYED	DRAWN	CHECKED	PASSED
A.L.	I.T.	A.L.	A.L.

PROJECT: GUNYAMA PARK AND GREEN SQUARE AQUATIC CENTRE

PLAN SHOWING ALIGNMENT IDENTIFICATION AND SITE AREAS GUNYAMA PARK AND GREEN SQUARE AQUATIC CENTRE PROJECT

CLIENT: CITY OF SYDNEY

SHEET 1 OF 1

DRAWING NUMBER	REV
117244500	05

Attachment 2: Proposed Development – General Arrangement Plan



SCALE 1:350@A1

0 5 10 15 20m

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NOTES

DO NOT SCALE OFF DRAWINGS

LEGEND

- Site Boundary
- Existing Trees to be protected
- Proposed Street trees
- Proposed tree & tall shrub planting
- Proposed lower shrubs & groundcover
- Green Roof

1. Aquatic & Recreation Centre
2. Entry
3. Café
4. Circuit Path
5. Overland Flow & Trunk drain (below)
6. Bike Parking
7. Rain Garden
8. Artwork
9. Mounded garden beds
10. Amenities Building, with canopy over
11. Exercise Station
12. Sports Field
13. Terrace & Seating Edge
14. BBQ Facilities
15. Lawn
16. Play Space, with canopy over
17. Skate Bowl
18. GPT locations in
19. Park Entry plaza

REV	DATE	ISSUE
-	13.05.16	DEVELOPMENT APPLICATION

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CLIENT

CITY OF SYDNEY
456 Kent St, Town Hall House
Sydney NSW 2000 Australia

PROJECT

Gunyama Park Aquatic and Recreation Centre

130 & 132-140 Joynton Avenue
Zetland NSW 2017
Australia

TITLE

General Arrangment Plan
Landscape Works

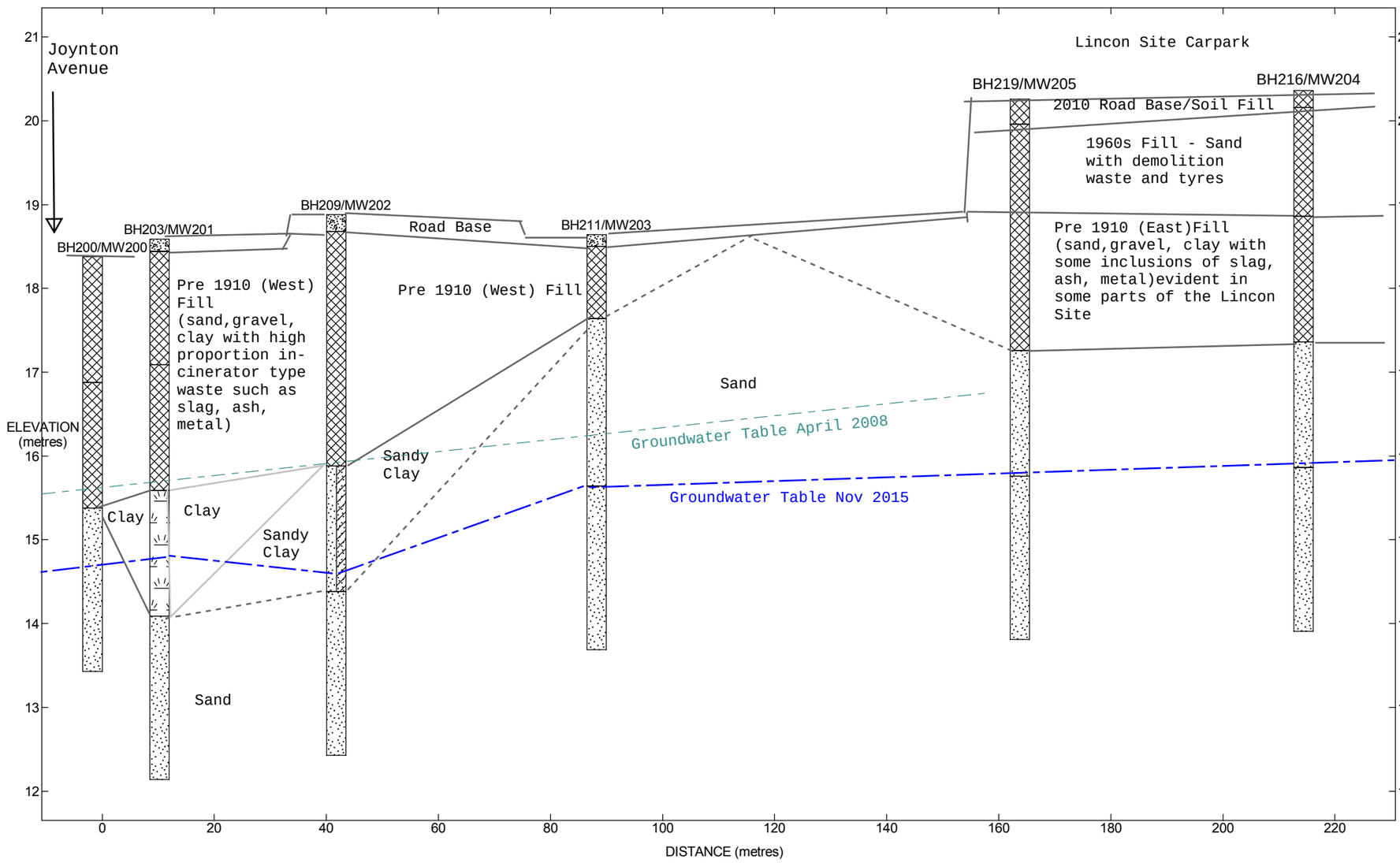
DRAWN: AL
CHECKED: SA
SCALE: 1:350 @A1
FIRST ISSUE: 13/05/16
DRAWING NO: ARC-T-DA-004
REV

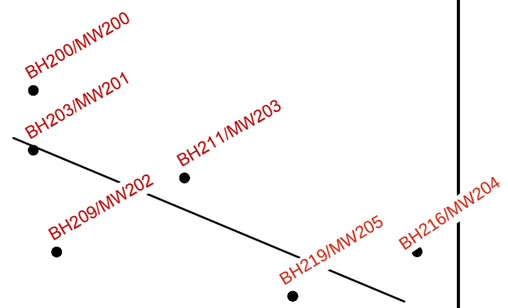
DEVELOPMENT APPLICATION

◄ North West

South East ►

Figure D4 A-A'
Cross Section - Green Square Aquatic Centre





Site Map Scale 1:3,175

Explanation:

Encountered Water Level

Stabilised Water Level

Horizontal Scale (metres)

Vertical Exaggeration: 15x

0 17

Lithology Graphics

- Fill (made ground)
- USCS Poorly-graded Sand
- Concrete
- USCS Peat
- USCS Poorly-graded Sand with Clay

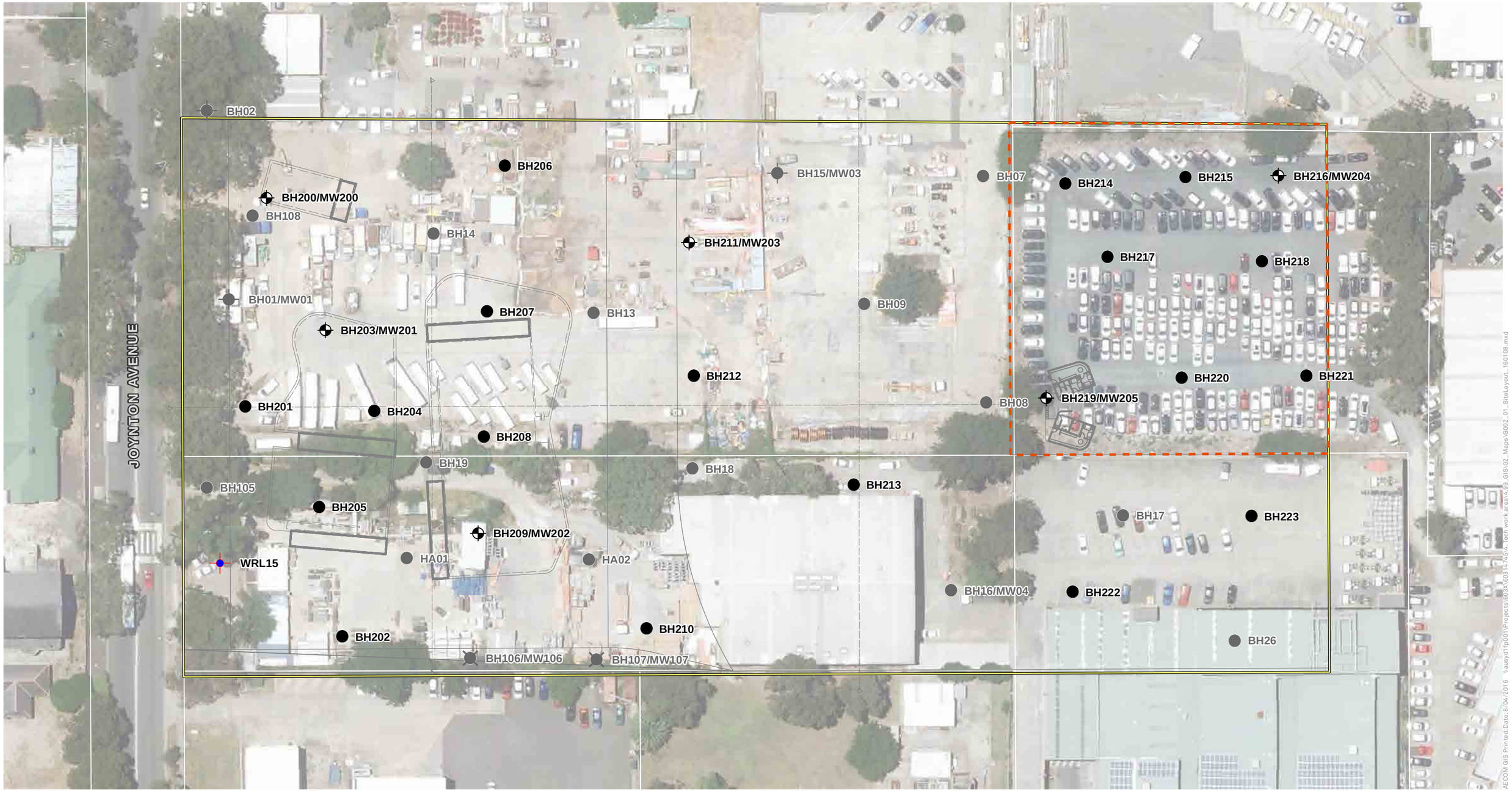
Well Graphics

AECOM

AECOM Australia Pty Ltd

FIGURE NUMBER	Green Square Aquatic Centre -
A-1	JOB NUMBER 60477501

BORELOGS_NOV2015_60477076.GPJ 16/12/15



KEY

- Site boundary
- Lincon development site
- AECOM (2015) borehole
- AECOM (2015) monitoring well
- Water Research Laboratory (2007) monitoring well
- ENSR (2008) borehole
- ENSR (2008) monitoring well
- HLA (2002) borehole

CITY OF SYDNEY 2030

AECOM

0 10 20 m

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SCALE 1:800 | SIZE A3

SHEET 1 of 1 | COORDINATE SYSTEM GDA 1994 MGA Zone 56

TITLE

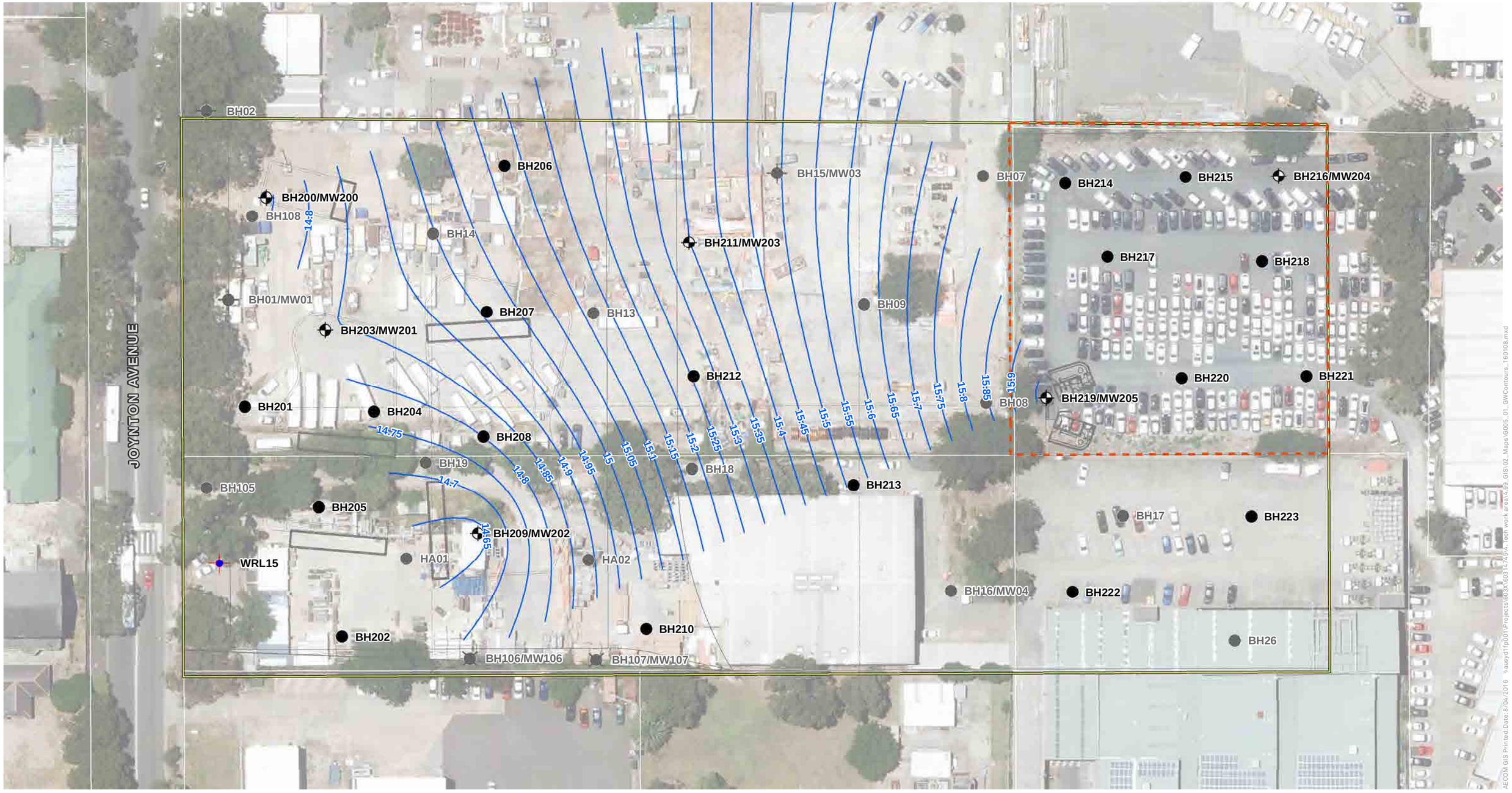
FIGURE D1 - Soil borehole and monitoring well locations

PROJECT GREEN SQUARE TOWN CENTRE

CLIENT CITY OF SYDNEY

DRAWN	DATE	MAP #	REV	Project
SC	11/01/2016	G002	01	60314745
CHECK	DATE			

AECOM GIS Printed:Date: 8/04/2016 \\ausyd1fp001\Projects\603X\60314745\4. Tech work area\4.99_GIS\02_Maps\G002_01_SiteLayout_160108.mxd



KEY

- Site boundary
- Lincon development site
- AECOM (2015) borehole
- AECOM (2015) monitoring well
- Water Research Laboratory (2007) monitoring well
- ENSR (2008) borehole
- ENSR (2008) monitoring well
- HLA (2002) borehole
- Groundwater contour (m)

CITY OF SYDNEY 2030

AECOM

N

0 10 20 m

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SCALE 1:800 | SIZE A3

SHEET 1 of 1 | COORDINATE SYSTEM GDA 1994 MGA Zone 56

TITLE **FIGURE D5** - Groundwater contours

PROJECT GREEN SQUARE TOWN CENTRE

CLIENT CITY OF SYDNEY

DRAWN	DATE	MAP #	REV	Project
SC	12/01/2016	G005	01	60314745
CHECK	DATE			

AECOM GIS Printed:Date: 8/04/2016 \\ausyd1fp001\Projects\603X\60314745\4. Tech work area\4.99_GIS\02_Maps\G005_01_GWContours_160108.mxd

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E melb@brt.com.au

consulting engineers

BRT

Project: Gunyama Park Aquatic and Recreation Centre (GPARC). Date 31-05-2016

1 SERVICES COORDINATION DESIGN STATEMENT No.3 Rev 01

100% DA Submission

1.1 DESIGN APPROACH/STRATEGY

The role of the services coordinator is to review all documentation at each stage of the project and provide feedback to all relevant parties with respect to the coordination of the services.

This review includes:

- Review of space allocations
- Review of the interface requirements between services
- Review impact of services on structure and architecture
- Provide report on the clash detection 3D model and provide recommendations and resolutions to clashes identified.

The strategy for services coordination was outlined to the CoS in a meeting held in December 2015.

This review includes:

- Review of all documentation
- Clash detection report
- 3D Modelling

The coordination has also included regular attendance at design meeting, review of 3D model with modellers, and review of DD documentation.

1.2 KEY CONSIDERATIONS

The key consideration relating to completing an effective services coordination include:

- Identification of coordination issue
- Identification of classes
- Audit report that can be monitored and revised to close out weaknesses in coordination and detected clashes.
- Resolution of equipment that will be installed within the building. AV, IT, Security, Gym Equipment etc
- Resolution of user interface and operational requirements of each space.

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Level 2, 55 Southbank Blvd
Southbank VIC 3006
T +61 3 9203 9000
ABN 74 109 448 982

13th May 2016

Aquatic Engineering Development Application Statement - Gunyama Park Aquatic and Recreation Centre

We are writing with reference to the Aquatics design for the development of Gunyama Park Aquatic and Recreation Centre, Green Square, NSW.

The aquatic engineering component consists of all the design and documentation of filtration system, chemical design, pool shell, tiling and fitments of the following pools:

- Outdoor 50m Pool
- Outdoor Leisure Pool
- Hydrotherapy Pool
- Indoor Leisure Pool
- Indoor Program Pool

The pools are analysed with respect to Public Swimming Pool and Spa Pool Advisory Document prepared by NSW Health April 2013 and Public Swimming Pools and Spa Pool Guidelines Prepared by NSW Health in June 1996 along with the relative Australian standards. The NSW health documents have prescriptive requirement with respect to the maximum turnover periods for the pools depending on their proposed use and depth.

The applicable Australian Standards are:

- A79 Glossary of names for earthmoving and constructional plant;
- AS 1289 Methods of testing soils for engineering purposes;
- AS 2294 Protective structures for operators of earthmoving machines;
- AS 3798 Guidelines on earthworks for commercial and residential developments;
- AS 1012 Methods of testing concrete
- AS 1141 Methods for sampling and testing aggregates
- AS 1379 Specification and supply of concrete
- AS 1478 Chemical admixtures for concrete mortar and grout
- AS 1527 Two-part polysulphide-based sealing compounds for the building industry
- AS 1554 Structural steel welding, part 3 - welding of reinforcing steel
- AS 2350 Methods of testing Portland and blended cements
- AS 2758.1 Aggregates and rock for engineering purposes part 1 - concrete aggregates Portland and blended cement
- AS 3600 Concrete structures
- AS 3610 Formwork for concrete
- AS 3735 Concrete structures for retaining liquids
- AS 3972 Portland and Blended Cements

- AS 4671 Reinforcing steel for concrete
- ASTM Preformed Sponge Rubber and Cork Expansion Joint Fillers
- D1752-67 for Concrete Paving and Structural Construction
- ASTM C309 Liquid Membrane-Forming Compounds for Curing Concrete.
- ACI 403 Guide for Use of Epoxy Compounds with Concrete
- BS 3148 Methods of Test for Water for Making Concrete
- BS 2571 Specification for Flexible PVC Compounds
- BS 5385 Wall and floor tiling
- AS3979 Hydrotherapy Pools.
- AS/NZ 3000: Electrical Installations (known as the Australian/New Zealand Wiring Rules). Wiring requirements for lift installations
- ISO 9001 - Quality Systems

Each pool has been designed for the following criteria:

Hydrotherapy Pool

- Area – 105 m2 – Including the ramp
- Shallow end depth – 1.10m
- Deep end depth – 1.50m

Outdoor 50m Pool

- Area – 1147 m2 – Including access ramps and stairs
- Shallow end depth – 1.20m for 6m – Will allow supervised diving off a pediment
- Deep end depth – 2.00m for 15m – Will allow diving off a starting block, and underwater hockey

The shallow areas of this pool are to be turned over more quickly due to the expected higher loading.

Outdoor Leisure Pool

- Area – 344 m2
- Shallow end depth – 0.00m
- Deep end depth – 1.1m

The shallow areas of this pool are be turned over more quickly due to the expected higher loading. The pool is graded from a beach entry to a depth of 1.1m and then steps up to a combined entry point to the 50m pool. This pool is not fitted with water features.

Indoor Leisure Pool

- Area – 474 m2
- Wetted Areas (including gutters) – 500m2

The shallow areas of this pool are to be turned over more quickly due to the expected higher loading. The pool has a large zero depth splash pad which will have an approximate water depth of 0-50mm while the features are operating. The zero depth splash pad then grades to a beach entry with a maximum grade of 1 in 20 to a depth of 0.9m. This pool is to be fitted with water features and for the purpose of capturing loads we have based our calculations on a feature flow of 62lt/s.

Program Pool

- Area – 538 sqm
- Average Depth – 1.90m - Including ramp and a moveable floor which requires a minimum of 600mm extra depth within the pool, average depth based on useable depth, i.e. above the moveable floor.

The shallow areas of this pool are to be turned over more quickly due to the expected higher loading. The pool has been specified with a vario moveable pool floor which requires an additional 600mm in pool depth and the pulleys within the base of the pool. This depth has been added onto the pool volume. The pool width is based on an 8 lane pool with 2.5m wide lanes.

The pool structures will be supported on piles in accordance with the project geotechnical investigation report.
The pools are of concrete construction designed as water retaining structures and are to have a fully tiled finish.

The pool underdrainage will be collected from each pool and the piped back to a common pump pit. Due to the level of the water table the under pool drainage system is to be used when the pools are to be emptied for maintenance purposes. The water around the pools is to be lowered prior to emptying the pools to reduce the stress applied on the pools as a results of uplift.
The filter waste tank has been upsized to enable it to take larger flows in case water is to be dumped in bulk from one of the pools. Enlarging this tank also allows alternative filters to the currently specified Neptune Bensons to be used on site.

The mechanical engineer is to provide ventilation through the plant room to comply with the relevant codes, we require the greater of 12 air changes per hour or 5Lt/s per square metre of plant room. The pools will be heated via heat exchangers which will receive heated water from the building's system.

The hydraulic engineer is to provide water supply to the plant room and sewer connections. We have provided buffer tanks to receive the high flows from filters and this will be released at a controlled rate to reduce the load on the sewer system. The hydraulic engineer is to also provide the plumbing to the plant room floor wastes and concourse drainage which will discharge to sewer.

The electrical engineer is to provide power to the plant room which is currently in peak demand 360 Amps per phase.
The electrical engineer is also to provide lighting to a minimum of 500Lux within the plant room.

MEMORANDUM

From:	Daniel Jones	*Date:*	18/05/2016
Project:	**Gunyama Park Aquatic & Recreation Centre**		
Subject:	**Hydraulic & Fire Services Design Statement**		
#pages:	3		

 Ref: CJA S0155 MM06

Please find below design statement detailing the design at the DA submission milestone.

- Scope of Services included:
  - Sewer Drainage
    - Sewer drainage from all fixtures and floor drains connect to a fully vented gravity drainage system to the authority connection. Sewer connection is made to existing authority sewer infrastructure in accordance with Sydney Water requirements. Venting of sewer drainage system is designed in accordance with AS3500 requirements. Pool deck is drained to sewer via primed and vented sealed disconnector gully and trench grates in the internal pool areas.
  - Trade Waste Drainage
    - Trade waste drainage from all cooking fixtures and floor wastes within food preparation areas are connected to a Sydney Water approved 3000L treatment apparatus and connected to the gravity sewer drainage system in accordance with Sydney Water Trade Waste Guidelines. All trade waste vents terminate to atmosphere.
  - Roof Drainage
    - The stormwater downpipe drainage is proposed to be designed based on 1 in 100 year rain fall intensity with provision for 100% overflow to the whole of the roof and canopy areas. The system will be a mixture of Syfonic drainage and conventional drainage with pipework reticulated at high level in ceiling spaces to reduce the quantity of in ground drainage required. All stormwater downpipes to be connected to the rainwater tank and civil drainage system for collection and gravity drainage to legal point of discharge. The main roof area is collected to the rainwater tank with the ancillary roofs and surface water drained to the civil drainage system.
  - Rainwater Tank

- The rainwater tank is proposed to be installed between the main floor slab and the existing surface level. The tank will be concrete structure with a waterproof liner.

- Cold Water Supply
  - Cold water supply for the site will be via tapping into the existing Sydney Water authority mains in Joynton Ave. The water supply will be pumped and reticulated throughout the site. Makeup to the rainwater system will be made complete with backflow prevention.
- Hot Water Supply
  - Hot water supply for the development will be delivered via calorifiers with heat sourced from the mechanical heating system. Hot water will be reticulated at 65 degrees with a flow and return system. Tempering of hot water to safe temperatures will be via thermostatic mixing valves for all basin, showers & washing fixtures.
- Rainwater & Recycled Water Supply
  - Rainwater supply will be from the rainwater tank with additional supply from a future authority recycled water supply. Makeup is made from the cold water supply when rainwater or recycled water supply is unavailable.
- Gas Supply
  - Gas supply for the site will be via tapping into the existing authority mains in Joynton Ave and will be reticulated throughout the site after being metered and regulated in the authority meter room. Gas supply is provided to the mechanical systems, cogeneration system and the café tenancy.
- Fire Hose Reel System
  - The fire hose reel system is fed from the domestic water system and located to provide coverage to the building.
- Fire Hydrant System
  - The fire hydrant system is fed from authority mains into a pumped system and reticulated via a ring main to the facility with hydrants located in fire stairs to provide full coverage to the building. The booster is located at the main entrance to the site and boosts the whole fire system.
- Fire Sprinkler System
  - The fire sprinkler system is provided to selected areas of the facility via control valves. Sprinkler hazard ratings are in accordance with AS2118 requirements.
- Fire Detection System
  - Fire detection systems will be installed throughout the facility in accordance with AS1670 requirements and linked to the FIP located at the building entrance with mimic panels as required.

- Building Occupant Warning Systems
    - Building Occupant Warning Systems will be installed throughout the facility in accordance with AS1670 requirements and linked to the FIP located at the building entrance with mimic panels as required.

- Codes which apply to and are adhered to in the scope of services
    - NCC - 2015
    - AS3500 - 2015
    - AS5601 - 2013
    - AS2441 - 2005
    - AS2419 - 2005
    - AS2118 - 2006
    - AS1670.1 - 2004
    - AS1670.4 - 2004

Please contact myself if you need anything further.

Regards,

Daniel Jones
CJ Arms & Associates

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consulting engineers

BRT

Project: Gunyama Park Aquatic and Recreation Centre (GPARC). Date 31-05-2016

1 MECHANICAL DESIGN STATEMENT No.3 Rev 03

100% DA

1.1 DESIGN APPROACH/STRATEGY

The mechanical systems have been designed to achieve the following:

- Provide heating cooling and ventilation throughout the building
- Provide heating for the aquatic systems throughout
- Meet or exceed all codes and regulations
- Minimise condensation in aquatic spaces
- Provide comfort to all occupants, both operators and patrons alike
- Not to locate any mechanical plant on main roof.
- Achieve required green star rating/energy efficiency systems

The strategy is to use central plant to the large spaces, including the pool halls, health and fitness areas, café and foyers. Localised energy efficient smaller plant for small offices and ancillary spaces for better efficiency and zonal control.

1.2 KEY CONSIDERATIONS

The key issues relating to the design of the mechanical systems include

- The use of proven cutting edge technology in treatment of the aquatic spaces to provide a condensation free space at low energy input. This is achieved through a pressurisation system.
- Careful planning of plant space to provide efficiency in installation and maintenance.
- Location of major plant near major plant infrastructure to minimise cost
- Coordination with architecture and structure
- Aesthetic planning of green roof.
- Minimisation of equipment on roof
- Coordination of services though services corridors either side of pool hall.

1.3 PERFORMANCE STANDARDS

The mechanical system has been designed to the following standards.

- Ventilation AS1668
- AG501 - Gas code

In particular -

- The building will be mechanically ventilated in accordance with Clause F4.5 of BCA2016 and AS1668.2-2012.

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- Any air conditioning to be provided with automatic shutdown in accordance with NSW Variation Table E2.2b where any air-handling system (other than non-ducted individual room units with a capacity not more than 1000 L/s and miscellaneous exhaust air systems installed in accordance with Sections 5 and 6 of AS/NZS 1668.1) which does not form part of the smoke hazard management system, on the activation of—

i. smoke detectors installed complying with Clause 5 of Specification E2.2a; and
ii. any other installed fire detection and alarm system, including a sprinkler system complying with Specification E1.5.

- The commercial kitchen will be provided with a kitchen exhaust hood in accordance with Clause F4.12 of BCA2016, and AS/NZS 1668.1 and AS1668.2.'
- The air-conditioning and ventilations systems will be designed and installed in accordance with Part J5 of BCA2016.

City of Sydney

C16116 Gunyama Park Aquatic and Recreation Centre

C16116 GPARC – Electrical Services– DA Design Statement

Electrical DA Design Statement

Revision 2 | 2 June 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 240516

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Arup Pty Ltd ABN 18 000 966 165

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ARUP

Document Verification

ARUP

Job title		C16116 Gunyama Park Aquatic and Recreation Centre		**Job number** 240516
Document title		C16116 GPARC – Electrical Services– DA Design Statement		**File reference**
Document ref		Electrical DA Design Statement		
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			Prepared by	Checked by	Approved by
		Name	Bernard Farrell		Jane Nixon
		Signature			
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			Prepared by	Checked by	Approved by
		Name	Bernard Farrell		Jane Nixon
		Signature			
		Filename		
		Description		
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename		
		Description		
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		Signature			
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1 Design Statement / Executive Summary

The Gunyama Park Aquatic and Recreation Centre development comprises a multi usage facility including aquatic centre, health and fitness centre, and external sports ground and park.

The electrical services design comprises the following major elements.

1. The electrical maximum demand for the facility is estimated at 665kVA.
2. The site shall form part of a Private Electrical Network, with the power supply to the facility proposed to originate at the adjacent South Sydney Hospital site (SSHS).
3. Reticulation to the site shall traverse Joynton Avenue via an underground conduit system. Design of the road crossing shall has been undertaken by others under a Level 3 design process and certified by Ausgrid.
4. A cogeneration and PV system is proposed to be provided to the facility, with the cogeneration system proposed to support the entire building load under typical conditions, and to export excess power to the South Sydney Hospital site.
5. Electrical supplies within the facility shall originate at the GPARC Main Switchboard, and from there shall be reticulation to a series of Distribution Boards located throughout the facility and in the Park Amenities building, where final sub-circuits shall reticulate.
6. Power supplies to the various other systems (Mechanical, Lifts, Hydraulic, Fire, Pool Systems, Communications & IT, Security etc.) shall originate at the Main Switchboard.
7. Lighting, emergency and egress lighting, and lighting controls shall be designed to achieve compliance with relevant standards, and to meet the requirements of the City of Sydney, and the architectural lighting design package.

2 Design Approach

2.1 Power Supply to the Facility

The site shall form part of a precinct scale private electrical network originating at the South Sydney Hospital site, and supplying both the South Sydney Hospital development, and GPARC facility.

The electrical supply shall originate at a 1500kVA kiosk substation located in the South Sydney Hospital site, and shall reticulate to the facility across Joynton Avenue.

The design of the South Sydney Hospital substation and supply switchboard to the GPARC has been undertaken as part of a separate scope of works. Please refer to the below drawing extracts for the South Sydney Hospital substation and main switchboard designs, which show the supply to the GPARC.

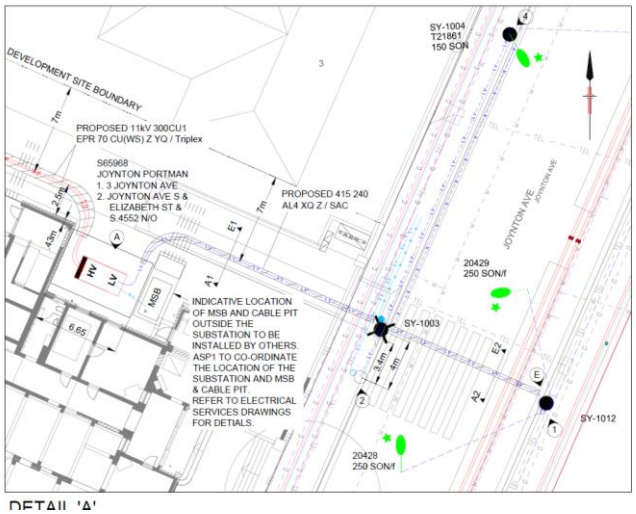

Figure 1 South Sydney Hospital Level 3 Design Extract

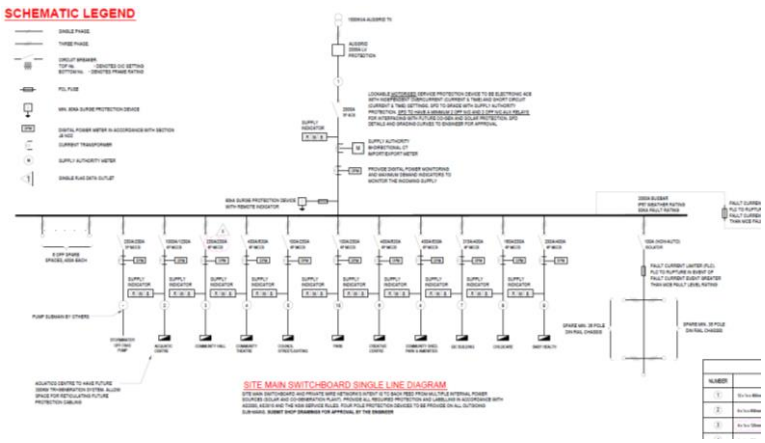

Figure 2 South Sydney Hospital Main Switchboard

2.2 Cogeneration & PV System

A Cogeneration and PV system shall be located at the Aquatic Centre, and shall be sized in the order of 200 to 260kW. , The proposed PV array is 96-150kW depending on available roof space and PV panel efficiencies.

The Cogeneration and PV system are proposed to supply the GPARC facility primarily, and to operate in a parallel with the Ausgrid supply. The system shall allow distribution of the Cogeneration and PV power to the SSHS network at times of low demand at GPARC, however no export to grid is proposed.

Liaison with Ausgrid will be undertaken by the specialist Cogeneration/PV contractors for coordination of cogeneration and PV systems, including protection and paralleling infrastructure.

The proposed topology of the private electrical network electrical supply is outlined in the below diagram.

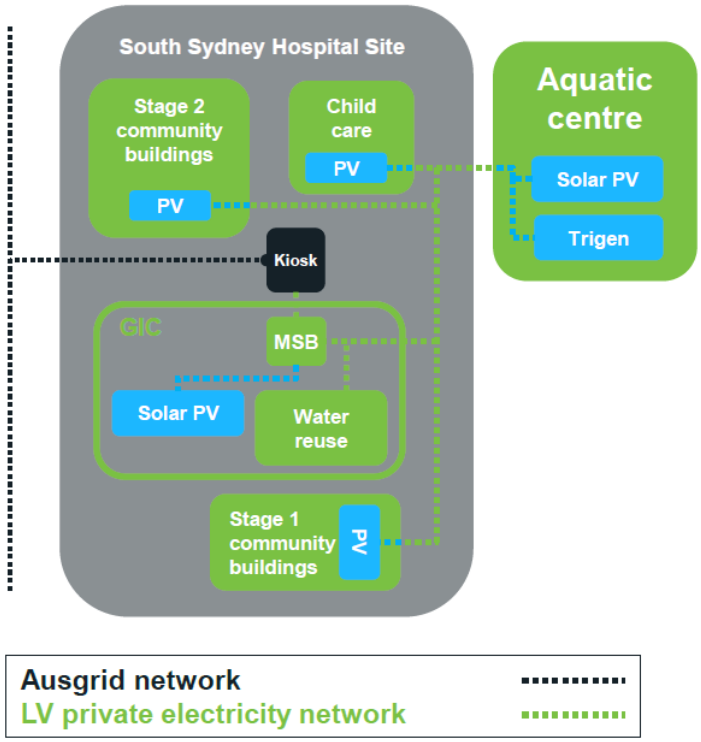

Figure 3 - Private Electrical Network - Cogeneration & PV Proposed Arrangement

2.3 Reticulation Methodology

2.3.1.1 Mains Power Supply

It is proposed that the power supply to the facility shall originate at the South Sydney Hospital site and reticulate across Joynton Avenue and terminate to the GPARC, as indicated on the drawing below.

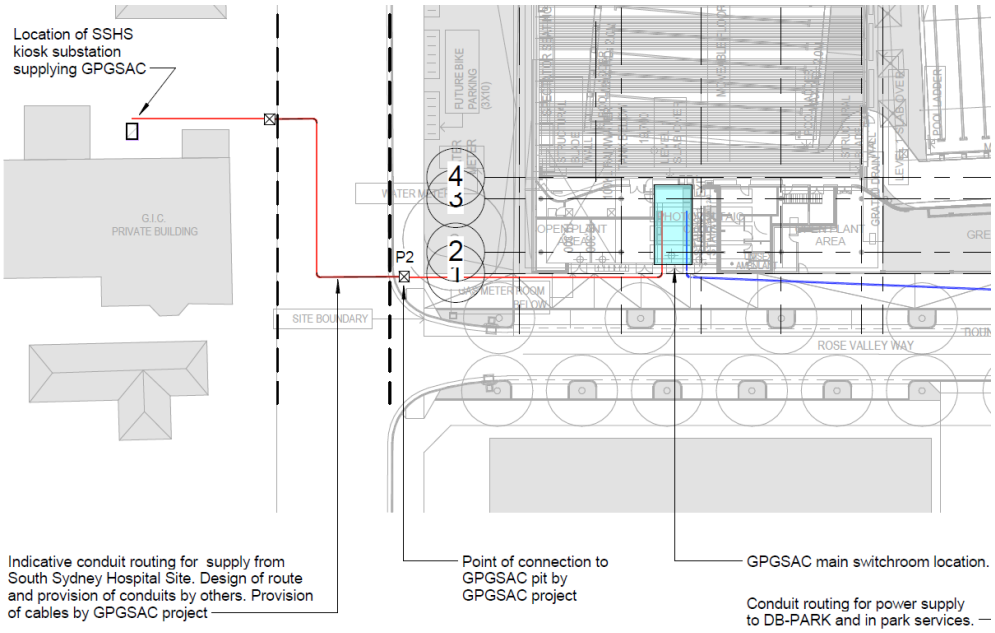

Figure 4 Main Power Supply Indicative Reticulation Route

2.3.1.2 Aquatic Centre Reticulation

Within the facility it is proposed that internal reticulation would originate at the Main Switchroom, and run in cable containment at high level in the two service corridors identified running South to North on each side of the facility. Cables would drop from here to their services on Ground Level.

Externally, and within the pool areas, it is proposed that cable reticulation would be in buried conduits.

It is proposed to locate conduits within the pool concourse area for supply to external lighting and pool services.

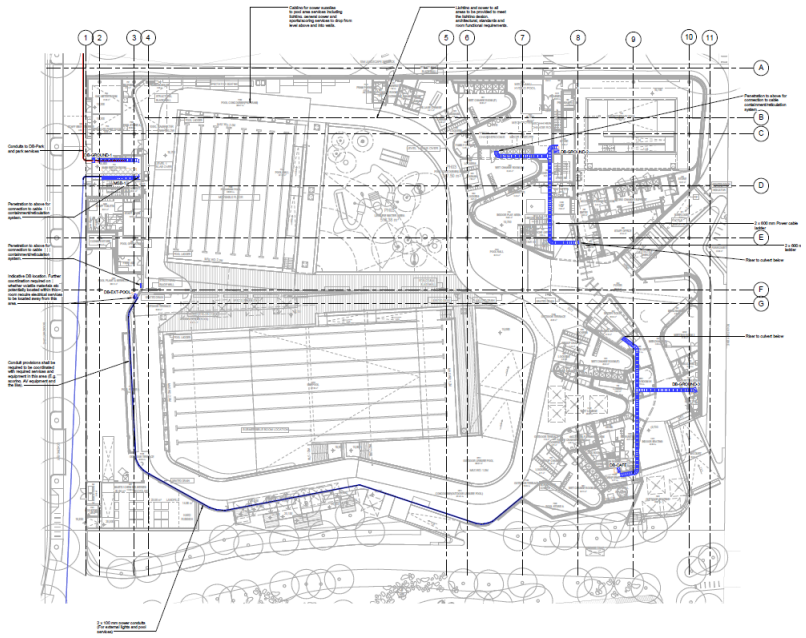

Figure 6 Aquatic Centre Ground Level Indicative Reticulation Route

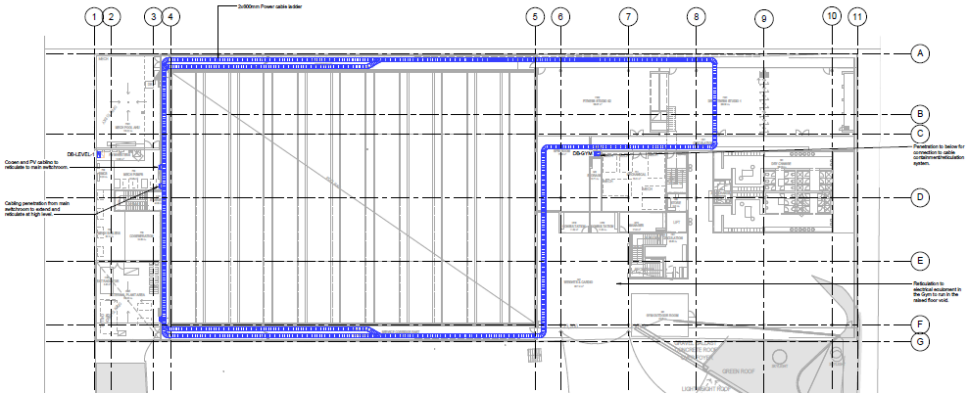

Figure 7 Aquatic Centre Upper Level Indicative Reticulation Route

2.3.1.3 Park & Sports Ground Reticulation

Within the park and sports grounds it is proposed that the mains reticulation would originate at the GPARC Main Switchboard, and supply to a park and sports ground distribution board (DB-Park) to be located within the Amenities building. Final reticulation to the sports ground lighting, and various power services (outlets, features and the like) would be via underground reticulation from DB-Park.

Conduit reticulation within the park and sports ground area is required for provision of supply to the various lighting fixtures and park services.

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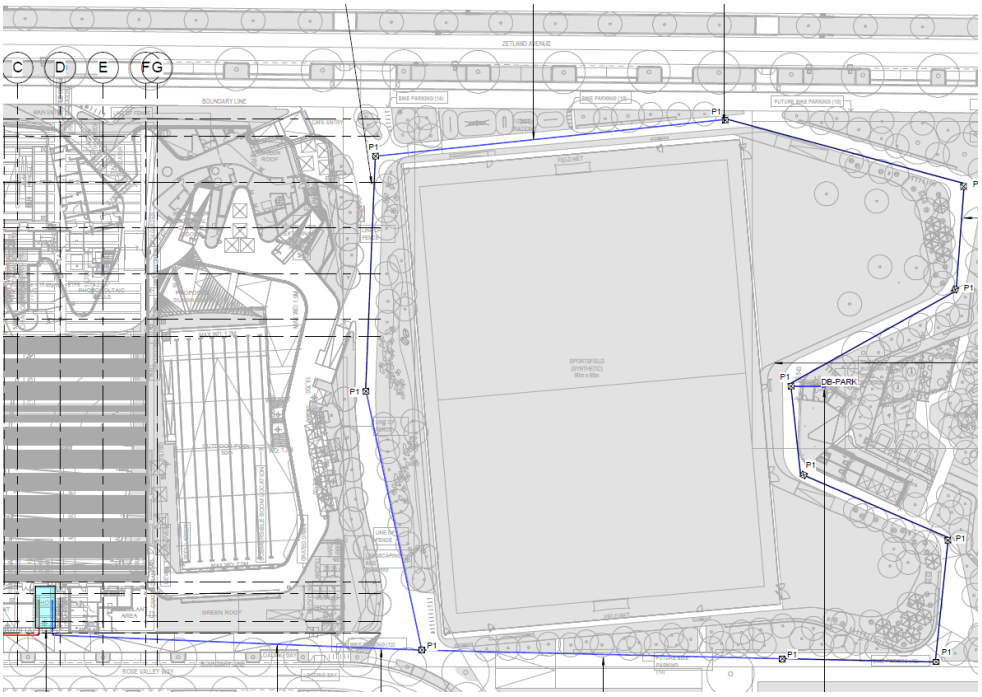

Figure 8 External & Park Lighting Indicative Reticulation Route

3 NCC/BCA COMPLIANCE & ESD

The electrical systems shall be designed to achieve compliance with NCC/BCA requirements, and with the project ESD objectives.

For detailed descriptions of the lighting scheme for the project refer to the stand alone lighting statement.

For comprehensive listing of all ESD objectives and initiatives refer to the ESD statement.

Where applicable, the lighting systems will be designed to achieve the recommended illumination levels in AS/NZS 1680, AS 1158 and AS4282, and clause F4.4 of the NCC.

The designed power density of the lighting design will comply with Part J6 of the BCA and the relevant ESD sustainable targets.

Lighting controls shall be installed to achieve the project objectives and in accordance with Part J6 of the BCA.

Emergency lighting will be installed throughout the development in accordance with Clause E4.2, E4.4 of BCA2016 and AS2293.1 – 2005

Exit signage will be installed in accordance with Clause E4.5, E4.7, and E4.8 of BCA2016 and AS2293.1.

Energy sub-metering shall be provided in accordance with BCA Section J6 and the ESD objectives.

4 Performance Standards

The latest edition of the relevant portions of the following codes and standards will form the basis of the Electrical Services design. This shall include:

- Wiring Rules: AS 3000
- Electrical installations – Selection of cables: AS 3008
- Interior Lighting: AS1680 (all parts)
- Exterior Lighting: AS1158.3.1
- Emergency Lighting to Buildings: AS 2293
- Low Voltage switchgear and control gear assemblies: AS 3439.1 and AS 3439.2
- Sports Lighting - Swimming Pools: 2560.2.5-2007
- NSW Service & Installation Rules
- The relevant Service Rules and Network Standards of Ausgrid
- The Australian Telecommunications Authority (Austel);
- The Sydney City Council;
- AS 2053 - Conduits and fittings for electrical installations
- Building Code of Australia (BCA);
- Work Cover.
- And any other Authority having jurisdiction over the works.

MEMORANDUM

From:	Daniel Jones	*Date:*	1/06/2016
Project:	**GPARC**		
Subject:	**Dry Fire Design Summary**		
#pages:	5		

Please find below design statement detailing the design at the DA submission milestone.

1.1 General

The Fire Services detailed herein form part of overall Fire Services package. The Fire Services must be executed in accordance with the following:

- Building Code of Australia (BCA)
- The Project / Client Design Brief
- Architectural Documentation
- All other services documentation
- All requirements of authorities having jurisdiction over the project.

The Fire Services works comprise the design, supply, installation, commissioning, testing, performance verification, placing into service, defect rectification and warranty of the fire services installation and includes the following services:

- Fire Detection System – AS 1670.1 2004
- Building Occupant Warning system – AS 1670.4 2004

2. Fire Detection System

2.1 General

The proposed building shall be provided with a fire detection system in accordance with the Building Code of Australia and AS/NZS 1670.1 2004, which shall include but not limited to the following:

- Fire Indicator Panel (FIP) located in the main entry lobby
- Fire Mimic Panels in the second building entry
- Fire Fan Controls on the FIP – if required
- Circuit interface panels including all modules.
- Power supplies, batteries and battery chargers.
- Equipment enclosures.
- Smoke detectors, thermal detectors, concealed space smoke detectors in ceiling voids, outside lifts, top of lift shafts, within fire stairs, outside fire stairs, within top of lift shafts, below ceilings,.
- Smoke detector remote indicator lights for concealed ceiling space mounted detectors.
- VESDA unit for the pool area to eliminate access and maintenance issues.
- Software and hardware as required providing a complete functioning system.

- Wiring and enclosures.
- Installation, testing, commissioning and completion of installers statement as per AS/NZS 1670.1
- The system must be an enhanced point addressable system with interactive detector heads.
- Detectors are to be analogue addressable type, compatible with the FIP. FIP to be Notifier 2800 or equivalent. Detector sensitivity will be programmable and correct type chosen for to suit location. Multi-criteria detectors to be installed sensitive areas to prevent false alarms.
- Interfaces for this will be included to ensure that the charging of the system is carried out on detection of fire Supply, install and terminate fire detection services in compliance with AS 1670 including detectors in the top of lift shafts.
- Supply, install and terminate interfaces and cables to lifts for special operation during fire alarm.
- Cabling and addressable points on the dry fire loop cabling for the monitoring of sprinkler isolation sprinkler valves, flow switches, solenoid valves, pressure switches and pumps at the FIP. Termination of cabling to all equipment under wet fire contract to be done by wet fire contractor.
- Contacts at the FIP for security system
- Provision of cable trays for wiring through exposed areas
- Provision of FIP interface with all new fire hydrant system related plant such as valve monitors, pumps indication etc with wiring and final connection to each device
- Provision of FIP interface with all new fire Sprinkler/ fire hydrant system related plant such as valve monitors, pumps indication, flow switches etc with wiring and final connection to each device
- General minimum Mechanical interface requirements
  - Supply AHUs, fire trips to MSSB

Fire Indicator Panel (FIP)

- FIP’s shall be fully addressable type and shall be either Notifier 2800 or approved equivalent. The type of panel proposed to be installed shall be subject to approval
- FIP's shall be sized to adequately serve the entire building in which they are located, with a minimum of 20% spare capacity on all control loops/lines
- FIP's shall be located at the building entrance designated as the entrance most accessible to the NSW Fire Brigade, ie, the entrance accessible to a fire appliance
- The FIP shall be placed in a position that allows for both audible and visual fault monitoring by the building occupants.
- Separate isolating facilities for each group of equipment interfaces shall be provided at the FIP for EWIS, magnetic door holders, security interface devices, air conditioning trips, sprinkler system interfaces and main fire bell/strobe
- Manual call points (MCP)
- Individual LED indicator lamps shall be provided for each of the following signals generated from interfaced equipment, when connected to the FIP:
  - Fire sprinkler alarms
  - Fire pump status indication -run, fault, low fuel level (for diesel types)

  - Fire sprinkler flow switch alarms (one indicator per flow switch
  - Fire sprinkler valve monitor switches (one indicator per location) open, closed
- Fire fan controls (separate panel if required) to AS 1668 – if required
- All fire detection and alarm systems are to be provided with fully addressable detectors, complete with adjustable sensitivity
- Detectors shall be suitably selected for each location in accordance with AS1670
- Where detectors are located in concealed spaces such as ceiling spaces, cupboards, air handling systems and the like, remote indicators shall be provided
- Remote LED indicators are required to be provided for both conventional and fully addressable type detectors.
- All detectors shall be fully accessible for maintenance. Accessibility to concealed spaces shall be achieved via ceiling access panels or accessible walkways.
- Photoelectric smoke detectors shall be provided in all electrical distribution board, cupboards, telecommunications cupboards, electrical switch rooms and lift motor rooms
- Paths of travel to exits, photoelectric smoke detectors are recommended to be installed. Where it is deemed inappropriate to install these detectors due to the possibility of unwanted alarms, combined CO & heat multisensory detectors may be considered

3 Building Occupant Warning System

3.1 General

The BOWS shall be Designed, supply and install in accordance with the Building Code of Australia and AS/NZS 1670.4 2004, which shall include but not limited to the following:

- Supply and installation of main BOWS panel, tone generators, microphone console, speakers, strobe lights, and associated wiring
- Supply and install electronic loop sounders.
- Supply and install recessed ceiling speakers, surface mounted speakers and horn speakers with associated wiring as required.
- Supply and installation of cables, conduits, trunking, cable trays etc. for the wiring work.
- BOWS shall activate on activation of the FIP.
- Supply and install fire alarm interconnection for the FIP for automatic activation and evacuation sequencing.
- Complete programming of the system.
- Supply and install all equipment labels.
- Supply maintenance log book, operation and maintenance manuals and as-built drawings and certification.
- Complete testing and commissioning of the installed system.
- Training of occupants on completion of installation

Master Emergency Control Panel
The MECP shall generally be located in an accessible location adjacent to the building FIP T

Where the MECP is proposed to be designed and installed flush into wall spaces, include ventilation space for heat dissipation from the cabinet as amplifiers generate considerable heat.
Each evacuation zone shall be provided with a dedicated amplifier. All amplifiers shall be provided with 30% spare capacity to allow for additional future speakers to be installed within each zone.

System Operation

Unless otherwise directed all EWIS shall be arranged for the following automatic sequence of operations:

- No delay from receipt of fire system activation to operation of ALERT signal throughout entire building
- ALERT signal shall sound for 60 seconds throughout the entire building then automatically change to EVAC signal throughout the entire building
- No cascading, ie, signals to be provided throughout all areas of the building simultaneously
- Standard & custom voice recorded messages shall be provided with the EVAC signal
- ALERT and EVAC signal types shall meet the requirements of AS1670.4
- Commissioning details indicating measured sound pressure levels and speech intelligibility shall be provided for all areas and rooms within the building. These details shall be provided on the as built drawings and within the O&M manual, for all works.

Please contact myself if you need anything further.

Regards,

Daniel Jones
CJ Arms & Associates

Surface Design

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Project Reference: 14011

17 May 2016

Façade Engineering Design Statement – Gunyama Park Aquatic and Recreation Centre

This statement has been prepared to summarise the performance requirements of the façade for the development of the Gunyama Park Aquatic and Recreation Centre.

The proposed façade consists of:

- Fixed Double Glazed windows with clear glazing
- Clear laminated glazing building entries
- Compressed Fibre panels supported from steel subframe
- Rendered blockwork walls to ground floor facade
- Aluminium mechanical ventilation louvres
- ETFE cushions to Pool Hall skylight

The façade is to be procured under a design and construct type arrangement. The facades to the building are to be designed and installed in accordance with the following Australian Standards as a minimum requirement:

AS/NZS 1170.1	Structural Design Actions – Permanent, imposed and other actions
AS/NZS 1170.2	Structural design action – Wind actions
AS/NZS 1170.4	Earthquake loads and commentary
AS 3600 and Supplement	Concrete structures
AS 4100 and Supplement	Steel Structures
AS/NZS 4600 and Supplement	Cold-formed steel structures
AS 3700 and Supplement	Masonry structures
AS/NZS 1664 and Commentaries	Aluminium structures – Part 1: Limit State Design Part 2: Allowable Stress Design
AS/NZS 4673	Cold-formed stainless steel structures
AS 1288	Glass in buildings – Selection and installation
AS1428.1	Design for access and mobility – General requirements for access – new building work
AS1657	Fixed platforms, walkways, stairways and ladders – design construction and installation
National Construction Code	2014 – Volume 1
OHS Regulations	NSW Work Health and Safety Regulation 2011 NSW Work Health and Safety Act 2011

The façade is to be designed to comply with the requirements set out in the Acoustic and Section J reports.

Should you have any questions please contact me without hesitation.

Yours faithfully,



Gavin McPherson

Surface Design

Gunyama Park Aquatic and Recreation Centre (GPARC)
132 – 140 Joynton Avenue, Zetland NSW 2017

City of Sydney

12 May 2016

Revision 1

Client Name	City of Sydney
Project Name	Gunyama Park Aquatic and Recreation Centre
Client Project ID	C16113
Description	DA Irrigation Consultant Statement
HP Project ID	13299
Revision	1

Revision No.	Date	Description	Author	Approved By	Reviewed By
1	12/05/2016	DRAFT ISSUE	PM	KC	
2	13/05/2016	Final	PM	KC	
3	27/05/2016	Final after response to CoS questions	PM		

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May 2016

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Figure 1: Irrigation Strategy Plan ..... **Error! Bookmark not defined.**

1 INTRODUCTION

This report has been prepared to provide DA Statement for the irrigation design planned for Gunyama Park Aquatic and Recreation Centre.

2 IRRIGATION DESIGN STATEMENT

The irrigation system design for Gunyama Park Aquatic and Recreation Centre shall endeavour to achieve the water sustainability targets as outlined in the WSUD study Revision P1.

The materials used will not include PVC and shall be specified to minimise the environmental impact.

The irrigation system shall be operated by an electronic control system programmed to operate at night time to minimise the water loss due to evaporation. There will be a rain sensor attached to the controller to prevent the irrigation from operating during and immediately after rainfall.

The layout of the irrigation system has been done to maximise the efficiency of application and minimise water wastage.

3 IRRIGATION STRATEGY

Figure 1 shows the Irrigation Strategy Plan for the Gunyama Park Aquatic and Recreation Centre.

3.1 Irrigation Equipment

The irrigation controller shall be of a reputable make and installed to prevent damage due to vandalism.

Irrigation control solenoids shall be hydraulically operated, normally closed valves and shall be located around the site adjacent to the irrigation mainline, as required to supply water to irrigation zones. These zones have been sized to accommodate the available water supply. A separate sub-meter shall manage park water uses.

3.2 Garden Hose Taps

The majority of the proposed landscape will be native planting and have no permanent irrigation installed. Hose taps shall be installed throughout these areas for the purpose of watering during establishment and in case of drought. Proposed hose tap locations are shown on Figure 1. Proposed taps shall be of vandal resistant type located in an in-ground valve boxes with lockable lids. Proposed water supply to the taps shall be potable mains water.

Water usage from the taps has not been considered in any water demand calculations for 2 reasons:

1 It is not expected these taps will be used frequently once gardens are established
2 Accurately estimating water usage via taps is impossible since usage time and flowrates are completely at the user's discretion.

3.3 Irrigated Gardens

Irrigated garden areas are indicated in Figure 1 with green "in-fill". These gardens are understood to be native for water demand calculations. Proposed irrigation method is subsurface drip. Proposed water supply shall be primarily rainwater with a back-up supply of either reticulated recycled water or potable mains water.

3.4 Roof Gardens and Berms

Irrigated roof gardens and berms are indicated in Figure 1 with green "in-fill". These areas are understood to be native for water demand calculations. Proposed irrigation method is subsurface drip. Proposed water supply shall be primarily rainwater with a back-up supply of either reticulated recycled water or potable mains water.

3.5 Irrigated Turf

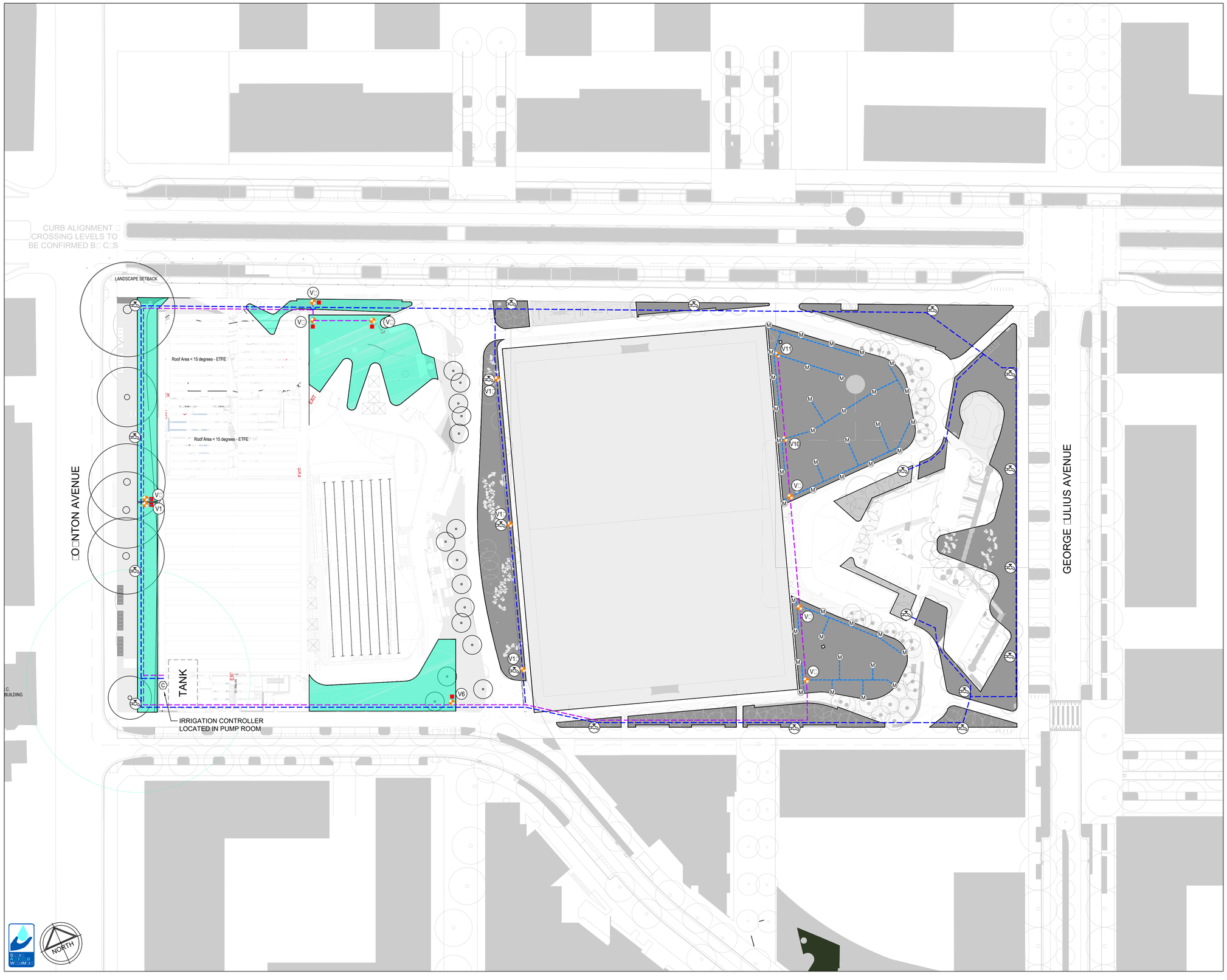
Irrigated turf areas are indicated in Figure 1 with small black circles to indicate sprinkler locations. These areas shall be considered warm-season turf for water demand calculations. Proposed irrigation method is pop-up spray utilising the Hunter MP Rotator attached to a pop-up spray body. Proposed water supply shall be primarily rainwater with a back-up supply of either reticulated recycled water or potable mains water.

3.6 Synthetic Sports Field Wash-Down Hose Taps

No irrigation is required for the synthetic sports field. However, the field will require period washing. Hose taps are required to wash down the synthetic sports field as required. The proposed location of these taps is shown on Figure 1. These taps would be located in the overrun area in valve boxes finished flush with the surface. Each tap will be connected to a solenoid control valve connected to the irrigation controller. A hand held radio remote will be supplied to operate the valves. This will allow the operator to activate a tap for a set period of time and so avoid the possibility of leaving a tap to run unattended for excessively long time periods.

The proposed location of the hose taps enables access to all parts of the field using a 50m hose. Proposed water supply shall be potable mains water.

Figure 1: Irrigation Strategy Plan



LEGEND

KE□	DESCRIPTION
C	PROPOSED IRRIGATION CONTROLLER
	PROPOSED POTABLE WATER MAIN
	PROPOSED REC□CLE WATER MAIN AND CONTROL CABLE IN SAME TRENCH
	PROPOSED LATERAL PIPE
	CONTROL CABLE IN CONDUIT TO SOLENOID VALVE
	MANUAL WATERING POINT □HOSE TAP□
	PROPOSED SUB-SURFACE DRIP IRRIGATION TO GARDEN BED AREAS
	WATER TAKE OFF POINT - SUB-SURFACE DRIP □ONE
	SOLENOID CONTROL VALVE ASSEMBL□
M	HUNTER MPR□000 SPRINKLER

SPRINKLER TABLE

KE□	MAKER	MODEL	NO□□LE□□	DESIGN□ □P□□	M□□□ R□d□□□ □ □	FLOW□LPM□
M	H□□□r	MPR	□000	□□0	□□	□□□□1 □□1

-□ 0 □ 10 1□ □0 □□ □0□
SCALE 1□□00 ORIGINAL SI□E A1

T.C.L

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3rd June 2016

GPARC Playground Statement

Design intent

Referencing the past industrial character of the site, the playground features a series of large pipe tunnels that are designed as a playful framework for a range of play equipment and activities. The tunnels are spaces to be explored and played within, beside, and below. The elevated tunnels are accessed by spiral staircases and fitted with slides, climbing nets, ladders, swings and climbing poles. The pipe tunnels set up a structured play circuit of varied and graded challenges, requiring an increased level of skill as children move through the loop.

The pipe tunnels will be internally clad in timber battens and punctuated with portals providing access and views into and out of the tunnels, some with coloured Perspex. A graphic representation of a Morris Minor production line will be integrated into the internals of one of the pipe tunnels, as a reference to the local history of car production. The playground materials and colour palette are consistent with the overall project, influenced by the original colours of Morris Minor vehicles previously produced here.

The playground is nestled within mounded garden beds of native planting, providing a defined edge and natural setting for children to explore and discover. Children can also hop between rock boulders which are strategically placed within the sand and nature play areas. The planting palette of trees and low shrubs references the original banksia scrub landscape while retaining clear sight lines.

This inclusive play space has been designed to accommodate children of all abilities, engaging older children as well as providing a dedicated junior play area for 1- 4 year olds. It provides a diverse range of play activity relative to each child's level of development. The play space will physically challenge and spark imaginative play, encourage conceptual thinking, perception, social ability and measured risk taking. The playground is a combination of fixed elements (boulders, play equipment), loose parts (sand, mulch, landscape) and musical elements (sound deck) to engage all the senses.

The dedicated toddler and junior play area incorporates two pipe tunnels at ground level with a series of portals for children to climb through, slide from, play in and explore at an appropriate scale. Rockers, diggers, sand and water play are also integrated into this space. A toddler swing is located nearby.

The diagram below diagrammatically illustrates the play activities and circuits within the playground.

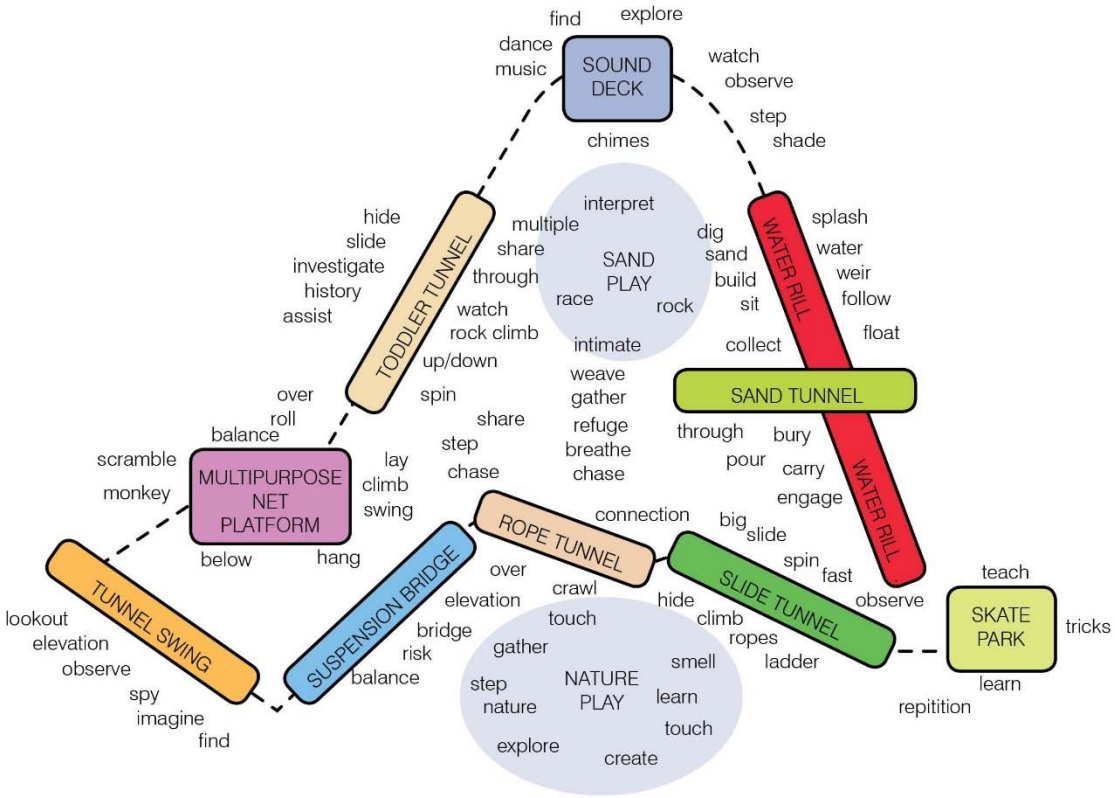

Figure 1: Play Activities and Circuits

Access and inclusion

The playground is located on the eastern side of the park, with clear and accessible connections to the family BBQ areas and amenities building. Ample seating is provided throughout the play space, both within activity zones and around the playground perimeter. Pram and wheelchair parking opportunities have been integrated into the seating layout, ensuring equal opportunity and social inclusion.

A perimeter and internal path network ensures level access to the main activities and play spaces, allowing children with disabilities and their carers to experience a diversity of play.

The level tunnel within the toddler play area is accessible and can be experienced independently from a wheelchair or with the aid of a carer. Safe and DDA compliant playground surface materials have been selected to ensure wheelchair access to the sand pit, water rill, basket swing, net platform, and spinner.

The diagram below summarises the areas designed for equal access.

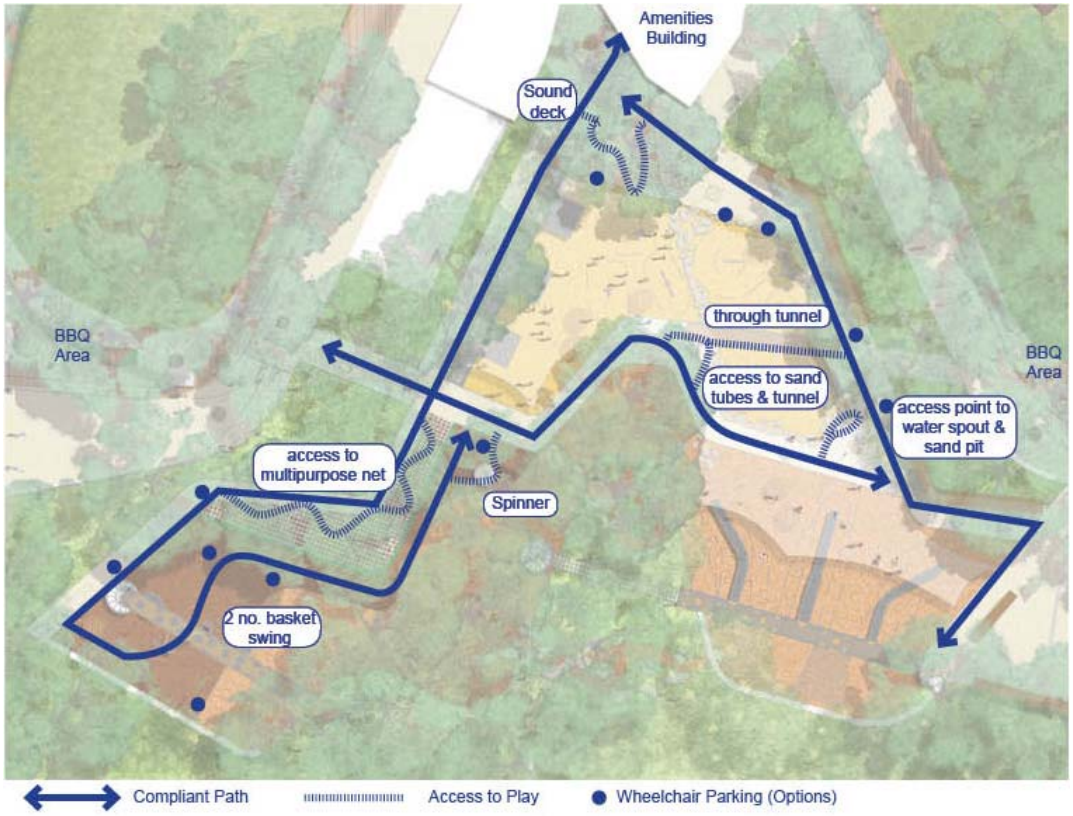

Figure 2: Equal Access routes and Play Opportunities

Shade and auxiliary facilities

A fixed shade structure will instantly provide shade to approximately 60% of the playground. It floats above zones where stationary play is encouraged (sand play) and over specific play equipment (slides) to minimise heat retention from direct sun. Dappled shade is also provided from the elevated pipe tunnels and canopies of trees extensively planted throughout the playground. Drinking fountains and refuse bins are placed near entry and exit points to the playground.

Applicable codes and standards

The playground is designed to be safe and compliant with the relevant Australian Standards listed below:

Australian and New Zealand Standard AS/NZS 4486.1:1997 Playgrounds and playground equipment
Part 1: Development, installation, inspection, maintenance and operation
Australian and New Zealand Standard AS/NZW 4422:1996 Playground surfacing
Specifications, requirements and test methods
Australian Standard AS4685:2014

Playground equipment and surfacing
Part 1: General safety requirements and test methods
Part 2: Particular safety requirements and test methods for swings
Part 3: Particular safety requirements and test methods for slides

Part 4: Particular safety requirements and test methods for cableways
Part 5: Particular safety requirements and test methods for carousels
Part 6: Particular safety requirements and test methods for rocking equipment Part 11: Particular safety requirements and test methods for spatial networks

Australian Standard AS4685:2014
Playground equipment and surfacing
Part 1: General safety requirements and test methods
Part 2: Particular safety requirements and test methods for swings
Part 3: Particular safety requirements and test methods for slides
Part 4: Particular safety requirements and test methods for cableways
Part 5: Particular safety requirements and test methods for carousels
Part 6: Particular safety requirements and test methods for rocking equipment
Part 11: Particular safety requirements and test methods for spatial networks