Mosman COUNCIL

ASSET MANAGEMENT Marine Structures

Adopted by Council 3 April 2012

1 Executive Summary

Mosman Municipal Council is located on the northern shores of Sydney Harbour, NSW and manages marine structures to ensure a safe, efficient and effective built environment for the people of Mosman.

The NSW Department for Local Government (DLG) has introduced requirements for asset management and reporting by 2012. Mosman Council (Council) engaged Opus International Consultants (Opus) to develop this asset management plan for their marine structures in order to conform with DLG requirements.

The purpose of the asset management plan is to have a tool which assists Council to achieve its asset management outcomes which are consistent with Mosplan, the Councils Community Strategic Plan.

This plan outlines the broad approach that Council will adopt to manage the condition of and use of marine structures assets over the next 12 years providing future directions for marine structure use, safety, and maintenance. All the assets considered are held to provide services oriented to the customer rather that the Council's provider of the services.

The asset subjects of this asset management plan and their current overall condition grade are described in the table below:

Baths and Jetties			
ID	Location / Name	Total Deck area (m^2)	Overall condition grade
BB1/BB2	Balmoral Baths	966.62	2
CG1/CG2	Clifton Gardens Jetty/Baths	724.56	2
IS1	Inkerman Street Jetty	20.9	4

Marine Structures

Sea Walls			
ID	Location / Name	Total Wall length (m)	Overall condition grade
RW41	Middle Harbour	15	5
RW54	Pearl Bay	91.5	1
RW79	The Spit	789.1	2
RW85	Ellery Park	109.7	2
RW83	The Spit	75.8	1
RW80	The Spit	28.3	3
RW81	The Spit	24.9	4
RW82	The Spit (East Side)	42.8	3
RW7	Balmoral Park	71.8	2
RW4	Hunter Park / Leahy Park	33.6	1
RW5	Hunters Park	58	2
RW6	Balmoral Park / Hunters Park	625.8	3
RW3	Balmoral Park	71.8	1
RW2	Balmoral Park	22.4	2
RW1	Balmoral Park	62	1
RW28	Clifton Gardens Reserve	221.3	3
W639	Musgrave Street	32.4	3
W640	Musgrave Street	91.8	1
W612	Mosman Street	12.8	2
RW42	Mosman Bay	372.1	2
RW38	Harnett Park	85.1	2
RW76	Sirius Cove Reserve	188.1	2
EB1	Clem Morath Pool	44.6	4
RW55	Bay Street Seawall	119	1

Council have a vision for population growth in Mosman: planning to grow to a maximum residential population in 2050 of 30,000 people. The planned population growth rate on average is 42 people per year until 2050. Therefore the Mosman marine structures should experience only a minimal increase in demand from residents, and no new assets are required to meet this minimal increase in demand. There may be growth in non-resident demand at the foreshore tourist destinations. No figures of that external demand were available, but local transport access limitations will moderate that demand.

Opus assessed the total replacement cost for the Mosman marine structure assets at $11,502,204 and a total optimised depreciated replacement cost at $5,095,969. The Annual Depreciation was identified as $750,715.

Routine maintenance actions are required to ensure the structures are in a safe condition and include the following items:

Baths and Jetties

- Visual inspection of timber pile every 3 years
- Visual inspection of timber headstocks and girders every 3 years
- Borer inspections every 5 years
- Patch works to concrete jetty deck
- Tightening of decking screws
- Repainting of handrails
- Repainting of non-slip sections of decks
- Clean off marine growth on swimming turn boards and ladders
- Replacing light bulbs to jetty lights
- Repair large holes to shark nets

Sea Walls

- Regrout between sandstone blocks of sandstone sea walls
- Grout up cracks in concrete seawalls to prevent water ingress
- Repainting of handrails
- Vegetation growth in sea walls to be removed
- Exposed reinforcement to be repaired
- Blocked drainage holes to be flushed
- Weathering of concrete rendering to be repaired

Below is a list of replacement/renewal items included in our maintenance plan.

Baths and Jetties

- Replacement of corroded steel connectors (Bolts, screws and splice places etc)
- Replacement of piles with a section loss 50% or greater.
- Replacement of timber stairs on the Inkerman Street jetty (severely deteriorated).
- Replace signage when out dated

Marine Structures

Sea Walls

- Replacement of collapsed sections of seawalls
- 5m section of collapsed sea wall to be replaced at Middle Harbour Seawall – RW41
- 4m section of collapsed seawall to be replaced at Clem Morath Pool – EB1
- Replace signage when out dated
- Replacement of sandstone blocks with greater than 30% loss of section.

Alternative funding scenarios are compared in this Plan. The funding scenario that better manages the level of exposure to risk over the decade requires a concentrated expenditure of $180,000 for the initial 3 years to eliminate a continuing accumulation of deferred demand through the decade. An expenditure of $180,000 for 3 years consumes the deferred renewal and maintenance demand and permits a reduction in annual budget to $70,000 per annum from Year 4.

Due to the lack of performance records for the assets, the predictions of asset performance applied in the plan, and hence the predictions of maintenance demand, are based on sound engineering practice and experience. Failure to undertake the maintenance activities at appropriate times may be detrimental to the marine structures, resulting in loss of service and increases in the extent of repair, renewal and rehabilitation of the assets.

There is an extensive existing demand for maintenance expenditure to ensure the safety of some structures and the public. This current situation indicates a misalignment between the provision of assets and the services provided by those assets. The service provided by the assets now in terminal or unsafe condition does not meet the intention behind the provision of the assets. That is, some asset are not delivering the service intended.
The maintenance of the assets has not matched the level of service provision expected for these assets. Therefore there is an evident inadequacy of maintenance, or the extent of service provision exceeds the funding allocation. Both situations result in a raised level of hazard to the assets and the users. A consideration of the level of service provision including a risk assessment is recommended to quantify the situation and inform decision making on the alignment of future maintenance to service provision.

The Council should consider revising this document in 2017 using the improved information collected in the interim, to generate a second generation AMP.

2 Introduction

Mosman Municipal Council is located on the northern shores of Sydney Harbour, NSW and manages marine structures to ensure a safe, efficient and effective built environment for the people of Mosman.

The NSW Department for Local Government (DLG) has introduced requirements for strategic and asset management and reporting by 2012.

Mosman Council (Council) has engaged Opus International Consultants (Opus) to develop the Asset Management Plan (AMP) for their marine structures in order to conform with DLG requirements.

2.1 Background

The purpose of this Asset Management Plan, is to have a tool which assists Council to achieve its asset management outcomes which are consistent with Mosplan, the Council's Community Strategic Plan.

This Asset Management Plan outlines the broad approach that Council will adopt to manage the condition of and use of marine structures assets over the next 20 years and provides direction for marine structure use, safety, and maintenance for a 12 year period. All the assets considered are held to provide services oriented to the customer rather than the Council's provider of the services.

2.2Goals and Objectives of Asset Ownership

10 year Program Objectives – Resource and Asset Management.

- To have provided directly or on behalf of other levels of government adequate, equitable and appropriate services and facilities for the community and to ensure that those services and facilities are managed efficiently and effectively, and are always of a high quality consistent with the requirements of the Mosman community;
- To aim to have Council's unrestricted current ratio at 2:1;
- To have business systems which will meet the increasing demands for management information and that add value to the Council and community by providing integrated, accurate, timely, cost effective and responsive service;
- To have Mosman Council regarded as an employer of choice by all its stakeholders;
- To have risk management strategies in place to ensure Mosman is a safe place to live, work and play; and
- To have integrated sustainable practices into Council's asset management planning and implementation.

2.3 Plan Frame Work

The Asset Management Plan follows the industry recognised format published in the International Infrastructure Management Manual.

The brief for the development of this Plan listed the following key elements to be considered in the Plan. There is limited information to support the reporting of some of these elements.

- The Plan is consistent with Council's vision, key priorities, meets the stated outcome and provides guidance in the development of key performance measures for levels of service, and incorporates the performance measures adopted by Council in 2011.
- The concepts of Level of Service and guidance on the further development of customer focussed measures of the delivery of service by assets are provided. Current levels of service measures relate to the response requirements for maintenance and the use of the marine structures. Commentary is provided on the gap between current service levels and customer focussed service levels relating to both condition and use of the assets.
- The Plan identifies ways for developing Level of Service measures to guide Council services towards better practice from a whole of life or operations perspective taking into consideration the government policies and financial environment for a 5 year funding horizon.
- Comment is provided on the nature of annual maintenance and capital investment programs for the next twelve years based on an assessment of demand, risk and the likely funding environment. Financial frameworks are proposed for the development of ongoing maintenance to assist Council in developing projects, programs and investments for ongoing maintenance and safety of the marine structures assets.

2.4 Core and Advanced Asset Management

Advanced asset management cannot be achieved because there is no recorded performance history for the assets.

2.5 Asset Inventory

The asset subjects of this asset management plan are as follows:

Table 1: Mosman Bath and Jetty Assets

Baths and Jetties		
ID	Location / Name	Total Deck area (m²)
BB1/BB2	Balmoral Baths and Jetty	966.62
CG1/CG2	Clifton Gardens Baths and Jetty	724.56
IS1	Inkerman Street Jetty	20.9

Table 2: Mosman Sea Wall Assets

Sea Walls		
ID	Location / Name	Total Wall area (m)
RW41	Middle Harbour	15
RW54	Pearl Bay	91.5
RW79	The Spit	789.1
RW85	Ellery Park	109.7
RW83	The Spit	75.8
RW80	The Spit	28.3
RW81	The spit	24.9
RW82	The Spit (East Side)	42.8
RW7	Balmoral Park	71.8
RW4	Hunter Park / Leahy Park	33.6
RW5	Hunters Par	58
RW6	Balmoral Park / Hunters Park	625.8

Marine Structures

Sea Walls		
ID	Location / Name	Total Wall area (m)
RW3	Balmoral Park	71.8
RW2	Balmoral Park	22.4
RW1	Balmoral Park	62
RW28	Clifton Gardens Reserve	221.3
W639	Musgrave Street	32.4
W640	Musgrave Street	91.8
W612	Mosman Street	12.8
RW42	Mosman Bay	372.1
RW38	Harnett Park	85.1
RW76	Sirius Cove Reserve	188.1
RW55	Bay Street	119

In addition there is one allied structure - the Clem Morath Pool is formed by a natural rock structure augmented with an artificial sea- wall.

ID	Location / Name	Total Wall area (m)
EB1	Clem Morath Pool	44.6


Pearl Bay Seawall
The Spit
Ellery Park Seawall
The Spit
The Spit
The Spit
Middle Harbour Seawall
Hunter Park
Leahy Park Seawall
Clem Moreth Pool
Bay Street Seawall
Balmoral Park Seawall
Hunters Park Seawall
Inkerman Street Jetty
Balmoral Park
Hunters Park Seawall
Hamett Park Seawall
Balmoral Baths
Balmoral Park Seawall
Balmoral Park
Mosman Bay Seawall
Musgrave Street
Sirius Cove
Clifton Gardens Jetty
Clifton Gardens
Reserve Seawall
INSET
Mosman Marine Stuctures Asset Management Plan
Overview Map
Inspection Sites
Mosman Local
Government Boundary
Metres
OPUS

3 Level of Service

Level of Service is an approach to defining the service provided. The service may be provided directly as a service to customers, or by the provision of an asset which services the community. For example, a jetty provides for transport and recreation through its use by the community. The service provided by a jetty may be measured in terms of quantity, quality, accessibility, availability, social benefits, sustainability, and risk.

The intent of the process for the assessment of the Level of Service is to align measurable attributes of the service to the corporate objectives of the organisation, thus providing a system that indicates the extent of performance of the service against the organisation's objectives. The measurable attributes are proxy measures for the community's value statements.

Level of service measures must be readily measurable, preferably from available data sources or otherwise directly. Levels of service should be determined by the agency procuring the service and be stated in terms that are appropriate to, and understood by the community for whom the service is provided. More detailed measurable technical performance measures may underlie the level of service measures.

3.1 Level of Service Matrix for Mosman Marine Structures Assets

Mosman's Vision addresses four themes:

- Governance
- Economic
- Social
- Cultural

Measures:

- Quantity
- Quality
- Location – Accessibility
- Time – Availability
- Social Benefits
- Sustainability
- Risk Levels – Quality of Life

In order to propose levels of service measures for the marine assets, the corporate planning documentation of the Council was inspected, and customer values relevant to the service provided by the marine assets were identified. For each customer value, an associated level of service is proposed. For each value, a measurable attribute is selected to provide a method of measuring performance, and a measurement criterion and ranking for measuring performance relative to a stated outcome. Table 3 provides the initial levels of service developed for the marine assets.

These levels of service should be applied and tested in practice and their suitability considered further after a trial period. Several iterations of refinements may be desirable to achieve a suite of service statements and performance measures that adequately define the delivery of the service, and are able to be comprehended by the user community.

Intervention Levels and other technical response criteria have been applied in the development of the forward maintenance programs to reflect the achievement of these levels of service. However, there is an existing current demand for maintenance to return some assets in terminal condition to acceptable condition. Therefore those terminal assets are not currently delivering service conforming within the level of service.

Table 3: Level of Service Matrix for Mosman Marine Structures Assets

Customer Values	Level of Service	Measured Attribute	Measurement Criterion	Ranking
Social Values retained				
Accessibility	Recreational use facilitated	Structure is adequate	Structural condition not to exceed minimum value	Not greater than condition rank 4
Quality	Suitability for use	Outstanding or Deferred Maintenance	Value of Outstanding or Deferred Maintenance	Not to exceed $60,000
Availability, Community Health and Wellbeing	Accessibility/ Reliability	Availability for use Sufficient for demand	Period (in days) when not available for use	Days closed < 5 per annum

Marine Structures

Customer Values	Level of Service	Measured Attribute	Measurement Criterion	Ranking
Social Values retained				
Quantity Abundant leisure and recreational opportunities	Recreational use facilitated	Recreational access facilitated	Safe water egress provided	Ladders, steps or ramp provided
Risk Safe infrastructure	Safe & Healthy in use	Injury incidence Secure to use	Hazard free surfaces Shark Nets are effective	All decking secure & sound. No holes>150mm diameter.
Environmental Values retained				
Quality	Foreshore land protected from erosion	Shoreline protected from erosion	Land retained with no erosion – condition value	Nil at condition 5
Quality	Aquatic habitat facilitated	Aquatic habitat maintained	Molluscs and plants colonise surfaces	Visible colonisation of marine zone.
Risk to habitat	Sustainability of habitat	Habitat diversity and longevity	Period between disturbance of habitat	Period between maintenance activity disturbance > 2 years
Economic Values retained				
Sufficiency	Quantity	Sufficient for demand	Visitation	Number of person visits
Quality	Quality	Customer complaints	Number of complaints	Complaints per annum

Customer Values	Level of Service	Measured Attribute	Measurement Criterion	Ranking
Social Values retained				
Affordability	Affordability	Notional user cost	Agency cost/number of users	$ per person visit
Sustainability	Sustainability of assets	Asset Value retained	Asset consumption/ Asset renewal	Equation solution =1

4 Future Demand

The Community of Mosman generates the demand for the services provided by the assets considered in this Plan. This section discusses the predictions of change in the population, and the likely corresponding changes in demand for these services.

The Mosman estimated population in June 2011 was 28,356 people (Mosplan, 2011).

4.1 Demand Forecast

Council have a vision for population growth in Mosman and plans for a maximum population in 2050 of 30,000 people. The maximum population growth rate on average is 42 people per year until 2050. This small population change is not considered significant for the performance of the marine assets.

Mosman's foreshore attracts and services external tourism, and growth in external demand is predicted but not quantified. Local access constraints are expected to limit the growth in demand.

The marine structures are located at the interface of the urban terrestrial and harbour aquatic habitats. The marine structures serve the community by supporting their aquatic access and recreation, and use of the foreshore. Environmental constraints arise due to the sensitivity of habitats at the land/aquatic interface.

Sea level rise due to global warming is unlikely to affect these structures in the life of this plan however future planning should consider this issue.

There is no currently available information provided to Opus establishing unsatisfied demand for additional waterfront water access and recreation structures, or foreshore protection structures. Nor is there evidence of substantial over provision of services for foreshore recreation and protection.

4.2 Changes in Technology

Marine borer attack to timber members in marine environments is reducing their section size and structural capacities at an ever increasing rate. A more resistant alternative to timber piles needs to be investigated, such as plastic sleaved steel piles.

4.3 Information about the Level of Service Provision

The current lack of information to assess the extent of service provision required to meet the community demand for foreshore recreation services and foreshore protection makes the determination of any gap between community needs and service provision unassessable.

Development of information on this service provision is recommended in order to inform future development of measurement of Levels of Service.

5 Lifecycle Management Plan

This Section of the AM plan should outline exactly what is planned in order to manage and operate the assets at the agreed levels of service (defined in the plan) while optimising lifecycle costs.

5.1 Asset Data Sources

The asset data for the jetty structures was provided by Mosman Council and verified from site observation including underwater inspections. The seawall asset data was collected from site observations.

No previous valuations were provided by council in order for a comparative assessment of network value change. Mosman Council advised that it wanted an independent assessment of its asset value and one that was not influenced by previous valuations or valuation methodology.

5.2 Condition Grading

Table 4: Marine Structures Condition Grading standard

Grade	Condition	Description
1	Very Good	Sound Physical condition. Asset likely to perform adequately without major work.
2	Good	Acceptable physical condition: minimal short term failure risk but potential for deterioration in long-term (10 years plus). Only minor work require (if any).
3	Fair	Significant deterioration evident; failure unlikely within next 2 years but further deterioration likely and replacement likely within next 10 years. Work may be required but asset is still serviceable: minor components or isolated sections of the asset need replacement or repair now, but asset still functions safely at an adequate level of service.
4	Poor	Failure likely in short-term. Likely need to replace most or all of asset within 2 years. Substantial work required in short term, asset barely serviceable: no immediate risk to health or safety but works required within 2 years to ensure asset remains safe.
5	Very Poor	Failed or failure imminent. Major work or replacement required urgently. Immediate need to replace most or all of asset. Health and safety hazards exist which present a possible risk to public safety, or asset cannot be serviced/operated without risk to users.

5.3 Jetty Structures

5.3.1 Balmoral Baths and Jetty

Asset Description

Balmoral Baths and Jetty consists of a 'U' shaped jetty structure enclosing a swimming area, and a berthing jetty at the north-east end. The structure contains 180 timber piles, 970m² of timber decking, 250m of shark net enclosing the swimming area, timber girders, headstocks, and handrails.

Figure 1: Balmoral Baths and Jetty

The jetty structure is 3.4m wide and 380m in length, with widened sections to accommodate "turning boards". The berthing section of jetty is 10m wide by 28m in length.

Balmoral baths is accessible to the public and is primarily used for recreational activities such as swimming, fishing, sightseeing, and access to vessels.

Asset Condition

Table 5 below contains descriptions of the condition of the main structure elements. For detailed condition information, refer to the condition report in Appendix A.

Table 5: Condition of Balmoral Baths and Jetty

Main Structure Elements	Condition Grade	Comment
Timber handrails	2	Some minor corrosion to connections
Timber decking	2	Some loose coach screws
Timber headstocks	1-4	Some headstocks display advanced weathering and severely corroded bolted connections
Timber girders	2	Some weathering and corrosion to bolted connections
Timber piles	1-5	30 new piles, 142 piles with 15% section loss and 8 piles requiring replacement
Shark netting	2	Some large holes in net requiring repair

5.3.2 Clifton Gardens Baths and Jetty

Asset Description

Clifton Gardens Baths and Jetty consists of an access jetty, pier head, swimming enclosure jetty and shark proof net with a section supported by piles. The structure contains 145 timber piles, 725m² of concrete deck, 210m of shark net enclosing the swimming area, timber girders, headstocks, and handrails.

Figure 2: Clifton Gardens Baths and Jetty

The jetty structure is 3.3m wide and 190m in length including the pier head. The berthing section of jetty is 6.6m wide.

Clifton Gardens Baths and Jetty is accessible to the public and is primarily used for recreational activities such as swimming, fishing, sightseeing, and access to vessels.

Asset Condition

Table 6 below contains descriptions of the condition of the main structure elements. For detailed condition information, refer to the condition report in Appendix A.

Table 6: Condition of Clifton Gardens Baths and Jetty

Main Structure Elements	Condition Grade	Comment
Timber handrails	1	Freshly painted
Concrete decking	2	Some minor loss of concrete
Timber headstocks	2	Corroded bolted connections
Timber girders	1-5	14 new piles, 124 piles with 15% section loss and 7 piles requiring replacement
Shark netting	2	Some large holes in net requiring repair

5.3.3 Inkerman Street Jetty

Asset Description

Inkerman Street Jetty consists of a narrow straight walkway deck, with a water access stair offset at the jetty head. The structure contains 4 FRC pipe sleeved timber piles and 2 timber piles, 21m² of timber decking, timber girders, stairs, a concrete 13m long causeway and steel tube handrails.

Marine Structures

Figure 3: Inkerman Street Jetty

The jetty structure is 1m wide and 21m in length including the end head section.

Inkerman Street Jetty is accessible to the public and is primarily used for recreational activities such as launching small craft, access to vessels, fishing, and sightseeing.

Asset Condition

Table 7 below contains descriptions of the condition of the main structure elements. For detailed condition information, refer to the condition report in Appendix A.

Table 7: Inkerman Street Jetty

Main Structure Elements	Condition Grade	Comment
Steel handrails	2	Missing central railing
Timber decking	1	Very Good condition
Timber stairs	5	Complete loss of connection to supporting timber piles. Close jetty and repair.
Timber girders	2	Some timber distortion at connections
Piles	3 & 4	Main piles condition 3 due to sleeve cracking at the top of pile. 2 end of stair piles are condition 4 due to worm attack.

Main Structure Elements	Condition Grade	Comment
Adjacent sandstone wall and cause way	5	Stones supporting footpath are loose, and grout around stones is eroded throughout wall.

5.4 Seawalls

Figure 4: Sandstone Seawall - Harnett Park - RW38

Figure 5: Concrete Seawall - The Spit - RW79

Table 8 below describes the sea walls and their general condition.

Table 8: Sea Wall Inventory and Overall Condition Grade

ID	Location / Name	Overall condition grade	Total Wall length (m)	Concrete Seawall H>1m (m)	Concrete Seawall H<1m (m)	Sandstone Seawalls H>1m (m)	Sandstone Seawalls H<1m (m)	Concrete / Sandstone steps #	Stainless Steel Handrail #	Stainless Steel stair #	Handrails (m)	Signs #	Boat Stands #
RW41	Middle Harbour	5	15			15							
RW54	Pearl Bay	1	91.5			91.5		1					
RW79	The Spit	2	789.1	771.5		17.6		4		1	5		Platform
RW85	Ellery Park	2	109.7	48.8		60.9			1	1	20		
RW83	The Spit	1	75.8			75.8		1	2				
RW80	The Spit	3	28.3				28.3						
RW81	The Spit	4	24.9			24.9							
RW82	The Spit (East Side)	3	42.8			42.8							Ramp
RW7	Balmoral Park	2	71.8				71.8						
RW4	Hunter Park/Leahy Park	1	33.6				33.6	1					
RW5	Hunters Park	2	58		3.9		54.1	3					
RW6	Balmoral/ Hunters Park	3	625.8	625.8				12	2		600		
RW3	Balmoral Park	1	71.8	71.8				4	4				

ID	Location / Name	Overall condition grade	Total Wall length (m)	Concrete Seawall H>1m (m)	Concrete Seawall H<1m (m)	Sandstone Seawalls H>1m (m)	Sandstone Seawalls H<1m (m)	Concrete / Sandstone steps #	Stainless Steel Handrail #	Stainless Steel stair #	Handrails (m)	Signs #	Boat Stands #
RW2	Balmoral Park	2	22.4			22.4		1					
RW1	Balmoral Park	1	62		62								
RW28	Clifton Gardens Reserve	3	221.3			22	199.3	2			12	2	
W639	Musgrave Street	3	32.4			32.4							
W640	Musgrave Street	1	91.8	22.8		69					30		
W612	Mosman Street	2	12.8			12.8							
RW42	Mosman Bay	2	372.1			372.1							
RW38	Harnett Park	2	85.1			85.1		1	1				2
RW76	Sirius Cove Reserve	2	188.1	3.5		184.6		2					
RW55	Bay Street	1	119			119		2					2
EB1	Clem Morath Pool	4	44.6	44.6									

5.5 Asset Performance

Remaining life predictions are based on an engineering assessment of the asset condition and remaining functional capacity with continuing minor maintenance. For example the potential life of sandstone block walls can be assured by periodic regrouting between blocks and replacement of severely weathered blocks. Neglect of routine minor maintenance may reduce the expected life of a structure. Timber piles reach their end of life when half the section dimension is lost.

5.6 Asset Valuation

5.6.1 Valuation Inputs

The existence, extent and condition of the assets was confirmed by site inspections undertaken by Opus personnel. The recognition of asset ownership was provided by Mosman Council.

The residual value and asset lives, as used for each asset type, was calculated based on site observations including diving inspections.

The assets recognised are those advised by Mosman Council as owned by the Council. Such assets which fall outside the jurisdiction of the Council were not considered in this valuation.

The land parcels occupied by any of the assets covered in this report were not valued.

Replacement costs were based upon Council maintenance project contract cost experience, and verified by comparison to market rate benchmarks. Where contract rates were not available, market rates were established from market reference published rates and industry knowledge.

5.6.2 Valuation Outputs

This valuation report describes the source asset data, and the valuation methodology and assumptions used to derive key inputs to the calculation of values. These key inputs were applied to determine the current replacement value, the depreciated replacement value and the annual depreciation for these assets. The outputs from this process include;

- Inventory of asset components and type;
- Replacement Cost (RC) of a Modern Engineering Equivalent Replacement Asset
- (MEERA);
- Depreciated Replacement Cost (DRC); and
- Annual Depreciation (D).

5.7 Existing Data

The following summary table identifies assets quantities that were valued.

Table 9: Summary of asset quantities

Asset number & name	Asset Component	Unit of measurement used in valuation	Qty	Current Replacement Cost
BB1 - Balmoral Baths	Deck	m²	967	$193,300
	Piles	#	180	$1,260,000
	Girders	m	883	$264,800
	Headstocks	m	522	$156,600
	Handrails	m²	360	$126,000
	Sharknet	m	243	$121,500
	Attached signage	#	3	$900
	Steel turning board	#	2	$100,000
CG1/CG2 – Clifton Gardens Jetty/Baths	Deck	m²	725	$362,300
	Piles	#	145	$1,015,000
	Girders	m	585	$175,600
	Headstocks	m	360	$107,800
	Handrails	m²	317	$111,000
	Sharknet	m	209	$104,500
	Attached signage	#	5	$1,500

Marine Structures

Asset number & name	Asset Component	Unit of measurement used in valuation	Qty	Current Replacement Cost
IS1 – Inkerman Street Jetty	Deck	m²	21	$4,200
	Piles	#	6	$42,000
	Girders	m	43	$13,000
	Handrails	m²	22	$7,600
	Attached signage	#	1	$300
RW41 - Middle Harbour	Sandstone Seawalls	m	15	$37,500
RW54 - Pearl Bay	Sandstone Seawall	m	91.5	$228,750
	Concrete/Sandstone steps	#	91.5	$228,750
RW79 - The Spit	Concrete Seawalls	m	772	$1,543,000
	Sandstone Seawalls	m	18	$44,000
	Concrete/Sandstone steps		4	$20,000
	Stainless Steel steps	#	1	1 $10,000
	Handrails	m	5	$1,750
	Timber Platform	#	1	$30,000
RW85 - Ellery Park	Concrete Seawalls	m	49	$97,600
	Sandstone Seawalls	m	61	$152,250

Asset number & name	Asset Component	Unit of measurement used in valuation	Qty	Current Replacement Cost
	Stainless Steel step Handrails	#	1	$4,000
	Stainless Steel steps	#	1	$10,000
	Handrails	m	20	$7,000
RW83 - The Spit	Sandstone Seawalls	m	76	$189,500
	Concrete/Sandstone steps	#	1	$5,000
	Stainless Steel Handrail	#	2	$8,000
RW80 - The Spit	Sandstone Seawalls	m	28	28 $28,300
RW81 - The Spit	Sandstone Seawalls	m	25	$62,250
RW82 - The Spit (East Side)	Sandstone Seawalls	m	43	$107,000
RW7 - Balmoral Park	Sandstone Seawalls	m	72	$71,800
RW4 - Hunter Park / Leahy Park	Sandstone Seawalls Concrete/Sandstone steps	m #	34 1	$33,600 $5,000
RW5 - Hunters Park	Concrete Seawalls Sandstone Seawalls Concrete/Sandstone steps	m m #	3.9 54.1 3	$3,900 $54,100 $15,000

Marine Structures

Asset number & name	Asset Component	Unit of measurement used in valuation	Qty	Current Replacement Cost
RW6 - Balmoral Park / Hunters Park	Concrete Seawall	m	625.8	$1,251,600
	Concrete/Sandstone Steps	#	12	$60,000
	Stainless Steel Handrail	#	2	$8,000
	Handrails	m	600	$210,000
RW3 - Balmoral Park	Concrete Seawall	m	71.8	$143,600
	Concrete/Sandstone Steps	#	4	$20,000
	Stainless Steel Handrail	#	4	$16,000
RW2 - Balmoral Park	Sandstone Seawalls	m	22.4	$56,000
	Concrete/Sandstone steps	#	1	$5,000
RW1 - Balmoral Park	Concrete Seawalls	m	62	$62,000
RW28 - Clifton Gardens Reserve	Sandstone Seawalls > 1m height	m	22	$55,000
	Sandstone Seawalls < 1m height	m	199.3	$199,300
	Concrete/Sandstone Steps	#	2	$10,000
	Handrails	m	12	$4,200
	Signs	#	2	$600

Asset number & name	Asset Component	Unit of measurement used in valuation	Qty	Current Replacement Cost
RW639 - Musgrave Street	Sandstone Seawalls	m	32.4	$81,000
RW640 - Musgrave Street	Concrete Seawall	m	22.8	$45,600
	Sandstone Seawalls	m	69	$172,500
	Handrails	m	30	$10,500
RW612 - Mosman Street	Sandstone Seawalls	m	12.8	$32,000
RW42 - Mosman Bay	Sandstone Seawalls	m	372.1	$930,250
RW38 - Harnett Park	Sandstone Seawalls	m	85.1	$212,750
	Concrete/Sandstone Steps	#	1	$5,000
	Stainless Steel Handrail	#	1	$4,000
	Boat Stands	#	2	$30,000
RW76 - Sirius Cove Reserve	Concrete Ramp	m	3.5	$7,000
	Sandstone Seawalls	m	184.6	$461,500
	Concrete/Sandstone steps	#	2	$10,000
EB1 - Clem Morath Pool	Concrete seawall	m	44.6	$89,200

Marine Structures

Asset number & name	Asset Component	Unit of measurement used in valuation	Qty	Current Replacement Cost
RW55 - Bay Street Seawall	Sandstone Seawalls	m	119	$297,500
	Concrete/Sandstone Steps	#	2	$10,000
	Boat Stands	#	2	$30,000

5.8 Methodology and Assumptions

5.8.1 Valuation Process

Each asset component identified has been valued at the current value of providing its modern engineering equivalent replacement asset, and depreciated replacement value apportioned from its assessed condition and predicted operational life. Opus undertook this valuation using the Rawlinsons Australian Construction Handbook, contract rates for previous maintenance works provided by Mosman Council, and market contract rates from other sources.

5.8.2 Replacement Cost

Current Replacement Costs (RC) for Mosman marine assets were valued as at 10 June 2011, in accordance with accepted Australian accounting practices. Replacement Cost was derived based on identifying a modern engineering technology that was able to perform the same level of service at the time of this valuation. Replacement Cost for an asset was derived by multiplying the asset quantity by the current unit cost rates.

The residual value for these structures have been assessed as nil value.
Unit rate costs for various brown-field construction works to provide asset components were estimated using Rawlinsons Estimation Handbook Edition 28 (2010). These rates were then compared with the contract rates provided by the Council. Rates were determined using both inputs to reflect prevailing market rates.

An overhead factor was applied to all replacement cost unit rates that were estimated using other than Council's contract rates to provide for supervision, design and site establishment fee components of replacing service provision.

5.8.3 Data Quality Rating

Data quality ratings are applied to asset value analysis in order to raise awareness of inadequate data or uncertain cost rates. This rating system is based on the Engineers

Australia infrastructure report cards which are used to evaluate the status of assets and planning processes (Refer to Section 5.1 of in the IIMM).

The data quality ratings used in this valuation is summarised below in Table 10.

Table 10: Confidence rating accuracy definitions

Grade	Label	Description
A	Accurate	Data based on sound records, procedures, investigation, and analysis which is properly document and recognised as the best method of assessment
B	Some inaccuracies	Data based on sound records, procedures investigation and analysis which is properly document but has minor short comings; for example the data is old, some documentation is missing and reliance is placed on unconfirmed reports or some extrapolation
C	Significant data estimated	Data based on local knowledge provided by experienced professional Council staff. Data based on sound records, procedures, investigation, and analysis which is incomplete or unsupported, or extrapolation from a representative sample for which grade A or B data is available
D	All data estimated	Data based on best estimates of experienced person Data based on unconfirmed verbal reports and/or cursory inspection and analysis
NA	Not Assessed	Opus did not undertake a valuation for this asset group

5.8.5 Impact of Data Quality Rating

Data quality has an impact on the accuracy of the overall valuations for each asset class.

The impacts have been classified as:

No impact
Minimal impact <5%
Low impact 5% to 10%

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Moderate impact – 10% to 15%
Significant impact >15%

Table 11 below illustrates our judgement of the overall data quality rating used in this valuation and includes an assessment of the impact of the data used.

Table 11: Data Quality summary including impact of the rating given

Asset	Quantity	Unit Cost	CRC	Life	R/Life	DRC	Impact
Jetty Structures	A	B	B	C	C	C	Low impact
Deck	A	B	B	C	C	C	
Piles	A	B	B	C	C	C	
Girders	B	B	B	C	C	C	
Headstocks	B	B	B	C	C	C	
Handrails	A	B	B	C	C	C	
Sharknet	A	C	C	C	C	C	
Attached signage	A	C	C	C	C	C	
Steel turning board	A	C	C	C	C	C	
Seawal Structures	A	C	C	C	C	C	Low impact
Concrete Seawalls	A	C	C	C	C	C	
Concrete Seawalls < 1m height	A	C	C	C	C	C	
Sandstone Seawalls > 1m height	A	C	C	C	C	C	
Sandstone Seawalls < 1m height	A	C	C	C	C	C	
Concrete/Sandstone steps	A	C	C	C	C	C	
Stainless Steel steps	A	C	C	C	C	C	
Stainless Steel handrails	A	C	C	C	C	C	

Asset	Quantity	Unit Cost	CRC	Life	R/Life	DRC	Impact
Handrails	A	C	C	C	C	C	
Timber Platform	A	C	C	C	C	C	
Boat Stands	A	C	C	C	C	C	

Table 11 Legend:

Abbreviation Term contracted
CRC Current Replacement Cost
Life Economic or Useful Life of Asset
R/Life Remaining Life of Asset
DRC Depreciated Replacement Cost

5.9 Marine Structures Asset Valuation

5.9.1 Asset Valuation Basis

For seawall asset components, we have utilised valuations based on per lineal metre of wall.

All unit rates used are in Australian Dollars.

5.9.2 Marine Structures

No documented records of the past life performance of Mosman marine structure components was available. Table 12 outlines the assumptions made on the economic life for each structure/component for the valuation of marine structure assets owned by Council.

Table 12: Economic Life

Asset	Economic Life
Jetty Deck – Timber	40
Jetty Deck – Concrete	60
Timber Piles	15
Timber Girders	60
Timber Headstocks	60

Marine Structures

Asset	Economic Life
Timber Handrails	40
Shark net	10
Attached signage	15
Steel turning board	18
HDPE sleeved steel piles	60
Concrete Seawalls > 1m height	50
Concrete Seawalls < 1m height	50
Sandstone Seawalls > 1m height	50
Sandstone Seawalls < 1m height	50
Concrete/Sandstone steps	50
Stainless Steel steps	40
Stainless Steel handrails	40
Timber Platform (periodically immersed)	35
Boat Stands	35

5.10 Marine Assets Valuation

Table 13: Mosman Council Valuation summary for Marine Assets

Asset Type	Current Replacement Cost ($)	Depreciated Replacement Cost ($)
BB1 - Balmoral Baths	$2,223,164	$1,482,828
CG1/CG2 - Clifton Gardens Jetty/Baths	$1,877,640	$1,066,916
IS1 - Inkerman Street Jetty	$67,000	$57,523
RW41 - Middle Harbour	$37,500	$1,500
RW54 - Pearl Bay	$233,750	$229,075

Asset Type	Current Replacement Cost ($)	Depreciated Replacement Cost ($)
RW79 - The Spit	$1,648,750	$665,745
RW85 - Ellery Park	$270,850	$48,453
RW83 - The Spit	$202,500	$192,800
RW80 - The Spit	$28,300	$5,094
RW81 - The Spit	$62,250	$2,490
RW82 - The Spit (East Side)	$137,000	$111,120
RW7 - Balmoral Park	$71,800	$12,924
RW4 - Hunter Park / Leahy Park	$38,600	$14,668
RW5 - Hunters Park	$73,000	$20,440
RW6 - Balmoral Park / Hunters Park	$1,529,600	$275,328
RW3 - Balmoral Park	$179,600	$62,808
RW2 - Balmoral Park	$61,000	$41,480
RW1 - Balmoral Park	$62,000	$42,160
RW28 - Clifton Gardens Reserve	$269,100	$47,098
RW639 - Musgrave Street	$81,000	$14,580
RW640 - Musgrave Street	$228,600	$76,716
RW612 - Mosman Street	$32,000	$5,760
RW42 - Mosman Bay	$930,250	$167,445
RW38 - Harnett Park	$251,750	$10,070
RW76 - Sirius Cove Reserve	$478,500	$131,580
RW55 - Bay Street	$337,500	$305,800
EB1 - Clem Morath Pool	$89,200	$3,568
Total for Marine Assets:	**$11,502,204.00**	**$5,095,969.00**

Marine Structures

5.11 Routine Maintenance Plan

Routine maintenance actions are required to ensure the structures are in a safe condition and include the following items:

Baths and Jetties

- Visual inspection of timber piles and nets every 3 years (diver inspection)
- Visual inspection of timber headstocks and girders every 3 years
- Borer inspections every 5 years
- Patch works to concrete jetty deck
- Tightening of decking screws
- Repainting of handrails
- Repainting of non-slip sections of decks
- Clean off marine growth on swimming turn boards and ladders
- Replacing light bulbs to jetty lights
- Repair large holes to shark nets

Sea Walls

- Regrout between sandstone blocks of sandstone sea walls
- Grout up cracks in concrete seawalls to prevent water ingress
- Repainting of handrails
- Vegetation growth in sea walls to be removed
- Exposed reinforcement to be repaired
- Blocked drainage holes to be flushed
- Weathering of concrete rendering to be repaired

5.12 Renewal/Replacement Plan

Below is a list of replacement items included in the maintenance plan.

Baths and Jetties

- Replacement of corroded steel connectors (Bolts, screws and splice plates etc)
- Replacement of piles with a section loss 50% or greater
- Replacement of piles, stair spine ends and lower treads to timber stairs on the Inkerman
- Street Jetty (severely deteriorated)
- Replace signage when out dated

Sea Walls

- Replacement of collapsed sections of seawalls:
- 5m section of collapsed seawall to be replaced at Middle Harbour Seawall – RW41
- 4m section of collapsed seawall to be replaced at Clem Morath Pool – EB1
- Replace signage when out dated
- Replacement of sandstone blocks with greater than 30% loss of section

5.13 Maintenance Plan

Table 14 below provides a detailed description of the maintenance actions required for the Mosman marine assets. The currently required maintenance and the future predicted maintenance and renewals for each asset are scheduled.

Marine Structures

Table 14: Balmoral Baths and Jetty Maintenance Plan

BB1 – Balmoral Baths and Jetty Maintenance Plan					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
Recommended Repairs to Timber Piles					
1	Pile 7B, Bottom of concrete casing exposed	Inspect every 3 years	Year 3, 6, 9, 12	200	800
2	Pile 8A, Bottom of concrete casing exposed	Inspect every 3 years	Year 3, 6, 9, 12	200	800
3	Pile 8B, Bottom of concrete casing exposed	Inspect every 3 years	Year 3, 6, 9, 12	200	800
4	Pile 24B, Cavity at tidal zone of pile, 50% of section remains. Cavity at seabed, 40% remains.	Prop adjacent decking and replace pile	Year 1	9,000	9,000
5	Pile 32AR, Worm damage seabed 30% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
6	34AR, Worm damage seabed 60% remaining	Inspect every 3 years	Year 3, 6	200	400
		Prop adjacent decking and replace pile	Year 7	9,000	9,000
7	34B, Cavity at tidal zone of pile, 55% remaining, worm damage at seabed 40% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000

BB1 – Balmoral Baths and Jetty Maintenance Plan					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
Recommended Repairs to Timber Piles					
8	Pile 37A, Worm damage seabed 70% remaining	Inspect every 3 years	Year 3, 6	200	400
		Prop adjacent decking and replace pile	Year 7	9,000	9,000
9	Pile 38A, Worm damage seabed 50% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
10	Pile 38AR, Worm damage seabed 30% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
11	Pile 39A, Worm damage seabed 60% remaining	Inspect every 3 years	Year 3, 6	200	400
		Prop adjacent decking and replace pile	Year 7	9,000	9,000
12	Pile 43A, Cavity at tidal zone of pile, 65% remaining	Inspect every 3 years	Year 3, 6	200	400
		Prop adjacent decking and replace pile	Year 7	9,000	9,000
13	Pile 45F, Cavities 2m above seabed, 66% pile remaining	Inspect every 3 years	Year 3, 6	200	400

Marine Structures

BB1 – Balmoral Baths and Jetty Maintenance Plan					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
Recommended Repairs to Timber Piles					
		Prop adjacent decking and replace pile	Year 7	9,000	9,000
14	Pile 47G, Cavity at tidal zone of pile, 65% remaining	Inspect every 3 years	Year 3, 6	200	400
		Prop adjacent decking and replace pile	Year 7	9,000	9,000
15	51A, Worm damage seabed 50% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
16	Pile 54A, Bottom of concrete encasing exposed, worm damage	Inspect every 3 years	Year 3, 6, 9, 12	200	800
17	Pile 54B, Bottom of concrete encasing exposed, worm damage	Inspect every 3 years	Year 3, 6, 9, 12	200	800
18	Pile 55B, Bottom of concrete encasing exposed, worm damage	Inspect every 3 years	Year 3, 6, 9, 12	200	800
19	Pile 58A, Head of pile split	Strap head of pile to prevent expansion of pile splitting.	Year 1	500	500

BB1 – Balmoral Baths and Jetty Maintenance Plan					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
Recommended Repairs to Timber Piles					
20	Pile 59A, Head of pile split	Strap head of pile to prevent splitting of pile expanding.	Year 1	500	500
21	Pile 68J, Cavity at tidal zone of pile, 30% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
	Timber Piles Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Year 7 Year 1 Years 3 & 6 Years 9 & 12	63,000 54,000 1,000 2,400 1,200	63,000 54,000 1,000 4,800 2,400

Marine Structures

Timber Girders and Headstocks					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
1	Headstocks at pier 29 has severely weathered ends	Remove decking and replace headstocks	Year 1	2,000	2,000
2	All headstock and girder members have 5-20% weathering, especially at the ends of the sections	Inspect every 3 years	Year 3, 6, 9, 12	2,000	2,000
3	There is extensive marine growth on the lower members of the north eastern berthing platform	Clean growth to inspect condition of members	Year 1, 6, 11	1,500	4,500
	Timber Girders & Headstocks Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Years 1 & 11 Years 3, 9 & 12 Year 6	2,000 1,500 2,000 3,500	2,000 3,000 6,000 3,500

Steel Connections					
1	Advanced corrosion of miscellaneous structural bolts throughout structure (5%). Confirm locations by inspection	Replace / Supplement	Year 1	7,000	7,000
2	Moderate corrosion of miscellaneous structural bolts throughout structure (15%). Confirm locations by inspection	Replace / Supplement	Year 3	21,000	21,000
3	Moderate corrosion of miscellaneous steel girder splice plate. Confirm locations by inspection. (i.e. Pile 44B)	Replace plate	Year 1	1,750	1,750
4	Moderate corrosion of miscellaneous diagonal bracing plate/bolt connections. Confirm locations by inspection. (i.e. 44B)	Clean and paint, or replace	Year 1	2,600	2,600
	Steel Connections Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Year 3 Year 1	8,750 21,000 2,600	8,750 21,000 2,600

Marine Structures

Timber Decking					
1	Remove corroded steel and loose timber formwork under concrete deck	Tighten coach bolts or relocating bolts to gain better connection	Year 1, 4, 7, 10	1,000	4,000
2	Weathering to non slip surface of lower deck of berthing jetty	Monitor and repaint as condition reduces further	Year 4	5,000	5,000
3	Nonslip decking surfacing to jetty landing area	Resurface landing area	Year 8	4,000	4,000
4	Anticipated weathering of low level landing jetty decking	Replace decking	Year 8	7,000	7,000
	Timber Decking Summary	**Renewal Estimate** **Maintenance Estimate**	Year 8 Years 1, 7 & 10 Year 4 Year 8	7,000 1,000 6,000 4,000	7,000 3,000 6,000 4,000

Ladders					
1	Marine growth build-up within tidal zone, on all 8 ladders.	Clean all ladders annually	Year 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	700	8,400
	Ladders Summary	**Maintenance Estimate**	Every Year	700	8,400

Timber Handrails					
1	Advanced corrosion of handrail post bolts connecting to timber girders throughout structure.	Replace bolts	Year 1	5,000	5,000
2	Moderate corrosion of handrail post bolted connections throughout structure.	Monitor and replace bolts	Year 3	7,500	7,500
3	Monitor condition of steel connections	Inspect handrail connections	Year 3, 8	5	1,000
4	Handrail paint in good condition	Monitor paint condition and paint when required.	Year 5, 10	15,500	31,000
	Timber Handrails Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Year 3 Years 3 & 8 Years 5 & 10	5,000 7,500 500 15,500	5,000 7,500 1,000 31,000

Marine Structures

Miscellaneous					
1	Signage in good condition	Replace when out dated	Year 8	2,000	2,000
2	Wire fence at southern end of jetty is unstable due to corroded base connections	Remove fence or repair base steel posts	Year 1	1,500	1,500
3	Miscellaneous timber components	Borer inspection	Year 1, 6, 11	1,500	4,500
4	Marine growth on tidal zone of swimming turn boards	Clean off marine growth annually	Year 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12	700	8,400
5	Minor corrosion on swimming turn boards	Clean and paint corrosion and maintain turn boards	Year 3, 8, 11	3,000	9,000
6	Broken steel wire on swimming turn boards	Repair wire on lifting mechanism. Clean and paint corrosion and maintain turn boards	Year 1	600	600
7	Shark net - Large hole at pile row 32 rubbing on raker pile	Patch shark net with a net section of net stitched into the existing net	Year 1, 6, 12	3,500	10,500
8	Shark net - Large hole at pile row 36 rubbing on raker pile	Patch shark net with a net section of net stitched into the existing net	Year 1, 6, 12	3,500	10,500

Miscellaneous					
9	Shark net - Large hole at pile row 38 rubbing on raker pile	Patch shark net with a net section of net stitched into the existing net	Year 1, 6, 12	3,500	10,500
10	Shark net - Small hole at pile row 48 rubbing on raker pile	Patch shark net with a net section of net stitched into the existing net	Year 1, 6, 12	3,000	9,000
11	Vertical timber bumper rails bolted to the fender piles on the eastern landing jetty have extensively weathered at the tidal zone	Replace vertical timber bumper rails bolted to the 7 fender pile, on the eastern landing jetty	Year 1	2,200	2,200
12	Broken light bulb and casing on landing jetty	Repair light on landing jetty	Year 1	200	200
	Miscellaneous Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Year 8 Year 1 Yrs 2,4,5,7,9,10 Years 3, 8 & 11 Years 6 & 12	2,200 2,000 17,300 700 3,700 14,200	2,200 2,000 17,300 4,200 11,100 28,400

Table 15 – Clifton Gardens Baths and Jetty Maintenance Plan

CG1 - Clifton Gardens Maintenance Plan					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
Recommended Repairs to Timber Piles					
1	Pile 4E, Hole at tidal zone of pile, 30% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
2	Pile14D, Cavity at tidal zone of pile, 60% remaining	Inspect every 3 years	Year 3, 6, 9, 12	200	800
3	Pile 15E, Cavity at tidal zone of pile, 25% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
4	Pile 17DR, Cavity at tidal zone of pile, 20% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
5	Pile 23D, Steel sleeve at seabed, appears to have no grout.	Inspect every 3 years	Year 3, 6, 9, 12	200	800
6	Pile25C, Cavity at tidal zone of pile, 70% remaining	Inspect every 3 years	Year 3, 6, 9, 12	200	800
7	Pile 21KR, Hole at tidal zone of pile, 30% remaining, Cavity 1m above seabed 70% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
8	Pile 19P, Hole at tidal zone of pile, 40% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000

CG1 - Clifton Gardens Maintenance Plan					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
Recommended Repairs to Timber Piles					
9	Pile21R, Cavity at tidal zone of pile, 70% remaining	Inspect every 3 years	Year 3, 6, 9, 12	200	800
10	Pile 19T, Hole at tidal zone of pile, 50% remaining	Prop adjacent decking and replace pile	Year 1	9,000	9,000
11	Pile17T, Heavy worm damage and necking, 66% remaining	Inspect every 3 years	Year 3, 6, 9, 12	200	800
	Timber Piles Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Years 3, 6, 9 & 12	54,000 1,000	54,000 4,000

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Timber Girders and Headstocks					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
1	All headstock and girder members have 5-20% weathering, especially at the ends of the sections.	Inspect every 3 years	Year 3, 6, 9, 12	2,000	8,000
2	There is extensive marine growth on the lower members of the north eastern berthing platform.	Clean growth to inspect condition of members	Year 1,6,11	1,500	4,500
	Timber Girders and Headstocks Summary	**Maintenance Estimate**	Years 1 & 11 Year 6 Years 3, 9 & 12	1,500 3,500 2,000	3,000 3,500 6,000

Steel Connections					
1	Advanced corrosion of miscellaneous structural bolts throughout structure (5%). Confirm locations by inspection	Replace / Supplement	Year 1	7,000	7,000
2	Moderate corrosion of miscellaneous structural bolts throughout structure (15%). Confirm locations by inspection	Replace / Supplement	Year 3	21,000	21,000
3	Moderate corrosion of miscellaneous steel girder splice plate. Confirm locations by inspection. (i.e. pile 17S)	Replace plate	Year 1	1,750	1,750
	Steel Connections Summary	**Renewal Estimate**	Year 1 Year 3	8,750 21,000	8,750 21,000

Decking					
1	Loose and corroded steel and timber formwork under concrete deck.	Remove corroded steel and loose timber formwork under concrete deck	Year 1	3,000	3,000
2	Miscellaneous concrete repair to concrete deck (i.e. between piles 18D and 20D)	Repair spalled sections of concrete deck	Year 2	2000	2000
3	Nonslip decking surfacing to jetty landing area	Resurface landing area	Year 8	4000	4000
4	Anticipated weathering of low level landing jetty decking	Replace decking	Year 8	6,000	6,000
	Decking Summary	**Renewal Estimate** **Maintenance Estimate**	Year 8 Year 1 Year 2 Year 8	6,000 3,000 2,000 4,000	6,000 3,000 2,000 4,000

Ladders					
1	Marine growth build-up within tidal zone, on all 3 ladders.	Clean all ladders annually	Year 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12	700	8,400
2	Sheared bolt at top fixing to western Stainless steel ladder	Replace bolt and nut	Year 1	200	200
	Ladders Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Years 1 to 12	200 700	200 8,400

Marine Structures

Timber Handrails					
1	Monitor condition of steel connections	Inspect handrail connections	Year 3, 8	500	1,000
2	Handrails paint in good condition	Monitor paint condition and paint when required.	Year 5, 10	15,500	31,000
	Timber Handrails Summary	**Maintenance Estimate**	Years 3 & 8 Years 5 & 10	500 15,500	1,000 31,000

Miscellaneous					
1	Signage in good condition	Replace when out dated	Year 8	2,000	2,000
2	NA	Borer inspection	Year 1, 6, 11	1,500	4,500
3	Leaking water pipe under timber landing jetty	Repair leaking pipe	Year 1	1,000	1,000
4	General maintenance of beach showers, taps and plumbing on jetty	Maintain plumbing and on jetty.	Year 8	1,000	1,000
	Miscellaneous Summary	**Renewal Estimate** **Maintenance Estimate**	Year 8 Year 1 Year 6 & 11	2,000 1,500 1,500	2,000 1,500 3,000

Shark Net – Piles numbered east to west					
1	PP3, pin pile snapped off 2m above seabed. Pile fail	Disconnect shark net and replace pile. Reconnect shark net.	Year 1	9,000	9,000
2	PP4, Worm damage to tidal zone of pin pile. 60% remaining	Inspect every 3 years	Year 3, 6, 9, 12	200	800
3	PP5R, worm damage and 50mm of raker pile remaining.	Replace raker pile	Year 1	9,000	9,000
4	PP6, pin pile snapped off 2m above seabed. Pile fail	Disconnect shark net and replace pile. Reconnect shark net	Year 1	9,000	9,000
5	PP8, Worm damage to tidal zone of pile. 50% remaining	Disconnect shark net and replace pile. Reconnect shark net.	Year 1	9,000	9,000
6	The stainless steel wire supporting the net across the pin pile area is not connected or tensioned	Reconnect and tension stainless steel wire supporting shark net	Year 1	3,000	3,000
7	Large holes in shark net at the following pile row locations: 4, 13, 19K, 19L, 19M, 19R, 16T, PP1, PP3	Patch shark net with a section of net stitched into the existing net	Year 1	15,000	15,000
	Shark Net & Net Piles Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Year 1 Yrs 3, 6, 9, &12	36,000 18,000 200	36,000 18,000 800

Table 16 - Inkerman Street Jetty Maintenance Plan

IS1 – Inkerman Street Jetty Maintenance Plan					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
Recommended Repairs to Timber Piles					
1	Pile 1, 2, 3 & 4 have cracked concrete encasement at the tops of the piles.	Remove loose concrete, and regrout	Year 1 & 7\	4,000	8,000
2	Pile 5 & 6 have worm damage	Inspect every 3 years	Year 3, 6, 9, 12	700	2,800
3	Anticipated worm damage to piles 5 & 6, requiring replacement	Replace pile	Year 6	18,000	18,000
	Timber Piles Summary	**Renewal Estimate** **Maintenance Estimate**	Year 6 Years 1 & 7 Yrs 3, 6, 9, &12	18,000 4,000 700	18,000 8,000 2,800

Stairs					
1	The stairs have disconnected from the supporting piles (5 & 6)	Close the stair immediately	Urgently	200	200
2	Stair stringers have completely weathered away at the tidal zone.	Replace stringers with more durable material. (Aluminium).	Year 1	4,000	4,000
3	Timber decking on stairs have weathered in the tidal zone and requires replacement	Replace timber deck on stairs	Year 1, 7	1,500	3,000
4	Nonslip decking surfacing to stairs	Paint steps	Year 1, 7	1,000	2,000
5	Handrail of stairs is currently supporting the stairs.	Reinstate new handrail when stairs are replaced. Do not attached new stair handrail to top of jetty, therefore the handrail can't support the stairs.	Year 1	1,500	1,500
	Stairs Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Year 7 Year 1 Year 7	7,000 1,500 1,200 1,000	7,000 1,500 1,200 1,000

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Timber Decking					
1	Anticipated loose coach screws	Tighten screws	Maintenance years 5, 10	400	800

Handrails					
1	Monitor condition of steel connections	Inspect handrail connections	Year 3, 8	200	400
2	Handrails paint in good condition	Monitor paint condition and paint when required.	Year 5, 10	500	1,000
3	Central handrail bars missing	Replace missing central rails in handrails and weld in place to prevent removal.	Year 1	1,000	1,000
	Handrails Summary	**Renewal Estimate** **Maintenance Estimate**	Year 1 Years 3 & 8 Years 5 & 10	1,000 200 500	1,000 400 1,000

Associated Seawalls and jetty approach					
1	Loss of grout and sandstones in seawalls	Reinstate sandstones and regrout wall. Then add rock riprap as specified in 'Brown drawing X04492-S02 2005'	Maintenance year 1	25,000	25,000

Miscellaneous					
1	Signage in god condition	Replace when out dated	Renewal year 8	500	500
2	NA	Borer inspection	Maintenance year 1, 6, 11	1,500	4,500

Advice on the selection of timbers for the marine environment of Sydney Harbour is provided at Appendix C Inspection and Condition Assessment Procedures.

Renewal and Maintenance Plans in annual format are provided at Appendix D.

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Table 17 - Maintenance Plan for Mosman Sea Walls

Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
RW41 – Middle Harbour					
1	Collapsed seawall, and concrete platform	Rebuild collapsed section of seawall and concrete platform	Year 1	3,000	3,000
2	Missing rail on park bench.	Replace rail on park bench	Year 1	200	200
3	Grout missing from sandstone wall	Regrout sandstone wall	Year 1	1,000	1,000
RW54 – Pearl Bay					
1	Anticipated loss of grout missing from sandstone wal	Regrout sandstone wall	Year 5	4,000	4,000
RW79 – The Spit					
1	Some cracking in concrete seawall at various locations (refer to attached condition report)	Repair cracking to prevent water ingress and deformation/ slumping of wall	Year 2	15,000	15,000
2	Anticipated loss of grout missing from southern sandstone seawall section	Regrout sandstone wall	Year 5	1,000	1,000

Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
3	Anticipated degrading of timber members and loose connections of timber platform.	Replace degraded members and tighten/replace loose/corroded connections	year 7	1,500	1,500
4	Anticipated weathered timber platform	Paint/stain timber	Year 8	1,500	1,500
5	Potentially blocked drainage holes	Flush drainage holes in concrete seawall	Year 5, 10	4,000	8,000
RW85 – Ellery Park					
1	Broken wire to SS handrail	Repair/replace ss handrail wire	Year 1	600	600
2	Loose 2nd from the base, timber step.	Reconnect step	Year 1	400	400
3	Minor loss to grout in sandstone section of seawall.	Regrout sandstone wall	Year 4	2,000	2,000
RW83 – The Spit					
RW80 – The Spit					
1	Loss of grout in sandstone block seawall	Regrout sandstone wall	Year 1	1,000	1,000
RW/1 – The Spit					

Marine Structures

Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
1	Loss of grout and sandstone blocks in sandstone seawall	Regrout and rebuild some sections of wall missing sandstone blocks	Year 1	10,000	10,000
RW82 – The Spit (East Side)					
1	Loss of grout to southern section of sandstone seawall	Regrout sandstone wall	Year 1	1,500	1,500
2	Minor loss to grout in to northern section of sandstone seawall.	Regrout sandstone wall	Year 5	1,500	1,500
3	Anticipated degrading of timber boat ramp.	Replace weathered timber and monitor steel structure	Year 7	1,500	1,500
RW7 – Balmoral Park					
1	Loss of grout and weathered sandstone blocks in sandstone seawall	Regrout and replace the weathered sandstone blocks when weathering is greater than 50%	Year 3	5,000	5,000
2	Signage in good condition	Replace when illegible/deteriorated	Year 8	500	500

Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
RW4 – Hunter Park / Leahy Park					
RW5 – Hunters Park					
1	Loss of grout in sandstone block seawall	Regrout sandstone wall	Year 5	2,000	2,000
RW6 - Balmoral Park / Hunters Park					
1	Poor aesthetic appearance of wall	Apply mineral stain to entire wall	Year 3	68,000	68,000
2	Loss of sections of rendering and cracking of rendering at various location and build up of dirt throughout length of wall (refer to conditions report)	Patch rendering at various locations, and high pressure wash ensuring to unblock drainage holes in wall.	Year 3, 6, 9, 12	11,000	44,000
3	Within northern section at chainage 152.8 - 162.2m the seawall has tilted.	The void between the wall and foot path above should be filled and sealed to prevent water ingress.	Year 1	700	700

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Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
4	Within northern section at chainage 152.8 - 162.2m the seawall has tilted.	The wall should be monitored to see if the void between the path and wall reappears after filling showing further wall movement	Year 2, 4, 6, 8, 10, 12	200	1,200
5	Spalled concrete and corroded reinforcement in southern section of wall, at chainage 38.5m	Remove loose concrete, clean reinforcement, paint reinforcement to stop corrosion and patch.	Year 1	year 1	500
6	Corroded base of steel handrail on steps in southern section at chainage 170.5m	Replace with ss handrail	Year 3	4,000	4,000
7	Spalled concrete and corroded reinforcement at southern section at the stormwater outlet (energy dissipater wall), at chainage 393.8m	Remove loose concrete, clean reinforcement, paint reinforcement to stop corrosion and patch.	Year 1	1,500	1,500

Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
8	Vertical crack in concrete handrail of stairs in the southern section of wall at chainage 438.3m.	Fill crack with grout	Year 1	400	400
9	N/A	Maintenance of beach showers and water taps	Year 5, 10	2,000	4,000
RW3 – Balmoral Park					
RW2 – Balmoral Park					
1	Minor loss to grout between sandstone blocks	Regrout between sandstone blocks	Year 8	1,500	1,500
RW1 – Balmoral Park					
RW28 – Clifton Gardens Reserve					
1	Some vegetation growth in wall at southern end of wall	Remove vegetation	Year 1, 5, 10	200	600
2	Spalled concrete and exposed reinforcement to steps at chainage 50m and 132.8m	Clean and paint exposed reinforcement. Patch steps extensively.	Year 1	3000	3000
3	Loss of grout between sandstone block of seawall, common throughout wall	Regrout between sandstone blocks	Year 8	4,500	4,500

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Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
4	Weathered sandstone blocks, throughout wall.	Replace >30% weathered sandstone blocks, especially, the top layer of blocks	Year 2	20,000	20,000
5	Handrails paint in good condition. Southern end of wall.	Monitor paint condition and paint when required.	Year 5, 10	500	1,000
W639 – Musgrave Street					
1	Loss of grout between sandstone block of seawall, common throughout wall	Regrout between sandstone blocks	Year 2	3,000	3,000
2	Weathered sandstone blocks, throughout wall	Replace >30% weathered sandstone blocks, especially, the top layer of blocks	Year 2	6,000	6,000
W640 – Musgrave Street					
1	Extensive weathering to concrete southern section of wall, however stability is OK	Inspect to monitor stability	Year 3, 6, 9, 12	200	800

Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
2	Timber handrail paint in fair condition. Handrail runs from chainage 21.5m to 49.7m.	Monitor paint condition and paint when required.	Year 3, 8	500	1,000
3	Loss of grout between sandstone block of seawall between chainage 56.4 to 69m.	Regrout between sandstone blocks	Year 2	3,000	3,000
W612 – Mosman Street					
1	Minor loss of grout between sandstone blocks at tidal zone of seawall	Regrout between sandstone blocks	Year 2	2,000	2,000
RW42 – Mosman Bay					
1	Loss of grout between sandstone blocks at tidal zone of seawall, throughout 372.1m length of wall	Regrout between sandstone blocks	Year 2	60,000	60,000
2	Loss of grout between sandstone block of tidal zone of seawall between chainage 0 to 51m.	Regrout between sandstone blocks	Year 4	2,000	2,000
3	Some minor cracking and loss of paint to timber dinghy stand	Repaint and replace various timber members as required.	Year 4	3,000	3,000

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Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
RW76 – Sirius Cove Reserve					
1	Loss of sandstone blocks to corner section of wall above 800mm diameter storm water pipe at the western end of wall.	Replace blocks forming a stepped/curved corner edge to prevent impact	Year 1	2,000	2,000
2	Vegetation growth in wall at chainage 11.7m and various locations throughout wall	Remove vegetation	Year 1	400	400
3	Loss of grout in sandstone block seawall at tidal zone throughout length of wall	Regrout between sandstone blocks	Year 4	15,000	15,000
4	Cracked and spalled concrete steps at chainage 151.3m.	Patch and seal with a non corrosive fibre reinforced concrete to confine existing steps	Year 1	5,000	5,000
RW55 – Bay Street					
1	Some loss of sandstone blocks to southern section of seawall	Add riprap to front face of wall	Year 2	5,000	5,000

Maintenance Plan for Mosman Sea Walls					
Item #	Inspection Results	Recommended Action	Recommended Time for Action	Indicative Cost Estimate $ Per item (excl. GST)	Indicative Total Cost Estimate $ (excl. GST)
	All Seawalls Summary	**Renewal Estimate**	Year 2 Year 3	32,000 4,000	32,000 4,000
		Maintenance Estimate	Year 1 Year 2 Year 3 Year 4 Year 5 Year6 Year7 Year 8 Year 9 Year 10 Year 12	37,900 88,200 84,700 22,200 18,200 11,400 3,000 8,700 11,200 9,900 11,400	37,900 88,200 84,700 22,200 18,200 11,400 3,000 8,700 11,200 9,900 11,400
EB1 – Clem Morath Pool					
1	Broken section of seawall between chainage 12.5 - 16.5m.	Move loose blocks forward to act as riprap and place onto the bedrock large sandstone blocks to replace section of walls	Year 1	20,000	20,000

6 Financial Management Summary

6.1 Summary of Maintenance Plan

The following tables summarise the planned annual maintenance cost estimates.

Table 18: Summary of Asset Renewals Cost Estimates

Years	Balmoral Baths & Jetty Indicative Renewals Cost Estimate	Clifton Garden Baths & Jetty Indicative Renewals Cost Estimate	Inkerman Jetty Indicative Renewals Cost Estimate	Various Seawalls Indicative Renewals Cost Estimate	Mosman Marine Assets Indicative Renewals Cost Estimate
1	80,950	98,950	8,000	20,000	207,900
2				32,000	32,000
3	28,500	21,000		4,000	53,500
4					
5					
6			18,000		18,000
7	54,000		1,500		55,500
8	9,000	8,000	200		17,200
9					
10					
11					
12					
Total	**172,450**	**127,950**	**27,700**	**56,000**	**384,100**

Table 19: Summary of Annual Maintenance Cost Estimates

Years	Balmoral Baths & Jetty Indicative Maintenance Cost Estimate	Clifton Garden Baths & Jetty Indicative Maintenance Cost Estimate	Inkerman Jetty Indicative Maintenance Cost Estimate	Various Seawalls Indicative Maintenance Cost Estimate	Mosman Marine Assets Indicative Maintenance Cost Estimate
1	24,800	25,700	31,500	37,900	119,900
2	1,400	2,700		88,200	92,300
3	9,300	4,400	900	84,700	99,300
4	7,400	700		22,200	30,300
5	16,900	16,200	400	18,200	51,700
6	22,300	6,900	2,200	11,400	42,800
7	2,400	700	5,000	3,000	11,100
8	8,900	6,200	500	8,700	24,300
9	4,600	3,900	700	11,200	20,400
10	17,900	16,200	900	9,900	44,900
11	7,400	3,700	1,500		12,600
12	4,600	3,900	700	11,400	20,600
Total	**127,900**	**91,200**	**44,300**	**306,800**	**570,200**

Figure 6: Annual Expenditure Demand

The chart above represents the sum cost of maintenance and renewal expenditures undertaken at the optimal time. There is an existing high demand for immediate renewal and maintenance expenditure necessary to bring the assets to within an acceptable level of service.

6.2 Funding Strategy

There is an extensive existing demand for maintenance expenditure to ensure the safety of some structures and the public. This current situation indicates a misalignment between the provision of assets and the services provided by those assets. The service provided by the assets now in terminal or unsafe condition does not meet the intention behind the provision of the assets. That is, some assets are now not delivering the service intended.

Council's brief for this project required the comparison of two funding scenarios, which are considered here. The first funding scenario provides the annual funding amount shown in the Combined Demand column in the table below. This is the optimal funding provision to assure the continuation of the delivery of services by the assets.

The second funding scenario is a ten year plan of maintenance and renewal projects with annual expenditure capped at the current budget level of continuing annual funding allocations of $100,000. This funding scenario will deliver a progressive reduction in the level of service achieved due to the deferral of maintenance on some items.

Table 20: Scenario 2 - Applying $100,000 annual funding limit

Year	Renewal Estimates	Maintenance Estimates	Combined Demand	Expenditure in Year	Accumulated Deferred Demand
1	207,900	119,900	327,800	100,000	227,800
2	32,000	92,300	124,300	100,000	352,100
3	53,500	99,300	152,800	100,000	304,900
4		30,300	30,300	100,000	235,200
5		51,700	51,700	100,000	186,900
6	18,000	42,800	60,800	100,000	147,700
7	55,500	11,100	66,600	100,000	114,300
8	17,200	24,300	41,500	100,000	55,800
9		20,400	20,400	76,200	0
10		44,900	44,900	44,900	0
11		12,600	12,600	12,600	0
12		20,600	20,600	20,600	0

In the second scenario, deferred maintenance demand accumulates in the first 3 years, and progressively reduces until in Year 9 the program, at which time the budget exceeds the expenditure demand. Users of the facilities are continuously exposed to risks from deferred maintenance and renewal items over 9 years before the situation improves. The extent of deferred maintenance and renewal is extensive, and may result in consequential damage to otherwise sound components. The resulting level of service may not be adequate for safe community use of some structures.

Table 21: Scenario 3 - Applying $180,000 annual funding limit for 3 years

Year	Renewal Estimates	Maintenance Estimates	Combined Demand	Expenditure in Year	Accumulated Deferred Demand
1	207,900	119,900	327,800	180,000	147,800
2	32,000	92,300	124,300	180,000	92,100
3	53,500	99,300	152,800	180,000	64,900
4		30,300	30,300	70,000	25,200
5		51,700	51,700	51,700	6,900
6	18,000	42,800	60,800	60,800	0
7	55,500	11,100	66,600	66,600	0
8	17,200	24,300	41,500	41,500	0
9		20,400	20,400	20,400	0
10		44,900	44,900	44,900	0
11		12,600	12,600	12,600	0
12		20,600	20,600	20,600	0

A concentrated expenditure of $180,000 is required for the initial 3 years to eliminate an continuing accumulation of deferred demand through the decade. The table below illustrates how the expenditure of $180,000 for 3 years consumes the deferred renewal and maintenance and permits a reduction in annual budget to $70,000 per annum in Year 4, and reducing thereafter. This third funding scenario better manages the level of exposure to risk over the decade.

The second funding scenario is a twelve year plan based upon a level of funding that delivers a relatively stable level of service. This approach assumes that the level of service is delivered continuously by the assets, and the expenditure varies to satisfy the demand.

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Long term funding for maintenance in the order of $70,000 per annum appears adequate for maintaining the level of service of the assets, assuming that asset renewals occur periodically, and are funded separately. If asset renewals are deferred, then maintenance costs will increase as the task to keep failing assets serviceable expands.

This asset management plan predicts asset performance for a twelve year period. Developing a longer forecast of renewal expenditures for the timber marine structures is dependent on the achieved performance of these structures. Council does not have continuing records of the performance of timber piles. Over recent years the performance of timber piles has been reducing, as the water quality in Sydney Harbour has improved. Similar decreasing performance due to marine borer attack has been experienced in other harbours where the water quality has significantly improved. As a response, new rehabilitation treatments are now being employed, and the material selection process in the repair design stages are sourcing materials that are not susceptible to marine borer attack.

A 20 year financial forecast for renewals that delivers a continuing satisfactory level of service would include provision for a complete replacement of all timber piles in all the structures, and the associated adjustments of superstructures. Alternative treatments may be applicable, but need to be implemented in the short term before the loss of structural capacity approaches terminal conditions. Rehabilitative treatments will require sufficient structure for the remedial system to be applied. It is therefore recommended that Council now consider the adoption and trialling of methods to rehabilitate deteriorated piles, or determine a structural solution that eliminates the material degradation issues and that can be applied progressively as the current timber piles fail.

6.3 Maintenance Action Implementation Assumptions

The continuing safe delivery of service by the marine structure assets is predicated on the continuance of routine maintenance activities, and timely renewal activities. These activities include:

- Inspection at periodic intervals
- Pile replacement in a timely manner
- Regrouting of sandstone walls
- Inkerman Jetty Stairs urgent replacement
- Concrete grouting repair of concrete seawalls
- Replacement of steel connections as the deterioration approaches terminal conditions
- Repair of damage to Shark nets
- Handrail painting

It is expected that maintenance and renewal will be undertaken in a manner to reduce future deterioration of assets. For example, timber raker piles cause abrasive wear to the shark nets. When due for renewal, the raker piles can be replaced by higher capacity vertical HDPE sleeved steel piles, thereby reducing the abrasive action with the netting.

It is understood that Council has utilised alternative methods for pile replacement and rehabilitative treatments in the past and this is evident at Clifton Gardens Jetty. It is recommended that Council continue to consider adopting and trialling of HDPE sleeved steel piles or other alternatives to timber piles in order to gain longer operational lives.

Failure to undertake the items of maintenance and renewal as identified in the Plan at the appropriate times may be detrimental to the marine structures, resulting in loss of service and increases in the extent of pending and future repair, renewal and rehabilitation of the assets. Such a situation may invalidate the assumptions on which the financial planning is predicated, making the forward predicted budgets inadequate.

7 Asset Management Practices

This is the first inventory and asset management plan for Mosman Marine Structures. NSW Department of Local Government policy requires Mosman Council to prepare a valuation and asset management plan for these assets. Council's asset management records for the marine assets considered in this asset management plan have previously been rudimentary, and are considered inadequate for the expected level of certainty in management decision making.

7.1 Accounting/Financial Systems

The value of the Mosman marine assets will now be recognised in the financial records. The valuation has been prepared in accordance with AASB116.

Due to the minimal increase in demand on the Mosman marine assets no assets are proposed to be augmented and no new assets are proposed to be developed.

7.2 Asset Management Systems

The Council provided Opus with recent works documentation and some condition audits of the jetty and baths structures, but no other history of construction, condition, cost and past performance.

Opus undertook field inspections to quantify the assets and assess their condition, leading to reliable and accurate inventory information. A spread sheet record of the data is now compiled and available on Council records.

This asset management plan recommends a cycle of inspections and condition inspections, to update this data.

7.3 Information Flow Requirements and Processes

It is essential to incorporate records of inspections, maintenance and renewal activities in the asset records to maintain their currency and to permit analysis of performance for the development of predictions of future performance.

Maintenance renewal activities should be prioritised to mitigate risk to the asset and it's users. For example timber piles should be replaced when their section diameter is reduced by 50% to limit the risk of collapse.

7.4 Standards and Guidelines

All work is to be undertaken in accordance with the relevant and current SAA Codes, By-laws and Ordinances and the appropriate specifications for works activity.

8 Plan Improvements and Monitoring

A schedule of asset inspections and performance testing needs to be implemented. This plan recommends monitoring inspections at regular intervals.

The resulting collection of performance history can be applied to guide future decision making. More accurate predictions of remaining life can be developed through analysis of the performance history.

8.1 Performance Measures

The performance measures adopted for this asset management plan are readily available, reasonably current and of adequate degree of accuracy.

This AMP will be deemed effective if the proposed maintenance and renewal actions are implemented, resulting in the continuance of the delivery of the level of service by the asset.

8.2 Improvement Program

The Council should consider revising this document in 2017 using the improved information collected in the interim, to generate a second generation asset management plan.

Based on this valuation, the following recommendations are made in order to improve the reliability and accuracy of the valuation.

There is an extensive existing demand for maintenance expenditure to ensure the safety of some structures and the public. This current situation indicates a misalignment between the provision of assets and the services provided by those assets. The service provided by the assets now in terminal or unsafe condition does not meet the intention behind the provision of the assets. That is, some asset are not delivering the service intended.

The maintenance of the assets has not matched the level of service provision expected for these assets. Therefore there is an evident inadequacy of maintenance OR the extent of service provision exceeds the funding allocation. Both situations result in a raised level of hazard to the assets and the users. A consideration of the level of service provision including a risk assessment is recommended to quantify the situation and inform decision making on the alignment of future maintenance to service provision.

A complete replacement of all timber piles in all the structures, and the associated adjustments of superstructures, is considered likely within the next 20 years. Alternative treatments may be applicable, but need to be implemented in the short term before the loss of structural capacity approaches terminal conditions. Rehabilitative treatments will require sufficient structure for the remedial system to be applied. It is therefore recommended that Council now consider the adoption and trialling of methods to rehabilitate deteriorated piles, or determine a structural solution that eliminates the material degradation issues and that can be applied progressively as the current timber piles fail.

Maintenance and renewal history data needs to be collected to record changes to the asset in order to accurately determine the economic life and depreciation rates of the assets.

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References

- Australian Infrastructure Financial Management Guidelines, (2009), Institute of Public Works Engineering Australia (IPWEA)
- International Infrastructure Management Manual, (2006), INGENIUM, Version 3.0, New Zealand
- MosPlan Community Strategic Plan 2011 – 2021, (7 June 2011), Mosman Council
- Opus Infrastructure Asset Valuation Data Requirements, (2005), Opus International Consultants

Appendix A – Individual Asset Condition Reports

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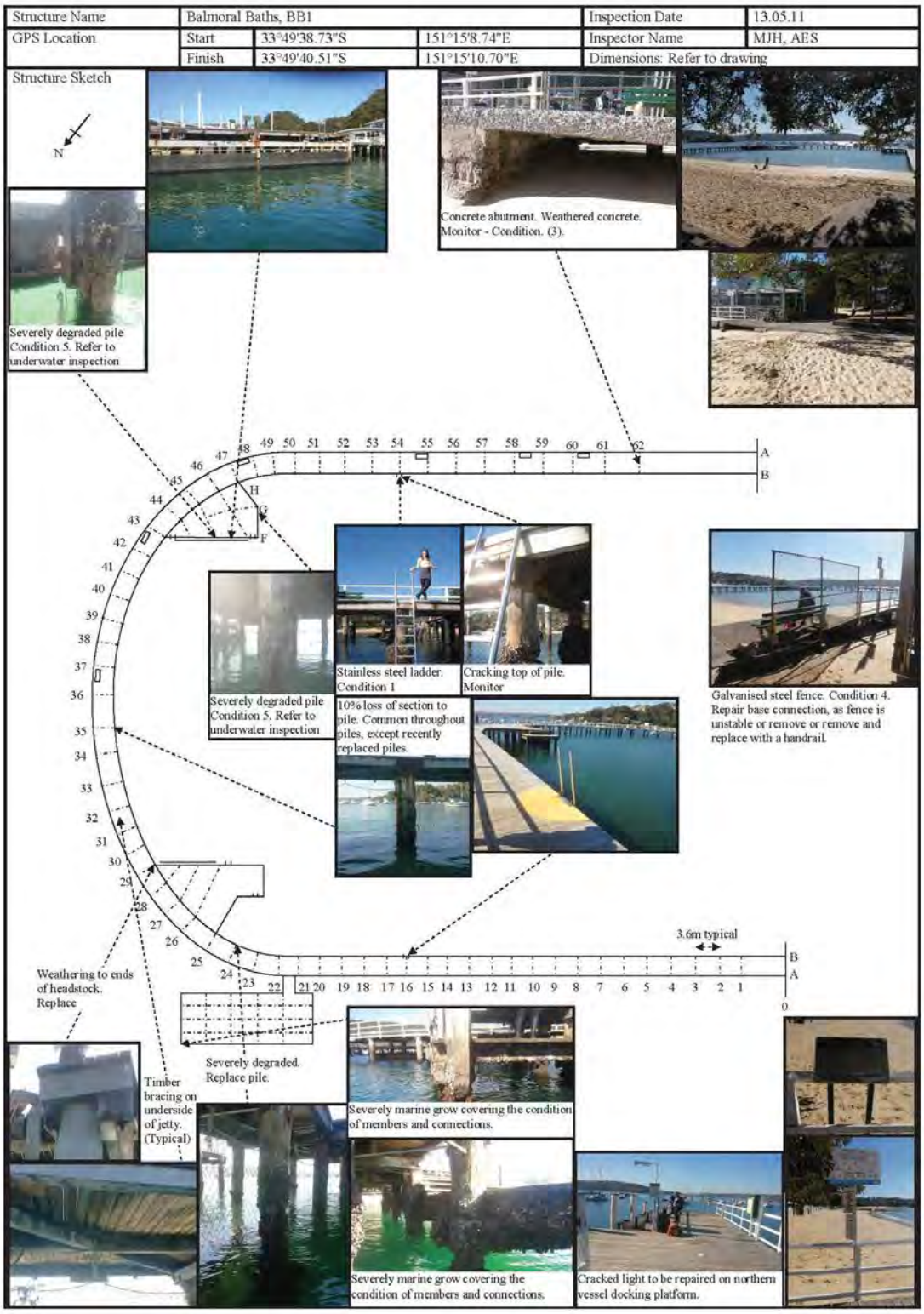
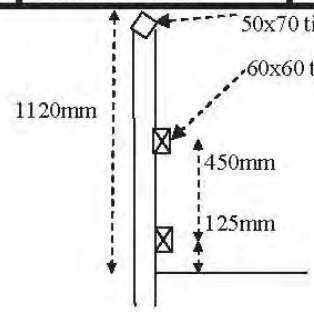


Structure Elements – BB1

Element 1 Timber handrails on jetty (Typical)

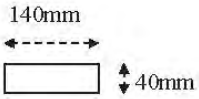
Element Material	Painted Timber	Condition Category:	2 – Corroded connections

Element Condition



Element 2	Timber Decking		
Element Material	Timber	Condition Category:	2 – Some loose coach screws

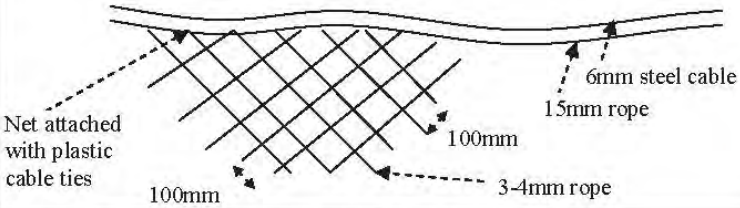
Element Condition



Element 3 Shark netting

Element Material	Rope	Condition Category:	2

Element Condition. Refer to underwater inspection notes for net condition underwater.



Element 4 Timber Headstocks (Typical)

Element Material	Timber	Condition Category:	4

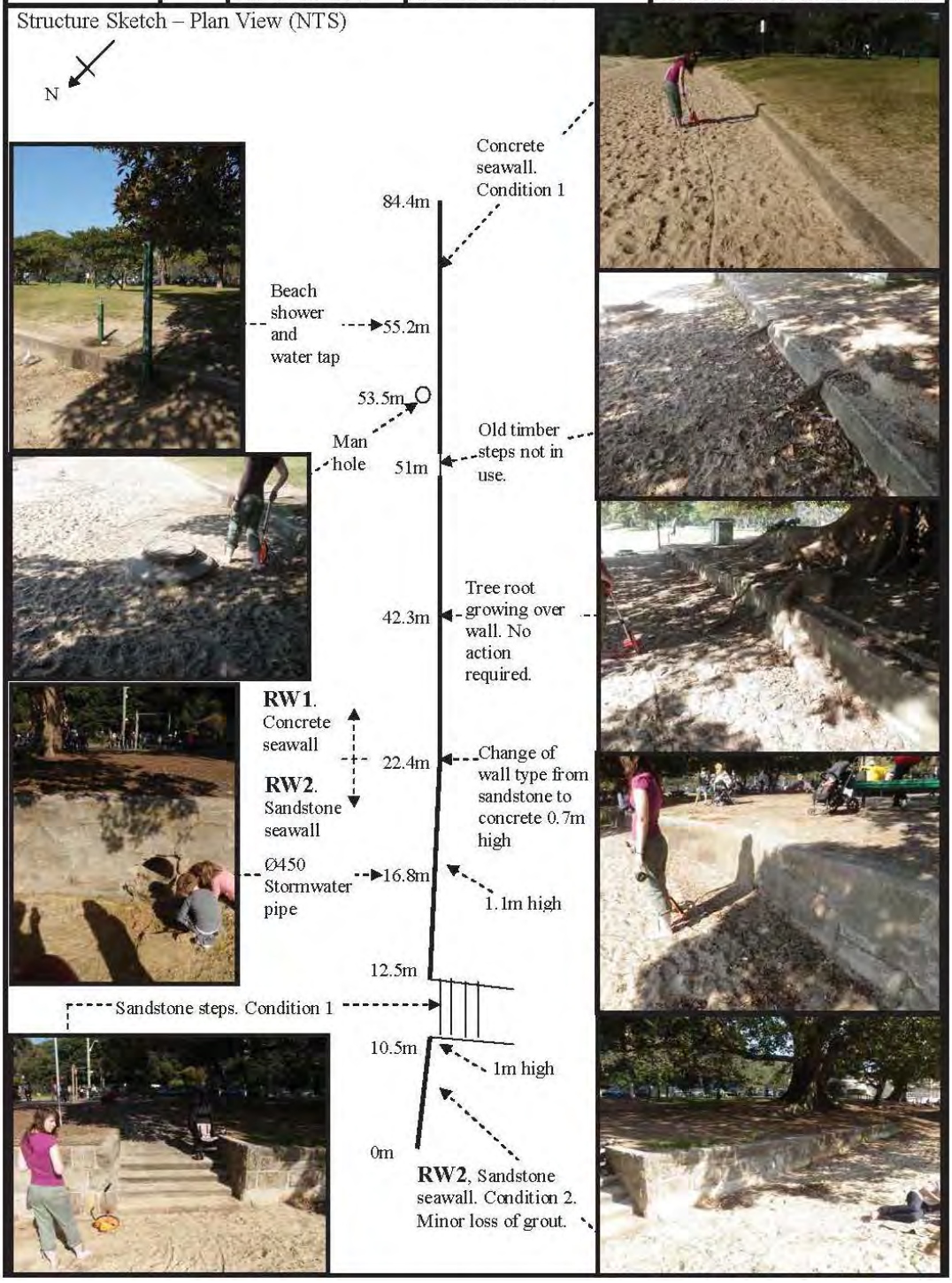
Element Condition

Weathering of timber headstocks notably at the timber ends (Typical). Risk of losing bearing of the timber bearer above – monitor. Bolted connections are severely corroded, and a replacement program is required.

Marine Structures

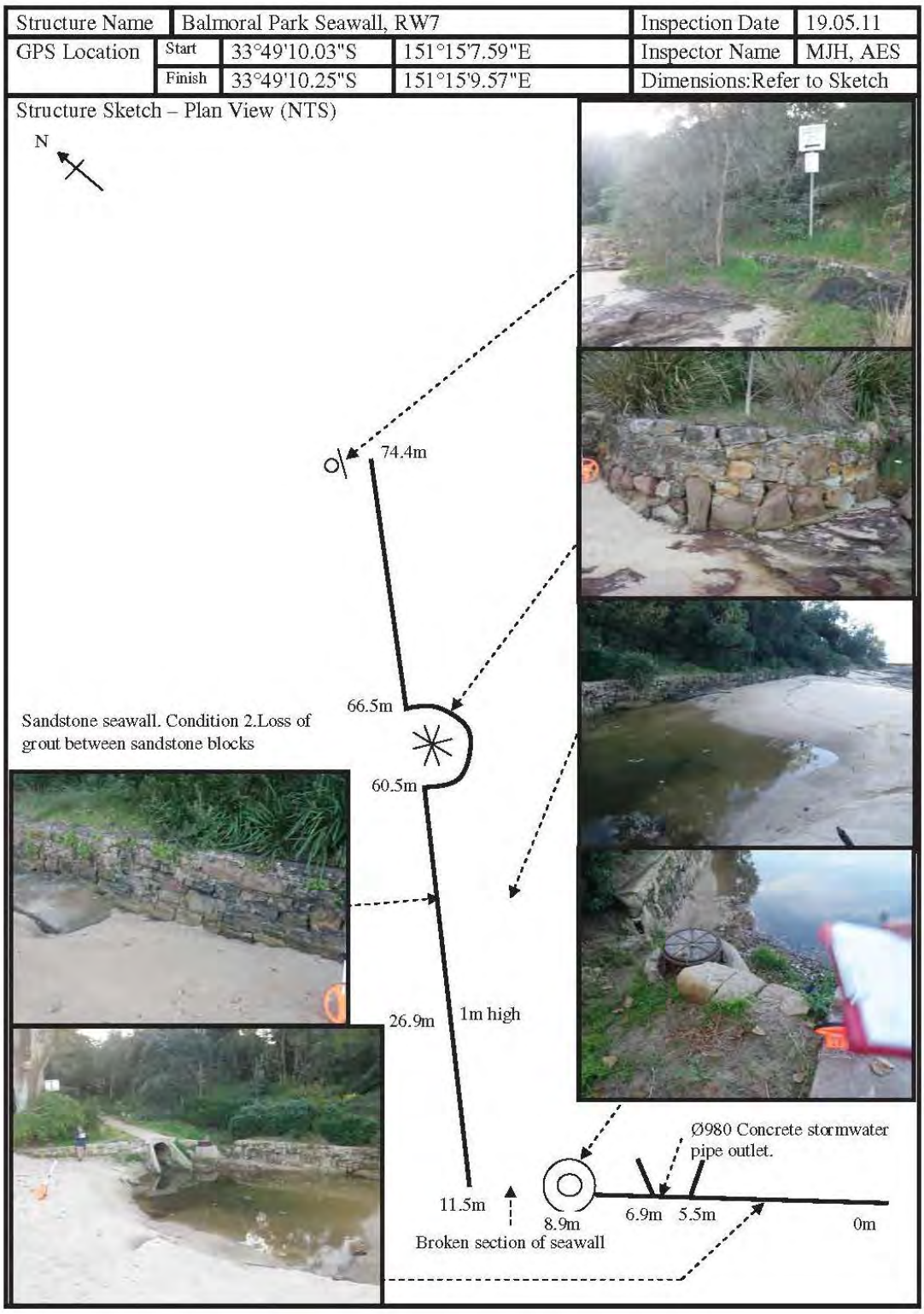
Structure Name		Balmoral Park Seawall, RW1_RW2		Inspection Date	20.05.11
GPS Location	RW1	33°49'41.97"S	151°15'13.22"E	Inspector Name	MJH, AES
	RW2	33°49'41.22"S	151°15'11.87"E	Dimensions: Refer to Sketch	

Structure Sketch – Plan View (NTS)



Structure Name	Balmoral Park Seawall, RW7			Inspection Date	19.05.11
GPS Location	Start	33°49'10.03"S	151°15'7.59"E	Inspector Name	MJH, AES
	Finish	33°49'10.25"S	151°15'9.57"E	Dimensions:Refer to Sketch	

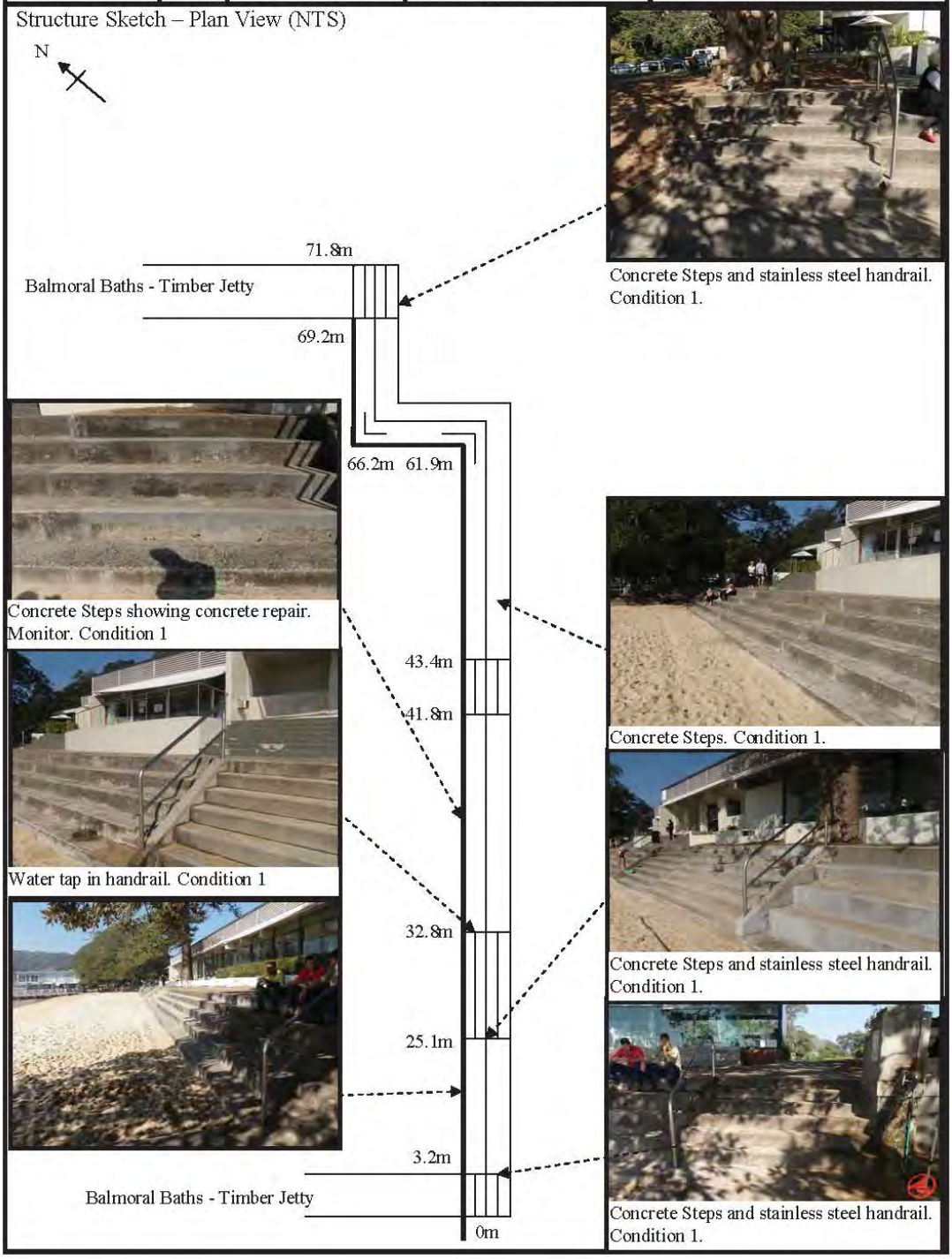
Structure Sketch – Plan View (NTS)



Marine Structures

Structure Name	Balmoral Park, RW3		Inspection Date	20.05.11
GPS Location	Start	33°49'38.81"S 151°15'8.69"E	Inspector Name	MJH, AES
	Finish	33°49'40.62"S 151°15'10.57"E	Dimensions:Refer to Sketch	

Structure Sketch – Plan View (NTS)



Concrete Steps and stainless steel handrail. Condition 1.

Concrete Steps showing concrete repair. Monitor. Condition 1

Concrete Steps. Condition 1.

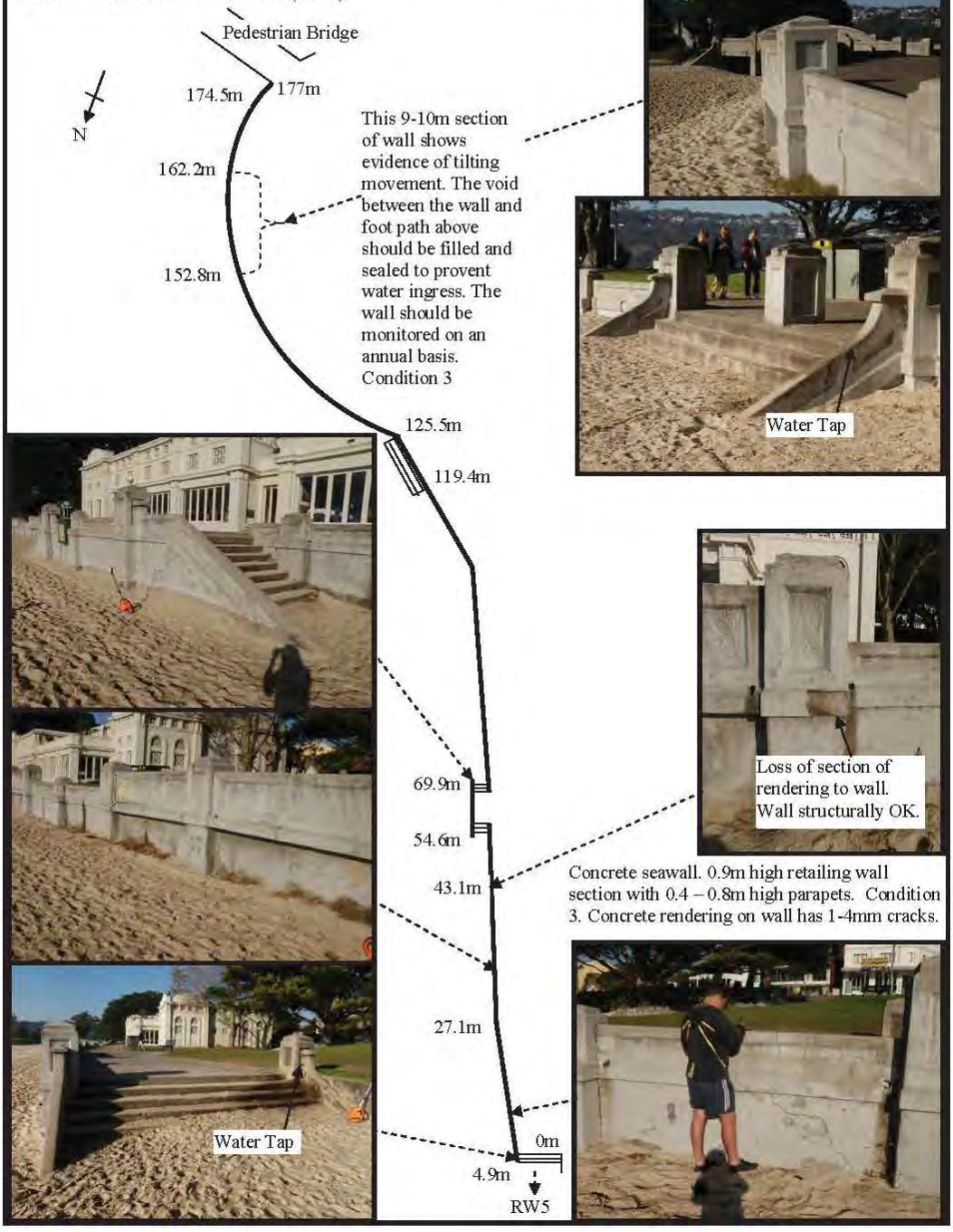
Water tap in handrail. Condition 1

Concrete Steps and stainless steel handrail. Condition 1.

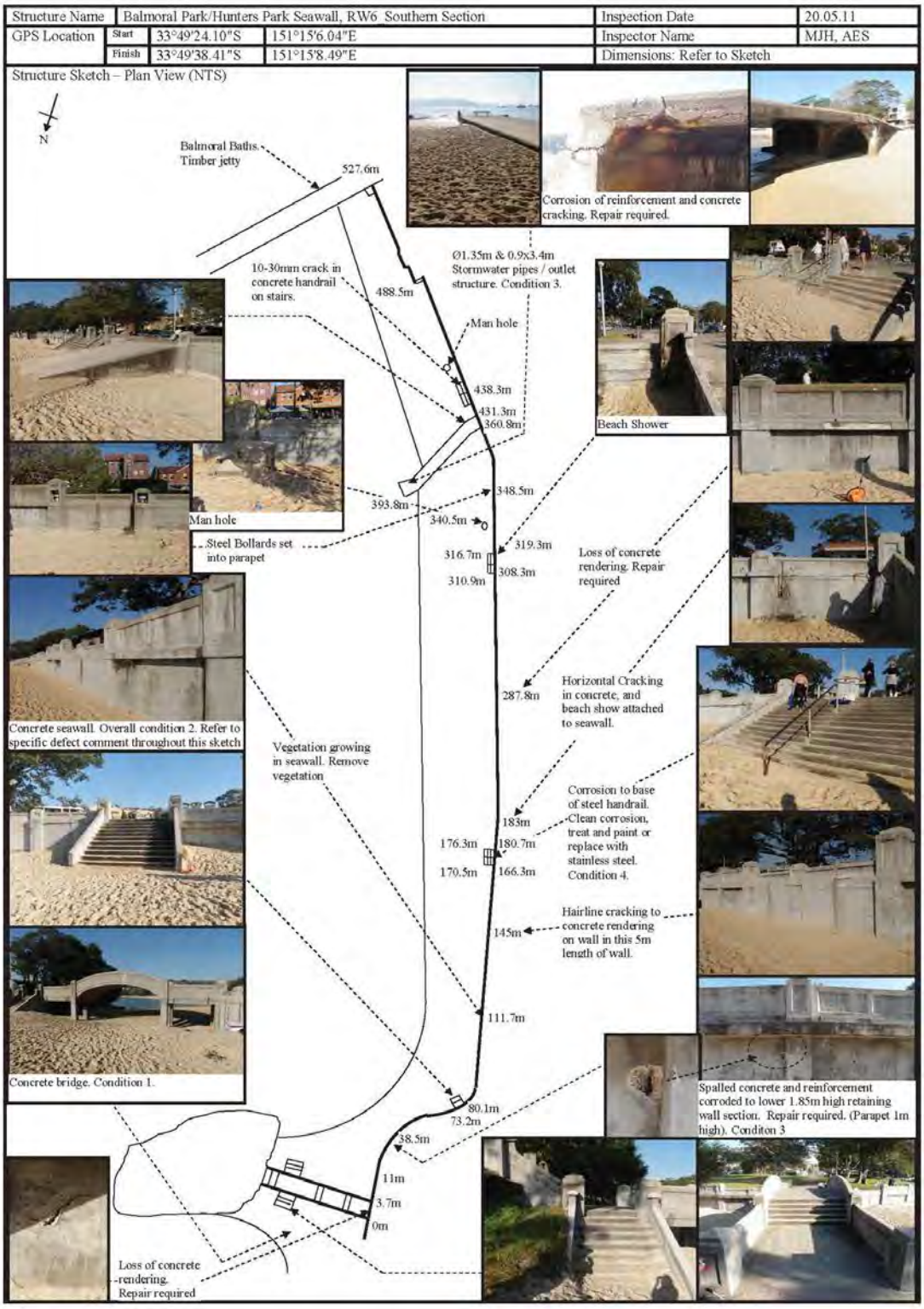
Concrete Steps and stainless steel handrail. Condition 1.

Structure Name	Balmoral Park/Hunters Park Seawall, RW6_Northern Section		Inspection Date	20.05.11
GPS Location	Start	33°49'18.74"S	151°15'3.24"E	Inspector Name	MJH, AES
	Finish	33°49'24.07"S	151°15'6.05"E	Dimensions: Refer to Sketch	

Structure Sketch – Plan View (NTS)

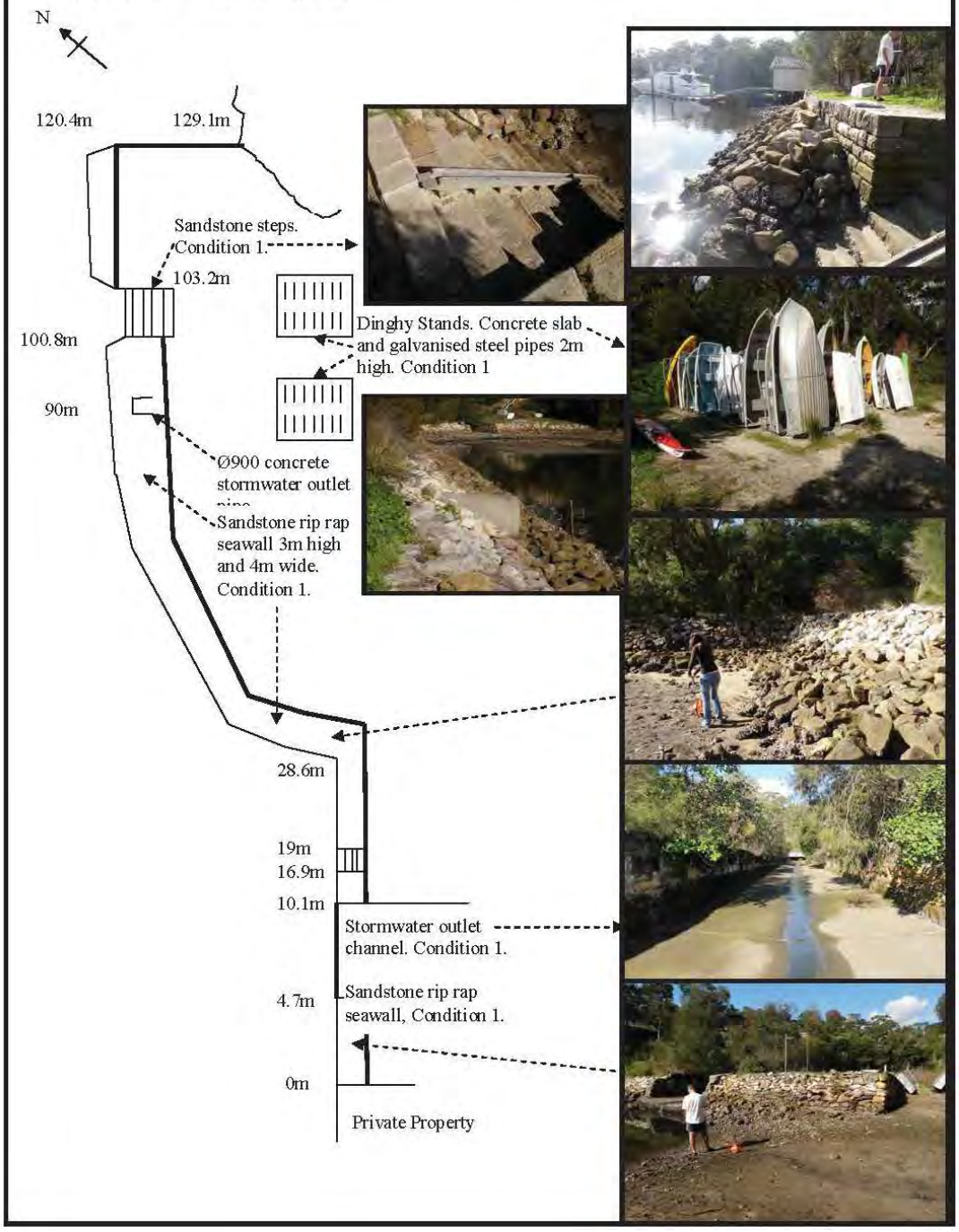


Marine Structures



Structure Name	Bay Street Seawall, RW55			Inspection Date	17.05.11
GPS Location	Start	33°49'1.36"S	151°14'20.53"E	Inspector Name	MJH, AES
	Finish	33°48'57.79"S	151°14'21.28"E	Dimensions:	Refer to Sketch

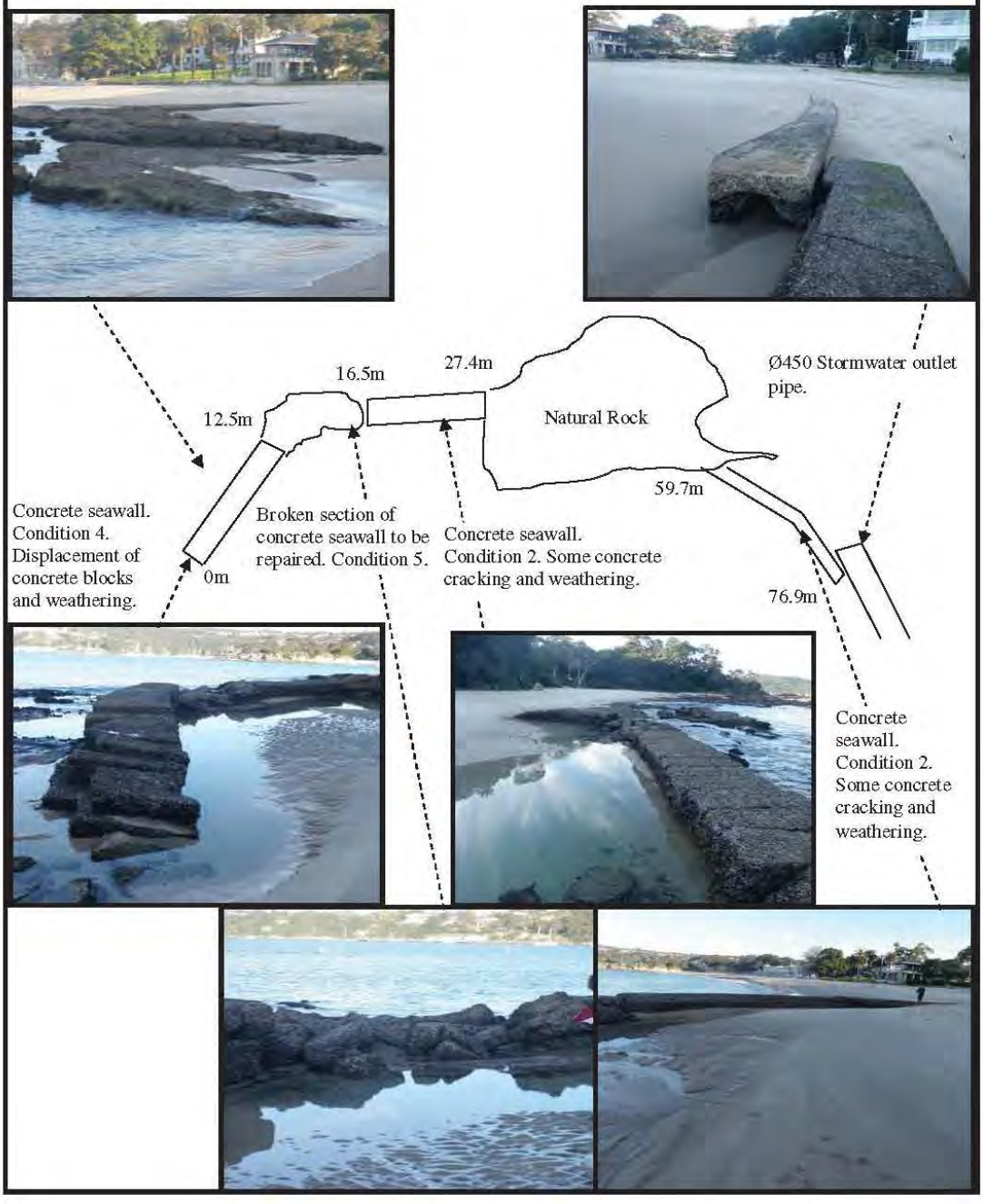
Structure Sketch – Plan View (NTS)



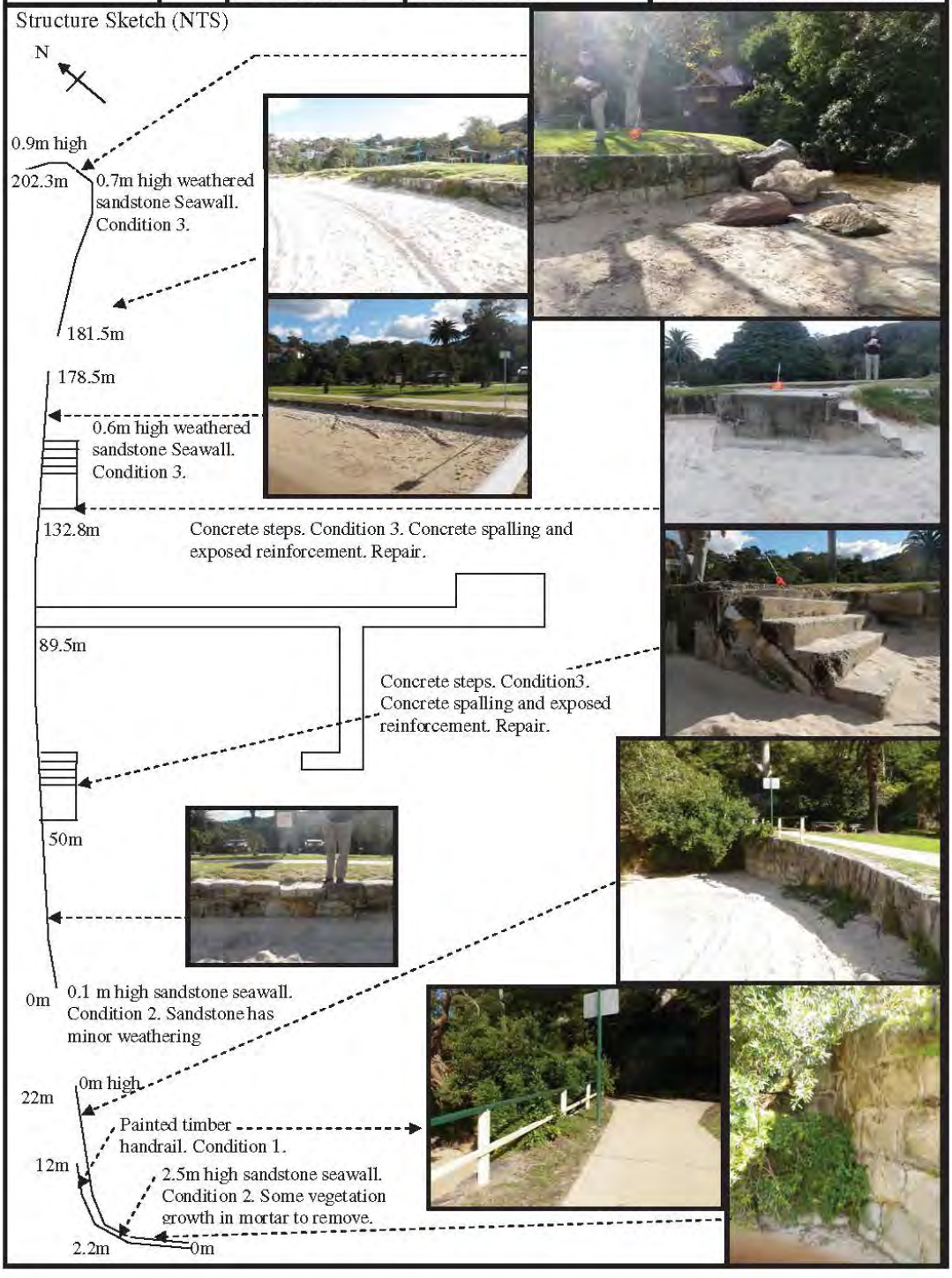
Marine Structures

Structure Name	Clem Moreth Pool, EB1		Inspection Date	19.05.11
GPS Location	Start	33°49'12.16"S 151°15'6.32"E	Inspector Name	MJH, AES
	Finish	33°49'14.16"S 151°15'5.18"E	Dimensions: Refer to Sketch	

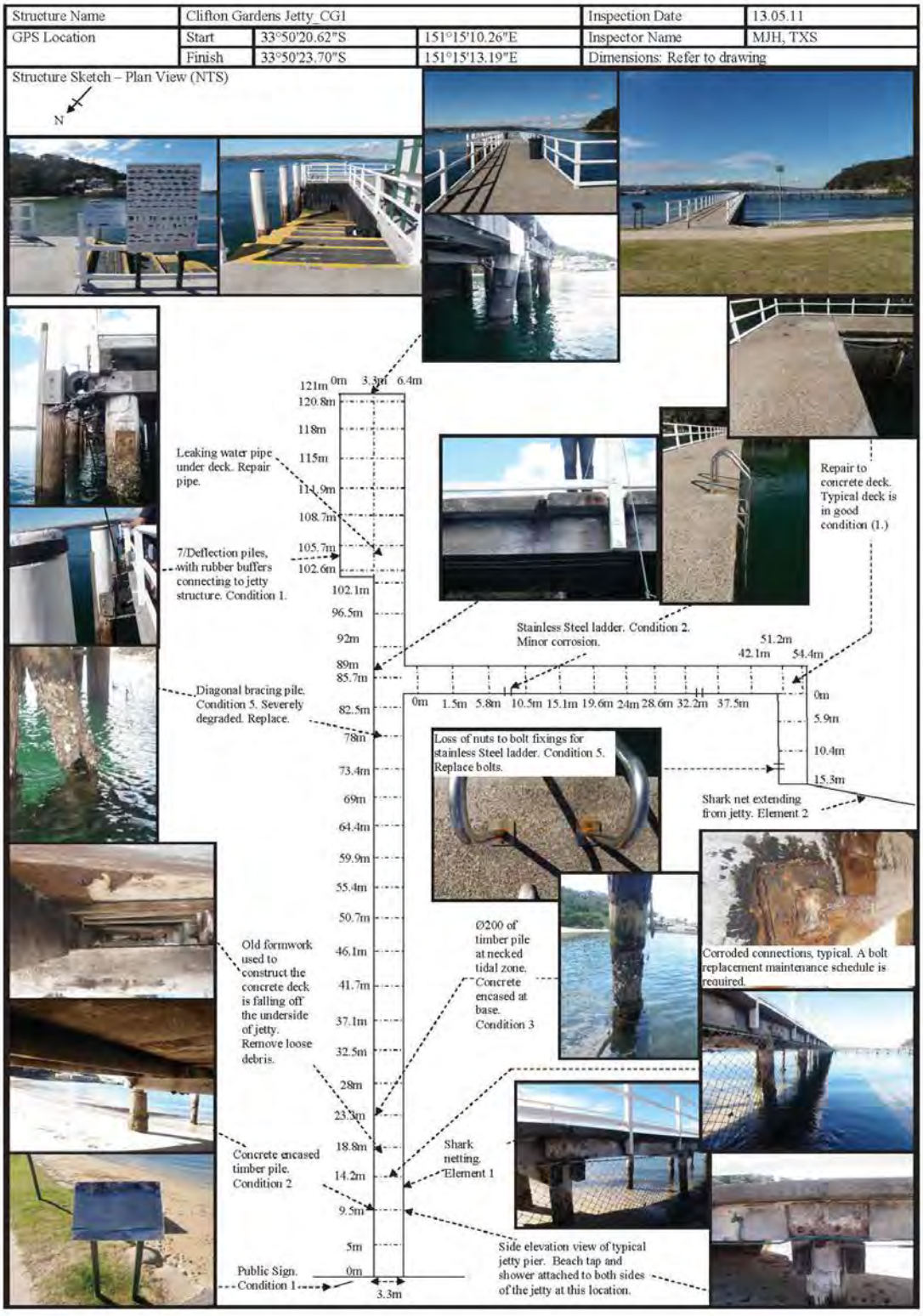
Structure Sketch – Plan View (NTS)



Structure Name	Clifton Gardens Reserve Seawall, RW28		Inspection Date	13.05.11
GPS Location	Start	33°50'24.08"S 151°15'7.46"E	Inspector Name	MJH, TS
	Finish	33°50'18.07"S 151°15'13.20"E	Dimensions: Refer to Sketch	



Marine Structures

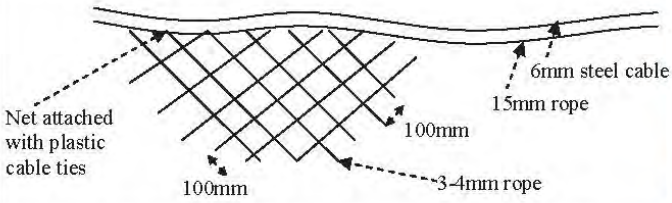


Structure Elements – CG1

Element 1 - Shark netting around jetty

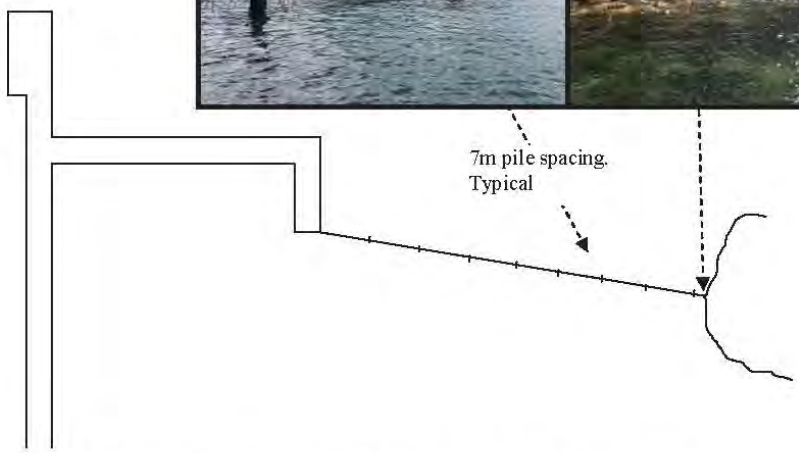
Element Material	Rope	Condition Category:	2

Element Condition – Refer to underwater inspection notes for net condition underwater.



Element 2	Shark net extending from jetty		
Element Material	Rope	Condition Category:	2

Element Condition
(Plan view of jetty, NTS)

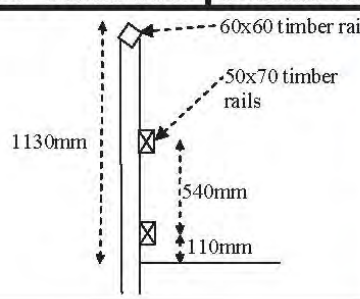


Refer to detailed underwater inspection notes for condition of shark net and piles.

Element 3 Jetty Handrails (Typical)

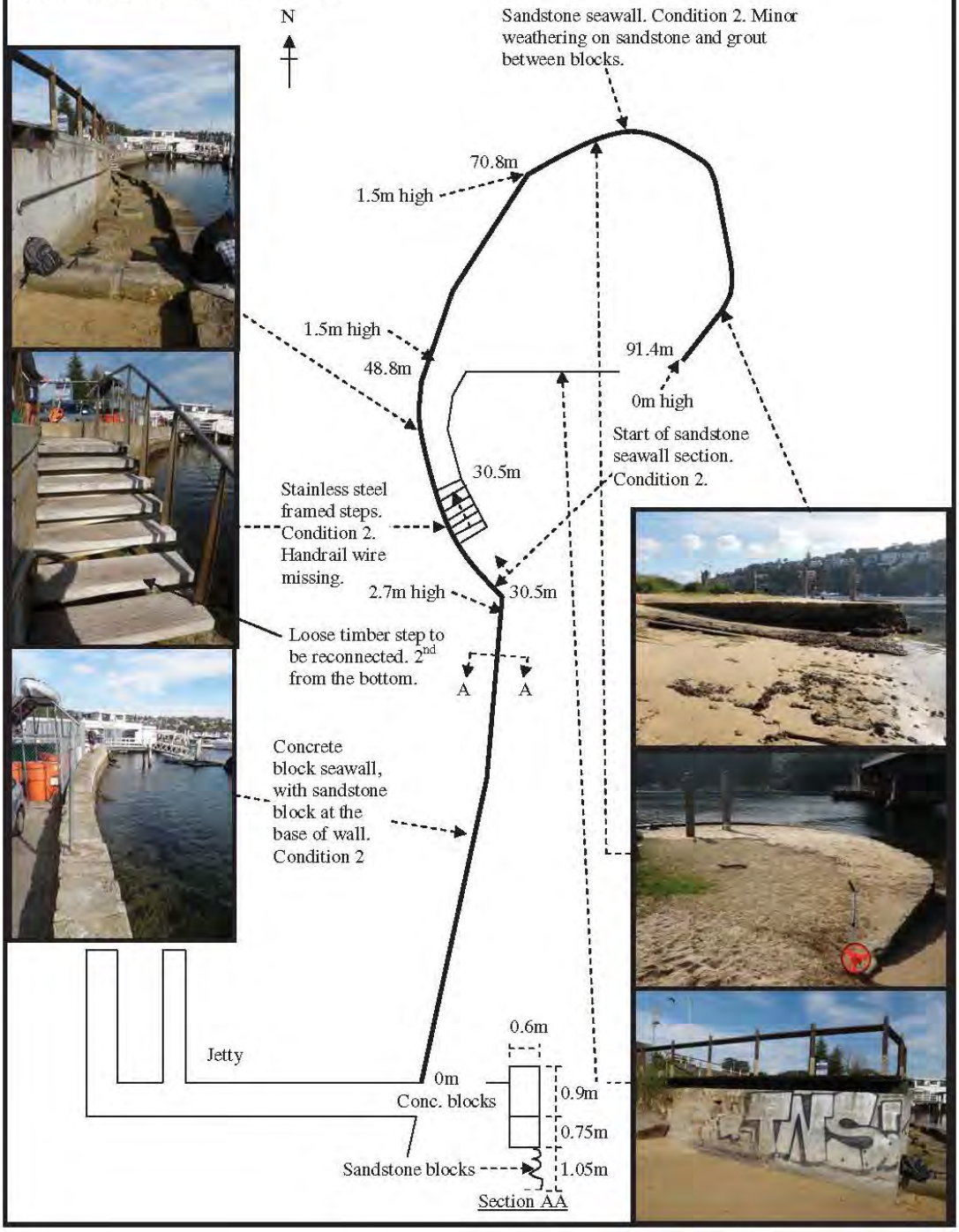
Element Material	Timber - Painted White	Condition Category:	1 – Good condition

Element Condition



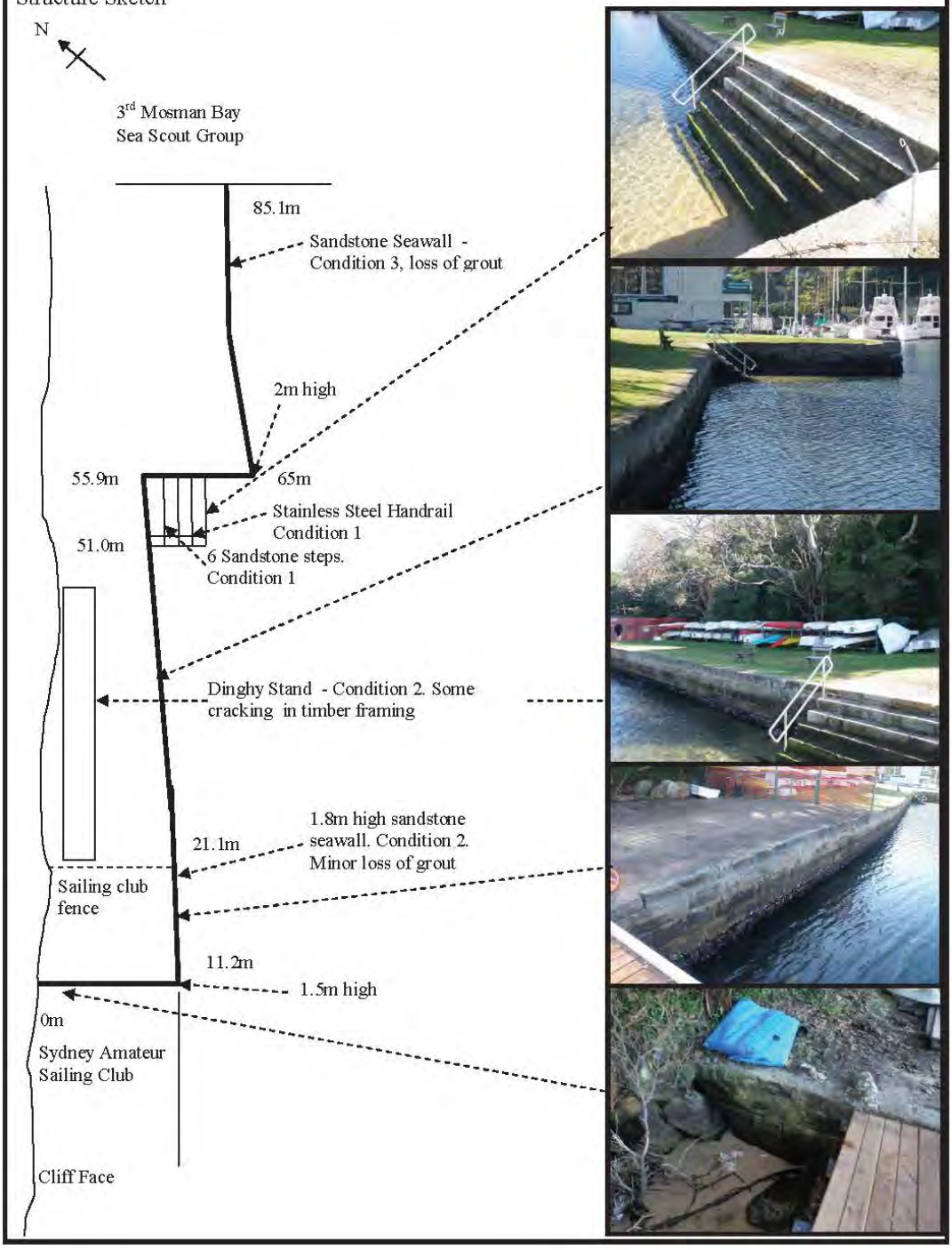
Structure Name	Ellery Park Seawall, RW85		Inspection Date	19.05.11
GPS Location	Start	33°48'14.19"S	151°14'44.40"E	Inspector Name	MJH, AES
	Finish	33°48'12.50"S	151°14'45.42"E	Dimensions: Refer to Sketch	

Structure Sketch – Plan View (NTS)



Structure Name	Harnett Park Seawall, RW38		Inspection Date	17.05.11
Location: Access via Harnett Avenue			Inspector Name	MJH & AES
GPS Location	33°50'15.97"S	151°13'53.63"E	Dimensions: Refer to Sketch	

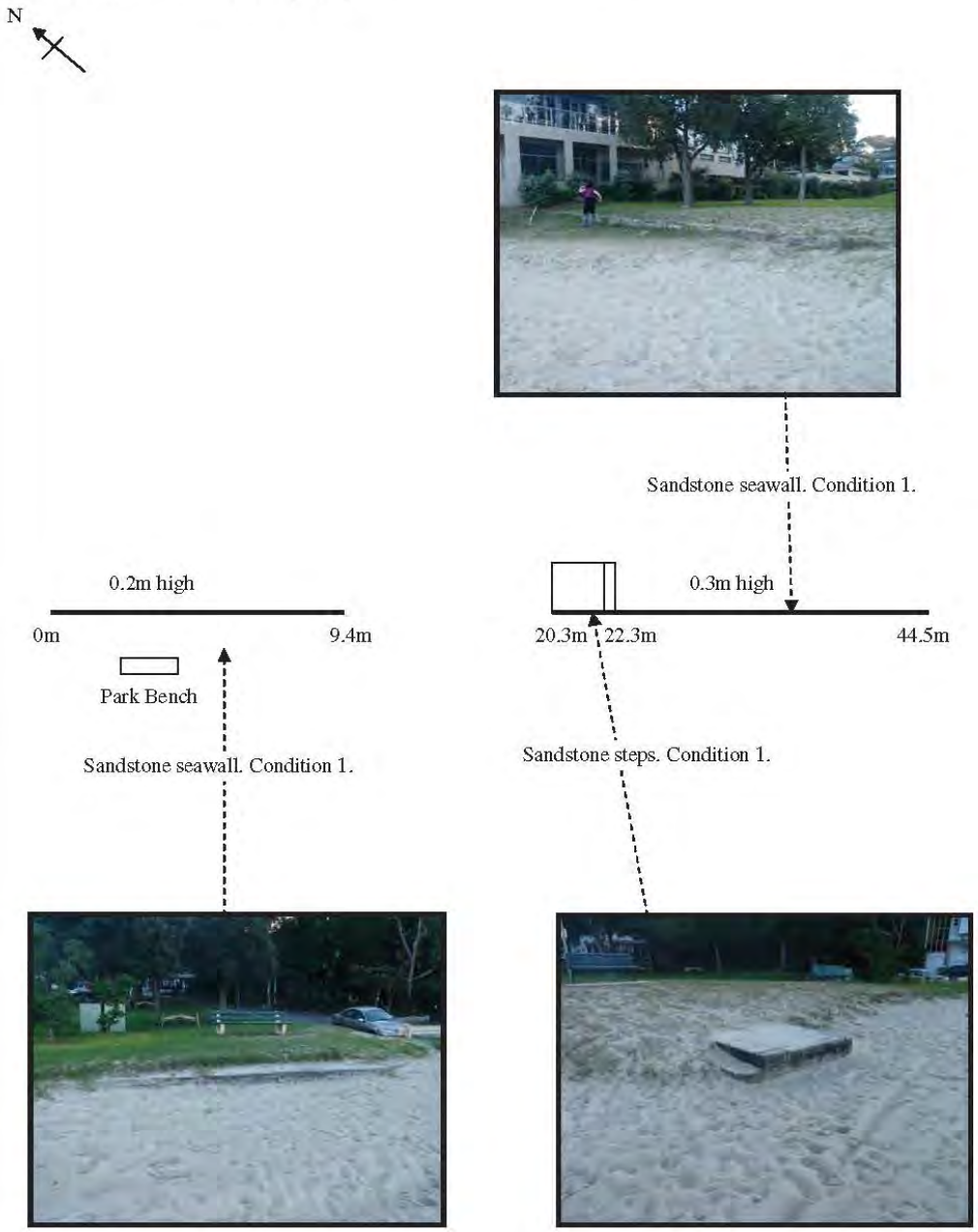
Structure Sketch



Marine Structures

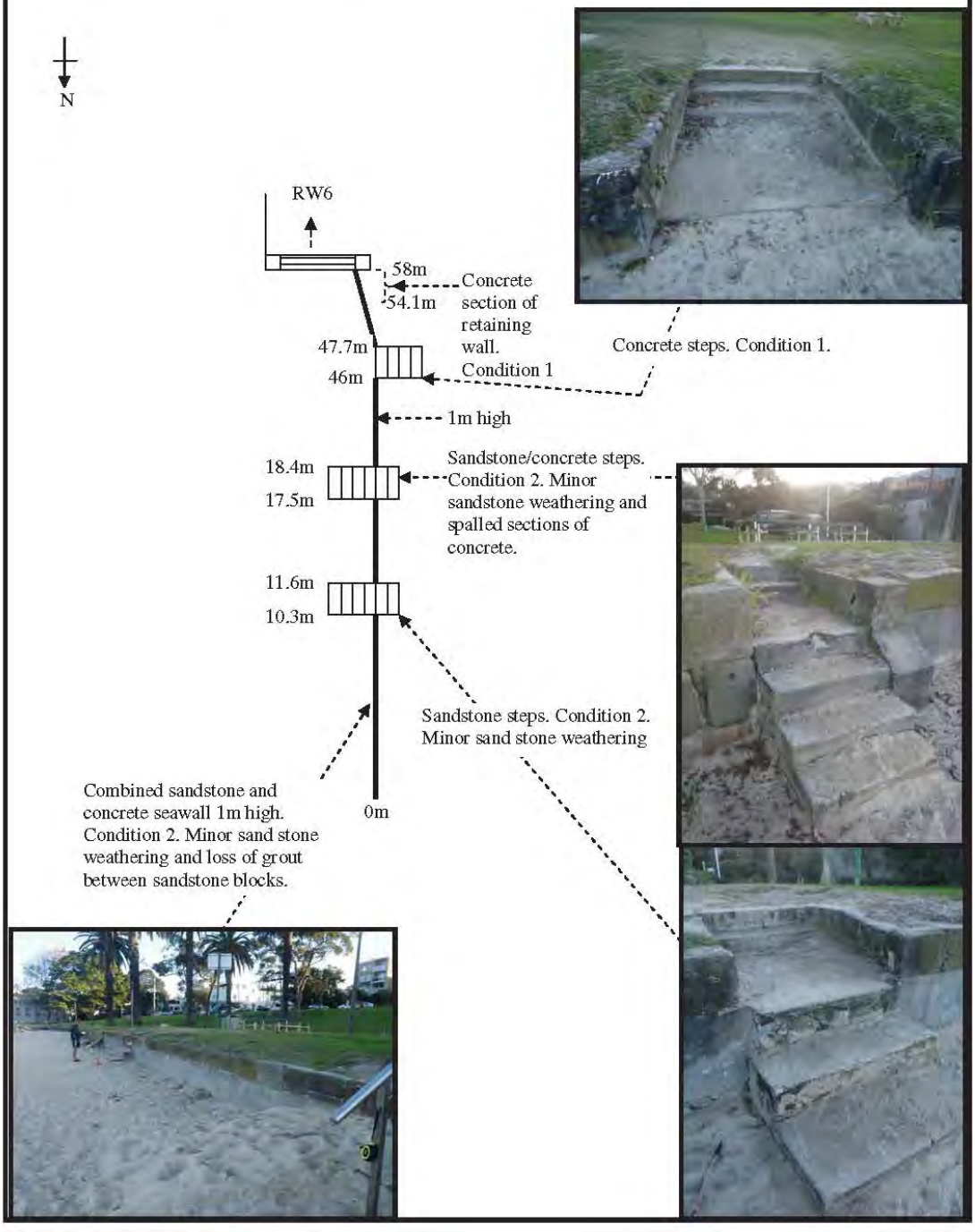
Structure Name	Hunter Park / Leahy Park Seawall, RW4		Inspection Date	19.05.11
GPS Location	33°49'15.54"S	151°15'3.05"E	Inspector Name	MJH, AES
			Dimensions:Refer to Sketch	

Structure Sketch – Plan View (NTS)



Structure Name	Hunters Park Seawall, RW5			Inspection Date	19.05.11
GPS Location	Start	33°49'16.78"S	151°15'3.21"E	Inspector Name	MJH, AES
	Finish	33°49'18.81"S	151°15'3.07"E	Dimensions:Refer to Sketch	

Structure Sketch – Plan View (NTS)



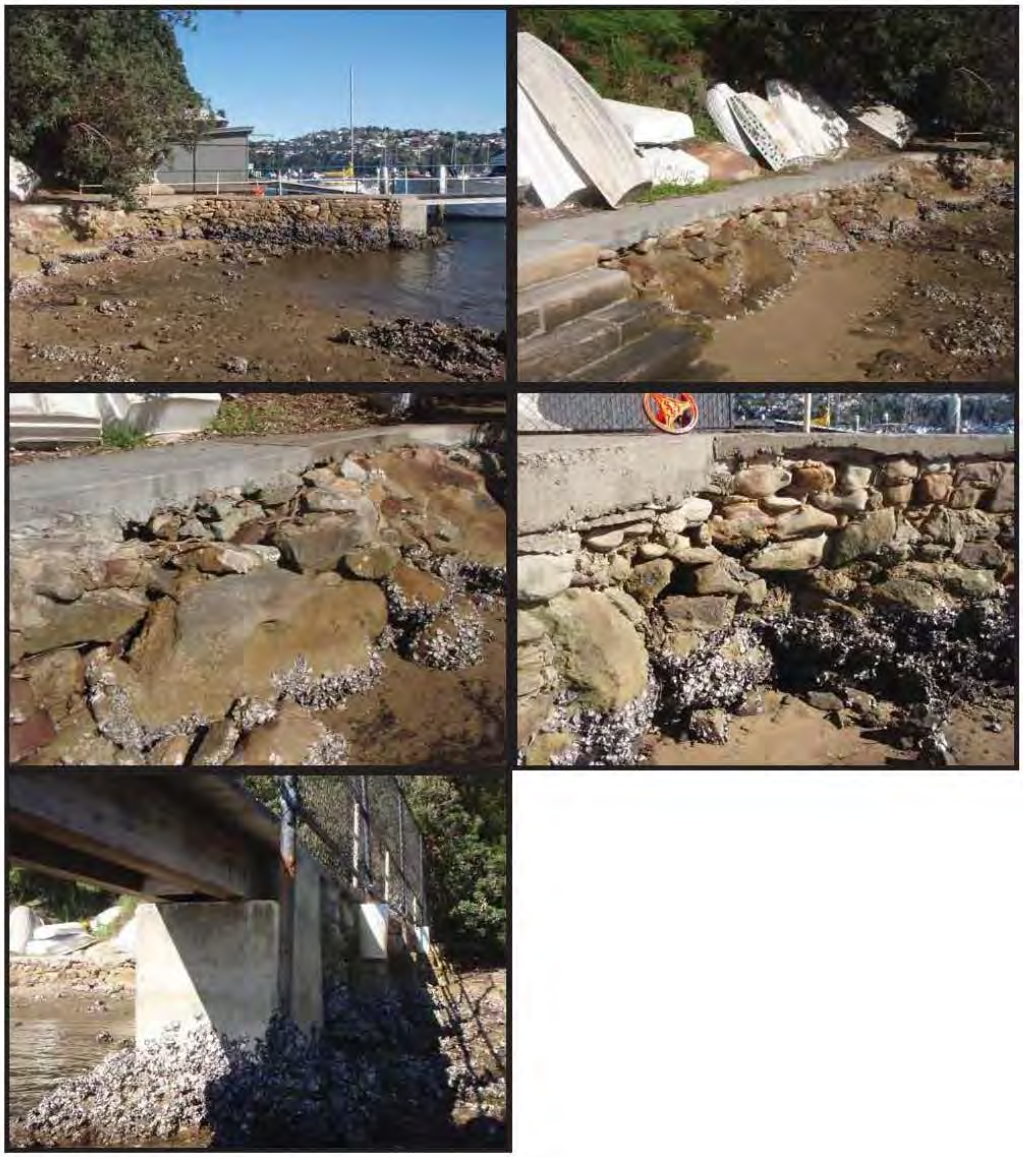
Structure Name	Inkerman Street Jetty – IS1		**Inspection Date**	12.05.11
Location: Access via Carrington Avenue, Mosman, NSW			**Inspector Name**	MJH & RJ
GPS Location	33°48'58.21"S	151°14'12.72"E	**Dimensions:** Refer to drawings	

Comments:
450mm stormwater pipe outlet at the eastern end of site.
Note: The neighbouring fence (not a council asset) on the eastern end of site has severe corrosion and requires replacement

General Photos.

Structure Elements - IS1			
Element 1 – Seawall adjacent to jetty including jetty causeway.			
Element Material	Sandstone		
Element Dimensions	0.9 – 1.1m high	**Condition Category:** 5 – Repair required	

Element Description:
Sandstone mass wall, including protrusions of natural sandstone bed rock. Stones loose and grout around stones eroded away throughout wall. Replace and inject grout between stones in seawall. Add riprap at 3:1 grade in front of seawall as specified in Brown drawing X04492-S02 attached.



Element 2			
Element Type	Handrail on Jetty	**Element Material**	Steel
Element Dimensions	1m high, 30.75m long	**Condition Category:** 1 – Overall good condition	

Element Description (IS1):
Three sections of central rail missing in jetty handrail to be replaced.

Element 3			
Element Type	Jetty piles	**Element Material**	Timber (Fibre reinforced pipe encased)
Element Dimensions		**Condition Category:** Main piles – 3, End stair piles - 4	

Element Description:
4/Main jetty supporting piles - timber encased with fibre reinforced pipe. Fibre reinforced pipe at the top of piles has cracked and spalled off.

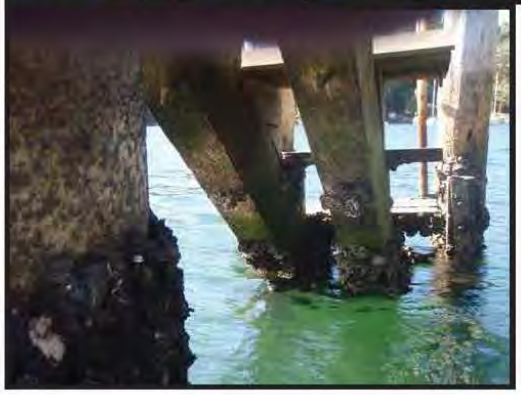
2/End piles located at base of stairs at end of jetty. Timber piles, with severe degradation and insect attack. Recommend replacement.

Element 4 – IS1			
Element Type	Stairs at end of jetty	**Element Material**	Timber
Element Dimensions	Refer to DWG's	**Condition Category:** 5 – Replacement required	

Element Description:

The jetty stairs have detached from the supporting piles at the base of the stairs due to severe degradation to the timber members. The bottom step has severe loss of section.

The stairs currently cantilever off the jetty, and the bending load is carried by the stair bearer connections and the steel hand rail which is over loading and in a potentially unsafe condition. We recommend the stairs be closed from service and replaced immediately.



Element 5 – IS1			
Element Type	Jetty Deck	**Element Material**	Timber
Element Dimensions	1m x 18m	**Condition Category:** 1 – Good condition	

Element Description:
Decking – 1000x150x50mm Timber planks connect to timber bearers by 4/SS coach screws per plank (16mm head size). Decking supported by twin timber bearers – 300x150x4.5m long. Timber bearers seated into top of timber piles, connected with twin SS 16mm bolts.

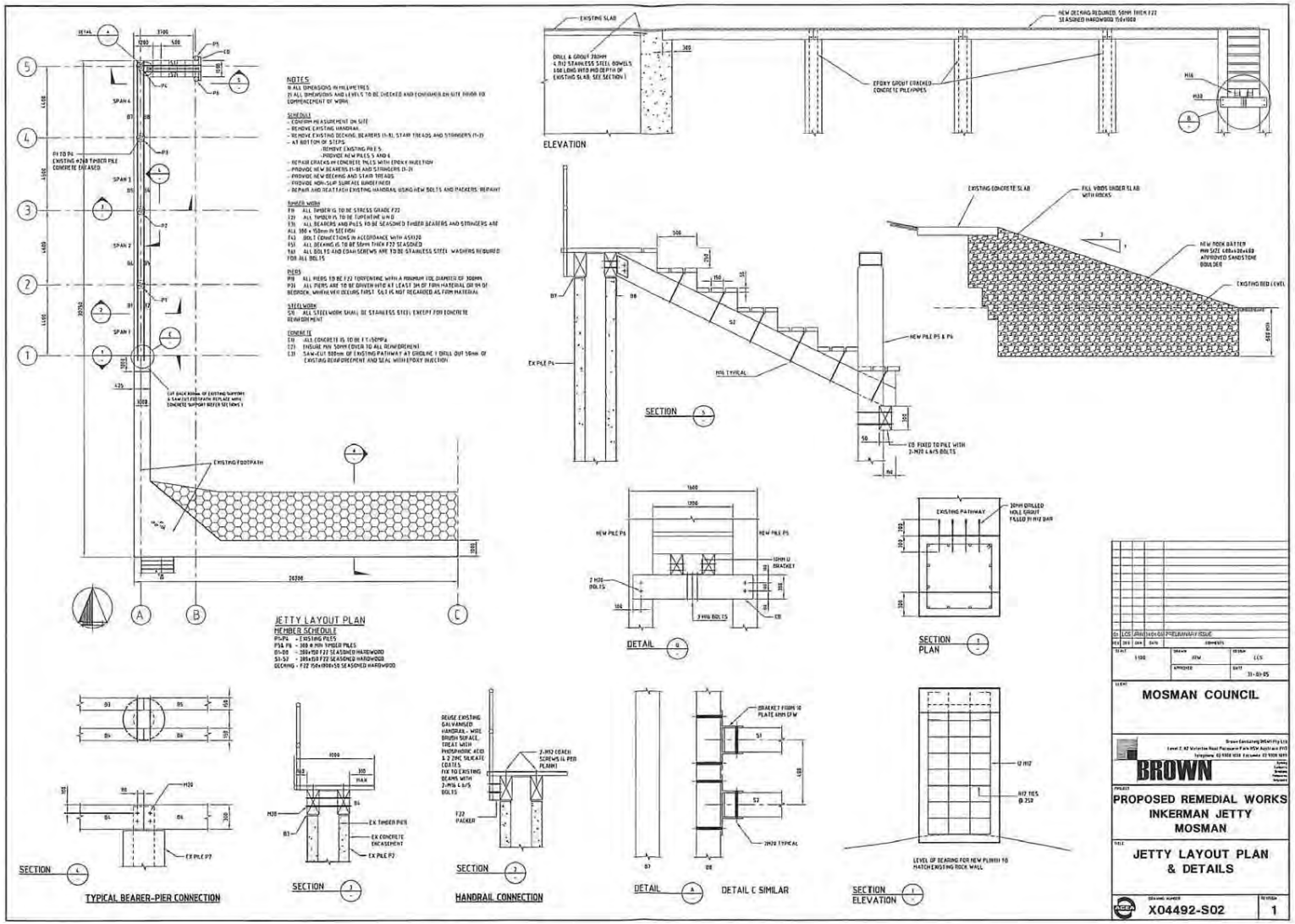
Element 6			
Element Type	Jetty Abutment	**Element Material**	Concrete
Element Dimensions	1m wide, 1.4m high, 1m deep, 0.3m bearing shelf.	**Condition Category:** 1 – good condition	

Element Description:
This concrete abutment is in good condition, except for cracking in the concrete where the handrail post is embedded into the concrete, which requires monitoring. This detail does not allow water to drain out of the handrail post void in the concrete and corrosion will further develop. Eventually this corner of concrete, will require cutting out and the handrail post should be bolted into the concrete so water can drain off easily.

Element 7 – IS1			
Element Type	General information Sign	**Element Material**	Steel
Element Dimensions: Refer to image below		**Condition Category:** 1 – good condition	

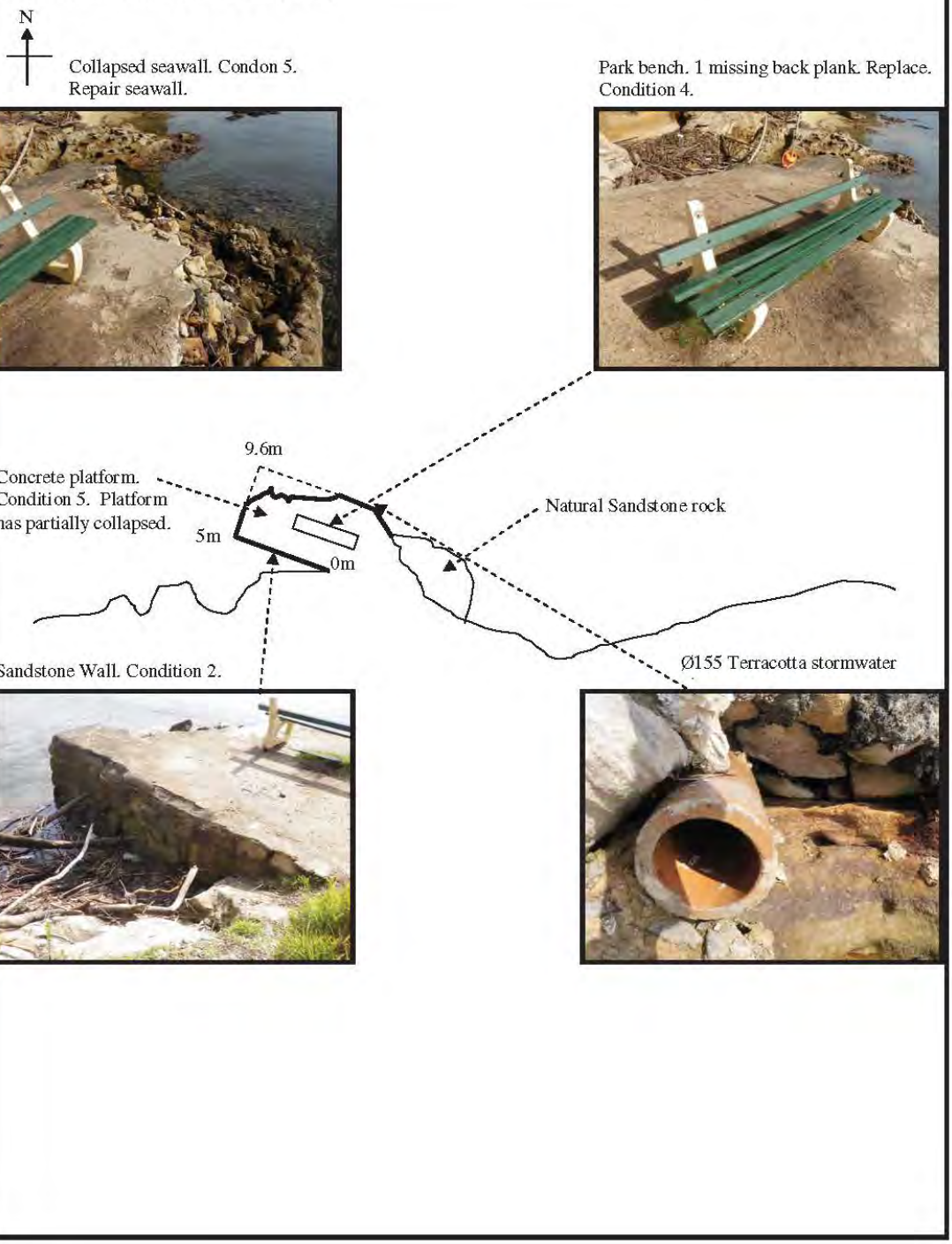
Element Description:
General information sign in good condition. Trim vegetation annually, in order for sign to remain visible.

Marine Structures



Structure Name	Middle Harbour Seawall, RW41			Inspection Date	19.05.11
GPS Location		33°48'29.36"S	151°14'21.65"E	Inspector Name	MJH, AES
				Dimensions: Refer to Sketch	

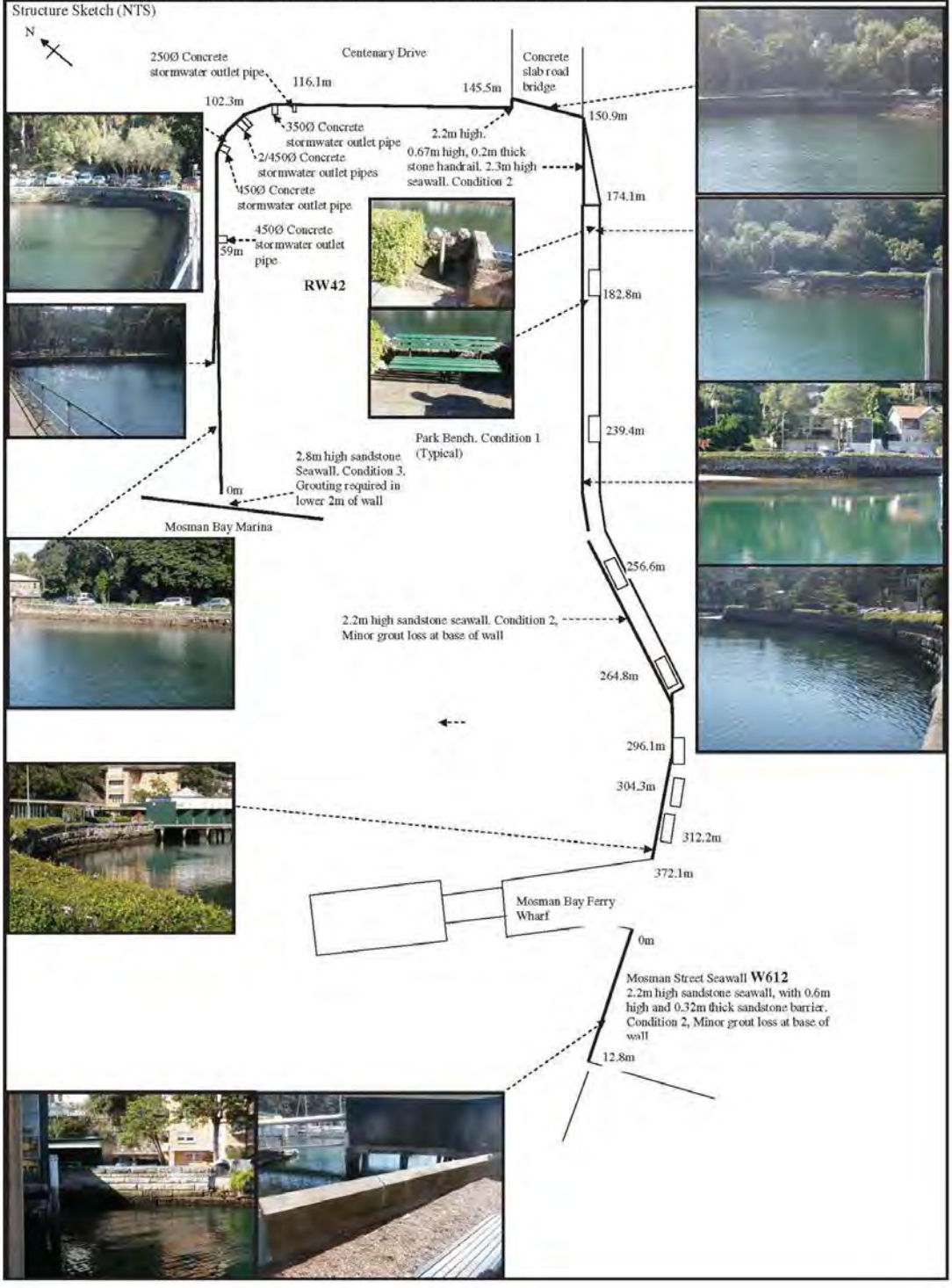
Structure Sketch – Plan View (NTS)



Marine Structures

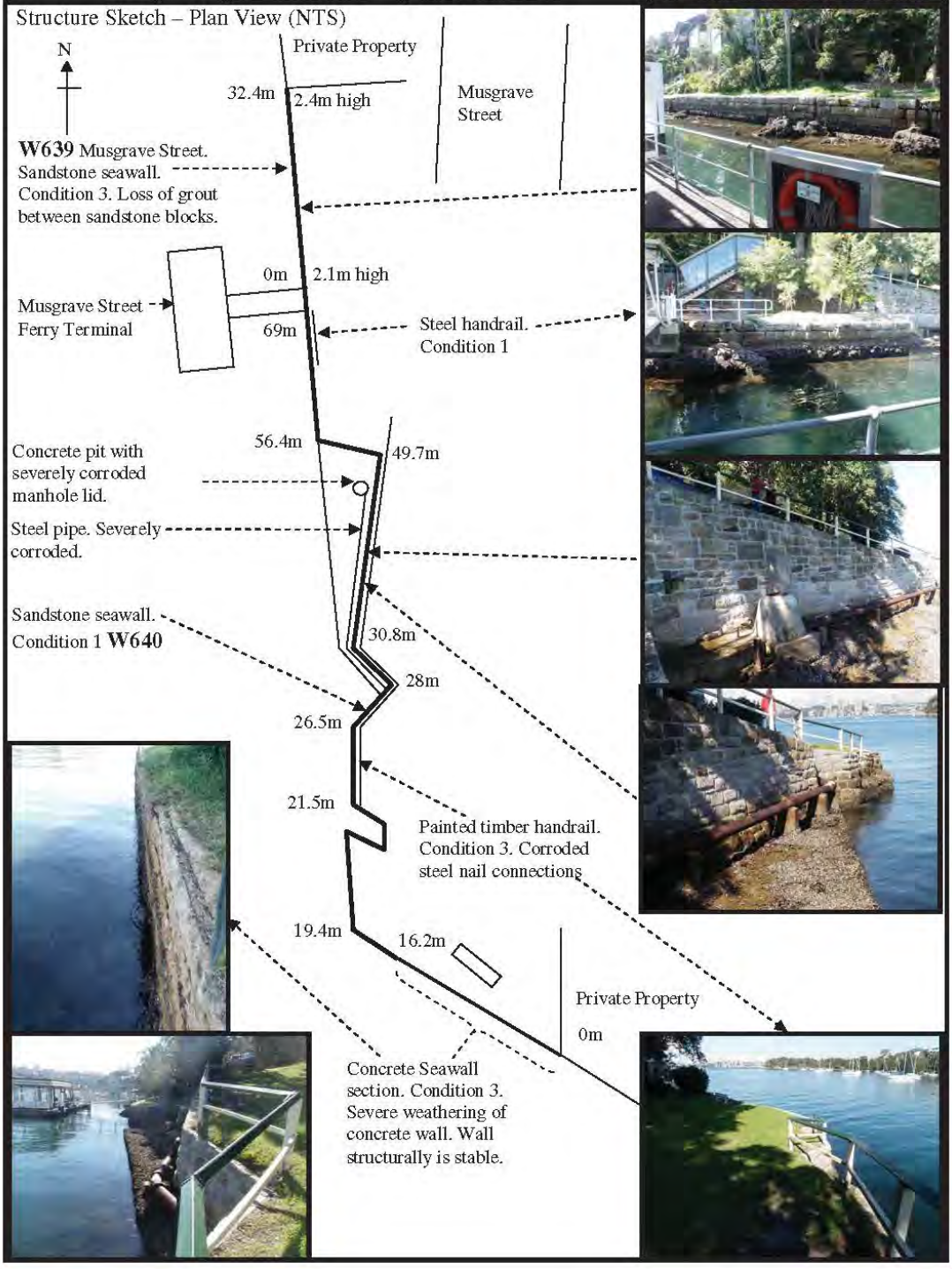
Structure Name	Mosman Bay Seawall, RW42 & W612		Inspection Date	17.05.11
GPS Location	Start	33°50'14.10"S	151°13'55.87"E	Inspector Name	MJH, AES
	Finish	33°50'18.20"S	151°13'57.86"E	Dimensions:	Refer to Sketch

Structure Sketch (NTS)



Structure Name	Musgrave Street Seawalls, W639 & W640			Inspection Date	17.05.11
GPS Location	W639	33°50'36.83"S	151°13'58.12"E	Inspector Name	MJH, AES
	W640	33°50'35.26"S	151°13'57.83"E	Dimensions: Refer to Sketch	

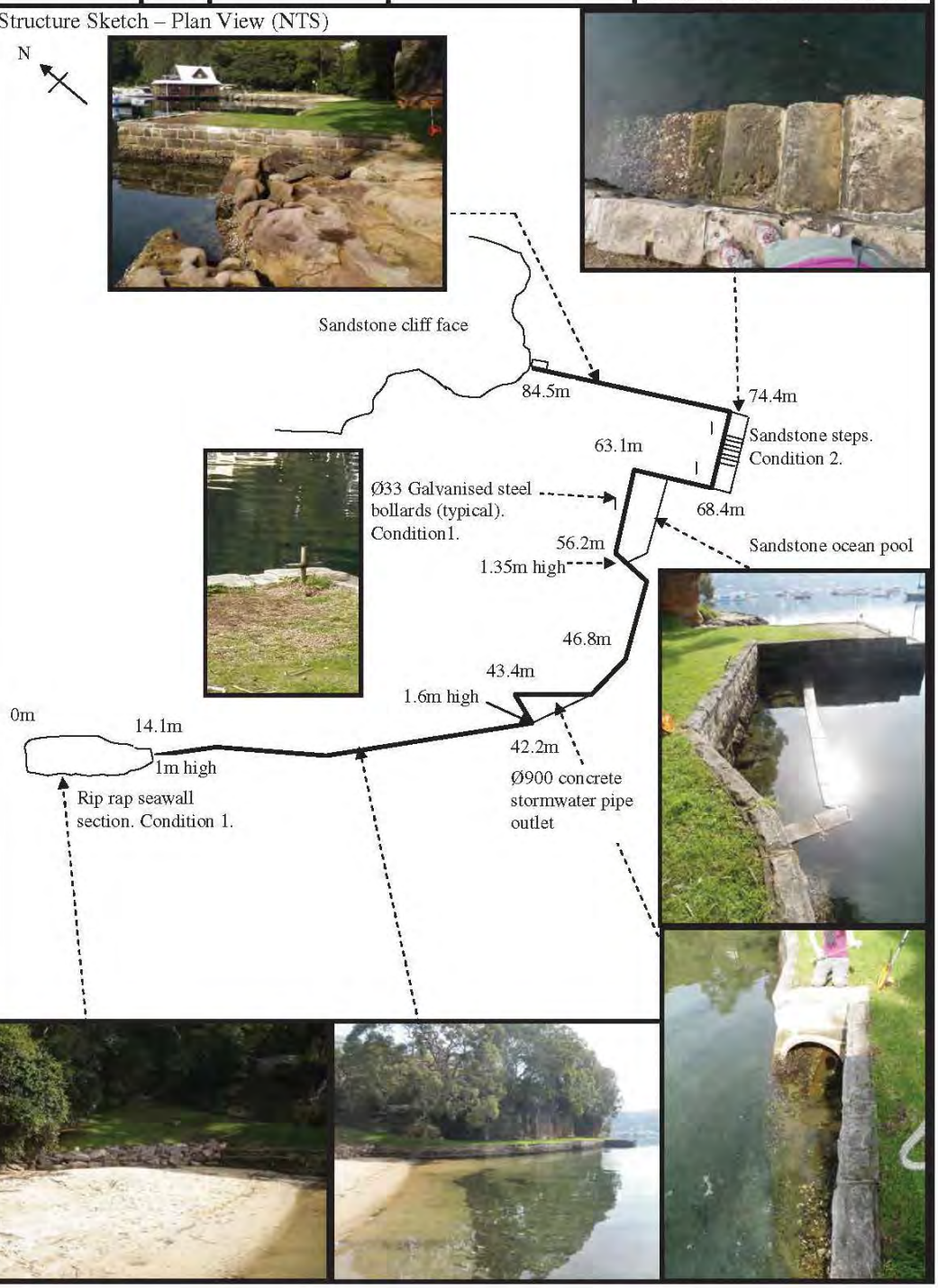
Structure Sketch – Plan View (NTS)



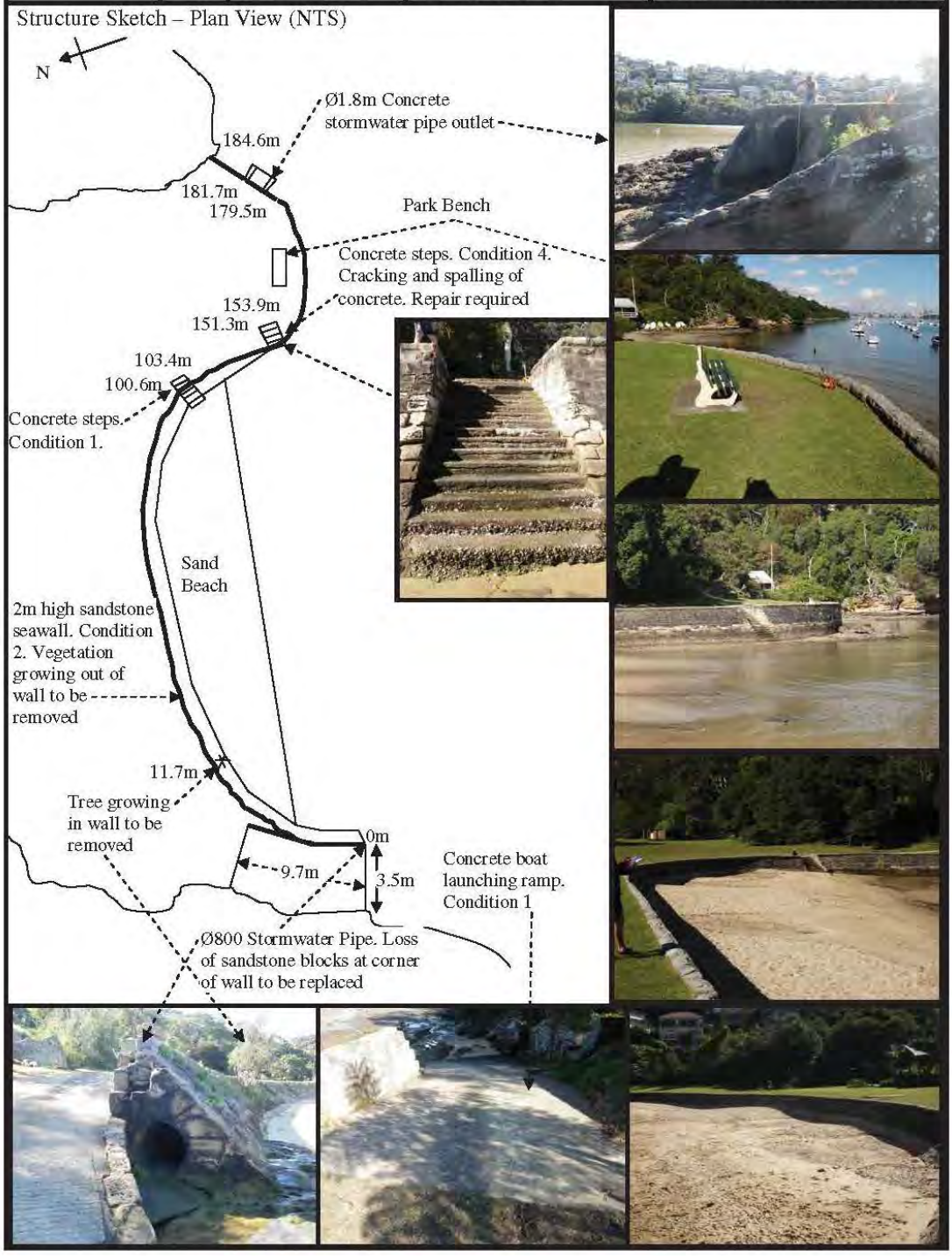
Marine Structures

Structure Name	Pearl Bay Seawall, RW54		Inspection Date	19.05.11
GPS Location	33°48'34.62"S	151°14'34.14"E	Inspector Name	MJH, AES
			Dimensions: Refer to Sketch	

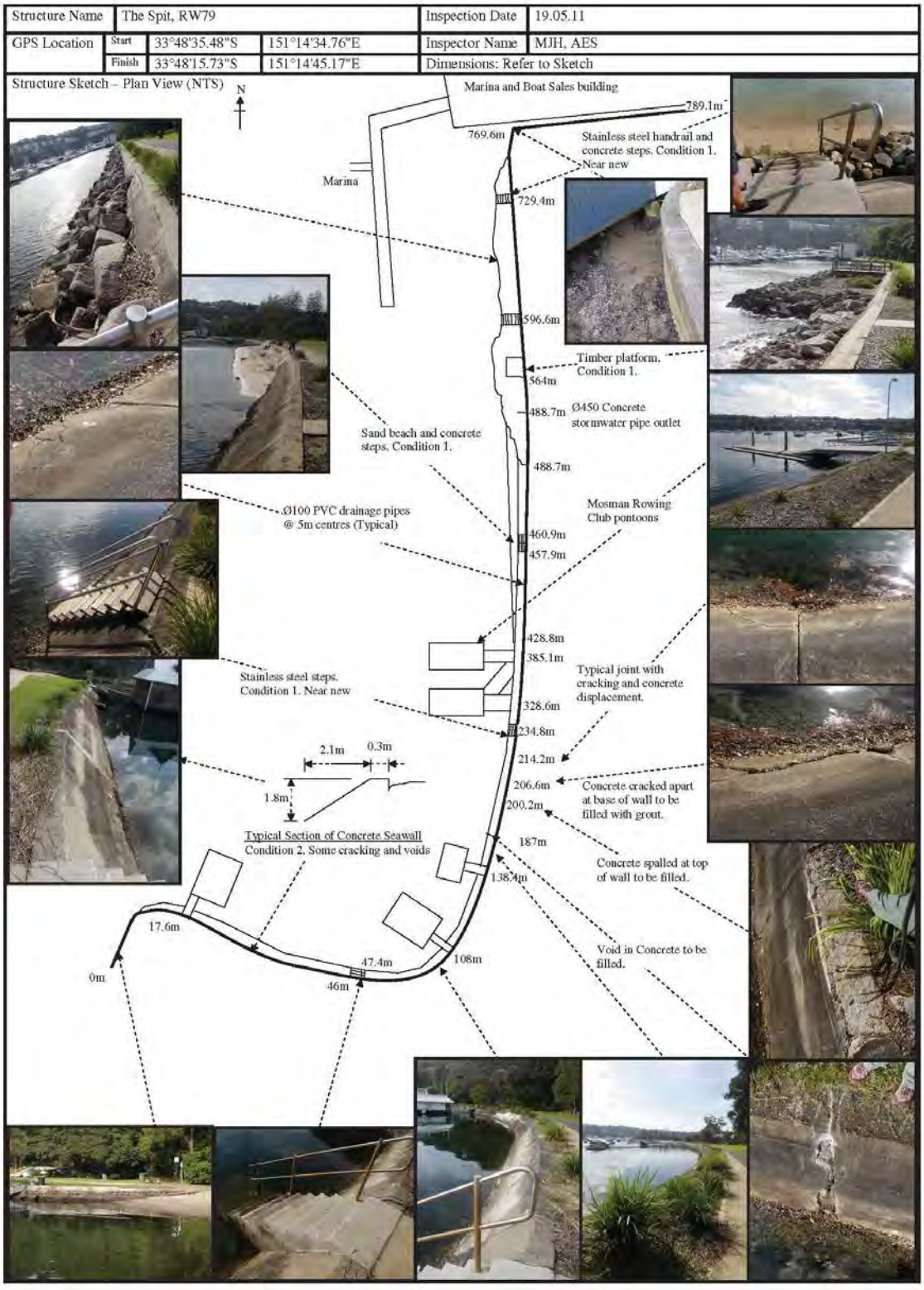
Structure Sketch – Plan View (NTS)



Structure Name	Sirius Cove Reserve Seawall. RW76			Inspection Date	17.05.11
GPS Location	Start	33°50'22.60"S	151°14'11.38"E	Inspector Name	MJH, AES
	Finish	33°50'25.31"S	151°14'15.15"E	Dimensions: Refer to Sketch	

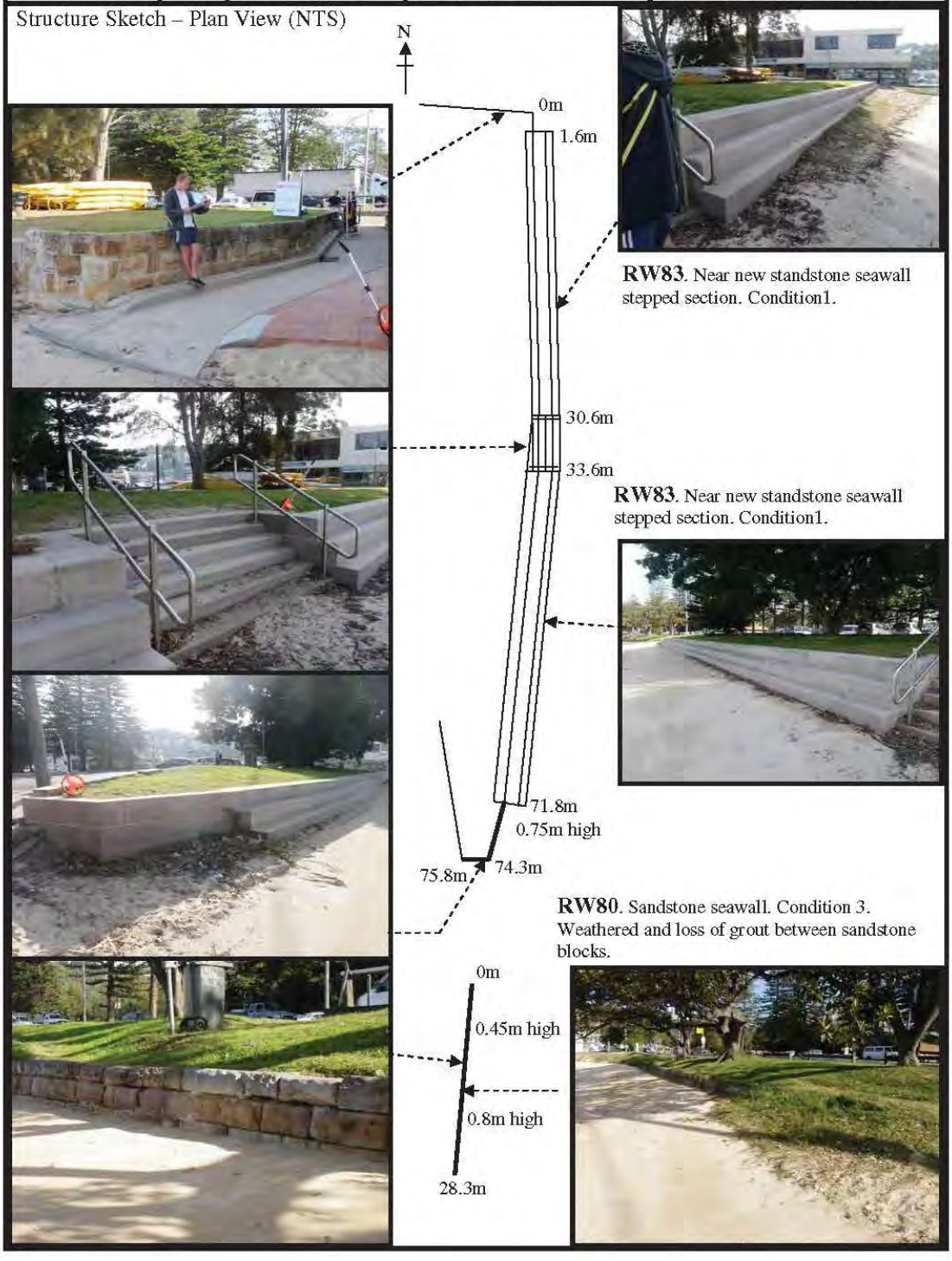


Marine Structures



Structure Name	The Spit Seawalls, RW80 & RW83		Inspection Date	19.05.11
GPS Location	RW80	33°48'18.63"S 151°14'47.48"E	Inspector Name	MJH, AES
	RW83	33°48'16.43"S 151°14'47.55"E	Dimensions:Refer to Sketch	

Structure Sketch – Plan View (NTS)



RW83. Near new standstone seawall stepped section. Condition1.

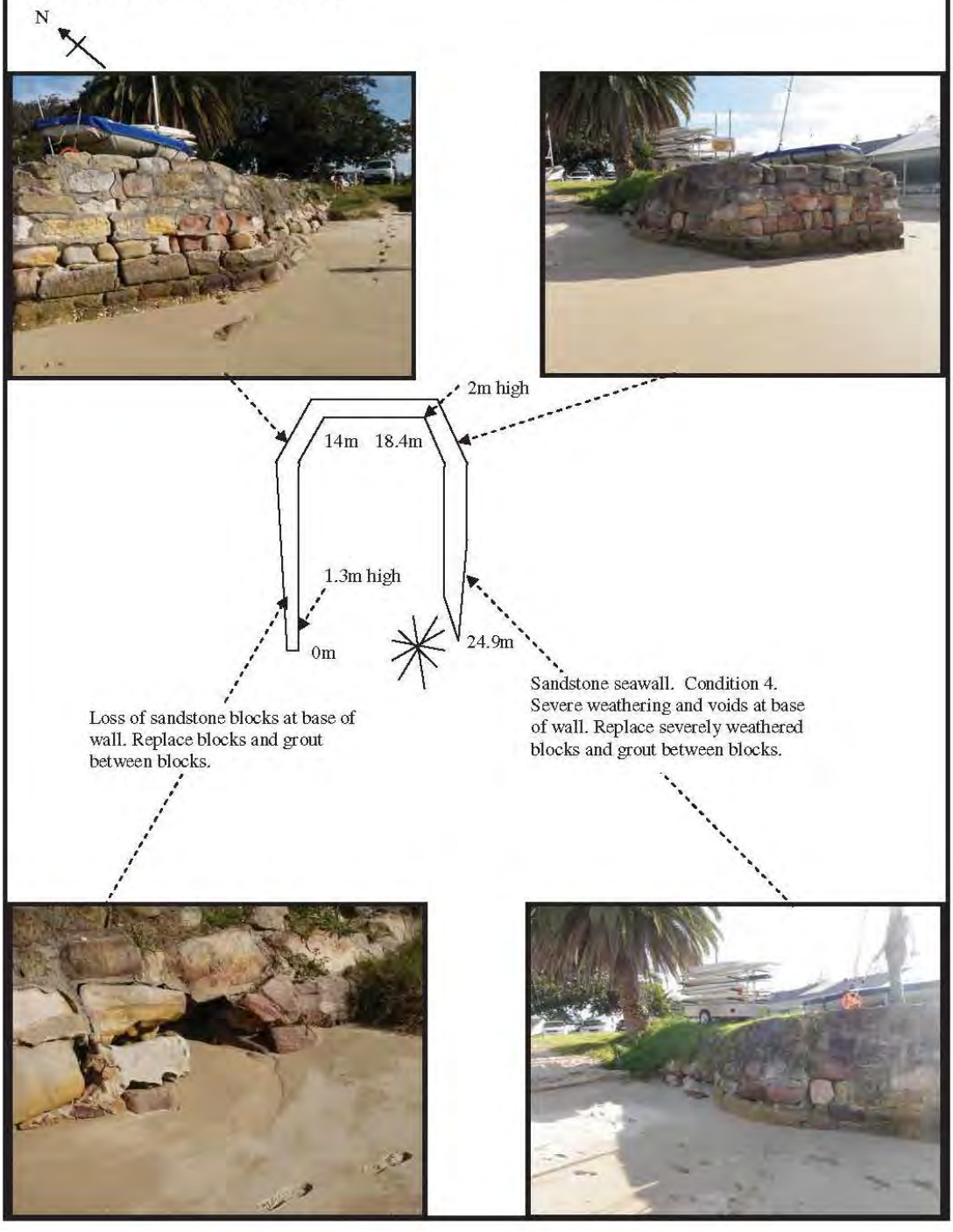
RW83. Near new standstone seawall stepped section. Condition1.

RW80. Sandstone seawall. Condition 3. Weathered and loss of grout between sandstone blocks.

Marine Structures

Structure Name	The Spit, RW81			Inspection Date	19.05.11
GPS Location	Start	33°48'23.61"S	151°14'50.82"E	Inspector Name	MJH, AES
	Finish	33°48'23.78"S	151°14'51.08"E	Dimensions: Refer to Sketch	

Structure Sketch – Plan View (NTS)



Structure Name	The Spit, RW82			Inspection Date	19.05.11
GPS Location	Start	33°48'27.64"S	151°14'53.54"E	Inspector Name	MJH, AES
	Finish	33°48'29.88"S	151°14'54.45"E	Dimensions: Refer to Sketch	

Structure Sketch – Plan View (NTS)

Marine Structures

Appendix B – Underwater Asset Condition Reports

www.divingco.com.au

The Diving Co (NSW) Pty.Ltd
Sub-Marine Contractors
20 Montauban Ave Seaforth
NSW 2092
Ph : (02) 99079900 Fax: (02) 99494764
email: admin@divingco.com.au
ABN 98 002 958 741

Opus International Consultants (NSW) Pty Ltd
PO Box 5340, West Chatswood NSW 1515

27th May 2011

Attn: Michael Hill (Civil Engineer)

RE: MOSMAN COUNCIL HARBOUR POOL SURVEY OF UNDERWATER ELEMENTS AT BALMORAL, CLIFTON GARDENS AND INKERMAN JETTY.

Michael,

Please find information below regarding the underwater survey carried out by The Diving Co NSW Pty Ltd this week the 23rd May to the 27th May 2011.

1. All elements were inspected including timber piles, shark net and support wire, ladders and timber landings.
2. Elements have been photographed and recorded.
3. Piles with significant damage have been noted and photographed. All piles have been inspected and reported on pile inspection sheet.
4. All photographs have been burned to CD and are supplied with pile inspection sheets.

Balmoral harbor pool:

Piles with significant damage:

Pile 7B:	Bottom of concrete casing exposed
Pile 8A:	Bottom of concrete casing exposed
Pile 8B:	Bottom of concrete casing exposed
Pile 24B:	Cavity at necking 50% remaining, cavity at seabed 40% remaining.
Pile 32AR:	Worm damage seabed 30% remaining
Pile 34AR:	Worm damage seabed 60% remaining
Pile 34B:	Cavity at necking 55% remaining, worm damage at seabed 40% remaining
Pile 37A:	Worm damage seabed 70% remaining
Pile 38A:	Worm damage seabed 50% remaining
Pile 38AR:	Worm damage seabed 30% remaining
Pile 39A:	Worm damage seabed 60% remaining
Pile 43A:	Cavity at necking 65% remaining
Pile 45F:	Cavities 2m above seabed 66% pile remaining.
Pile47G:	Cavity at necking 65% remaining
Pile51A:	Worm damage seabed 50% remaining
Pile54A:	Bottom of concrete encasing exposed, worm damage.
Pile 54B:	Bottom of concrete encasing exposed, worm damage
Pile 55B:	Bottom of concrete encasing exposed, worm damage
Pile58A:	Head of pile split
Pile 59A:	Head of pile split
Pile 68J:	Cavity at necking 30% remaining

Balmoral Pool Shark Net:

The shark net support wire has been broken for some time and the net is secured to the underside of the walkway with soft line to keep the top of the net above the high water line.
Large hole at pile row 32 rubbing on raker pile
Large hole at pile row 36 rubbing on raker pile
Large hole at pile row 38 rubbing on raker pile
Small hole at pile row 48 rubbing on raker pile.

Ladders and fixings:

All SS ladders and fixings are in good condition and some have been recently changed by the Divingco.

Starting boards and steel structure:

Starting boards and steel structure in fair condition due to maintenance carried out by Divingco this year. The starting boards have new large diameter ss washers holding the boards as the light weight steel structure is showing deterioration. All elements are currently working but will require continuing maintenance.

Timber Landing:

The timber landing appears to be in good condition however heavy marine oyster growth obscures the timber underneath. No holes are visible.

Clifton Gardens Harbour Pool:

Piles with significant damage:

Pile 4E:	Hole at necking 30% remaining
Pile14D:	Cavity at necking 60% remaining
Pile15E:	Cavity at necking 25% remaining
Pile 17DR:	Cavity at necking 20% remaining
Pile 23D:	Steel can at seabed, appears to have no grout!!
Pile 25C:	Cavity at necking 70% remaining
Pile 21KR:	Hole at necking 30% remaining, Cavity 1m above seabed 70% remaining.
Pile 19P:	Cavity at necking 40% remaining
Pile 21R:	Cavity at necking 70%remaining
Pile 19T:	Cavity at necking 50% remaining
Pile 17T:	Heavy worm damage necking 66% remaining

Clifton Garden Shark net pin piles numbered East to West:

Pile PP3:	Pin pile snapped off 2m above seabed pile FAIL
Pile PP4:	Worm damage at necking 60% remaining
Pile PP5R:	Worm damage necking 50mm remaining pile FAIL
Pile PP6:	Pin pile snapped off 1.5m above seabed pile FAIL
Pile PP8;	Worm damage at necking 50% remaining.

Clifton Gardens shark net:

The SS wire is not connected or tensioned supporting the net across the pin pile area.
Hole on net pile row 4,13,19K,19L,19M,19R,16T, PP1,PP3.

Ladders and fixings:

Ladders and fixings are in good condition.

The timber boat landing

The timber boat landing appears to be in good condition however heavy oyster growth is present on timer structure. No holes are visible.

Inkerman Jetty:

Pile P1: Concrete encased timber pile.
Pile P2: Concrete encased timber pile, top 200mm of case cracked and broken.
Pile P3: Concrete encased timber pile, top 300mm of case cracked and broken. Pile head split and rotting.
Pile P4: Concrete encased timber pile, top 500mm of casing starting to crack.
Pile P5: Pile OK but worm damage along length of pile. Timber landing stairs disconnected at P5, needs spacer block and re-bolting. Waler OK.
Pile P6: Pile OK but worm damage along length of pile.

Timber bearers:	150 mm x 300mm
Decking timbers:	1.1m x 140mm x 50mm
Stairs:	1.1m x 140mm x 50mm

Timber landing stairs in poor condition or non existing.

Please contact the writer at any time regarding this report.

Regards

Mark Dowd (Diving Superintendent)
The Diving Co NSW Pty Ltd.

www.divingco.com.au

Appendix C – Inspection and Condition Assessment Procedures

Mosman Marine Assets Inspection and Condition Assessment Procedures

Condition Assessment Grading Standard

This standard describes the condition values applied in the assessment of the condition of the marine assets of Mosman Council.

A common industry condition grading methodology was applied for the assessment of the condition of the marine assets. The method is adapted from the International Infrastructure Management Manual, Appendix B Figure B3, which is designed for application to civil structures.

This methodology has been selected as it applies for long life civil structures equivalent to the sea wall and timber pile and frame structures. With the exception of the immersed length of the marine piles, the materials used in these civil structures normally deteriorate slowly and are serviceable for lives of 25 years or greater. Mild steel connection components used previously degrade in the salt water proximate zone, but are generally of robust dimensions in order to delay failure due to corrosion. Stainless steel connections are now more commonly used, and provide a service life exceeding 25 years.

Grade Condition Description	Grade Condition Description	Grade Condition Description
0	Non-existent	Asset no longer exists
1	Very good	Sound physical condition. Asset likely to perform adequately without major work (for the period expected for full design life).
2	Good	Acceptable physical condition, minimal short term failure risk but expected to deteriorate in the long term (10 years plus). Only minor work required (if any).
3	Fair	Significant deterioration evident; failure unlikely within next 2 years but further deterioration likely and replacement likely within next 10 years. Work may be required but asset is still serviceable: minor components or isolated sections of the asset need replacement or repair now, but asset still functions safely at an adequate level of service.
4	Poor	Failure likely in the short term. Likely need to replace most or all of the asset within 2 years. Substantial work required in short term, asset barely serviceable: no immediate risk to health or safety but works required within 2 years to ensure asset remains safe.
5	Very poor	Failed or failure imminent. Major work or replacement required urgently. Immediate need to replace most or all of asset. Health and safety hazards exist which present a risk to public safety, or asset cannot be used without risk to users.

Inspection Procedure

Inspections will be performed by an engineer experienced in civil structures in the marine environment, with a developed appreciation for the performance of materials in marine exposure locations.

The inspecting engineer will be accompanied by another person to assist in the asset identification and recording tasks, and to provide safety assistance.

Marine Structures

Both members of the inspection team are to be competent swimmers and aware of foreshore hazards.
The work will be performed within the controls scheduled in the safe work method statement.

The jetty structures are inspected above the waterline from the deck above, and from a small vessel.
Divers are to inspect all components below the waterline.

All assets are to be recorded in photographs, and located spatially. Inspections are limited to the visible surfaces of the assets. The condition of the surfaces will be determined by manual probing of defects in order to establish the extent, nature and severity of the defect. Wherever practical, a photograph of the defect will be taken to record the extent and nature of the defect. The interior of the assets are not tested.

Jetty Structures

The jetty structure assets to be assessed include:

- Piles including raker piles
- Girders
- Capwales
- Cross bracings
- Decking
- Turning board assemblies
- Hand rails
- Steel ladders
- Furniture (including signage)
- Shark nets and supporting structures/cables
- Protective structures
- Stormwater outlet structures
- Sandstone ledges
- Wall foundations
- Vertical walls
- Slope protection

Assessing the performance of timber piles

Timber piles are assed for their serviceability at any connections and in their integrity. Marine borer attack, marine organism growth, and decay all impact upon timber performance. The loss of section diameter is recorded, and a loss of 50% is adopted as condition 5 – end of serviceable life.

Timber marine piles within Sydney Harbour have in recent years become more susceptible to aggressive rates of deterioration due to marine borer attack. There are several reasons postulated for the shorter life expectancy now being experienced, including the cessation of the use of timbers infused or coated with marine borer deterrent chemical treatments, using logs of less maturity, using logs not containing natural deterrent oils, and an improved harbour water habitat for marine borers.
The same timbers are performing well outside the saturation zone.

Sea Wall Structures

Seawalls are to be inspected at low tides, or when the tide provides adequate vision of the wet wall face. No inspections are undertaken below ground surface.

Wall Inspection attribute data is to include:

- Wall Identity
- Inspection Date
- Inspector
- Wall Location
- Material
- Structural form
- Wall face Length
- Wall retained height
- Wall face slope dimension
- Foundation condition
- Water face condition, jointing and wall elements
- Capping condition
- Assessed remaining life (inclusive of routine maintenance)
- GIS identifier
- Photograph references

For each defect identified, the following attribute data is to be collected:

- Defect ID
- Location of defect
- Description of wall panel deformities or other defects
- Dimensions of Defect: Length
- Face slope dimension
- Mode of failure
- Probable cause of distress
- Severity
- Defect Implication/ Consequence
- Repair method

Marine Structures

- Estimated Priority
- Photograph references

Selection of Timber for Marine Structures in Sydney Harbour

Timbers of NSW used for Marine Structures

Extracted from K R Bootle (1971)"The Commercial Timbers of NSW and Their Use".

Marine piles are usually partially in mud, partly in tidal water, plus a relatively small section above water level. The embedded section is free of hazard while the top section is only subject to weathering and mechanical abrasion; the middle section is subject to the very great hazard in New South Wales waters because of attack by marine borers, and protection is necessary either in the form of impregnation of the wood with toxic chemical or barriers such as copper sheathing and floating collars of creosote. Turpentine is the only species with much natural resistance to marine borer attack. Other species selected for use will need a wide sapwood to provide an adequate barrier of preservative treated wood. All knots, damaged sapwood, etc, in the area of hazard must be protected with a mechanical barrier even though the pile has been preservative treated. Species and treatment recommended vary with location of piling, and the advice of the Forestry Commissions Division of Wood Technology should be sought for each particular application.

Rubbing strakes and fender piling: Brush box.
Girders, corbels, headstocks: Ironbark, grey gum, spotted gum, white mahogany.
Decking: Blackbutt, brush box, grey box, yellow stringybark, tallowwood, turpentine.
Piles: Red bloodwood, grey gum, ironbark, white mahogany, turpentine.

In waters where marine organisms are very destructive, turpentine is the best species. It is common practice to use turpentine with the bark left intact on the pile, the purpose being to prevent lodgement of Cobra larvae. It is not so effective against Limnoria and Sphaeroma, but it has been estimated that it adds an extra 3 months to 5 years of life to the pile, varying with the types of marine organism present.

In Sydney Harbour Cobra does not attack turpentine piles severely, even when bark is absent. Limnoria is a crustacean which works in any depth of water but does not attack heartwood. Sphaeroma is another crustacean which attacks the surface layers of wood. Its speed of attack on turpentine is slow and is confined to the inter-tidal zone.

Nausitora is a molluscan borer of the Cobra family which can attack turpentine severely but is only found in water of low salinity, as at the head of tidal limits.

Marine Structures

The hazard from marine organisms varies greatly with water temperature and salinity levels. In tropical areas no timber, even when impregnated with preservatives, is completely free of attack.

Turpentine has outstanding marine borer resistance and in temperate zones should give many years of satisfactory service but in some tropical waters even it may last only a few years so it is essential to know the actual conditions of the port before making recommendations.

If turpentine is unavailable, preservative treated hardwood or softwood can be used. In tropical waters they too may have a similarly limited service life, For best performance, softwoods are given a double lot of pressure impregnation., first with copper-chrome-arsenic salts to a loading of 1 5 - 2 lb/cu. ft and then with creosote until about 20 lb/cu. ft is absorbed. Eucalypt hardwoods are pressure treated to a loading of 17 to 20 lb/cu. ft of creosote.[1]
If Limnoria are present in the water eucalypts seem to give a better performance than the softwoods.

Author's Notes:
1. Copper-chrome-arsenic salts and Creosote are no longer generally applied treatments due to the health and safety hazards in handling and the application process.
2. An emerging treatment method for the mechanical protection of piles is described in the journal article:
A Case Study on the Use of Advanced Fiber Wrap Composites for Timber Pile Repair and Protection of a Pier Structure; T. Jiménez, D. Kost, and J. Percival, ASCE Conference Proceedings, August 21, 2011, Volume 422, Issue 41190.

Appendix D – Annual Maintenance and Renewal Plans

Mosman Marine Assets Annual Maintenance and Renewal Plans

Structures

Seawalls

Pool

Marine Structures

Year 1 2011 – 2012 Marine Structure	Deficiency	Recommended Action	Indicative Cost Estimate $ Per item (excl. GST)
BB1, BB2 - Balmoral Baths and Jetty Renewal Plan	Pile 24B, Cavity at tidal zone of pile. Cavity at seabed.	Prop adjacent decking and replace pile	9,000
	Pile 32AR, Worm damage seabed	Prop adjacent decking and replace pile	9,000
	34B, Cavity at tidal zone of pile, worm damage at seabed	Prop adjacent decking and replace pile	9,000
	Pile 38A, Worm damage seabed	Prop adjacent decking and replace pile	9,000
	Pile 38AR, Worm damage seabed	Prop adjacent decking and replace pile	9,00
	51A, Worm damage seabed	Prop adjacent decking and replace pile	9,000
	Pile 68J, Cavity at tidal zone of pile	Prop adjacent decking and replace pile	9,000
	Headstocks at pier 29 has severely weathered ends	Remove decking and replace headstocks	2,000
	Advanced corrosion of miscellaneous structural bolts throughout structure (5%). Confirm locations by inspection	Replace / Supplement	7,000
	Moderate corrosion of miscellaneous steel girder splice plate. Confirm locations by inspection. (Pile 44B)	Replace plate	1,750

Year 1 2011 – 2012 Marine Structure	Deficiency	Recommended Action	Indicative Cost Estimate $ Per item (excl. GST)
	Advanced corrosion of handrail post bolts connecting to timber girders throughout structure.	Replace bolts	5,000
	Vertical timber bumper rails bolted to the fender piles on the eastern landing jetty have extensively weathered at the tidal zone	Replace vertical timber bumper rails bolted to the 7 fender pile, on the eastern landing jetty	2,200
Indicative Budget			**80,950**
BB1, BB2 - Balmoral Baths and Jetty Maintenance Plan	Pile 58A, Head of pile split	Strap head of pile to prevent expansion of pile splitting.	500
	Pile 59A, Head of pile split	Strap head of pile to prevent splitting of pile expanding	500
	Remove marine growth on the lower members of the north eastern berthing platform.	Clean growth to inspect condition of members	1,500
	Moderate corrosion of miscellaneous diagonal bracing plate/bolt connections. Confirm locations by inspection. (i.e. 44B)	Clean and paint, or replace.	2,600
	Remove corroded steel and loose timber formwork under concrete deck	Tighten coach bolts or relocating bolts to gain better connection	1,000

Marine Structures

Year 1 2011 – 2012 Marine Structure	Deficiency	Recommended Action	Indicative Cost Estimate $ Per item (excl. GST)
	Marine growth build-up within tidal zone, on all 8 ladders.	Clean all ladders annually	700
	Wire fence at southern end of jetty is unstable due to corroded base connections	Remove fence or repair base steel posts	1,500
	Miscellaneous timber components	Borer inspection	1,500
	Marine growth on tidal zone of swimming turn boards	Clean off marine growth annually	700
	Broken steel wire on swimming turn boards	Repair wire on lifting mechanism. Clean and paint corrosion and maintain turn boards	600
	Shark net - Large hole at pile row 32 rubbing on raker pile	Patch shark net with a net section of net stitched into the existing net	3,500
	Shark net - Large hole at pile row 36 rubbing on raker pile	Patch shark net with a net section of net stitched into the existing net	3,500
	Shark net - Large hole at pile row 38 rubbing on raker pile	Patch shark net with a net section of net stitched into the existing net	3,500
	Shark net - Small hole at pile row 48 rubbing on raker pile	Patch shark net with a net section of net stitched into the existing net	3,000
	Broken light bulb and casing on landing jetty	Repair light on landing jetty	200
Indicative Budget			**24,800**

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