APPENDIX 2a - What is the design of the infrastructure?

Scheme overview schematic

System overview schematic

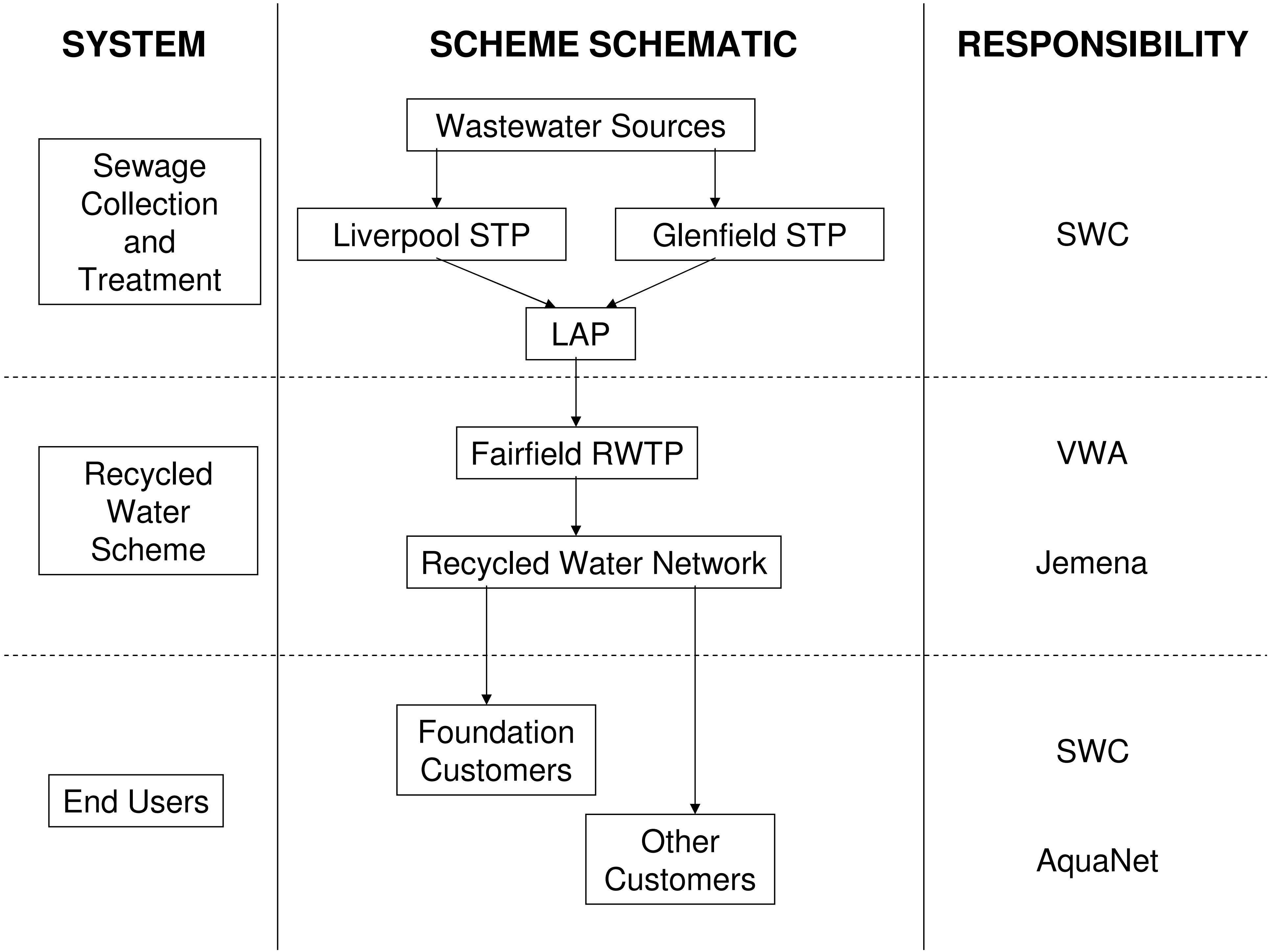
Technical Sufficiency – Schedule 6 of tender submission.

Certainty of Delivery - Schedule 7 of tender submission

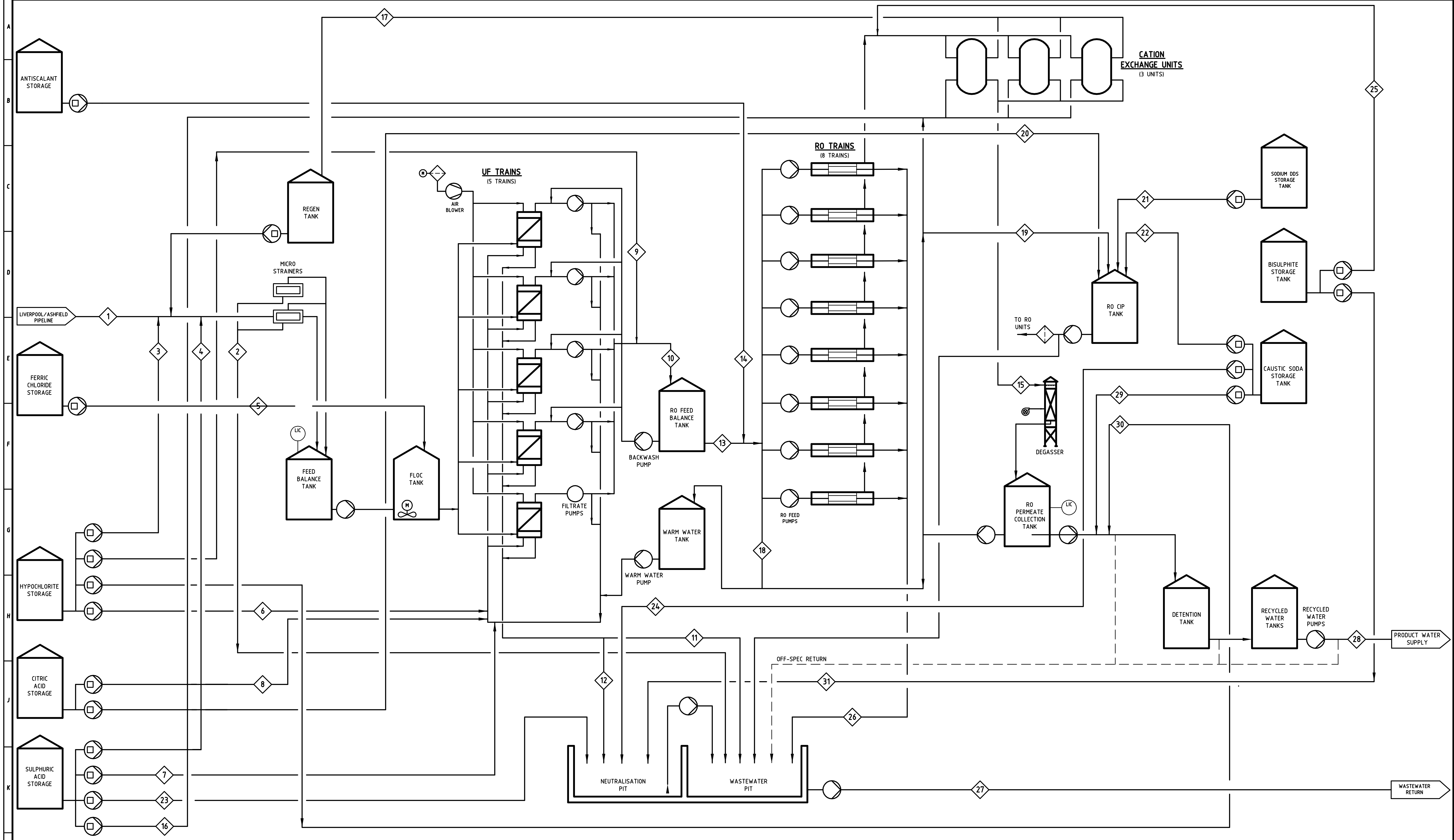
WCWRP Validation Plan

Report prepared by the Independent Verifier KBR on the project as tendered.

Verification Management Plan


SYSTEM
SCHEME SCHEMATIC
RESPONSIBILITY
Sewage Collection and Treatment
Wastewater Sources
Liverpool STP
Glenfield STP
LAP
SWC
Recycled Water Scheme
Fairfield RWTP
VWA
Recycled Water Network
Jemena
End Users
Foundation Customers
SWC
Other Customers
AquaNet

SYSTEM	PROCESSES	RESPONSIBILITY
Treatment System	Primary Secondary	SWC
	Advanced: Micro-strainer Coagulation Reverse Osmosis Ultra-filtration Ion Exchange Disinfection	VWA
Storages	Recycled Water Reservoirs Fairfield, Woodville Rd, Camellia	Jemena
Distribution Systems	SWC Sewerage System Glenfield effluent pipeline Liverpool to Ashfield pipeline (LAP)	SWC
	Recycled water network (pipelines)	Jemena



Stream ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Description	Feed	Str Flush	Hypo	Sulphuric	Ferric	Hypo	Sulphuric	Citric acid	Hypo	Filtrate	Backwash	CIP	RO Feed	Antiscalant	Permeate	Sulphuric	Recycle	RO flush	CIP water	Citric acid	Na DDS	Caustic	Sulphuric	Caustic	Bisulphite	Conc	Waste	Product	Caustic	Hypo	Bisulphite
Flow, L/sec	325	1.4								293	33	0.1	292		234		0.8	1.0	1.1							58	92	231			
TDS, mg/L	575	575	-	-	-	-	-	-	-	575	575	3000	574	-	50	-	0.1	50	50	-	-	-	-	-	-	2700	2000	56	-	-	-
NH4, mg/L	33	33	-	-	-	-	-	-	-	33	33	0.1	35	-	3	-	836	0.1	0.1	-	-	-	-	-	-	164	116	0.1	-	-	-
Chemical, kg/day	-	-	746	1194	1389	7.2	7.3	18	106	-	-		-	75	-	788	-	-	-	34	0.2	1.8	1.1	45	2.9	-	-	-	436	200	193

REV	REVISION	DRAWN	CHECKED	APPVD.	DATE	REV	REVISION	DRAWN	CHECKED	APPVD.	DATE
3	REVISED	SLM			26/07/07						
2	REVISED	SLM			06/07/07						
1	TENDER ISSUE	SLM			26/03/07						
0	ORIGINAL	SLM			19/01/07						

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• THIRD ANGLE PROJECTION

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VEOLIA WATER Solutions & Technologies

CUSTOMER SYDNEY WATER

TITLE CAMELLIA RECYCLED WATER PROJECT
PROCESS FLOW DIAGRAM - 20 MLD

SCALE : NTS
CLIENT DRAWING No.
SIZE A1
DRAWING No. B0223-P-0000-01
ISSUE 3

RETURNABLE SCHEDULE 6

TECHNICAL SUFFICIENCY

C3.1	**Technical Sufficiency of the System**	Technical evidence of robustness, operability, flexibility and maintainability of proposed system including treatment plant, pumping systems, storage and reticulation to deliver recycled water

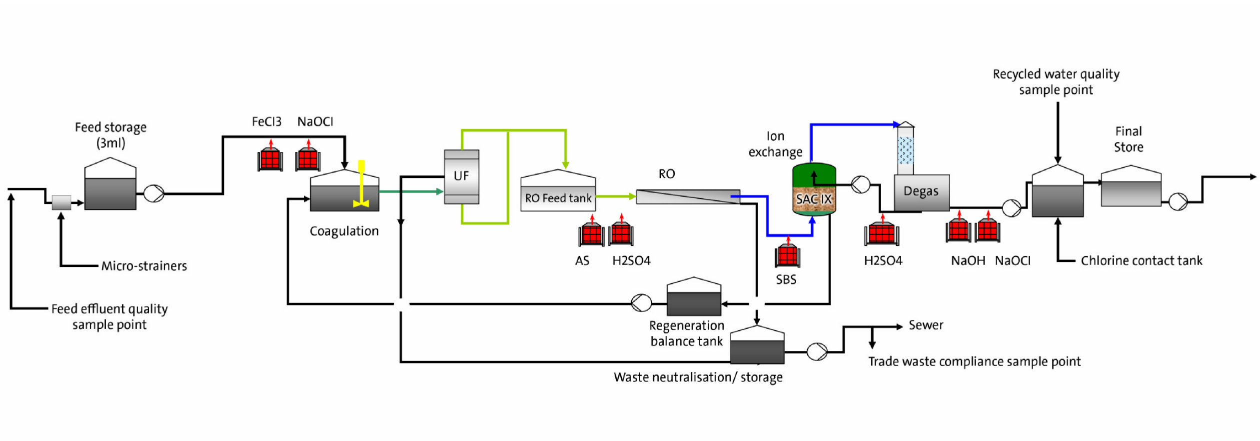
INTRODUCTION

This schedule provides a detailed description of the design for the Camellia Recycled Water project plant and network, which is used to demonstrate the technical sufficiency of the overall system.

SYSTEM DESIGN SUMMARY

The Camellia Recycled Water Treatment Plant (Plant) is designed for an initial treated water output of 20 ML/day (“initial design”) with the ability to cost-effectively expand to an output of 25 ML/d (“expansion design”) to meet expected future demand for recycled water. The Plant will take secondary treated effluent from the LAP located at the boundary of the Fairfield SSTP.

The plant design ensures AVA can safely and reliably produce recycled water that meets the specification. The robust design also ensures that high quality recycled water can continue to be produced even during times of varying effluent quality. As such, AVA has maximised the time in which recycled water will be produced and hence the potable water savings from the scheme.



Key features of the plant include:

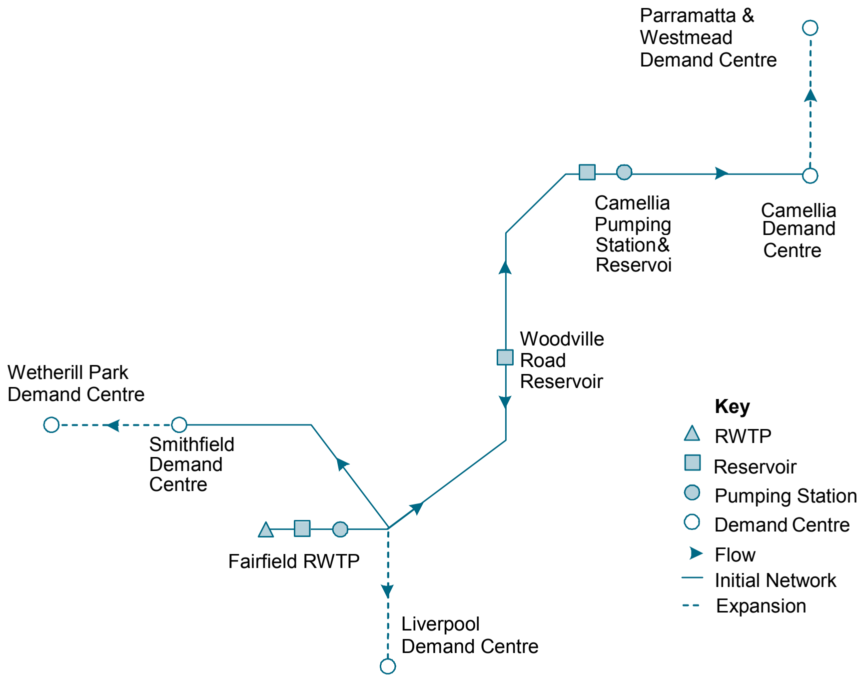
- Ability to manage variations in the feed effluent quality
- Additional production capacity to secure the supply to both foundation and additional customers
- Certainty with regards to meeting the recycled water specifications.

To manage variations in the effluent quality, AVA has added an effluent storage tank to the inlet of the plant. This will maintain effluent supply in the event of short-term excursions in effluent quality. In order to protect the UF membranes from fouling, an additional process step of coagulation has been added. Coagulation prior to UF will help with the removal of some TOC and BOD and will reduce the risk of oil and grease fouling the UF membranes. A conservative UF design flux has also be applied to allow an increased load on the membranes and the operational costs include an allowance for increased cleaning of the UF membranes.

To ensure the plant can reliably achieve the recycled water specification, especially in relation to ammonia, an ion exchange unit has been included. This process is used to polish the RO permeate, reducing the ammonia and the TDS, without significantly increasing the concentrate disposal. In addition, a chlorine contact facility has also been incorporated.

AVA has designed an efficient water recycling plant in keeping with the ideals of energy efficiency. Furthermore, in comparison with water produced by desalination, the energy consumption from water recycling plants is low. When operating at its maximum production of 20 ML/d and under average conditions, the Camellia RWTP will consume 1.4 MWh of electricity to produce 1 ML of water. In comparison, a desalination plant might be expected to consume in the order of 3.8 MWh of electricity per ML under average conditions.

The network configuration for the proposed design is summarised in the following figure and tables.



Summary of Proposed Design Key Components	
Network Capacity	
Average Day Demand (ML/day) – Initial	12.9
Average Day Demand (ML/day) – Expansion	20
Max Day Demand (ML/day) – Initial	23
Max Day Demand (ML/day) - Expansion	32.6
No of Customers – Initial	7 Foundation + 6 non-foundation
No of Customers – Expansion	Initial case + at least 20 Non foundation
Treatment Plant	
Location	Fairfield SSTP
Output – Initial	20 ML/d
Output – Expansion	25 ML/d
Fairfield Pump Station	
Installed Capacity	555 kW (duty/duty/standby)
Pumping Capacity	28 ML/d
Camellia Pump Station	
Installed Capacity - Initial	135 kW (duty/duty/standby)
Installed Capacity - Expansion	180 kW (duty/duty/duty/standby)
Pumping Capacity - Initial	13 ML/d
Pumping Capacity – Expansion	17 ML/d
Reservoirs	
Woodville Rd Elevated Reservoir	0.7 ML
Fairfield Plant Recycled Water Tank	3 ML
Camellia Surface Reservoir	6 ML
Pipelines	
Pipeline Length	19.9 km
Pipe Material	PVC-O, GRP and PE100
Design Basis	Peak Daily Flow
Pipe Class	PN16 & PN10
Maximum Pressure	75 m

The 20km network design utilises 5km of isolated gas main in Woodville Rd. Use of the isolated gas main provides significant triple bottom line benefits and provides access to Woodville Golf course which is the most elevated point in the area. Security of supply is maximised by utilising this elevation, a zonal design and by including 9ML of distributed storage capacity. The network route also minimises public land issues and has support from local government.

The network utilises Alinta's existing Parramatta Control Centre for 24 hour system and network monitoring encompassing the management of customer service and emergency response. The Foundation Customers and top-up connection points will be provided with intelligent magnetic flow meters providing real time data that will utilised by the SCADA system to monitor and control the recycled water network. Line-of-Main customers will be supplied with remote actuated valves so that supply can be adjusted to ensure the contracted levels of service to the Foundation Customers.

DESIGN TECHNICAL DESCRIPTION

The Camellia Recycled Water Treatment Plant (Plant) is designed for an initial treated water output of 20 ML/day ("initial design") with the ability to cost-effectively expand to an output of 25 ML/d ("expansion design") to meet expected future demand for recycled water. The Plant will take secondary treated effluent from the LAP located at the boundary of the Fairfield SSTP. The network configuration for the proposed design is summarised in the following figure and tables.

Plant Process Description

The newly designed treatment train is more robust than the process previously proposed by AVA and includes equipment designed to protect the UF and RO membranes against fluctuations in effluent quality.

A 3 ML/d effluent storage tank has been added to the inlet of the plant in order to maintain effluent supply in the event of short-term excursions in effluent quality which cannot be accepted into the Plant for risk of damage to the membranes. Such events will be limited to excursions in certain key effluent characteristics which pose substantial risk to the ultrafiltration (UF) and reverse osmosis (RO) membranes. Effluent storage will mean that the intake of effluent to the plant can be stopped for a period of some hours while production of recycled water continues.

This effluent storage tank will have the additional advantage of being able to buffer some of the diurnal flows which may be present in the LAP. However, as AVA has received no information from SWC regarding the predicted operation of the LAP, AVA cannot at this stage confirm whether all diurnal variations could be managed by a 3 ML tank.

Recycled water storage at the outlet of the plant and within the network will also allow continuity of supply to the recycled water customers during short periods of plant shutdown.

Membrane filtration is the accepted method of pre-treatment for secondary or tertiary treated sewage prior to treatment by reverse osmosis, and AVA's new concept design retains the submerged UF system proposed in its April submission. In order to protect the UF membranes from fouling due to variations in effluent quality, basket strainers have been retained in the concept design and an additional process step of coagulation has been added. Coagulation prior to UF will help with the removal of some TOC and BOD and will reduce the risk of oil and grease fouling of the UF membranes.

The membrane filtration stages remain similar to that proposed in AVA's April 2007 submission; however lower flux rates in the UF system have been employed to provide increased robustness against membrane fouling. With four UF trains operating, the operating flux will be 41 L/m^2h, while when the standby train is also operational the flux will drop to only 33 L/m^2h. It is anticipated that all five trains will be kept in operation the majority of the time in order to ensure the lowest flux through the UF, unless one train is being backwashed or cleaned.

In order to ensure that the recycled water meets the specification provided by SWC, particularly with regard to ammonia, AVA has added a cation exchange unit to its process train as a polishing step following RO. Strong acid counter-current regenerated ion exchange is a well-proven technology used both within Australia and internationally. This technology has been chosen by AVA because of its capability to easily meet the recycled water output specification and because it is less expensive than using a second-pass RO to further reduce the TDS and ammonia concentrations.

Cation exchange will essentially replace all cations in the RO permeate with hydrogen ions. The resulting acidity will convert all alkalinity in the water to carbon dioxide, which will be subsequently removed in the degasser tower.

In order to meet the recycled water specification of 1 mg/L free residual chlorine after one hour, a detention tank with 1 hour detention time has been added to the process train. The monitoring point for recycled water quality will be at the outlet of the detention tank, which is after all chemical dosing, including pH adjustment.

The Plant is designed for 24-hour/day operation and includes:

- Automatic operation, including start-up and shutdown procedures
- Feed basket stainers to protect the downstream membrane processes
- Feed storage tank of 3 ML to assist with managing feed effluent quality fluctuations
- Coagulation and flocculation for oil & grease and phosphorus removal. This will also result in some reduction in the TOC and BOD of the incoming effluent.
- Submerged UF membranes
- Two-stage RO process
- Cation exchange for polishing of RO permeate
- Degassing, pH control and chlorination
- Automatic control of RO recovery and flow
- Automatic UF Clean In Place (CIP) including CIP solution batching (with ability to change the concentrations of the chemical cleaning solutions)
- Semi-automatic batching of RO CIP solutions
- Automatic control of dosing pumps in response to process flow and measured process parameters
- Data-logging and on-line normalisation of RO operating data
- Multilevel access to plant control settings and set-point adjustment
- Diagnostic plant alarms to detect possible faults before they compromise plant operation
- A high level of instrumentation for process monitoring and control

Key operational features of the membrane processes are described below. Details of the plant offered are shown on the accompanying Process Flow Diagram (see Attachment 1). Process and instrumentation diagrams and general plant arrangement drawings are also provided in Attachments 2 and 3, respectively. It should be noted that these drawings and diagrams are preliminary and may change in the detailed design stage during the project execution.

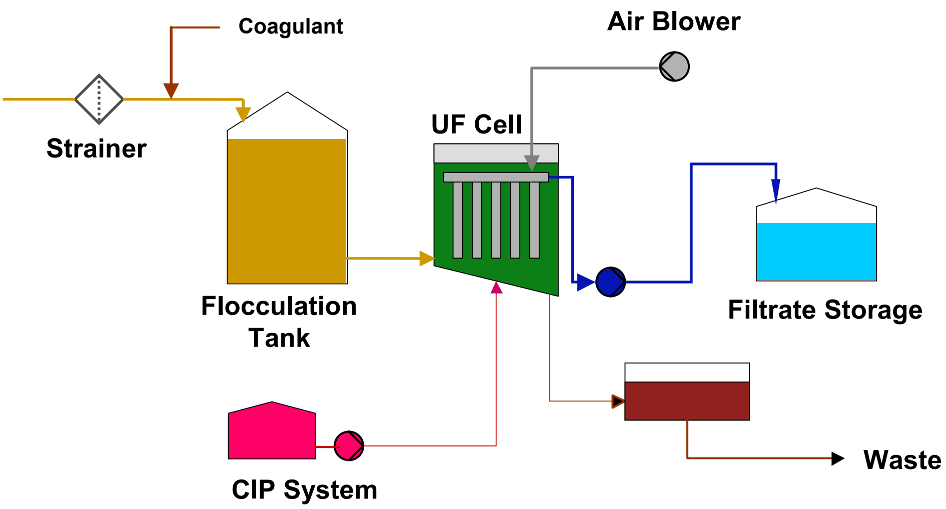
Key Process Units

Ultrafiltration

Memcor's submerged UF system allows continuous filtration of fluid streams to 0.1 micron. The system uses PVDF hollow fibre membranes to produce high quality treated water as well as concentrating removed particles for further processing or disposal.

Veolia has selected this system based on previous experience, including water recycling experience at the Kwinana Water Reclamation Plant in Western Australia and operations experience in water treatment at the Aqua Project (Victoria), which Veolia has operated for five years.

A key advantage of this submerged system is that the backwash air scour is introduced within the membrane bundles and scours the surface of the membranes with a scrubbing action that is not achievable with external air scour techniques.



Membrane Integrity and Maintenance

Membrane integrity is monitored via the automatic pressure decay test and SCADA trending. Defective modules are quickly identified by visual inspection for leaks (bubbles) during a leak test. Each four-module sub manifold has an individual isolation valve that can be operated without entering the filter cell. The module rack is suspended in the cell and is detached and lifted directly from the cell in approximately 15 minutes via a moving service platform. Individual sub-modules can then be removed for pin repair or replacement in a matter of minutes. The cell is off-line during module service.

Pressure Decay Test (PDT)

The Pressure Decay Test checks the fibres and filtrate side of the modules for leaks. This cycle drains the fibre lumens and pressurises the filtrate side of the module assembly with low-pressure air. The air is then isolated and the rate of decay of filtrate side air pressure is measured by the PLC. Membrane integrity is confirmed automatically when rate of pressure drop remains less than a predetermined value.

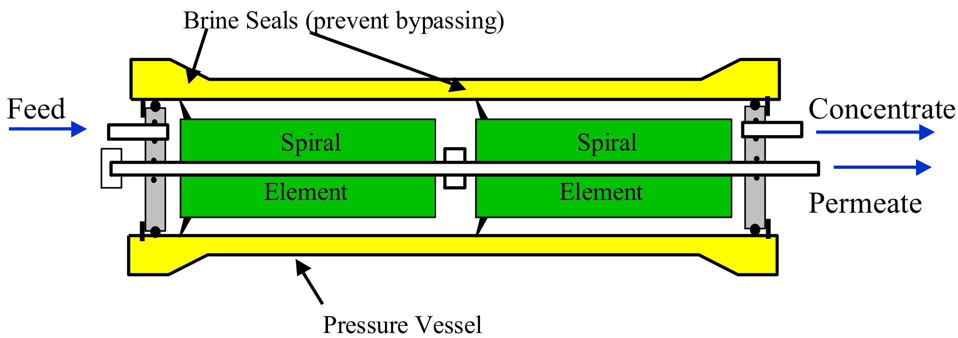
UF CIP (including CEBW)

Each UF cell requires periodic chemical cleaning to ensure long-term stable operation. The Chemically Enhanced Back-Wash (CEBW) and CIP are both automated processes taking approximately 30 minutes and six hours respectively to complete.

The cleaning frequency will be determined during operations, based on optimising membrane performance and minimising chemical costs. However; AVA has made allowance for a high frequency of CEBW of the UF membranes to ensure protection against fouling, particularly in the event of effluent quality excursions.

Reverse Osmosis

The RO system uses a semi-permeable polyamide membrane to separate water from dissolved solids. High pressure overcomes natural osmosis to allow water to pass through the membrane, leaving a saline concentrate stream.



The pressure to drive the process is supplied by the combination of a high pressure feed pump and a concentrate backpressure (or reject) control valve. Permeate output is controlled by a variable speed drive on the feed pump, while recovery is controlled by the reject control valve.

RO Train Design

Each RO train consists of a two-stage 18:8 tapered array of pressure vessels, with 7 membrane elements per vessel. This array will be expandable to 19:9 for the ultimate capacity requirement of 25 MLD.

The RO High Pressure Feed Pumps supply filtered water under pressure to the first stage array. Approximately 53% of the feed water is recovered as permeate in this stage.

Concentrate from the first stage flows to the smaller second stage array. The second stage operates in the same manner as the first, with a further 22% of the feed water being recovered. The combined permeate from Stages 1 and 2 is discharged to the ion exchange unit (see below for further details).

Pressures, flows and conductivities are monitored throughout the RO train, and raise alarms if any operating parameters diverge from the expected values. The flows though the train are controlled automatically through the combined action of feed pump speed control, and modulating valve position control on the RO concentrate.

Cation Exchange Units

To achieve the specified ammonia residual in the treated water, it will be necessary to polish the RO permeate using ion exchange technology. In this case, only cation exchange will be required due to the relatively low level of dissolved solids in the RO permeate. The resulting acidity will react with alkalinity present in the water to produce carbon dioxide, which is subsequently removed in the degasser tower.

Two duty/standby cation exchange units are proposed, each measuring 3.6 m diameter by 1.8 m height on straight. These units will be regenerated after 24 hours service using a solution of dilute sulphuric acid. The resulting acidic waste will be injected into the incoming plant feedwater, thereby offsetting the amount of acid required for pH adjustment.

Degasser Tower

The acidified RO permeate leaving the cation exchange unit will have a relatively high concentration of carbon dioxide which must be removed from solution. This is necessary to reduce the amount of caustic soda required for pH control.

Water is introduced to the top of the tower via a header and lateral distribution system and cascades downwards through a section of random plastic packing. A counter-current air stream flows upwards through the packed section, stripping the dissolved carbon dioxide gas from the water. The RO permeate exiting from the base of the tower will have less than 5 mg/L of carbon dioxide.

The degasser tower has been designed for the ultimate plant capacity of 25 MLD.

Ancillary Equipment/Features

Antiscalant Dosing

The feed water is dosed with antiscalant (in conjunction with upstream acid) to control the precipitation of sparingly soluble salts. The plant is supplied with 2 x 100% duty standby dosing pumps which dose the neat chemical (without dilution) from a 2,000 L storage tank.

The dosing pumps operate during the startup and operation of the RO trains. Dosing flow rate is initially set manually and is then controlled automatically to proportion the dosing flow to the feed flow to the RO units. This ensures that the dose remains at the required level independent of any variations in flow (such as switching off one train).

The dosing system is instrumented with level interlocks and discharge flow transmitters to monitor the dosing of antiscalant. A failure in one pump will raise an alarm and automatically switch to the standby pump.

RO CIP

Periodic CIP is required to maintain membrane performance. CIP is manually initiated on the basis of a 10% change in normalised flow or operating pressure.

Two types of CIP are undertaken. The first is an acidic clean using a 2% solution of citric acid, which is used to remove inorganic deposits from the membrane surface. The second clean is an alkaline detergent clean used to remove biological and organic foulants from the membrane. Preparation of the CIP solution is automatic (apart from manual addition of a small amount of sodium dodecylsulphate).

The RO CIP system includes:

- RO CIP tank to batch and recycle dilute cleaning solution. The tank is fitted with a heater to enhance cleaning efficiency.
- RO CIP pump to mix the chemicals and to recirculate the CIP solution to the RO membranes being cleaned
- RO CIP bag filter to remove solids from the recirculating CIP solution.

One RO train is cleaned at a time while the others can remain on-line.

Noise and Odours

The Plant includes noise mitigation to ensure compliance with industrial noise exposure limits of <85dBA at 1 metre. The major process equipment will be housed in a main building with other external pumps enclosed to minimise noise emissions.

Odour mitigation includes the provision of covered storage tanks, most critically the feed effluent tanks. As all of the major process units will be housed in an enclosed building, odour emissions will be minimised. AVA considers that these controls will be sufficient to adequately mitigate both noise and odour from the Plant.

Plant Process Design Basis

Plant Capacity

The Plant has been designed to produce a net continuous output of 20 ML/day of nominal 50 mg/L TDS grade recycled water. Plant design will cater for a capacity turndown ratio of 7:1 (based on the number of RO trains in operation)

In summary the Plant capacity is as follows:

- Minimum production rate – approx. 2,857 kL/day (1 RO train on-line)
- Maximum production rate – 22,857 kL/day (all 7 duty RO trains and 1 standby train on line)
- Design continuous production rate – 20,000 kL/day
- Turndown ratio – 7:1
- Whilst the initial design capacity of the plant is 20 MLD, it will be possible to run the plant for short periods of time at a peak capacity of 22.86 MLD (with average or better feedwater quality).

The Plant has been designed to be easily upgradeable to a capacity of 25 ML/d to cater for further expansion of the market. AVA has achieved this by:

- Designing the Plant layout to accommodate a 25 ML/d Plant;
- Designing the Plant hydraulics to accommodate a 25 ML/d Plant;
- Where required, providing pipework with blank flanges for the addition of process units, thereby ensuring minimal disruptions to existing Operations during any upgrade works;
- Designing the existing RO trains with the capacity to expand from an 18:8 array for the 20 ML/d plant to a 19:9 array for the 25 ML/d plant (the addition of a ninth train will also be required);
- Sizing chemical storage facilities for 24 + 7-day storage capacity at 25 ML/d production;
- Sizing the feed effluent tank, all intermediate tanks and the chlorine detention tank to have sufficient capacity to handle the increase in flow;
- Sizing the degasser tower for the 25 ML/d production.

These considerations at this point in the design process mean that a future expansion can be managed cost-effectively, with minimal disruption to existing operations. It also ensures functionality in operations, particularly with regard to access and layout, chemical storage and turn-down ratio.

Feed Effluent Demand

The Recycled Water Scheme will require varying quantities of effluent feed from the LAP for different scheme operating conditions. The effluent requirements are summarised in the table below.

Summary of Feed Effluent Demand		
Operating Condition	**Plant Recycled Water Production (ML/d)**	**Effluent Required from the LAP (ML/d)**
Foundation Customers' Average Daily Demand (ADD)	11.8	16.6
Foundation Customers' and non-foundation customers' ADD	12.8	18.0
Foundation Customers' Peak Demand	20	28.1

Feedwater Quality

The feed to the Plant will comprise a blend of secondary treated effluent from Glenfield and Liverpool Sewage Treatment Plants and will be transferred to the Plant via the LAP.

The composition of secondary effluent has been provided in Table 3.1 of the Tender Document, as a file entitled *'Preview – STP Data Extract'* (issued as part of Addendum No 6), and in further information provided at AVA's request subsequent to AVA's April tender submission. A summary of the average and design feedwater is provided in the table below. This feedwater analysis is based on the 90th percentile figures provided in the RDP document, except for the temperature, iron, and oil and grease limits which are discussed below. The 10 percentile figures were assumed as a design base for alkalinity and temperature only.

Parameter	Final Recycled Water	Feed-Effluent (10%ile)	Feed-Effluent (50%ile)	Feed-Effluent (90%ile)	Sewage Discharge Limits
Oil and Grease			<5	12	110
Aluminium (mg/L)	<0.1		0.15	0.2	100
Ammonia (mg/L)	<1		28	33	100
Chloride (mg/L)	<20		118	130	
Iron (soluble) (mg/L)	<0.05		0.44	0.5	50
Manganese (mg/L)	<0.05		0.07	0.17	10
Sodium (mg/L)			105	111	
Zinc (mg/L)	<0.1		0.04	0.13	5
Calcium (mg/L Ca^{+2} as $CaCO_3$)	<10		19	20.5	
pH (pH units)	6.5 to 8.5		7.3	7.7	7 to 10
Total Dissolved Solids (mg/L) Short Term Peak TDS	<50		440	450	
Total Dissolved Solids (mg/L) Average	<50		440	450	10,000
Total Suspended Solids (mg/L)			13	29	600

Parameter	Final Recycled Water	Feed-Effluent (10%ile)	Feed-Effluent (50%ile)	Feed-Effluent (90%ile)	Sewage Discharg e Limits
NOX (mg/L)			2	8	
TKN (mg/L)			32	43	
Total Nitrogen (mg/L)	<10		34	43	150
Total Phosphorous (mg/L)	<2		6	9	50
Temperature (°C)		16	20	25	
Alkalinity (mg/L as CaCO3)	Low	130	180	200	
Biochemical Oxygen Demand (mg/L)	<2		8.5	20	
Faecal Coliform (cfu/100mL)			34,000	360,000	
Total Organic Carbon				25	
Silica				7.7	
Barium				0.01	2
Fluoride				1.2	20
Strontium				0.085	10
Hardness (mg/L as CaCO3)	<20				
Turbidity (NTU)	<2				
Free Residual Chlorine (mg/L)**	1		0	0	10
E.coli Coliforms	<1 in 100ml				
Total Coliforms	<10 in 100ml				
Virus	<1 in 50L				
Parasites	<1 in 50L				

Feed Effluent Soluble Iron Levels

The values of soluble iron provided in Table 3.1 of the RDP appear to be an error, as it is highly unlikely that such concentrations of soluble iron would be found in secondary treated effluent. For this reason, AVA requested further information from SWC, which was provided after AVA's April submission in the form of data from the EKAMS Reporting Tool. This data showed soluble iron levels of 0.44 mg/L (50%ile) and 0.5 mg/L (90%ile), which AVA has used as a design basis for the Plant, as indicated in the table above.

Oil and Grease

AVA was not provided with 50%ile and 90%ile values for oil and grease within Table 3.1 of the RDP; however oil and grease can cause substantial membrane fouling above certain levels. AVA has reviewed the information in the file *Preview – STP Data Extract* (issued as part of Addendum No 6) and the subsequent information provided after the April submission and, based on this data, has assumed for design purposes a 50%ile concentration of <5 mg/L and a 90%ile concentration of 12 mg/L, as shown in the table above.

Providing the oil and grease is not free or mineral oil then short term levels up to 15 mg/L can be handled by the pre-treatment system which comprises coagulation and ultrafiltration. During peak loads of oil and grease AVA would expect that more frequent membrane cleaning would be required. Some of the oil and grease data supplied from Glenfield peaks at 21 ppm. Assuming Glenfield is about 40% of the total flow in the pipe the mixture would have oil and grease peak at 10 to 12 pm.

If the oil and grease is free-floating then this would impact on the UF process. Given the processes at the Liverpool and Glenfield STPs, this is considered to be unlikely. Should an event occur in which free-floating oil and grease is encountered, it is likely to be in conjunction with a broader effluent quality incident in the LAP, which will be identified through LAP monitoring. Such events can be managed by short-term suspension of effluent extraction from the LAP or, depending on the type of effluent quality event, through additional UF cleaning cycles.

The 3 ML storage tank at the inlet to the plant will allow short-term suspension of effluent extraction from the LAP without requiring the shutdown of the Plant.

Recycled Water Quality

The required recycled water quality has been provided by SWC in Table 8.1 of the RDP. AVA has designed a robust Plant capable of meeting SWC's requirements with fluctuating feed water quality.

Specifically, SWC has requested that AVA address how it intends to achieve ammonia, alkalinity, total nitrogen and total phosphorous limits.

Ammonia and Nitrogen Removal

AVA proposes achieving the 1 mg/L limit through single pass reverse osmosis followed by strong acid cation exchange. The RO membranes reject 80% of the nitrate and 85% of the ammonia in the feed water. The 85% rejection of ammonia is a conservative figured based on RO membrane supplier projection software that normally suggests closer to 90% rejection of ammonia.

A final step of ion exchange has been added as a strong barrier against ammonia. The ion exchange will remove all residual ammonia in the RO permeate and will protect against any reduction in ammonia rejection through the RO membranes. This will virtually eliminate ammonia in the recycled water stream, easily meeting the treatment limits proposed by SWC. This will have the additional benefit of allowing 1 mg/L of free residual chlorine to be achieved without the need for break-point chlorination.

The treated water will contain significantly less than the 10 ppm total nitrogen required by SWC.

Phosphorous Removal

The rejection of phosphate by an RO membrane is typically better than 95%. Over 90% of the total phosphorous entering the plant should be as reactive phosphate, therefore easily removed. The final treated water quality will be less than 2 ppm total phosphorous.

Alkalinity

AVA has based its design on the understanding that, as indicated by SWC in Addendum 5, the alkalinity value stated in Table 8.1 of the RDP document is not a target; it is rather stated for the information of the Proponent and the users of the recycled water. As a result of the process train proposed, the alkalinity of the recycled water will be low; however the process train contains no specific processes aimed at producing an alkalinity of < 5 mg/L.

BOD

AVA would like to note that in considering the recycled water quality specification for BOD (<2 mg/L), SWC should consider that it is difficult to obtain accurate analytical results for BOD at this low level. AVA would like to discuss with SWC how this will be managed when assessing recycled water quality compliance.

Ensuring Recycled Water Quality

With the exception of certain key effluent quality characteristics which have the potential to damage the Plant, AVA has provided a commitment to use best endeavours to produce in-specification recycled water even with varying feed effluent quality.

One mechanism at AVA's disposal to achieve this is to recycle a portion of the RO permeate back to the RO feed tank if the Plant is struggling to produce in-specification recycled water. This will send a better quality of water through the RO system and assist in achieving in-specification recycled water. It should be noted that this permeate recycle line is not shown on the Process Flow Diagram but it is indicated on the PID for the RO Train System Manifold (B0223-P-4000-10).

The key issues associated with this option are summarised in the table below:

Item	Advantages	Disadvantages
RO fouling	By blending the RO feed with better quality recycled water, the concentration of contaminants is reduced and the RO membranes are less likely to become fouled.	
Plant Capacity		Plant capacity will be reduced according to the volume of water recycled. Storage and, if required, top-up water will be used to manage the demand from Foundation Customers. This is unlikely to be required if demand from Foundation Customers is average or less. Furthermore, it may be possible to run the RO stand-by train to boost capacity.
UF system	By recycling a portion of the RO permeate back to the RO feed tank, the flux through the UF system can be reduced if the load on the membranes is high due to poor feed effluent quality.	
Operating costs		The operating costs per unit of water produced will be increased. AVA has made a commitment to use best endeavours to produce in-specification recycled water, including absorbing any additional operating costs associated with this.

Limits of Trade Waste Discharge

Reverse osmosis is a physical separation process which produces a purified water stream and a waste stream containing concentrated contaminants in proportion to the contaminants in the incoming stream. The smaller the volume of waste, the higher the concentration of contaminants within it, up to a limit above which RO cannot provide further concentration because of membrane fouling issues.

SWC requested that AVA minimise as much as possible the volume of discharge to sewer to avoid jeopardising SWC's capability to achieve its target wet weather overflow levels of a maximum of 40 overflow events per ten years. AVA has based its design for the Camellia Plant on the principle of selecting optimum recovery to minimise the discharge volume to sewer without threatening the life of its membranes or its ability to cope with varying feed water quality. This approach will result in an ammonia discharge of 116 mg/L to sewer when the incoming ammonia levels are 33 mg/L, as indicated by the 90%ile concentration. This ammonia concentration exceeds the trade waste acceptance standard of 100 mg/L.

Since designing and pricing this option, SWC has indicated to AVA that for environmental and OH&S reasons, it will not be possible to discharge greater than 100 mg/L of ammonia to the sewer.

In order to remove ammonia from the total outgoing streams from the Plant (recycled water plus waste to sewer), a biological ammonia removal process such as Veolia's Biostyr would be required, coupled with a sludge thickening process. The addition of these processes would have large capital and operating cost implications and may also pose difficulties in the planning process, due to the possibility of odours in the vicinity of residential housing. For these reasons, biological ammonia removal was not considered an appropriate solution.

In order to limit the concentration of ammonia to sewer to 100 mg/L, AVA has therefore proposed a mechanism whereby the waste from the RO process, combined with other plant waste streams, will be diluted with secondary effluent taken directly from the LAP. As the majority of the nitrogen present in the system is in the form of ammonia, this will also control the total nitrogen levels in the trade waste. All other contaminants in the waste stream are expected to be well below the relevant acceptance standards. Note that the trade waste limit on TDS has been assumed to be an ocean discharge limit of 10,000 ppm.

Further details on the approach to waste stream dilution are provided below in the discussion on waste management.

Process Considerations & Assumptions

Influent Design Flow Rate

The plant pipework and storage tanks will be designed to accept 37.5 ML/day feed water. This is the requirement for the 25 ML/day final buildout recycled water production, assuming that the waste stream will be required to cater for a discharge of no more than 100 mg/L ammonia to sewer at 33 mg/L ammonia influent.

Basket strainers

Basket strainers will be installed prior to the feed balance tank primarily to protect the UF system. These will be 500 micron strainers and will include automatic self-cleaning.

Feed Storage

A 3 ML feed storage tank has been included in the design to assist with managing effluent quality variations within the LAP. The storage tank will provide several hours' storage of feed effluent (at the design recycled water production of 20 ML/d). This will allow effluent feed to be suspended in the event of a short term effluent quality fluctuation, thereby protecting the plant without impacting on the supply of recycled water. Recycled water storage on site and within the network will also assist with maintaining recycled water supply to customers in these situations

The feed storage tank will have the added advantage of reducing the impact of any diurnal flow variations within the LAP on the plant operation. As AVA has not been provided with information on the extent of diurnal variations within the LAP, it is unable to assess whether the feed storage tank, as currently sized, will fully buffer diurnal flow variations. Diurnal variations in the LAP will depend on SWC's proposed approach to managing this system. It is likely that SWC may choose to pump more or less continuously into the LAP and allow on-site storage at Liverpool STP to buffer the LAP against the rises and falls of sewage flows. This would provide the optimum service to any organisations undertaking sewer mining from the LAP and is likely to also provide operational benefits to SWC. For example, SWC would consume equal amounts energy at all times of the day, rather than decreasing energy consumption overnight when sewage flows are reduced but energy prices are also lower.

The feed storage tank will be provided with aeration to reduce the soluble iron in the feed stream by converting it to insoluble oxides of iron. This will assist with achieving the required output specification for iron.

Coagulation

Coagulation prior to the UF process will provide additional robustness of the plant in handling excursions in oil and grease and TOC levels in the feed. A flocculation tank with a residence time of 10 minutes (at 25 MLD) has been provided downstream of the coagulation injection. The optimal selection and dosage rate of coagulant will be evaluated during the pilot phase, however at this stage, based on the effluent feed quality characteristics, it is expected that ferric chloride or alum will be dosed at approximately 20 ppm.

Ultrafiltration System

Membrane filtration is now the accepted method of pre-treatment for secondary or tertiary treated sewage prior to reverse osmosis desalination. Membrane filtration offers increased plant reliability as well as a reduction in whole-of-life costs. The design flux has been dropped from 48 L/m^{2}h in AVA's April submission to 41 L/m^{2}h (by 15%) to ensure that the new design concept is robust and can treat the greater levels of solids which may occur during effluent quality fluctuations and as a result of chemical coagulation.

The UF process has been designed with one fully redundant train. This will allow for periods of membrane cleaning and maintenance. Normally all UF membranes would be on-line resulting in an operating flux of 33 L/m^{2}h at the design plant production of 20 ML/d.

RO System

RO membrane selection for this project will depend on the characteristics of the Liverpool-Glenfield STP effluent. As a result, final membrane selection will be made following pilot trials conducted post-award. AVA's initial choice, based on favourable performance trials at SWC's Wollongong Recycled Water Plant, is the Saehan 8040-FEn membrane. The RO system has been designed with a conservative average flux rate of 17.2 L/m^{2}h. This design is based on operating experience gained at plants within Australia and overseas that show that lower flux rates substantially reduce membrane fouling.

An RO recovery of 80% has been chosen as the basis for design. This is achieved using a two-array design with the first array providing a recovery of 56% and the second array providing the remaining 24%.The recovery rate for secondary-treated effluent will be limited by the levels of calcium phosphate and organics in the feed. The selected recovery rate will (i) reduce the amount of chemical cleaning required and (ii) extend membrane life.

Control of Membrane Fouling

The most important consideration in designing a plant of this type is the control of fouling on both the UF and RO membranes. The most common forms of fouling for wastewater treatment are bio-fouling, organic fouling and calcium phosphate scaling.

The most successful method of controlling bio-fouling is by chloramination ahead of the UF membranes, with significant operating experience having been gained at other recycled water treatment plants using this method. Chloramines work very well because they provide a continuous biocidal action on both the UF & RO membranes. The level of ammonia in the incoming effluent stream is sufficient for chloramination and no ammonia dosing system will be required. Hypochlorite will be dosed ahead of the feedwater balance tank, thereby allowing sufficient contact time for the formation of the chloramines ahead of the UF system. The hypochlorite is added to the carrier water stream prior to injection into the feed to minimise the formation of organo-chlorine by-products. As a safeguard, instrumentation is provided to monitor total chlorine levels and redox potential ahead of both the UF and RO trains.

Organic material present in the secondary effluent feed will tend to adhere to the surface of the RO membranes. This organic fouling is best controlled by the diligent selection of RO membranes, and cleaning using a suitable alkaline detergent cleaner.

The relatively high levels of phosphorous in the feed will increase the scaling potential of calcium phosphate for the Plant. To optimise antiscalant dosing, a sulphuric acid dosing facility has been included in the design to allow acid dosing when required to maintain a pH of 7.2 in the feedwater. The recycle stream from the ion exchange unit to the coagulation tank will also be acidic, which will reduce the requirement for acid dosing.

The use of sulphuric acid and the recycle stream from the ion exchange unit for pH adjustment of the feedwater will lead to an increase in the supersaturation of barium sulphate, however the antiscalant proposed will provide effective control against membrane scaling for all anticipated operating conditions.

Ion Exchange

The RO permeate will have levels of ammonia above those called for in the Specification. The most economic way to reduce the ammonia level is by using counter current regenerated cation exchange unit. There will be one duty and one standby unit. Each unit will conform to current ion exchange design guidelines for treatment of RO permeate. The acidic regeneration waste will be recycled back to the incoming feedwater and will reduce the acid required for pH control.

Ion exchange resins, as the name implies, have the capacity to exchange one ion, whose presence may be undesirable, for another. There are many types of resins made for different purposes, but most of those in commercial use are based on a polystyrene bead with various types of exchange structure added during manufacture. They are inert and insoluble in water and have a useful life of up to 5 years or more depending on the type of resin and service conditions. Broadly speaking, the resins fall into two categories, those used for cation exchange and those used for anion exchange.

Ion exchange resins are usually in the form of spherical beads ranging from about 0.5 to 1.5 millimetres in diameter. Many types of resin are available having either cation or anion exchange properties. Strong acid cation resins are multi-functional and will convert salts to their equivalent strong or weak acids. In RO permeate water the main cations will be sodium and ammonia with traces of potassium and calcium.

The ammonia cation is exchanged with a hydrogen ion from the strong acid cation resin in the hydrogen form (shown as $R(H^+)$) as follows:-

$$R(H^+) + NH_4^+ \text{ (Aqueous)} + NH_4^+ \text{ (Aqueous)} \rightarrow R(NH_4^+) + H^+ \text{ (Aqueous)}$$

The sodium cation is also exchanged -

$$R(H^+) + Na^+\text{(Aqueous)} \rightarrow R(Na^+) + H^+ \text{ (Aqueous)}$$

The H^+ (Aqueous) is acidic and will react with any residual bicarbonate ions in the RO permeate creating additional CO2 which will be stripped in the Degas Tower.

$$H^+ + HCO_3^- \rightarrow CO_2 + H_2O$$

Ion exchange followed by a degasser tower will reduce both the ammonia and residual bicarbonate. This lowers the TDS of the final product water.

The spent resin will be primarily be in the sodium or ammonia form and is easily regenerated with 5% w/v sulphuric acid solution. The regeneration process involves the counter-current passage of sulphuric acid upwards through the ion exchange column for about 25 minutes, followed by a displacement rinse and finally a fast rinse. The regeneration process will typically last about 1.5 hours. Each Ion exchange vessel will be regenerated every 24 to 48 hours depending on the RO permeate quality.

The ion exchange vessels have been designed to handle, without a decrease in performance, the full range of flows expected through the plant in full consideration of the plant's 1:7 turndown ratio.

RO Permeate Degassing

The RO permeate will contain carbon dioxide resulting from the initial pH correction of the RO feedwater, and from conversion of alkalinity following passage through the cation exchange unit. This will result in dissolved carbon dioxide levels in the RO permeate of up to 80 mg/L. To reduce the dosage rate of caustic soda, the RO permeate will be passed through a degasser tower to reduce the level of carbon dioxide below 5 mg/L.

pH Correction and Chlorination

Caustic will be added to correct the pH and sodium hypochlorite added to meet the required chlorine residual. A dedicated Detention Tank will provide a 1 hour retention time. The recycled water will be monitored at the discharge of the detention tank for compliance against all recycled water quality limits.

Process Design Summary

The design of the proposed Plant is shown on the accompanying Process Flow Diagram (see Attachment 1). Important aspects of the plant design are discussed below.

UF & RO Train Selection

The number of UF and RO trains was chosen after consideration of the following criteria:

- Requirement for one standby UF cell and one standby RO train to achieve a high level of availability.
- Plant turndown requirements
- Economic train size

For the nameplate capacity of 20 ML/d, a total of five UF trains and eight RO trains have been selected. To match feed requirements of the operating RO train(s), the output from the UF trains will be turned down as required. While the UF system is designed to operate continuously with one train on standby, all trains would normally operate. This is done to lower UF membrane flux rates and thereby reduce operating costs and maximise membrane life.

The table below provides a summary of the system design offered.

Parameter	Units	Value
Secondary effluent feed	ML/d	28.1
Total no of UF trains	-	5
No of standby UF trains		1
No of UF sub-modules per Cell	-	252
UF flux rate (5 trains operating)	L/m^2h	33
UF flux rate (4 trains operating)	L/m^2h	41
Average UF recovery	%	90
Net UF filtrate output	ML/d	25.2
UF wastewater volume	ML/d	2.8

Parameter	Units	Value
Total no of RO trains	-	8
No of standby RO trains	-	1
RO train array (initial)	-	18:8
RO train array (ultimate)	-	19:9
RO average flux rate	L/m^{2}h	17.2
RO recovery	%	80
Net recycled water output	ML/d	20
RO concentrate volume	ML/d	5.1

Because reverse osmosis plants have very little turndown capability, the treatment plant will operate at discrete outputs dependant on the number of RO trains in operation

Power Requirements

The average power consumption of the plant is estimated to be 1,370 kW-hr/ML of treated water based on 20 ML/d production. As the power consumption of the RO process is dependant on feed temperature and TDS, as well as membrane age and fouling, this will be variable across the project life. .

Chemical Storage Requirements

Chemical storage tanks have been sized for 24 plus 7 days storage at the ultimate design production of 25 ML/d. A summary of chemical storage arrangements is provided in the table below:

Chemical	Conc (%w/w)	Storage (kL)	Delivery
Sodium hypochlorite	12.5	34	Tanker
Ferric Chloride	40	38	Tanker
Sulphuric acid	98	20	Tanker
Antiscalant	100	2	Bulki-bin
Caustic soda	49	7	Tanker
Sodium bisulphite	30	2	Bulki-bin
Citric acid	50	2	Bulki-bin

Pilot Plant Investigation

A pilot plant investigation will be undertaken for at least five months prior to the design and construction of the Plant. The pilot plant for the Camellia Recycled Water Project will comprise the following major components:

- Feedwater strainer (0.5 mm screen size)
- Coagulant dosing system
- 1,000 L flocculation tank
- Memcor submerged ultrafiltration unit comprising 9 sub-modules
- Two RO units, each comprising a high pressure pump and two 2:1 arrays of 4” pressure vessels (for parallel testing of two different membrane types)

- One 300 mm diameter SAC ion exchange column with manual regeneration
- One 380 mm diameter degasser tower
- 2,000L RO permeate collection tank
- 4,000 L chlorine detention tank
- Chemical dosing facilities for chloramination, feedwater pH adjustment, antiscalant injection and treated water pH adjustment
- Chemical cleaning facilities for both the UF and RO units
- Manual acid regeneration system for the cation exchange column
- Neutralisation tank and recirculation pump
- Backwash collection tank and transfer pump

The pilot plant design will emulate the membrane flux rates proposed for the full-scale plant.

Pilot Plant Process Description

The pilot plant will be constructed as containerised or skid-mounted units using new UF and RO equipment rated for a treated water output of over 100 m^3/d.

The feedwater screen, flocculation tank, UF membrane cell, and associated backwash and CIP facilities will be all be skid-mounted. Filtrate will be stored in an adjacent storage tank and will provide continuous feed to the RO unit as well as for backwashing of the UF cell.

The two RO trains will be designed and manufactured to suit the specific requirements of the project. The high pressure feed pump, RO pressure vessel array and CIP facilities will be containerised along with chemical dosing facilities for antiscalant and treated water pH adjustment. One tank will be provided for storage of RO permeate and another for storage of chlorinated water.

The cation exchange column and degasser tower will be mounted on a separate structural steel skid. The degasser tower will be elevated to allow gravity flow into the RO permeate collection tank.

Backwash waste will be collected in a backwash collection tank for return to the head of works. All CIP waste will be neutralised prior to transfer to the backwash collection tank for subsequent disposal. All recycled water will be returned to the Liverpool STP effluent discharge or some other acceptable point of disposal.

Instrumentation & Controls

Instrumentation and controls will be provided to allow important plant parameters to be continuously monitored. Data will be exported to a PC for normalisation of RO performance. Facilities will be provided to allow remote access by authorised personnel for the purpose of monitoring plant performance.

Pilot Testing Program

The purpose of the pilot testing will be to:

- confirm that effluent quality is as indicated by SWC in the RDP;
- confirm selection of the most appropriate RO membranes.

Pilot testing will be undertaken at Liverpool STP site on a blend of effluent from the Liverpool STP and the Glenfield STP. An area of land approximately 200m^2 will be required for the pilot plant.

Initial testing will be conducted on a selection of RO membrane elements. Experience has shown that the impact of organic fouling on plant performance can be quickly determined. Two preferred membranes will then be chosen for further testing. The pilot plant will continue operation for a further three months. During this period the effectiveness of the proposed chemical cleaning regime will also be investigated.

On completion of pilot plant testing a comprehensive report will be prepared for consideration during the design phase.

Plant Electrical System

High Voltage Installation

HV Installation Provisions

The Recycled Water Treatment Plant will be provided with HV switchgear and HV cabling network as per the proposed Power Distribution System Overall Single Line Diagram of Drawing No.B0223-E-1000-01, provided in Attachment 3.

HV Switchgear Description

Schneider Electric SM6 Merlin Gerlin or equivalent circuit breakers will be installed in the proposed indoor substation comprising of the following switchgear:

- 2 x DM1-W withdrawable circuit breaker panels with S20 relay for protection.
- 2 x DM1-W withdrawable circuit breaker panels with S40 relay for protection and metering, including VTs for incomers.
- 1 x DM1-W withdrawable circuit breaker panel with S40 relay for protection and metering, including VTs for incomers.

Each switchgear unit will be fitted with a Sepam 1000 Protection and power monitoring system. Each unit will be connected via an Ethernet to Modbus gateway to the PLC system.

Each main HV feeder unit will be fitted with kWh power consuming meters for recording and monitoring the power consuming of the overall Recycled Water Treatment Plant operation.

The equipment proposed in this offer has been designed, manufactured and tested in compliance with IEC recommendations.

Water Recycling Plant Feeder Power Transformers Supply and Installation

Two off 2 MVA 11/.433 kV TESA oil-filled, ground-mounted transformers for the power supply to the Plant Main 415 V MCC's will be provided as per the proposed HV & LV Single Line Diagram Drawing No.B0223-E-1000-01.

The transformers will be installed in two separate outdoor transformer bays constructed with two-hour rated fire walls as indicated on Drawing No. B0223-C-0001-01 Site Layout Plan, provided in Attachment 3.

The two 2 MVA transformers have been selected and arranged so that one transformer is able to service the Plant total power demand requirements, with the unlikely condition if one of the two transformers failed. This transformer arrangement in combination with HV distribution network will provide the best practice redundant power supply to the Recycled Water Treatment Plant.

MCC/PLC Control Panel Construction & Assembly Description

The proposed Recycled Water Treatment Plant 415 V Motor Control Centre (MCC) will be manufactured and assembled with two back-to-back main power distribution busbar sections A & B and supplied with two separate main Air Circuit Breakers (ACBs), suitably rated for the total estimated maximum demand (1500 kVA) and fitted with an equivalently rated MCC sections A and B centrally mounted mains busbar ACB Bus-Tie.

The MCC Main ACBs will be supplied with fitted mechanical interlocking key type (Castel) system such that the ACB Bus-Tie cannot be closed if both incomers' ACBs are closed; and if the Bus-Tie ACB is closed, then it shall not be possible to close both incomer ACB's, only one at a time.

Additionally, key pumps and process operational plant are split between the two MCCs, thus providing a measure of redundancy at a device level. In the unlikely event that power is totally lost to one MCC, at least half of the process can remain running. All pumps can be run manually if required, with local 'start-stop' stations provided at each pump.

The main MCC sections will be manufactured and designed to a type tested low voltage switchgear and control gear assembly which has passed AS3439.1-1993 type tests for temperature rise, dielectric properties, impulse voltage withstand clearance and creep age distance, short circuit withstand. The MCC will be manufactured and assembled to a minimum fault rating of 50kA RMS for 1 Second peak factor 2.1 mechanical properties and degree of protection,

The MCC main incomer ACBs (Manufactured Type Schneider Masterpact or equal) will to be supplied with the following protection facilities and fault rating:

- Overcurrent with adjustable instantaneous long time and short time characteristic
- Short time withstand current: 50 kA for 1 second

The MCC will be supplied and installed with the following equipment for each main incomer:

- PQM or ABB Equivalent Power Monitors (V, A, KW ,KVAr, PF & Hz Incomer metering with RS232 or RS485 Communications
- Earth Fault CTs.
- Under/Over Voltage Relays-Time Adjustable
- Phase Failure Relays-Time Adjustable
- Surge Diverters Rated Voltage 440 V

The MCC will have installed in each A & B section the following Power Factor correction switchgear and equipment which shall maintain a 0.95 pf Lagging or better and ratted voltage of 470V.

- Power Factor Controllers
- Power Factor De-Tuning Reactors and kVar Correction Capacitors with Discharge Resistors
- Suitable ratted Protection Circuit Breakers and Service Contactors

The MCC will be manufactured and assembled to Form 4A, Type and Arc Faulted tested, with Segregation Construction for all Motor Drives 11 kW and above and all Motor Drives below 11 kW to be manufactured and assembled in Form 2 Type Segregation sections with Form 4A Segregated Fault Limiting Power Supply Feeders.

The MCC/PLC Control Panel manufacture and assembly shall have provision for bottom and top field cable entry. And the installation of all PLC hardware, power supply units, Variable Speed Units (VSD's), UPS Unit and all other associated MCC/PLC control panel equipment.

The MCC will include provision for connection of standby generators in the event of an extended power outage. The generators would be hired on an as-needs basis, as has been done by Veolia at other operational sites in the past.

The MCC 415 V motor starter and control switchgear supply and installation will be as per the following proposed typical electrical schematic diagrams, provided in Attachment 3.

- Typical DOL Starter Drive below 15kW Electrical Schematic Diagram Drawing No. B0223-E-1200-01.
- Typical DOL Starter Drive 15kW & above Electrical Schematic Diagram Drawing No. B0223-E-1200-02.
- Typical VSD Starter Drive Electrical Schematic Diagram Drawing No. B0223-E-1200-03.

- Typical Heater Circuit Electrical Schematic Diagram Drawing No. B0223-E-1200-04.

- Typical 240V AC Chemical Dosing Pumps Electrical Schematic Diagram Drawing No. B0223-E-1200-05.

PLC Control Panel Manufacturer and Assembly

The Recycled Water Treatment Plant PLC Control Panel will be assembled and integrated as part of the Main 415 V Motor Control Centre and in accordance with AS/NZS 3000 Wiring Rules. The PLC Control Panel sections will consist of separate MCC tiers to accommodate the proposed PLC hardware, as detailed on the PLC System Hardware Configuration Diagram refer Drawing No.B0223-E-1100-04.

Uninterruptible Power Supplies (UPS) provide main power to the PLC system and associated ELV power circuits. This provides security against brown-out and supply fluctuations, which can cause PLC processors to reset. The UPS Units will be supplied with a two hour battery backup hold up time.

PLC Remote I/O / Pneumatic Control Panels

The Recycled Water Treatment Plant will be provided with all PLC Remote I/O panels as well as associated marshalling and pneumatic solenoid valve panels required to interface and connect with instrumentation, field devices and valve actuators as indicated on the process and instrumentation diagrams.

Solenoid valves will be Burkert or equal manufactured type pneumatic solenoid valves, installed in Rittal type 316SS enclosures to IP65 Enclosure rating, with integrally mounted DIN rail terminals for termination PLC signal control multi-core cables.

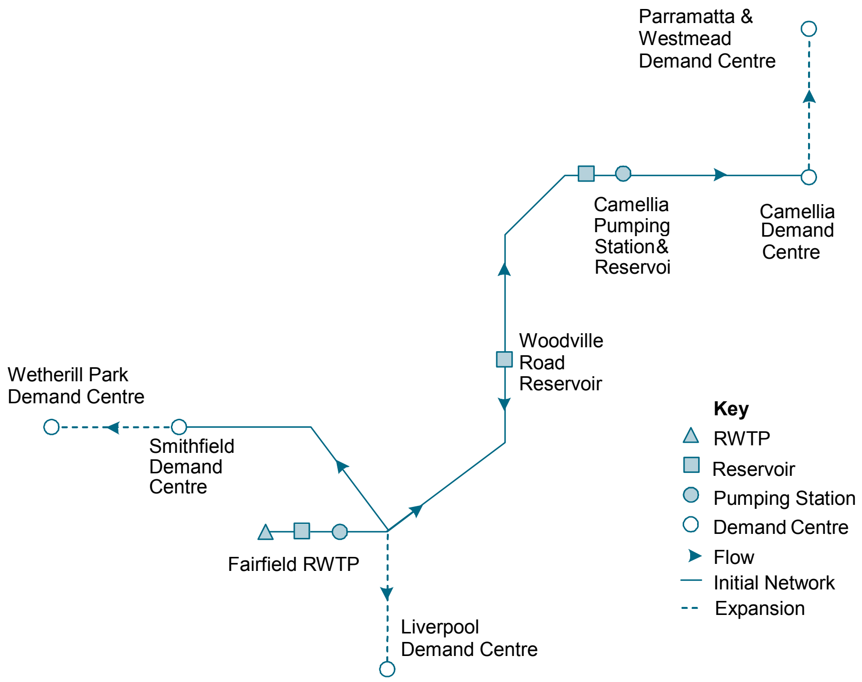
The pneumatic solenoid valves will be mounted on common manifolds. With pressure filter regulators mounted on the side of Solenoid Valve Panels.

All pneumatic tubing will be polyethylene 6mm tubing terminated with stainless steel one-touch bulkhead fittings and all field pneumatic tubing will be installed on hot dipped galvanised cable tray.

Distribution System Description

The distribution system will be split into two key zones based on the demand centres of Smithfield and Camellia. The following text should be read in conjunction with the system layout plan present in **Attachment 1** and P&IDs presented in **Attachment 2**.

A schematic diagram of the distribution network is provided below.



The distribution system is designed to have an expansion capability of up to 33 ML/d. Initially the system will be able to deliver peak hourly flows to the seven foundation customers identified by SWC plus the six non-foundation line-of-main customers. As demand for recycled water increases the plant and Camellia pumping station can be upsized to deliver the expansion peak day demand of 33 ML/d. Note: potable water top up will be required to meet the deficit between the maximum Plant capacity (25 ML/d) and the ultimate Peak Day Demand (**PDD**) of 33 ML/d.

Initial Phase

Recycled Water will be transferred from the recycled water plant at Fairfield into a clean water storage tank before being boosted from the site by variable speed transfer pumps, operating in a duty / assist / standby arrangement, into the distribution network towards the demand centres of Smithfield and Camellia. Pumping from Fairfield will generally be controlled by the new Woodville Elevated Reservoir water level, howver during peak flows Fairfield Pumping Station will boost the pressure in the Smithfield area. Fairfield Pumping Station will be designed to deliver flows to meet ADD for the whole network plus allow for delivery of PDD flows. A peak demand of 23 ML/d will be achievable from the pumping station based on a 20 ML/d output from the RWTP and reservoir storage.

Water will be transferred via a new trunk main to a new elevated storage reservoir at Woodville Golf Course and directly to demand centres in Smithfield. This storage reservoir will:

- Provide control for pumps at Fairfield
- Maintain supply to the Smithfield area when the Fairfield pumps are not operating at times of low flow
- Allow water to gravitate to the new Camellia Storage Reservoir; and
- Provide an air gap for top-up water from the SW potable water system

Supply to the Smithfield area will be via a branch from the pumped main between the Fairfield pumping station and inlet to the Woodville storage reservoir. A new main will be laid to these customers. When the Fairfield pumps are not running, water pressure and flow will be maintained by a gravity return from the Woodville Reservoir. If pressure monitored in the network drops to critical levels at times of peak demand the pumps at Fairfield will 'kick in' to restore pressure to an acceptable level.

Supply to the Camellia area will be by gravity from the Woodville storage reservoir via a gravity pipeline to the Camellia Storage Reservoir. A site for the reservoir is proposed at the Rosehill Gardens Racecourse and negotiations for the site are currently underway between AVA and the AJC. The Camellia storage reservoir will consist of two separate tanks which will normally operate in parallel, unless either tank is out of service for maintenance. Pumped recycled water flow from the Recycled Water Transfer Pumping Station at Fairfield will enter the Woodville reservoir at a low level and Camellia reservoir at a high level.

A new transfer pumping station will be provided on the outlet to the Camellia Storage Reservoir to pump recycled water directly into the distribution network using variable speed drive pumps controlled on pressure. This Pumping Station is designed to allow delivery of peak hourly demand to the Foundation customers in Camellia.

All reservoirs will be connected to the SW potable water network (top up) to allow supply to meet peak day demand. Initially, a deficit between supply and demand at Foundation Customer PDD of 0.4 ML/d is anticipated. It is proposed the deficit is addressed by being able to deposit top up water into each reservoir, in a ratio similar to that of the zonal demand increases. Sydney Water have agreed that 3.1 ML/d is available at Fairfield, 4.6 ML/d at Woodville Road and 4.6 ML/d at Camellia.

At Fairfield water disinfection will be undertaken at the RWTP via the chlorine contact tank. Disinfection will be controlled by monitoring at the RWTP and downstream of Woodville Reservoir, as well as chlorine residual at the inlet to the pumping station. In addition chlorine dosing will be incorporated on the inlet to Camellia storage reservoir to boost chlorine concentration as required to ensure correct disinfection levels within the recycled water supply are maintained.

The recycled water transfer pumps at both pumping stations will be single stage centrifugal type. System isolation valve arrangements are as shown on the accompanying P&I Diagrams. Double isolation will be incorporated on storage tanks / reservoirs and customer supply points, as shown. Customer supply points will each be fitted with mechanical type pressure regulating valves if required and flow metering. Pumps will be fitted with vents and drains as shown on the P&ID; pipelines will incorporate vents, scours and isolation valves as noted on the P&ID.

There are seven foundation customers who will be supplied to meet their peak demand requirements. Non-foundation customers will be limited to allow delivery of 1.5x their ADD and the system is designed on this basis. The supply to non-foundation customers will be controlled by operation of a motorised remotely controlled inlet valve. Control will be developed over the first year of operation, to allow optimisation of the system.

The distribution network design includes sufficient storage to meet the peak day demand for the 7 foundation customers over consecutive days without the use of potable top up water. As the network expands, the use of potable water (via the top up points at the Fairfield, Woodville Rd and Camellia reservoirs) can be incorporated to meet any deficit between supply and peak day demand. With the Plant supplying 20 ML/d, a maximum deficit of 12.6 ML/d between supply and ultimate peak day demand (32.6 ML/d) is anticipated. It is proposed the deficit is addressed by being able to deposit top up water across the three reservoirs at Fairfield (3.1 ML/d) Woodville Road (4.6 ML/d) and Camellia (4.6 ML/d). With the Plant expanded to produce 25 ML/d, the maximum deficit is reduced to 7.6 ML/d, resulting in a lower potable top up requirement across the network.

Expansion Phase

The trunk main network to Smithfield and Camellia will be designed to allow for system expansion. There will be a need to expand the network to cater for the additional non-foundation customers. Three additional zones will be created as follows:

- Liverpool
- Wetherill Park and Bonnyrigg
- Parramatta and Westmead

To limit the delivery head and energy costs from Fairfield Pumping Station, it is proposed a booster be installed downstream of the Marubeni take-off at Smithfield to serve the Wetherill Park and Bonnyrigg demands. The booster would be controlled on delivery head requirements.

On site customer storage will be provided at non-foundation customers to allow for peak demands. There will be a need to establish customer demand profiles at an early stage to assess the size of required storage. In addition consideration will have to be given to the interaction of potable and recycled water supplies to the sites and need to maintain water quality.

Key components of the distribution system are detailed in table below.

Details of Distribution System Key Components	
Fairfield Pump Station	
Installed Capacity	555 kW
Pumping Arrangement	Duty/Duty/Standby
Pumping Capacity	116 L/s (min) 231 L/s (ADD) 324 L/s (max)
Motor Type	Variable Speed

Details of Distribution System Key Components	
Camellia Pump Station	
Installed Capacity – Initial Installed Capacity - Expansion	135 kW 180 kW
Pumping Arrangement - Initial Pumping Arrangement - Expansion	Duty/Assist/Standby Duty/Assist/Assist/Standby
Pumping Capacity - Initial	38.7 L/s (min) 81.3 L/s (ADD) 150.9 L/s (max)
Pumping Capacity - Ultimate	38.7 L/s (min) 116 L/s (ADD) 203 L/s (max)
Motor Type	Variable Speed
Woodville Road Reservoir	
Reservoir Capacity	0.7 ML
Reservoir Type	Elevated (Base approximately 5m above local ground level)
Tank Compartments	1 tank
Camellia Reservoir	
Reservoir Capacity	6 ML
Reservoir Type	Surface
Tank Compartments	2 tanks (3 ML capacity each tank)
Transfer Main Pipeline[1]	
Pipeline Length	11.9 km
Pipe Material	PVC-M, PVC-O and PE100
Pipe Class	PN16, PN10
Design Basis	Peak Daily Flow
Roughness Coefficient	0.015 mm
Maximum Headloss[2]	7 m/km
Maximum Velocity[2]	1.95 m/s
Distribution Main Pipeline[1]	
Pipeline Length	8.0 km
Pipe Material	PVC-O
Pipe Class	PN16
Design Basis	Peak Hourly Flow
Roughness Coefficient	0.015 mm
Maximum Headloss	4.6 m/km
Maximum Velocity	1.6 m/s
Note 1: Transfer mains defined as those upstream of system balancing storage, and distribution mains defined as those downstream of system balancing storage. **Note 2:** maximum velocity and headloss values are based on the expansion network flows. Initial maximum headloss and velocities are lower.	

Distribution System Design Criteria

The scheme has been designed to comply with WSA 03 – 2002_2.2 SWC Edition. The following criteria have been met:

- Transfer mains have been sized for foundation customer peak daily demands and the anticipated growth in non-foundation customer demand
- Reticulation mains have been sized for Foundation Customer peak hourly demands and the additional expansion capacity required for non-foundation customers
- Peak demand for non-foundation customers has been based on an allowance of 1.5 times the ADD. AVA's market development work obtained over the last two years has demonstrated that this is an appropriate factor when all the peak demands are averaged across the total network.
- The roughness coefficient used was 0.015 mm, based on the Colebrook-White formula. A common value for reticulation and distribution mains was used based on the typically large main size in the network. A value of 0.015 mm is the upper limit in AS2200 for PVC and PE pipe.
- To optimise the network, the maximum head loss experienced in the system at the ultimate peak day demand is in the order of 7 m/km.
- PN16 rated pipe has been used for all trenched mains
- Pipe material used for open trenching pipelines is PVC-O PN16 up to and including DN375 and PVC-M for DN450.
- Pipe material used for directionally drilled and thrust bored sections is PE100 PN16
- The pipeline connecting the LAP to the Plant has been sized for 37 ML/d to allow future maximum production of 25 ML/d recycled water from the Plant
- The waste line from the Plant to the SWC nominated discharge sewer located on the southern side of the Fairfield SSTP has been sized to transfer 10 ML/d waste
- The Woodville Rd elevated reservoir has been sized to cater for operational fluctuations in diurnal demands in the network. Peak hourly demand for the foundation customers has been used to calculate this value as given in the Water Supply Code WSA 03 - using a value of 0.8, this gives a volume of 700 kL.
- With the Plant operating at 20 ML/d, a supply deficit of 0.44 ML/d exists during peak day conditions between the production capacity of the Plant and the peak day demand of the foundation customers. Note that the peak day demand for the Foundation customers included the ADD for STC. Available network storage of 6 ML at Camellia and 3 ML at Fairfield is sufficient to meet peak day conditions for a three consecutive peak day event without the use of potable top up. During average day conditions, the storage at the two sites would allow for approximately 15 hours of emergency supply if the Plant was offline. Note: operational storage requirements are separate to available network storage.

Overall network storage has been sized accordingly to include both available and operational storage.

- The treatment plant, network storage and top up arrangements are capable of supplying consecutive peak day events.

- The reservoir design provides a gross available volume of 6 ML storage at Camellia and 3 ML at Fairfield. The following have been accounted for in the design:

    - Operational volume for diurnal demand fluctuations, equivalent to 0.8 times foundation customer peak hour demand of the system as a whole (700 kL)

    - Dead volume of 0.25 m at the base of the tanks

    - Freeboard of 0.25 m high

- The maximum pressure head in the distribution system is 75 m which occurs at the Fairfield Pump Station; this pressure head is required to transfer the recycled water to the system high point at the Woodville Rd elevated reservoir and to account for friction losses; at average day demand, the network pressure will not exceed 60 m in the pumped sections between Fairfield Pump Station and the intersection of Woodville Rd and the Visy off-take in Smithfield

- Pumping station capacity at Fairfield Pump Station has been designed to deliver an ultimate volume of 28 ML/d using variable speed pumps controlled by the Woodville Rd reservoir level and system pressure measured at Marubeni

- The pumping station capacity at Camellia Pump Station has been designed to provide an ultimate peak hour demand of 17 ML/d using variable speed drive pumps controlled on system pressure

- The use of variable speed drive pumps at Camellia will allow turndown of pump motors to allow delivery of lower flows than average day demand; if, however, flows are very low or approaching zero and different to that indicated in the tender document, consideration will need to be given to installation of a small pump to maintain pressure during these periods, recirculation of water or storage of additional flows by a third party during periods of low demand. In this design, a 50% turndown has been assumed to give 3.4 ML/d minimum flow

Pipeline Routes

Effluent Transfer and LAP Connection

The pipeline transferring effluent from the LAP to the Plant has been designed to mostly follow nature strips along the sides of existing roads. It will share a trench with the recycled water distribution pipeline to minimise the excavation.

The pipeline will connect to the LAP at the 600 mm off-take from the LAP incorporated by SWC. At the Plant, the pipeline will discharge the effluent to a Feed Balance Tank.

The pipe has been sized for a capacity of 37 ML/d of effluent, to allow delivery of the maximum expansion capacity of the plant, ie 25 ML/d.

Details of the pipeline are provided the table below.

Details of Effluent Transfer Pipeline		
Pipe Size (Nominal, mm)	**Pipe Material**	**Length (m)**
DN525	GRP PN16	400

The effluent transfer pipeline corridor is shown on the map presented in Attachment 1.

Recycled Water Delivery Network

The recycled delivery network is presented in Attachment 1.

- The section of pipeline route from Fairfield Plant to the Smithfield off-take in Fairfield East is designed to pass through Fairfield Park and follows nature strips alongside roads either side of the park; this section of pipeline includes directional drills at Prospect Creek in Fairfield Park, a culvert crossing on Tangerine Street Fairfield East and under both the LAP and Prospect Creek at Fairfield East; pipe jacking or thrust boring will be required under Bland Street in Fairfield East and under The Horsley Drive in Fairfield East

- The pipeline section from the Smithfield off-take to Woodville Road follows the nature strip on the north side of Tangerine Street in Fairfield East; pipe jacking or thrust boring will be required under Woodville Road in Fairfield East

- The Woodville Road route was chosen as Alinta owns a 12 inch isolated gas main running under the road, which will be used to allow easier installation of the recycled water main along the busy highway; pipe bursting technologies are to be used and successful trials have been undertaken by Alinta to confirm suitability. Bridge crossings are required near Springfield Street over the SWC Prospect Reservoir Transfer Mains and over Duck Creek at Granville Park

- The section of pipeline between Woodville Road (at Elizabeth St) and the Camellia reservoir has been selected as it mostly follows nature strips, footpaths and parks; pipe jacking or thrust boring is required at the Clyde railway crossing, under Parramatta Road Clyde, under Duck Creek near Clyde Showground, under the railway along Grand Avenue Camellia and under the roadway at Grand Avenue Camellia; bridge crossing will be required at Duck Creek on Elizabeth Street Granville

- The routes for the main and associated off-take supplying Foundation and Non-foundation Customers in Camellia predominantly follows nature strips alongside the roads in Camellia leading to customer delivery points.

- The Smithfield off-take rising main supplying the Smithfield foundation customers and Non-foundation Customers has been located in nature strips alongside roads and beside Prospect Creek; pipe jacking or thrust boring will be required at the Yennora Railway crossing and under Fairfield Road at the junction of Dursley Road at Yennora

Note: A route alongside the RailCorp rail network was considered, but was rejected due to opposition from RailCorp (Refer Attachment 4).

During commissioning of the Plant the section of recycled water pipeline, running from the Plant to the point where it crosses the LAP, will be used to transfer wastewater used in the commissioning process to the LAP. For this purpose a cross-connection between the recycled water pipeline and the LAP will been provided. Valving will be provided to ensure commissioning water is discharged to the LAP and does not proceed further down the recycled water pipeline. Upon completion of commissioning, the section of recycled water pipeline used will be cleaned and the pipeline isolated from the LAP.

The approximate lengths of mains for the network are shown in the table below.

Details of Recycled Water Network Mains		
Pipe Size (Nominal, mm)	**Pipe Material**	**Length (m)**
DN100	PVC-O PN16	355
DN150	PVC-O PN16	385
DN225	PVC-O PN16	165
DN250	PVC-O PN16	1055
DN300	PVC-O PN16	445
DN375	PVC-O PN16	9700
DN400	PE100 PN10	4870
DN450	PVC-M PN16	2920

USE OF POTABLE WATER

Construction

The use of potable water during construction of the Plant and the distribution network will be limited.

Commissioning

During commissioning, water will be required for the following:

- Testing of the works (run to waste)
- Testing of mains with pressure testing, swabbing and chlorination of mains
- Testing of pumping stations including pressure and water quality testing and running the pumping station to waste
- Testing of reservoirs including pressure testing of pipework, water quality testing, and drop tests of reservoirs themselves

Plant Operation

During Operation, potable water will be required for:

- Laboratory wash-up
- Site area wash down (where recycled water cannot be used)
- Usual domestic purposes – hand washing, sinks, showers, toilets

System Top-Up Usage

Potable water from SWC will be used to "top-up" the recycled water levels in the Fairfield, Woodville Rd and Camellia network storage reservoirs during times of extended peak demands. With the Plant operating at 20 ML/d, a supply deficit of 0.44 ML/d exists during peak day conditions between the production capacity of the Plant and the peak day demand of the foundation customers. Available network storage of 6 ML at Camellia and 3 ML at Fairfield is sufficient to meet peak day conditions for consecutive peak day events without the use of potable top up. During average day conditions, the storage at the two sites would allow for approximately 15 hours of emergency supply if the Plant was offline. An additional emergency supply will be provided by the SWC back-up supply at the Foundation customer sites.

As the network expands, the use of potable water (via the top up points at the reservoirs) can be incorporated to meet any deficit between supply and peak day demand. With the Plant supplying 20 ML/d, a maximum deficit of 12.6 ML/d between supply and ultimate peak day demand (32.6 ML/d) is anticipated. It is proposed the deficit is addressed by being able to deposit top up water to a total volume of 12.3 ML/d across the three reservoirs at Fairfield, Woodville Road and Camellia..

With the Plant expanded to produce 25 ML/d, the maximum deficit is reduced to 7.6 ML/d, resulting in a lower potable top up requirement across the network.

PLANT & FACILITY WASTE MANAGEMENT DURING ALL PHASES

Plant Waste Management During Commissioning

During the wet commissioning all effluent or potable water that is used will be discharged at a low rate to the sewer. Temporary and permanent recycle lines will be utilised during the wet commissioning period to minimise the use of potable water and/or effluent and to reduce the quantity to be discharged to the sewer.

To prove the Plant, a 30 day proof test will be conducted. The Plant will be operated normally during this proofing period with the recycled water that is produced returned to the LAP via a temporary connection downstream of the feed effluent off-take. For a short period of the proof test the recycled water may be pumped into the network, but no recycled water will be supplied to the customers. Any recycled water pumped into the network will be discharged to the sewer via the scour valves. During the proof test a rigorous sampling and analysis program will be implemented to ensure that the recycled water meets the SWC requirements and complies with the National Guidelines for Water Recycling.

Plant Waste Management During Operations

Process wastes from the water recycling process will form the majority of wastes discharged from the Plant site during Operations. These wastes will be discharged to sewer in accordance with a trade waste consent. In accordance with SWC's Trade Waste Management Plan for Industrial Customers, AVA will pay a fee only for the additional load of substances discharged back to the sewer. However, SWC has advised AVA that regardless of whether any additional load is added, there are limits to the quality and quantity of trade waste that SWC can accept.

RO is a physical separation process which produces a purified water stream and a waste stream containing concentrated contaminants in proportion to the contaminants in the incoming stream. The smaller the volume of waste, the higher the concentration of contaminants within it, up to a limit above which reverse osmosis cannot provide further concentration because of membrane fouling issues.

SWC requested that AVA minimise as much as possible the volume of discharge to sewer to avoid jeopardising SWC's capability to achieve its target overflow levels of a maximum of 40 overflow events per ten years. AVA has based its design for the Camellia Plant on the principle of selecting optimum recovery to minimise the discharge volume to sewer without threatening the life of its membranes or its ability to cope with varying feed effluent quality. This approach will result in an ammonia discharge of 116 mg/L to sewer when the incoming ammonia levels are 33 mg/L, as indicated by the 90%ile concentration. This ammonia concentration exceeds the trade waste acceptance standard of 100 mg/L.

As discussed under Design, above, ammonia removal by biological processes was not considered the most viable approach for this project. In order to limit the concentration of ammonia to sewer to 100 mg/L, AVA has therefore proposed a mechanism whereby the waste from the RO process, combined with other plant waste streams, will be diluted with secondary effluent taken directly from the LAP. As the majority of the nitrogen present in the system is in the form of ammonia, this will also control the Total Nitrogen levels in the trade waste. All other contaminants in the waste stream are expected to be well below the relevant acceptance standards.

In order to minimise the volumetric discharge to sewer and the quantity of effluent removed from the LAP, AVA proposes to dilute the plant wastes only when required by the ammonia concentration and only with the required volume to meet the trade waste acceptance standard. The volume of secondary effluent transferred to the waste pit for dilution will be controlled by an on-line ammonia meter at the waste pit. By the nature of the RO process, the concentration of ammonia in the plant waste will be dependant on its concentration in the LAP. When the concentration of ammonia in the LAP is less than or equal to its 50%ile level of 28 mg/L, no dilution will be required and 8.2 ML/d will be discharged to sewer at 20 ML/d production. At 90%ile ammonia concentration in the LAP (33 mg/L) and maximum production (20 ML/d), it is anticipated that 10.1 ML/d will be sent to sewer.

If wet weather events restrict the permitted discharge to sewer to below that required to produce 20 ML/d recycled water, the production of the plant can be reduced and storage plus top-up and/or back-up water used to ensure supply to Foundation Customers. Note also that SWC has indicated that if wet weather events occur, effluent from Glenfield STP will not be sent to the LAP and that sufficient secondary effluent to produce 20 ML/d may not be available.

To produce the Foundation Customers' average day demand of 11.8 ML/d, only 6.3 ML/d of diluted waste will be produced at 90%ile LAP effluent conditions, and around 5 ML/d at 50%ile LAP effluent conditions. For this reason, it is unlikely that restrictions in the waste to sewer will lead to top-up or back-up water being required, unless the Foundation Customers are consuming significantly greater than their average demand. Supply to Non-foundation Customers is intended to profit from excess production when Foundation Customers are using less than peak demand and as such is not required unless there is sufficient surplus production capacity to permit it.

For these reasons it is not anticipated that large on-site storage of waste will be required to cater for sewage discharge restrictions caused by wet weather events.

As described above, monitoring of ammonia will be carried out on-line in the waste pit prior to discharge to sewer. Other contaminants in the trade waste stream are anticipated to be well below their respective acceptance standards. Monitoring for these contaminants will be determined in conjunction with SWC when AVA and SWC negotiate a consent to discharge industrial trade wastewater. SWC will use a risk index to determine the terms of the consent and frequency of ongoing monitoring.

An example of a possible trade waste monitoring program is shown below:

Analyte	Type	Frequency
Suspended solids	Composite	Quarterly
BOD5	Composite	Quarterly
Grease	Composite	Quarterly
Ammonia	Composite	Quarterly
Nitrogen	Composite	Quarterly
Phosphorus	Composite	Quarterly
Aluminium	Composite	Quarterly
Arsenic	Composite	Quarterly
Barium	Composite	Quarterly
Benzene	Composite	Quarterly
Boron	Composite	Quarterly
Bromine	Composite	Quarterly
Cadmium	Composite	Quarterly
Chlorinated phenolics	Composite	Quarterly
Chlorine	Composite	Quarterly
Chromium	Composite	Quarterly
Cobalt	Composite	Quarterly
Copper	Composite	Quarterly
Cyanide	Composite	Quarterly
Fluoride	Composite	Quarterly
Formaldehyde	Composite	Quarterly
General pesticides	Composite	Quarterly
Herbicides and defoliants	Composite	Quarterly
Iron	Composite	Quarterly
Lead	Composite	Quarterly
Manganese	Composite	Quarterly
Mercaptans	Composite	Quarterly
Mercury	Composite	Quarterly
Molybdenum	Composite	Quarterly
Nickel	Composite	Quarterly
Organoarsenic compounds	Composite	Quarterly
Phosphorus	Composite	Quarterly
Petroleum hydrocarbons (flammable)	Composite	Quarterly
Phenolic compounds (non-chlorinated)	Composite	Quarterly
Polynuclear aromatic hydrocarbons	Composite	Quarterly
Selenium	Composite	Quarterly
Silver	Composite	Quarterly

Analyte	Type	Frequency
Sulphide	Composite	Quarterly
Sulphite	Composite	Quarterly
Thiosulphate	Composite	Quarterly
Tin	Composite	Quarterly
Uranium	Composite	Quarterly
Volatile halocarbons	Composite	Quarterly
Zinc	Composite	Quarterly

Neutralisation Pit

The revised process will include a neutralisation pit as per the original submission. All chemical waste from the Plant including UF and RO CIP waste, tank bund drains and chemical unloading bay drains will be discharged to the neutralisation pit. The chemical wastes will be recirculated and neutralised by batch dosing of either sulphuric acid or caustic soda. Once the waste solution has been neutralised, it will be transferred at a slow rate to the wastewater pit.

Wastewater Pit

The wastewater pit receives UF backwash effluent, neutralised waste and RO concentrate for subsequent disposal. It also receives intermittent transfers from the neutralisation pit.

In summary, the Plant process will produce the following residual and waste streams at the design recycled water production of 20 ML/d. These flows do not include any required dilution water to meet the trade waste acceptance standards.

Stream	Estimated volume	Frequency	Total estimated annual volume	Average daily volume
Basket strainer backwash water	1.4 L/s	Continuous	66.2 ML	181.4 kL
UF backwash water		1 backwash per 28 minutes	1040 ML	2.95 ML
UF chemically-enhanced backwash residual	19/1 kL	1 CEB per 2 days per unit	17.43 ML	47.75 kL
Used UF clean-in-place solution	38.1 kL	1 clean per 21 days per unit	3.32 ML	9.1 kL
RO concentrate	5.0 ML/d	Continuous	1829 ML	5.0 ML
Used RO clean-in-place solution (acid)	7.0 kL	1 CIP per 70 days per train	0.29 ML	0.8 kL
Used RO clean-in-place solution (alkaline)	7.0 kL	1 CIP per 70 days per train	0.29 ML	0.8 kL
RO flush water	25 kL	3.5 trains flushed daily	31.9 ML	87.5 kL

Wastewater is drained from each UF cell every time a backwash is performed. This waste has a similar composition to the feed, but with higher TDS (up to 1600 mg/L), 2-3 mg/L of chloramines and a pH of 6.8 – 7.2.

RO concentrate is continuously discharged from each RO train to the wastewater pit. This waste has a TDS of up to 3,000 mg/L and a pH of approximately 7.8. Antiscalant will be present in this stream at concentrations up to 20 mg/L. The RO concentrate will also have an elevated level of ammonium due to the high ammonia level in the feed effluent. The combined waste that is pumped from the waste water pit will be maintained below the trade waste acceptance standard for ammonia by dilution with secondary treated effluent taken directly from the LAP, as outlined above.

From time to time, neutralised chemical waste will be transferred from the neutralisation pit at a controlled rate to afford maximum dilution with the other waste streams. On such occasions, an increase in chloride and sulphate concentrations will occur for short periods of time. The combined wastewater discharge will have an average dissolved solid content of 2 g/L. The combined wastewater water is pumped by one of 2 x 100% wastewater pumps to the nearby sewer connection.

As outlined above, is not anticipated that additional wastewater storage will be required to manage wastewater discharge to sewer, for the following reasons:

- Restrictions to the Plant's capacity to discharge to sewer are based around the sewer's capacity to handle wet weather events (SWC has targeted no more than 40 wet weather overflow events in ten years).
- During wet weather events, SWC has indicated that the effluent available in the LAP may not be sufficient for maximum Plant production (20 ML/d).
- During wet weather periods, AVA can reduce Plant production (to cater for sewer restrictions and reduced effluent availability) and use network storage and top-up water to supply Foundation Customers. Non-foundation customers will not be supplied in instances where sewer or effluent availability restricts production capability.
- Wastewater discharge of 10.1 ML/d is required only when the ammonia concentration in the LAP is at its 90%ile value of 33 mg/L and production is 20 ML/d.

Disposal of Out-of-Specification Recycled Water

There may be occasions during the operation of the Plant when the recycled water quality does not meet the specification detailed in SWC's RDP. Out of specification recycled water falls into two categories:

1. Failure to meet the recycled water quality specification as set out in Table 8.1 of the RDP.
2. A recycled water product failure incident, defined as the failure to meet the recycled water limits set out in Table 8.2 of the RDP.

In the event that the water quality is out of specification but does not exceed the critical criteria defining a recycled water product failure incident, AVA will not be obliged to suspend the supply of recycled water to the customers. However, AVA will follow pre-determined protocols during and following these events to ensure proper management of the event, rapid rectification of the recycled water quality and ongoing management to prevent reoccurrence of the event. These protocols will cover:

- Key roles and responsibilities;
- Communications between AVA Plant and AVA Networks;
- Communications with SWC, Foundation Customers and any additional customers, including information regarding contact personnel for daytime hours and out-of-hours events;
- Ability to supply water to customers (each customer's requirements in terms of recycled water quality are likely to be different);
- Troubleshooting and rectification of problems;
- Follow-up of incidents;
- Other.

These protocols will be developed in detail prior to the commencement of the Operations Phase of the project. AVA will work with each of its customers to determine the criticality of various recycled water quality parameters and to define recycled water quality limits for supply of recycled water to each customer.

In the event of a recycled water product failure incident, however, the recycled water cannot be supplied to the customers and alternative options must be considered to manage the recycled water until it returns to specification.

In most circumstances as soon as a quality excursion is confirmed, the recycled water will be immediately diverted to the wastewater pit for discharge to the sewer (with the concentrate). As this sewer has a limited capacity, the Plant production will immediately be reduced to the minimum operating rate (1 RO train on-line). This equates to a combined recycled water and concentrate flow of less than the concentrate flow alone when the plant is operating at the normal production rate. In most cases, it will be necessary to continue operating the Plant when recycled water goes out of specification to allow the problem to be identified and rectified as quickly as possible. This will minimise the potential period where the Plant is not supplying recycled water to the network. Provided the quality returns to normal within a few hours it is likely that the customers will not be impacted as the network capacity will cater for this downtime.

At this stage it is not considered feasible to continue to operate the Plant at normal production rates when the quality is out of specification due to the limitation of the sewer and the difficulties in disposing of the recycled water via alternate options. This will not prevent AVA considering the alternatives available to manage recycled water when it does not meet the SWC specifications. These options are discussed briefly below but would require more detailed investigation during detailed design and then on-going throughout the operation of the recycled water scheme.

Alternative Options for Disposal of Out of Specification Recycled Water

Discharge to irrigation customers

There are several important details that need to be considered if out of specification recycled water is discharged to irrigator customers. The DEC will need to approve the use of recycled water at the customers' sites and often numerous controls are required. This will depend on the recycled water quality. The table below provides a comparison of the recycled water specification and the guidelines for using recycled water for irrigation. One difficulty is that the limits for recycled water quality vary depending on the soil characteristics of the irrigation site and the application rates.

Parameter	NSW Recycled Quality Guideline (95%ile) mg/L	Irrigated Effluent Guideline (BOLD is tighter than recycled water)	Comments
Total nitrogen	< 10		Depends on soil concentration at the site applied.
Nitrate		10 mg/L	
Ammonia	< 1	Not specific	Total nitrogen is of more concern, although ammonia should not be too high.
Total phosphorus	< 2	10 mg/L	
Suspended solids			
BOD	< 2	Not specific	Depends on the organic content in soil where the recycled water is applied.
Boron		2 mg/L	Toxic to plants.
Aluminium	< 0.1	5 mg/L	
Calcium	< 10	Not specific	
Chromium		0.1 mg/L	
Copper		0.2 mg/L	
Lead		0.2 mg/L	
Manganese	< 0.05	0.2 mg/L	
Arsenic		0.1 mg/L	
Cadmium		0.01 mg/L	
Iron	< 0.05	1 mg/L	
Nickel		0.2 mg/L	
Zinc	< 0.1	2 mg/L	
TDS	< 75	250 mg/L	Safety factor applied.
Faecal coliforms	< 10	< 300 cfu/100mL	
Viruses and parasites	< 1 in 50L	Not required	
Turbidity	< 2	Not specific	Low enough not to cause issues for

Parameter	NSW Recycled Quality Guideline (95%ile) mg/L	Irrigated Effluent Guideline (BOLD is tighter than recycled water)	Comments
			irrigated systems.
Hardness	< 20	Not specific	
Sodium		70 mg/L	Protect clay based soil structure. Measured via SAR in soil at site where applied.
Chloride	< 20	Not specific	
Chlorine	> 1	Not specific	Free residual
pH	6.5 – 8.5	6.5 – 8.5	

Site Monitoring

Site conditions at the different irrigation customer sites would need to be assessed to determine:

- Organic matter content (maximum loading rate of 40 kg/ha/day recommended)
- Nitrogen (prefered in the form of nitrate for plant uptake)
- Phosphorus
- Depth to groundwater
- Sodium adsorption ratio (SAR) - aim for less than 8.0 when operating
- Available land for irrigation (excluding buffer zones, public zones, waterways, shallow groundwater zones)
- Water balance to assess loading rates, and determine maximum hydraulic loading rates

The recycled water quality would then need to be classified as high, intermediate or low according to its strength, as in the Table below. Out of specification recycled water from the Plant would likely be classified as low according to this Table.

Parameter (mg/L)	Low	Intermediate	High
Total nitrogen	< 50	50 – 100	> 100
Total phosphorus	< 10	10 – 20	> 20
BOD	< 40	40 – 1500	> 1500
TDS	< 500	500 – 1000	> 1000

On-site Controls

Numerous on-site controls would need to be considered at the irrigation sites. These could include:

- Excluding the public from the vicinity during any spraying operation.
- Possible requirement for effluent storage..
- Erosion control where sprayed.
- Buffer zones from public access and natural waterways (20 m should be provided according to the Guidelines for public access, and generally 50 to 100 m is required for natural waterways).
- Preference for trickle or spray irrigation.
- Groundwater minimum maintenance depth of greater than 3 m (that is, where the groundwater depth is shallower than 3 m, irrigated effluent should not be applied)
- Operation in association with a soil moisture monitoring system – such as on-site in-ground probes.
- Zero effluent runoff assumed in design of hydraulic loading and operating practise.
- Maximum BOD loading rate of 40 kg/ha/day recommended.

Plant-Related Operating Philosophy

As the table above indicates, it is feasible for the recycled water to be used by irrigation customers if it is out of specification. However, there may be difficulties associated with contaminating other parts of the network if irrigation customers are still supplied this recycled water. It would be necessary to consider either a dedicated system that supplies only irrigator/s or a means to ensure that the system is effectively flushed prior to resuming supply to all customers. These factors will be considered in more detail during the planning and detailed design phases of project to determine the feasibility and cost implications of this option.

If cost-effective from a whole of life perspective, AVA may consider taking effluent post-UF and pre-RO to maintain some nutrient content. This will be investigated at a later date.

Discharge to storm water

Discharge to storm water is an option that would be considered only after discussions with SWC and agreement from both SWC and the DEC. The main risk is that the recycled water is normally chlorinated to 1 mg/L (or higher). This chlorinated water would have a negative impact on the receiving waters if it is discharged as storm water. It may be feasible to provide a bypass to discharge out of specification recycled water to the Fairfield SSTP (most likely to the discharge point). This would only be acceptable if the chlorination of the recycled water was stopped and the recycled water was tested to confirm that there was no chlorine present or if additional dechlorination facilities were installed to treat the recycled water prior to discharge.

If successful, AVA would enter into discussions with SWC to further develop this option.

Removal by tanker

Removal of out of specification recycled water by tanker to an approved facility would only be considered if the recycled water was affected by a contaminant not normally present in secondary effluent. In this circumstance the Plant would be shut down and isolated from both the LAP and the network. Tankers would then be used to drain all tanks and the contaminated water would be disposed of appropriately (depending on the nature of the contaminant). This is considered to be an unlikely event in the life of the recycled water scheme's operation.

Return to the LAP

It may be feasible for out of specification recycled water to be returned to the LAP. It is likely that the recycled water would be of significantly better quality than the secondary effluent in the LAP and it would therefore be acceptable for others that may extract effluent from the LAP. Providing a means for connection to the LAP may be difficult as it raises the problem of cross-connection and possible contamination of the recycled water system with secondary effluent from the LAP. The use of an air gap tank and other control measures makes this option a highly feasible option for consideration during the detailed design phase of the project.

Distribution Network Waste Management

For the scour pipe discharges it has been assumed that connection to sewers by gravity is preferred. Scours at the Plant and along the pipeline will discharge to sewers proposed by SWC on 28 February 2007. Woodville Rd reservoir will drain to storage on the Woodville Golf Course and Camellia reservoir will drain to storage on the Rosehill Gardens Racecourse, as specified by SWC on 28 February 2007. Scour pipes shall have a single check valve to prevent backflow of sewage to the recycled water main.

Where there is no sewer in the vicinity of the scour point, a pump out pit shall be provided, such as at manholes with scour facilities. Pumped out water will be tankered to an authorised waste management facility.

RETURNABLE SCHEDULE 6 – CONFORMING DESIGN TECHNICAL SUFFICIENCY TABLES

Proposed Design - Use of Potable Water

ID	Project Phase (eg construction, operation)	Description/Purpose (eg Plant process supply, Plant domestic supply, top-up supply)	Location (eg Plant, reservoir location)	Flow Rate Required (ML/d)	Pressure Required (m)
PW1	Operation	Top up Water	Woodville Rd Reservoir	4.6 max	15
PW2	Operation	Top up Water	Camellia Reservoir	4.6 max	10
PW3	Operation	Top up Water	Fairfield Reservoir	3.1 max	10
PW4	Operation	Plant Domestic Supply	Plant	~ 0.001 (1kL/day)	Standard

Conforming Design – Waste Management

Provide a description of the proposed waste management methodology for all waste streams from the Plant, for all phases of the Recycled Water System from construction to operation, including but not limited to domestic waste, waste activated sludge, brine reject and filter backwash streams

	Project Phase (eg pilot plant if used, commissioning, operation)	Description of Waste (eg WAS, brine reject filter backwash)	Load (kg/d)	Concentration (% solids)	Flow Rate (ML/d)	Waste Treatment	Waste Storage Required (ML)	Waste Disposal Location	Meet Trade Waste Approval Requirements (ie TSS<600 mg/L)
	Pilot Plant Operation	Combined Waste	~ 5	Same as feed (~ 20 mg/ L TSS)	~100 kL/ d	None	None	Head of works – Liverpool STP	N/A
	Plant Operation	UF backwash and RO	393	39 mg/ L TSS	10.1 ML/d	Neutralisation	TBA	Sewer	Yes
	Plant Operation	Domestic Sewage	<5	Raw Sewage (~280 mg/L TSS)	<10 kL/d	None	None	Sewer	Yes

Proposed Design Characteristics – Reservoirs										
ID	**Location**	**Current Land Zoning**	**Site Area Required (ha)**	**Type (eg surface, elevated)**	**Full Supply Level (m AHD)**	**Depth (m)**	**Total available Volume (ML)[3]**	**Reserve Volume (ML)**	**Operating Volume (ML)**	**Top-up Req'd (Y/N)***
R1	Fairfield	WWTW	TBC	Surface	16	6.6	3	2.3	0.7	Y
R2	Woodville Road Golf Course	Golf Course	0.14 ha	Elevated	58.5	3.5	0.7	-	0.7	Y
R3	Camellia	Race course	0.56 ha[2]	Surface	12	6	6	5.3	0.7	Y

* potable top-up requirements to be entered into Table 6.5

Note 1: Total area required for Plant, Reservoir and Pumping Station

Note 2: Total area required for Reservoir and Pumping Station

Note 3: Total available volume does not include dead volume or free board

Proposed Design Characteristics – Pumping Stations										
ID	**Location**	**Current Land Zoning**	**Site Area Required (ha)**	**Pump Type**	**Flow Delivered (ML/d)**	**Pressure Delivered (m Head)**	**Power (Installed kW)**	**Pump Control (eg reservoir level, HGL)**	**Pump Unit Configuration (Duty/ Standby**	**Pump Centreline (m AHD)**
PS1	Fairfield	WWTW	TBC	Booster	28	75	555	Reservoir level, System Pressure	Duty/Assist/ Standby	10
PS2	Camellia	Race course	0.56 ha[2]	Booster	17	50	180[3]	System Pressure	Duty/Assist/Assist/ Standby	6

Note 1: Total area required for Plant, Reservoir and Pumping Station

Note 2: Total area required for Reservoir and Pumping Station

Note 3: This is the ultimate capacity of the Camellia Pumping Station. The initial Pumping Station will only have 3 pumps

Proposed Characteristics – Pipelines								
ID	**Purpose (eg, RSTP inlet, sewer connections, distribution, potable top-up)**	**Route Description**	**Route Alignment (eg road, footpath, reserve)**	**Nominal Diameter (mm)**	**Length (m)**	**Construction Method (eg trenching)**	**Material)**	**Easement Required (Y/N)**
S1	Plant inlet	From LAP in Orchard Rd via North St to Plant site	Road/ Nature strip	600	400	Open cut	GRP	N – Public Highway/ WWTW site
S2	Plant waste pipeline	From Plant SE across the WWTW site to the sewer discharge point	Nature strip	300	300	Open cut	GRP	N – WWTW site
M1	Plant Outlet Main	Fairfield Plant to Smithfield Take-off via Fairfield Park to Tangerine Street	Road/ Nature strip/ Park	450	1998	Open cut	PVC-M	N – Public highway
M2	Plant Outlet Main	Smithfield take-off to Woodville Road along Tangerine St	Road/ Nature strip/ Park	450	878	Open cut	PVC-M	N – Public highway
M3	Plant Outlet Main	Along Woodville Road to Woodville Rd Res	Road	400	1755	Bursting	PE	N – Public highway
M4	Transfer main to Camellia Reservoir	Along Woodville Road – Woodville Res to Elizabeth St	Road	400	3177	Bursting	PE	N – Public highway
M5	Transfer main to Camellia Reservoir	Woodville Rd to Camellia Reservoir, Unwin Street	Road / Nature strip	375	4054	Open cut	PVC-O	N – Public highway
M6	Transfer main to Camellia Customers	Camellia Res to Devon Street	Road / Nature strip	375	1184	Open cut	PVC-O	N – Public highway

Proposed Characteristics – Pipelines								
ID	**Purpose (eg, RSTP inlet, sewer connections, distribution, potable top-up)**	**Route Description**	**Route Alignment (eg road, footpath, reserve)**	**Nominal Diameter (mm)**	**Length (m)**	**Construction Method (eg trenching)**	**Material)**	**Easement Required (Y/N)**
M7	Camellia Customer take -off	To STC	Road/ Nature strip	150	353	Open cut	PVC-O	N – Public highway
M8	Camellia Customer take -off	To James Hardie along Durham St	Road/ Nature strip	250	400	Open cut/stitch bore	PVC-O	N – Public highway
M9	Camellia Customer take -off	To Boral along Thackeray St	Road/ Nature strip	250	816	Open cut/stitch bore	PVC-O	N – Public highway
M10	Smithfield Customer Take off	To Smithfield via Yennora via Road then along the banks of Prospect Creek	Road/ Nature strip	375	4090	Open cut	PVC-O	Public highway plus some private land
M11	Smithfield Customer Take-off	To Visy	Nature Strip	200	162	Open cut	PVC-O	Y – private Land
M12	Smithfield Customer Take-off	To Marubeni	Nature Strip	300	1009	Open cut	PVC-O	Y – private Land

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Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
SFF	Fairfield Plant	Clear water reservoir scour valve	Gate	200	Scour discharge, manual, reservoir maintenance	Closed
WGC	Woodville Golf Course, south west corner	Elevated reservoir scour valve	Gate	200	Scour discharge, manual, reservoir maintenance	Closed
CR	Unwin St, Rosehill, 350 west of intersection with Shirley St	Surface reservoir scour valve	Gate	200	Scour discharge, manual, reservoir maintenance	Closed
S1	North St, Fairfield. Halfway between Orchard St and Wilga St	Pipeline scour valve	Gate	100	Scour discharge, manual, pipeline maintenance	Closed
S2	Intersection of North St and Riverview Rd, Fairfield	Pipeline scour valve	Gate	150	Scour discharge, manual, pipeline maintenance	Closed
S3	Fairfield Park, Ch910m	Pipeline scour valve	Gate	150	Scour discharge, manual, pipeline maintenance	Closed
S4	Tangerine St, Fairfield East. Halfway between Loftus St and Normanby St	Pipeline scour valve	Gate	150	Scour discharge, manual, pipeline maintenance	Closed
S5	Tangerine St, Fairfield East. 180m west of Mandarin St.	Pipeline scour valve	Gate	200	Scour discharge, manual, pipeline maintenance	Closed
S6	Woodville Rd, Fairfield East, Halfway between Roger Bowman Lane and Fuller Rd	Pipeline scour valve	Gate	200	Scour discharge, manual, pipeline maintenance	Closed
S7	Intersection of Woodville Rd and Wynyard St, Granville	Pipeline scour valve	Gate	200	Scour discharge, manual, pipeline maintenance	Closed

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
S8	Intersection of Woodville Rd and Meadows St, Granville	Pipeline scour valve	Gate	200	Scour discharge, manual, pipeline maintenance	Closed
S9	Elizabeth St, Granville, 76m west of intersection with Blaxcell St	Pipeline scour valve	Gate	200	Scour discharge, manual, pipeline maintenance	Closed
S10	Intersection of Wentworth St and Martha St, Clyde	Pipeline scour valve	Gate	200	Scour discharge, manual, pipeline maintenance	Closed
S11	Devon St, 225m east of Colquhoun St	Pipeline scour valve	Gate	200	Scour discharge, manual, pipeline maintenance	Closed
S12	Loftus Rd, Yennora, 200m east of Pine Rd	Pipeline scour valve	Gate	200	Scour discharge, manual, pipeline maintenance	Closed
S13	Fairfield Rd Park, 108m from Fairfield Rd	Pipeline scour valve	Gate	200	Scour discharge, manual, pipeline maintenance	Closed
A1	Intersection of North St and Taylor St, Fairfield	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A2	Intersection of North St and Orchard St, Fairfield	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A3	Fairfield Park, ~Ch850m	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A4	Fairfield Park, ~Ch1,095m	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A5	Tangerine St, east side of Horsley Dr, Fairfield East	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A6	Intersection of Woodville Rd and Lisbon St, Fairfield East	Pipeline air valve	Double acting air valve	80	Air pressure	Open

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
A7	Intersection of Woodville Rd and Cleone St, Granville	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A8	Intersection of Woodville Rd and Elizabeth St, Granville	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A9	Intersection of Factory St and First St, Granville	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A10	Intersection of Martha St and Harbord St, Clyde	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A11	North end of Deniehy St, Clyde	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A12	Crown St, Fairfield East. Halfway between Gordon St and Diprose St	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A13	Intersection of Ellis Pde and Railway St, Yennora	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A14	Intersection of Dursley Rd and Pine Rd, Yennora	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A15	Fairfield Rd Park, 108m from Fairfield Rd	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A16	Intersection of Tangerine St and Normanby St, Fairfield East	Pipeline air valve	Double acting air valve	80	Air pressure	Open
A17	Crest of Woodville Rd	Pipeline air valve	Double acting air valve	80	Air pressure	Open
FX1	Fairfield Pump Station pump inlet	Pump isolation	Resilient seated gate valve	300	Manual, maintenance	Open
FX2	Fairfield Pump Station pump inlet	Pump isolation	Resilient seated gate valve	300	Manual, maintenance	Open
FX3	Fairfield Pump Station pump inlet	Pump isolation	Resilient seated gate valve	300	Manual, maintenance	Open

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
FA1	Fairfield Pump Station pump inlet	Air valve	Double acting air valve	80	Air pressure	Open
FA2	Fairfield Pump Station pump inlet	Air valve	Double acting air valve	80	Air pressure	Open
FA3	Fairfield Pump Station pump inlet	Air valve	Double acting air valve	80	Air pressure	Open
FX4	Fairfield Pump Station pump outlet	Non return valve	Swing check valve	300	Direction of flow	Open
FX5	Fairfield Pump Station pump outlet	Non return valve	Swing check valve	300	Direction of flow	Open
FX6	Fairfield Pump Station pump outlet	Non return valve	Swing check valve	300	Direction of flow	Open
FX7	Fairfield Pump Station pump outlet	Pump isolation	Resilient seated gate valve	300	Manual, maintenance	Open
FX8	Fairfield Pump Station pump outlet	Pump isolation	Resilient seated gate valve	300	Manual, maintenance	Open
FX9	Fairfield Pump Station pump outlet	Pump isolation	Resilient seated gate valve	300	Manual, maintenance	Open
FX10	Fairfield Pump Station pump outlet	Isolation valve - delivery	Motorised butterfly valve with actuator	300	Pump start and stop	Open
FX11	Fairfield Pump Station pump outlet	Isolation valve - delivery	Motorised butterfly valve with actuator	300	Pump start and stop	Closed
FX12	Fairfield Pump Station pump outlet	Isolation valve - delivery	Motorised butterfly valve with actuator	300	Pump start and stop	Closed
FX13	Fairfield Pump Station pump outlet manifold	Isolation valve	Resilient seated gate valve	450	Manual, maintenance	Open
CX1	Camellia Pump Station pump inlet	Pump isolation	Resilient seated gate valve	250	Manual, maintenance	Open

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
CX2	Camellia Pump Station pump inlet	Pump isolation	Resilient seated gate valve	250	Manual, maintenance	Open
CX3	Camellia Pump Station pump inlet	Pump isolation	Resilient seated gate valve	250	Manual, maintenance	Open
CA1	Camellia Pump Station pump inlet	Air valve	Double acting air valve	80	Air pressure	Open
CA2	Camellia Pump Station pump inlet	Air valve	Double acting air valve	80	Air pressure	Open
CA3	Camellia Pump Station pump inlet	Air valve	Double acting air valve	80	Air pressure	Open
CX4	Camellia Pump Station pump outlet	Non return valve	Swing check valve	200	Direction of flow	Open
CX5	Camellia Pump Station pump outlet	Non return valve	Swing check valve	200	Direction of flow	Open
CX6	Camellia Pump Station pump outlet	Non return valve	Swing check valve	200	Direction of flow	Open
CX7	Camellia Pump Station pump outlet	Pump isolation	Resilient seated gate valve	200	Manual, maintenance	Open
CX8	Camellia Pump Station pump outlet	Pump isolation	Resilient seated gate valve	200	Manual, maintenance	Open
CX9	Camellia Pump Station pump outlet	Pump isolation	Resilient seated gate valve	200	Manual, maintenance	Open
CX10	Camellia Pump Station pump outlet	Isolation valve - delivery	Motorised butterfly valve with actuator	200	Direction of flow	Open
CX11	Camellia Pump Station pump outlet	Isolation valve - delivery	Motorised butterfly valve with actuator	200	Direction of flow	Open
CX12	Camellia Pump Station pump outlet	Isolation valve - delivery	Motorised butterfly valve with actuator	200	Direction of flow	Open

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
CX13	Camellia Pump Station pump outlet manifold	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
X1	Fairfield Park, Ch1150m. West bank of Prospect Creek	Isolation valve	Resilient seated gate valve	450	Manual, maintenance	Open
X2	Fairfield Park, Ch1175m. East bank of Prospect Creek	Isolation valve	Resilient seated gate valve	450	Manual, maintenance	Open
X3	Intersection of Tangerine St and Normanby St, Fairfield East	Isolation valve	Resilient seated gate valve	450	Manual, maintenance	Open
X4	Intersection of Tangerine St and Woodville Rd, Fairfield East	Isolation valve	Resilient seated gate valve	450	Manual, maintenance	Open
X5	Woodville Golf Course Reservoir	Isolation valve	Resilient seated gate valve	375	Reservoir bypass valve	Closed
X6	Intersection of Woodville Rd and Oxford St, Granville	Isolation valve	Resilient seated gate valve	375	Reservoir bypass - manual	Open
X7	Woodville Rd, South Granville at Elizabeth St	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X8	West bank of Duck Creek, Granville	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X9	East bank of Duck Creek, Granville	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X10	Southern side of Clyde Railway Crossing	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X11	Northern side of Clyde Railway Crossing	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X12	Intersection of Colquhorn St and Devon St immediately after STC off-take, Rosehill	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X13	Devon St immediately after Shell off-take	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
X14	Devon St immediately after Basell off-take	Isolation valve	Resilient seated gate valve	250	Manual, maintenance	Open
X15	Durham St immediately after James Hardie off-take	Isolation valve	Resilient seated gate valve	250	Manual, maintenance	Open
X16	Southern side of Grand Ave railway crossing	Isolation valve	Resilient seated gate valve	150	Manual, maintenance	Open
X17	Northern side of Grand Ave railway crossing	Isolation valve	Resilient seated gate valve	150	Manual, maintenance	Open
X18	Normanby St	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X19	Southern side of Yennora railway crossing	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X20	Northern side of Yennora railway crossing	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X21	Near S13	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X22	Prospect Creek bank immediately after Visy off-take	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
X23	Marubeni immediately after take-off	Isolation valve	Resilient seated gate valve	375	End of line	Closed
X24	Grand Ave, Monier entrance	Isolation valve	Resilient seated gate valve	250	End of line	Open
X26	Foundation Customer A	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
X27	Foundation Customer B	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
X28	Foundation Customer C	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
X29	Foundation Customer D	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open
X30	Foundation Customer E	Isolation valve	Resilient seated gate valve	150	Manual, maintenance	Open
X31	Foundation Customer E	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
X32	Foundation Customer G	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
X33	Monier off-take (non-foundation customer)	Isolation valve	Resilient seated gate valve	50	Manual, maintenance	Open
X34	Tanert off-take (non-foundation customer)	Isolation valve	Resilient seated gate valve	80	Manual, maintenance	Open
X35	Alcoa off-take (non-foundation customer)	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open
X36	Tyco off-take (non-foundation customer)	Isolation valve	Resilient seated gate valve	50	Manual, maintenance	Open
X37	Dana off-take (non-foundation customer)	Isolation valve	Resilient seated gate valve	80	Manual, maintenance	Open
X38	Woodville off-take (non-foundation customer)	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open
X39	Fairfield Plant recycled water line connection to LAP for testing and commissioning of the Plant	Isolation valve	Resilient seated gate valve	450	Manual (commissioning only)	Open during Plant commissioning
X40	Fairfield Plant recycled water line connection to LAP for testing and commissioning of the Plant	Non-return valve	Swing check valve	450(TBC)	Direction of flow	Open during Plant commissioning

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
X41	Fairfield Plant recycled water line connection to LAP for testing and commissioning of the Plant	Isolation valve	Resilient seated gate valve	450(TBC)	Manual, maintenance	Open during normal operation, closed during commissioning
MX1	Customer A meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
MX2	Customer A meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
MX3	Customer A meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
MX4	Customer A meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Closed
MX5	Customer B meter	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
MX6	Customer B meter	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
MX7	Customer B meter	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
MX8	Customer B meter	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Closed
MX9	Customer C meter	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open
MX10	Customer C meter	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open
MX11	Customer C meter	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open
MX12	Customer C meter	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Closed
MX13	Customer D meter	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
MX14	Customer D meter	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open
MX15	Customer D meter	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Open
MX16	Customer D meter	Isolation valve	Resilient seated gate valve	100	Manual, maintenance	Closed
MX17	Customer E meter	Isolation valve	Resilient seated gate valve	150	Manual, maintenance	Open
MX18	Customer E meter	Isolation valve	Resilient seated gate valve	150	Manual, maintenance	Open
MX19	Customer E meter	Isolation valve	Resilient seated gate valve	150	Manual, maintenance	Open
MX20	Customer E meter	Isolation valve	Resilient seated gate valve	150	Manual, maintenance	Closed
MX21	Customer F meter	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
MX22	Customer F meter	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
MX23	Customer F meter	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
MX24	Customer F meter	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Closed
MX25	Customer G meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
MX26	Customer G meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
MX27	Customer G meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
MX28	Customer G meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Closed
RX1	Woodville Rd reservoir, recycled water inlet	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
RX2	Woodville Rd reservoir, recycled water inlet	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
RX3	Woodville Rd reservoir, recycled water outlet	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
RX4	Woodville Rd reservoir, recycled water outlet	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
RX5	Woodville Rd reservoir, recycled water outlet	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Open
RX6	Woodville Rd reservoir, drain line	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Closed
RX7	Woodville Rd reservoir, drain line	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Closed
RX8	Woodville Rd reservoir, bypass	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Closed
RX9	Woodville Rd reservoir, drain from outlet line	Isolation valve	Resilient seated gate valve	375	Manual, maintenance	Closed
RX10	Woodville Rd reservoir, potable water top-up	Control valve	Motorised butterfly valve with actuator	300	SCADA (top-up)	Closed – normal operation
RX11	Woodville Rd reservoir, potable water top-up	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX12	Woodville Rd reservoir, potable water top-up meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX13	Woodville Rd reservoir, potable water top-up meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
RX14	Woodville Rd reservoir, potable water top-up meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX15	Woodville Rd reservoir, potable water top-up meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Closed
RX16	Camellia reservoir, recycled water inlet, tank 1	Isolation valve	Motorised butterfly valve with actuator	300	Reservoir level	Open
RX17	Camellia reservoir, recycled water inlet, tank 1	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX18	Camellia reservoir, recycled water inlet, tank 2	Isolation valve	Motorised butterfly valve with actuator	300	Reservoir level	Open
RX19	Camellia reservoir, recycled water inlet, tank 2	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX20	Camellia reservoir, recycled water outlet, tank 1	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX21	Camellia reservoir, recycled water outlet, tank 1	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX22	Camellia reservoir, recycled water outlet, tank 1	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX23	Camellia reservoir, recycled water outlet drain line, tank 1	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Closed
RX24	Camellia reservoir, recycled water outlet, tank 2	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX25	Camellia reservoir, recycled water outlet, tank 2	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX26	Camellia reservoir, recycled water outlet, tank 2	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX27	Camellia reservoir, recycled water outlet drain line, tank 2	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Closed

Proposed Design Characteristics – Valves						
ID	**Location**	**Value Purpose (eg control valves, air valves, section valves, scour valves, pressure reducing valves, reflux valves, etc)**	**Valve Type (eg gate)**	**Valve Size (mm)**	**Valve Control (eg reservoir level)**	**Valve Control Setting**
RX28	Camellia reservoir, drain line, tank 1	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Closed
RX29	Camellia reservoir, drain line, tank 1	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Closed
RX30	Camellia reservoir, drain line, tank 2	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Closed
RX31	Camellia reservoir, drain line, tank 2	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Closed
RX32	Camellia reservoir, potable water top-up	Isolation valve	Motorised butterfly valve with actuator	300	SCADA (top-up)	Closed – normal operation
RX33	Camellia reservoir, potable water top-up, tank 1	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
RX34	Camellia reservoir, potable water top-up, tank 2	Isolation valve	Resilient seated gate valve	200	Manual, maintenance	Open
RX35	Camellia reservoir, potable water top-up, meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX36	Camellia reservoir, potable water top-up, meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX37	Camellia reservoir, potable water top-up, meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Open
RX38	Camellia reservoir, potable water top-up, meter	Isolation valve	Resilient seated gate valve	300	Manual, maintenance	Closed

SITE REQUIREMENTS

Fairfield Plant

The proposed Plant is to be located on a parcel of land adjacent to SWC's Fairfield SSTP. The land requirements are provided in the plan included as **Attachment 2**.

General Layout

General layout arrangements are provided in Attachment 3 to this Schedule.

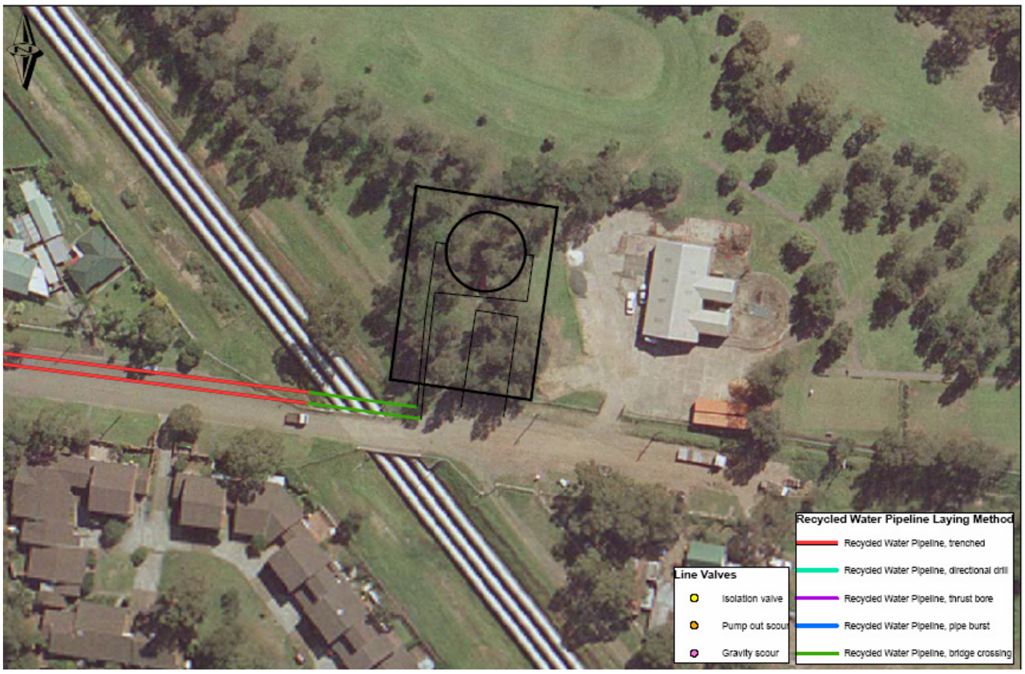
These general arrangements include:

1. site layout plan (B0223-C-0001-01)
2. UF plant building layout (B0223-C-0001-02)
3. civil loadings layout (B0223-C-0001-03)
4. chemical storage tank bund details (B0223-C-0001-04)
5. Foundation details (B0223-C-0001-05)
6. Underground piping (B0223-C-0001-06)

Woodville Golf Course

The elevated reservoir located at Woodville Golf Course will be situated opposite the Barbers Rd entrance to the golf course maintenance shed, approximately 360m from Woodville Rd. The site will be rectangular with dimensions approximately 37 m by 27 m, and allows for both the elevated reservoir and access facilities. Access to the site will be from Barbers Road. Overflow from the reservoir will flow to the scour discharge line to the Woodville Golf Course storage facility.

The site of the elevated reservoir and associated access facilities is shown on the following aerial map.



Rosehill Racecourse, Camellia

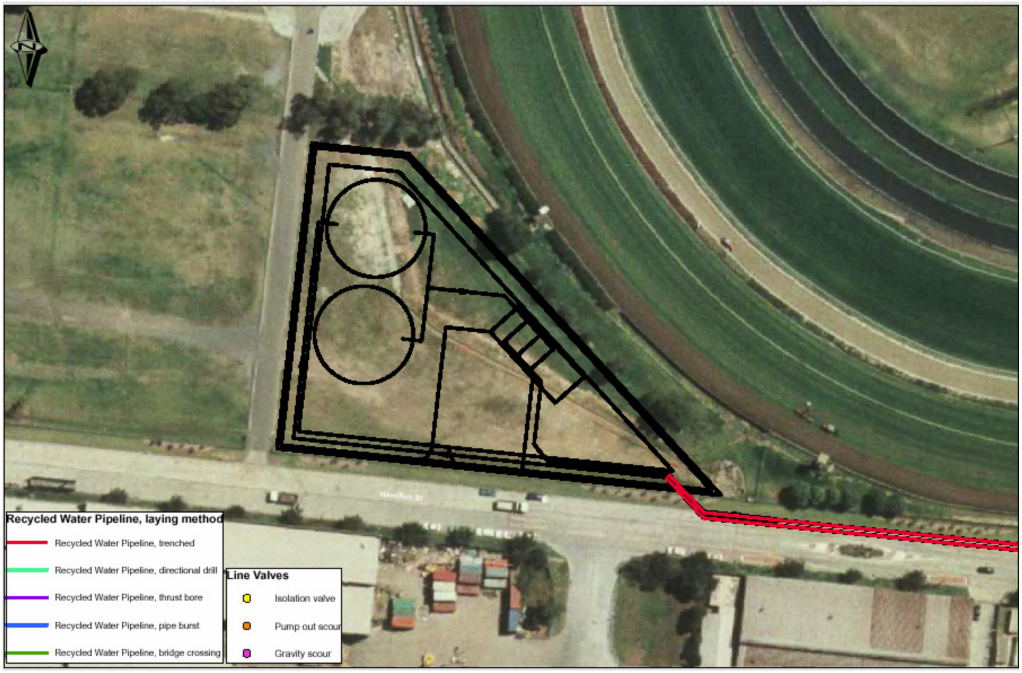
It is proposed to purchase a site to construct a reservoir and pumping station in the Camellia area.

The proposed reservoir and pumping station at Camellia will be located at a site currently in the south-west corner of the Rosehill Gardens Racecourse, on Unwin St. The site extends 115 m along Unwin St, 80 m to the north, and is roughly triangular. Two 3 ML tanks will be constructed on the site for the surface water storage facility, as well as a pumping station including parking and access area. If chlorination of the water at the Camellia reservoirs is found to be necessary in the future, a sodium hypochlorite dosing facility will be installed at the site. Overflow from the reservoir will flow to the scour discharge line to the Rosehill Gardens Racecourse storage facility.

Recycled water pipelines transferring water from Fairfield and to Camellia customers will enter the site from the east along Unwin Street. Potable water will be supplied to the storage reservoirs for top-up supply from a 300 mm diameter SWC water pipeline running south of Unwin Street, near Kay Street.

A stormwater culvert currently runs across the surface of the site, and will be relocated to the north-eastern boundary of the site during construction of the reservoirs and pumping station.

The site of the Camellia surface reservoir, pump station and associated access facilities is shown on the following aerial map. Note that the pumping station layout will change to account for the addition of a fourth pump to supply non-foundation customer growth.


Recycled Water Pipeline, laying method
Recycled Water Pipeline, trenched
Recycled Water Pipeline, directional drill
Recycled Water Pipeline, thrust bore
Recycled Water Pipeline, pipe burst
Recycled Water Pipeline, bridge crossing
Line Valves
Isolation valve
Pump out scour
Gravity scour

PROPONENTS ASSETS

The cost of establishing the recycled water reticulation network will be minimised by rehabilitating isolated gas mains (by pipebursting) for recycled water service wherever feasible.

The isolated gas mains are cast iron pipes that were installed during the period when manufactured/towns gas was reticulated at low pressures. Following the arrival of natural gas in 1976, new technology was progressively adopted that was better suited to the efficient distribution of natural gas, including operating at higher pressures. The cast iron mains were unsuitable for high pressure service and were bypassed by, and isolated from, the network as the new technology was deployed principally through the Gold Line project which began in the late 1980s. The isolated mains were generally left clean and empty however, as cement plugs were inserted in some locations to stop groundwater that enters the pipes from flowing along them. The isolated mains remain in the ownership of the Alinta group and have been monitored and managed with a view to potential use.

The isolated mains that are candidates for insertion for recycled water service have been surveyed at a number of locations during the process of planning for the current project. The surveys involved dig-ups and internal video inspections. They confirm that the mains are mapped correctly and that rehabilitation is viable.

It is proposed that Alinta will utilise their existing isolated gas main assets in Woodville Rd to allow easier installation of mains along the busy highway. Over the past year Alinta has internally inspected 1.4 km of the isolated gas main located in Woodville Rd. In addition to this, Alinta has recently undertaken a successful pipe burst trial with DN400 PE pipe in Woodville Rd to confirm the suitability of the isolated 12” main for the proposed installation method.

INTERFACES AND INTERCONNECTIONS

Connections to the LAP

The pipeline transferring effluent from the LAP to the Plant will be connected to the LAP at the 600 mm off-take nominated by SWC. It has been confirmed by SWC that a connection and double valving will be provided on the LAP for this purpose.

The recycled water pipeline transferring water from the Plant to customers will be cross-connected to the LAP to allow discharge of waste potable water used during the commissioning phase of the Plant. An off-take including isolation valve and blank flange will be provided by others. The discharge pipework connected to the LAP will be DN375 size. Upon completion of the commissioning, the cross-connection will be shut-off and sacrificed.

AVA also intends to install an on-line instrument into the LAP (or in a sample off-take from the LAP) just upstream of the point where the feed effluent to the Plant is taken. The installation of this instrument will be done in consultation with SWC. This instrument is required in this location as it will allow the effluent quality within the LAP to be measured regardless of whether the Plant is operating. This will be important in the event of an effluent quality event where the Plant is stopped but it is necessary to continue to measure the effluent quality in the LAP to determine the point when the Plant can be re-started.

Connections to SWC Potable Water Supply

The distribution network will be connected to the existing SWC potable water supply network to provide the system with top-up and back-up water supplies. The top-up water supplies will be provided at the Fairfield, Woodville Rd and Camellia reservoirs. All potable connections will pass through an approved air-gap to prevent back-flow of recycled water into the potable water system. Potable water top-up requirements are detailed in the table Fairfield Design - Use of Potable Water.

The Fairfield potable water top–up will be supplied from the Symons Rd and Fairfield SSTP site mains.

The potable water top-up for the Woodville Road reservoir will be supplied from the SWC DN375 main located on the southern side of, and parallel to, the SWC Prospect Reservoir Transfer mains.

Potable water top-up supply for the Camellia reservoirs will be sourced from the SWC DN300 main to the south of Unwin Street, near Kay Street.

A potable water supply will also be required for the Plant for domestic use only.

In addition, potable water back-up supplies will be provided locally at the customer sites as an emergency water supply. Back-up water supply, connection points and associated works will be provided by others.

Connections to SWC Sewerage

Pipeline gravity scours along the distribution network will scour wastewater to SWC nominated sewers. Scour valves are detailed in table Fairfield Design Characteristics– Valves.

The Plant will require connection to the sewer in two locations. The first for the combined process waste stream and the second for domestic waste from the amenities building.

INSTRUMENTATION AND MEASUREMENT

Instrumentation and Control Methodology

The instrumentation and control methodology should be considered in conjunction with the PIDs, provided in Appendix 2.

Plant Influent Quality

The influent quality will be monitored on-line as indicated in the table below.

Process Stream	Parameter Measured	Purpose for Measuring
Secondary Effluent **(within the LAP)**	Various (including BOD, TSS and other organic contaminants)	Monitoring and alarm (to warn of contaminants for membrane protection)
Feed	Turbidity	Monitor only
	PH	Monitor only
	Conductivity	Monitor only

Process Stream	Parameter Measured	Purpose for Measuring
	Oxidation reduction potential	Control of chemical dose, in conjunction with total chlorine ensures there is no risk to membranes
Feed post-strainers	Total Chlorine	Control of chemical dose
	Ammonia	Monitor only
	Oxidation reduction potential	In conjunction with total chlorine ensures there is no risk to membranes
	pH	Control of chemical dose
Feed balance tank outlet	Total Chlorine	In conjunction with ORP ensures there is no risk to membranes
	Oxidation reduction potential	In conjunction with total chlorine ensures there is no risk to membranes
	pH	Control

Recycled Water Quality

The recycled water quality will be monitored on-line as indicated in the table below.

Process Stream	Parameter Measured	Purpose for Measuring
Recycled Water Process Stream	Turbidity	Monitor, contract need
	PH	Monitor, contract need
	Residual Chlorine	Monitor, contract need
	Conductivity	Monitor
	Ammonia	Monitor, contract need

SCADA/PLC Control System

General Controls and Description

The Plant will be equipped with on-line instrumentation to monitor all areas of the water recycling treatment and plant status information. Measured variables will be logged and stored on the PC-based Supervisory Control and Data Acquisition (SCADA) systems based on the Citect SCADA™ platform. The entire process will be controlled and monitored from two PC-based Citect SCADA™ nodes. A third Citect SCADA™ license will be available for use by a third Citect SCADA™ client Notebook PC for the remote monitoring and operation of the Plant.

The duty standby PC Citect SCADA™ workstations will be installed in the Plant Control Room comprising of two servers connected via managed switches to a ‘self healing ‘ fibre optic Ethernet ring running between the control room and the main MCC switchroom. Please refer the proposed SCADA/PLC Configuration Diagram Drg. No B0223-E-1100-04 at Attachment 3.

The PLC Control System will closely monitor the process instrumentation and control system during the plant operation, by raising warnings or shutdown alarms if the process measurements are outside the normally expected range. This will help prevent operation of the plant control system outside the recommended limits and improve safety and the degree of protection from failure or damage to the plant components. Key process data such as total dissolved solid, turbidity, pH, and flowrate, will be captured by the PLC, and made available for logging, display and trending on the Citect SCADA™. The logged data will be stored in DBF files on the SCADA system PC. These files will be kept for a pre-determined time, after which that data will be written over by new data. All logged data will be able to be trended, reviewed and printed if desired.

Configured alarms will be logged and available for display via the native Citect SCADA™ alarm logger which will display the alarm and time of alarm. Alarms may also be configured according to process groups. In alarm paging system will be incorporated into the SCADA system to alert personnel to any plant failures.

HMI/SCADA Details

The Plant SCADA local PC workstations will be computer based system using Citect SCADA™ software which will provide detailed control and monitoring functions for the Water Recycling Plant. The SCADA workstation will allow normal operation or service and maintenance functions to be performed quickly and easily.

The SCADA workstation will provide the following features:

- Current day and previous day flow totalisers
- Operational information to assist operators in collection of daily plant operating data
- Ability for operators to adjust plant setpoints within predefined limits
- Real time trends and trend histories of instrument readings for review of plant operation or trouble shooting
- Alarm indication and configuration where any plant warnings or alarms which occur are displayed
- Manual initiation of most plant functions

Operator Graphic Displays

Operator Graphic Displays are simplified versions of the Plant P&ID's (icons representing process equipment are based on AS 1345). Overview displays serve as a menu for operator ease. Separate "Group Displays" are used for different sections of the plant, eg chemical dosing, sludge treatment, plants status, etc. Group displays are accessed from the Overview displays and include all status and analogue information available (drive-running, stopped, faulted, valve-opened, closed, modulation, etc). Operators can control functions (motor auto/manual or start/stop stations, valve auto/manual and open/close switches etc) via "pop up" windows (usually by double-clicking on the device you want to control).

Alarm Displays

Alarm monitoring facilities are available for analogue/digital alarm inputs and calculated variables. While an alarm input will directly initiate an alarm, deviation alarms and both high and low absolute alarms will be provided for analogue inputs. The Alarm Paging system uses these configured alarms as a basis to allow operators to configure which alarms are to be paged.

Trend Displays

Trend displays are line graphs with time on a linear, continuous horizontal axis and the trended variable on the vertical axis. The displays feature "Pan" and "Zoom" facilities for both x and y ranges. Trends are configured with a fixed number of key points for the operator's general use and a separate configurable page for the engineer's/technician's use. All analogue points are available to the trending system. Variables can be configured for archival trending. Trend files for variables configured for archival trending can be stored on backup optical media. The data, stored with variable name and time/date information, can be uploaded and restored if and when archived data needs to be viewed. Event logging will be configured for the Water Recycling Plant. Alarms and faults (including individual drive and valve faults) are added to an existing event log as they activate and clear (time and date information is also recorded).

Plant Instrumentation

These will be reviewed during the detailed design to ensure that best value is being obtained for the project.

General Description

The Plant will be equipped with Endress+Hauser (E+H) instrumentation generally, in accordance with the Process and Instrumentation Diagrams (Attachment 2) and on the basis of the following advantages of standardisation of the instrumentation vendor.

- Common look and feel
- Common programming methodology
- Common spares including cross discipline
- Standardised SMART interfaces
- One stop shopping

Instrumentation Selection

Wherever possible instruments and sensors will be of the same E+H model and type throughout the Plant and selection of instrumentation will be in accordance with the following procedures as a minimum.

- Instrument accuracy will be suited for the intended purpose
- Instrument scales will be chosen where the normal maximum working point is approximately 75% full scale. No compressed scales will be used below 100% full scale
- All instruments shall be capable of withstanding 150% full scale without deterioration, damage, loss of accuracy or repeatability
- Instruments shall be either loop or externally powered. If external power is required it shall be 240V DC

Distribution Network Control System Methodology

An integrated control system will be provided for the Plant and distribution network as shown on the communication network diagram. Refer to Attachment 3: CNF & Associates drawing number 07-04-001. One RTU will be provided at the Plant control for communications to all remote distribution network sites including the Woodville Rd Reservoir, Camellia pump station and reservoirs, foundation customers and non-foundation customer sites. A second RTU will be provided at the Plant control for communications to Alinta's network control room.

A SCADA System will be provided for operator interface for control, monitoring, alarms and trending of the Recycled Water Distribution Network. SCADA terminals will be located in the Plant Control Room. No SCADA terminals or other screen based operator interface will be provided at the distribution network pump stations, reservoirs, metering stations or actuated valve stations. The SCADA Server and SCADA display hardware will be supplied complete with Citect and the Plant SCADA application by others.

An industrial ethernet network will be provided for data communications around the Fairfield site while communications to remote sites will be via a telemetry system. Local hardwired operator controls are provided at pumping stations and reservoirs for field control of pumps, valves and associated equipment. The SCADA System will be connected to a dual redundant self healing local area network for PLCs and RTUs located at the Fairfield site with a telemetry system utilising GMS communications for all sites remote from Fairfield. The SCADA System will be developed using Citect and will be provided with "SCADA Reports" and "Web Server" to provide SWC with access to on-line and off-line process monitoring via a website as per the requirement of 8.9 of the RDP.

The recycled water distribution network, pump stations, reservoir, actuated valve stations and metering stations will be fully automated and suitable for unsupervised control and operation of the process on a 24 hour a day, 7 day a week basis. The pump station, reservoir, actuated valve station and metering station sites will typically be unmanned and a minimum of operator intervention is required to maintain distribution network and pump station operation. The control system will be capable of automatically restarting the distribution network, pump stations, reservoirs, actuated valve stations and metering stations after any interruption to site power supplies without operator intervention. All control functions will be implemented in local programmable controllers (PLCs or RTUs). No control functions will be implemented in the remote SCADA terminals

All RTUs will be Serck eNet series. All RTUs will be configured for ethernet local communication and provided with a GMS modem for communication with remote sites. All RTUs will be provided with power supply and security monitoring similar to SWC IICATS standard.

To maintain commonality between the Plant and the network, all PLCs will be Schneider Quantum and where possible instrumentation will be Endress+Hauser.

The control system will provide the following modes of operation:

Mode of Operation	Description
Automatic	This is the normal operation mode. Selected from the SCADA System. Plant operates under automatic sequence from the local programmable controller (PLC/RTU).
Manual	Selected from the SCADA System. Equipment control by operator from SCADA System.
Field	Selected from the SCADA System. Equipment control by operator from handstation local to equipment.
Out of Service	Selected from the SCADA System. Equipment not available for operation by automatic sequence or operator control.

Power availability will be monitored at each pump station, reservoir, actuated valve station and metering station. A UPS will be provided at each pump station to maintain supply to the PLC and instruments. All RTUs will be provided with a back up battery supply. Voltage surge diverters will be provided on all incoming and outgoing electrical and communication services.

Reservoirs

General

Levels at the storage reservoirs at Woodville Rd and Camellia will be monitored by ultrasonic level instrument in each reservoir. Further, in each reservoir a high-level switch will indicate reservoir high level; a high high-level switch will indicate reservoir Overflow level; a low level switch will indicate reservoir low level; and a low low-level switch will indicate reservoir 90% empty level. All reservoir level signals will be relayed to the Fairfield Pumping Station control system via telemetry link.

A reservoir low-level signal will be sent to the Fairfield Pumping Station to notify the PLC that a reservoir may run empty. A decision will be made by the Plant PLC based on pre-set values whether to initiate potable water make-up to the reservoir, to maintain water supply. On Low level being cleared the Plant PLC will be prompted to close the potable water make-up valve. On level measured via the ultrasonic level transmitter returning to a normal value, measured against the rate of fill (approximately 40%, Supervisor adjustable parameter), the potable water make-up valve will close automatically. Potable water top-up facilities will be provided at both Woodville Rd and Camellia reservoirs, with water able to be delivered into all reservoir compartments via one actuated valve with Opened/Closed position indication.

Woodville Road Elevated Reservoir

Woodville Rd Reservoir will be provided with an RTU for water quality monitoring, control of the top up water actuated valve and for communications to the SCADA System. Woodville Rd storage reservoir levels will be used (at Fairfield Pumping Station) within the pump control algorithm to start and stop the pumps. In addition, local hardwired interlocks will stop the Fairfield Pumps on reservoir high high-level. Pumping will be stopped on high discharge pressure via local software control and/or hardwired interlocks. This will remove any risk of loss of telemetry signals leading to reservoir overflow. The pumps will also be stopped should suction side pressure in the recycled clean water storage fall below the minimum level.

An electrically actuated Emergency Inlet Control Valve (EICV), arrangement is not to be installed on the Woodville Rd Reservoir inlet as back flows are required to support Smithfield when Fairfield pumps are isolated.

A new 415 V, 32 A, three-phase power supply to the reservoir switchboard will be provided. This supply will be connected to an existing overhead low voltage distribution network.

Camellia Surface Reservoir

Camellia Pump Station and Reservoirs will be controlled by a PLC. On-line water quality monitoring will also be provided at this site. The optional chemical dosing plant would also be controlled from this PLC. An RTU will be provided for communications to the SCADA System.

An electrically actuated EICV arrangement fitted with pneumatic back-up actuation, will be installed on the Camellia storage reservoir inlet. EICV pneumatic back-up actuation will be by air supplied from compressed air cylinders. The air supply will incorporate a low-pressure alarm switch connected to the telemetry system. Each EICV will be hardwired to the respective storage reservoir high high-level switch to close on reservoir overflow level. The EICV will be a slow closing type valve, with a closing time in the range of 5 to 10 minutes to prevent hydraulic surge/water hammer. Closing time will be determined during detailed design via system hydraulic surge analysis.

A new high voltage supply to the Camellia pump station will be provided. This supply will be connected to the existing overhead high voltage distribution network located on the south side of Unwin Street. The high voltage supply will include a pole top isolating switch and high voltage underground cable and 11kV/415V substation. Refer to drawings 07-04-004 and 07-04-005 in Attachment 3.

Pumping Stations

General

All transfer pumps starting and stopping will be interlocked via hardwired control sequence with the pump discharge actuated isolation valve. The pump will start against a closed valve, and the valve will open once the pump has started. The valve will close prior to the pump stopping. Valve opening and closing time will be in the range of 1 to 5 minutes to prevent hydraulic surge/water hammer. Opening and closing time will be determined during detailed design via system hydraulic surge analysis.

Pump starts will be limited to the maximum permissible number of starts per hour, and minimum time period between pump stopping and restarting, via the software control system.

Pumps will be controlled from the SCADA system, sited in the Fairfield Plant, via telemetry link.

Recycled water flow rate and transferred volume will be monitored by an electromagnetic flow meter on the pumps discharge line.

Each pump will be fitted with suction and discharge manifold pressure transmitters for pump monitoring, and Low and High alarm pressure switches for pump protection. Each pump will be further protected via hardwired low flow proximity switch fitted to the NRV on each pump discharge. In addition pumps will be monitored for vibration and temperature on a programmed maintenance basis.

The Recycled Water Transfer Pumps will each be provided with AUTO / MANUAL / OUT OF SERVICE / FIELD selection at the SCADA. When selected as AUTO the pumps will be controlled according to the pumping algorithm based on the control requirements. When selected as MANUAL the pumps will be started and stopped and controlled manually via SCADA. When selected as FIELD the pumps will be started and stopped from hand stations located adjacent to each pump. When selected as OUT OF SERVICE the pump is not available for operation.

In FIELD mode, local operation will be available to allow operation of individual items of equipment from a hand station located adjacent to them. This mode will permit operation under direct supervision of an operator for maintenance purposes and when the PLC system is not available. No automatic sequence is available in this mode. In this mode the SCADA system will monitor operations but has no control of equipment

Hardwired controls, interlocks and protection measures will continue to operate when the pumps are selected for SCADA AUTOMATIC or MANUAL control.

Fairfield Pumping Station

The recycled water transfer pumps at Fairfield will be started on Woodville storage reservoir falling to a refill level. The recycled water transfer pumps at Fairfield will normally be stopped on distribution network storage reservoir level at Woodville rising to Full level. The pumps will incorporate an additional software interlock to stop on High level, should the analogue level value be incorrect or fail for any reason. In addition, to ensure pressures are maintained when the zone is supplied by a back feed from Woodville Road Reservoir, a pressure transducer will be sited at Smithfield in the network linked to the control system. If pressure in the network falls below a preset level when the pumps are not in operation, then the control system will instruct the pumps to start up to maintain pressure levels.

Power supply to Fairfield Pump Station site will be connected to the Plant high voltage supply. A new high voltage supply to the pump station from the high voltage switchroom at the Plant will be provided. This will include provision of an 11kV indoor ring main unit (RMU) complete with isolating switches, earthing switches and circuit breaker for the pump station high voltage supply. The RMU is to be located in the Plant high voltage switchroom adjacent to the RMUs provided by others for the treatment plant. The RMU is to be connected by treatment plant RMUs by busbar or other suitable method. Refer to drawing 07-04-001 and 07-04-002 in **Attachment 3**.

Camellia Pumping Station

The Camellia transfer pumps will be controlled by a pressure transmitter located at a critical point in the distribution network, probably located at the most remote customer. A second pressure transmitter will be installed at the pump station outlet to act as a back up pressure sensor in case of telemetry communications failure. Pumps will start on pump discharge pressure falling below a pump start pressure, and stopped on pressure rising above a pump stop pressure. The design assumes that during normal operation pumping will be continuous and pump speed and the number of pumps operating will be varied to maintain a target pressure between the start and stop pressures. The pumps will also be stopped should suction side pressure in the Camellia storage system fall below the minimum level. Low low-level instrument located in the storage tanks will be hardwired to protect the pumps (suction side).

A new high voltage supply to the pump station will be provided. This supply will be connected to the existing overhead high voltage distribution network located on the south side of Unwin Street. The high voltage supply will include a pole top isolating switch and high voltage underground cable and 11 kV/415 V substation. Refer to drawings 07-04-004 and 07-04-005 **Attachment 3**.

Expansion phase booster station

A booster station, located near Marubeni, is proposed for the expanded network to ensure sufficient delivery pressures in the outlying areas of the larger network. This booster station will be controlled by pressure sensors located at critical points in the distribution network, (most likely at the most remote customers), with a suction safety cut out. A bypass will be provided to the pumps to allow water to bypass the pumps if pressures are acceptable. Pumps will start on pump discharge pressure falling below a pump start pressure, and stopped on pressure rising above a pump stop pressure. The design assumes that during normal operation pumping will be continuous and pump speed and the number of pumps operating will be varied to maintain a target pressure between the start and stop pressures. The pumps will also be stopped should suction side pressure fall below the minimum level.

Additional pressure monitoring may be inserted in the Parramatta/Westmead network and linked to the control system which controls the operation of the Camellia pumps.

Customer Meters

Seven electromagnetic flow meters shall be installed at the foundation customers' supply points to allow on-line flow measurement. Non-foundation customers' water usage will be measured manually using mechanical type flow meters and be controlled via a remotely controlled actuated inlet valve as well as customer storage (provided by others). In addition, one Foundation Customer (G) will also be provided with on-line water quality monitoring.

Each of the six non-foundation customer sites will be provided with an RTU for control of the actuated valve at these sites.

For the expansion network, it is proposed that electromagnetic flow meters will be installed to monitor flows into the Wetherill Park/Bonnyrigg, Liverpool and Parramatta/Westmead zones. These will most likely be monitored via the telemetry system.

Camellia Chlorine Dosing System

Chlorine dosing will be controlled by the monitoring of the chlorine residual downstream of the Camellia Storage Reservoir. A sodium hypochlorite dosing system has been included at the site to allow for boosting of the chlorine residual within the water downstream of Camellia Pumping Station. In addition, over the period of time approximately two to three years following construction, there may be potential for biofilms to develop in the pipe network and additional dosing will help eradicate this problem.

The design allows for the dosing of sodium hypochlorite to the recycled water transfer system, on the Camellia reservoir inlet manifold. The dosing system shall be able to dose the recycled water across the expected recycled water flow rate range.

The chemical dosing plant is to be fully automated and suitable for unsupervised control and operation of the process on a 24-hour/day, 7-day/week basis. The chemical dosing plant and adjacent pumping station sites will typically be unmanned and the control system shall require a minimum of operator intervention to maintain plant operation.

The control system shall be capable of automatically restarting the chemical dosing plant after any interruption to the site power supply without operator intervention.

A programmable controller (PLC) is to be provided for control of the chemical dosing plant. All control functions will be implemented in the local programmable controller. No control functions shall be implemented in the remote SCADA terminals.

The chemical dosing plant PLC is to be connected to the pumping station PLC via an ethernet LAN. The LAN will connect the chemical dosing plant PLC to the remotely located SCADA system being provided by others for network monitoring, alarms and supervisory control.

Instrument Calibration

Calibration certificates will be provided for instruments such as magnetic flow meters, pressure transmitters, pressure switches and the elements for turbidity and pH elements.

All other instruments, including ultrasonic level transmitters, float level switches, chlorine residual analysers, pH analysers and turbidity analysers, will require configuration or calibration on site after installation.

Chlorine residual analysers, pH analysers and turbidity analysers will require regular calibration and replacement of sensor elements in accordance with the instrument manufacturer's recommendations.

Records will be kept of as commissioned calibration data and on-going records for regular calibration checks.

On-line Monitoring System

Network

The following network operating parameters will be monitored on-line:

- Water quality monitoring at the outlet of the Woodville Rd Reservoir, Camellia Reservoir and at Customer G at the end of the Smithfield section.
- Residual chlorine, turbidity and pH will be measured at each water quality monitoring station.
- Flow meters will be provided at each foundation customer for flow monitoring.
- An RTU will be provided at each flow and/or water quality monitoring station to collect, average and forward the data to the Plant SCADA System and to Alinta's North Parramatta Control Centre.
- On-line water quality data will be collected continuously as an analogue signal and stored as 15 minute averages in the RTU.

- On-line flow meter data will be collected continuously as an analogue signal and stored as 15 minute averages in the RTU in megalitres per day (to three decimal places).

- On-line totalised flow meter data will be collected as a pulsed signal and stored in the RTU in megalitres (to three decimal places).

- Once every twenty-four hours the on-line monitoring data stored in each RTU will be transferred to the Plant SCADA System via a GMS telemetry network.

- This data will be stored in the Plant SCADA System and presented in the daily report.

- Pressure measurement at the pumping stations and in the Camellia distribution network and at the Marubeni customer site

Plant

On-line instrumentation is critical for management of effluent quality risk, monitoring recycled water quality, identifying trends which may provide early warning of any technical problems and troubleshooting problems within the Plant.

On-line monitoring information is displayed on the SCADA for evaluation by the Operators, Water Quality Officer and Plant Supervisor. The Operators and Water Quality Officer will be trained to evaluate trends in on-line readings and to respond when they indicate process disruptions within the plant.

The table below summarises the on-line instrumentation proposed for the Plant. Please also see the P&IDs attached to this Schedule.

Process Stream	Parameter Measured	Purpose for Measuring
LAP	Multiple parameters (including BOD, TSS and other organic contaminants) measured using the s::can spectrolyser™	Monitoring and alarm for mitigation of effluent quality risk
Feed	Turbidity	Monitor only
	pH	Control of chemical dose
	Conductivity	Monitor only
Feed post-strainers	Oxygen reduction potential	Control of chemical dose, in conjunction with total chlorine ensures there is no risk to membranes
	Total Chlorine	Control of chemical dose
	Ammonia	Control of chemical dose
Feed balance tank outlet	Total Chlorine	In conjunction with ORP ensures there is no risk to membranes
	Oxygen reduction potential	In conjunction with total chlorine ensures there is no risk to membranes
	pH	Control
UF Filtrate	pH	Monitor
RO feed	Total chlorine	Control of chemical dose

Process Stream	Parameter Measured	Purpose for Measuring
	Turbidity	Control MF operation
	ORP	Control
	pH	Control
	Ammonia	Monitor
	Conductivity	Monitor
RO system permeate	Conductivity	Monitor
RO stage 1 + 1A permeate	Conductivity	Monitor
RO stage 2 permeate	Conductivity	Monitor
RO system concentrate	Conductivity	Monitor
Cation outlet	NH4	Monitor
Degasser outlet	Conductivity	Monitor
Post-permeate collection tank	Free residual chlorine	Monitor
	Turbidity	Monitor
	pH	Monitor
Recycled Water	Turbidity	Monitor, contract need
	PH	Monitor, contract need
	Residual Chlorine	Monitor, contract need
	Conductivity	Monitor
	Ammonia	Monitor, contract need
Warn Water Tank Outlet	pH	Monitor
	Conductivity	Monitor
Neutralisation pit	pH	Monitor
	ORP	Monitor
Wastewater line to sewer	NH4	Monitor
	Turbidity	Monitor
	Conductivity	Monitor
	pH	Monitor

Off-line Analysis

The following will be monitored off-line, using the on-site and off-site laboratory capabilities. This will be centrally managed for the Plant and Network monitoring required, and directed by the Water Quality Officer.

In addition to the quality monitoring program detailed in the tables below, water consumption at the non-foundation customer flow meters will be manually captured in megalitres (to three decimal places). This data will be collected at three monthly intervals.

Plant Related Routine Monitoring – On-site Laboratory

Analyte	Type	Frequency
Recycled water		
Alkalinity	Composite	Weekly
Aluminium	Composite	Weekly
Ammonia	Composite	Weekly

Analyte	Type	Frequency
Chloride	Composite	Weekly
Iron	Composite	Weekly
Manganese	Composite	Weekly
Zinc	Composite	Weekly
Calcium	Composite	Weekly
pH	Online	Weekly
Hardness	Composite	Weekly
TDS	Online	Weekly
Turbidity	Online	Weekly
Free residual chlorine	Online	Weekly
Suspended solids	Composite	Daily
COD	Composite	Daily
Total nitrogen	Composite	Daily
Total phosphorus	Composite	Daily
Influent		
pH	Online	Weekly
TDS	Online	Weekly
Turbidity	Online	Weekly
Free residual chlorine	Online	Weekly
Suspended solids	Composite	Daily
COD	Composite	Daily
Total nitrogen	Composite	Daily
Total phosphorus	Composite	Daily
TOC	Composite	Weekly
Silica	Composite	Daily
Aluminium	Composite	Weekly
Ammonia	Composite	Weekly
Chloride	Composite	Weekly
Iron	Composite	Weekly
Manganese	Composite	Weekly
Sodium	Composite	Weekly
Zinc	Composite	Weekly
Calcium	Composite	Weekly
Nox	Composite	Weekly
Alkalinity	Composite	Weekly

Network Related Routine Monitoring – On-site Laboratory

Analyte	Type	Frequency
Delivered water - customer A to G		
Alkalinity	Composite	Weekly
Aluminium	Composite	Weekly
Ammonia	Composite	Weekly
Chloride	Composite	Weekly
Iron	Composite	Weekly

Analyte	Type	Frequency
Manganese	Composite	Weekly
Zinc	Composite	Weekly
Calcium	Composite	Weekly
pH	Online	Weekly
hardness	Composite	Weekly
TDS	Online	Weekly
Turbidity	Online	Weekly
Free residual chlorine	Online	Weekly
Suspended solids	Composite	Weekly
COD	Composite	Weekly
Total nitrogen	Composite	Weekly
Total phosphorus	Composite	Weekly
Network storages - 3 sites		
Suspended solids	Composite	Monthly
COD	Composite	Monthly
Total nitrogen	Composite	Monthly
Total phosphorus	Composite	Monthly

Plant Related Routine Monitoring – Off-site Laboratory

Analyte	Type	Frequency
Recycled Water		
Alkalinity	Composite	Monthly
Aluminium	Composite	Monthly
Ammonia	Composite	Monthly
Chloride	Composite	Monthly
Iron	Composite	Monthly
Manganese	Composite	Monthly
Zinc	Composite	Monthly
Calcium	Composite	Monthly
pH	Online	Monthly grab
hardness	Composite	Monthly
TDS	Online	Monthly grab
Turbidity	Online	Monthly grab
Free residual chlorine	Online	Monthly grab
BOD5	Composite	Monthly
Total nitrogen	Composite	Monthly
Total phosphorus	Composite	Monthly
E coli	Grab	Weekly
Total coliforms	Grab	Monthly
Viruses (suite of 6)	Grab	Quarterly
Parasites (cryptosporidium and giardia)	Grab	Quarterly
EDCs (GCMS scan)	Composite	Twice yearly
Pharmaceuticals	Composite	Twice yearly

Analyte	Type	Frequency
PCPs	Composite	Twice yearly
Pesticides	Composite	Twice yearly
THMs	Grab	Twice yearly
Helminths	Grab	Twice yearly
Influent		
Alkalinity	Composite	Twice yearly
Aluminium	Composite	Twice yearly
Ammonia	Composite	Quarterly
Chloride	Composite	Twice yearly
Iron	Composite	Twice yearly
Manganese	Composite	Twice yearly
Zinc	Composite	Twice yearly
Calcium	Composite	Twice yearly
pH	Online	Monthly grab
hardness	Composite	Twice yearly
TDS	Online	Monthly grab
TOC	Composite	Quarterly
Silica	Composite	Quarterly
Turbidity	Online	Monthly grab
Free residual chlorine	Online	Monthly grab
BOD5	Composite	Weekly
Total nitrogen	Composite	Twice yearly
Total phosphorus	Composite	Twice yearly
E coli	Grab	Twice yearly
Total coliforms	Grab	Twice yearly
Viruses (suite of 6)	Grab	Twice yearly
Parasites (cryptosporidium and giardia)	Grab	Twice yearly
EDCs (GCMS scan)	Composite	Twice yearly
Pharmaceuticals	Composite	Twice yearly
PCPs	Composite	Twice yearly
Pesticides	Composite	Twice yearly
THMs	Grab	Twice yearly
Helminths	Grab	Twice yearly
Faecal Coliforms	Grab	Weekly
Oil and grease	Composite	Weekly

Network Related Routine Monitoring – Off Site Laboratory

Analyte	Type	Frequency
Secondary effluent		
Suspended solids	Composite	Weekly
BOD	Composite	Weekly
TOC	Composite	Weekly
Silica	Composite	Weekly

Analyte	Type	Frequency
Ammonia	Composite	Weekly
Total Nitrogen	Composite	Weekly
Total Phosphorus	Composite	Weekly
Delivered water - customer A to G		
Alkalinity	Composite	Monthly
Aluminium	Composite	Monthly
Ammonia	Composite	Monthly
Chloride	Composite	Monthly
Iron	Composite	Monthly
Manganese	Composite	Monthly
Zinc	Composite	Monthly
Calcium	Composite	Monthly
pH	Online	Monthly grab
hardness	Composite	Monthly
TDS	Online	Monthly grab
Turbidity	Online	Monthly grab
Free residual chlorine	Online	Monthly grab
BOD5	Composite	Monthly
Total nitrogen	Composite	Monthly
Total phosphorus	Composite	Monthly
E coli	Grab	Monthly
Total coliforms	Grab	Monthly
Viruses (suite of 6)	Grab	Yearly
Parasites (cryptosporidium and giardia)	Grab	Yearly
EDCs (GCMS scan)	Composite	Yearly
Pharmaceuticals	Composite	Yearly
PCPs	Composite	Yearly
Pesticides	Composite	Yearly
THMs	Grab	Yearly
Helminths	Grab	Yearly
Network storages - 3 sites		
Alkalinity	Composite	Twice yearly
Aluminium	Composite	Twice yearly
Ammonia	Composite	Twice yearly
Chloride	Composite	Twice yearly
Iron	Composite	Twice yearly
Manganese	Composite	Twice yearly
Zinc	Composite	Twice yearly
Calcium	Composite	Twice yearly
pH	Online	Monthly grab
hardness	Composite	Twice yearly
TDS	Online	Monthly grab
Turbidity	Online	Monthly grab
Free residual chlorine	Online	Monthly grab

Analyte	Type	Frequency
BOD5	Composite	Twice yearly
Total nitrogen	Composite	Twice yearly
Total phosphorus	Composite	Twice yearly
E coli	Grab	Twice yearly
Total coliforms	Grab	Twice yearly

Monitoring of discharge to trade waste will be negotiated as part of the development of a trade waste discharge consent with SWC. A possible trade waste monitoring regime is shown below:

Analyte	Type	Frequency
Suspended solids	Composite	Quarterly
BOD5	Composite	Quarterly
Grease	Composite	Quarterly
Ammonia	Composite	Quarterly
Nitrogen	Composite	Quarterly
Phosphorus	Composite	Quarterly
Aluminium	Composite	Quarterly
Arsenic	Composite	Quarterly
Barium	Composite	Quarterly
Benzene	Composite	Quarterly
Boron	Composite	Quarterly
Bromine	Composite	Quarterly
Cadmium	Composite	Quarterly
Chlorinated phenolics	Composite	Quarterly
Chlorine	Composite	Quarterly
Chromium	Composite	Quarterly
Cobalt	Composite	Quarterly
Copper	Composite	Quarterly
Cyanide	Composite	Quarterly
Fluoride	Composite	Quarterly
Formaldehyde	Composite	Quarterly
General pesticides	Composite	Quarterly
Herbicides and defoliants	Composite	Quarterly
Iron	Composite	Quarterly
Lead	Composite	Quarterly
Manganese	Composite	Quarterly
Mercaptans	Composite	Quarterly
Mercury	Composite	Quarterly
Molybdenum	Composite	Quarterly
Nickel	Composite	Quarterly
Organoarsenic compounds	Composite	Quarterly
Phosphorus	Composite	Quarterly

Analyte	Type	Frequency
Petroleum hydrocarbons (flammable)	Composite	Quarterly
Phenolic compounds (non-chlorinated)	Composite	Quarterly
Polynuclear aromatic hydrocarbons	Composite	Quarterly
Selenium	Composite	Quarterly
Silver	Composite	Quarterly
Sulphide	Composite	Quarterly
Sulphite	Composite	Quarterly
Thiosulphate	Composite	Quarterly
Tin	Composite	Quarterly
Uranium	Composite	Quarterly
Volatile halocarbons	Composite	Quarterly
Zinc	Composite	Quarterly

All data and information from off-line analysis will be managed in an on-site remote Laboratory Information Management System (**LIMS**), which can also access and download Excel-based data from on-line instruments. The Water Quality Officer will centrally manage all data from on-line and off-line analysis, producing required reports, and notifying trends of issue to the Operations and Network Supervisors, as well as the System Manager. The Water Quality Officer will also contribute to the monthly report to SWC on the data aspects. This will include a review of QA/QC data quality objectives met and sample and data integrity. This can all be linked to the on-site SCADA system.

Availability of Information to SWC

There are no proposed changes to the reporting process to SWC from the original submission. This has been included below.

The SCADA System will be developed using Citect and will be provided with “SCADA Reports” and “Web Server” to provide SWC with access to on-line and off-line process monitoring via a website as per the requirement of 8.9 of the RDP. While the on line data will collected and averaged according to the intervals provided in Section 8.9 of the RDP, a daily update only to the SWC web server will be provided by AVA to balance.

INFORMATION PROVISION TO SWC

Verification

AVA’s proposed Independent Verifier is Kellogg Brown & Root (KBR). The Independent Verification Response is provided in a separate document. Please see Attachment 5.

ATTACHMENTS

Attachment 1:

Plant Process Flow Diagram (Veolia Attachment)

Network System Layout Plans

2114294A_2033A_D1A_Section_Plan	System Section Plan
2114294A_2033A_D1A_Pipe_1	Recycled Water Pipeline Sheet 1
2114294A_2033A_D1A_Pipe_2	Recycled Water Pipeline Sheet 2
2114294A_2033A_D1A_Pipe_3	Recycled Water Pipeline Sheet 3
2114294A_2033A_D1A_Pipe_4	Recycled Water Pipeline Sheet 4
2114294A_2033A_D1A_Pipe_5	Recycled Water Pipeline Sheet 5
2114294A_2033A_D1A_Pipe_6	Recycled Water Pipeline Sheet 6
2114294A_2033A_D1A_Pipe_7	Recycled Water Pipeline Sheet 7
2114294A_2033A_D1A_Pipe_8	Recycled Water Pipeline Sheet 8
2114294A_2033A_D1A_Pipe_9	Recycled Water Pipeline Sheet 9
2114294A_2033A_D1A_Overview	System Overview
2114294A_2033A_D1A_WGC_GA	Woodville Road Elevated Reservoir General Arrangement
2114294A_2033A_D1A_Camellia_CC	Camellia Reservoir and Pumping Station General Arrangement
2114294A_2033A_D1A_FRWTP	Fairfield Plant, Reservoir and Pumping Station General Arrangement

Attachment 2:

Fairfield Land Requirements (Veolia Attachment)

Network P&ID's

2114294A-G01	Fairfield pumping station P&ID diagram
2114294A-G02	Fairfield to Woodville Storage Reservoir Distribution Network P&ID diagram
2114294A-G03	Camellia Storage Reservoir and Distribution Network P&ID Diagram
2114294A-G04	Camellia pumping station P&ID diagram
2114294A-G05	Hypochlorite Dosing System P&ID Diagram

Plant P&ID's

B0223-P-0000-01	Process Flow Diagram
B0223-P-1000-10	Ultrafiltration Feed System
B0223-P-2000-10	UF System Manifold
B0223-P-2100-10	UF Cell 1 of 5
B0223-P-2800-10	UF Blower System
B0223-P-3000-10	RO Feed Pumps
B0223-P-4000-10	RO Train – Manifold
B0223-P-4100-10	RO Units – Train 1 or 8

B0223-P-4500-10	Cation Exchange Units
B0223-P-5000-10	RO Permeate Collection tank
B0223-P-6000-10	Recycled Water Storage & Pumping
B0223-P-7000-10	UF CIP System
B0223-P-7100-10	RO CIP System
B0223-P-7300-10	Hypochlorite Dosing System
B0223-P-7300-11	Hypochlorite Dosing System – RO
B0223-P-7400-10	Ferric Chloride Dosing System
B0223-P-7500-10	Acid Dosing System
B0223-P-7600-10	Caustic Dosing System
B0223-P-7700-10	Antiscalant Dosing System
B0223-P-7800-10	Citric Acid Dosing System
B0223-P-7900-10	Bisulphite Dosing System
B0223-P-8000-10	Neutralisation Pit
B0223-P-8100-10	Wastewater Pit
B0223-P-9000-10	Compressed Air System Sht1
B0223-P-9000-11	Compressed Air System Sht2
B0223-P-9000-12	Compressed Air System Sht3
B0223-P-9100-10	Non-Potable Water System
B0223-P-9200-10	Potable Water System

Attachment 3:

Network Other Drawings

2114294A-G06	Woodville Road Elevated Storage Reservoir
2114294A-G07	Camellia Storage Reservoir and Pumping Station Site Layout
2114294A-G08	Camellia Storage Reservoir Plan and Sections
2114294A-G09	Fairfield RWTP and Pumping Station Site Layout
2114294A-G10	Fairfield RWTP and Pumping Station Pipeline Long Section
07-04-001	RW Treatment Plant, Transfer Pump Station and Dist. Network Communications Network Diagram
07-04-002	Fairfield RW Transfer Pump Station Single Line Diagram – Scheme D1 Sheet 1 of 2
07-04-003	Fairfield RW Transfer Pump Station Single Line Diagram – Scheme D1 Sheet 2 of 2
07-04-004	Camellia RW Transfer Pump Station Single Line Diagram – Scheme D1 Sheet 1 of 2
07-04-005	Camellia RW Transfer Pump Station Single Line Diagram – Scheme D1 Sheet 2 of 2

Plant Other Drawings

B0223-C-0001-01	Site Layout Plan
B0223-C-0001-02	Building Layout
B0223-C-0001-03	Civil Loadings Layout
B0223-C-0001-04	Chemical Storage Tanks – Bund Details
B0223-C-0001-05	Foundation Details
B0223-C-0001-06	Underground Piping
B0223-E-0001-01	Electrical Conduit Layout
B0223-E-1000-01	Electrical Power Distribution Single Line Diagram
B0223-E-1100-04	SCADA/PLC Control System – Configuration Diagram
B0223-E-1200-01	Typical DOL starter drive below 15 KW Electrical Schematic Diagram
B0223-E-1200-02	Typical DOL starter drive 15 KW & above Electrical Schematic Diagram
B0223-E-1200-03	Typical VSD starter drive below Electrical Schematic Diagram
B0223-E-1200-04	Typical Tank Heater circuit Electrical Schematic Diagram
B0223-E-1200-05	Typical 240V AC Electrical Schematic Diagram

Attachment 4:

Rail Corp Letter rejecting the proposal for laying the recycled main in the railway corridor.

Attachment 5

IV report from KBR according to section 7.7.8 of the RDP Tender Document.

RETURNABLE SCHEDULE 7

ABILITY TO MEET SERVICE DELIVERY REQUIREMENTS

C3.2	**Ability to Meet Service Delivery Requirements**	Technical evidence of robustness, operability, flexibility and maintainability of the proposed Recycled Water System including treatment plant, pumping systems, storage and reticulation to deliver recycled water to meet Sydney Water's desired outcomes

RECYCLED WATER SYSTEM CAPACITY

The Camellia Recycled Water system has been designed to meet consecutive peak day Foundation Customer demand. The distribution network has capacity to supply a peak demand of 33 ML/d. With a 20 ML/d Recycled Water Treatment Plant the supply deficit is approximately 0.4 ML/d at Foundation Customer Peak Daily Demand (PDD), allowing for supply over consecutive peak days with minimum reliance on potable water top-up.

The off peak capacity in the network design will be used to expand the scheme and supply 20 ML/d of recycled water. As the scheme expands, priority supply will be given to the foundation customers by the use of remote telemetered actuated control valves for each of the non-foundation customers. Potable water top-up totalling 12.3 ML/d is also included across the Fairfield, Woodville Rd and Camellia Reservoirs to ensure continuity of supply to the foundation customers during consecutive peak day events, particularly as the scheme is expanded.

The Recycled Water Treatment Plant (Plant) at Fairfield has been designed to deliver 20 ML/d on a daily basis. The annual capacity of the Plant is up to 7,154 ML (based on the Plant's design capacity to produce 20 ML/d consistently if required by customer demand and 98% plant availability).

This Plant capacity has been selected to ensure a highly reliable supply of recycled water to the seven Foundation Customers. These customers have a peak daily demand of 21 ML/d. To cater for a periods of consecutive peak day demand the plant has been designed to almost match the Foundation Customers demand so that they are not reliant on network storage or potable water top-up to cover these high demand periods.

9 ML of reservoir storage is to be provided in the network with the storage split between the Fairfield (3 ML) and Camellia sites (6 ML). Reservoirs will be recharged following a peak day event using the spare capacity in the Plant over and above Average Daily Demand (ADD), and/or the SWC top-up water. SWC potable water top-up will be available at Fairfield (3.1 ML/d) and the Woodville Road and Camellia reservoir sites. (4.6 ML/d each).

The Fairfield pumping station and outlet main are sized to deliver an ultimate volume of 28 ML/d. Mains between Woodville Road elevated reservoir and Smithfield demand centre are designed for a capacity to cater for Smithfield foundation customer Peak Hourly Demand (PHD) plus a peak day demand allowance for non foundation customers in the area.

Woodville Road Reservoir will act as a balancing tank and has limited emergency storage with a maximum volume of 0.7 ML. Downstream of the tank leading to Camellia the mains will be sized to cater for the Camellia zone peak day demand.

At Camellia, recycled water is firstly transferred into the storage reservoir (6 ML) before being transferred into distribution mains via the pumping station. The Camellia pumping station and distribution mains downstream of the station are sized to deliver an ultimate volume of 17.5 ML/d. The distribution mains allow for the supply of the Camellia foundation customers PHD plus a peak day demand allowance for non foundation customers in the area.The network design allows for a minimum pressure of 20 m head at the customers' property boundary.

RECYCLED WATER SYSTEM RELIABILITY

Recycled Water Treatment Plant Reliability

Operating Life and Outage Rates

The Plant has been designed with the following operating life:

- Civil works 50 years
- Mechanical Equipment 15 to 20 years
- Major Electrical Equipment 15 to 20 years
- Ultrafiltration (UF) membranes 7 years
- Reverse Osmosis (RO) membranes 5 years

A fully detailed asset renewal and replacement program has been developed to ensure the on-going operability and reliability of the Plant.

Maintenance of the Plant will be managed with a focus on planned maintenance as opposed to reactive or breakdown maintenance. This, along with the level of equipment and process redundancy described below, will ensure that plant outages will be kept to a minimum. Membrane replacements have the potential to cause a major plant outage if they are not well planned. The replacements will be planned to maintain an average membrane life that optimises the cost of capital replacement with the operational costs associated with the increased power and cleaning costs related to older membranes. This will mean that it is unlikely that the membranes will be pushed to the limits of their life as this is not economical due to the increased operating costs. Therefore the impact of membrane replacements on plant operation should be minimal as the replacements will be managed in smaller batches as opposed to a complete membrane change-out.

Robustness, Operability, Flexibility and Maintainability

The Plant will be installed with redundancy in all critical systems including a spare UF and a spare RO train. This redundancy will ensure that the Plant can maintain full output capacity even with a substantial failure and allow time for regular maintenance and servicing. Reliability is also enhanced through redundancy in ancillary systems such as; electrical (HV feeders, transformers, switchgear), pumps, chemical dosing pumps, blowers, control system (PLC/SCADA including UPS), etc.

The Plant will provide a high degree of automation to minimise the level of operator attendance. The central control system will continuously monitor the plant and make appropriate adjustments to ensure optimum performance and quality of supply. When abnormal situations arise, alarms will be raised and appropriate action will be taken by the Operator.

Instrumentation and controls will be provided to allow all important plant parameters to be continuously monitored (please see Schedule 6). All on-line instruments will be monitored by the Plant SCADA system so that the operators are continuously aware of the water quality and plant reliability issues.

One of the key instruments included in the Plant design is an on-line analyser that will be installed in the LAP prior to the Plant off-take. This analyser will monitor critical parameters such as TSS and BOD in addition to organic contaminants. This instrument will provide an early warning of poor quality effluent and allow the Plant to be shut down if necessary to protect the membranes from damaging contaminants.

In addition to the high level of equipment and process redundancy the Plant will be provided with storages for both feed effluent from the LAP and for recycled water. These storages will allow the plant to continue to operate during periods where the feed effluent quality is poor or the quantity available is low. The 3 ML feed storage tank will provide approximately 2.5 hours of continued plant operation at the design production of 20 ML/d without the need for any feed from the LAP. At average customer demand this would extend to almost 5 hours of uninterrupted plant operation. Recycled water storage at the plant of 3 ML and storage in the network will provide the opportunity for short term outages for most planned and unplanned maintenance activities with little or no impact on customer supply. The on site storage supplemented with network storages provides for up to 24 hours of Plant outage (at average daily demand) before the supply to customers would be affected.

The plant has been designed to be able to effectively treat the feed effluent to achieve the recycled water quality when the feed effluent is at the 90%-ile levels specified by SWC in the RDP document (see Schedule 6). The Plant will be able to handle minor fluctuations beyond these 90%-ile values for many parameters. This is possible through the following design features and operational strategies:

- conservative design membrane fluxes,
- the use of standby process trains,
- increasing membrane cleaning frequencies,
- increasing RO feed pump operating pressure,
- utilising feed storage to allow continued plant operation without accepting poor quality feed,
- or a combination of the above strategies.

There are several other important aspects of the Plant design that provide flexibility and contribute to the robust nature of the design. These include:

- Turn down – the Plant will be capable of operating at discrete production rates ranging from one RO train on-line to all eight RO trains on-line (for a limited duration). This provides the ability to produce from 2.9 ML/d (one train) to 22.9 ML/d (eight trains) of recycled water.

- Redundancy – as detailed above the plant has significant equipment and process redundancy.

- Recycling – provision of internal recycling capability for the RO permeate provides flexibility in operations (this design feature is fully described in Schedule 6). This will assist in situations where feed effluent is above normal design limits or where plant performance is reduced. The recycling of a portion of permeate will ensure that in specification recycled water continues to be produced during poor feed quality or poor membrane performance events (this will have an obvious reduction in the plant output capacity).

- Design basis – the selection of the 90%ile feed effluent quality as the plant design basis ensures that normally the plant will be treating effluent that is of better quality than it is capable of treating. This will provide a more robust plant with increased operability and flexibility for 90% of the operations.

- Storages – as noted above the use of both feed effluent and recycled water storages provides the flexibility to manage poor feed and recycled water quality, maintenance and other plant issues with minimum impact on the supply of recycled water to customers.

The Plant has been designed to provide a high level of maintainability. The flexibility described in the paragraphs above provides ample opportunity for maintenance to be performed on most equipment with little or no impact on recycled water production and the delivery of recycled water to customers. In addition to this the following aspects of the Plant design will further enhance the high level of maintainability:

1. The design of the plant has been thoroughly reviewed by experienced operations personnel. This review process will continue through the detailed design and construction phases of the project to ensure that the future maintenance needs are considered and equipment selection is based on “whole of life” costs.

2. A 3-dimensional CAD model will be used during the detailed design phase of the project. This will be used to identify issues associated with operational and maintenance access.

Membrane Processes – reliability, interchangability and spares availability

One of the key assets associated with the plant are the UF and RO membranes. The Plant will be designed using state of the art UF and RO membrane technology. The chosen membrane systems are from proven manufacturers, each with many years of operating experience.

The Siemens Memcor S10V system has been used for over eight years and Veolia has built many plants using this system. The Memcor membranes come with a seven-year pro-rata warranty and, in similar applications this type of membrane has achieved an operating life of more than eight years. The Memcor membrane is manufactured in Western Sydney and therefore manufacturer support is local and immediate. Memcor is a stable company owned by a large multinational, which will ensure that spare parts are available for the life of the Plant. Component design for the UF membrane system is based on proven experience from the Kwinana WRP and Kranji WWTP. This experience will ensure that a robust system is designed using reliable ancillary systems. Operating experience from the Veolia operated Bendigo WTP, shows that the Memcor S10V membrane system can be operated with minimum maintenance and low levels of outages. The Bendigo WTP also shows that pressure decay testing and membrane pinning can maintain membrane integrity at a high level over the life of the UF membranes.

The RO membranes will be standard eight-inch TFC membranes which are well proven in the water treatment industry. This type of membrane is manufactured by many suppliers around the world, most of which are interchangeable. For this reason, replacement membranes will be readily available. Most RO membrane manufacturers are offering a five-year pro-rata warranty when UF pre-treatment is used. Final selection of the RO membrane supplier will be made after validation of performance in the pilot trials.

It should be noted that AVA has assumed an appropriate membrane replacement profile based on extensive experience with these types of plants. The risks associated with this membrane replacement profile are assumed by AVA.

Power Supply Reliability

The Plant will be provided with the capability for a diesel generator to be connected to provide power in the event of long term power outages (greater than 24 hours). This will ensure that the plant will be able to operate (if required) to supply recycled water to customers in this situation. The network pumping stations will also be capable of being powered by portable generators if required.

Generators will be hired as required with service agreements established to ensure that the generators are available whenever necessary. Annual testing of the plant under diesel generator power supply will be conducted as part of emergency scenario training.

It is considered unnecessary to provide installed standby generators for the plant for several reasons:

- High capital cost
- High maintenance cost to ensure their reliability
- Availability of “back-up” water for customers
- Availability of “top-up” water for the reservoirs
- Potential that the customers may also be impacted by a local power outage (stopping their recycled water use)

Spares Availability

Most of the mechanical and electrical equipment associated with the Plant is standard equipment and is available through local suppliers. In the detailed design phase of the project critical equipment will be identified and a fully detailed critical spares list will be developed from this criticality analysis. These critical spares, along with a suite of standard minor spares, will be kept in stock at the Plant to allow a rapid response to any critical equipment failure.

Key equipment Mean Time Before Failure (MTBF) and Mean Time To Repair (MTTR)

As part of the detailed Asset Management Plan used to manage the maintenance of the Plant, the MTBF and MTTR of all key equipment will be estimated during the detailed design phase of the project. This will allow the maintenance strategies to be tailored to the specific equipment selected in the final design of the plant. These MTBF and MTTR details will be fine tuned during commissioning and in the early stages of plant operation. The Maintenance and Asset Management Plans for the Plant provides further details on the maintenance strategies that will be employed to maximise the reliability of the Plant.

The Plant is a membrane plant and therefore as noted above the key components of the process are the ultra-filtration and reverse osmosis membranes. The pro-rata warranties offered by the membrane suppliers provide an indication of the expected MTBF (seven years for UF membranes and five years for RO membranes). The close proximity of the UF membrane suppliers ensures that any UF membrane failures will be able to be resolved quickly with the assistance from the supplier (Memcor). Moreover, both UF and RO systems are equipped with an installed standby train.

Distribution Network Reliability

It is assumed the distribution network components will have the following lifespans

- Mechanical equipment and apparatus 20 years
- Pipelines 100 years
- Civil works 50 years

As part of the detailed Asset Management Plan used to manage the maintenance of the equipment, MTBF and MTTR of all key equipment will be estimated during the detailed design phase of the project. This will allow the maintenance strategies to be tailored to the specific equipment selected in the final design of the Network. These MTBF and MTTR details will be fine tuned during commissioning and in the early stages of system operation. The Maintenance and Asset Management Plans for the Network provides further details on the maintenance strategies that will be employed to maximise the reliability of the Network assets.

Outage of the system with respect to interruption of customer supply is not expected due to the robust backup supply systems in the form of reservoir storage and SWC potable water top-up in the design. These backup systems also offer operational flexibility.

Pumps and motors will be monitored for fatigue (vibration and temperature) and protected from adverse conditions by monitoring equipment (eg pressure). A standby pump is available at all sites as a back-up, in case of pump failure.

Other equipment that could be susceptible to failure is the valve actuators. All actuators will be linked to the SCADA system to notify the operator of failure. Manual operation will be available if failure occurs.

Failure of mains is not expected due to the relatively low operating pressures. VSDs are incorporated in the pump operation to limit sudden pressure changes which could have a negative effect on the network. Repair equipment will be readily available for the pipelines. Network performance with respect to unaccounted for water including leakage will be monitored on a continual basis using the network flow measurement. Periodic network patrols and leakage surveys of the network will be undertaken.

The proposed key components such as pumps are purchased from recognised and established local suppliers limiting potential maintenance issues.

RECYCLED WATER QUALITY, QUANTITY & PRESSURE

Recycled water quality will be maintained by the implementation of the following key aspects:

- Provision of a Plant that has been designed with multiple barriers and on-line monitoring equipment to ensure recycled water quality
- Designing Plant and Network that is highly reliable, robust and capable of handling variations in feed quality (as detailed in the section on Plant Reliability earlier in this schedule)
- Supplying chlorine booster dosing in the network (if required)
- Providing a high level of training to all staff
- Implementing detailed operating procedures for the operation of the Plant and Network
- Providing a 24/7 call-out provision to manage any Plant and Network issues in a timely manner
- Implementing an appropriate level of maintenance on the Plant and Network as detailed in the Maintenance and Asset Management Plans
- Implementing an intensive monitoring program during the operations period for the Plant and Network
- Providing a NATA accredited laboratory on-site
- Using a NATA accredited laboratory off-site
- Following NATA sampling systems
- High quality data management and integrity assessment
- Engaging a full-time Water Quality Officer
- Adopting a HACCP framework to the entire Scheme
- Centrally managing and resourcing the monitoring program for the Plant and the Network
- Utilising Veolia and Alinta Head Office technical support personnel
- Making use of central management of on-line data in association with analytical data

Monitoring

Recycled water quality will be monitored in the Network with on-line monitoring (Turbidity, Chlorine residual and pH) downstream of the Plant and outlets from Woodville and Camellia reservoirs. In addition water quality on-line monitoring is to be provided at the end of the distribution Network at Smithfield. Manual water quality monitoring is to be undertaken at all Foundation Customer supply inlets. This Network monitoring will be managed by the full-time Water Quality Officer in addition to the monitoring associated with the Plant.

Flow quantities are to be monitored leaving the Fairfield and Camellia Pumping Stations and on delivery to all customers. Monitoring will be on-line.

Pressure will be monitored on the suction and delivery sides of the pumping. At Camellia the pump delivery is to be controlled on pressure with a pressure transducer placed at the end of the network near the inlet to customer E respectively. At Fairfield the pump delivery will be controlled primarily on the elevated reservoir level. During peak flow conditions the Fairfield pump additional be controlled on pressure with a pressure transducer placed at customer G.

The delivery pressure of the recycled water is to be set at a slightly lower level than that currently experienced in the potable water network. Hence, by such operation it is proposed the recycled water system will meet the requirements of SWC's differential pressure planning design rule, and thus reduce any potential for back siphonage between the potable and recycled water systems. In addition potable and recycled water will be kept separate by the use of air gaps when the potable water network feeds the recycled network. Different coloured pipelines will be used for the two networks.

System monitoring is shown on the distribution network P&IDs provided as an attachment to Schedule 6.

RECYCLED WATER SYSTEM TESTING AND COMMISSIONING

Testing and commissioning of the distribution network is centred on three key components: pumping stations, pipelines and reservoirs. Outline testing and commissioning for each component and the whole distribution network is discussed below:

Pumping Stations (Fairfield and Camellia)

- Mechanical and electrical equipment factory acceptance tests including panels and pumps
- Mechanical and electrical equipment site acceptance tests including panels, pumps and valves
- Pressure testing and Water Quality testing of pipework
- Testing and Commissioning of instrumentation, control and automation elements including calibration of meters, pressure transducers.
- PLC programming

- Testing of signals to SCADA system and associated programming
- Wet testing of the Pumping Station – run to waste
- Monitoring of pumps performance (including vibration, noise, delivery and pressure)

Pipelines

- Physical testing of mechanical items including gate valves, air valves, meters, etc
- Mains pressure testing
- Mains swabbing and water quality testing
- Operation of apparatus
- Commissioning of monitoring equipment in the network including pressure transducer, water quality sampling and meters
- Calibration of monitoring equipment
- Commissioning of network telemetry
- Configuration to PLC and SCADA

Reservoirs (Woodville Road and Camellia)

- Physical testing of mechanical items including gate valves, actuators etc
- Pipework pressure testing
- Pipework swabbing and water quality testing
- Storage Reservoir water quality and drop tests
- Commissioning of actuated valves (inlets and top-up)
- Commissioning of control equipment (level probes)
- Commissioning of monitoring equipment at the reservoir including pressure transducer, water quality sampling and meters
- Calibration of monitoring equipment
- Commissioning of network telemetry
- Configuration to PLC and SCADA

Network

- Configure operation of pumping stations with respect to pump control (Reservoir level or system pressure)
- Ensure mains are disinfected; re-test if required
- Pump from Fairfield to Woodville Rd Reservoir to fill the reservoir (flow on to Camellia isolated)
- Gravitate from Woodville Rd Reservoir to Smithfield Customers
- Pressure boost at Fairfield pump station based on customer G pressure
- Pump to both Woodville Rd Reservoir and Smithfield Customers
- Monitor pressure and water quality
- Allow water to gravitate from Woodville Rd Reservoir to Camellia following full commissioning of the Smithfield zone
- Fill Camellia Storage Reservoir
- Pump to Camellia Customers
- Monitor pressure and water quality in the Camellia zone

A detailed testing and commissioning plan will be developed for the approval of SWC.

Recycled Water Treatment Plant

The commissioning of the Plant will be conducted as detailed in the Commissioning Management Plan. This section summarises the key items of the commissioning process. Veolia have a high level of experience commissioning membrane plants of this nature. The personnel that will be involved in the commissioning of the Plant are detailed in Schedule 8 along with their commissioning experience.

The commissioning process for the Plant will be separated into the following phases:

- **Construction Verification**
  All installation integrity activities including pre-electrical energisation testing
- **Pre-commissioning**
  Electrical energisation (Power-up) and dry (or no-load) commissioning
- **(Wet or Load) Commissioning**
  Including introduction of water, first fill of chemicals, tuning and preliminary optimising
- **Proofing Period (Performance Test)**
  In accordance with the Performance Test Plan

Construction verification will be carried out by construction subcontractors within their fixed lump sum contract price. Subcontractors normally provide trade attendance for pre-commissioning and commissioning. Detail commissioning is the domain of the individual specialist engineering discipline; outcomes of these specialties are recorded into Inspection and Test Plans (ITPs). ITPs are then filed by Material Data Register (MDR), sub-system and package as appropriate.

ITPs form the crux of documentation required for managing, commencing, monitoring, controlling and completing commissioning. Each phase of commissioning shall be documented, checked and signed off by the responsible person involved and then signed off by the Commissioning Manager or his or her representative.

The commissioning activities are summarised in the table below. The responsible parties for each aspect of the commissioning process are allocated and each responsible person shall ensure that all of the necessary tools, commissioning spares, safety equipment, oil, greases, bulk and laboratory chemicals, test kits, sample bottles and other consumable items are available in advance on site for the pre-commissioning, commissioning and performance testing phases.

Commissioning Activities

Construction	Precommissioning		Commissioning	Proofing Period
Construction Verification	**Energise**	**Dry (no load) Commission**	**Wet (load) Commission**	**Performance Test**
All activities before power up including mechanical alignments, piping hydro testing, lubrication fill & importantly all pre power-up electrical integrity checks.	Power up and follow-on electrical checks prior to dry commissioning (no load) tests.	Bumping, valve stroking & other activities from SCADA/PLC and remote first by Device, then Package (P&ID) then by System.	Firstly on suitable water if effluent not available, then on effluent, all from SCADA/PLC by System and total Plant plus field checks followed by plant tuning.	In accordance with Performance Test Plan to achieve performance standards.

During the wet commissioning all effluent or potable water that is used will be discharged at a low rate to the sewer. Temporary and permanent recycle lines will be utilised during the wet commissioning period to minimise the use of potable water and/or effluent. This will also reduce the quantity to be discharged to the sewer.

To prove the Plant a 30 day Performance Test will be conducted. The Plant will be operated normally during this “proofing period” with the recycled water that is produced returned to the LAP via a temporary connection downstream of the feed effluent off-take. For a short period of the Performance Test the recycled water may be pumped into the network, but no recycled water will be supplied to the customers. Any recycled water pumped into the network will be discharged to the sewer via the scour valves. During the Performance Test a rigorous sampling and analysis program will be implemented to ensure that the recycled water meets the SWC requirements and complies with the National Guidelines for Water Recycling. Details on the sampling and testing proposed for the proving period are provided in the Recycled Water System Monitoring and Reporting section below. The plant will be operated at full normal operation during this test. Full normal operating production is considered to be 15 ML/d.

A detailed testing and commissioning plan will be developed for the approval of SWC.

RECYCLED WATER SYSTEM MONITORING & REPORTING

Overview

Reliable and accurate monitoring is required to ensure process performance specifications are met, membrane systems are protected to maximise their life and that the environment and human health are protected. A range of approaches will be used to meet the needs of SWC, and the needs of the operator in running the Plant. On-site and off-site laboratory services will be used, various forms of samples collected from a range of process streams, analysis conducted for many parameters, coupled with on-line monitoring, and all in consideration of a minimum 20 percent QA/QC check system. Both on-site and off-site analysis and sampling will be NATA accredited.

Plant and Network monitoring will be centrally managed and resourced using the AVA staff and laboratory services. As such, a central Water Quality Officer will be responsible for the entire Plant and Network Monitoring Plan, and report to the Plant and Network Operations Supervisors.

A fully maintained and operational laboratory will be established on-site during the Plant construction, and will become operational during the commissioning period. The on-site laboratory will be operated long term by trained staff and use field meters, spectrophotometer kits, and some physical on-site testing. The on-site laboratory will be NATA accredited for the parameters tested.

An annual services agreement will be maintained with an external laboratory, NATA accredited for the tests to be analysed. This contract will be reviewed annually with regard to price and performance KPIs. The Water Quality Officer will be responsible for the laboratory contract, ensuring good service and delivery of data is provided.

Sampling will generally be performed by the Water Quality Officer, and trained AVA operators following NATA accreditation. From time to time, the laboratory contracted for external analysis may become responsible for sampling under the terms of a services agreement. Additionally, SWC staff may also come on-site and collect samples for SWC purposes.

Sampling will be done at least at the following points:

- Secondary effluent (LAP and/or plant inlet)
- Plant outlet (Recycled Water)
- Plant concentrate as trade waste discharge
- Customer connections (seven Foundation Customers)
- Network storages (three in total)

The following Tables detail the proposed monitoring schedules for on-site and off-site monitoring, conducted during the proving and operating periods. This has been developed in consideration of the NSW Guidelines for Urban and Residential Use of Reclaimed Water (May 1993), the National Water Recycling Guidelines (November 2006), and AVA's proposed adoption of a HACCP framework for the Camellia Recycled Water Project.

On-site Laboratory Monitoring during Proving and Operations

The monitoring associated with the recycled water scheme is detailed fully in the Plant and Network Operation Management Plans. This section summarises these details.

Process Proving - Monitoring

The monitoring that will be undertaken at the Plant during the process proving period is detailed in the table below. All analysis will be performed in an external, independent NATA certified laboratory during the proving period. On-line instruments will be monitored and calibrated by the AVA Operations Team.

Plant Monitoring – Proving Period

Sample Location/Analyte	Type	Frequency
Recycled Water		
Alkalinity	Composite	Daily
Aluminium	Composite	Daily
Ammonia	Composite	Daily
Chloride	Composite	Daily
Iron	Composite	Daily
Manganese	Composite	Daily
Zinc	Composite	Daily
Calcium	Composite	Daily
pH	Online	Online
Hardness	Composite	Daily
TDS	Online	Online
Turbidity	Online	Online
Free residual chlorine	Online	Online
BOD_5	Composite	Daily
Total nitrogen	Composite	Daily
Total phosphorus	Composite	Daily
E coli	Grab	Daily
Total coliforms	Grab	Daily
Viruses (suite of 6)	Grab	Weekly
Parasites (cryptosporidium and giardia)	Grab	Weekly
Phage spike event	Proving	Two events
Trade Waste Concentrate		
Suspended solids	Composite	Daily
BOD_5	Composite	Daily
Grease	Composite	Daily
Ammonia	Composite	Daily
Nitrogen	Composite	Daily
Phosphorus	Composite	Daily
Aluminium	Composite	Weekly
Arsenic	Composite	Weekly
Barium	Composite	Weekly

Sample Location/Analyte	Type	Frequency
Benzene	Composite	Weekly
Boron	Composite	Weekly
Bromine	Composite	Weekly
Cadmium	Composite	Weekly
Chlorinated phenolics	Composite	Weekly
Chlorine	Composite	Weekly
Chromium	Composite	Weekly
Cobalt	Composite	Weekly
Copper	Composite	Weekly
Cyanide	Composite	Weekly
Fluoride	Composite	Weekly
Formaldehyde	Composite	Weekly
General pesticides	Composite	Weekly
Herbicides and defoliants	Composite	Weekly
Iron	Composite	Weekly
Lead	Composite	Weekly
Manganese	Composite	Weekly
Mercaptans	Composite	Weekly
Mercury	Composite	Weekly
Molybdenum	Composite	Weekly
Nickel	Composite	Weekly
Organoarsenic compounds	Composite	Weekly
Phosphorus	Composite	Weekly
Petroleum hydrocarbons (flammable)	Composite	Weekly
Phenolic compounds (non-chlorinated)	Composite	Weekly
Polynuclear aromatic hydrocarbons	Composite	Weekly
Selenium	Composite	Weekly
Silver	Composite	Weekly
Sulphide	Composite	Weekly
Sulphite	Composite	Weekly
Thiosulphate	Composite	Weekly
Tin	Composite	Weekly
Uranium	Composite	Weekly
Volatile halocarbons	Composite	Weekly
Zinc	Composite	Weekly
Influent		
Suspended solids	Composite	Daily
BOD_5	Composite	Daily
Total nitrogen	Composite	Daily
Total phosphorus	Composite	Daily
Total Organic Carbon (TOC)	Composite	Daily
Silica	Composite	Daily

The monitoring in the Network that will be undertaken during the process proving period is summarised in the table below. Once again all analysis during the proving period will be undertaken in an external, independent NATA certified laboratory.

Network Monitoring During Proving Period

Analyte	Type	Frequency
Scours discharged to sewer - 13 scour sites		
Suspended solids	Composite	Commissioning
BOD_5	Composite	Commissioning
Grease	Composite	Commissioning
Ammonia	Composite	Commissioning
Nitrogen	Composite	Commissioning
Phosphorus	Composite	Commissioning
Aluminium	Composite	Commissioning
Arsenic	Composite	Commissioning
Barium	Composite	Commissioning
Benzene	Composite	Commissioning
Boron	Composite	Commissioning
Bromine	Composite	Commissioning
Cadmium	Composite	Commissioning
Chlorinated phenolics	Composite	Commissioning
Chlorine	Composite	Commissioning
Chromium	Composite	Commissioning
Cobalt	Composite	Commissioning
Copper	Composite	Commissioning
Cyanide	Composite	Commissioning
Fluoride	Composite	Commissioning
Formaldehyde	Composite	Commissioning
General pesticides	Composite	Commissioning
Herbicides and defoliants	Composite	Commissioning
Iron	Composite	Commissioning
Lead	Composite	Commissioning
Manganese	Composite	Commissioning
Mercaptans	Composite	Commissioning
Mercury	Composite	Commissioning
Molybdenum	Composite	Commissioning
Nickel	Composite	Commissioning
Organoarsenic compounds	Composite	Commissioning
Phosphorus	Composite	Commissioning
Petroleum hydrocarbons (flammable)	Composite	Commissioning
Phenolic compounds (non-chlorinated)	Composite	Commissioning
Polynuclear aromatic hydrocarbons	Composite	Commissioning
Selenium	Composite	Commissioning
Silver	Composite	Commissioning
Sulphide	Composite	Commissioning
Sulphite	Composite	Commissioning

Analyte	Type	Frequency
Scours discharged to sewer - 13 scour sites		
Thiosulphate	Composite	Commissioning
Tin	Composite	Commissioning
Uranium	Composite	Commissioning
Volatile halocarbons	Composite	Commissioning
Zinc	Composite	Commissioning

Analyte	Type	Frequency
Network storages - 3 sites		
Alkalinity	Composite	Twice
Aluminium	Composite	Twice
Ammonia	Composite	Twice
Chloride	Composite	Twice
Iron	Composite	Twice
Manganese	Composite	Twice
Zinc	Composite	Twice
Calcium	Composite	Twice
pH	Online	Twice
hardness	Composite	Twice
TDS	Online	Twice
Turbidity	Online	Twice
Free residual chlorine	Online	Twice
BOD_5	Composite	Twice
Total nitrogen	Composite	Twice
Total phosphorus	Composite	Twice
E coli	Grab	Twice
Total coliforms	Grab	Twice
Viruses (suite of 6)	Grab	Twice
Parasites (cryptosporidium and giardia)	Grab	Twice

On-site Laboratory

During normal operations a laboratory will be operational on site. This laboratory will be NATA certified as soon as possible. Samples will be analysed in this laboratory by AVA personnel. To validate these results there will be additional samples analysed in an external, independent NATA accredited laboratory. It has been considered that prior to the on-site laboratory being NATA accredited no additional validation from external laboratories will be required.

The monitoring proposed for the on site laboratory during normal operations is summarised for the Plant and Network in the tables below.

Plant Related Routine Monitoring – On-site Laboratory

Analyte	Type	Frequency
Recycled Water		
Alkalinity	Composite	Weekly
Aluminium	Composite	Weekly

Analyte	Type	Frequency
Ammonia	Composite	Weekly
Chloride	Composite	Weekly
Iron	Composite	Weekly
Manganese	Composite	Weekly
Zinc	Composite	Weekly
Calcium	Composite	Weekly
pH	Online	Online
Hardness	Composite	Weekly
TDS	Online	Weekly
Turbidity	Online	Weekly
Free residual chlorine	Online	Weekly
Suspended solids	Composite	Daily
COD	Composite	Daily
Total nitrogen	Composite	Daily
Total phosphorus	Composite	Daily
Influent		
pH	Online	Online
TDS	Online	Online
Turbidity	Online	Online
Free residual chlorine	Online	Online
Suspended solids	Composite	Daily
COD	Composite	Daily
Total nitrogen	Composite	Daily
Total phosphorus	Composite	Daily
Total Organic Carbon (TOC)	Composite	Weekly
Silica	Composite	Daily
Aluminium	Composite	Weekly
Ammonia	Composite	Weekly
Chloride	Composite	Weekly
Iron	Composite	Weekly
Manganese	Composite	Weekly
Sodium	Composite	Weekly
Zinc	Composite	Weekly
Calcium	Composite	Weekly
NOx	Composite	Weekly
Alkalinity	Composite	Weekly

Network Related Routine Monitoring – On-site Laboratory

Analyte	Type	Frequency
Delivered water - customer A to G		
Alkalinity	Composite	Weekly
Aluminium	Composite	Weekly
Ammonia	Composite	Weekly
Chloride	Composite	Weekly

Analyte	Type	Frequency
Delivered water - customer A to G		
Iron	Composite	Weekly
Manganese	Composite	Weekly
Zinc	Composite	Weekly
Calcium	Composite	Weekly
pH **(1 customer site)**	Online	Online
hardness	Composite	Weekly
TDS **(1 customer site)**	Online	Online
Turbidity **(1 customer site)**	Online	Online
Free residual chlorine **(1 customer site)**	Online	Online
Suspended solids	Composite	Weekly
COD	Composite	Weekly
Total nitrogen	Composite	Weekly
Total phosphorus	Composite	Weekly
Network storages - 3 sites		
pH	Online	Online
Free residual chlorine	Online	Online
Suspended solids	Composite	Monthly
COD	Composite	Monthly
Total nitrogen	Composite	Monthly
Total phosphorus	Composite	Monthly

Off-site Laboratory Monitoring during Normal Operations

In addition to the monitoring performed at the on-site laboratory a monitoring regime will be undertaken at an external, independent NATA certified laboratory. This is detailed in the tables below.

Plant Related Routine Monitoring – External Laboratory

Analyte	Type	Frequency
Recycled Water		
Alkalinity	Composite	Monthly
Aluminium	Composite	Monthly
Ammonia	Composite	Monthly
Chloride	Composite	Monthly
Iron	Composite	Monthly
Manganese	Composite	Monthly
Zinc	Composite	Monthly
Calcium	Composite	Monthly
pH	Online	Monthly grab
Hardness	Composite	Monthly
TDS	Online	Monthly grab
Turbidity	Online	Monthly grab
Free residual chlorine	Online	Monthly grab

Analyte	Type	Frequency
BOD_5	Composite	Monthly
Total nitrogen	Composite	Monthly
Total phosphorus	Composite	Monthly
E coli	Grab	Monthly
Total coliforms	Grab	Monthly
Viruses (suite of 6)	Grab	Quarterly
Parasites (cryptosporidium and giardia)	Grab	Quarterly
EDCs (GCMS scan)	Composite	Twice yearly
Pharmaceuticals	Composite	Twice yearly
PCPs	Composite	Twice yearly
Pesticides	Composite	Twice yearly
THMs	Grab	Twice yearly
Helminths	Grab	Twice yearly
Influent		
Alkalinity	Composite	Twice yearly
Aluminium	Composite	Twice yearly
Ammonia	Composite	Quarterly
Chloride	Composite	Twice yearly
Iron	Composite	Twice yearly
Manganese	Composite	Twice yearly
Zinc	Composite	Twice yearly
Calcium	Composite	Twice yearly
pH	Online	Monthly
Hardness	Composite	Twice yearly
TDS	Composite	Twice yearly
Total Organic Carbon (TOC)	Composite	Quarterly
Silica	Composite	Quarterly
Turbidity	Composite	Twice yearly
Free residual chlorine	Grab	Twice yearly
BOD_5	Composite	Twice yearly
Total nitrogen	Composite	Twice yearly
Total phosphorus	Composite	Twice yearly
E coli	Grab	Twice yearly
Total coliforms	Grab	Twice yearly
Viruses (suite of 6)	Grab	Twice yearly
Parasites (cryptosporidium and giardia)	Grab	Twice yearly
EDCs (GCMS scan)	Composite	Twice yearly
Pharmaceuticals	Composite	Twice yearly
PCPs	Composite	Twice yearly
Pesticides	Composite	Twice yearly
THMs	Grab	Twice yearly
Helminths	Grab	Twice yearly
Faecal Coliforms	Grab	Weekly
Oil & Grease	Composite	Weekly

Analyte	Type	Frequency
Trade Waste Concentrate		
Suspended solids	Composite	Quarterly
BOD_5	Composite	Quarterly
Grease	Composite	Quarterly
Ammonia	Composite	Quarterly
Nitrogen	Composite	Quarterly
Phosphorus	Composite	Quarterly
Aluminium	Composite	Quarterly
Arsenic	Composite	Quarterly
Barium	Composite	Quarterly
Benzene	Composite	Quarterly
Boron	Composite	Quarterly
Bromine	Composite	Quarterly
Cadmium	Composite	Quarterly
Chlorinated phenolics	Composite	Quarterly
Chlorine	Composite	Quarterly
Chromium	Composite	Quarterly
Cobalt	Composite	Quarterly
Copper	Composite	Quarterly
Cyanide	Composite	Quarterly
Fluoride	Composite	Quarterly
Formaldehyde	Composite	Quarterly
General pesticides	Composite	Quarterly
Herbicides and defoliants	Composite	Quarterly
Iron	Composite	Quarterly
Lead	Composite	Quarterly
Manganese	Composite	Quarterly
Mercaptans	Composite	Quarterly
Mercury	Composite	Quarterly
Molybdenum	Composite	Quarterly
Nickel	Composite	Quarterly
Organoarsenic compounds	Composite	Quarterly
Phosphorus	Composite	Quarterly
Petroleum hydrocarbons (flammable)	Composite	Quarterly
Phenolic compounds (non-chlorinated)	Composite	Quarterly
Polynuclear aromatic hydrocarbons	Composite	Quarterly
Selenium	Composite	Quarterly
Silver	Composite	Quarterly
Sulphide	Composite	Quarterly
Sulphite	Composite	Quarterly
Thiosulphate	Composite	Quarterly
Tin	Composite	Quarterly
Uranium	Composite	Quarterly
Volatile halocarbons	Composite	Quarterly
Zinc	Composite	Quarterly

Network Related Routine Monitoring – External Laboratory

Analyte	Type	Frequency
Delivered water - customer A to G		
Alkalinity	Composite	Monthly
Aluminium	Composite	Monthly
Ammonia	Composite	Monthly
Chloride	Composite	Monthly
Iron	Composite	Monthly
Manganese	Composite	Monthly
Zinc	Composite	Monthly
Calcium	Composite	Monthly
pH	Composite	Monthly grab
Hardness	Composite	Monthly
TDS	Composite	Monthly grab
Turbidity	Composite	Monthly grab
Free residual chlorine	Grab	Monthly grab
BOD_5	Composite	Monthly
Total nitrogen	Composite	Monthly
Total phosphorus	Composite	Monthly
E coli	Grab	Monthly
Total coliforms	Grab	Monthly
Viruses (suite of 6)	Grab	Yearly
Parasites (cryptosporidium and giardia)	Grab	Yearly
EDCs (GCMS scan)	Composite	Yearly
Pharmaceuticals	Composite	Yearly
PCPs	Composite	Yearly
Pesticides	Composite	Yearly
THMs	Grab	Yearly
Helminths	Grab	Yearly
Network storages - 3 sites		
Alkalinity	Composite	Twice yearly
Aluminium	Composite	Twice yearly
Ammonia	Composite	Twice yearly
Chloride	Composite	Twice yearly
Iron	Composite	Twice yearly
Manganese	Composite	Twice yearly
Zinc	Composite	Twice yearly
Calcium	Composite	Twice yearly
pH	Composite	Monthly grab
hardness	Composite	Twice yearly
TDS	Composite	Monthly grab
Turbidity	Composite	Monthly grab
Free residual chlorine	Grab	Monthly grab
BOD5	Composite	Twice yearly
Total nitrogen	Composite	Twice yearly

Analyte	Type	Frequency
Total phosphorus	Composite	Twice yearly
E coli	Grab	Twice yearly
Total coliforms	Grab	Twice yearly
Scours Discharge to Sewer		
Suspended solids	Composite	When occur
BOD_5	Composite	When occur
Grease	Composite	When occur
Ammonia	Composite	When occur
Nitrogen	Composite	When occur
Phosphorus	Composite	When occur
Aluminium	Composite	When occur
Arsenic	Composite	When occur
Barium	Composite	When occur
Benzene	Composite	When occur
Boron	Composite	When occur
Bromine	Composite	When occur
Cadmium	Composite	When occur
Chlorinated phenolics	Composite	When occur
Chlorine	Composite	When occur
Chromium	Composite	When occur
Cobalt	Composite	When occur
Copper	Composite	When occur
Cyanide	Composite	When occur
Fluoride	Composite	When occur
Formaldehyde	Composite	When occur
General pesticides	Composite	When occur
Herbicides and defoliants	Composite	When occur
Iron	Composite	When occur
Lead	Composite	When occur
Manganese	Composite	When occur
Mercaptans	Composite	When occur
Mercury	Composite	When occur
Molybdenum	Composite	When occur
Nickel	Composite	When occur
Organoarsenic compounds	Composite	When occur
Phosphorus	Composite	When occur
Petroleum hydrocarbons (flammable)	Composite	When occur
Phenolic compounds (non-chlorinated)	Composite	When occur
Polynuclear aromatic hydrocarbons	Composite	When occur
Selenium	Composite	When occur
Silver	Composite	When occur
Sulphide	Composite	When occur
Sulphite	Composite	When occur
Thiosulphate	Composite	When occur
Tin	Composite	When occur

Analyte	Type	Frequency
Uranium	Composite	When occur
Volatile halocarbons	Composite	When occur
Zinc	Composite	When occur

Data Reporting to SWC

Process data is collected through on-line monitoring, in-house laboratory testing, external laboratory testing and process logs. The integrity of the information measured, calculated or observed is ensured through:

- Calibration of on-line instrumentation at pre-determined intervals. These calibrations are carried out by trained staff according to documented and approved methods or are carried out by qualified and approved subcontractors.

- Pre-determined sampling regimes which are designed to represent the characteristics of the process as well as possible by:

  - Taking composite samples where appropriate

  - Conducting a 6-day rolling sampling program for weekly testing to avoid measuring recurring characteristics which occur on a given day of the week (for example compounds due to trade waste discharges to sewer which may be subject to a manufacturing site's production program) and/or

  - Conducting sampling over three days and taking the geometric mean of the results

- Training of staff to carry out internal laboratory testing according to documented and approved methods. Placement of a Water Quality Officer on-site to coordinate and manage all sampling and analysis in the on-site and off-site laboratory

- Ensuring that the external laboratories used are NATA-accredited for the tests carried out or where a NATA-accredited laboratory is not available, that the laboratory has provided evidence of using proper laboratory methods

- Central management of water quality monitoring (on-site, off-site, on-line) at the Plant site

- A well-designed operator log system which is used with discipline

- Laboratory quality control and quality assurance as outlined in Chapter 4 of the Plant Operations Management Plan. Laboratory, Sampling, Analysis

Veolia is currently coordinating an Australia-wide project to establish an operations database to manage all process data. This database will represent a significant improvement in data integrity by:

- Providing a single location for the storage of all operational data
- Providing a tangible improvement over Microsoft Excel-based data storage and manipulation which relies on the accuracy of a large number of formulae which are often easily accessible and modifiable at the user interface
- Prompting data-entry personnel if they attempt to enter out-of-range data and automatically generating an incident report if out-of-range data is entered
- Eliminating multiple-handling of data, and
- Avoiding miss-reporting of data by using the database itself to generate reports

The proposed design of the operations database is based on that developed by United Water, Veolia's wholly-owned subsidiary. United Water has a 15.5-year contract with the South Australian Government and SA Water to manage, maintain and operate the city's water and wastewater assets. This includes six water treatment plants, five wastewater treatment plants, over 453,000 service connections, 9,900 km of water mains and 7,000km of wastewater mains. United Water has successfully built and managed its operations database to handle process data from all 11 of its plants in Adelaide and Veolia will build on this success to roll-out an operations database to all of its Australian operations sites.

All process and other data will be made available to SWC upon request. This will be managed in accordance with a site laboratory management system to record sample receipt, data entry, result outcome. In addition, recycled water quality will be statistically interrogated and reported in accordance with the SWC specified criteria, and reported in the monthly report. The Water Quality Officer will be the custodian of the laboratory management system, and all data reporting. The System Manager or Operations Supervisor will cross-sign all released data reports.

On-line instrument data will also be managed by the Water Quality Officer. This will also be data reviewed and statistically alarmed to show outlier data points.

Any recycled water quality incidents or effluent quality events will be formally reported within 24 hours to SWC of the analysis being performed and the result obtained. This will trigger an incident report investigating the cause and rectification measures implemented. The Water Quality Officer will inform the Operations Supervisor of any such events promptly. This will be reported to SWC according to the Incident Reporting System.

An "early warning" system will be proposed by AVA to keep both SWC and customers informed of any potential threats to recycled water quality or quantity. This system will be developed in consultation with SWC and the recycled water customers and it will become a part of the communication protocols in addition to being reported in the monthly report.

All data will be maintained in the Plant SCADA and IT systems at the site. Laboratory data management will be in accordance with the NATA accreditation to be held for the site.

AVA will develop, in consultation with SWC, a fully detailed monthly client report that describes all aspects of the Recycled Water Scheme's performance. A similar report will also be made available to all customers (pending agreement by SWC).

The monthly report will cover as a minimum:

(a) the daily and monthly aggregate of Recycled Water manufactured at the Plant;

(b) a review of the performance of the O&M Services and compliance with the performance requirements;

(c) any issues associated with the provision of the O&M Services along with strategies implemented or proposed to overcome issues;

(d) details of safety-related issues, including lost-time injury records;

(e) industrial relations issues affecting, or which may affect, the O&M Services;

(f) details of quality assurance activities during the month including a summary of all calibration activities related to payment or environmental compliance;

(g) a summary of maintenance, repair or Renewal activities carried out in the month, including itemised sums spent on Asset replacement;

(h) details of any reductions due to failure to meet the performance requirements;

(i) a summary of the monthly payments claimed for the O&M Services; and

(j) any other matter material to the work and compliance with the Agreement.

All process data sets (such as feed effluent and recycled water quality) will include commentary as noted in the table below:

Item	Comment
Data Quality Objectives Status	Discuss spikes, blanks, duplicates data for on-site and off-site lab
Issues	Discuss any issues with poor quality, outlier data, sample collection, "early warning" notifications
Network samples	Discuss any extraneous data
Plant samples	Discuss any extraneous data
Recycled Water quality	See Table below

An indicative table for Recycled Water Quality monthly results is provided below:

Parameter	95%ile Limit	No. of Samples	Min	Avg	Max	95%ile for the Month *(On-site Lab data)*	95%ile for the Month *(Off-site Lab data)*
Aluminium (mg/L)	<0.1						
Ammonia (mg/L)	<1						
Chloride (mg/L)	<20						

Parameter	95%ile Limit	No. of Samples	Min	Avg	Max	95%ile for the Month *(On-site Lab data)*	95%ile for the Month *(Off-site Lab data)*
Iron (mg/L) (soluble)	<0.05						
Manganese (mg/L)	<0.05						
Zinc (mg/L)	<0.1						
Calcium (mg/L as $CaCO_3$)	<10						
pH (pH units)	6.5 – 8.5						
Hardness (mg/L as $CaCO_3$)	< 20						
Total Dissolved Solids (mg/L)	<50						
Turbidity (NTU)	<2						
Free Residual Chlorine (mg/L)	1						
Biochemical Oxygen Demand (mg/L)	<2						
Total Nitrogen (mg/L)	<10						
Total Phosphorous (mg/L)	<2						
E. coli Coliforms	<1 in 100 mL						
Total Coliforms	<10 in 100 mL						
Viruses	<1 in 50 L						
Parasites	<1 in 50 L						

OPERATIONAL RISK MANAGEMENT ASSESSMENT

A preliminary operational risk assessment has been conducted on the recycled water scheme. This risk assessment is provided as **Attachment 1** to this schedule. The preliminary risk assessment focuses on the following risk categories:

- Access and security
- Compliance
- Human resources
- Health, safety and environment
- IT systems and communication
- Operations – Network and Plant

The risks have been scored based on an initial series of proposed controls. In some cases additional actions have been identified to further mitigate risk.

In summary the main failure scenarios associated with the operation of the recycled water network include:

- Failure of incoming supply from the Liverpool to Ashfield Pipeline (LAP) – Reservoir storage and SWC top up supply will be used until the feed is available. Additionally, feed effluent storage (of 3 ML) has been provided at the Plant that will allow normal operation for short interruptions to the supply of effluent from the LAP.

- Pump failure – a standby pump has been allowed for in all pumping station arrangements

- Pumping Station outage at Fairfield; if the pumps were to fail at Fairfield the distribution of water from the storage reservoir and Plant at the site would cease. The Camellia zone would be supported by its storage reservoir (6 ML) and pumping station. The Smithfield zone would be supported by water back fed from Woodville Rd Reservoir . Storage is limited at Woodville Rd Reservoir, however at both sites the supply would then be augmented by SWC top up water

- Pumping Station outage at Camellia; if the pumps were to fail at Camellia the distribution of water from the storage reservoir would cease. The Camellia zone would be supported at reduced pressure by water gravitating from Woodville Rd Reservoir Storage Reservoir and bypassing the Camellia Reservoir and pumping station. During ADD demand it is envisaged the network will maintain pressure requirements when served from Woodville Rd Reservoir. However, pressure will drop significantly below the pressure standard at PDD

- Failure at Both Pumping Station Sites; if outage does occur, a backup supply will be provided to both zones via Woodville Road Reservoir and the SWC top-up supply

- Main failure or burst – a number of allowances have been made to limit the impact of a main failure. These include:

    - The design allows for isolation at 1km centres and on all branches

    - Reservoir storage is incorporated in the network for instance if a main failure were to occur upstream of Camellia Reservoir, the Camellia customers can still be supplied

    - Pressure and flow monitoring at Pumping Stations will indicate a potential problem on the network and hence trigger action by operations

    - Emergency fittings will be retained at each pumping station to allow a quick repair of mains

    - Actuator failure – manual or pneumatic operation is available before maintenance is undertaken

- Water quality failure /contamination – during such an event the network affected will be isolated from customers and customers will receive an emergency back-up supply direct from SWC

The most significant risks related to the operation of the Plant are associated with complying with the quality and quantity requirements for recycled water. This highlights the importance of pilot trials on the effluent blend prior to validate the Plant design and confirm the feed effluent quality. This will also allow the identification of any unusual membrane fouling and allow optimum cleaning regimes to be developed to manage membrane fouling.

A preliminary risk assessment will be updated after the completion of the pilot plant then further revised after the detailed design has been completed. All of the actions shall be tracked as part of the Integrated Business Management System (IMBS) to ensure that they adequately mitigate the risk. The controls will be further checked to ensure that they adequately mitigate the risk once the scheme is operational. The operational risk assessment will be finalised during the proving period for implementation during operation of the scheme. This risk assessment will be updated in the event of any incident and in its entirety on an annual basis.

Parameters Measured Outside 95 Percentile Limits

On-line and laboratory data will be recorded directly into the Plant site SCADA system. This system will be set up such that an alarm will tigger if 95 percentile limits for recycled water quality are breached. The Water Quality Officer will be responsible for managing this recording and reporting system, including the identification of poor quality trends which may lead to a breach of the product quality guidelines.

The Plant on-line monitoring will include monitoring at the following points:

- Effluent in the LAP
- Effluent feed to the Plant
- Intermediate streams with in the Plant processes
- Prior to the Plant recycled water storage tanks
- Post the Plant recycled water storage tanks
- Within the network
- At the customer sites

This minimises the possibility of “out of specification” recycled water being supplied to the customer as multiple instruments can be used to verify quality incidents.

There are several aspects associated with the Plant design that will also minimise the potential for production of out of specification recycled water. These are fully detailed in the Recycled Water Treatment Plant Reliability section at the beginning of this Schedule. One of the major design aspects that will allow recycled water quality to be tightly controlled is the ability to return permeate to the RO feed tank (this design feature is fully described in Schedule 6). This will reduce the plant production of recycled water but will ensure that any deviations in recycled water quality can be managed prior to impacting on the customers. The Plant will also be able to divert out of specification recycled water back to the sewer with the Plant operating at minimum production. This will allow the Plant to continue operating if slight quality excursions occur with no risk to customers. Once the quality meets the requirements for 30 minutes, recycled water can be returned to customers.

The recycled water network has sufficient storage capacity to allow approximately 15 hours’ supply at ADD, assuming that all reservoirs are full. This will provide a buffer that will minimise interruption to customers in the event of a short term quality excursion. Obviously, these quality excursions would still be reported to SWC as detailed below.

Recycled water quality that breaches the 95 percentile limits will be directly reported to the Operations Supervisor, who will notify the System Manager. The System Manager will work with the Operations Supervisor to mitigate the impact, aiming for restoration within a short timeframe. If this cannot be achieved, AVA will notify SWC of the Incident.

AVA acknowledges that SWC needs to be notified of significant and ongoing breaches of the recycled water quality criteria, as do Foundation Customers, depending on the nature and severity of the quality issue.

During the O&M Period, recycled water quality falling outside the 95%ile limits will be reported to SWC immediately, via the Incident Reporting System. Where the issue is not readily mitigated, SWC will be notified that discharge to sewer is required of out-of-specification product effluent. The System Manager will be responsible for such notifications, and for advising when quality has been resumed.

AVA will develop customer management plans in consultation with SWC and each recycled water customer. These plans will focus on the requirements of the National Recycled Water Guidelines (November 2006) and include a HACCP. The plans will focus on the development of site specific control measures for recycled water use. In addition to this the customer plans will quantify acceptable recycled water quality for each customer outside the limits specified in the SWC RDP document.

A series of control measures will be developed to manage deviation in recycled water quality at the plant. These will be appropriate to the customer's upper limits for acceptance of recycled water quality based on their recycled water use.

Prior to Transition, all notifications of recycled water quality to Foundation Customers will be via SWC.

Further details on the notification process to SWC are provided in the draft O&M Integration and Communication Management Plan.

Validation Plan

Western Corridor Recycled Water Project - AWTPs

PL-GWA-WC-2003-3

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VEOLIA
WATER

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

SECTION 1 INTRODUCTION

1.1 PURPOSE

This plan is the Validation Plan for Western Corridor Recycled Water Pty Ltd required under the Water Supply Act (Safety and Reliability) 2008 for a critical recycled water schcme.

This document outlines the plan by which validation and commissioning verification of the Advanced Water Treatment Plants (AWTPs) will be conducted to comply with the requirements of the Act.

All supporting documents such as policies, plans procedures and work instructions referred to in this document form part of the Veolia Integrated Business Management System (IBMS) and can be accessed via the Veolia intranet (Go Fish!).

1.2 SCOPE

This plan consists of three sub plans which cover the three distinct phases of validation required under the guidelines. These include:

- Pre-commissioning validation.
- Commissioning validation.
- Commissioning verification.

Each of these sub plans is described in more detail in section 1.3 below.

1.2.1 REVIEW OF THE PLAN

This plan will be reviewed annually in accordance with the Veolia IBMS requirements.

Each review will be submitted for approval to WCRW. Reviews will be incorporated in updates of the WCRW Recycled Water Management Plan and submitted for regulatory approval.

1.3 DEFINITIONS

1.3.1 PRE – COMMISSIONING VALIDATION

Pre-commissioning validation is primarily a desk top study used to determine the treatment process barriers required to meet the required recycled water quality as defined in the Water Quality Guidelines for Recycled Water Schemes (June 2008). Pre commissioning validation provides a sound justification of the selection of critical control points for the process. The validation will assess the efficiency of each barrier for treatment of water quality hazards and may include:

1. Historical data from other schemes.
2. Manufacturer's specification and guarantees.

3. Performance statistics from peer reviewed published information and historical data from other schemes on removal efficiency of target parameters and proof of manufacturer's guarantees.
4. Accreditation of process efficiency provided by reputable international agencies (such as the California Department of Health or the USEPA) for the specific type and model of equipment installed.
5. Results from pilot plant testing (applicable from the Luggage Point and Gibson Island Demonstration plants).

The Pre-Commissioning Validation plan is detailed in section 2.

1.3.2 COMMISSIONING VALIDATION

Commissioning validation is effectively a plant performance test that confirms that the treatment process barriers control water quality hazards as expected from the pre-commissioning validation. The commissioning validation test will confirm the operation at each critical control point. It will monitor target chemical and microbiological parameters at each critical control point to confirm that target log removals can be achieved.

Commissioning validation will include:

- Membrane integrity testing.
- On line water quality analysis (relevant to each process barrier).
- Operational process trend data.
- Water quality testing (relevant to each process barrier).

The Commissioning Validation plan is detailed in section 3.

1.3.3 COMMISSIONING VERIFICATION

Commissioning verification is a testing program conducted on the treated water to provide that the expected water quality is being produced. This testing will monitor target chemical and microbiological parameters

The parameters that will be chosen for verification testing are based on the Source Water Characterisation and monitoring program conducted in 2007.

The Commissioning Verification plan is detailed in section 4.

1.4 ROLES AND RESPONSIBILITIES

Roles and responsibilities are defined in each of the relevant pre-commissioning validation, commissioning validation and commissioning verification sections of this plan.

1.5 REFERENCES

Refer to appendix 1 for a list of referenced documents

SECTION 2 PRE-COMISSIONING VALIDATION

2.1 PRE-COMMISSIONING VALIDATION STATUS

At the time of production of the validation plan, all AWTPs had largely reached the completion stage of design. As such, bench top validation information currently available for the process has been included in this plan.

2.2 PROCESS BARRIERS AND CRITICAL CONTROL POINTS

A series of critical control points (CCPs) controlling water quality health hazards at AWTP process treatment barriers were identified during the Veolia Operational Hazard Assessment workshop.

The overall scheme will contain other treatment barriers that are not included in this plan, but will be covered in the scheme manager validation plan. These barriers will include:

- Wastewater treatment plants.
- Natural barrier at the Wivenhoe reservoir.
- Water treatment plants.

This plan has adopted a conservative approach and assumed that **all** contaminant removal will take place at the AWTP, especially for virus.

The key barriers for health hazards identified were:

Table 1 - List of Critical Control Points

Critical Control Point Identifier	Process Treatment Barrier
CCP 1	Raw Water Pump Stations
CCP 5	Microfiltration
CCP 9	Reverse Osmosis
CCP 10	Advanced Oxidation Process

The critical control points are monitored online using both surrogate and indicator parameters that measure the performance of a process unit and can be related to how that process would perform on parameters that pose a water quality health hazard.

Drewes (2007) defined indicator and surrogate parameters as follows:

Surrogate: Quantifiable change of a bulk parameter that can serve as a performance measure of individual unit processes or operations regarding their removal of trace compounds (e.g. TOC, conductivity, ammonia etc).

Indicator – Individual chemical occurring at quantifiable level, which represents certain physicochemical and biodegradable characteristics of a family of trace constituents that are relevant to fate and transport during treatment, and provides a conservative assessment of removal (e.g Ibuprofen, NDMA).

The pre-commissioning validation provides a justification for each of the critical control points. The table below contains the summary of the CCPs that were identified as being controlled in the AWTP, how their effectiveness will be monitored (i.e. which surrogate and/or indicator parameter will be used) and how that point will be validated.

Table Summary of AWTP Validation information

Table 2 - Summary of AWTP Validation Information

CCP	Critical Process	Hazard controlled	Monitoring procedure / surrogate	Pre-commissioning Validation Information
CCP 1	Raw Water Pump Station	Water quality beyond capability of plant to treat).	On line instruments: • Ammonia • WWTP in bypass mode.	This CCP assumes that an exceedance in ammonia is an indication that the WWTP process may not be operating correctly, hence removal of health hazards at the WWTP may be compromised. Ammonia has been selected as the WWTP nitrifying bacteria are considered very sensitive to process upsets. The key indicator of a process upset will be a rise in the level of ammonia from the plant. The on line analyser based control point will be compared against composite sampled data from each of the pump stations to ensure that the raw water quality is not beyond the treatment capability of the plant, and to provide baseline performance data. In this respect, the actual values of critical and alert limits may be amended following the validation test. The CCP cannot be validated in the scope of the AWTP validation, as it is dependent on performance of upstream processes outside the scope of AWTP validation. If the WWTP is in a bypass condition (for example during a storm event) then the removal of health parameters is also considered to be compromised. For this reason, bypass will be considered a trigger for CCP1 for AWTPs where bypass flow enters upstream of AWTP intakes.
CCP 5	Microfiltration (Gibson Is/Bundamba)	Bacteria	• Membrane Pressure Decay Test (PDT) – daily indirect integrity testing.	Challenge test work conducted by Siemens Memcor has demonstrated a > 6 log removal of *B. megaterium* for a polypropyelene 0.2 micron microfiltration system "*Demonstrating the Integrity of a Full Scale Microfiltration Plant Using a Bacillus Spore Challenge Test"*

	Memcor L20V		• Membrane filtered water turbidity – continuous integrity testing.	Trimboli et al. This study was conducted on a drinking water installation with higher flux rates and also a lesser fouling layer than would be expected for the Western Corridor applications, and thus could be considered a more stringent test. Singapore's NEWater demonstration plant demonstrated a > 4 log removal for Faecal Coliforms, Enterococci & Clostridium Perfringes. *Extract from the Expert Panel's Report on the Singapore NEWater Study, June 2002.* The NEWater demonstration plant is a similar design to membrane portion of the Western Corridor Plants. Both of these examples were for polypropyelene membranes of 0.2 micron nominal pore size, in contrast to the higher 0.08 micron particle nominal pore size of the L20V membrane used at Gibson Is and Bundamba.
		Protozoa		State of California Department of Health 4 log removal credit for Cryptosporidium and Giardia . Memcor Warranty: PDT < 3.5 kPa/min for year 1, <5 kPa/min for year 2-3. (CCP alert and critical limits are set at each plant to ensure 4 log removal of 3 micron particle as per ASTM D6938-03, "Standard Practice for Integrity Testing of Water Filtration membrane Systems". Actual PDT limits are dependent upon MF unit configuration, filtrate volumes and minimum unit flow setpoint
		Viruses		State of California Department of Health 1.5 log removal credit for Viruses. Memcor Warranty: PDT < 3.5 kPa/min for year 1, <5 kPa/min for yea 2-3. "*Validation and Operational Monitoring for Virus Removal by Membrane Filtration*" McCormick, Zha et al. This paper demonstrates a 3.0 log virus removal for like membrane material and further correlates virus removal to PDT result.

	Microfiltration (Luggage Point) Pall Microza UNA 620	Bacteria	• Membrane Pressure Decay Test (PDT) – indirect integrity testing. • Membrane filtered water turbidity – continuous integrity testing.	Challenge test work for the Siemens system (Trimboli et al) showed a > 6 log removal of B. Megaterium for a microfiltration membrane of 0.2 micron nominal pore size. The similar results from the Singapore NEWater study were for this same membrane configuration. While this membrane was a different model to the Pall UNA 620 module, it has the same nominal pore size. Similarly, it uses the same ASTM pressure decay integrity test method to verify the level of integrity. Given these similarities, the membrane is expected to have at least the same level of removal as seen in Singapore.
		Protozoa		State of California Department of Health log removal credit for Cryptosporidium and Giardia = 4. Pall Warranty 4.5 kPa per 5 minute test.
		Viruses		State of California Department of Health log removal credit for viruses = 0.5.
CCP9	Reverse Osmosis	Bacteria	• On line conductivity (surrogate).	Practically, the RO unit is likely to remove all remaining bacteria. However, we are limited to validate according to the resolution of the integrity surrogate. The membrane integrity is monitored on line with conductivity, a method which can only demonstrate a log removal in line with membrane salt rejection – in the order of 1.0 to 1.5. A 2 log conductivity reduction will not be achieved for the RO system, hence log reduction will be assessed at slightly less than 1.5 log, or as demonstrated during the test. Use of TOC may be used as an on line measurement that will have a slightly higher resolution to provide a demonstration of 2 log removal.

				Bacterial regrowth (measured as total coliforms and HPC) is possible from contamination regrowth in downstream processes. Given a chloramine residual through the RO membranes at all times, along with a downstream UV process, this is not considered a substantial risk.
		Protozoa		USEPA SWTR Guidance Manual (1991) states that "Reverse Osmosis is a membrane filtration method used to remove dissolved solids from water supplies…..Credit can be given for at least a 3-log Giardia cyst and 4 log virus removal, with no demonstration. It should be noted that this removal credit assumes the membranes are in tact with no holes in the membranes allowing for the passage of organisms". The membrane integrity is monitored on line with conductivity, a method which can only demonstrate a log removal in line with membrane salt rejection – in the order of 1.0 to 1.5. A 2 log conductivity reduction will not be achieved for the RO system, hence log reduction will be assessed at slightly less than 1.5 log, or as demonstrated during the test. Use of TOC may be used as an on line measurement that will have a slightly higher resolution to provide a demonstration of 2 log removal. Table 4.9 of draft AGWR2 provides an indicative removal of > 6.0 log for enteric pathogens and indicator organisms (including viruses).
		Viruses		Montgomery Watson Harza proved 5 log removal of viruses through challenge testing of Koch HR membrane Adham et al , 2006.
		Endocrine disruptors		Published information: Snyder et al (2007) – removal > 80% (including: • Estradiol • Estriol

				• Estrone • Progesterone) AGWR2 (2007) – removal >90% Drewes et al (2005) – removal of > 80% demonstrated at West Basin WRP and Scottsdale Water Campus, specifically: • 17ß-Estradiol • Estriol • Testosterone
		Pharmaceuticals, herbicides and pesticides		Published information Snyder et al (2007) – removal > 80%. Specifically: • Diazepam • Caffeine • DEET • Ibuprofen • Triclosan AGWR2 (2007) – removal>90% for most products.
CCP10	Advanced Oxidation	Cryptosporidium & Giardia	UV dose – relate to log reduction value	USEPA long term surface water treatment rule allow 4 log removal at UV intensity of 22 mJ/cm^2 for low pressure UV lamps at 254 nm. Note that the LT2 ESWTR provides 4-log Crypto credit for this laboratory-scale dose. For full-scale UV applications, this laboratory-scale dose must be achieved by a validated full-scale reactor Reduction Equivalent Dose (RED) for a challenge organism, and the full-scale dose divided by the Validation Factor (VF) must be >/= 22 mJ/cm^2. The VF accounts for full-scale reactor factors such as hydraulics, monitoring, and validation process.

				The UV system for the Western Corridor Scheme has been designed for advanced chemical oxidation, and has UV doses far in excess of those used for disinfection. (A typical dose is 500 mJ/cm^2). Hence validation for bacteria and protozoa removal is not warranted. Validation of micro-organism removal was conducted using an identical UV reactor on the Orange County Groundwater Replenishment System (*Trojan Technologies, 2004*).
		Viruses		USEPA LT2 ESWTR allow 4 log removal at UV intensity of 186 mJ/cm^2 for low pressure UV lamps at 254 nm. Minimum 4.4 log reduction of MS2 phage for single reactor operation at 5 MGD (19 MLD). "Orange County Groundwater Replenishment System – Demonstration UV Disinfection and Oxidation System (*Trojan Technologies, 2004*)." Minimum operation of 8 log virus if running minimum of 2 reactors in series.
		NDMA	Electrical energy per unit volume per log order NDMA destruction. Monitor ratio between actual power vs power required.	Vendor guarantee to get 1 – 1.2 log removal for NDMA if power required = power delivered. (Different log removal negotiated by different alliances). 96 % NDMA removal proven during Purified Water Monitoring Program at Bundamba 1A AWTP. Published information: Linden (2007) 90% removal at UV dose of 550 mJ/cm^2 > 1.2 log reduction in NDMA validated for 4 of 6 reactors at Orange County Groundwater Project. "Orange County Groundwater Replenishment System – Demonstration UV Disinfection and Oxidation System (*Trojan Technologies, 2004*)."
		Endocrine disruptors		Published information provided for reference only. AOP will not be validated for these parameters.

				Snyder et al (2007) – removal > 80% except androsterone – 50-80% removal.
		Pharmaceuticals, herbicides and pesticides		Published information provided for refrence only. AOP will not be validated for these parameters. Snyder et al (2007) – removal > 80% for most, some 50-80%
CCP 12	Chlorination	Bacteria	Residual Concentration X contact time (CT). A minimum free chlorine value is monitored according to a minimum retention time in each treated water storage.	
		Protozoa		Table 2-13 USEPA Alternative Disinfectants and Oxidants Guidance Manual 3 log giardia removal is 104 mgmin/L.
		Viruses		Table 2-13 USEPA Alternative Disinfectants and Oxidants Guidance Manual 3 log virus removal with CT of 4 mgmin/L and CT of 6 mgmin/L.

The table below provides a summary of the log reductions that will be validated across the AWTPs. It should be noted that the actual log removal across most of these barriers is higher than that stated below, however the values proposed are those which can actually be validated for the process using on line measurements or surrogates.

Details for each barrier are discussed in the relevant process sections below.

Table 3 - Summary of Micro-organism Log Reductions

Process Step	Log Removal Credit Viruses – Luggage Point AWTP	Log Removal Credit Viruses – Gibson Island And Bundamba AWTPs	Log Removal Credit Bacteria	Log Removal Cryptosporidium/Giardia
Microfiltration (Memcor L10V)		3.0	4	4
Microfiltration (Pall Microza UNA 620)	0.5		4	4
Reverse Osmosis	1	1	1	1
Advanced oxidation	8	8	4	4
Chlorination[1]	0	0	0	0
Total	**9.5**	**12.0**	**9**	**9**
Required Log Removal (source : AGWR2)	**9.5**	**9.5**	**8**	**8**

The log removals as required by AGWR2 are intended for the entire scheme, from the inlet to the sewage treatment plant through to the purified recycled water at the AWTP. This validation plan has taken a conservative approach and attempted to meet the log requirements within the AWTP given the appropriateness of instrumentation within the plant.

1. Chlorination had been considered as critical control point (CCP) to monitor as a treatment barrier at the AWTP. However, due to the difficulties of operation at the AWTP, this will no longer be considered for validation of the AWTP. Chlorination will be required at each AWTP to achieve treated water quality requirements with respect to total nitrogen, thus a free chlorine residual will be achieved at each plant's treated water tank. As such, consideration can be given to a chlorine residual in the delivery pipeline to the Wivenhoe release for additional log credits for microbiological removal.

2.2.1 BARRIERS NOT CONSIDERED

A very conservative approach to validation has been undertaken, particularly in terms of virus removal. There are additional process barriers within the plant which was have not considered for validation. This is to ensure the validation process is not overcomplicated. They include:

- Chloramination

  Chloramination is employed at the AWTPs to provide a disinfection residual through the membrane systems (both RO and UV) to minimize biological fouling. The chloramine will also provide a level of disinfection for virus and bacteria. Chloramine is a relatively weak disinfectant compared with free chlorine and despite longer residence times we have elected not to consider it for validation purposes. To consider it would require a CCP for chloramine control and an accurate assessment of contact time through the process.

- Coagulation and Clarification

Coagulation and Clarification is used at the AWTPs to remove phosphorus. The clarification process will also provide some removal of virus, bacteria and protozoa. We have elected not to use the clarifier for validation as the log credit will be minimal and the CCP may be more difficult to maintain than other barriers, especially considering possible solids carryover events.

These additional barriers will provide further redundancy in the AWTP for pathogen reduction.

2.2.2 ESTIMATED LOG REMOVALS

The validation process relies on online verifiable results to demonstrate a log removal across a process barrier. Many of these barriers actually can perform significantly better than we can demonstrate as we are limited by the resolution of available instrumentation. The chart below provides a summary of the estimated log removals that each barrier is likely to actually achieve. Note that we have included in this case some barriers that are not considered as part of our validation work (as described above) yet will in fact provide some removal.

Table 4 - Estimated Log Removals for Barriers

Process Step	Log Removal Credit Viruses – Luggage Point AWTP	Log Removal Credit Viruses – Gibson Island And Bundamba AWTP	Log Removal Credit Bacteria	Log Removal Cryptosporidium/Giardia
Chloramination[1]	1	1	1	1
Coagulation and Clarification[2]	1	1	2 - 3	2 - 3
Microfiltration (Memcor L10V)		3.0	> 6	> 6
Microfiltration (Pall Microza UNA 620)	0.5		> 6	. 6
Reverse Osmosis	5 - 6	5 - 6	> 6	> 6
Advanced oxidation	8 - 16	8 - 16	8 - 16	8 - 16
Chlorination (Treated Water Tank)[3]	4	4	4	3
Chlorination (Pipeline)[3]	**> 6 (to be determined)**	**> 6 (to be determined)**	**> 4**	**> 4**
Total	**25.5 – 34.5**	**28.0 – 37.0**	**31 – 40**	**30 – 39**

1. USEPA Alternative disinfectants and oxidants guidance manual Table 6.4 & 6.5
2. USEPA Alternative disinfectants and oxidants guidance manual Table 2.4
3. USEPA Alternative disinfectants and oxidants guidance manual Table 2.13 & 2.14

2.2.3 PRECOMMISSIONING VALIDATION – RAW WATER PUMP STATION AMMONIA

The Raw Water Pump Station CCP assumes that a breach in any of the on line analysed parameters is an indication that the WWTP process may not be operating correctly, hence removal of health parameters of concern at the WWTP may be compromised. The critical control point has been identified as ammonia concentration.

Ammonia has been selected as the WWTP nitrifying bacteria are considered very sensitive to process upsets. The key indicator of a process upset will be a rise in the level of ammonia from the plant as the performance of nitrification (conversion of ammonia to nitrate) is impacted.

There is no information on direct correlation between ammonia concentration and any health parameters, however we intend comparing performance against WWTP historical data.

Initial CCP values have been based on an assessment of historical performance data. During operation, the on line analyser based control point will be compared against composite sampled data from each of the pump stations to ensure that the raw water quality is not beyond the treatment capability of the plant, and to provide baseline performance data. In this respect, the actual values of critical and alert limits may be amended following the validation test.

Of secondary consideration is the direct impact on treatment of high levels of some of the following parameters:

- Nutrients (Nitrate, Phosphate) are surrogates for the biological performance of the WWTP.
- Turbidity is a surrogate for the solids removal capability of the WWTP (i.e. is the secondary sludge clarifier operational).
- TOC is an indicator of potential trade waste contamination.

These parameters are treated as critical operating points. While important for plant operation, they are not considered necessary for validation.

The CCP cannot be validated in the scope of the AWTP validation, as it is dependent on performance of upstream processes outside the scope of AWTP validation.

If the WWTP is in a bypass condition (for example during a storm event) then the removal of health parameters is also considered to be compromised. For this reason, bypass will be considered a trigger for CCP1 for AWTPs where bypass flow enters upstream of AWTP intakes.

2.2.4 PRECOMMISSIONING VALIDATION - MICROFILTRATION

The microfiltration system is designed to remove suspended matter from the water prior to the reverse osmosis system. In doing this, it improves the operability of the RO system by significantly reducing fouling. It also is able to provide a level of removal of bacteria , protozoa and viruses. The CCP is set at this point to monitor this removal of microorganisms.

The microfiltration system CCP includes two surrogate monitoring parameters:

- Pressure Decay Test (PDT)
- On line turbidity measurement of the MF filtrate.

PDT is by far a more sensitive test than turbidity with log reduction values of greater than 4 for particles of > 3 microns capable of being confirmed. The shortcoming of this test is that it is not continuous. Turbidity is capable of only verifying a log reduction of at best 2 log due to the limitations of feed turbidity and measurement accuracy of instrumentation in the filtrate. (Typical inlet turbidity of < 10 and outlet of 0.1 NTU turbidity = 2 log reduction). Turbidity does however have the advantage of being continuously on line. Turbidity will provide an indication only if there is a gross failure of the membrane system.

A summary of the critical control points for the MF is in the table below. The critical control point and response procedures are controlled documents which are housed in the Veolia IBMS system. Revision control is managed in this system, and the current revision may not be the one referenced below.

Table 5 - CCP 5 Summary

CCP	Alert Limit	Critical Limit
CCP 5	Combined filtrate turbidity > 0.15 NTU 95% of time > 2 hours	Combined filtrate turbidity > 0.45 NTU > 15 mins.
	Bundamba (Doc reference WI-GWA-WCB-2005-6 CCP 5 **)**	
	Pressure Decay Test	
	Daily pressure decay integrity test > 2.0 kPa/min for 2 consecutive tests.	Daily pressure decay test > 3.0 kPa/min
	Turbidity	
	Combined filtrate turbidity > 0.15 NTU 95% of time > 2 hours	Combined filtrate turbidity > 0.45 NTU > 15 mins.
	Gibson Is (Doc reference WI-GWA-WCG-2005-5 CCP 5 **)**	
	Pressure Decay Test	
	>2 kPa / minute for 2 consecutive	Daily pressure decay test >3.2 kPa /

	tests	minute
	Turbidity	
	Combined filtrate turbidity > 0.15 NTU 95% of time > 2 hours	Combined filtrate turbidity > 0.45 NTU > 15 mins.
	Luggage Point (Doc reference WI-GWA-WCL-2005-1 CCP 5 **)**	
	Pressure Decay Test	
	> 0.59 kPa/5 min	> 0.45 kPa/5 min
	Turbidity	
	> 0.05 NTU for > 2 hours	> 0.1 NTU for > 2 hours

The pressure decay test results for each plant will be calculated using ASTM 6908-06 "Standard Practice for Integrity Testing of Water Filtration Membrane Systems".

2.2.4.1 BACKGROUND – PRESSURE DECAY TEST AND LOG REDUCTION VALUES

Challenge tests are a valuable means of measuring membrane integrity, however microbiological testing is relatively slow and expensive and not practical for very large systems. To overcome this problem, the pressure decay test (PDT) has been developed..

The PDT is a method of direct integrity testing used to identify and isolate breaches in the membrane barrier. The test involves pressurizing one side of the membrane fibres with air and measuring the rate of pressure decay with the other side exposed to atmospheric pressure. Each vendor on the WCRWP utilizes a pressure decay test according to ASTM 6908-06 "Standard Practice for Integrity Testing of Water Filtration Membrane Systems". The test was developed as a means of demonstrating compliance with the US Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) for Cryptosporidium removal and as such has a resolution of 3 microns or less.

A methodology for converting the PDT test readings to a log reduction value is detailed in the USEPA Membrane Filtration Guidance Manual (Chapter 4). The test is based on the phenomenon that when a certain air pressure is applied to one side of an integral, fully wetted membrane (all membrane pores are filled with liquid) almost no air will pass through the membrane. This is because a minimum air pressure (the bubble point) is required to break the surface tension forces and displace the liquid.

Provided the air test pressure is below the bubble point, no air will escape from the pressurised side of the membrane except for a small flow that diffuses through liquid in the pores (diffusive air flow). If a leak or defect is present, air will displace the liquid and flow freely at this point, provided the defect size is not so small that the applied test pressure cannot overcome the surface tension forces.

A membrane's bubble point and hence the test pressure required to demonstrate a 3 micron compliance is calculated from the Bubble Point Equation (USEPA Membrane Filtration Guidance Manual Equation 4.1).

$P_{test} = (4*k*\sigma*Cos(\theta))/d + BP_{max}$ .... *Guidance Manual Equation 4.1*

Where:

P_{test} = minimum test pressure in kPa
K = pore shape correction factor (dimensionless)
σ = surface tension at the air-liquid interface (dynes/cm)
θ = liquid-membrane contact angle (degrees)
BP_{max} = maximum backpressure on the system during the test (kPa)
d = defect diameter in microns

Figure 1 - Membrane Filtration Guidance Manual Equation 4.1

As the diameter decreases, the bubble point pressure increases.

It is possible to estimate the log reduction value for a membrane unit using the bubble point principle. This is detailed in Chapter 4 and Appendix C of the USEPA Membrane Filtration Guidance Manual.

The log reduction is based on an estimate of the flow that will bypass the membrane barrier through the breach. The log rejection is then simply the ratio between the filtrate bypass flow and the membrane unit filtrate flow.

$LRV = Log_{10}(Q_{fil}/Q_{bypass})$

Where

LRV = Log reduction value
Q_{fil} = Filtered Water flow rate
Q_{bypass} = Bypass flow rate.

The exact calculation used to determine the Qbypass flow is a fuction of the particular system design including unit module and pipe volumes, operating membrane differential pressure and nominal membrane pore size. The exact formulas required to relate log reduction value for the MF systems will be supplied by the system vendors.

The LRV calculated from each pressure decay test will be reported on the AWTP plant SCADA.

2.2.4.2 RELEVANT ACCREDITATION

There are two different microfiltration systems that will be used on the Western Corridor Scheme:

- Siemens Memcor L20V – Bundamba and Gibson Island
- Pall Microza UNA 260 – Luggage Point

The California Department of Health Services (CDHS) is considered a benchmark for log removal accreditation. The following accreditations are relevant because they refer to systems using the same membranes as used in the MF systems at Western Corridor.

Table 6 - MF Accreditation Summary

Plant	MF Membrane Modules	Relevant Accreditation
Bundamba/Gibson Island	Siemens: Memcor L20V[1]	• 4 log credit for cryptosporidium and giardia • 1.5 log credit for virus. • Credit dated 17th June 2008
Luggage Point	Pall: Microza UNA 620	• 4 log credit for cryptosporidium and giardia • 0.5 log credit for virus • Credit dated 19 July 2004.

1. CDHS letters of accreditation for both systems have been included in the appendices.

2.2.4.3 ADDITIONAL VALIDATION OF VIRUS REMOVAL – SIEMENS MEMCOR SYSTEMS.

While the ASTM standard PDT test is valid for 3 micron particles, recent work by Siemens Water Technologies have demonstrated that virus reduction can also be deduced from the PDT result, given an accredited virus log removal value.

A series of MS2 phage challenge tests were conducted on a secondary effluent application near Sydney which demonstrated a minimum virus log reduction of 2.99 for PVdF membrane (model L10V). This was from a series of 6 test runs at different levels of membrane fouling. "*Validation and Operational Monitoring for Virus Removal by Membrane Filtration*" McCormick, Zha et al. These challenge tests differed from the CDHS accreditation provided in section 2.2.2.2 above in that these tests were conducted on a secondary effluent, whereas the CDHS tests were conducted on a surface water.

The challenge test was operated at a feed turbidity of between 1.2 and 5.4, an average flux of 70 LMH and a TMP of between 17.7 kPa and 58 kPa. The Gibson Is and Bundamba units will operated at a more conservative flux (max of 44 LMH). This lower flux results in a more stringent PDT test requirement to achieve the LRV of 4. The feedwater quality conditions are broadly similar, with slightly lower turbidities expected at Western Corridor.

Challenge testing was performed for L10V modules. The L10V modules on the challenge test unit are different to the L20V modules used at Gibson Is and Bundamba in only the following respects:

- An increased module length from 1.1 meters to 1.8 meters.
- An increase in the fibre diameter from 0.8 mm to 1.8 mm to accommodate a larger lumen to reduce pressure losses due to the longer length.
- An increase in the fibre wall thickness, which provides greater structural strength.
- A decrease in the number of fibres per module to accommodate the increased fibre diameter.

It has been granted the same log credit removal for virus, cryptosporidium and giardia as the L10V by the California Dept of Public Health.

(Source: Letter *California Dept of Public Health* Conditional Acceptance of the Memcor® L20V Ultrafiltration Membrane.)

The pressure decay integrity test does not provide a certain LRV for particles smaller than 1 to 2 microns such as viruses. However, the Siemens paper has shown that the system log reduction for any pathogen that is small enough to pass through the sum of all breaches is indepent of breach size. This log reduction can be calculated by knowing the log credit awarded to the system (from a challenge test) and the flow through breaches of a size that can be determined by PDT.

For a system with 3.0 log virus removal shown from challenge testing, there is minimal change in rejection of virus as the pressure decay test result increases (refer chart below).

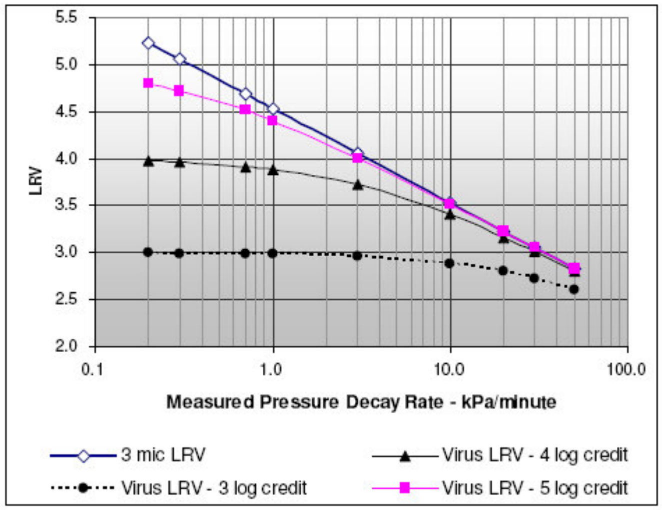


Figure 10 - Loss in virus LRV from flow through detected defects

Figure 2 - Siemens/Memcor Virus Log Removal for Change in PDT
Source: “*Validation and Operational Monitoring for Virus Removal by Membrane Filtration*” McCormick, Zha et al.

There is potential bypass possible for defects too small for the pressure decay test to detect but large enough for viruses. McCormick et al have shown the relationship for the number of defects per mm of fibre length to cause a 1 log drop in virus rejection (refer chart below). While it is not possible to measure defects less than PDT resolution, it is assumed that large numbers of small holes are unlikely to occur.

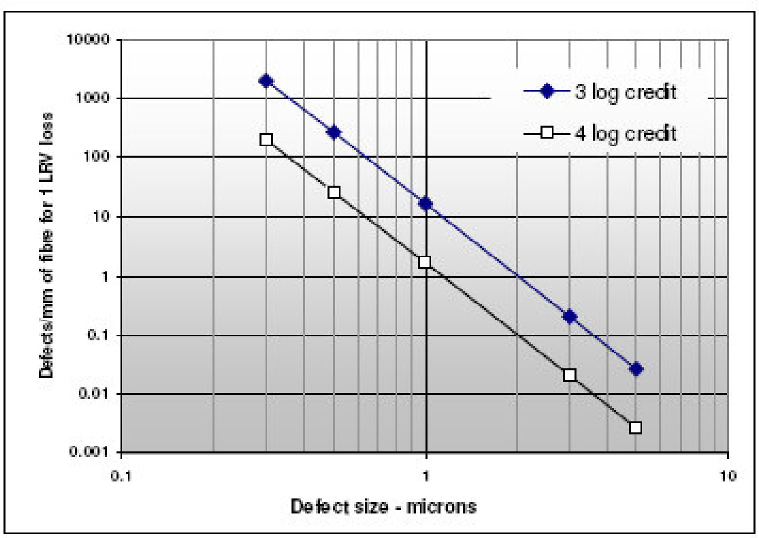


Figure 9 – Defects required to generate 1-log loss in virus rejection

Figure 3 - Siemens/Memcor Defects Required to Generate 1 log loss in virus rejection. Source: “*Validation and Operational Monitoring for Virus Removal by Membrane Filtration*” McCormick, Zha et al.

As shown by McCormick et al, In practice for a virus log credit of 3, the PDT measured LRV for 3 micron particles should not drop below 4.1. We have rounded this level to an LRV result of 4.0.

This information became available in May 2008 and is hence a new addition to this draft of the precommissioning validation.

2.2.4.4 MANUFACTURER'S WARRANTIES

Manufacturer's warranties are applied to both of the membrane systems. The warranties provided are as follows:

Table 7 - Membrane Manufacturers Warranty

Plant	Warranty Condition	
Bundamba	Year 1 < 3.5 kPa/min LRV = approximately 4.0[1]	Year 1 – 7 < 5.0 kPa/min LRV = approximately 3.8[1]
Gibson Island	Year 1 < 3.5 kPa/min	Year 1 – 7 < 5.0 kPa/min
Luggage Point	4.5 kPa per 5 minute test LRV = approximately 4.0[1]	4.5 kPa per 5 minute test LRV = approximately 4.0[1]

Note 1: Where pressure decay test results are used, the actual LRV for that figure will vary depending on membrane unit flowrate and membrane differential pressure. This calculation will be performed on the plant SCADA and reported during the commissioning validation test.

2.2.4.5 CONCLUSION MF PRECOMMISSIONING VALIDATION

The MF system will be validated primarily using pressure decay testing according to ASTM 6908-06 "Standard Practice for Integrity Testing of Water Filtration Membrane Systems". These tests have been or will be an automated sequence for all three AWTPs. All three systems will be maintained at a log reduction value (LRV) of 4.0 for 3 micron particles, which is representative of Cryptosporidium.

Virus removal log credit for the Pall system at Luggage Point is 0.5 log as accredited by California Department of Health.

It is recommended that the Siemens/Memcor systems at Bundamba and Gibson Island be credited with 3.0 log virus removal based on the recent work discussed in section 2.2.4.3.

2.2.5 PRECOMMISSIONING VALIDATION - REVERSE OSMOSIS

The reverse osmosis (RO) system is designed to remove the majority of dissolved substances both to meet the requirements of industrial customers, and also to ensure removal of most of the PRW health parameters of concern including:

- Dissolved metals
- Dissolved organic compounds such as pharmaceuticals, personal care products, endocrine disrupting compounds and hormones.
- Some level of viruses.

RO is primarily a process for the removal of dissolved salts. Consequently, it uses the surrogate parameter of conductivity as a metric of the rejection of dissolved salts, and also to monitor the integrity of the RO membrane barrier. The CCP for this process is as follows:

Table 8 - CCP9 Summary

CCP	Alert Limit	Critical Limit
CCP 9	**Bundamba AWTP** (WI-GWA-WCB-2009-3)	
	RO train specific conductivity > 100 uS/cm	RO train specific conductivity > 150 uS/cm
	Gibson Is AWTP (WI-GWA-WCG-2009-5)	
	RO train specific conductivity > 50 uS/cm	RO train specific conductivity > 80 uS/cm
	Luggage Pt AWTP (WI-GWA-WCL-2009-1)	
	RO train specific conductivity:[1] 100 uS/cm when RO feed conductivity < 3000 uS/cm 120 uS/cm when RO feed conductivity > 3000 uS/cm	RO train specific conductivity > 150 uS/cm 150 uS/cm when RO feed conductivity < 3000 uS/cm 170 uS/cm when RO feed conductivity > 3000 uS/cm

1. Luggage Pt AWTP has significant fluctuations in feed conductivity which may make the use of a single RO unit permeate conductivity setpoint difficult to use in practice. During the validation test, it will be determined if this setpoint, or alternatively a log removal of conductivity across the system is more applicable. Both will be reported in the commissioning validation test report.

The major limitation of conductivity is that it is limited in its ability to measure membrane integrity in terms of micro-biological removal, particularly viruses. Challenge test studies (refer to section 2.2.5.3 below) have shown that RO can achieve a better than log 5.0 rejection, however there is no on line surrogate or automatic integrity test with the resolution to demonstrate this rejection in the field.

Conductivity measurement can only verify a removal according to the rejection of salts. For wastewater applications such as at Western Corridor, this is likely to be in the range of 95% to 97% rejection (i.e. 1.3 to 1.5 log). For validation, the intent is to demonstrate 1.0 log removal, hence a 1.0 log removal for all microbial constituents.

A more sensitive potential surrogate is on line total organic carbon (TOC). This may provide a resolution to 2 log. Experience at the NewWater plants in Singapore has shown that TOC on RO permeate typically operates in the range of < 100 ppb. Given a typical feed concentration of 10 mg/L (10,000 ppb) this equates to a log 2 removal. At the time of writing this report, the TOC meters at Bundamba have not proven suitably reliable to operate as a critical control point and hence will be quarantined from the validation test. Follow up work may allow a re-validation of the RO system demonstrate log 2 removal.

Gibson Is and Luggage Pt will be equipped with TOC instrumentation as used on the Singapore plants (GE Sievers 900 on line TOC analyser).

During the early period of plant operation, the instruments will be logged to gather baseline data, with a view to incorporation of TOC as a critical control point. It is anticipated that this work will take in the order of 3 to 4 months.

2.2.5.1 BACKGROUND – RO SYSTEM DISSOLVED ORGANIC REMOVAL

RO is a process designed for the removal of dissolved salts from a membrane. It is generally accepted as removing salts according to a solution-diffusion model whereby each component in a pressurised solution dissolves into the membrane. The flow of water and the flow of salt are independent of each other, with water flowing much faster through the membrane. (Water flow is governed by membrane differential pressure, whereas salt transport is governed by membrane differential concentration).

The RO membranes are operated such that a cross flow is employed to flush salts past the membrane surface while allowing water to pass through.

The rejection of dissolved organic chemicals is more complex.and is determined by complex interactions between the dissolved substance, the water and the membrane itself.

The three mechanisms by which an organic molecule may be rejected by the RO membrane include:

- Size exclusion – a sieving process for which molecular size or geometry prevents large molecules from passing through the dense molecular structure of the membrane surface. This is believed to be the dominant retention mechanism for relatively large organic molecules such as hormones, most pharmaceuticals, proteins and other molecules with a molecular weight greater than 200 atomic mass units.
- Electrostatic Properties – a highly charged molecule is removed by electrostatic repulsion which does not allow the molecule to permeate the membrane.
- Hydrophobic adsorption – by which molecules are adsorbed on to the surface of the membrane but do not permeate.

While some work has been done to predict the rejection of various dissolved organic molecules, the final concentration in the RO permeate is dependent on the configuration of the membrane unit, the type of membrane, the membrane surface charge and molecular weight cut off. Of equal importance are operating conditions such as pressure, membrane flux and pH. Equally, membrane fouling, which occurs to some degree in normal operation, will also play a part in the rejection of certain molecules.

(Above taken from G Leslie, S Khan. *Advanced Water Treatment Technologies*. In T. Gardner, C. Yeates & R Shaw (Eds) *Purified Recycled Water for Drinking: The Technical Issues*, Queensland Water Commission).

2.2.5.2 PLANT FULL SCALE STUDIES – ORGANIC REMOVAL

The rejection of organic micropollutants has been conducted at various facilities in similar recycling plants around the world. In the US, testing was conducted on the full scale facilities at West Basin, CA and Scottsdale AZ. Both of these plants will operate at similar flux rates and recoveries as on this scheme. Targeted compounds were present in the feedwater for both plants, and following a sampling campaign conducted over 24 hours, there were no quantifiable detections for any target compound except for low concentrations of caffeine at one facility (*Rejection of Wastewater Derived Micropollutants in High Pressure Membrane Applications Leading to Indirect Potable Reuse* Drewes et al 2005)

Additional work conducted at California's Water Factory 21 in the mid 1990s, thin film composite membranes were shown to be very effective at removing so called "wastewater signature compounds." These compounds are derivatives of chemicals commonly used in foods and detergents and include Ethylenediamine tetraacetic acid (EDTA), Nitriloacetic acid (NTA), naphthalene dicarboxylate (NDC) and total alkylphenol polyethoxy carboxylates (APEC).

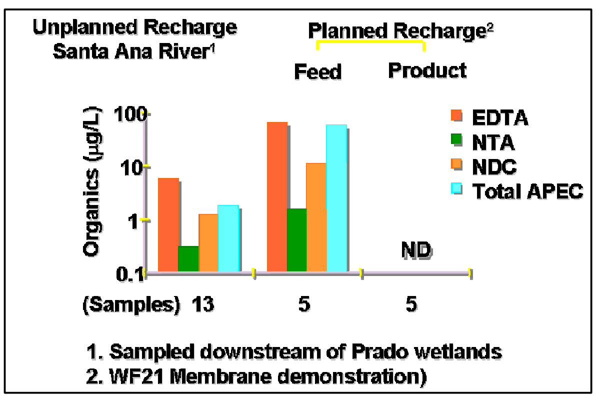


Figure 4 - Wastewater Signature Compounds - Water Factory 21

2.2.5.3 RO MICROBIOLOGICAL RELEVANT ACCREDITATION

Table 4.9 in the AGWR2 provides an indicative a 6 log removal efficiency by reverse osmosis for all micro-organisms.

Work carried out at San Diego in 2000 and later in Orange County showed that MS2 phage removal over RO membranes varied from 4 – 6 logs. Challenge tests carried out in Singapore in late 2000 on membranes that were some 7 months old, showed MS2 removals of 4 -5 logs.

A further pilot study by Montgomery Watson Harza in 2006 in San Diego demonstrated a 5 log removal through challenge testing of a Koch TFC-HR membrane using MS2 Phage.

CDHS has granted the Groundwater Replenishment Project combined microfiltration and reverse osmosis process log 2 removal credit for virus only. This is because there is no suitable surrogate parameter that can be used to demonstrate membrane integrity over the life of the membrane other than conductivity and TOC..

2.2.5.4 MANUFACTURER'S WARRANTIES

The manufacturer's warranties for the WCRWP AWTPs do not provide for levels of treated water dissolved organics or virus removal. Rather, the warranties are based upon total dissolved solids (measured via the surrogate of conductivity) and nutrient parameters (Nitrogen and Phosphorus). Consequently, it can only be inferred that the RO membrane system will remove other dissolved species consistent with performance at other similar facilities, based on the level of membrane rejection performance required to meet the parameters that are warranted. The nitrogen levels warranted at the plant (0.8 mg/L as N in the first year, 1.2 mg/L as N thereafter) are quite stringent, and hence the membrane integrity will be maintained sufficiently to meet that parameter.

2.2.5.5 CONCLUSION RO PRECOMMISSIONING VALIDATION

The RO system is will remove the majority of dissolved organic micropollutants of concern and also likely most viruses. However, we are limited in using on line conductivity as a surrogate parameter for the critical control point for the first stage of validation . Commissioning verification will require provide a confirmation of the membrane integrity via conductivity montoring. Treated water testing during the performance verification (as part of commissioning verification) will be used to confirm that micropollutants are indeed removed sufficiently at this level of membrane integrity.

The microbial log removal will be credited for each plant based on the removal of conductivity across the RO system. TOC analysers will be established to potentially replace or enhance this CCP once a baseline has been established.

2.2.6 PRECOMMISSIONING VALIDATION – ADVANCED OXIDATION

The advanced oxidation systems will be installed at the AWTPs to remove NDMA and 1-4 dioxane, micropollutants which are not well rejected by the reverse osmosis system.

In utilizing UV radiation, the AOP system will also provide a significant barrier to micro-organisms, in particular viruses.

The systems are required to achieve a removal of 1.0 log removal (1.2 at Luggage Point) of NDMA and 0.5 log removal of 1,4 dioxane.

Advanced oxidation works with a combination of low pressure UV radiation coupled with a dose of hydrogen peroxide. The UV light destroys the NDMA nitrogen bond by photolytic reaction, and the hydrogen peroxide adds scavenging hydroxyl radicals to the water which oxidize the 1,4 dioxane and prevents reformation of the NDMA molecule.

The CCP for advanced oxidation is as follows:

Table 9 - CCP10 Summary

CCP	Alert Limit	Critical Limit
CCP 10 All AWTPs	Present Power Ratio < 100% for > 10 mins	Present Power Ratio < 90% for > 10 mins
	Hydrogen peroxide dose flow +/- 20% of flow setpoint for > 10 mins	Hydrogen peroxide dose flow +/- 50% of setpoint for more than 10 mins
	6 or more lamps failed on an individual reactor	30 or more lamps failed on an individual reactor (this will initiate train shutdown)
	CCP Response Procedures: Bundamba: WI-GWA-WCB-2010-3 Gibson Is: WI-GWA-WCG-2010-5 Luggage Pt: WI-GWA-WCL-2010-1	

2.2.6.1 BACKGROUND – EEO AND PRESENT POWER RATIO

The EE/O is the Electrical Energy per Order used to design and validate a UV system. It's a metric defined as the number of kilowatt hours of electrical energy required to reduce the concentration of a contaminant by one order of magnitude (90% removal) in one cubic meter (or thousand gallons) of water.

EE/O values [in kWh/m^3/order] can be calculated using the following formulas:

$$EE/O = \frac{1000Pt}{V\log(Ci/Cf)}$$ batch operation

$$EE/O = \frac{P}{F\log(Ci/Cf)}$$ flow-through operation

Where *P* is the rated power (kW) of the Advanced Oxidation Process (AOP), *V* is the volume of water (L) treated in the time *t* (h), *Ci* and *Cf* are the initial and final concentration (mol/L) of the pollutant, and *F* is the water flow rate (m^3/h).

This equation assumes a first order kinetics, that is, log (Ci/Cf) = $0.4343k_1t$ where t (min) is the reaction time in the reactor and k_1 is the first order rate constant (min^{-1}) for the pollutant decay in the UV reactor.

The EE/O is both contaminant- and reactor-specific. It's the main parameter used for design and validate the UV system.

Considering assumptions made in the kinetic and fluence rate distribution models, Bolton [(J.R. Bolton and M.I. Stefan, *Fundamental photochemical approach to the concept of fluence (UV dose) and electrical energy efficiency in photochemical degradation reaction*, in : Res. Chem. Intermed. Vol 28, No 7-9, pp 857-870 (2002)] was able to use this equation to theoretically establish the relation between EE/O and UV fluence (dose) for laboratory-scale UV reactors, where, the investigated system can be regarded as an "ideal system".

However, large-scale systems present significant complexities to modelling. In order to predict the reactor performance for contaminant destruction, one must have thorough knowledge of many empirical conditions, such as the detailed nature of the fluid flow and mixing of the fluid throughout the reactor, the spatial distribution of light within the reactor (this will be affected by the lamp types, power level and age of the lamps, transmission and fouling of the quartz sleeves, light absorbance and scattering properties of the water) and, when combined with H_2O_2, the oxidant concentrations as a function of location within the reactor [S.Parsons, in : *Advanced Oxidation Processes for Water and Wastewater Treatment*, IWA Publishing)]. Almost all these variables are reactor-specific.

The EEO for the Western Corridor AWTPs have been determined by the vendor in consultation with the three alliances. These figures have been based on previous validation work in the US (see section 2.2.3.2 below) and in the case of Luggage Point, computational fluid dymanic modeling.

The EEO and design basis for each AWTP are shown in the table below.

Table 10 - AOP Design Summary

Plant	EE/o (kWh/order/kgal) New lamps – old lamps	% Minimum design Transmittance	End of Lamp Life Factor % new lamp intensity	Lamp Fouling Factor	Log_{10} reduction	Max Inle NDMA c ppt
Bundamba	0.24 – 0.33	95	90	0.8	1.0	50
Gibson Island	0.25 – 0.29	95	92	1.0	1.0	50
Luggage Point	0.29 – 0.37	95	80	None[1]	1.2	80

Note 1 – Lamp fouling factor accounted for in End of Lamp Life Factor for Luggage Point design.

The control system utilized at the AWTPs is based on the EE/O and Electrical Energy Dose (EED). The target EE/O for the system is calculated given the measured UVT. The target EED is calculated by dividing the EE/O value by the target log reduction and has units of kWh/kgal. The measured flow rate is then used to calculate a target power, in kW, for the train which is then used to determine how much UV energy is required for NDMA treatment.

The critical control point for the UV system is the Present Power Ratio (PPR) which is the ratio of actual operating power to the target power. The UV control system is designed to operate the UV system above a power ratio of 100% to ensure there is sufficient treatment.

2.2.6.2 SIMILAR PLANT VALIDATION

Validation testing for NDMA removal was conducted by the UV system vendor at the Orange County Water District Demonstration Plant in July 2004. [(Trojan UV, *Orange County Groundwater Replenishment System – Demonstration UV Disinfection and Oxidation System – Performance Validation Report* (2004)].

The EE/o values resulting from this system testing averaged approximately 0.25 kWh/kgal/order for new lamps. The ability of the system to destroy NDMA was determined by measuring the log reduction of NDMA concentration after passing through the UV system. The variables studied included flow rate, hydrogen peroxide concentration and the number of reactors powered on. NDMA was spiked into the feed sample to ensure sufficient NDMA in the feed to accurately determine log reduction across the system.

The trial utilized the same reactor as used at all the Western Corridor AWTPs with the following results:

Table 11 - Orange County Trial Result Summary

Parameter	Result
Design Flow Rate	19.6 MLD
UV Transmittance	95%
End of Lamp Life output factor	80% of new lamp intensity
Log Reduction	1.2 order
EEO	0.25 kWh/kgal/order (average for tests)

2.2.6.3 UV – MICROBIOLOGICAL DISINFECTION

The AOP process will provide a disinfection barrier for any virus and bacteria.

The USEPA guidelines accredit UV systems for different log inactivation of giardia and cryptosporidium based on various UV doses.

Table 1.4. UV Dose Requirements – millijoules per centimeter squared (mJ/cm^2) [1]

Target Pathogens	Log Inactivation							
	0.5	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
Cryptosporidium	1.6	2.5	3.9	5.8	8.5	12	15	22
Giardia	1.5	2.1	3.0	5.2	7.7	11	15	22
Virus	39	58	79	100	121	143	163	186

[1] 40 CFR 141.720(d)(1)

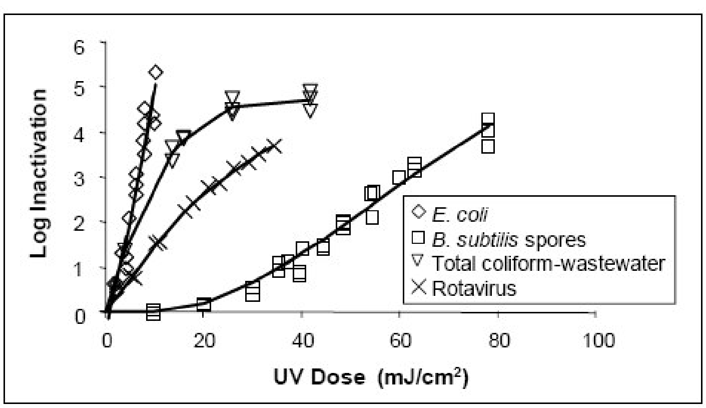
Figure 5 - USEPA Log Inactivation for UV dose ULTRAVIOLET DISINFECTION GUIDANCE MANUALFOR THE FINAL LONG TERM 2 ENHANCEDSURFACE WATER TREATMENT RULE

Note that the LT2 ESWTR provides 4-log Crypto credit for this laboratory-scale dose. For full-scale UV applications, this laboratory-scale dose must be achieved by a validated full-scale reactor Reduction Equivalent Dose (RED) for a challenge organism, and the full-scale dose divided by the Validation Factor (VF) must be >/= 22 mJ/cm^2. The VF accounts for full-scale reactor factors such as hydraulics, monitoring, and validation process

However, the USEPA figures in this application are very conservative, and do not take into account the impact of the RO process upstream. A UV system downstream of RO at Bedok, one of the Singapore Newater projects gave a 4.0 log removal of MS2 phage on RO permeate at a dose of 90 mJ/cm^2.

Similarly, inactivation of E.Coli and other bacteria is expected to be well above 4.0 log inactivation at UV doses above 100 mJ/cm^2 (refer to graph below).

Figure 2.8. Shapes of UV Dose-Response Curves



Source: Adapted from Chang et al. (1985)

Figure 6 - UV Dose Response for Selected Bacteria Source: **ULTRAVIOLET DISINFECTION GUIDANCE MANUAL FOR THE FINAL LONG TERM 2 ENHANCED SURFACE WATER TREATMENT RULE**

The UV dose for advanced oxidation is very high compared with a typical disinfection dose. The predicted dose ranges are typically in the range of 450 – 800 mJ/cm^2. On this basis, a log 4.0 inactivation of viruses, bacteria, cryptosporidium and giardia will be easily achieved. As the AOP system delivers significantly higher doses of UV radiation, the USEPA guidelines are far too conservative and insufficient for AOP applications. Virus challenge validation work conducted at Orange County (discussed in the section below) is a more relevant approach to virus inactivation validation for Western Corridor.

2.2.6.4 VIRUS CHALLENGE TESTING AT ORANGE COUNTY

MS2 phage testing was conducted at the Orange County Water District (OCWD) Groundwater Replenishment System demonstration UV and Oxidation system in 2004.

Collimated beam testing was performed to document log inactivation of seeded MS2 phage for ranges of delivered UV doses (as per 2003 UV guidelines). Response curves are employed as calibration curves to calculate bioassay-determined reduction equivalent doses (RED) from measured log reductions achieved.

A single UV reactor in the Orange County system was able to demonstrate between 4.4 to 5.6 log removal of MS2 phage at a minimum Reduction Equivalent Dose (RED) delivery of 115 mJ/cm^2.

There is no commercially available equipment that is 100% accurate in confirming a UV dose. Further, the AOP system is designed to operate far in excess of typical regulatory disinfection doses. One of the goals of the Orange County validation was to confirm how much disinfection was achieved at doses for NDMA removal, determined by the EE/o metric (> 4.0 log inactivation per reactor).

As it was demonstrated (via NDMA challenge testing) that reactor performance is additive, 2 reactors in service will provide greater than 8.0 log inactivation. The Western Corridor AOP systems will operate with a minimum of 2 reactors in service (at Bundamba, Gibson Is and Luggage Pt are greater) for all AWTPs and thus will achieve a minimum of 8.0 log inactivation.

The mean EE/o at design at Orange County design conditions was 0.21 kWh/kgal/order with 3 mg/L dose of hydrogen peroxide and 95% UVT. Section 2.2.6.1 shows EE/o levels for each of the Western Corridor plants, each of which is higher than Orange County and thus a greater energy input per log order removal will be provided for NDMA removal than Orange County thus we can confirm virus removal as at Orange county as a minimum.

The EE/o metric is calculated based on UVT. Note that if UVT is less than 95%, the reactors will ramp to 100% power and ensure adequate dosing.

The Western Corridor and Orange County UV systems utilize identical reactors with slight differences in the inlet/outlet designs. Validation testing performed at one installation can be applied to another installation without site specific testing if the hydraulics of the compared systems can be proven similar (according to 2003 NWRI guidelines). This approach was used to validate the West Basin Water Recycling Facility AOP system in July 2007 (West Basin Water Recycling Facility UV Disinfection and Oxidation System – Summary Report of Performance Testing , *Neil Brown, July 2007*).

The Californian West Basin facility, which has identical inlet/outlet configuration as Western Corridor, was able to demonstrate hydraulic correlation between itself and Orange County based on lithium chloride tracer studies conducted in October 2005. This correlation is equally valid for Western Corridor and hence Orange County testing work remains valid.

The PPR (present power ratio) will similarly be used as the CCP for virus removal UV dose will not be measured separately.

2.2.6.5 UV – REMOVAL OF OTHER MICROPOLLUTANTS.

Snyder et al (*Removal of EDCs and Pharmaceuticals in Drinking and Re-use Treatment Processes* AWWA Research Foundation – 2007) showed a removal of greater than 80% for a number of endocrine disrupting and pharmaceutical compounds at a dose of 372 mJ/cm^2 and 5 mg/L of hydrogen peroxide. Of interest, there was a significant improvement with the dose of hydrogen peroxide.

This data demonstrates that the AOP process will provide a reduction in these compounds, however it is as yet unclear how many of these constituents and to what concentration they may appear in RO permeate upstream of the UV system. The AOP has not been explicitly designed for the removal of these compounds, and UV dose and controls are not designed around them. At this time, the system will not be validated against removal of any of these compounds.

2.2.6.6 CONCLUSION – PRECOMMISSIONING VALIDATION OF ADVANCED OXIDATION

Validation work from Orange County Water District in the US has demonstrated a 1.2 log removal of NDMA and > 4 log inactivation of MS2-phage for a water source that will be similar to all three AWTPS, and using combinations of the same UV reactor design. It has also demonstrated a > 4.0 log virus inactivation per reactor. As a minimum of 2 reactors will always be in operation at doses targeting NDMA removal, a minimum 8.0 log of virus inactivation will be achieved at the AOP.

The control system for each of the plants will ensure a delivered electrical energy dose as required to meet the guaranteed log removal for NDMA, monitored by the PPR (present power ratio). Monitoring of the PPR will constitute the validation testing. At

Bundamba AWTP, there may be sufficient NDMA to enable a validation test to be performed without spiking of the influent. We do not propose any spiking to be performed if NDMA is insufficient to validate the log removal.

2.2.7 PRECOMMISSIONING VALIDATION – CHLORINE DISINFECTION

Treated water chlorine is employed primarily to achieve breakpoint chlorination and remove chloramine and ammonia from the treated water that is not removed via the RO system. Chlorine contact time will also provide log removal credit for bacteria and viruses.

Chlorine dosing has been considered in the early revisions of the validation plan and was subsequently used as a critical control point for the Bundamba Validation test. It was used as it appeared relatively simple to justify additional microbiological removal credit with no substantial change to operations. Upstream barriers (microfiltration, reverse osmosis and AOP) for all AWTPs will successfully achieve a > 9.5 log removal & inactivation of viruses prior to chlorine disinfection, and hence final chlorination is not mandatory from the point of view of meeting guideline requirements.

The CT requirement for virus removal is very small, and consequently a small chlorine residual in the treated water tank, which will be required for other process reasons, may be prudent to retain an additional barrier. However, none of the AWTP treated water tanks are designed as contact tanks, and thus a determination of tank detention time is more difficult. For this reason, final chlorine disinfection has been removed as a critical control point and hence from validation. The discussion section will remain in this report, however, should chlorine be reconsidered at a later date.

It should also be considered that the treated water pipeline from the AWTPs to the Wivenhoe release will also likely be chlorinated. As this is commissioned, it may be prudent to consider this section of pipeline as an additional barrier for microbiological removal.

2.2.7.1 BACKGROUND – CHLORINE CT TO REMOVE MICRO-ORGANISMS

The USEPA Alternative Disinfectants and Oxidation Guidance Manual (1999) has provided the following CT values for the inactivation of Giardia Cysts and viruses.

Table 2-14. CT Values for Inactivation of *Giardia* Cysts

Disinfectant	Inactivation (mg · min/L)					
	0.5-log	1-log	1.5-log	2-log	2.5-log	3-log
Chlorine[1]	17	35	52	69	87	104
Chloramine[2]	310	615	930	1,230	1,540	1,850
Chlorine Dioxide[3]	4	7.7	12	15	19	23
Ozone[3]	0.23	0.48	0.72	0.95	1.2	1.43

CT values were obtained from AWWA, 1991.
[1] Values are based on a free chlorine residual less than or equal to 0.4 mg/L, temperature of 10°C, and a pH of 7.
[2] Values are based on a temperature of 10°C and a pH in the range of 6 to 9.
[3] Values are based on a temperature of 10°C and a pH of 6 to 9.

Figure 7 - Source - USEPA Alternative Disinfectant and Oxidation Guidance Manual (1999).

Given that the required log removal of giardia has been achieved prior to the treated water tank, it is not recommended to operate at CT levels for any additional log removal.

Table 2-13. CT Values for Inactivation of Viruses

Disinfectant	Units	Inactivation		
		2-log	3-log	4-log
Chlorine[1]	mg · min/L	3	4	6
Chloramine[2]	mg · min/L	643	1,067	1,491
Chlorine Dioxide[3]	mg · min/L	4.2	12.8	25.1
Ozone	mg · min/L	0.5	0.8	1.0
UV	mW · s/cm^2	21	36	not available

CT values were obtained from AWWA, 1991.
[1] Values are based on a temperature of 10°C, pH range of 6 to 9, and a free chlorine residual of 0.2 to 0.5 mg/L.
[2] Values are based on a temperature of 10°C and a pH of 8.
[3] Values are based on a temperature of 10°C and a pH range of 6 to 9.

Figure 8 - Source - USEPA Alternative Disinfectant and Oxidation Guidance Manual (1999).

The CT requirement of 6 for 4 log virus inactivation is a relatively easy target to achieve and consequently we believe it is prudent to aim for this level in the treated water tank. As it is not strictly required however, we do not consider it necessary to perform tracer studies on treated water storage tanks, but rather ensure that the chlorine concentration is sufficient such that sufficient CT is implied.

The CT relies on the residual chlorine concentration and detention time in the treated water tank. The treated water tank detention times at full plant capacity are as follows:

Table 12 - Treated Water Detention Time Summary

Plant	Treated Water Tank Detention Time at Full Plant Capacity
Bundamba	8 hours

Gibson Island	30 minutes
Luggage Point	30 minutes

CT is problematic for the Western Corridor AWTPs in that the treated water storages have been designed as storage tanks and not specifically as contact tanks.

The AWTPs can be operated to maintain a minimum free chlorine residual of 0.2 mg/Lin the treated water tank, which will also act as a confirmation of breakpoint chlorination. Based on this minimum residual, the CTs for each plant are then:

Table 13 - AWTP Minimum CT Summary

Plant	**Chlorine Concentration x Time (CT)(mg/L/min)**
Bundamba	96
Gibson Island	6
Luggage Point	6

These results will provide a 3.0 log inactivation of virus.

SECTION 3 COMMISSIONING VALIDATION PLAN

3.1 INTRODUCTION

Commissioning validation is effectively a plant performance test that confirms that the treatment process barriers control water quality hazards as expected from the pre-commissioning validation. The commissioning validation test will confirm the operation at each critical control point.

Validation is also a test that the critical control points that have been selected in the HACCP analysis are appropriate and that the critical control point response procedures are robust and workable.

Table 14 - Validation Test Summary

Expected Commencement Date		Bundamba June 2008 Gibson Is – Sept 2008 Luggage Point – Sept 2008.
Duration		4 weeks
Test Staffing	Test run by	Veolia
	Test Witnessed by	WCRWPL
	Report prepared by	Veolia
Notice of Test	WCRWPL to Alliance	Min 2 weeks
Notice of Test	WCRWPL to Regulator	Min 2 weeks

3.2 ROLES AND RESPONSIBILITIES

3.2.1 SCHEME OPERATOR

Veolia Water Australia is the Scheme Operator and will be responsible for plant operation during the commissioning validation test period. Veolia will be responsible for managing the commissioning validation test including:

- Plant monitoring.
- Sampling and analysis.
- Instrument calibration.
- Liaison and management of vendors if required for specific testing.

- Test reporting to WCRWPL and on their behalf to the regulator.
- On site co-ordination with alliance personnel.

3.2.2 WCRWPL

The commissioning validation is not an explicit part of the alliance's requirements in the delivery of each AWTP. As a result, careful co-ordination is required with the alliance to ensure that the commissioning validation testing is conducted in a timely fashion without impeding alliance goals. As scheme owner and member of the Alliance, WCRWPL are responsible for:

- co-ordination of the Alliance to ensure the plant has achieved a sufficient state of completeness to proceed with the commissioning validation test.
- providing notice to the alliance when the commissioning validation test is to proceed.
- ensuring the scheme operator is empowered to operate the plant as required for the commissioning validation test.
- ensure the Scheme Operator has adequate resources available as requested to perform the commissioning validation test.
- Act as referee should any dispute occur between the Scheme Operator and Alliance during the commissioning test period.

3.2.3 ALLIANCE

The alliance is responsible for ensuring the plant has achieved a sufficient state of completeness to proceed with the validation test. The commissioning validation test may run in parallel with performance testing or proving period activities. Any conflicts that may arise from this parallel testing are to be resolved by the assistance of WCRWPL who are an alliance member.

3.2.4 REGULATOR

The regulator will provide approval for:

- Commissioning validation test.
- Commissioning validation test report.

:

3.3 COMMISSIONING VALIDATION – SCHEME OPERATOR PERSONNEL

The following flowchart details the Scheme Operator's proposed structure of the commissioning validation.

A commissioning validation team will focus on the validation test work. This team will be comprised largely of members of the scheme operations team.

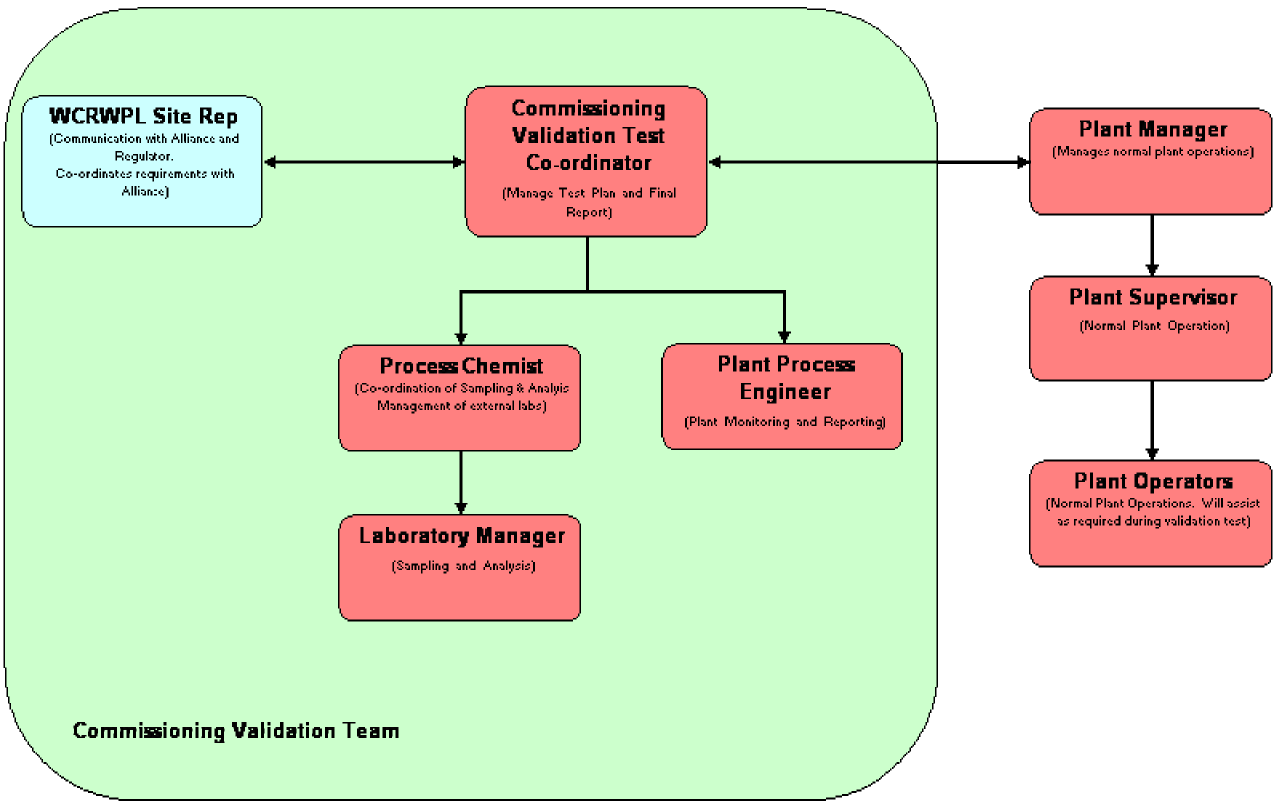


Figure 9 - Commissioning Validation Team

3.3.1 COMMISSIONING VALIDATION TEST CO-ORDINATOR

The role of the Commissioning Validation Test Co-ordinator is to:

- Be the main contact person for the Scheme Operator during the validation test.
- Liaise with WCRWPL on all tests and results. This will be conducted during a weekly on site commissioning validation test meeting.

- Completion of the validation test report.
- Management of Commissioning Validation Team

3.3.2 PROCESS CHEMIST

The role of the Process Chemist is to co-ordinate all sampling and analysis that is required for the validation test. This includes:

- Management and co-ordination of sample procedures.
- Management of external laboratories including QA and chain of custody.
- Provide technical support for on line analysers.
- Provide support for the laboratory manager.

3.3.3 PLANT PROCESS ENGINEER

The plant process engineer will be responsible for daily on site co-ordination of the commissioning validation test. This role will include:

- Plant monitoring and collection of on line data.
- Liaison with the plant operating team.
- Set up of any required tests.

3.3.4 LABORATORY MANAGER

The role of the Laboratory Manager is the following:

- Co-ordination of sampling.
- Co-ordination of sample labeling and bottling.
- Setup to courier samples.
- Manage stocks of essential reagents.
- Manage/Supervise Laboratory QA/QC including COC forms etc

3.4 PLANT OPERATION DURING COMMISSIONING VALIDATION TEST

3.4.1 PLANT DEMAND

The commissioning validation test will be conducted while the plant is operating normally. The AWTPs will not necessarily be capable of operating at full output capacity during the commissioning validation test either due to limitations of raw feed supply or limitations of customer demand. As much of the plant is constructed in discrete modular units, attention will be made to each unit for validation. Where possible, the plant will be operated for periods such that individual units are operated close to their design capacity if that is required to fully validate the CCP.

This is possible for CCP5 and CCP 9.

It is a requirement of the test that all individual trains be operated so that all discrete units are validated. Membrane units are discrete and this will not impact CCPs. The AOP unit must be run for significant periods during the test such that the system is not at minimum turndown (2 reactors at 60% power).

3.4.2 PLANT REPORTING

The commissioning validation plan will concentrate on the critical control points. Some other process monitoring information that is relevant to each critical process will be included in the commissioning validation report – the remainder of plant process operation information will be included in regular plant operational reporting.

A fortnightly commissioning validation report will be provided to the regulator, which will include as a minimum:

- Any exceedances of alert or critical limits for CCPs reported.
- Performance of the plant with respect to critical control points.
- Any lessons learned or improvements to operation.

3.4.2.1 REPORTING FROM PLANT SCADA

The majority of plant performance data will be gathered from the plant SCADA system. Ideally, this information will be provided from the SCADA reporting function and established trend information. Prior to the validation test taking place, it is essential that the trend data is available on SCADA and is recorded in the Historian to ensure the integrity of that data.

Understanding that SCADA reporting and trending systems are often late completion items, we will make our best efforts to gather on line data. An audit will be performed prior to the Commissioning Validation test and the status of all instrumentation, SCADA reporting functionality and data trending will be assessed. If any issues arise, it will be the responsibility of WCRWPL to arrange for completion or provide a note of acceptance of that item's status prior to the test beginning.

3.4.2.2 FINAL COMMISSIONING VALIDATION REPORT

A final commissioning validation report will be submitted no later than four weeks following the completion of the commissioning validation test. The report will be submitted pending any outstanding analysis results to avoid any delay in progress of the following plant verification testing. A revision of the report will be submitted on receipt of those results.

The commissioning validation report will be the responsibility of the commissioning validation trial co-ordinator.

3.4.3 COMMISSIONING VALIDATION TEST WEEKLY MEETING

A weekly meeting will be held each Friday at the AWTP to discuss the performance of the commissioning validation test. The meeting will be attended by as a minimum:

- Commissioning Validation Trial Co-ordinator
- Plant Process Engineer
- Manager – Environment and Compliance
- WCRW representative.
- Alliance representative (optional)

A representative of the regulator may elect to attend the meeting, however is not required.

3.4.4 INSTRUMENT CALIBRATION

The following instruments shall be calibrated and/or verified prior to the beginning of the commissioning validation test.

Table 15 - Instrument Calibration List

Process Area	Instrument Name	Bundamba		Gibson Island	Luggage Point
		1A	1B		
Raw Water Pump stations (Bundamba/Goodna/Oxley/Wacol)	Raw Water Turbidity	AIT			

Process Area	Instrument Name	Bundamba		Gibson Island	Luggage Point
		1A	1B		
CCP1	Raw Water Nitrate	AIT			
	Raw Water Phosphorus	AIT			
	Raw Water Ammonia	AIT			
MF Filtrate **CCP 5**	MF Filtrate Individual Unit Turbidity	AIT 1911			
	MF Filtrate common turbidity	AIT 1921			
RO Feed	RO Feed Conductivity				
RO Units **CCP 9**	RO Unit Combined Permeate Conductivity Meter	AIT 220#-05			
	RO Permeate TOC				
UV	UV Transmittance	AIT 4850			
	Hydrogen Peroxide Flow Meter	FIT 4621			
Treated Water	Treated Water Tank inlet Free Chlorine **CCP12**	AIT xxxx			

3.4.5 MEMBRANE INTEGRITY

All MF systems are to be in an integral condition prior to the commissioning validation test. All MF units for Bundamba must achieve a pressure decay test result below critical limit prior to the test commencing. Ideally, this should be below the alert limit. If the plant is under alliance control at the time of the test, WCRW shall be responsible for ensuring adequate maintenance takes place to achieve this result. If the plant is under the control of the Scheme Operator, they shall be responsible for ensuring that this level of integrity is achieved.

3.5 RAW FEED PUMP STATION

The raw feed pump ammonia analyser constitutes CCP1 for the plant. During the commissioning validation test period, each of the instruments at the raw water pump station shall be monitored via SCADA and the ammonia result will be reported.

Response procedures must be followed if the alert or critical limit is exceeded for CCP1.

Response procedures are as follows. Note that these procedures are controlled documents which are managed by Veolia's business management system. Revision control is as per this system and the revisions below may be out of date.

Table 16 - CCP 1 Procedure Summary

AWTP	Procedure
Bundamba	WI-GWA-WCB-2001-5
Gibson Island	WI-GWA-WCG-2001-5
Luggage Point	WI-GWA-WCL-2001-1

.

If the critical limit for ammonia is exceeded for the specified time at any of the raw water pump stations to the AWTPs, then the pump station will be shut down. Any exceedance of alert limit shall be logged in the operator's logged and any critical exceedance shall be reported via the Scheme Operator's Incident Response Procedure. All incidences will be reported in the commissioning validation test report.

3.6 MICROFILTRATION VALIDATION TEST

The microfiltration system validation will concentrate on the requirements of critical control point 5 as shown in the table below:

Table 17 - CCP5 Summary

CCP	Alert Limit	Critical Limit
CCP 5	Combined filtrate turbidity > 0.15 NTU 95% of time > 2 hours	Combined filtrate turbidity > 0.45 NTU > 15 mins.
	Bundamba (Doc reference WI-GWA-WCB-2005-6 CCP 5 **)**	
	Pressure Decay Test	
	Daily pressure decay integrity test > 2.0 kPa/min for 2 consecutive tests.	Daily pressure decay test > 3.0 kPa/min
	Turbidity	
	Combined filtrate turbidity > 0.15 NTU 95% of time > 2 hours	Combined filtrate turbidity > 0.45 NTU > 15 mins.
	Gibson Is (Doc reference WI-GWA-WCG-2005-5 CCP 5 **)**	
	Pressure Decay Test	
	>2 kPa / minute for 2 consecutive tests	Daily pressure decay test >3.2 kPa / minute
	Turbidity	
	Combined filtrate turbidity > 0.15 NTU 95% of time > 2 hours	Combined filtrate turbidity > 0.45 NTU > 15 mins.
	Luggage Point (Doc reference WI-GWA-WCL-2005-1 CCP 5 **)**	
	Pressure Decay Test	
	> 0.59 kPa/5 min	> 0.45 kPa/5 min
	Turbidity	
	> 0.05 NTU for > 2 hours	> 0.1 NTU for > 2 hours

The pressure decay test can be related to a log reduction value for 3 micron particles. The following calculation (based on the bubble point theory as described in section 2.2.4.1) will be used to convert pressure decay test results to a log reduction value.

The pressure decay test result estimates a bypass flow from a breach through the membranes. The log reduction value is then the log of the ratio of MF unit filtrate flow to the breach. As a result, the higher the MF unit filtrate flow for a given bypass flow, the higher the log reduction. For this reason, the log reduction value may change even with a consistent pressure decay test result. Both results will be logged for the commissioning validation test.

The critical control point for the microfiltration system identifies membrane integrity.

Response procedures are as follows:

Table 18 - CCP5 Procedure Summary

AWTP	Procedure
Bundamba	WI-GWA-WCB-2005

Gibson Island	WI-GWA-WCG-2005
Luggage Point	WI-GWA-WCL-2005

3.6.1 TURBIDITY MONITORING

MF filtrate turbidity can be monitored for each individual MF unit, and for the combined filtrate train. SCADA trends will be recorded for the duration of the commissioning validation test.

As the plant may not be at full capacity during the commissioning validation test, not all units may be required for operation. Individual MF units will be cycled for duty during the test period to ensure all MF units are validated.

Combined filtrate turbidity shall be logged on the SCADA and a trend report will be provided for the entire commissioning validation test.

If the filtrate turbidity exceeds the alert limit, the CCP5 response procedure shall be followed and the incident logged and attached in the commissioning test report. This shall not constitute a failure of the commissioning validation test.

If the filtrate turbidity exceeds the critical limit, the MF system will be shut down.

The commissioning validation shall only deemed to have failed if there is a high frequency of critical limit breach **and** the CCP response procedure does not adequately resolve the problem. For the purposes of this test, a failure of the barrier must not occur during the test.

3.6.1.1 SUMMARY

Table 19 - CCP5 Monitoring Summary

Test Parameter	**MF Filtrate Unit Turbidity**
Test Parameter	MF Combined Filtrate Turbidity
Validation Data Recorded	MF Combined Filtrate SCADA trend
Action if Alert Limit Breached	CCP response procedure
Validation Criteria	No exceedance of critical limit during the validation test.

3.6.2 PRESSURE DECAY INTEGRITY TEST

The pressure decay integrity test shall be performed on each MF unit every 24 hours of operation. This is programmed into the SCADA system, however the plant process engineer will ensure that results are logged for each unit over this period.

The pressure decay test results shall be reported as trend data for the commissioning validation test period.

Each test shall be conducted such that the start pressure is within the required limits. Should this pressure be outside this range, the result will be discarded and the test repeated.

In this test, effectively each MF unit is validated separately. If an individual unit exceeds the critical limit, the unit must shut down automatically. The CCP response procedure must then be followed to isolate and/or repair membranes prior to returning the unit to service.

A failure of the validation test will occur if a unit operates following an exceedance of the CCP without a shutdown and repair according to the response procedure. As the units are validated separately, in the event of failure that unit will be deemed to have failed and the commissioning validation period for that unit will recommence.

3.6.2.1 PRESSURE DECAY TEST SUMMARY

Table 20 - Pressure Decay Test Summary

Test Parameter	**Pressure Decay Test**
Validation Data Recorded	Pressure decay test result. Pressure decay test start pressure.
Action if Alert Limit Breached	CCP response procedure.
Validation Criteria	Results below the CCP critical limit with no more than two breaches following successful following of the CCP response procedure.

3.7 RO VALIDATION TEST

The RO system commissioning validation test will concentrate on the requirement of critical control point 9 as shown in the table below:

Table 21 - CCP9 Summary

CCP	Alert Limit	Critical Limit
CCP 9	**Bundamba AWTP** (WI-GWA-WCB-2009-3)	
	RO train specific conductivity > 100 uS/cm	RO train specific conductivity > 150 uS/cm
	Gibson Is AWTP (WI-GWA-WCG-2009-5)	
	RO train specific conductivity > 50 uS/cm	RO train specific conductivity > 80 uS/cm
	Luggage Pt AWTP (WI-GWA-WCL-2009-1)	
	RO train specific conductivity:[1] 100 uS/cm when RO feed conductivity < 3000 uS/cm 120 uS/cm when RO feed conductivity > 3000 uS/cm	RO train specific conductivity > 150 uS/cm 150 uS/cm when RO feed conductivity < 3000 uS/cm 170 uS/cm when RO feed conductivity > 3000 uS/cm

The CCP response procedures for AOP are as follows:

Table 22 - CCP9 Response Procedure Summary

AWTP	Procedure
Bundamba	WI-GWA-WCB-2009
Gibson Island	WI-GWA-WCG-2009
Luggage Point	WI-GWA-WCL-2009

3.7.1 RO CONDUCTIVITY MONITORING

The RO conductivity will be monitored by on line instrumentation at the combined permeate for each unit. A SCADA trend of this information will be provided in the report, along with the permeate flow trend from each unit. Conductivity data will be filtered to include only data when the RO unit is delivering water to service.

If the conductivity exceeds the critical limit, CCP9 response procedure shall be followed. A commissioning validation test will be considered a failure if the integrity of the RO unit cannot be restored after following the response procedure. As for the MF system, the RO units are effectively validated individually.

A failure of the test will occur if any unit operates when the CCP critical limit has been exceeded. If this occurs with any unit, the problem will be corrected and the commissioning validation period will recommence for that unit only.

3.7.1.1 SUMMARY

Table 23 - Pressure Decay Test Summary

Test Parameter	Pressure Decay Test
Validation Data Recorded	RO unit permeate conductivity.
Action if Alert Limit Breached	CCP9 response procedure.
Validation Criteria	RO conductivity < critical limit for entire commissioning validation test. If CCP critical limit exceeded, RO unit shuts down and response procedure followed.

3.7.2 RO UNIT TOC MONITORING

Beginning during the commissioning validation test, the RO combined permeate TOC shall be recorded to begin establishment of a baseline. This will not occur at Bundamba until instruments have been commissioned, however will begin at Gibson Is and Luggage Pt.

It should be noted that Luggage Pt cycle the instrument between three individual train sample points.

3.8 AOP VALIDATION TEST

The Advanced Oxidation System validation will concentrate on the requirement of critical control point 10 as shown in the table below.

Table 24 - CCP10 Summary

CCP	Alert Limit	Critical Limit
CCP 10 All AWTPs	Present Power Ratio < 100% for > 10 mins	Present Power Ratio < 90% for > 10 mins
	Hydrogen peroxide dose flow +/- 20% of flow setpoint for > 10 mins	Hydrogen peroxide dose flow +/- 50% of setpoint for more than 10 mins
	6 or more lamps failed on an individual reactor	30 or more lamps failed on an individual reactor (this will initiate train shutdown)
	CCP Response Procedures: Bundamba: WI-GWA-WCB-2010-3 Gibson Is: WI-GWA-WCG-2010-5 Luggage Pt: WI-GWA-WCL-2010-1	

The response procedure for CCP10 is as follows:

Table 25 - CCP10 Response Procedure Summary

AWTP	Procedure
Bundamba	WI-GWA-WCB-2010
Gibson Island	WI-GWA-WCG-2010
Luggage Point	WI-GWA-WCL-2010

Unlike the membrane unit operations of MF and RO which have a set of multiple trains to achieve plant capacity, the advanced oxidation is configured as either a duty/standby or duty/duty operation. The AOP system relies on achieving a sufficient dose of UV radiation to provide the required log destruction of NDMA.

Each UV system is arranged in a set of reactors as follows:

Table 26 - UV Summary

Plant	No Trains	No Vessels/Train	No Reactors/Vessel	No Lamps/Reactor
Bundamba AWTP	2 x duty	2	2	72
Gibson Is AWTP	3 x duty, 1 x standby	3	2	72

Luggage Pt AWTP	3 x duty, 1 x standby	3	2	72

The UV reactor energy input is based on throughput. The reactors have a minimum turndown of 60%, thus at some low flow conditions, an effective overdose may occur. The system must be operated during the commissioning validation test so that UV units are operated for representative periods at flow paced doses.

In order to meet an 8.0 log inactivation of viruses, a minimum of 2 reactors shall be run in series at all times. At Gibson Is and Luggage Pt, this will occur by default due to the capacity design of the trains. At Bundamba this will be included in the program.

At Bundamba AWTP, the opportunity exists to measure the log removal of NDMA directly as the feed level is sufficiently high to see a result in the outlet stream. Bundamba will be used as a validation for the scheme to back up previous work conducted at Orange County. This will not be conducted at Gibson Is or Luggage Pt.

3.8.1 NORMAL AOP MONITORING

The AOP system will be monitored for the following normal performance parameters:

- UV transmittance
- Hydrogen peroxide flow
- PPR (Present Power Ratio)

3.8.2 AOP MONITORING

The present power ratio will be monitored for the AOP system. A SCADA trend of this information will be provided for the commissioning validation test along with a combined RO permeate flow.

If the PPR level drops below the critical limit, CCP10 response procedure shall be followed and the UV train must shut down. At Gibson Is, the RO units will be placed into recirculation mode while the standby UV train warms up. A commissioning validation test will be considered a failure if the UV trains do not shut down on CCP critical limit and the response procedure is not followed.

3.8.2.1 PLANT FLOW RATE

The systems are designed to achieve log 1.2 (log 1.0 at Bundamba) destruction of NDMA at full plant capacity. It is possible during the commissioning validation test that full plant capacity may not be possible due to limitations in raw water supply. To ensure that the system is validated meaningfully, the number of reactors available will be matched as close as possible to the plant flowrate.

The number of RO trains and UV trains at each plant are shown in the table below.

Table 27 - No of UV reactors and RO Trains

Plant	No RO Trains (duty)	No UV Trains (Duty)	No Reactors per train
Bundamba[1]	4	2	4
Gibson Is	6	3	6
Luggage Point	3	3	6

Note 1 – Bundamba 1B consists of 4 x duty RO trains, one standby. Bundamba 1A consists of 3 x duty RO trains and one standby. The combined plant shares one standby RO train, hence Bundamba 1A can operate all four RO trains which are matched to both UV trains running.

Prior to the test, the number of trains and reactors will be set to match the RO permeate flow. At Bundamba, NDMA sampling will be conducted across the UV system to verify NDMA log removal.

3.8.2.2 BUNDAMBA VALIDATION

Bundamba has measured NDMA values approaching 300 ppt in the feed to the UV system. This is likely due to the high detention time in upstream tankage during the early low flow periods of the plant. This level of NDMA is sufficient to determine a better than 1.2 log removal from the system.

At Bundamba, water will be sampled upstream and downstream of the UV system for NDMA. This will be conducted for a minimum of 5 runs over the four week commissioning validation test period.

Samples will be taken from immediately upstream of the UV reactors (VBA 4851-1 or VBA 4851-2). Samples will then be taken at the downstream side of the reactors (valve to be determined). The samples will be sent to NATA certified external laboratory for analysis.

For each run, the following parameters will be measured:

- RO permeate combined flowrate

- Hydrogen peroxide dosing flow rate (to calculated a dose)
- No of reactors on line.
- PPR

3.8.2.3 SUMMARY

Table 28 - Present Power Ratio Summary

Test Parameter	Present Power Ratio
Validation Data Recorded	Present Power Ratio
Action if Alert Limit Breached	CCP10 response procedure.
Validation Criteria	PPR > 90% for entire test duration.
Validation Criteria	NDMA testing to verify EE/O at Bundamba.

SECTION 4 COMMISSIONING VERIFICATION PLAN

4.1 SELECTION OF PARAMETERS TO INCLUDE IN VERIFICATION MONITORING

A Source Water Characterisation Program conducted from March 2007 to July 2007 provided results on the concentration of a very broad spectrum of compounds in the treated wastewater from the six wastewater treatment plants that supply the WCRWP.

The selection of parameters to monitor the quality of the PRW produced by the AWTPs has been determined from the results of this program. Due to the continuous improvement nature of verification programs the parameters to be monitored in the PRW during ongoing verification programs will be updated on an ongoing basis using information from ongoing source water monitoring and catchment risk assessments.

The complete list of verification parameters proposed to be monitored for each of the AWTPs is shown in Schedules 1 to 4 in appendix 2.

The rationale behind the selection of the key verification parameters is provided below.

4.1.1 NUTRIENTS, METALS, OTHER INORGANIC SALTS AND ORGANIC INDICATORS

Nutrients, metals and other inorganic and organic indicator compounds are good indicators of AWTP performance. Some inorganic compounds such as heavy metals have health limits for drinking water. A very good historical database on the occurrence of these compounds in the source water to the AWTPs exists and has facilitated selection of parameters from these groups.

Parameters from these groups of compounds have been included in the verification monitoring unless their levels in the source water were below detection which reduces their value as indicator compounds and also limits the likelihood of them presenting a health hazard.

4.1.2 MICROBIOLOGICAL INDICATORS

The microbiological indicators recommended in the AGWR2 have been included.

Additional microbiological monitoring may be included in the long term verification program should further risk assessment show this to be prudent.

4.1.3 DISINFECTION BY-PRODUCTS

The formation of disinfection by-products through chlorination or other oxidation processes is a widely known and well documented phenomenon in water treatment. All the AWTPs employ disinfection by chlorine and chloramine at two process steps as well as an advanced oxidation step. Therefore, the PRW should be tested for the disinfection byproducts known to form in the water and recycled water treatment industry even if these compounds were not detected during source water characterisation.

Parameters included in the verification program include:

- inorganic disinfection products chlorate, chlorite, perchlorate and bromate.
- organic disinfection products Nitrosamines (including NDMA), Trihalomethanes (Bromochloromethane, Dibromochloromethane, Chloroform and Bromoform.
- chlorophenols (incorporated in phenol screen) and halo-acetic acids. As these compounds require the presence of larger pre-cursor organic compounds, they are less likely to occur in PRW than the trihalomethanes as the compounds and their precursors may be removed via reverse osmosis. Their inclusion in any longer term verification program will be subject to a risk assessment.

4.1.4 RADIOLOGICAL COMPOUNDS

Gross beta analyses on source water showed levels above drinking water guidelines in some source waters. Gross alpha and beta analyses have been included.

Gamma spectrometry can be used to determine the cause of the radiological activity in most cases. Gamma spectrometry has been included to allow determination of the cause of any gross beta activity observed. Their inclusion in any longer term verification program will be subject to a risk assessment.

4.1.5 PHARMACEUTICALS, HERBICIDES, PESTICIDES AND ENDOCRINE DISRUPTOR COMPOUNDS

Of the 331 compounds included in the organic analytical screens, around 95 were detected in one or more treated wastewater source. These compounds were mostly water soluble and apart from phenols and endocrine disruptors, could be detected using Liquid Chromatography Mass Spectrometry.

There is however uncertainty about temporal and spatial variation in occurrence and concentration of these compounds in the source water because the source water characterisation was conducted over a relatively short period of time. To accommodate this uncertainty, the following approach has been taken to selecting parameters to include in the verification monitoring.

Parameters have been included if they were detected:

- in any of the source waters, even if they were detected at levels below applicable guideline limits because temporal variation in concentration could potentially result in higher concentrations of that compound at different times or seasons.
- even if no health guideline value has been defined for that compound in the ADWG or the AGWR2. This will allow Queensland Health to evaluate if the compound occurs at significant frequency and concentration to require a health standard to be developed.

The same list of parameters has been included for verification of all the AWTPs, regardless of whether all those compounds were detected in each of the source waters. While the parameters had similar characteristics (ie they were water soluble), there was significant variation in the parameters detected in each of the treated wastewater sources. However including them all in the verification program should allow for some of the uncertainty about spatial variation in types of compounds occurring within catchments to be addressed.

The analytical techniques used to determine the selected parameters will also produce results for parameters that are part of a standard suite for each class of compound. This will result in screening for compounds that were not necessarily detected during the source water characterisation program, which addresses some of the uncertainty about temporal and spatial variation in the occurrence of these compounds.

4.2 FREQUENCY OF SAMPLING

The ideal scenario from a risk management point of view is to gather enough data to allow a statistical analysis of the variance in occurrence and concentration of hazardous substances in water to determine the risk of exposure.

It is understood that Queensland Health requires that a minimum of 26 data points (twice per week for 13 weeks) for each parameter during a minimum of three months in order to verify that each AWTP will produce water compliant with drinking water standards.

The frequency of sampling for each parameter has been selected on this basis.

4.2.1 VERIFICATION TEST

The verification test should begin at the conclusion of the commissioning validation test. At Bundamba, consideration may be given to starting the verification test in parallel with the commissioning validation test, however due consideration should be given to the state of completion of the plant and any process risks that may entail.

The Luggage Point and Gibson Island AWTPs will start verification testing at the completion of commissioning validation.

At the conclusion of each of the Verification Tests it is expected that approval will be granted for the PRW to be released to Wivenhoe Dam.

4.2.2 ONGOING VERIFICATION MONITORING

The Ongoing Verification Monitoring for each of the AWTPs will commence at the end of each of the Verification Tests.

The Ongoing Verification Monitoring program will be defined largely based on the results of the Verification Tests and sourcewater monitoring programs. It is likely that the long term verification program will be based around frequent monitoring of indicator and surrogate compounds with less frequent screening of specific contaminants of concern.

Monitoring contaminants of concern

Screening the product water (PRW) for contaminants of concern will occur at a lesser frequency than monitoring indicator organisms.

Selection of parameters to include in such screens will be guided by the following:

- The screens used during the Verification Test will be used as a starting point.
- The Verification Test Screens will be augmented with any compound that is detected with reasonable frequency during the ongoing source water monitoring.
- Additional contaminants of concern that may not be part of the existing source water analytical screens will be identified as follows:
- Source Characterisation (Trade waste surveys) to identify compounds not included in analytical screens.
- Review of the US list of contaminants of concern by Queensland Health for use of these compounds in Australia and in this region. If frequent use is identified such compounds will be included in source water screens.
- Queensland Health will determine the health impact and a guideline values for compounds not listed in the ADWG or AWGR2.
- If these compounds are detected at reasonable frequency in the source water it will be include in PRW screen.

The frequency of screening product water (PRW) for contaminants of concern in the Ongoing Verification Monitoring is proposed to be monthly.

4.3 SAMPLING AND ANALYSIS

Samples will be taken according to Veolia's sample collection work instruction WI-GWA-WCB-2415-2. On site sampling requirements will be the responsibility of the Plant Laboratory Manager.

The

4.3.1.1 LABORATORY AND CHAIN OF CUSTODY

Chain-of-custody forms are used to ensure sample integrity from collection to data reporting. This includes the ability to trace possession and handling of the sample from the time of collection through analysis and final disposition. This process is referred to as "chain of custody" and is required to demonstrate sample control when the data are to be used for regulation. The following topics are associated with the major aspects of chain-of-custody, and are addressed in draft Work Instruction WI-GWA-WCB-2415-2.

- Sample Labels
- Sample Seals
- Field Log Book
- Chain-of-Custody Record (refer to BWSAS COC)
- Sample Analysis Request Sheet
- Sample Delivery to the Laboratory
- Receipt and Logging of Sample;
- Assignment of Sample for Analysis; and
- Disposal.

A sample chain of custody form, as used with BWSAS has been attached in appendix 3.

4.4 RESULTS AND REPORTING

Results will be provided in a monthly report. This will be provided by the Manager, Environmental and Compliance.

The report will be provided with results pending. Any results that are not available due to delays in laboratory analysis will be updated in the subsequent reports.

Appendices

Appendix 1 Literature References

J Drewes et al ***Rejection of Wastewater Derived Micropollutants in High-Pressure Membrane Applications Leading to Indirect Potable Re-use*** Environmental Progress (Vol 24, No4 Dec 2005).

G Leslie, S Khan. ***Advanced Water Treatment Technologies***. In T. Gardner, C. Yeates & R Shaw (Eds) *Purified Recycled Water for Drinking: The Technical Issues*, Queensland Water Commission)

USEPA ***Surface Water Treatment Rule Guidance Manual*** (Section 4) 1991.

J.R. Bolton and M.I. Stefan**, *Fundamental photochemical approach to the concept of fluence (UV dose) and electrical energy efficiency in photochemical degradation reaction***, in : Res. Chem. Intermed. Vol 28, No 7-9, pp 857-870 (2002)]

S.Parsons, in : ***Advanced Oxidation Processes for Water and Wastewater Treatment*, **IWA Publishing)].

Trojan UV, ***Orange County Groundwater Replenishment System – Demonstration UV Disinfection and Oxidation System – Performance Validation Report*** (2004)].

Trojan UV, **West Basin Water Recycling Facility UV Disinfection and Oxidation System** (2007).

USEPA Log Inactivation for UV dose ***ULTRAVIOLET DISINFECTION GUIDANCE MANUALFOR THE FINAL LONG TERM 2 ENHANCEDSURFACE WATER TREATMENT RULE***

Snyder et al (***Removal of EDCs and Pharmaceuticals in Drinking and Re-use Treatment Processes*** **AWWA** Research Foundation – 2007)

Siemens/Memcor "*Validation and Operational Monitoring for Virus Removal by Membrane Filtration*" McCormick, Zha et al. 2008 **(Commercial In Confidence)**

Pall Water Processing **Validation of Pall Microza® MF Membranes in Drinking Water and Wastewater Reuse for Compliance with USEPA LT2ESWTR and embrane Filtration Guidance Manual** (2006)

Sakaji, R et al **Final Report for the Challenges of the Pall Microza USV-6203, UNA-620A, and XUSV-5203 Membranes** June 2004

Letter – **Conditional Acceptance of Memcor L20V Ultrafiltration Membrane** (June 17, 2008).

Letter – **Conditional Acceptance of Pall Microza UNA 620A Membrane as an Alternative Filtration Technology** (June 2004)
Montgomery Watson Harza – **Point Loma Wastewater Treatment Plant RO Membrane Challenge Test** Letter June 2006

Linden, K **Fundamentals of UV-Based Advanced Oxidation Processes** (Veolia Seminar , October 2007)

Trimboli P, Lozier J, Johnson W **Demonstrating the Integrity of a Full Scale Microfiltration Plant Using a Bacillus Spore Challenge Test** 1998.

Extract from the Expert Panel's Report on the Singapore NEWater Study, June 2002

Appendix 2 Critical Control Point Response Procedures

Appendix 3 Verification Test Schedules

INDEPENDENT VERIFICATION REPORT

Camellia Recycled Water Project - Tender Design Expanded Scheme

Prepared for:

AVA WATER CONSORTIUM

(Alinta Asset Management/Veolia Water Australia JV)
Level 14, 1 O'Connell Street
Sydney NSW, 2000

In accordance with:

Section 7.7.8 Verification of the *Request for Detailed Proposal for the Camellia Recycled Water Project*

Prepared by:

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23 August 2007

Limitations Statement

This report has been prepared by Kellogg Brown and Root Pty Ltd (KBR) for AVA Water Consortium ('the Client') in relation to the proposed Camellia Recycled Water Project Tender Design ('the Project') and subject to the terms and conditions and in accordance with the scope of services set out in the contract dated 23/02/2007 ('the Contract').

The information observations findings and conclusions in this report have been based wholly or partly in reliance upon data and information obtained from the Client, Government sources and/or from others identified in the report. KBR has relied upon such data and information and has assumed it to be complete and accurate. Except as otherwise stated in the Report KBR has not attempted to verify the accuracy completeness of currency of any such data and information. The passage of time, manifestation of latent conditions or impacts of future events may require re-evaluation of the findings, observations and conclusions expressed in this report.

Except as expressed in the Contract KBR gives no warranty or guarantee whether express or implied concerning the accuracy or fitness for purpose of the Report. This Report does not constitute and is not represented by KBR to be an opinion or recommendation concerning financial matters, the soundness of any investment, any legal position, any level of risk or about the success or failure of any activity. The Client is solely responsible for the level of reliance it places upon the application and use of this Report in the context of the many independent and variable factors required to be taken into account when making commercial or lending decisions.

This Independent Verification report is signed on behalf of the Kellogg Brown & Root Pty Ltd (KBR) Independent Verification team by the KBR Industry Director (Water) NSW David Abbey. Refer to Appendix A for details of the Independent Verification team's qualifications and experience.

Report Signatory:
David Abbey – MSc (Structures), BSc (Civil Engineering),
NSW Industry Director- Water KBR

Signed: Date: 23/8/07

1 Introduction

In late 2005 Sydney Water Corporation (SWC) called for expressions of interest to design, construct, commission and operate the Camellia Recycled Water Project. The tender evaluation and assessment program is now in Stage 2 with two short-listed tenderers.

Sydney Water proposes to develop the Project through a Design, Build, Own and Operate delivery process. The Returnable Schedule 6 - Technical Sufficiency, from the Request for Detailed Proposal (RDP) requires an independent verifier to provide a design verification report. Kellogg Brown & Root Pty Ltd (KBR) was contracted by AVA Water Consortium (AVA) to provide a verification report.

Based on comments from Sydney Water, the initial scheme has been modified to 25MLD. This report provides verification of the modified scheme.

2 Verification Methodology

The IV considers that the essential service was to assess the proposed design outlined in the revised schedule 6 against the requirements of the SWC Request for Detailed Proposal (RDP). Verification did not consist of a detailed check of the tender design, however the service will provide assurance to AVA and SWC that the proposed solution complies with SWC requirements.

The design is at concept level for tendering purposes. KBR have based their comments on the information provided by AVA.

The intent of this verification is to provide a 'high level' check on the proposed design and review of assumptions and design criteria ensuring that the design assumptions by AVA are reasonable and that the methodologies undertaken for risk, cost and timing are acceptable in meeting SWC requirements.

3 Information Reviewed

The following information was supplied for review:

- Revised Proposal: Camellia Recycled Water Project: - Returnable Schedule 6- Technical Sufficiency -Submitted to SWC on 29th June 2007
- The technical information reviewed as part of the IV report dated 14th April 2007 for the original Camellia Recycling Scheme
- Document No:B0223-MR-0000-01
- Operational costing model and P&IDs viewed at on Veolia's computers (23/08/07)
- Documents : D1A_No.2 REV 4, D1A_No.3 REV 4, D1A_No.4 REV 5 & D1A_No.9 REV 3,

4 Verification Findings

4.1 Review of response to SWC feedback

Clarify how the proposed treatment train will achieve the limits for ammonia alkalinity and total nitrogen and phosphorous as stated in the RDP

Ammonia &Total N

AVA has introduced a cationic ion exchange plant downstream of the RO plant. The IV concurs with the comment that the introduction of this unit operation will increase the ammonia removal achieved by the system.

Furthermore, AVA advise that the additional unit will ensure compliance with the total nitrogen & ammonia limits proposed by SWC.

Alkalinity

AVA advice that they have based their design on the understanding that the alkalinity value specified in Table 8.1 of the RDP document is not a target (Addendum 5). Consequently, the process train does not contain a specific process aimed at producing an alkalinity of <5mg/L. The IV concurs with the statement that despite no specific process it is expected that the plant will produce water with a reasonably low alkalinity. However, there is insufficient information for the IV to ensure that the plant will achieve an alkalinity of <5mg/L.

Phosphorous

AVA has noted that over 95% of the total phosphorous entering the plant should be as reactive phosphate. Furthermore, the IV notes that the introduction of a coagulation step will also reduce the phosphorous load on the membrane plant.

Rejection rates of phosphate, nitrate and ammonia outlined in Schedule 6 are typical for RO membranes. However, it is noted that the rejection rates are dependent on a number of conditions specific to the plant such as membrane types, membrane age, temperature and speciation of the ion. A detailed assessment on specific plant conditions has not been undertaken for this initial review.

Clarify why the trigger limits for Chlorine and TDS are inconsistent with the limits in the RDP

AVA have noted that the design has been modified to ensure that trigger limits for chlorine and TDS are consistent with the RDP

There are inconsistencies regarding the volume of the waste stream. Refer to Pages 21,27,31 53 and 98 of Schedule 6. Clarify the amount of UF waste stream volumes and total waste stream volumes

AVA has identified the daily UF waste stream volume as 2851Kl/day or 2908Kl/day including the chemically enhanced backwash and UF CIP.

AVA have advised that the Wastewater discharge for the 20ML/d plant can range from 8.2ML/day to 10.1ML/day depending on the ammonia concentration in the LAP. The high variation in waste volumes is due to the proposed dilution of the ammonia levels.

AVA advice that dilution will not be required when the concentration of the ammonia in the LAP is less than or equal to its 50%ile level of 28mg/l. Maximum dilution is expected when the ammonia concentration in the LAP is at its 90%ile value of 33mg/L.

Explain how waste flow to the sewer will be controlled to meet sewer capacity requirements.

The IV notes that volume and ammonia concentration limits are the limiting factors in meeting requirements. AVA propose to dilute the plant waste only when required to meet the requirements of the trade waste standards.

AVA also note that they do not anticipate that large on site storage of waste will be required to cater for sewage discharge restrictions caused by wet weather events since SWC has indicated that if wet weather events occur, effluent from the Glenfield STP will be diverted and thus the LAP will not have sufficient capacity to service the plant at 20ML/day.

The requirements for onsite wet weather storage was not verified in this initial review. However, AVA advice that there is sufficient storage space available if required.

In your Submission, you note that TDS would be measured before pH adjustment. Clarify how this measurement will comply with the RDP requirements for TDS of 50mg/L

AVA has adequately addressed this issue by locating the monitoring point for recycled water quality, including TDS, at the outlet of the chlorine holding tank. The chlorine holding tank is located down stream of chlorine dosing and pH adjustment.

In your Submission, no CCT is nominated in your process train. Clarify how you propose to comply with 1mg/L of free chlorine after 1 hour detention

AVA plan to introduce a chlorine holding tank with a 1 hour residence time prior to final storage. The tank size is 1050kL which is an adequate size to provide a detention time of 1 hour when operating the AWTP at 25ML/day.

4.2 Verification of plant process design - quality, quantity and reliability

Treatment Process Overview

The main unit operations incorporated in the treatment process as shown in Veolia's process flow diagram are; basket strainers, ultrafiltration (UF), reverse osmosis (RO), ion exchange and degasser, waste neutralization and disposal, storages (feed balance storage, RO feed balance, RO permeate collection, recycled water and RO clean in place (CIP) tank), chemical dosing (ammonia, hypochlorite, citric acid, sulphuric acid, sodium bisulphite and caustic soda).

The treatment process information provided is limited and consequently the IV's assessment is limited to the process overview. However, the level of technical design undertaken is considered satisfactory for a conceptual level design.

Basket Strainers

Basket strainers with a screen size of 500 micron are proposed to screen incoming effluent. This appears to be an appropriate technology selection for the protection of the UF membranes. The capacity of the units, material selection, instrumentation or control system was not verified in this initial review.

Ultrafiltration

A Memcor submerged Ultrafiltration system has been proposed. The technology selection appears to be an appropriate pre-treatment for the reverse osmosis system. The risks attendant with UF fouling and subsequent loss of flow to the RO is mitigated by the inclusion of a single fully redundant train, which lowers the design operating flux from 41 L/m^2h to 33 L/m^2h when in operation .

Coagulation prior to the UF process has been introduced which will also help reduce the risk of fouling in addition to the removal of some TOC/BOD. The proposed type of coagulant and approximate dosage rate appear to be appropriate for this application.

Reverse Osmosis

A two (2) stage reverse osmosis system consisting of Saehan membranes has been provided. The technology selection is an appropriate desalination system. The system has in total eight (8) RO trains and has been sized on a flux of 17.2L/m^2/h to provide a net permeate of 20ML/d. The system appears to be adequately sized for flow requirements of the network distribution design.

Ion Exchange and degasser

The AVA have introduced Ion Exchange (IX) to remove residual ammonia from the RO permeate. This technology is appropriate for the removal of ammonia from water, however; details provided to the IV are limited for this initial review. Data on resin type, capacity, selectivity and kinetics is required in order for the IV to comment on the IX plant.

Process flow diagrams indicate that the IX waste is recycled back to the coagulation tank, a review of the chemistry and mass balance is recommended to assess the risk of scaling & if the IX is adequately sized.

The 5% sulphuric acid used to regenerate the IX will be produced in-situ. Review of the energy balance around this operation is recommended to assess if this will have an adverse effect on resin life.

Waste Neutralization and Disposal

A waste neutralization and disposal system has been provided for the waste streams. This is considered an acceptable technology selection for the neutralization and disposal of the waste streams. Information on the capacity of the units, details of mechanical fit outs, size of units, material selection, instrumentation or control system was not provided for this initial verification.

Storage Tanks

AVA notes that the on-site chemical storage has been sized to provide 24 days consumption plus an additional 7 days to allow for chemical delivery lead times based on the 25ML/day plant capacity. The IV notes that the storage capacities appear to be sufficient.

Chemical Dosing

Generally the chemical dosing proposed appears satisfactory for the concept design of the RWTP. Information on dosing rates was not provided for this initial review.

Plant Size

The plant is designed for an average output of 20ML/d with a potential to expand to 25ML/d thereby satisfying the requirements of the distribution network design to ultimately meet customer demand. The concept design appears to provide sufficient treatment capacity based on installed membrane area and intermediate and final storage capacity to deliver the rated plant output.

Waste Disposal and Bypass

Estimates of waste generation are in the vicinity of 8 to10 ML/day. This ratio is dependent upon a request for the relaxation of the ammonia concentration limit. There is a proposed cross connection with the Liverpool to Ashfield Pipeline (LAP) that is sized to bypass the peak output of the RWTP for use during commissioning. Any out of specification recycled water will now be discharged to the sewer at the minimum plant operating rate.

RWTP Reliability

The IV cannot verify operating life expectancy of plant components as is not possible to comment on issues such as fouling management and membrane protection due to limited information on the level of instrumentation and data management.

The UF system consists of 5 trains with 1 standby train and the RO system consists of 8 trains with 1 standby train. The system appears to have adequate redundancy.

Interchange ability is provided for the RO process. The RO trains use standard element pressure vessels which can accommodate a range of RO membranes. The UF system will be limited to membranes supplied by Siemens.

4.3 Verification of the proposed distribution network design

AVA have designed the network with two distinct operating zones, southern Smithfield region and northern Camellia region. AVA has noted that this design philosophy allows increased reliability, with the ability to operate each zone independently. The three reservoirs (Fairfield RWTP clear water tank, elevated reservoir and Camellia reservoir) have been provided with potable water top-up, allowing for a total of 12.3ML/d to supplement the recycled water supply.

Verify Distribution Network Design

The head loss at some sections of the transfer mains is estimated by AVA at 7 m/km during peak flow periods, which exceeds the recommended level of WSA Water Supply Codes. However, despite the higher design head loss, the velocity remains within the WSA guidelines of 2m/s. AVA have noted that the design approach was to maximise the use of the 12" gas main along Woodville Rd. AVA consider this approach to be consistent with the intent of the code to provide an economic design.

AVA propose to use SDR 17 polyethylene pipe downstream of the Woodville reservoir. This pipe class is less than the minimum pipe class rating of PN16, recommended in WSA 03-2002. AVA have addressed the risk associated with this and have noted that the maximum operating pressure in this section will be much lower than the recommended maximum operating pressure of SDR 17 polyethylene pipe.

It is understood that preliminary hydraulic assessment has been conducted to optimize head loss and achieve desired performance along RW distribution network. The hydraulic assessment has not been verified in this initial review.

Verify Pipe Networks & Valve Selections

The network components and connection details appear to be in compliance with WSA03-2002 and WSA02-2002. The valve types offered appear to be appropriate under the WSA specifications however valve sizes are yet to be selected.

Pipe material selections offered are all plastic which are appropriate for recycled water systems. The predominant choice is PVC-O or GRP for trenched section and PE100 for directionally drilled and thrust bored sections. No jointing systems have yet been specified.

4.4 Verification of operation, monitoring and reporting protocols

Verify Flow Estimation (Inflow - Secondary Treated Effluent)

AVA have indicated that the RWTP inlet and waste discharge have been designed for capacities of 37 ML/d and 10ML/d respectively. These capacities are adequate for the design flows of the RWTP.

Verify Supply Reliability from Reservoirs

The sizing of the reservoirs at Woodville Golf Course and Camellia appear to be satisfactory and have accounted for

- operation volume that is 0.8 times the foundation customers peak hour demand
- A Dead volume of 0.25m at the base of the tanks
- and a freeboard of 0.25m

Verify Operation and Maintenance

Reservoirs

The operation and maintenance of Woodville Golf Course and Camellia Reservoirs without disruption to services is possible under the current configuration. The storage at twin compartments of Camellia Reservoir (storage capacity equivalent to a mean day demand) and potable water top up arrangements are expected to ensure the continuous supply of RW.

Water Supply Network

The water distribution network, pump stations, reservoir, actuated valve and metering stations will be fully automated and suitable for unsupervised control and operation.

The pump at the transfer pump station will be fitted with suitable instrumentation and will be controlled from the SCADA system sited in the Fairfield plant. Both the Camellia and Fairfield pump stations contain variable speed drives.

It is proposed that the pumping units at the Fairfield Pump Station will be controlled via the level at the Woodville Elevated reservoir with additional pressure feedback from the pressure transmitter at the Marubeni off take, while the pumping units at Camellia Pumping Station will be controlled by a pressure transducer at a remote location of the transfer main. Additional review of this arrangement is recommended.

AVA has indicated that the locations and discharge rates of the scour valve outlets to the sewerage system have been identified and approved by SWC.

Maintenance of Critical Mains and Mechanical-Electrical Components

The asset management plan presented by Alinta for periodic and preventative maintenance of critical RW mains, pumps, valves, motors and ancillary components appears to be satisfactory and in line with the asset management plan of major water utilities. There appears to be minimal disruption of services when a pumping unit is off-line for maintenance purposes at RWTP and Camellia Reservoir.

RWTP

There appears to be minimal disruption of RW production during maintenance of UF and RO units. The adjustment of flux rate at UF unit and inclusion of an additional RO unit appear to be adequate to undertake scheduled maintenance works without affecting the RW production.

SCADA System

The SCADA system and ancillary instrumentation and monitoring units appear to be satisfactory. The system will be designed to log a number of process parameters suitable for tracking the plant performance and also for development of O&M plan. Instrumentation to monitor inflow rate from LAP, waste generation and volume of RW production could not be verified

4.5 Verification of operating cost estimates

The methodology adopted in determining the operating cost appears to be satisfactory. The costs appears to be based on supplier quotes and in-house experience.

Appendix A - KBR Independent Verification team qualifications and experience.

The verification team for the revised scheme comprises the following IV Staff:

- Kanishka Banerjee - *MESc (Environmental), BE (Chemical)*
  Technical Input - Process engineering review.
  Experience - Kanishka has more than 12 years of experience in water and wastewater treatment and the chemical industry, specialising in the treatment of industrial and municipal wastewater.
- Brendan Halyburton - BE (*Chemical*) (Honours)
  Technical Input - Report co-ordinator, author and process engineering review.
  Experience - Brendan is a chemical engineer with 5 years experience in the mining, water and wastewater industry. He has experience with membrane based separation process and adsorption process such as ultrafiltration, reveres osmosis, nanofiltration and ion exchange.
- Martin Vries - MBA (Economics & Finance) , MSc (Civil & Coastal Engineering)
  Technical Input - Project supervisor.
  Experience - Martin has over 20 years of experience with a solid background in project management, business development, sales, production and business unit management He has an extensive knowledge in developing and implementing infrastructure related business strategies in Australia

Rosehill and Camellia Recycled Water Project

Plant Agreement

AquaNet Sydney Pty Limited
(as agent for Rosehill Project Joint Venture)

ACN 131 235 124
Project Company

Veolia Water Australia Pty Ltd

ACN 99 061 161 279
Veolia Company

Exhibit J: Verification Management Plan

Signed for identification purposes by on behalf of **Project Company**	Signature
Signed for identification purposes by on behalf of the **Veolia Company**	Signature

EXHIBIT J

VERIFICATION MANAGEMENT PLAN

DOCUMENT CONTROL

Rev No	Date	Revision Details	Prepared	Checked	Reviewed	Approved
1	20-08-07	Included as Part of Camellia RDP tender submission	KBR	ALINTA		ALINTA
2	03-04-08	Up-dated by KBR to Sydney Water requests (letter 19 March 2008)	KBR	ALINTA		
3	08-04-08	Final agreed changes to Section 7.6 (page 21) and Section 10.1 (page 27)	KBR	ALINTA	ALINTA	
4	10-04-08	All references to AVA renamed as AquaNet. Changes sent to Veolia	CS	LC		
	21-04-08	Veolia Changes incorporated	CS	CS		

CONTENTS

1. INDEPENDENT VERIFIER DETAILS

Kellogg Brown & Root Pty Ltd (KBR) is AquaNet's proposed Independent Verifier.

The key verification signatory representing KBR, nominated as the IV Representative (Project Director), will be **Martin Vries** (Senior Project Manager) with credentials of a Master of Business Administration (Economics and Finance)University of Rochester and The Erasmus University of Rotterdam, Master of Science (Civil & Coastal Engineering),Technical University of Delft.

In case of the need for alternatives, **David Abbey** (Director, Major Projects) or **Geoff Borton** (Industry Director, Water) are nominated KBR management staff with approved verification responsibility.

KBR has the following Independent Verification, and design and construction certification project experience:

Project	Sector	Certification of design, construction	Independent Review	Asset Valuation
Sydney Desalination Plant (BlueWater)	Water		✓	
Murrumbidgee Irrigation Mini Hydro	Water		✓	
Grampians Water BOOT	Water	✓		
Illawarra & Woronora Treatment Plants	Water			✓
Yarra Valley Water	Water		✓	
Townsville International Airport	Airports		✓	
Stadium Australia	Buildings	✓	✓	
Central 2000	Buildings	✓		
Gas distribution, Melbourne CBD	Gas		✓	
Moura Ammonium Nitrate Plant	P&C	✓		
EFIC Technical Assessment Services	P&C	✓	✓	✓
Flinders Ports	Ports	✓		
Basslink	Power		✓	
Rolling stock acquisition	Rail	✓		
Auckland Rail corridor audit	Rail		✓	
Tranz Rail Infrastructure	Rail		✓	
Bauhinia Regional Rail Project, Qld	Rail	✓	✓	
M5 SW Motorway	Roads		✓	✓

2. INTRODUCTION

The verification functions of the Independent Verifier (IV) role are summarised in Schedule 2 of the Independent Verifier's Deed of the Project Agreement.

This Verification Management Plan (VMP) provides an outline of the verification procedures to be used by KBR in the Rosehill and Camellia Recycled Water Project.

At this stage of the project, namely AquaNet's design and construction submission, full details are being established and only the principles for the development of the VMP are provided. Upon approval of the IV role and agreement under the Deed, verification activities will commence, including an up-date of this VMP to meet final (agreed) design and construction details and schedules.

Generally the Independent Verifier shall review plans, reports, documents, submissions, and records submitted, provided or supplied by AquaNet, for review. The Independent Verifier will assess the plans, reports, documents, submissions and records for compliance with the requirements of the Project Agreement, the consolidated AquaNet revised offer of 24 August 2007 and any subsequent agreed terms and conditions. All verification activities will be carried out in accordance with this VMP.

The Independent Verifier shall report directly to both Sydney Water and AquaNet.

3. PROJECT DEFINITION

3.1. SCOPE OF WORK

A Recycled Water System will be designed and built to supply seven (7) Foundation Customers and (6) six Non-Foundation Customers in the Camellia and Smithfield areas.

The system will involve sewer mining from the Liverpool to Ashfield Pipeline (LAP) followed by treatment to produce recycled water and a piping network for distribution to initially these Foundation Customers and Non-Foundation Customers.

The project scope will include:

- Obtaining approvals for the recycled water treatment plant and the delivery pipe network (Recycled Water System) to deliver recycled water to Foundation and Non-Foundation Customers
- Designing, constructing and commissioning the Recycled Water System
- Operating and maintaining the Recycled Water System
- Engaging with stakeholders and consulting with the community at each stage of the project
- Arranging financing for the design, construction, commissioning and operation of the Recycled Water System and supply of recycled water
- Providing recycled water to SWC for on-sale to its Foundation Customers

To ensure contract compliance and in order to facilitate the timely and successful delivery of this project, an Independent Verifier (IV) is to be appointed. The Independent Verifier is required to verify the adequacy of the AquaNet management systems and will be required to receive, review, observe, monitor, audit, verify and endorse AquaNet's documents, management plans, processes and other works outlined in the Project Agreement. The IV has verified and issued a certificate for the tender project scheme, as well certifying the subsequent 24 August 2007 revised scheme from AquaNet.

The IV role is not to undertake any "proof engineering" services as a part of this project.

3.2. OBJECTIVES

The objectives of this VMP are:

- To provide a detailed description of how the Independent Verifier and AquaNet intend to carry out their obligations in connection with the Independent Verification in accordance with the requirements of the Project Agreement

- To demonstrate to SWC that the Independent Verifier has the understanding and capability at all times to carry out the verification activities in accordance with the requirements of the Project Agreement

- To ensure that the verification activities comply with the requirements of the Project Agreement and the finally agreed project scheme

- To define responsibilities, resources and processes for planning and performing the verification activities

- To allow SWC and AquaNet to understand how the Independent Verifier will achieve the performance outcomes specified in the Project Agreement

3.3. INDEPENDENT VERIFIER OBJECTIVES

The Independent Verifier has the following objectives:

- Verify that the processes employed in the design of the Recycled Water System comply with the requirements of the Project Agreement, relevant specifications, and the Project Management Plans

- Verify that the processes employed in the construction and commissioning of the Recycled Water System comply with the requirements of the Project Agreement, relevant specifications, and the Project Management Plans

- Add value as appropriate to the design components of the Recycled Water System

- Support Sydney Water and AquaNet in delivering an incident-free project

- Provide assurance to Sydney Water that the Recycled Water System has been delivered according to specifications and procedures agreed and as required by Sydney Water and is “fit for purpose”.

3.4. SCOPE OF SERVICES

The Independent Verifier is required to complete the functions specified in Schedule 2 - Independent Verifier Services of the Project Agreement.

The scope of services can be summarised as follows:

- Review the Project Management Plans (PMPs)

- Review, up-dated or amended PMPs

- Up-date the VMP in accordance with changes in other PMPs and the detailed development of construction and commissioning schedules

- Undertake verification of the detailed design work packages (review of technical adequacy for compliance with the Project Agreement and necessary specifications)

- Certify final design packages are in accordance with the Project Agreement (noting that no forms of “proof engineering” of the scheme will be undertaken under this IV role)

Undertake audits of AquaNet's design process including:

- Audit the execution of the Design Management Plan and other Management Plans relevant to the design process
- Audit methods and records for the design work packages
- Audit the compliance records relating to the review of each design work package
- Monitor the construction works and schedule and advise whether works are being constructed in accordance with the project requirements
- Audit the execution of the Time Management Plan, Construction Management Plan, Commissioning Management Plan, OH&S, Environmental and Quality Management Plan, and the Community Consultation Management Plan
- Advise SWC on applications for extensions to the Date for Completion
- Audit, monitor and inspect the commissioning process and certify compliance for commissioning Inspection and Test Plans (ITPs)
- Verify and certify defect rectification documentation
- Provide advice on determinations for Practical Completion and Completion
- Provide advice allowing issue of Certificates for Practical Completion and Completion
- Audit records and endorse Completion of the works
- Where the Independent Verifier considers that any plans, reports, documents, submissions or records provided by AquaNet do not comply with the requirements of the Project Agreement or the Management Plans, the Independent Verifier will notify AquaNet and SWC of the areas of non-compliance

In addition to the above scope of services, the Independent Verifier will be responsible for the delivery of the Independent Verification in accordance with this VMP. As such, verification project management services shall include (to the extent necessary to deliver the technical scope):

- Management of client interfaces and inputs
- Attendance at project control group monthly meetings
- Updates and implementation of the VMP
- Quality management
- Project controls
- Health, safety and environmental management
- Risk management
- Project reporting
- Quality auditing

- Close-out management

The Independent Verifier's Scope of Services explicitly excludes Proof Engineering and/or Preferential Engineering of any of the Designs that make-up the scheme.

3.5. ROLES, RESPONSIBILITIES AND AUTHORITIES

This section summarises the roles, responsibilities and authorities of the Independent Verifier and AquaNet in relation to the independent verification of the Project works as required by the Project Agreement.

3.5.1. INDEPENDENT VERIFIER ROLES AND RESPONSIBILITIES

The role of the Independent Verifier is to:

- Independently verify in accordance with the Project Agreement, the Deed of Appointment of Independent Verifier and this Verification Management Plan that the Project Works and AquaNet's Work comply with the requirements of the Project Agreement, the Service Delivery Outcome Specification and the PMP's

- Provide advice on determinations of extensions of time, Commissioning and Completion and other matters that the Project Agreement requires be determined by the Independent Verifier

- In accordance with this Verification Management Plan, monitor AquaNet's Work in order to form an opinion as to whether the construction obligations of AquaNet are being complied with and, in particular, whether the Project Works are being constructed in accordance with the requirements of the Project Agreement, the Service Delivery Outcome Specification and the Project Management Plans

The responsibilities of the Independent Verifier are:

- To provide suitably experience and skilled personnel

- To act independently of the Parties, the Financiers, their Associates and any of their subcontractors

- Conduct reviews, verifications and audits as required by this Verification Management Plan

- Discharge all functions referred to or contemplated in the Deed of Appointment of Independent Verifier

3.5.2. INDEPENDENT VERIFIER AUTHORITIES

The authorities of the Independent Verifier are:

- Right of access during usual business and/or construction hours or on reasonable notice to Project Land and areas relevant to AquaNet's Work (subject to safety and security constraints)

Determinations made by the Independent Verifier will be final and binding upon the Parties except in the case of manifest error.

Authority for the Independent Verifier or person/s nominated by the Independent Verifier to monitor such commissioning tests.

3.5.3. CONTRACTOR RESPONSIBILITIES

AquaNet's responsibilities to the independent verification process are:

- To ensure that internal verification and validation is complete prior to submitting material to the Independent Verifier
- To submit documents in sufficient time for their review, return and resubmission in accordance with the agreed programme
- To provide to the Independent Verifier on a monthly basis an updated schedule of drawings showing current issue and amendment status

4. DELIVERABLES AND METHODOLOGY

4.1. DELIVERABLES

4.1.1. CERTIFICATIONS

The primary deliverables from the Independent Verifier are:

- Certification of compliance for Project Management Plans
- Certification of design reports and drawings
- Certification of construction and commissioning reports and drawings
- Certification of defect rectification

4.1.2. REPORTING AND NOTIFICATION

The primary deliverables from the Independent Verifier are:

- Notification to SWC of non-compliant plans/packages
- Design Validation Reports
- Audit Reports
- Compliance Records

4.2. PROJECT PLANS

Verification commences with a review of the AquaNet's PMP's:

- Project Management Plan

- Time Management Plan
- Approvals Management Plan
- Design Management Plan
- Construction Management Plan
- Commissioning Management Plan
- OH&S, Environmental and Quality Management Plan
- Operations & Asset Management Plan
- Community Consultation Management Plan
- Verification Management Plan

These PMP's shall be assigned for verification by the IV Project Manager to appropriate (approved) personnel to verify compliance with the Project Agreement. Certification of compliance of all management plans shall be provided to both AquaNet and Sydney Water.

Verification of the PMP's will ensure that they include:

- Detailed descriptions of how AquaNet intends to carry out it's obligations in accordance with the Project Agreement and with respect to the subject matter of each PMP
- Evidence that AquaNet has the understanding, capacity and capability to carry out AquaNet's work in accordance with the requirements of the Project Agreement
- Ensure that the project works comply with the requirements of the Project Agreement
- Defined responsibilities, resources and processes for planning, performing and verifying AquaNet's work

Where the Independent Verifier considers that any of the above plans supplied by AquaNet do not comply with the requirements of the Project Agreement, the Independent Verifier will advise AquaNet and Sydney Water of areas of non-compliance for correction.

4.2.1. UPDATED AND AMENDED PROJECT PLANS

The PMP's will require ongoing development, amendment and updating throughout the duration of AquaNet's work. These updated Project Management Plans will be submitted to the Independent Verifier. The Independent Verifier will review and certify these plans as outlined above.

4.2.2. UPDATE OF THE VERIFICATION MANAGEMENT PLAN

Updates of this VMP will be undertaken throughout the duration of AquaNet's work to align with changes in the PMP's, and subsequent detailed development of the construction and commissioning schedules.

4.3. TECHNICAL VERIFICATION

The Independent Verifier is required to review and confirm, by reasonable overview and general checking, the adequacy and compliance of the design, construction and commissioning elements of the project; as required to verify the adequacy of the AquaNet management systems and endorse AquaNet's documents, management plans, processes and other works outlined in the Project Agreement.

The Independent Verifier has issued a certificate for the tender project scheme, as well certifying the subsequent 24 August 2007 revised scheme from AquaNet.

The Independent verifier will not provide a "preferential engineering" function nor undertake any "proof engineering" services as a part of this project.

4.3.1. ENGINEERING DESIGN VERIFICATION

The Independent Verifier will review compliance with the design verification which will be conducted at prescribed stages of design development. Generally the design verification will include:

- Overall design concept and assumptions
- Validity of the processes and compliance with Sydney Water's requirements used to arrive at design inputs, assumptions, design requirements and calculation methodology
- Methodology proposed for the design construction including associated technical and scientific field work
- Technical design compliance with the Project Agreement
- Technical feasibility of proposed construction techniques
- Electrical and instrumentation design
- Control philosophy for the scheme
- Prevailing environmental factors that may affect the design,=
- Compliance with statutory requirements
- The design's consistency with industry and Sydney Water standards
- Efficiency of the design and/or recommendations in terms of time and cost
- Health, Safety and Environmental requirements
- The standard of supporting documentation defining the design

Procedures and requirements for the design verification are contained in Section 9 - Engineering Design.

4.3.2. CONSTRUCTION AND COMMISSIONING VERIFICATION

The Independent Verifier will use on-site inspection, observation, audit and review of AquaNet's Quality System, Procedures Manuals and Quality Control Procedure to verify compliance with construction and commissioning activities. This will include:

- Review and verify the Construction Management Plan, construction planning documents and construction work packages
- Monitor compliance with project plans, specifications and with approved design plans
- Verify the compliance of the processes and outputs described in the Commissioning Management Plan

Procedures and requirements for the construction and commissioning verification are contained in Section 10 – Construction and Commissioning.

4.4. PROJECT AUDITS

Generally the auditing process will be split into three (3) areas; design process audits, construction process audits and commissioning process audits. A general overview of the auditing methodology is presented in this section. Detailed auditing procedures are found in Section 9 – Engineering Design, Section 10 – Construction and Commissioning, and referenced Appendices.

4.4.1. DESIGN PROCESS AUDITS

Auditing of the design process is generally an audit of the execution of the Design Management Plan and other Management Plans associated with the design process. Specifically the audits will consider the methods, procedures and records used by AquaNet in preparing, verifying and validating the respective design work packages.

Audits will be undertaken of the compliance documentation supplied with the design work packages. Audits will also be scheduled in AquaNet's and associated sub-contractors' offices to review compliance with the design quality assurance systems as described in the Design Management Plan.

4.4.2. CONSTRUCTION AUDITS

Auditing of the construction process is generally an audit of the execution of the Construction Management Plan and other relevant Management Plans, particularly the OH&S, Environmental and Quality Management Plan, the Time Management Plan, and the Approvals Management Plan.

Based on AquaNet's Inspection and Test Plans (ITPs) and construction programme, a schedule of regular quality compliance audits will be prepared. This schedule is subject to continual change and updates, as the construction programme changes to suit actual on site activities.

The quality compliance audit will consist of auditing all AquaNet's quality records, to ensure that AquaNet has documented evidence to show that the completed works comply in all respects with the requirements of the contract documents, and to ensure that AquaNet is providing surveillance and checking of quality in accordance with approved ITPs.

4.4.3. COMMISSIONING AUDITS

Auditing of the commissioning process is generally an audit of the execution of the Commissioning Management Plan and other Management Plans associated with the commissioning process.

The quality compliance audit will consist of auditing AquaNet's quality records, to ensure that AquaNet has documented evidence to show that the commissioning of works comply in all respects with the requirements of the contract documents, and to ensure that AquaNet is providing surveillance and checking of quality in accordance with approved ITPs.

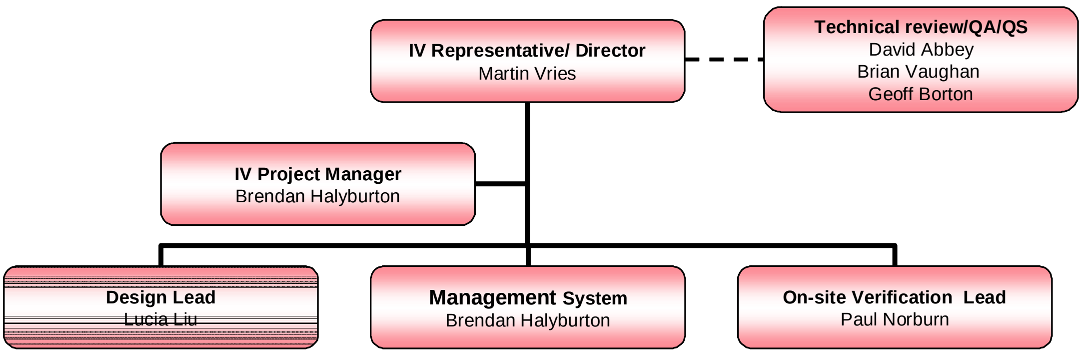
5. PROPOSED INDEPENDENT VERIFIER ORGANISATION AND COMMUNICATION

5.1. PROJECT TEAM

The proposed Independent Verifier's project team key members and the lines of communication of the verification team shall be as follows in Figure 1.

Personnel nominated below have current IV experience and procedural compliance skills, being primarily the team members from the existing BlueWater JV (John Holland and Veolia) seawater desalination plant project for Sydney Water. The nominated external auditor (Brian Wytes) is also from that project. The nominated specialist for Membranes includes UNSW academics that had been involved with the original certification work for this project.

Figure 1: Project Verification Organisation Chart



Independent Verification Resources

Process: Lucia Liu	**Mechanical:** Mukhlesur Rahman	**Environmental:** Emma Taylor
Civil/ Structural: Paul Norburn	**Electrical:** Tim McCluskey	**Commissioning:** Fred Barendregt
Risk/Reliability: Ragu Nayak	**OH&S/ Quality:** Simon Pickles	**Procurement:** Geoff Borton
Membranes (external expert): Irving Moch (USA) & Dr Greg Leslie (UNSW)		**Membranes (local):** Dr Tony Fane
Instrumentation: Romero D'Souza	**Structures**: Richard Wilson	**Piping/pump stations:** Geoff Byrne
Hydraulic & Network: Robert Wilson	**Construction:** Ben Shannon	**Auditor:** Brian Wytes (external)
Approvals/Planning: Penny Goldin	**Environment:** Ana Reilly	**Pipelines:** Vincent Cheah
Mechanical: Hendra Sutoyo	**Mechanical:** Dianne Thomas	**Operating/Asset Management:** Ian Watts
Time Management: Anthony Hough	**Process:** Catherine Vero	**Approvals:** Angelique Easton
Pipeline/network: Emma Roberts	**Pipeline/Network:** Navneet Kaur	**Process:** Kanishka Banerjee

5.2. ORGANISATION AND MANAGEMENT

The Independent Verification role will be managed by the proposed IV Representative (Project Director) and the IV Project Manager. The IV Representative's responsibilities and authority include:

- Discharge all functions under the IV Deed and the relevant clauses of the AquaNet Project Agreement;
- Accept overall responsibility for outcomes of the IV processes;
- Issues Certificates and determinations as required under the IV Deed;
- Ensure the VMP provides the necessary compliance controls to ensure conformance with the Independent Verifier's contractual obligations and achievement of the IV Quality Policy;
- Authorise and Review the IV Management Plan and all subordinate policies, plans and procedures;
- Participate in the review of the IV Management Plan;
- Represent the IV Team at meetings with the Project Parties (AquaNet and Sydney Water);
- Undertake and authorise/approve commercial and technical negotiations;
- Manage financial matters relating to the IV Deed ; including cost reporting, IV fee variations, forecasts and progress claims;
- Check that effective communication is maintained at all time with the stakeholders;
- Check that adequately trained and qualified personnel are available to meet the requirements of the IV Deed
- Establish arrangements that will ensure that all IV staff are aware of their responsibilities under the IV Quality System;
- Promote a culture of responsive service and continuous improvement to business processes;
- Ensure regular audit and review of the IV Quality System; and
- Receive advice from and provide direction to the IV Project Manager.

The IV Project Manager is to manage the day-to-day activities, including being the principal interface of the IV resources with both AquaNet and Sydney Waters Representative. Functions will include:

- Receive all relevant documentation from AquaNet and Sydney Water's Representative
- Manage and be responsible for the assessment of AquaNet's Project Plans

- Assign design verification, construction verification, commissioning verification and auditing tasks to relevant (appropriate and approved) team personnel
- Manage meeting attendances with AquaNet and Sydney Water's Representative for verification personnel
- Provide the certifications required by Schedule 2 - Independent Verifier Services

5.3. PROJECT COMMUNICATION

Internal project communication will involve the following:

- Presentation of this VMP to all team members
- Independent Verifier team meetings
- Independent Verifier review team meetings
- Management team meetings

External communication with AquaNet and Sydney Water will be initiated by the IV Project Manager, and will consist of:

- Design verification reports (in the form of work verification records)
- Scheduled meetings
- Audit reports
- Progress reporting
- Schedule variation/revision
- Confirmations/clarifications
- Formal notifications (all types)
- Further information requests

5.4. DOCUMENT CONTROL

The Independent Verification process document control shall be in accordance with our proposed Independent Verifier, KBR procedure WM-AUSTMUL- DM-003, Project documentation management.

All incoming and outgoing documentation shall be issued and received via the Document Controller.

All documents and drawings shall be stored electronically in a web based proprietary document management system called Documentum. All approved project personnel will have access to Documentum. All deliverables shall be transferred to the Released cabinet by the Document Controller in accordance with KBR procedure PM-AUST-MULDM- 002, Documentum - Data transfer working - released cabinets.

The Document Controller shall maintain a complete document register for the project using the Document Management System (DMS version 3.08).

All wet signature master documents and/or drawings shall be filed in the Document Control Area. All compliance records shall be filed in the Document Control Area.

6. RISK MITIGATION STRATEGY

6.1. OVERVIEW

Risk management strategies will be work-shopped with AquaNet and their Designers when the designs are sufficiently developed to lead to meaningful conclusions.

The major risks for the Independent Verifier have initially been identified as timing (related to turn around of the design packages within the time limits set by Sydney Water), the ability to complete the work packages within the defined budget. Community consultation and statutory approvals are high risk items, but beyond the control of AquaNet and the IV role. A number of other risk items and strategies related to these independent verifier risks are outlined below:

Risk category	Description	Possible consequence	Risk treatment strategy
Cost	The designers may fall behind programme.	Cost increases caused by inefficiencies in the IV process.	Monitor progress through design meeting processes to refine resource scheduling.
Time	Construction departs from design. Designer would advise rectification which may require IV approval.	Time delays.	Monitoring by IV to ensure system is capturing this as non-conformance, and disposition is reviewed and agreed prior to corrective action.
Time	Impact of other (similar) projects may limit resources for this project.	IV milestones are missed resulting in overall project delays.	Ensure estimated hours are fed into MSP enterprise resource pool for future forward workload management. Operations Manager may need to be involved to help identify alternate resources (maybe from interstate offices, or external contractors).
Cost	Non-continuity of project staff (ie. due to competition from other projects and long programme).	Cost increases caused by inefficiencies in the IV process.	Involve Operations Manager in any discussions re transfer of key/lead project staff onto other projects.
Communication	Duplication and gaps in the verification.	Cost and time increases. Re-work.	Communication is adequately managed both up and across the team. Sharing of methods will be necessary to develop consistency. Regular team meetings will be used to facilitate this process.

Risk category	Description	Possible consequence	Risk treatment strategy
Cost	Poor control and identification of variations, eg. repeat submissions of design packages.	Time and cost increases.	It is important that personnel advise the PS of potential variations due to repeated submissions or errors. A package register will be kept to monitor the number of submissions of each package.
Scope	Unforeseen scope creep. IV may be required to carry out work that has not been budgeted nor ability to claim a variation.	Time and cost increases.	The IV Project Manager will determine the best way in which to carry out work related to unforeseen scope, which may involve using senior staff or other efficient methods for completing the work. A suitable contingency will be included in the cost estimates.
Quality	Adequate checking and reviews not undertaken.	Project deliverables do not meet client requirements.	Checking and reviews to be scheduled by the IV Project Manager and detailed in the Project Execution Plan and this Verification Management Plan.
Health & Safety	Refer to Schedule 9.7a OH&S Management Plan	Possible time delays	Ongoing verification reviews/compliance checks

7. PROJECT CONTROLS

All project controls in the following section relate specifically to the Independent Verification process.

7.1. PROJECT CONTROL TOOLS

The Independent Verification process will be controlled using System Application Products (SAP) and Microsoft Project 2003 (MSP). SAP will contain approved budget and progress/status information. Project resources and scheduling will be controlled in MSP, with project progress fed into SAP. This control role will be undertaken by the IV Project Manager in close co-operation with the IV Representative..

7.2. CORRESPONDENCE AND FILING

7.2.1. INCOMING CORRESPONDENCE

All correspondence shall be held in accordance with KBR's standard correspondence management procedure WM-AUST-MUL-DM-004, *Project correspondence management*.

All incoming letters shall be handled as follows:

- All incoming letters shall be forwarded to the Project Administrator upon receipt for date stamping
- The IV Project Administrator (internally assigned personnel) shall then seek distribution from the addressee or IV Project Manager
- The Project Administrator shall then scan to a .pdf and save in Documentum in Working/S/SEG/SEGxxx/C - Correspondence and apply relevant metadata
- The Project Administrator shall then forward pdf of letter via a Documentum web-link
- Original letter shall be filed in the relevant SEGxxxx project files
- Documentum name will contain the following: yymmdd-SEGxxx-C1/C2-R000x

All incoming e-mails shall be handled as follows:

- Recipients (To: field) and senders of emails shall drag and drop such emails into the Public Folders for SEGxxx periodically
- The Project Administrator shall then periodically drag and drop into Documentum in Working/S/SEG/SEGxxx/C - Correspondence. Relevant metadata shall be applied by the Project Administrator
- Documentum name will contain the following: yymmdd-SEGxxx-C1/C2-R000x

All incoming faxes (received as .tif files) shall be handled as follows:

- The Project Administrator shall save in Documentum in Working/S /SEG/SEGxxx/C - Correspondence and apply relevant metadata
- Documentum name will contain the following: yymmdd-SEGxxx-C1/C2-R000x
- The Project Administrator shall then forward .tif to recipients if they didn't receive original fax

7.2.2. OUTGOING CORRESPONDENCE

All outgoing correspondence shall be sent in accordance with KBR's standard correspondence management procedure WM-AUST-MUL-DM-004, Project correspondence management.

All outgoing letters (formal correspondence) shall be handled as follows:

- All outgoing letters shall have a reference number that is obtained from the Project Administrator and will follow the convention of SEGxxx-C1/C2-S000x
- A .doc and signed scanned .pdf shall be saved in Documentum in Working/S/SEG/ SEGxxx/C - Correspondence. Relevant metadata shall be applied by the Project Administrator
- Documentum name will contain the following: yymmdd-SEGxxx-C1/C2-S000x
- A hard copy shall be filed in the project files

All outgoing emails (informal correspondence) shall be handled as follows:

- Recipients (To: field) and senders of emails shall drag and drop such emails into the Public Folders for SEGxxx periodically

- The Project Administrator shall then periodically drag and drop into Documentum in Working/S/SEGxxx/C - Correspondence. Relevant metadata shall be applied by the Project Administrator

- Documentum name will contain the following: yymmdd-SEGxxx-C1/C2-S000x

7.2.3. INTERNAL CORRESPONDENCE

All internal emails shall be handled as follows:

- The 'final' recipient shall drag and drop email into the Public Folders for SEGxxx periodically

- The Project Administrator shall then periodically drag and drop into Documentum in Working/S/SEG/SEGxxx/C - Correspondence. Relevant metadata shall be applied by the Project Administrator

- Documentum name will contain the following: yymmdd-SEGxxx-C3

7.2.4. REGISTRATION OF FOREIGN DOCUMENTS AND DRAWINGS

All foreign documents and packages received by KBR shall be registered and controlled in accordance with procedure WM-AUST-MUL-DM-003 Project documentation management.

7.3. WORK BREAKDOWN STRUCTURE

The Work Breakdown Structure (WBS) provides estimated durations for checking packages at each design stage, as well as the estimated commitment for personnel during construction verification and audit processes. The IV's work breakdown structure for control of this project will be developed in conjunction with the review of AquaNet's relevant Project Management Plans. The WBS will be used as the basis for controlling costs on the project.

7.4. SCHEDULE CONTROL

The overall schedule will be dictated by AquaNet's progress, but in general, the IV role will follow that schedule.

Generally there will be a seven (7) working day turnaround for detailed design package verification and a three (3) working day turnaround for final detailed design certification. These will be subject to the final design package structure and schedule.

Turnaround times for construction verification and commissioning verification works will be nominated once those components of the VMP are finalised under the project Agreement.

Each in-coming package will be date stamped by the Project Administrator and monitored by the IV Project Manager to ensure the IV role meets the nominated milestones.

7.5. COST CONTROL

The IV Project Manager will monitor costs against the budgets set in the WBS for the proofing of design elements, and also for the construction verification and commissioning verification.

The IV Project Manager will maintain a balance sheet and a cash flow chart for presentation to and approval by, the IV Representative/Project Director on a monthly basis.

7.6. SCOPE CHANGE (VARIATIONS)

Changes to the IV scope of work or scope of service outcomes will be identified to the IV Project Manager as they become apparent. The IV Project Manager shall notify AquaNet and Sydney Water's Representative as soon as possible. A Variation Register shall be established and maintained using Form P1-2-10. The following will be deemed as variations to the IV role and related Deed:

- Any changes to the IV scope of services as outlined in the IV Deed
- Design packages that are submitted to the Independent Verifier are based on an average review repeat factor of 2.0 (industry acceptable standard) over the duration of the project
- Time extensions to the project beyond the agreed base-line program, resulting in extensions to the Independent Verifier's role

The Independent Verifier will monitor the submission of design packages to determine the number of times a package is submitted at each stage as well as the overall average design work package review repeat factor. A register of design packages will be kept by the Project Administrator to facilitate this. All personnel are required to assess the design documentation for repeated errors and bring these to the attention of the IV Project Manager. The Independent Verifier will advise the client in writing of a potential variation to obtain agreement prior to commencing work on the variation. A register of approved variations will be maintained by the Project Administrator.

8. QUALITY PROCEDURES AND ASSURANCE

8.1. SYSTEMS AND PROCEDURES

This section outlines KBR's internal quality procedures and assurance system that may be utilised within the IV role. Application of the following procedures is usual for all KBR projects:

- WM-AUST-MUL-PM-008, Project financials (or Preparing and controlling the Project Services Budget)
- WM-AUST-MUL-DM-004, Project correspondence management
- WI-AUST-MUL-DM-001, Bid and project filing directory and structure
- WM-AUST-MUL-DM-003, Project documentation management
- WM-AUST-MUL-PM-009, Personnel appointment and briefing
- WM-AUST-MUL-EN-007, Project review
- WM-AUST-MUL-PM-001, Project execution plans—management and engineering projects
- System P1-17, Control of deliverables
- WM-AUST-MUL-PM-005, Project close-out

The following procedures are also relevant to KBR's scope of services for this project and will be applied:

- PM-AUST-KBR-OPS-002, Management of a project
- WM-APAC-GID-PM-001, Overview of project financials
- PM-APAC-GID-PM-001, Project establishment in SAP
- PM-APAC-GID-PM-002, Billings process
- PM-APAC-GID-PM-003, Debtors and collections
- PM-APAC-GID-PM-004, Project re-forecasting
- WM-APAC-INF-PM-001, Client satisfaction and loyalty evaluation
- WM-AUST-MUL-PM-004, Meetings and minutes
- System P1-18, Projects daily diary
- WM-AUST-MUL-PM-007, Site Instructions
- WM-AUST-MUL-EN-004, Reports and studies – preparing, checking, reviewing, approving and revising
- WM-AUST-MUL-EN-009, Interdisciplinary design check (includes work packages)
- WM-AUST-MUL-EN-008, Project Review - Reports and Studies
- WM-APAC-GID-MP-002, Engagement and management of sub-consultants
- WM-AUST-MUL-EN-011, Review of construction contractor documentation

The above systems and procedures have been prepared as guidelines for project personnel.

8.2. STAGE/GATE SYSTEM

The Project Quality Assurance process is based on the stage/gate system, under which the project is divided into a number of stages or work activities, between each of which there is a quality control checkpoint, or 'gate'.

The project package requirements determine the gate that will apply to progress of the services. The following gates have been identified for this project:

- **Gate 1**
  Technical review prior to submission of the Work Verification Record Form for each package

- **Gate 2**
  Technical review prior to certification for each package

Further stages and gates will be determined as the construction and commissioning elements of this VMP plan are developed.

8.3. PROJECT AUDIT SCHEDULE

The project shall be audited via the NSW State auditing process. A minimum of two (2) quality audits are to take place, the first after project establishment, with subsequent audits scheduled at suitable intervals during the project.

Audit documentation is to be filed in the Project Systems File S01. KBR's Project Director will be responsible for this project's conformance with KBR's management system, and ensuring that all follow-up tasks identified in project audits are completed.

8.4. SUB-CONSULTANTS

Sub-consultants have been nominated for specific (specialised) tasks and will be required to provide services relating to the verification of the design work packages, but may also be required as part of the construction verification and commissioning verification and IV program auditing. Sub-consultant contracts, variations and invoicing data will be stored in Documentum under B2 - Supplier Contracts and Invoicing. Sub-consultant deliverables shall be recorded and registered in accordance with WMAUST- MUL-DM-003, *Project documentation management*.

9. ENGINEERING DESIGN

It is proposed the engineering design will be split into thirteen (13) packages for the network distribution system and (current assumption) of eight (8) packages for the Plant as described in the Design Management Plan.

The nominated design packages are required to facilitate design review, verification and validation. AquaNet will supply all design packages for review after internal review, verification and validation according to the Design Management Plan. The design work packages are to contain compliance records detailing AquaNet's completed verification and validation processes.

The Independent Verifier will allow seven (7) working days from delivery of a final draft detailed design package to submit the review and comments to AquaNet. The Independent Verifier will allow three (3) working days from delivery of a final detailed design package to submit the review and certification of that package to AquaNet. These allowances are subject to review pending confirmation of final package numbers and sizes. These allowances are also subject to satisfactory correction of identified non-conformances in the draft design stage. Major and repetitive non-conformances will not be accommodated in this allowance.

9.1. TECHNICAL VERIFICATION

The technical verification process is detailed in two (2) sections:

- The overall design work package process outlining the relationship between the Designers, AquaNet and the Independent Verifier

- The Independent Verifier independent technical verification process for the design work packages

9.1.1. DESIGN PACKAGES VERIFICATION PROCESS

Technical verification will include reviewing the schedule, alternative analysis and value engineering, code compliance review, constructability reviews, and compliance with the Project Agreement and the Service Delivery Outcomes Specification.

The design verification process will adopt a two (2) phase approach:

- Review at detailed design (final draft)
- Review at final design

Work Verification Records (WVR) will be tabulated verification schedules. WVR's will be prepared for each design package and for each review phase, categorising the issues raised. The categories will be defined as observation, minor non-conformance, or non-conformance.

Communication between the Designer and Independent Verifier will be through the WVR's, whereby matters identified by the Independent Verifier will require a written response from the Designer. Verification certification will be through signature on design drawings and specifications.

A general outline of the proposed methodology for the design package verification procedure is included in Figure 2 – Design Verification Flow Chart on page 35. The general methodology will include:

- Design will generally commence with concept reports, drawings and specifications provided by the Designer. These will allow for internal verification and where required validation
- Internal design review and verification will be completed by AquaNet with modification by the Designer as required to produce a final draft detailed design
- AquaNet will complete verification and validation of the final detailed design package before submission to the Independent Verifier
- The independent verification of the design elements will commence with the necessary reviews
- Design packages requiring action will be sent with appropriate comments and recommendations to AquaNet
- The designer will produce the final detailed design package and submit to AquaNet for final validation
- AquaNet will issue the final design for acceptance by the Independent Verifier
- Acceptance of the final design package will lead to certification of the design package, at which stage the design package will be issued for construction
- SWC will be notified of the design package acceptance

Notification of variations to the documented design will be provided back to the designers and design verifiers. Design changes will become part of the approved documented works and will be included in the independent verification activities.

9.1.2. INDEPENDENT VERIFICATION PROCESS

Upon receipt from AquaNet of each design package for verification, the procedure shall be:

- Project Administrator to register incoming package on the Correspondence File
- Registration shall include placing the component and its covering correspondence on the correspondence file, placing a .pdf copy of the reports, drawings and specifications in the appropriate package directory in Documentum, and placing an A3 size hardcopy of the drawings in appropriate section drawing files
- The IV Project Manager shall examine the design package and identify the relevant lead design engineer and the appropriately qualified support staff, who shall verify the package
- The verification team will verify the design in accordance with this Verification Management Plan, the Project Agreement, and the Service Delivery Outcomes Specification
- The nominated lead engineer will clarify where necessary with AquaNet and/or the Designer by email, matters which may impact on the verification
- The verification team will document all verification comments on the WVR form in conjunction with comments if appropriate on copies of design drawings
- The IV Project Manager shall review the WVR
- The IV Project Manager will issue the WVR (as a Word document) and comments on design drawings (as a .pdf attachment) to AquaNet by email
- The IV Project Manager will receive and review responses to verification comments and sign off on acceptability of responses

Following verification of the final detailed design, certification will be provided to AquaNet and notification will be made to the Sydney Water representative.

9.2. DESIGN AUDITING

9.2.1. DESIGN PACKAGES AUDITING

When the design packages are submitted, the nominated IV lead engineer will involve the required project auditor to verify and certify the compliance records associated with the design package. Work Audit Records (WAR) will be tabulated audit schedules. WAR's will be prepared for each design package and for each audit function, categorising the issues raised. The categories will be defined as observation, minor non-conformance, or non-conformance.

9.2.2. AUDITING OF THE DESIGN PROCESS

Over the design duration, scheduled audits (three in total) will be conducted by the Independent Verifier on AquaNet's and relevant sub-contractor's premises. These audits will examine compliance with the design process requirements as outlined in the Design Management Plan. Audit checklists will be completed and maintained by the Independent Verifier.

The external audits will be conducted in accordance with the Independent Verifier system P1-19 - *External Quality Auditing.* The Project Auditor will audit AquaNet's Design Management Plan process and executions ensuring the following general design requirements are met:

- Objectives, requirements and scope of the design
- Structure and relationship obligations of the design with respect to the other management plans, and process for the integration of design with procurement, construction, commissioning, proving, operation and maintenance of the works
- Organisational structure, including allocation of roles, responsibilities and accountabilities required to complete the design requirements
- Process for allocation of suitable resources for the planning, managing, performing and reviewing design documentation
- Packaging of design tasks documentation including the management of interface between design packages
- Process of planning, undertaking and control of design review, verification and validation activities
- Process for control and transmittal of design documentation and collection and maintenance of design compliance records
- Process for change management during all phases of the project

10. CONSTRUCTION AND COMMISSIONING

10.1. REVIEW OF CONSTRUCTION PROCEDURES

AquaNet is required to perform construction activities in accordance with the Construction Management Plan (CsMP). This plan will ensure the satisfactory and timely construction of the project. The CsMP will also contain a schedule listing the proposed inspection and test plans and the proposed work method statements. Refer to Figure 3.

A programme of inspections will be prepared by the Independent Verifier once the construction programme has been reviewed. Based on the programme, periodic inspections will be carried out to monitor construction activities for compliance with the contract document, design drawings and specifications. Where applicable, Hold Points will be either released or withheld, depending on the results of the inspection.

The Verification Management Plan (VMP) will document the procedures to be followed by the Independent Verifier throughout the construction component of this project, verifying that the design intent is transferred to the construction.

The first draft of the construction component of the VMP will be completed prior to any construction activities commencing. It will be updated during the course of the construction as required to align with the construction schedule. The VMP will address the responsibilities of the Independent Verifier during the construction phase including:

- Review of AquaNet's Inspection and Test Plans (ITPs), including reference to the Hold Points and Witness Points

- Undertake inspections to monitor construction activities to identify issues related to compliance with the contract document, design drawings and specifications;
- Carry out general audits and system audits to confirm quality control processes are being adequately implemented
- Review of the selection and testing procedures to ensure that the specified random sampling procedure, the required frequency of testing and the test methods are in accordance with the requirements of the Specification
- Verify that testing is carried out by an appropriately certified testing facility and authorised by an approved signatory
- Review the construction schedule and provide advice for determinations on requests for extensions of time
- Review of shop drawings of key elements for design intent
- Provide notification to the designers and design verifiers where the Constructor varies from the verified design
- Identify non-conformances as part of the site inspection regime, provide notification to AquaNet and approve close out
- Participate in site meetings, monthly project control group meetings and contribute to review of quality issues, quality of work and any remedial measures required
- Advise whether Practical Completion has occurred and provide advice allowing issue of a Certificate of Practical Completion or notify a list of works required for Practical Completion

10.2. REVIEW OF COMMISSIONING TEST PROCEDURES

AquaNet is required to undertake commissioning of the Plant and the distribution system in accordance with the Commissioning Management Plan (CmMP). AquaNet is required to submit the draft CmMP no later than six (6) months before the proposed commissioning start date.

The first draft of the commissioning component of the Verification Management Plan will be completed at least three (3) months prior to any commissioning activities.

KBR will audit AquaNet's Commissioning Management Plan process and execution including the following general commissioning requirements:

- The operation of the Plant and all equipment as a whole are to be fully tested during commissioning
- The Plant is to undergo proof testing as part of commissioning (period of proof testing and required output levels will be specified in the CmMP).
- Achieve the required quality testing frequency during the process proofing period and how remedial action will be undertaken in the event of failure to meet quality standards

- The involvement and notice period required of the Independent Verifier and Sydney Water in witnessing tests
- The testing and commissioning of the distribution system including reservoirs, pumping stations, pipework, valves and ancillaries

Commissioning verification will also include:

- Audit of commissioning processes and provide a Certificate of Compliance for commissioning ITPs
- Determine whether Completion has occurred and issue a Certificate of Completion or notify a list of works required for Completion

10.3. ITP REVIEW

AquaNet is required to submit an Inspection and Test Plan (ITP) and procedures for factory acceptance testing for all major items to be tested. Prior to commencement of any construction or commissioning activity, AquaNet's (ITP) for that activity will be reviewed. The Independent Verifier will review these plans and procedures. The ITP will be assessed to confirm that it contains adequate contractor sign-off points to ensure the quality of the works is being adequately monitored. It will also be assessed for conformance with the design drawings, the specifications and construction management plan procedures. Hold points, witness points and test procedures will be checked for agreement with the Specifications.

Upon agreement with the ITP, a Certificate of Compliance will be issued. Any disagreements with the ITPs will be addressed with AquaNet and SWC as required.

Based on AquaNet's ITPs and commissioning programme, a schedule of inspections and test audits will be agreed. This schedule is subject to continual change and updates, as the commissioning programme changes to suit actual on site activities.

A review of the selection and testing procedures will be undertaken to ensure that the specified random sampling procedure, the required frequency of testing and the test methods are in accordance with the requirements of the Specifications. Verification will also confirm that testing is carried out by an accredited NATA Laboratory and authorised by an approved signatory.

The test compliance audit will consist of auditing all AquaNet's test records, to determine if AquaNet has a test record of all test elements and the compliance testing specified in the relevant specification is in accordance with the design and contract requirements.

An assessment will be undertaken to determine which test procedures require observation during the testing.

Where applicable, Hold Points will be either released or withheld, depending on the results of the test.

10.4. AUDITING

Compliance and produce audits will be scheduled in accordance with the construction and commissioning schedules of AquaNet. These audits will be conducted in accordance with KBR system P1-19 - *External Quality Auditing.*

Generally the Compliance audits will be at set stages of progress for each construction or commissioning package, typically:

- First compliance audit—30% of construction activity
- Second compliance audit—50% of construction activity
- Third compliance audit—70% of construction activity

A product compliance audit would be at completion of construction, and would be in conjunction with a determination of Practical Completion. Smaller and less complex construction and commissioning packages may not require three compliance audits.

The general requirements of the Auditor are summarised below:

- The nominated auditor must be suitably qualified and experienced (as defined in AS/NZS ISO 19011:2003)
- The auditor should not breach AquaNet's commercial confidentiality, and the audit should have a scope and depth that meets AquaNet's contractual needs
- The auditor should not breach AquaNet's copyright by retaining AquaNet's management system documentation after the audit
- The auditor should conduct an opening meeting in which the scope and objectives of the audit are explained, including an explanation of the audit method and procedures that are to be used. Clarification may be sought on any issues by the auditee
- All observations or non-conformances should be reviewed with the responsible auditee manager (IV Project Manager or IV Project Representative/Project Director. The observations and non-conformances must be acknowledged by the auditee manager only if the auditee manager agrees with them
- The auditor should conduct a closing meeting to present the audit results, ensuring that the auditee's representatives clearly understand them. The lead auditor should also present the audit team's conclusions regarding the quality system's effectiveness in meeting the project quality objectives
- As a minimum, the auditor should minute the closing meeting and preferably also the opening meeting as well. AquaNet should be given a copy of the minutes. At the closing meeting the auditor should also advise what time is allowed for resolving the issues raised in the audit report
- The auditor should present the audit report to the client promptly, or advise both the client and auditee if it is delayed
- The client is responsible for providing the auditee with a copy of the audit report. This should be done promptly

AquaNet must respond to the report and address any agreed non-conformance issues within a time frame agreed with the client, in conjunction with the auditor. Follow-up audits, if required, should occur in the agreed time frame.

Figure 2: Design Verification Flow Chart

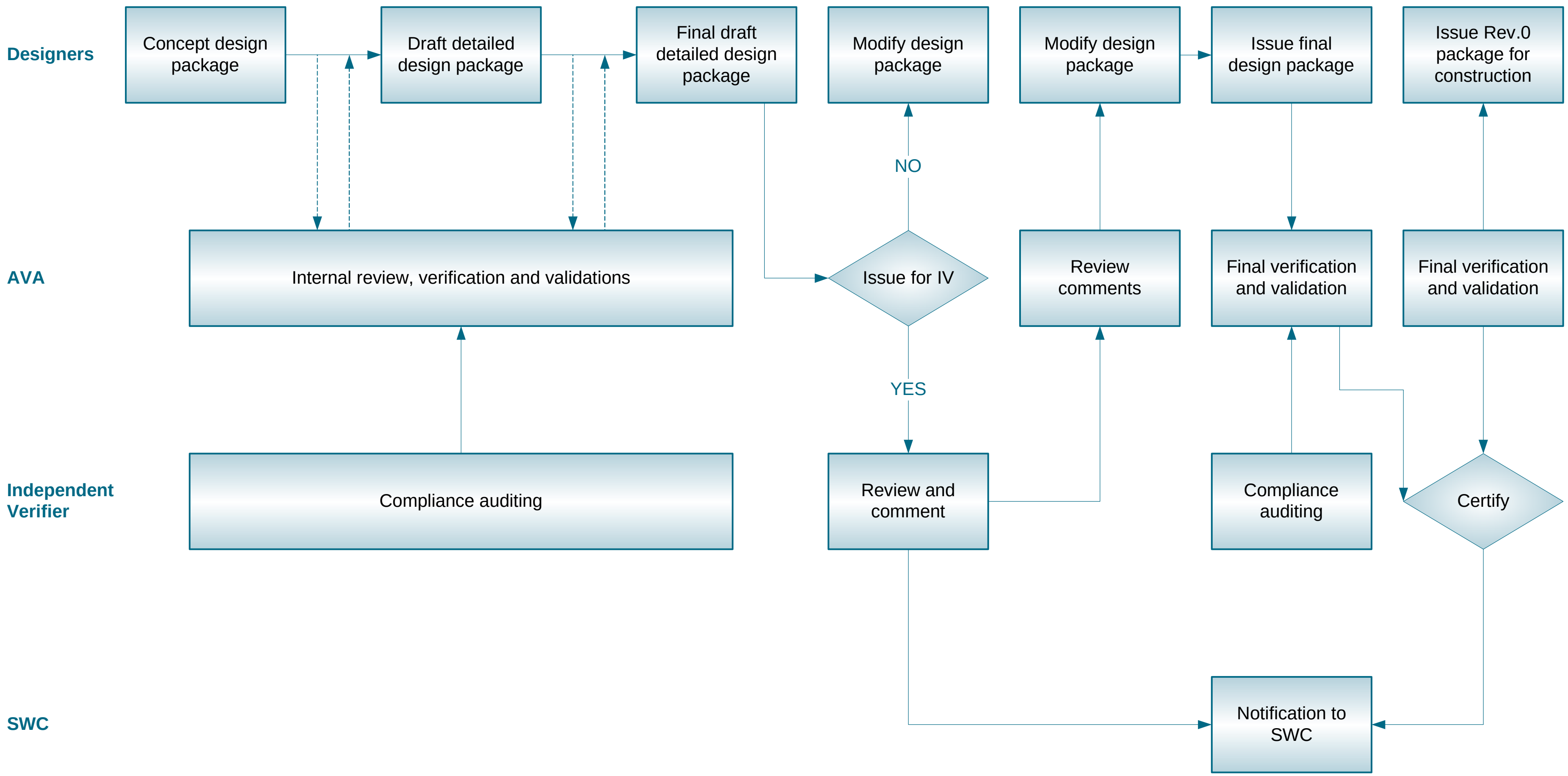
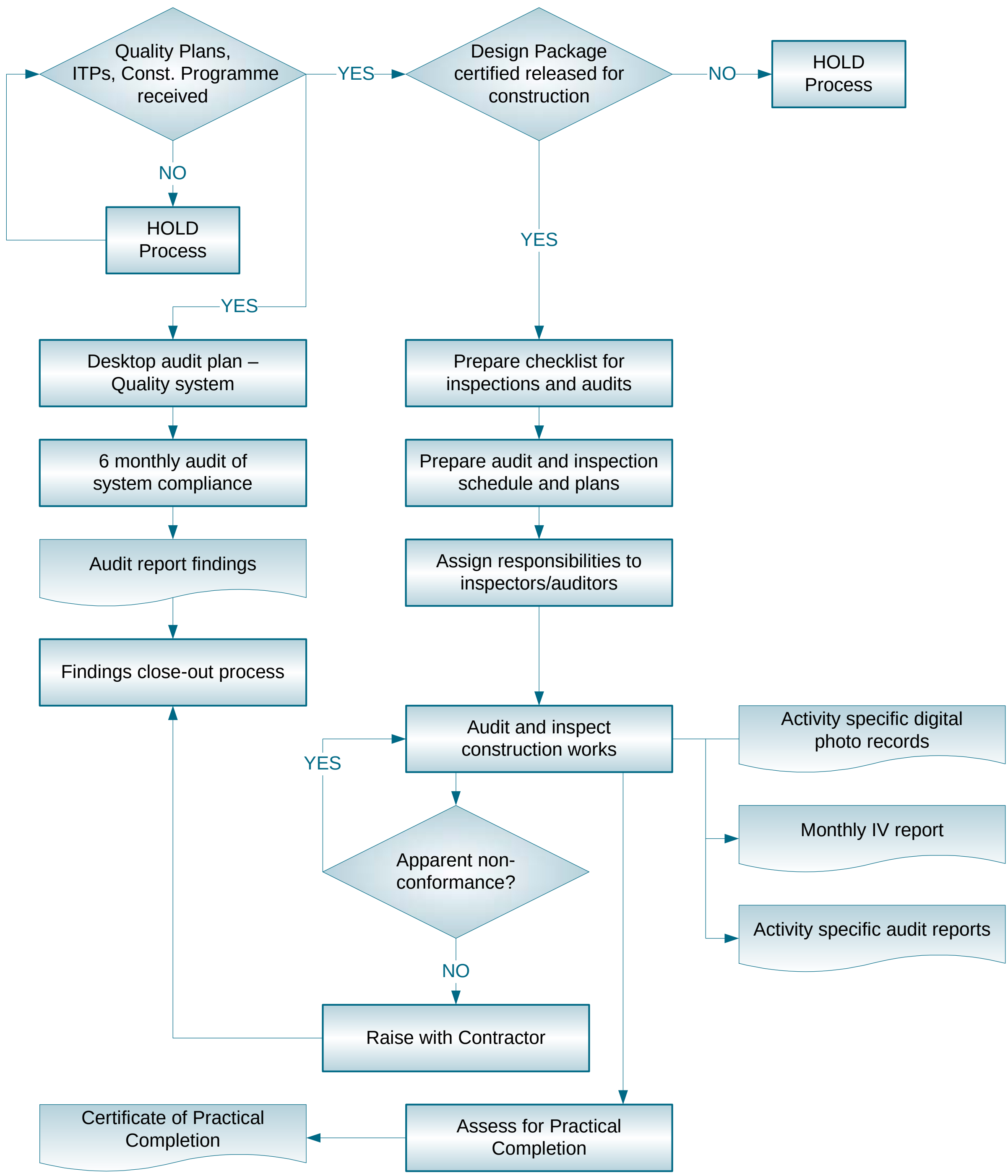


Figure 3: Construction and Commissioning Flow Chart

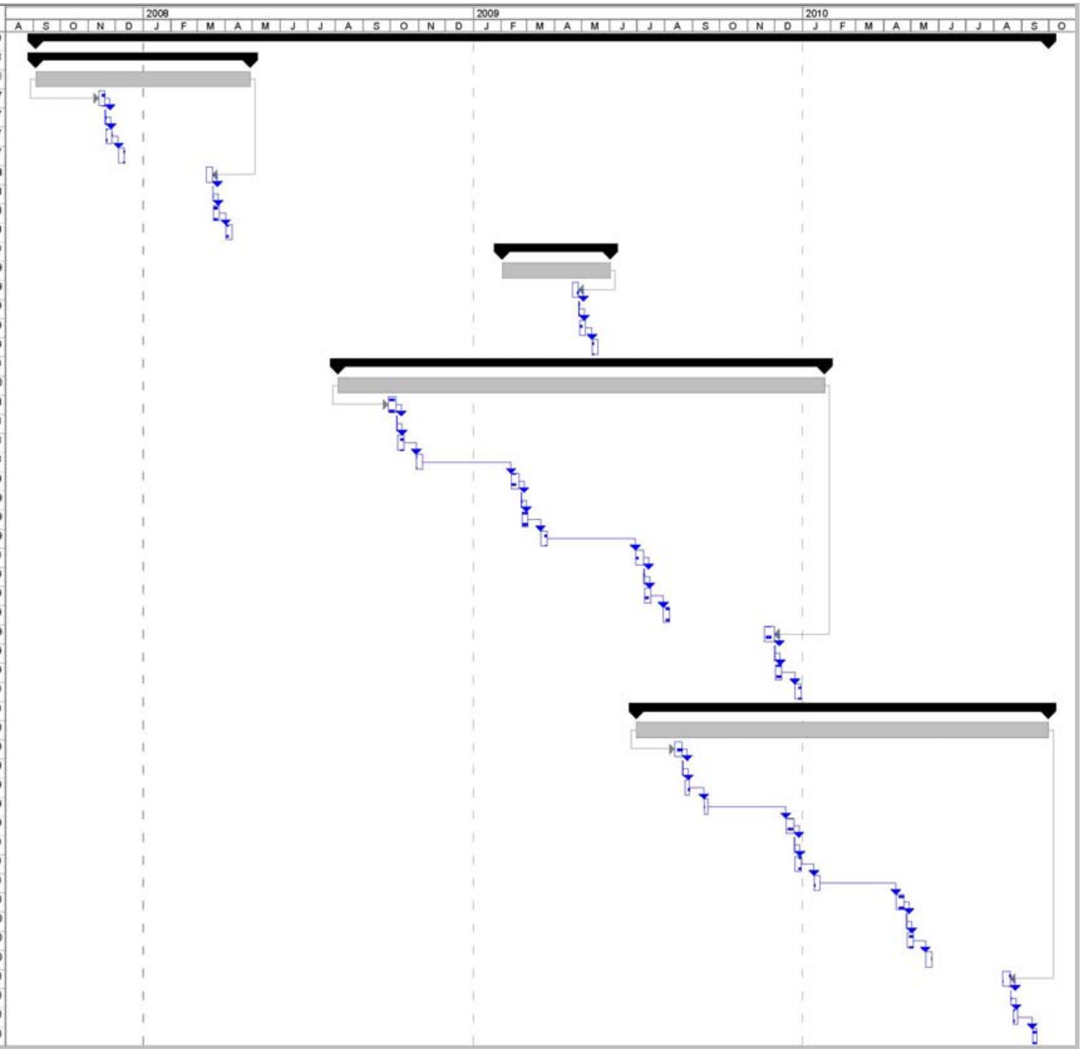


APPENDIX A –
INDEPENDENT VERIFIER AUDIT SCHEDULE

The following process auditing schedule is indicative of how the process audits will align with the Contractors major design and construction activities. The audit schedule will be finalised after review of the Management Plans and finalised schedules.

PROCESS AUDITING SCHEDULE

ID		Task Name	Duration	Start	Finish
1		**Independent Verifier Audit Schedule**	**803 days**	**Tue 4/9/07**	**Thu 30/9/10**
2		**Design period - Network**	**170 days**	**Tue 4/9/07**	**Mon 28/4/08**
3		Design period - Alinta	170 days	Tue 4/9/07	Mon 28/4/08
4		Prepare audit 1	5 days	Tue 13/11/07	Mon 19/11/07
5		Audit 1	1 day	Tue 20/11/07	Tue 20/11/07
6		Report audit 1	5 days	Wed 21/11/07	Tue 27/11/07
7		Close-outs 1	5 days	Wed 5/12/07	Tue 11/12/07
8		Prepare audit 2	5 days	Tue 11/3/08	Mon 17/3/08
9		Audit 2	1 day	Tue 18/3/08	Tue 18/3/08
10		Report audit 2	5 days	Wed 19/3/08	Tue 25/3/08
11		Close-outs 2	5 days	Wed 2/4/08	Tue 8/4/08
12		**Design period - Plant**	**86 days**	**Mon 2/2/09**	**Mon 1/6/09**
13		Design period - Veolia	86 days	Mon 2/2/09	Mon 1/6/09
14		Prepare audit 1	5 days	Tue 21/4/09	Mon 27/4/09
15		Audit 1	1 day	Tue 28/4/09	Tue 28/4/09
16		Report audit 1	5 days	Wed 29/4/09	Tue 5/5/09
17		Close-outs 1	5 days	Wed 13/5/09	Tue 19/5/09
18		**Construction period - Network**	**386 days**	**Mon 4/8/08**	**Mon 25/1/10**
19		Construction period - Alinta	386 days	Mon 4/8/08	Mon 25/1/10
20		Prepare audit 1	7 days	Mon 29/9/08	Tue 7/10/08
21		Audit 1	1 day	Wed 8/10/08	Wed 8/10/08
22		Report audit 1	5 days	Thu 9/10/08	Wed 15/10/08
23		Close-outs 1	5 days	Thu 30/10/08	Wed 5/11/08
24		Prepare audit 2	7 days	Thu 12/2/09	Fri 20/2/09
25		Audit 2	1 day	Mon 23/2/09	Mon 23/2/09
26		Report audit 2	5 days	Tue 24/2/09	Mon 2/3/09
27		Close-outs 2	5 days	Tue 17/3/09	Mon 23/3/09
28		Prepare audit 3	7 days	Tue 30/6/09	Wed 8/7/09
29		Audit 3	1 day	Thu 9/7/09	Thu 9/7/09
30		Report audit 3	5 days	Fri 10/7/09	Thu 16/7/09
31		Close-outs 3	5 days	Fri 31/7/09	Thu 6/8/09
32		Prepare audit 4	7 days	Fri 20/11/09	Mon 30/11/09
33		Audit 4	1 day	Tue 1/12/09	Tue 1/12/09
34		Report audit 4	5 days	Wed 2/12/09	Tue 8/12/09
35		Close-outs 4	5 days	Thu 24/12/09	Wed 30/12/09
36		**Construction period - Plant**	**327 days**	**Wed 1/7/09**	**Thu 30/9/10**
37		Construction period - Veolia	327 days	Wed 1/7/09	Thu 30/9/10
38		Prepare audit 1	7 days	Wed 12/8/09	Thu 20/8/09
39		Audit 1	1 day	Fri 21/8/09	Fri 21/8/09
40		Report audit 1	5 days	Mon 24/8/09	Fri 28/8/09
41		Close-outs 1	5 days	Mon 14/9/09	Fri 18/9/09
42		Prepare audit 2	7 days	Mon 14/12/09	Tue 22/12/09
43		Audit 2	1 day	Wed 23/12/09	Wed 23/12/09
44		Report audit 2	5 days	Thu 24/12/09	Wed 30/12/09
45		Close-outs 2	5 days	Thu 14/1/10	Wed 20/1/10
46		Prepare audit 3	7 days	Thu 15/4/10	Fri 23/4/10
47		Audit 3	1 day	Mon 26/4/10	Mon 26/4/10
48		Report audit 3	5 days	Tue 27/4/10	Mon 3/5/10
49		Close-outs 3	5 days	Tue 18/5/10	Mon 24/5/10
50		Prepare audit 4	7 days	Wed 11/8/10	Thu 19/8/10
51		Audit 4	1 day	Fri 20/8/10	Fri 20/8/10
52		Report audit 4	5 days	Mon 23/8/10	Fri 27/8/10
53		Close-outs 4	5 days	Mon 13/9/10	Fri 17/9/10



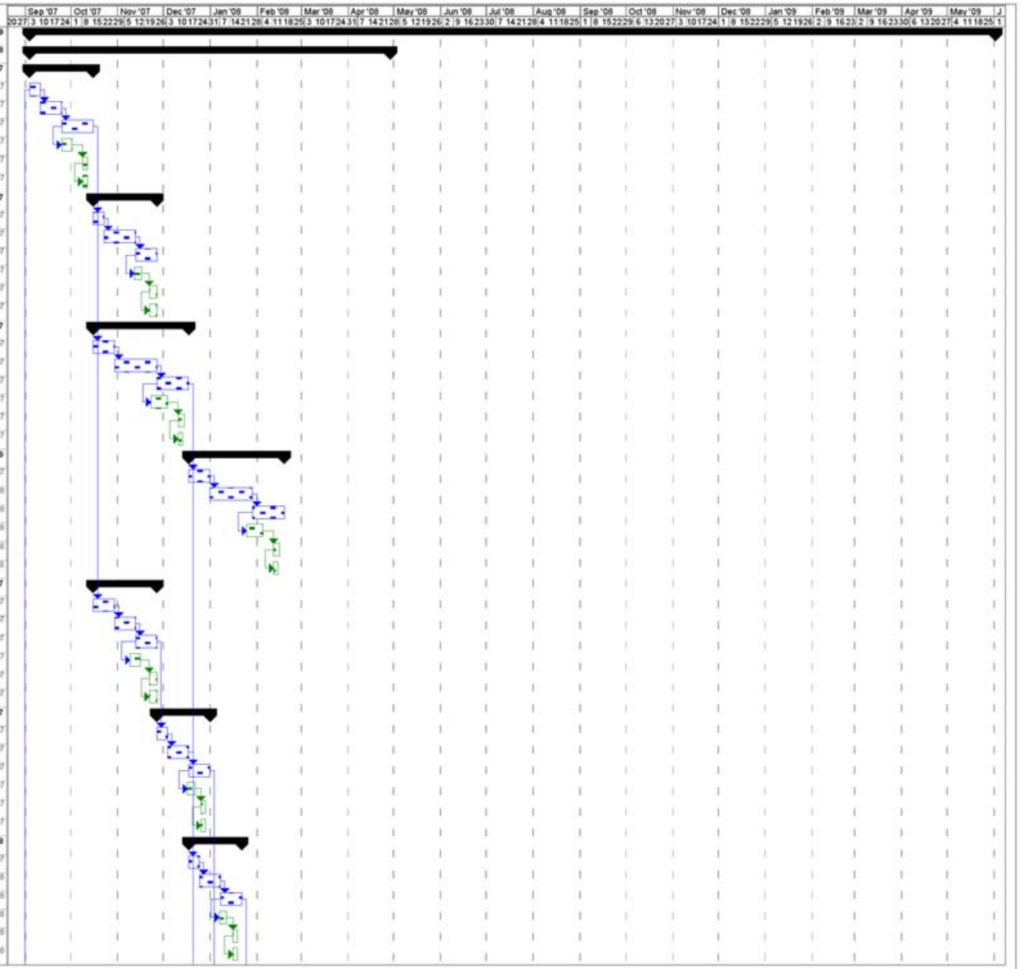
APPENDIX B – INDEPENDENT VERIFICATION SCHEDULE

This verification schedule is based on the current draft project schedule and is provided to be indicative of how the independent verification schedule will align with the design schedule.

Currently only the design verification schedule has been considered. The construction verification schedule will be finalised following finalisation and review of the relevant Management Plans and updated schedule information.

VERIFICATION SCHEDULE

ID	Task Name	Duration	Start	Finish
1	**Design Schedule with Independent Verification**	**455 days**	**Tue 4/9/07**	**Mon 1/6/09**
2	**Design Packages Alinta**	**170 days**	**Tue 4/9/07**	**Mon 28/4/08**
3	**Functional Description**	**30 days**	**Tue 4/9/07**	**Mon 15/10/07**
4	Prepare detailed concept design	5 days	Tue 4/9/07	Mon 10/9/07
5	Preliminary drawings/specifications/material data sheets	10 days	Tue 11/9/07	Mon 24/9/07
6	Final review and for construction documentation	15 days	Tue 25/9/07	Mon 15/10/07
7	Draft detailed design independent verification	5 days	Tue 25/9/07	Mon 1/10/07
8	Final detailed design independent verification and certification	3 days	Tue 9/10/07	Thu 11/10/07
9	Audit of verification and validation records	3 days	Tue 9/10/07	Thu 11/10/07
10	**Fairfield to Woodville Rd Pipeline**	**30 days**	**Tue 16/10/07**	**Mon 26/11/07**
11	Prepare detailed concept design	5 days	Tue 16/10/07	Mon 22/10/07
12	Preliminary drawings/specifications/material data sheets	15 days	Tue 23/10/07	Mon 12/11/07
13	Final review and for construction documentation	10 days	Tue 13/11/07	Mon 26/11/07
14	Draft detailed design independent verification	5 days	Mon 12/11/07	Fri 16/11/07
15	Final detailed design independent verification and certification	3 days	Thu 22/11/07	Mon 26/11/07
16	Audit of verification and validation records	3 days	Thu 22/11/07	Mon 26/11/07
17	**Existing Woodville Rd Pulpeline**	**45 days**	**Tue 16/10/07**	**Mon 17/12/07**
18	Prepare detailed concept design	10 days	Tue 16/10/07	Mon 29/10/07
19	Preliminary drawings/specifications/material data sheets	20 days	Tue 30/10/07	Mon 26/11/07
20	Final review and for construction documentation	15 days	Tue 27/11/07	Mon 17/12/07
21	Draft detailed design independent verification	7 days	Fri 23/11/07	Mon 3/12/07
22	Final detailed design independent verification and certification	4 days	Tue 11/12/07	Fri 14/12/07
23	Audit of verification and validation records	3 days	Tue 11/12/07	Thu 13/12/07
24	**Woodville Rd/Granville to Camellia Pipeline**	**45 days**	**Tue 18/12/07**	**Mon 18/2/08**
25	Prepare detailed concept design	10 days	Tue 18/12/07	Mon 31/12/07
26	Preliminary drawings/specifications/material data sheets	20 days	Tue 1/1/08	Mon 28/1/08
27	Final review and for construction documentation	15 days	Tue 29/1/08	Mon 18/2/08
28	Draft detailed design independent verification	7 days	Fri 25/1/08	Mon 4/2/08
29	Final detailed design independent verification and certification	4 days	Tue 12/2/08	Fri 15/2/08
30	Audit of verification and validation records	3 days	Tue 12/2/08	Thu 14/2/08
31	**Recycled Water Pumping Stations**	**30 days**	**Tue 16/10/07**	**Mon 26/11/07**
32	Prepare detailed concept design	10 days	Tue 16/10/07	Mon 29/10/07
33	Preliminary drawings/specifications/material data sheets	10 days	Tue 30/10/07	Mon 12/11/07
34	Final review and for construction documentation	10 days	Tue 13/11/07	Mon 26/11/07
35	Draft detailed design independent verification	5 days	Fri 9/11/07	Thu 15/11/07
36	Final detailed design independent verification and certification	3 days	Thu 22/11/07	Mon 26/11/07
37	Audit of verification and validation records	3 days	Thu 22/11/07	Mon 26/11/07
38	**Boosters Pumping Station Design Package**	**25 days**	**Tue 27/11/07**	**Mon 31/12/07**
39	Prepare detailed concept design	5 days	Tue 27/11/07	Mon 3/12/07
40	Preliminary drawings/specifications/material data sheets	10 days	Tue 4/12/07	Mon 17/12/07
41	Final review and for construction documentation	10 days	Tue 18/12/07	Mon 31/12/07
42	Draft detailed design independent verification	5 days	Mon 17/12/07	Fri 21/12/07
43	Final detailed design independent verification and certification	3 days	Wed 26/12/07	Fri 28/12/07
44	Audit of verification and validation records	3 days	Wed 26/12/07	Fri 28/12/07
45	**Reservoirs**	**25 days**	**Tue 18/12/07**	**Mon 21/1/08**
46	Prepare detailed concept design	5 days	Tue 18/12/07	Mon 24/12/07
47	Preliminary drawings/specifications/material data sheets	10 days	Tue 25/12/07	Mon 7/1/08
48	Final review and for construction documentation	10 days	Tue 8/1/08	Mon 21/1/08
49	Draft detailed design independent verification	5 days	Mon 7/1/08	Fri 11/1/08
50	Final detailed design independent verification and certification	3 days	Wed 16/1/08	Fri 18/1/08
51	Audit of verification and validation records	3 days	Wed 16/1/08	Fri 18/1/08



Project: Verification schedule.mpp
Date: Wed 21/3/07

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Page 1

ID	Task Name	Duration	Start	Finish
52	**Customer Storage Tanks**	**25 days**	**Tue 22/1/08**	**Mon 25/2/08**
53	Prepare detailed concept design	5 days	Tue 22/1/08	Mon 28/1/08
54	Preliminary drawings/specifications/material data sheets	10 days	Tue 29/1/08	Mon 11/2/08
55	Final review and for construction documentation	10 days	Tue 12/2/08	Mon 25/2/08
56	Draft detailed design independent verification	5 days	Mon 11/2/08	Fri 15/2/08
57	Final detailed design independent verification and certification	3 days	Wed 20/2/08	Fri 22/2/08
58	Audit of verification and validation records	3 days	Wed 20/2/08	Fri 22/2/08
59	**Miscellaneous Works**	**30 days**	**Tue 26/2/08**	**Mon 7/4/08**
60	Prepare detailed concept design	5 days	Tue 26/2/08	Mon 3/3/08
61	Preliminary drawings/specifications/material data sheets	10 days	Tue 4/3/08	Mon 17/3/08
62	Final review and for construction documentation	15 days	Tue 18/3/08	Mon 7/4/08
63	Draft detailed design independent verification	5 days	Tue 18/3/08	Mon 24/3/08
64	Final detailed design independent verification and certification	3 days	Tue 1/4/08	Thu 3/4/08
65	Audit of verification and validation records	3 days	Tue 1/4/08	Thu 3/4/08
66	**Instrumentation and Control**	**30 days**	**Tue 1/1/08**	**Mon 11/2/08**
67	Prepare detailed concept design	5 days	Tue 1/1/08	Mon 7/1/08
68	Preliminary drawings/specifications/material data sheets	10 days	Tue 8/1/08	Mon 21/1/08
69	Final review and for construction documentation	15 days	Tue 22/1/08	Mon 11/2/08
70	Draft detailed design independent verification	5 days	Tue 22/1/08	Mon 28/1/08
71	Final detailed design independent verification and certification	3 days	Tue 5/2/08	Thu 7/2/08
72	Audit of verification and validation records	3 days	Tue 5/2/08	Thu 7/2/08
73	**Electrical**	**30 days**	**Tue 12/2/08**	**Mon 24/3/08**
74	Prepare detailed concept design	5 days	Tue 12/2/08	Mon 18/2/08
75	Preliminary drawings/specifications/material data sheets	10 days	Tue 19/2/08	Mon 3/3/08
76	Final review and for construction documentation	15 days	Tue 4/3/08	Mon 24/3/08
77	Draft detailed design independent verification	5 days	Tue 4/3/08	Mon 10/3/08
78	Final detailed design independent verification and certification	3 days	Tue 18/3/08	Thu 20/3/08
79	Audit of verification and validation records	3 days	Tue 18/3/08	Thu 20/3/08
80	**SCADA**	**25 days**	**Tue 25/3/08**	**Mon 28/4/08**
81	Prepare detailed concept design	5 days	Tue 25/3/08	Mon 31/3/08
82	Preliminary drawings/specifications/material data sheets	10 days	Tue 1/4/08	Mon 14/4/08
83	Final review and for construction documentation	10 days	Tue 15/4/08	Mon 28/4/08
84	Draft detailed design independent verification	5 days	Mon 14/4/08	Fri 18/4/08
85	Final detailed design independent verification and certification	3 days	Wed 23/4/08	Fri 25/4/08
86	Audit of verification and validation records	3 days	Wed 23/4/08	Fri 25/4/08
87	**Camellia Site Hypochlorite Dosing Facility**	**45 days**	**Tue 18/12/07**	**Mon 18/2/08**
88	Prepare detailed concept design	10 days	Tue 18/12/07	Mon 31/12/07
89	Preliminary drawings/specifications/material data sheets	20 days	Tue 1/1/08	Mon 28/1/08
90	Final review and for construction documentation	15 days	Tue 29/1/08	Mon 18/2/08
91	Draft detailed design independent verification	7 days	Fri 25/1/08	Mon 4/2/08
92	Final detailed design independent verification and certification	4 days	Tue 12/2/08	Fri 15/2/08
93	Audit of verification and validation records	3 days	Tue 12/2/08	Thu 14/2/08
94	**Design Schedule Veolia**	**436 days**	**Mon 1/10/07**	**Mon 1/6/09**
95	Concept Design of RWTP	66 days	Mon 1/10/07	Mon 31/12/07
96	Concept design independent verification	11 days	Mon 10/12/07	Mon 24/12/07
97	Pilot Report	22 days	Thu 1/1/09	Fri 30/1/09
98	Detailed Design of the RWTP	86 days	Mon 2/2/09	Mon 1/6/09
99	Review of the pilot report	7 days	Mon 2/2/09	Tue 10/2/09
100	Draft detailed design independent verification	30 days	Thu 19/3/09	Thu 30/4/09
101	Final detailed design verification and certification	15 days	Thu 7/5/09	Wed 27/5/09
102	Audit of verification and validation records	10 days	Thu 7/5/09	Wed 20/5/09

Project: Verification schedule.mpp
Date: Wed 21/3/07

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Page 2

APPENDIX 2b – If applicable, what arrangements have been or will be made in relation to the construction of the infrastructure?

Construction Management Plan (as tendered)

AVA
Water Consortium

9.5

CONSTRUCTION MANAGEMENT PLAN

(PLANT AND NETWORK)

Alinta VEOLIA WATER

CONTENTS

1. INTRODUCTION

AVA will be responsible for the project management and delivery of activities including design, approval and construction of a recycled water plant and new recycled water main network.

This Construction Management Plan (CMP) provides the construction management activities associated with the construction phase of the Camellia Recycled Water Project (CRWP) including planning, responsibility, delivery, monitoring and reporting that are applicable to the construction and commissioning phases of the project.

AVA is committed to deliver the Camellia Recycled Water Project conforming to or exceeding the expectations of Sydney Water Corporation (SWC) and the community.

AVA will be pursuing innovative methodology and processes by the reuse of isolated gas mains for sections of the new network.

Improvement will be achieved through AVAs commitment to their integrated management system which complies with ISO 9001, AS 4801 and ISO 14001 standards and involvement of all employees in an environment that encourages initiative and innovation.

AVA will accomplish our business objectives as a responsible and ethical member of our community, sensitive to the social and environmental impact of our actions.

A detailed Construction Management Plan will be prepared during the detailed design phase.

1.1. CONSTRUCTION MANAGEMENT SYSTEM

1.1.1. PURPOSE OF THE CONSTRUCTION MANAGEMENT PLAN

- Documents procedures and responsibilities for management of time, cost, quality, safety and environment requirements during the construction stage
- Guides the project team and contractors in carrying out their duties consistently and efficiently
- Facilitates continual improvement on the project
- Complies with quality standard AS/NZS ISO 9001
- Meet the requirements of the Project Management Plan

2. HEALTH, SAFETY & ENVIRONMENTAL POLICY & COMMITMENT

AVA is committed to responsible health, safety and environmental management of the CRWP and believe that all potential adverse impacts can be effectively managed.

All planning, construction and operation activities will be conducted in accordance with AVA's HS&E Policies, which outline our commitment to sound management of all aspects of the project. Schedule 9.7 has details of AVA's OH&S and Environmental Policies.

3. PROJECT PLANNING

AVA will submit applications for specific licences and approvals necessary for the delivery of the project. AVA will be responsible for complying with the relevant requirements of legislation and approvals during the construction phase of the project.

The Approval Management Plan (AMP) details the level of approval and methodology in gaining approvals necessary for construction to commence. AVA will meet with relevant government departments, councils and external authorities prior to and during construction to identify key impacts, guidelines, people and processes associated with the project.

3.1. CONSTRUCTION TIMEFRAME

Details of the construction timing can be found in Schedule 9.02 Time Management Plan. The Construction timetable will be reviewed regularly and updated prior to commencement of the Construction Phase.

4. CONSTRUCTION TEAM AND RESPONSIBILITIES

4.1. CONSTRUCTION MANAGEMENT ROLE

The Construction Manager has the authority and responsibility for all on-site operations culminating in the delivery of the project to the client in accordance with the contract documents, on time and within the construction budget. The Construction Manager reports directly to the Project Manager for the performance, time, cost and quality of the project.

The Construction Manager will ensure that all work is performed in accordance with contractual commitment's, that all AVA Policies and Procedures are observed, and that other activities and issues conform to the project specific quality requirements of the respective project plans.

4.2. SITE SUPERVISOR

The Site Supervisor must deliver with the subcontractors all current design and contractual requirements necessary for the subcontractors to properly deliver the Project. The Site Supervisor reports directly to the Construction Manager in accordance with the Quality Plan.

4.3. SUBCONTRACTORS

Subcontractors are responsible for complying with project design plans, OH&S and environmental requirements and delivery of completed infrastructure in accordance with contractual arrangements with AVA.

4.4. PLANS AND REGISTERS

Following review by Sydney Water of the design and contractual documentation, the Construction Manager prepares the Site Specific Construction Plan, in accordance with the Quality Plan for approval by the Project Manager.

The level of detail in the Construction Plan and associated documents will depend upon the nature and complexity of the Project and is determined by the Project Manager and will be delivered in accordance with the Quality Plan.

Other plans that will be reviewed by the Construction Manager and incorporated into the Construction Plan include the:

- Quality Plan
- Safety Plan
- Environmental Management Plan
- Cultural Heritage Plan
- Project Plan
- Design Management Plan
- Community Consultation Management Plan
- Commissioning Management Plan

5. DELIVERY

5.1. PRE-CONSTRUCTION

AVA will prepare a procurement strategy in accordance with the Quality Plan to identify those items required and raise requisitions for purchasing those items and consumables necessary for the execution of the Project.

Prior to construction commencing, a formal Hazard Identification and Risk Assessment (HIDRA) will be undertaken by an experienced consultant facilitator to provide a forum for the process of Hazard Identification.

AVA will ensure that pre-construction surveys/reports are undertaken and signed-off by the parties potentially affected by the works. This needs to occur at least two weeks prior to construction being undertaken. Post-construction surveys will be carried out at the completion of the works.

5.2. DESCRIPTION OF CONSTRUCTION WORKS

AVA will undertake the following construction works to supply recycled water to SWC Foundation Customers by:

- Constructing a new 20 ML/d capacity (with future expansion capacity of 25 ML/ d) Recycled Water Treatment Plant at Fairfield

- Constructing approximately 20 kilometres of network mains from the new Recycled Water Treatment Plant to the Foundation Customers and non-foundation customers at Camellia and Smithfield. The network will also contain two pumping stations, reservoirs and other associated infrastructure including valves and flow meters.

5.3. SUBCONTRACTS, TENDERING AND PROCUREMENT STRATEGY

The responsibility for awarding major subcontracts sits with the Project Manager. The Construction Manager has the responsibility for awarding subcontracts for minor works and services within the prescribed level of authority.

AVA Quality Plan will ensure that purchased products conform to specified design and procurement requirements.

AVA shall evaluate and select suppliers based on their ability to supply products in accordance with AVA's requirements. Criteria for selection, evaluation and re-evaluation shall be established. Records of the results of evaluations and any necessary actions arising from the evaluation shall be maintained.

5.4. PROJECT ADMINISTRATION

The initiation, processing, transmittal, recording and filing of all on-site project documentation will be undertaken by AVA strictly in accordance with Project Quality Plan guidelines and current quality systems and procedures.

5.5. TRAFFIC AND CONSTRUCTION HOURS

Due to the nature of the construction of the recycled water main being located in road reserve, adherence to traffic management guidelines provided by road authorities will be enforced for construction activities, delivery of materials, vehicle and pedestrian movement around the work zone. The prescribed construction hours will be in accordance with the road authority and Department of Environment and Conservation guidelines.

Some work may be required to be done at night to avoid traffic flow disruption during the day.

The project demands will dictate working hours but the general plan of construction work will be:

- Monday to Friday – 7am to 6pm

- Saturday – 8am to 1pm

- No construction work on Sundays or public holidays

- Noisy activities on Saturdays are to be avoided prior to 8am

5.6. SAFETY AND WORK METHOD STATEMENT

AVA is responsible for measuring and monitoring key characteristics of operations and activities that can have an impact on the safety and environment.

On all sites, regular monitoring of potentially environment aspects and hazardous processes shall be performed to ensure that controls have been effective and specific site safety rules are followed.

AVA shall prepare safety and environment reports by drawing on environmental incidence and injury experience. These indices shall be presented for management review and appropriate corrective action shall be taken to eliminate the hazards or potential hazards.

Injury experience is measured in terms of frequency of occurrence of certain types of injury such as:

- Minor and disabling injury frequency or case rate
- Lost time injury from work severity rate
- Average days lost per disabling injury
- The subcontractors will provide necessary health surveillance to all employees where appropriate.

The following Work Method Statements have been prepared for site personnel to apply to their activities to ensure hazards are listed and the risk associated to these tasks have been identified and addressed prior to persons signing and accepting the SWMS.

WMS	Construction	Personnel
WMS-001	Site Establishment	All
WMS-002	Service Locating Potholing	All
WMS-003	Excavation and Backfill	All
WMS-004	Traffic Control	Traffic Controllers
WMS-008	Trucks Working on Site	Truck Drivers
WMS-017	Gas Services Repairs & Incidents	All
WMS-019	Disconnection & Repair of Water Services	Trained Persons / Licenced Plumber
WMS-020	Confined Space - bell holes, case bores and excess depth	All
WMS-021	Confined Space - standard trench only	All
WMS-023	Grit Blasting and Coating of Pipes	Welders / Trades / Sleeve Applicators

WMS	Special Tasks	Personnel
WMS-009	Maintenance of Plant & Equipment	Maintenance Fitter
WMS-010	Anchor Blocks Concrete Encasement In Situ Concrete Pits	Crew
WMS-027	Personal Safety During Surveys and Inspections	Community Team / Individuals
WMS-011	Case Boring & Pipe Jacking	All
WMS-028	Transport of pipe and plant	Supervisor / Foreman / LH / Truck Driver
WMS-029	Survey at Rail Crossings	Surveyor
WMS	TIE-INS	PERSONNEL
WMS-012	Pipe connection	Crew
WMS-013	Installation of By-pass Pipework	Crew
WMS-014	Lay Inlet Service Short Mains Extension	Crew

5.7. INDUCTION

To satisfy our legislative responsibilities, AVA will ensure all personnel on site have the required induction and records are complete, AVA will ensure:

- All induction records to be brought up to date
- Review all SWMS records and sign-offs
- Update training records
- Update Incident Register and closeout incident reports (combined responsibility of Safety Manager / Construction Manager)

5.8. EMERGENCY PLAN

To minimise the impacts in an emergency, an Incident Management Plan (IMP) will be prepared for implementation in emergency situations. The IMP will be prepared in accordance with AVA's Emergency Procedure, which outlines procedures to be followed in emergency situations. The IMP will specify names and 24-hour telephone numbers that will reach the subcontractors, AVA's team members as well as other project personnel who will be available to deal with any incidents or emergencies relevant to the project. These contact numbers will be displayed at each work location at all times.

5.9. CONSTRUCTION

AVA will undertake the construction of the CRWP network in accordance with the Water Supply Code of Australia, Sydney Water Edition (WSA 03-2002) and Sewerage Code of Australia (WSA 02-2002) and the project design plan for the Recycled Water Plant contained in the Design Management Plan (Plant). The Design Management Plan (DMP) provides the level of design, guidelines and codes that were used in the preparation of the construction designs.

The construction of the recycled water main network will see a combination of direct trench excavation, pipe bursting of isolated gas mains, thrust boring at rail crossings and horizontal directional drilling (HDD) for creeks and waterways. A variety of plant and equipment will be utilized by subcontractors during construction that is suitable for the scope of activities.

5.10. CONSTRUCTION AUDITS

Construction audits will be undertaken by suitably accredited project and external personnel. The audits will examine:

- Construction site safety
- Environmental system implementation.
- Compliance with the CMP and site EMPs.
- Close out of non-conformances.
- Outcomes in the time since the previous audit (or start of the construction phase for the first audit).

Action Requests and non-conformances will be raised to improve processes and address non compliance of safety requirements. Status of Action Requests will be managed and reported and tabled at project meetings.

5.11. COMMISSIONING AND HANDOVER

The commissioning of the water recycling plant and recycled water main network can only proceed when the plant equipment and its associated power and communication infrastructure has been installed and tested and the recycled water main network completed.

The commissioning of both the Plant and Network will be in accordance with the respective Commissioning Management Plan (CMP).

During commissioning and handover, the Construction Manager's responsibility is to provide any necessary on-site assistance to ensure that the Commissioning Manager can satisfactorily undertake the commissioning activities.

The Construction Manager will develop a construction plan, in conjunction with the project team, that confirms to the dates of practical and project completion to enable the issue of respective certificates to the Client.

A dedicated program linked to the milestone installation dates in the Master Project Program has been developed for the commissioning phase. Regular meetings will be undertaken and attended by all interfacing parties to brief, discuss and plan forthcoming commissioning works.

A Gantt chart view of the Commissioning Program will be developed to track and manage the progress of the works towards completion. Interdependencies built into the Program are created by the use of a Pert Chart view of the installed Subsystems, allowing a Critical Path Analysis to be performed for the commissioning phase.

The Commissioning will be divided into two stages:

1. Water Recycling Plant

2. New recycled water main network, including the reservoirs and pump stations

A detailed look ahead program will be produced to effectively manage commissioning interfaces during the commissioning phase. This plan will be transmitted to all interfacing parties and will itemise the works being undertaken.

5.12. INSPECTION AND TESTING

All equipment delivered to site will have undergone a series of factory tests and will be installed in accordance with the Construction Program. AVA will perform all required testing and commissioning of the recycled water treatment plant, distribution network, reservoirs, pump stations and ancillary equipment in accordance with WSA 03-2002 and plant design codes. The Inspection and Test Plans (ITP), their implementation and the provision of any inspection and testing is the responsibility of AVA. AVA will provide any necessary on-site assistance to accredited external testers and commissioning inspectors to ensure that all required inspections and tests can be satisfactorily carried out.

To verify that all of the necessary inspections and tests have been performed, AVA will establish arrangements and processes including:

- Defined criteria for review and approval of the processes
- Approval of equipment and qualification of personnel
- Use of specific methods and procedures
- Requirements for records, and
- Revalidation

AVA with SWC, shall undertake a joint inspection of both the recycled water treatment plant and recycled water network at practical completion. AVA will be responsible for the preparation of a practical completion report to be made available to SWC.

The report shall detail the following:

- The new water recycling plant is delivering the agreed volume of recycled water
- The effectiveness of the new recycled water main network to Foundation customers
- Any process improvements identified

The Construction Manager will ensure that all construction files are properly closed and available to SWC as appropriate.

5.13. RESTORATIONS

AVA will undertake or arrange all necessary restorations to road pavement, footpaths and park area affected by the construction works. A meeting will be arranged with the respective asset owner (council/RTA) after completion of construction to agree on the scope of restorations. The restorations will be undertaken and a “Restoration Handover Certificate” (please see **Appendix 1** of this document) will be signed by the asset owner at the completion of the restorations.

APPENDIX 1

Camellia Recycled Water Project

Restoration Handover Certificate

CAMELLIA RECYCLED WATER PROJECT ("PROJECT") CERTIFICATE – COMPLIANCE

In accordance with the Camellia Recyled Water Project requirements with respect to the restoration of .... ,

We hereby certify that:

a) Restoration works have been completed;

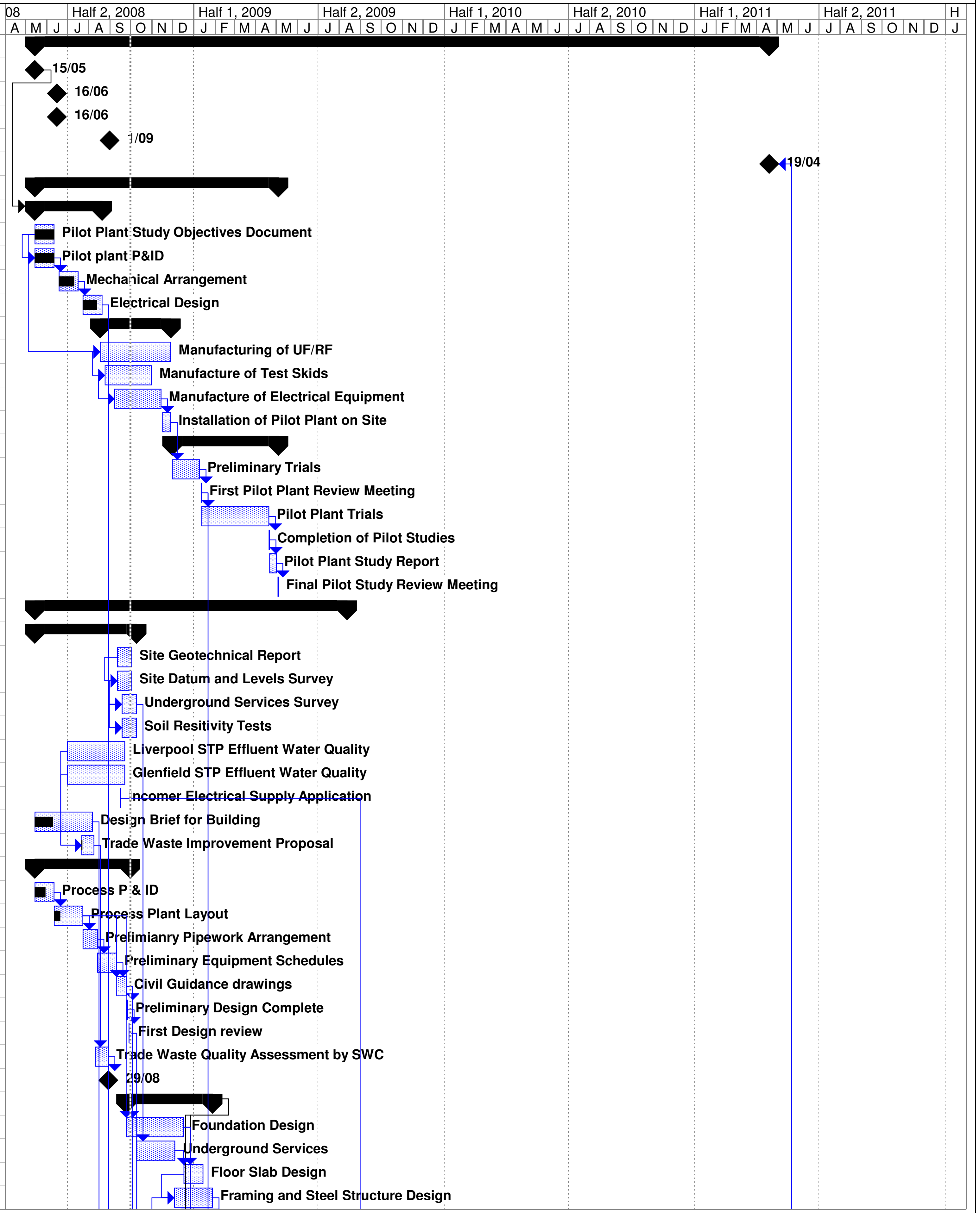
b) The restoration complies with and satisfies the requirements stated below;

c) All documentation has been recorded and is maintained by Alinta in accordance with the project Quality Management Plan.

Description	Specification No.	Completion Date
RTA Road Restoration Specification	M 209	
NSW Specifications 306U: Road Opening and Restorations	Auspec 306U	
Council Specifications for Restoration of Roads and Footpaths	As applicable	

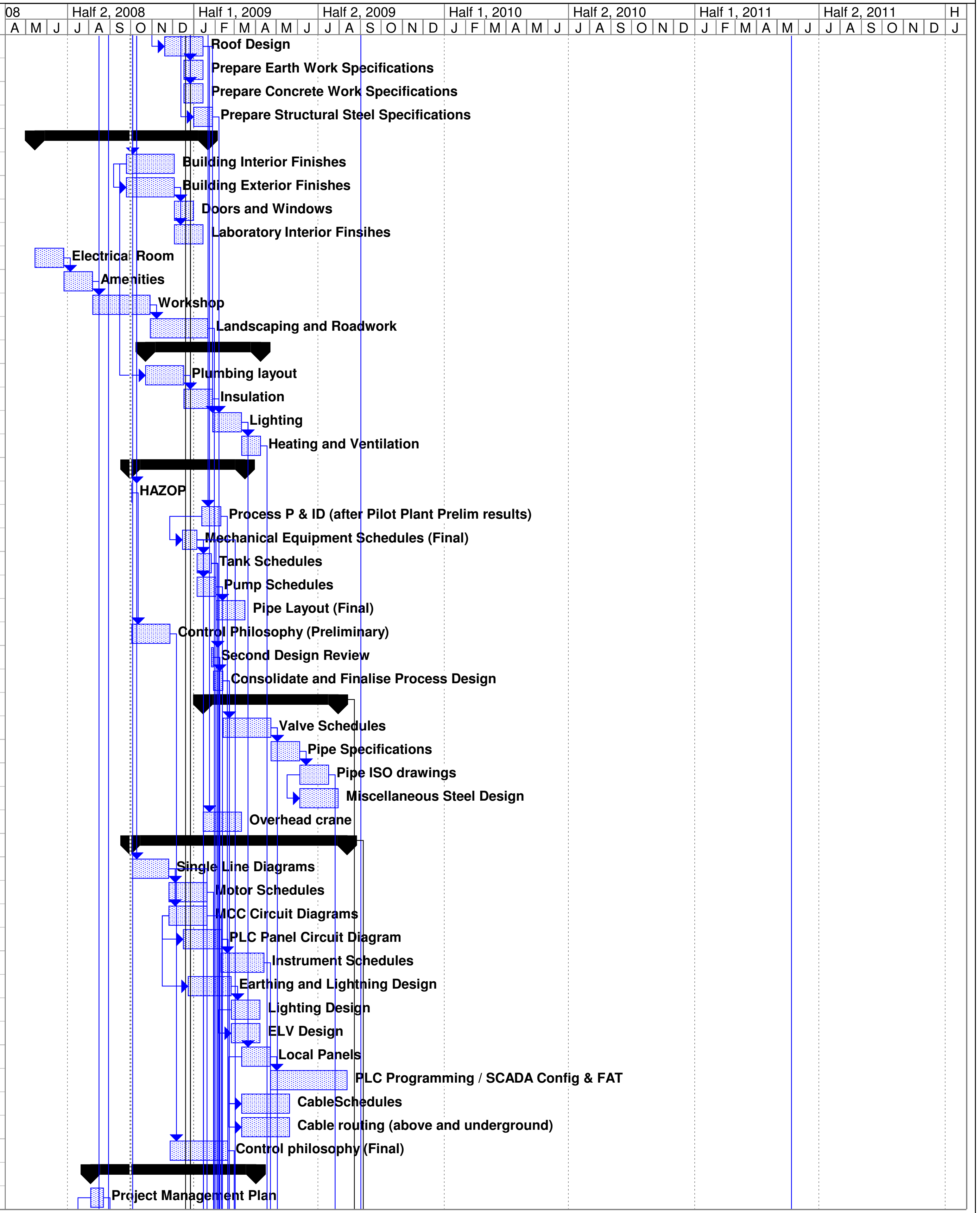
Alinta's Certification	Council/RTA Acceptance
This is to certify that the Works described by this Certificate have been completed in accordance with the above referenced Specifications of the Camellia Recycled Water Project.	This is to certify that the Works as covered by this Certificate have been accepted by Council/RTA and to the best of our knowledge and belief have been completed in accordance with the above reference Specifications of the Camellia Recycled Water Project. Note: Subject to a 12 month Defects Liability Period.
Alinta Representative BY: .... TITLE: .... DATE:	**Council/RTA Representative** ....

ID		Task Name	Duration	Start	Finish	Predecessors
1		**1 GENERAL**	**765 days**	**Thu 15/05/08**	**Tue 19/04/11**	
2		1.1 Contract award	0 days	Thu 15/05/08	Thu 15/05/08	
3		1.2 VWA site survey issued for construction	0 days	Mon 16/06/08	Mon 16/06/08	
4		1.3 VWA site geotech report issued for construction	0 days	Mon 16/06/08	Mon 16/06/08	
5		1.4 Development Consent Provided from VWA	0 days	Mon 1/09/08	Mon 1/09/08	
6		1.5 Finall Completion	0 days	Tue 19/04/11	Tue 19/04/11	292FF
7		**2 PILOT PLANT**	**253 days**	**Thu 15/05/08**	**Mon 4/05/09**	
8		**2.1 Pilot Plant Design and Procurement**	**70 days**	**Thu 15/05/08**	**Wed 20/08/08**	**2**
9		2.1.1 Pilot Plant Study Objectives Document	20 days	Thu 15/05/08	Wed 11/06/08	
10		2.1.2 Pilot plant P&ID	20 days	Thu 15/05/08	Wed 11/06/08	9SS
11		2.1.3 Mechanical Arrangement	20 days	Thu 19/06/08	Wed 16/07/08	10FS+5 days
12		2.1.4 Electrical Design	20 days	Thu 24/07/08	Wed 20/08/08	11FS+5 days
13		**2.2 Procurement of Pilot Plant Equipment**	**75 days**	**Mon 18/08/08**	**Fri 28/11/08**	
14		2.2.1 Manufacturing of UF/RF	15 wks	Mon 18/08/08	Fri 28/11/08	9SS+5 days
15		2.2.2 Manufacture of Test Skids	10 wks	Mon 25/08/08	Fri 31/10/08	14SS+1 wk
16		2.2.3 Manufacture of Electrical Equipment	10 wks	Mon 8/09/08	Fri 14/11/08	15SS+2 wks
17		2.2.4 Installation of Pilot Plant on Site	10 days	Mon 17/11/08	Fri 28/11/08	16
18		**2.3 Pilot Plant Trials**	**111 days**	**Mon 1/12/08**	**Mon 4/05/09**	
19		2.3.1 Preliminary Trials	6 wks	Mon 1/12/08	Fri 9/01/09	17
20		2.3.2 First Pilot Plant Review Meeting	1 day	Mon 12/01/09	Mon 12/01/09	19
21		2.3.3 Pilot Plant Trials	14 wks	Tue 13/01/09	Mon 20/04/09	20
22		2.3.4 Completion of Pilot Studies	1 day	Tue 21/04/09	Tue 21/04/09	21
23		2.3.5 Pilot Plant Study Report	8 days	Wed 22/04/09	Fri 1/05/09	22
24		2.3.6 Final Pilot Study Review Meeting	1 day	Mon 4/05/09	Mon 4/05/09	23
25		**3 DESIGN**	**325 days**	**Thu 15/05/08**	**Wed 12/08/09**	
26		**3.1 Design Input**	**106 days**	**Thu 15/05/08**	**Thu 9/10/08**	
27		3.1.1 Site Geotechnical Report	3 wks	Fri 12/09/08	Thu 2/10/08	
28		3.1.2 Site Datum and Levels Survey	3 wks	Fri 12/09/08	Thu 2/10/08	27SS
29		3.1.3 Underground Services Survey	3 wks	Fri 19/09/08	Thu 9/10/08	28SS+5 days
30		3.1.4 Soil Resitivity Tests	3 wks	Fri 19/09/08	Thu 9/10/08	29SS
31		3.1.5 Liverpool STP Effluent Water Quality	12 wks	Tue 1/07/08	Mon 22/09/08	
32		3.1.6 Glenfield STP Effluent Water Quality	12 wks	Tue 1/07/08	Mon 22/09/08	
33		3.1.7 Incomer Electrical Supply Application	1 day	Tue 16/09/08	Tue 16/09/08	
34		3.1.8 Design Brief for Building	12 wks	Thu 15/05/08	Wed 6/08/08	
35		3.1.9 Trade Waste Improvement Proposal	14 days	Tue 22/07/08	Fri 8/08/08	31SS+3 wks,32SS+3 wks
36		**3.2 Prelimianry Process Design**	**99 days**	**Thu 15/05/08**	**Tue 30/09/08**	
37		3.2.1 Process P & ID	4 wks	Thu 15/05/08	Wed 11/06/08	
38		3.2.2 Process Plant Layout	6 wks	Thu 12/06/08	Wed 23/07/08	37
39		3.2.3 Prelimianry Pipework Arrangement	3 wks	Thu 24/07/08	Wed 13/08/08	38
40		3.2.4 Preliminary Equipment Schedules	4 wks	Thu 14/08/08	Wed 10/09/08	39
41		3.2.5 Civil Guidance drawings	2 wks	Thu 11/09/08	Wed 24/09/08	40,38
42		3.2.6 Preliminary Design Complete	2 days	Thu 25/09/08	Fri 26/09/08	41
43		3.2.7 First Design review	2 days	Mon 29/09/08	Tue 30/09/08	42
44		3.2.8 Trade Waste Quality Assessment by SWC	3 wks	Mon 11/08/08	Fri 29/08/08	35
45		3.2.9 Drop Dead Date for for Trade Waste Improvement	0 days	Fri 29/08/08	Fri 29/08/08	44
46		**3.3 Civil and Structural Design**	**90 days**	**Thu 25/09/08**	**Wed 28/01/09**	
47		3.3.1 Foundation Design	12 wks	Thu 25/09/08	Wed 17/12/08	38,41
48		3.3.2 Underground Services	8 wks	Fri 10/10/08	Thu 4/12/08	29
49		3.3.3 Floor Slab Design	4 wks	Thu 18/12/08	Wed 14/01/09	47,48FS-2 wks
50		3.3.4 Framing and Steel Structure Design	8 wks	Thu 4/12/08	Wed 28/01/09	49SS-2 wks



Project: Porject Program (rev 1) Date: Tue 30/09/08	Task		Progress		Summary		External Tasks		Deadline
	Split		Milestone		Project Summary		External Milestone		

ID		Task Name	Duration	Start	Finish	Predecessors
51		3.3.5 Roof Design	8 wks	Thu 20/11/08	Wed 14/01/09	50SS-2 wks
52		3.3.6 Prepare Earth Work Specifications	4 wks	Thu 18/12/08	Wed 14/01/09	47
53		3.3.7 Prepare Concrete Work Specifications	4 wks	Thu 18/12/08	Wed 14/01/09	47
54		3.3.8 Prepare Structural Steel Specifications	4 wks	Thu 1/01/09	Wed 28/01/09	50FS-4 wks
55		**3.4 Architectural Design**	**180 days**	**Thu 15/05/08**	**Wed 21/01/09**	
56		3.4.1 Building Interior Finishes	10 wks	Thu 25/09/08	Wed 3/12/08	41
57		3.4.2 Building Exterior Finishes	10 wks	Thu 25/09/08	Wed 3/12/08	56SS
58		3.4.3 Doors and Windows	4 wks	Thu 4/12/08	Wed 31/12/08	57
59		3.4.4 Laboratory Interior Finsihes	6 wks	Thu 4/12/08	Wed 14/01/09	57
60		3.4.5 Electrical Room	6 wks	Thu 15/05/08	Wed 25/06/08	
61		3.4.6 Amenities	6 wks	Thu 26/06/08	Wed 6/08/08	60
62		3.4.7 Workshop	12 wks	Thu 7/08/08	Wed 29/10/08	61
63		3.4.8 Landscaping and Roadwork	12 wks	Thu 30/10/08	Wed 21/01/09	62
64		**3.5 Buildign Services**	**120 days**	**Thu 23/10/08**	**Wed 8/04/09**	
65		3.5.1 Plumbing layout	8 wks	Thu 23/10/08	Wed 17/12/08	56SS+4 wks
66		3.5.2 Insulation	6 wks	Thu 18/12/08	Wed 28/01/09	65
67		3.5.3 Lighting	6 wks	Thu 29/01/09	Wed 11/03/09	66,51
68		3.5.4 Heating and Ventilation	4 wks	Thu 12/03/09	Wed 8/04/09	67
69		**3.6 Detailed Process Design**	**119 days**	**Wed 1/10/08**	**Mon 16/03/09**	
70		3.6.1 HAZOP	2 days	Wed 1/10/08	Thu 2/10/08	43
71		3.6.2 Process P & ID (after Pilot Plant Prelim results)	4 wks	Tue 13/01/09	Mon 9/02/09	20
72		3.6.3 Mechanical Equipment Schedules (Final)	3 wks	Tue 16/12/08	Mon 5/01/09	71SS-4 wks
73		3.6.4 Tank Schedules	3 wks	Tue 6/01/09	Mon 26/01/09	72
74		3.6.5 Pump Schedules	4 wks	Tue 6/01/09	Mon 2/02/09	72
75		3.6.6 Pipe Layout (Final)	6 wks	Tue 3/02/09	Mon 16/03/09	74
76		3.6.7 Control Philosophy (Preliminary)	8 wks	Fri 3/10/08	Thu 27/11/08	70
77		3.6.8 Second Design Review	3 days	Tue 27/01/09	Thu 29/01/09	73
78		3.6.9 Consolidate and Finalise Process Design	2 wks	Fri 30/01/09	Thu 12/02/09	77
79		**3.7 Mechanical Design**	**141 days**	**Thu 15/01/09**	**Thu 30/07/09**	
80		3.7.1 Valve Schedules	10 wks	Fri 13/02/09	Thu 23/04/09	78
81		3.7.2 Pipe Specifications	6 wks	Fri 24/04/09	Thu 4/06/09	80
82		3.7.3 Pipe ISO drawings	6 wks	Fri 5/06/09	Thu 16/07/09	81
83		3.7.4 Miscellaneous Steel Design	8 wks	Fri 5/06/09	Thu 30/07/09	82SS
84		3.7.5 Overhead crane	8 wks	Thu 15/01/09	Wed 11/03/09	51
85		**3.8 Electrical Design**	**226 days**	**Wed 1/10/08**	**Wed 12/08/09**	
86		3.8.1 Single Line Diagrams	8 wks	Wed 1/10/08	Tue 25/11/08	43
87		3.8.2 Motor Schedules	8 wks	Wed 26/11/08	Tue 20/01/09	86
88		3.8.3 MCC Circuit Diagrams	8 wks	Wed 26/11/08	Tue 20/01/09	86
89		3.8.4 PLC Panel Circuit Diagram	8 wks	Wed 17/12/08	Tue 10/02/09	88SS+3 wks
90		3.8.5 Instrument Schedules	9 wks	Tue 10/02/09	Mon 13/04/09	71
91		3.8.6 Earthing and Lightning Design	9 wks	Wed 24/12/08	Tue 24/02/09	88SS+4 wks
92		3.8.7 Lighting Design	6 wks	Wed 25/02/09	Tue 7/04/09	91
93		3.8.8 ELV Design	6 wks	Wed 25/02/09	Tue 7/04/09	92SS
94		3.8.9 Local Panels	6 wks	Thu 12/03/09	Wed 22/04/09	67
95		3.8.10 PLC Programming / SCADA Config & FAT	16 wks	Thu 23/04/09	Wed 12/08/09	94
96		3.8.11 CableSchedules	10 wks	Thu 12/03/09	Wed 20/05/09	94SS
97		3.8.12 Cable routing (above and underground)	10 wks	Thu 12/03/09	Wed 20/05/09	96SS
98		3.8.13 Control philosophy (Final)	12 wks	Fri 28/11/08	Thu 19/02/09	76
99		**4 Document Deliverables**	**173 days**	**Mon 4/08/08**	**Wed 1/04/09**	
100		4.1 Project Management Plan	3 wks	Mon 4/08/08	Fri 22/08/08	



Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			

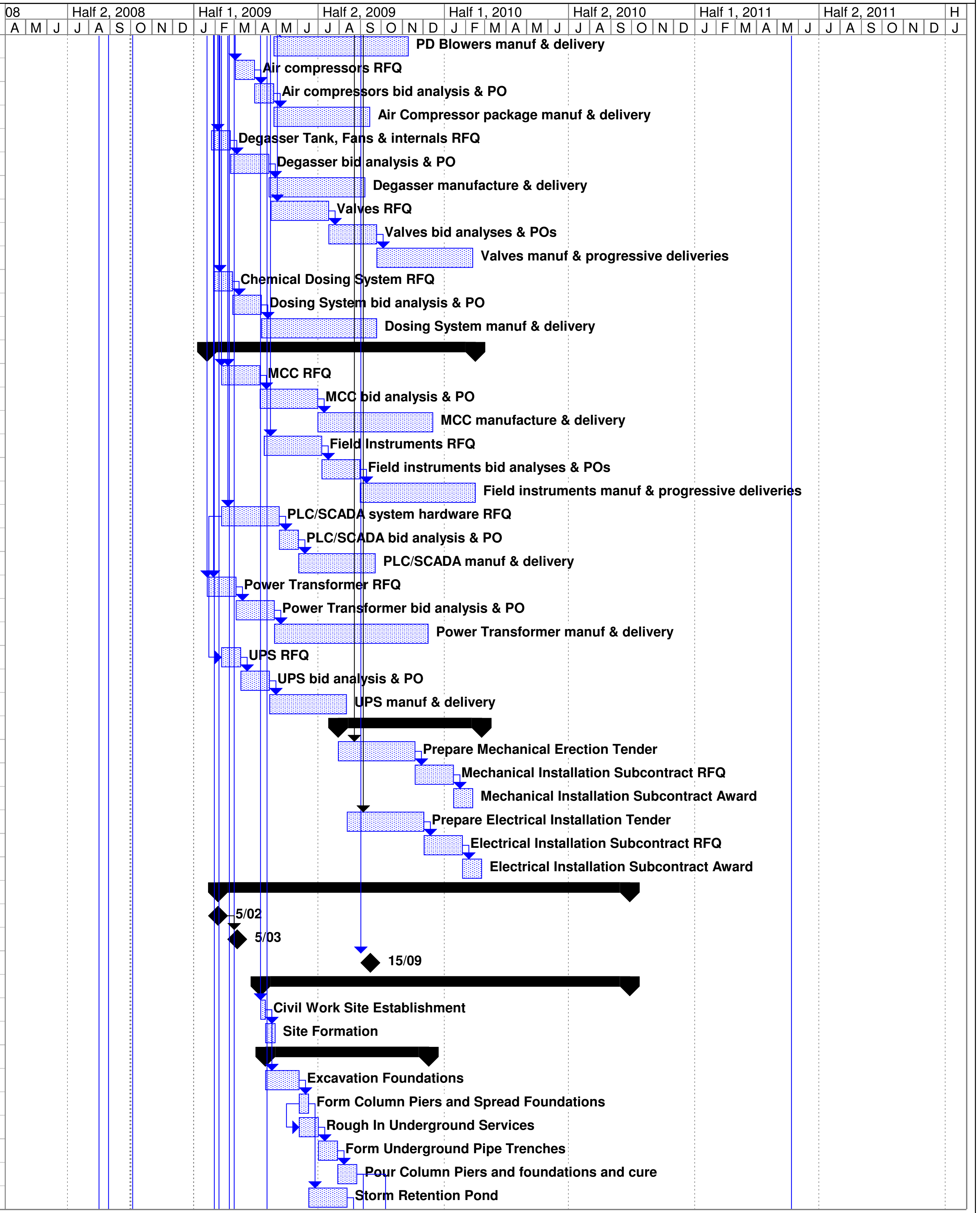
Project: Porject Program (rev 1)
Date: Tue 30/09/08

ID		Task Name	Duration	Start	Finish	Predecessors
101		4.2 Design Management Plan	3 wks	Mon 4/08/08	Fri 22/08/08	100SS
102		4.3 Construction Plan	8 wks	Thu 8/01/09	Wed 4/03/09	46FS-3 wks
103		4.4 Site Specific Safety Plan	4 wks	Thu 5/03/09	Wed 1/04/09	102
104		4.5 Environmental Management Plan	4 wks	Thu 5/03/09	Wed 1/04/09	103SS
105		4.6 Procurement Plan	6 wks	Mon 25/08/08	Fri 3/10/08	100
106		**5 PROCUREMENT, MANUFACTURE & DELIVERY**	**298 days**	**Tue 6/01/09**	**Thu 25/02/10**	
107		**5.1 Building Construction Procurement**	**110 days**	**Thu 15/01/09**	**Wed 17/06/09**	
108		5.1.1 Prepare Substructure Tender	4 wks	Thu 15/01/09	Wed 11/02/09	46FS-2 wks
109		5.1.2 Prepare Superstructure Tender	4 wks	Thu 15/01/09	Wed 11/02/09	46FS-2 wks
110		5.1.3 Foundation RFQ and Contract Award	6 wks	Thu 12/02/09	Wed 25/03/09	108
111		5.1.4 Building RFQ and Contract Award	10 wks	Thu 12/02/09	Wed 22/04/09	109
112		5.1.5 Preapre Building Services Tender	10 wks	Thu 12/02/09	Wed 22/04/09	109
113		5.1.6 Building Services RFQ and Contract Award	8 wks	Thu 23/04/09	Wed 17/06/09	112
114		**5.2 Mechanical Equipment Procurement**	**298 days**	**Tue 6/01/09**	**Thu 25/02/10**	
115		5.2.1 UF package RFQ	8 wks	Tue 6/01/09	Mon 2/03/09	72
116		5.2.2 UF bid analysis & PO	10 wks	Tue 3/03/09	Mon 11/05/09	115
117		5.2.3 UF package manufacture & delivery	8 mons	Tue 12/05/09	Mon 21/12/09	116
118		5.2.4 RO Membrane RFQ	4 wks	Tue 3/03/09	Mon 30/03/09	115
119		5.2.5 RO membrane bid analysis & PO	8 wks	Tue 31/03/09	Mon 25/05/09	118
120		5.2.6 RO membrane manufacture & delivery	6 mons	Tue 26/05/09	Mon 9/11/09	119
121		5.2.7 RO Pressure Vessel RFQ	4 wks	Tue 31/03/09	Mon 27/04/09	118
122		5.2.8 RO Pressure Vessel bid analysis & PO	8 wks	Tue 28/04/09	Mon 22/06/09	121
123		5.2.9 RO Pressure Vessel manuf & delivery skid manufa	4 mons	Tue 23/06/09	Mon 12/10/09	122
124		5.2.10 RO skid RFQ	4 wks	Tue 31/03/09	Mon 27/04/09	121SS
125		5.2.11 RO skid bid analysis & PO	5 wks	Tue 28/04/09	Mon 1/06/09	124
126		5.2.12 RO skids manufacture & assembly	6 mons	Tue 2/06/09	Mon 16/11/09	125
127		5.2.13 RO skid delivery to site	4 wks	Tue 17/11/09	Mon 14/12/09	126
128		5.2.14 Panel Tanks RFQ	4 wks	Tue 27/01/09	Mon 23/02/09	73
129		5.2.15 Panel Tanks bid analysis & PO	8 wks	Tue 24/02/09	Mon 20/04/09	128
130		5.2.16 Panel Tanks manufacture & delivery	4 mons	Tue 21/04/09	Mon 10/08/09	129
131		5.2.17 Welded Steel Tanks RFQ	4 wks	Tue 27/01/09	Mon 23/02/09	73
132		5.2.18 Welded Steel Tanks bid analysis & PO	8 wks	Tue 24/02/09	Mon 20/04/09	131
133		5.2.19 Welded Steel Tanks manufacture & delivery	22 wks	Tue 21/04/09	Mon 21/09/09	132
134		5.2.20 Ion Exchange Vessel RFQ	4 wks	Tue 27/01/09	Mon 23/02/09	73
135		5.2.21 Ion Exchange Vessel bid analysis & PO	8 wks	Tue 24/02/09	Mon 20/04/09	134
136		5.2.22 Ion Exchange Vessel manufacture & delivery	25 wks	Tue 21/04/09	Mon 12/10/09	135
137		5.2.23 FRP Tanks RFQ	4 wks	Tue 27/01/09	Mon 23/02/09	73
138		5.2.24 FRP Tanks bid analysis & PO	8 wks	Tue 24/02/09	Mon 20/04/09	137
139		5.2.25 FRP Tanks manufacture & delivery	25 wks	Tue 21/04/09	Mon 12/10/09	138
140		5.2.26 UF Cell RFQ	12 wks	Tue 6/01/09	Mon 30/03/09	72
141		5.2.27 UF Cell bid analysis & PO	6 wks	Tue 31/03/09	Mon 11/05/09	140
142		5.2.28 UF Cell manufacture & delivery	8 mons	Tue 12/05/09	Mon 21/12/09	141
143		5.2.29 Pump RFQs	6 wks	Tue 3/02/09	Mon 16/03/09	74
144		5.2.30 Pump bids analyses & PO	8 wks	Tue 17/03/09	Mon 11/05/09	143
145		5.2.31 Pump manufacture & deliveries	7 mons	Tue 12/05/09	Mon 23/11/09	144
146		5.2.32 I/C Pipework RFQ	6 wks	Fri 17/07/09	Thu 27/08/09	82
147		5.2.33 I/C Pipework bid analysis & PO	6 wks	Fri 28/08/09	Thu 8/10/09	146
148		5.2.34 I/C Pipework shop fab & progressive deliveries	5 mons	Fri 9/10/09	Thu 25/02/10	147
149		5.2.35 PD Blowers RFQ	4 wks	Tue 3/02/09	Mon 2/03/09	72FS+4 wks
150		5.2.36 PD Blowers bid analysis & RO	8 wks	Tue 3/03/09	Mon 27/04/09	149

Project: Porject Program (rev 1)
Date: Tue 30/09/08

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

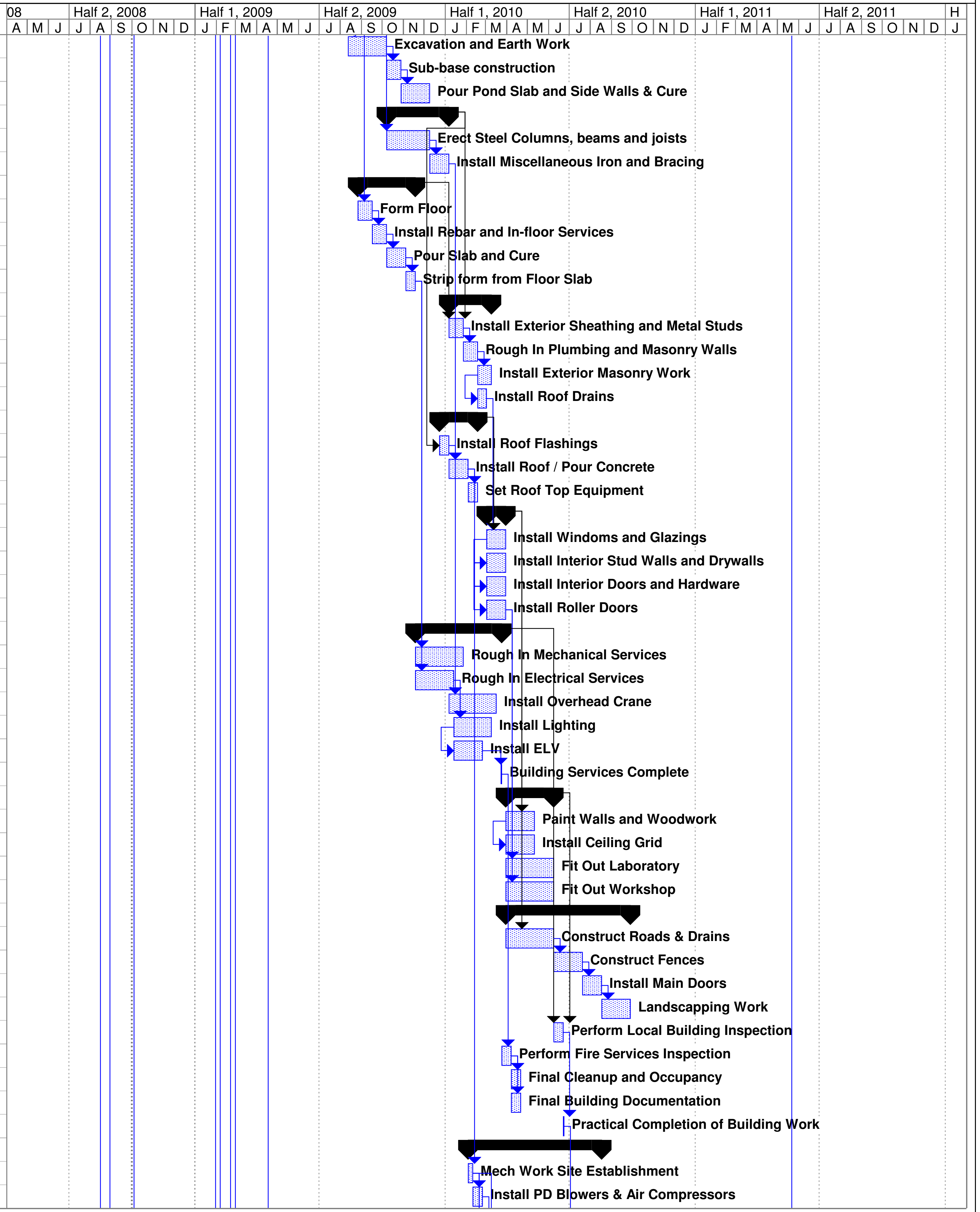
ID	Task Name	Duration	Start	Finish	Predecessors
151	5.2.37 PD Blowers manuf & delivery	7 mons	Tue 28/04/09	Mon 9/11/09	150
152	5.2.38 Air compressors RFQ	4 wks	Tue 3/03/09	Mon 30/03/09	72FS+8 wks
153	5.2.39 Air compressors bid analysis & PO	4 wks	Tue 31/03/09	Mon 27/04/09	152
154	5.2.40 Air Compressor package manuf & delivery	5 mons	Tue 28/04/09	Mon 14/09/09	153
155	5.2.41 Degasser Tank, Fans & internals RFQ	4 wks	Tue 27/01/09	Mon 23/02/09	73
156	5.2.42 Degasser bid analysis & PO	8 wks	Tue 24/02/09	Mon 20/04/09	155
157	5.2.43 Degasser manufacture & delivery	5 mons	Tue 21/04/09	Mon 7/09/09	156
158	5.2.44 Valves RFQ	12 wks	Fri 24/04/09	Thu 16/07/09	80
159	5.2.45 Valves bid analyses & POs	10 wks	Fri 17/07/09	Thu 24/09/09	158
160	5.2.46 Valves manuf & progressive deliveries	5 mons	Fri 25/09/09	Thu 11/02/10	159
161	5.2.47 Chemical Dosing System RFQ	4 wks	Fri 30/01/09	Thu 26/02/09	77
162	5.2.48 Dosing System bid analysis & PO	6 wks	Fri 27/02/09	Thu 9/04/09	161
163	5.2.49 Dosing System manuf & delivery	6 mons	Fri 10/04/09	Thu 24/09/09	162
164	**5.3 Electrical Equipment RFQ**	**279 days**	**Wed 21/01/09**	**Mon 15/02/10**	
165	5.3.1 MCC RFQ	8 wks	Wed 11/02/09	Tue 7/04/09	88,89
166	5.3.2 MCC bid analysis & PO	12 wks	Wed 8/04/09	Tue 30/06/09	165
167	5.3.3 MCC manufacture & delivery	6 mons	Wed 1/07/09	Tue 15/12/09	166
168	5.3.4 Field Instruments RFQ	12 wks	Tue 14/04/09	Mon 6/07/09	90
169	5.3.5 Field instruments bid analyses & POs	8 wks	Tue 7/07/09	Mon 31/08/09	168
170	5.3.6 Field instruments manuf & progressive deliveries	6 mons	Tue 1/09/09	Mon 15/02/10	169
171	5.3.7 PLC/SCADA system hardware RFQ	12 wks	Wed 11/02/09	Tue 5/05/09	89
172	5.3.8 PLC/SCADA bid analysis & PO	4 wks	Wed 6/05/09	Tue 2/06/09	171
173	5.3.9 PLC/SCADA manuf & delivery	4 mons	Wed 3/06/09	Tue 22/09/09	172
174	5.3.10 Power Transformer RFQ	6 wks	Wed 21/01/09	Tue 3/03/09	86,87
175	5.3.11 Power Transformer bid analysis & PO	8 wks	Wed 4/03/09	Tue 28/04/09	174
176	5.3.12 Power Transformer manuf & delivery	8 mons	Wed 29/04/09	Tue 8/12/09	175
177	5.3.13 UPS RFQ	4 wks	Wed 11/02/09	Tue 10/03/09	171SS
178	5.3.14 UPS bid analysis & PO	6 wks	Wed 11/03/09	Tue 21/04/09	177
179	5.3.15 UPS manuf & delivery	4 mons	Wed 22/04/09	Tue 11/08/09	178
180	**5.4 M & E Subcontractors**	**149 days**	**Fri 31/07/09**	**Wed 24/02/10**	
181	5.4.1 Prepare Mechanical Erection Tender	4 mons	Fri 31/07/09	Thu 19/11/09	79
182	5.4.2 Mechanical Installation Subcontract RFQ	2 mons	Fri 20/11/09	Thu 14/01/10	181
183	5.4.3 Mechanical Installation Subcontract Award	1 mon	Fri 15/01/10	Thu 11/02/10	182
184	5.4.4 Prepare Electrical Installation Tender	4 mons	Thu 13/08/09	Wed 2/12/09	85
185	5.4.5 Electrical Installation Subcontract RFQ	2 mons	Thu 3/12/09	Wed 27/01/10	184
186	5.4.6 Electrical Installation Subcontract Award	1 mon	Thu 28/01/10	Wed 24/02/10	185
187	**6 CONSTRUCTION & INSTALLATION**	**429 days**	**Thu 5/02/09**	**Tue 28/09/10**	
188	6.1 VWA provide VWS access to fully remediated site	0 days	Thu 5/02/09	Thu 5/02/09	
189	6.2 Construction Power to Site Available	0 days	Thu 5/03/09	Thu 5/03/09	188FS+4 wks
190	6.3 Permanent Power Supply to Site Available	0 days	Tue 15/09/09	Tue 15/09/09	33FS+52 wks
191	**6.4 Civil Works**	**385 days**	**Thu 9/04/09**	**Tue 28/09/10**	
192	6.4.1 Civil Work Site Establishment	5 days	Thu 9/04/09	Wed 15/04/09	110FS+2 wks
193	6.4.2 Site Formation	2 wks	Thu 16/04/09	Wed 29/04/09	192
194	**6.4.3 Foundations**	**170 days**	**Thu 16/04/09**	**Wed 9/12/09**	
195	6.4.3.1 Excavation Foundations	7 wks	Thu 16/04/09	Wed 3/06/09	192
196	6.4.3.2 Form Column Piers and Spread Foundation	2 wks	Thu 4/06/09	Wed 17/06/09	195
197	6.4.3.3 Rough In Underground Services	4 wks	Thu 4/06/09	Wed 1/07/09	196SS
198	6.4.3.4 Form Underground Pipe Trenches	4 wks	Thu 2/07/09	Wed 29/07/09	197
199	6.4.3.5 Pour Column Piers and foundations and cur	4 wks	Thu 30/07/09	Wed 26/08/09	198
200	6.4.3.6 Storm Retention Pond	8 wks	Thu 18/06/09	Wed 12/08/09	196



Project: Porject Program (rev 1)
Date: Tue 30/09/08

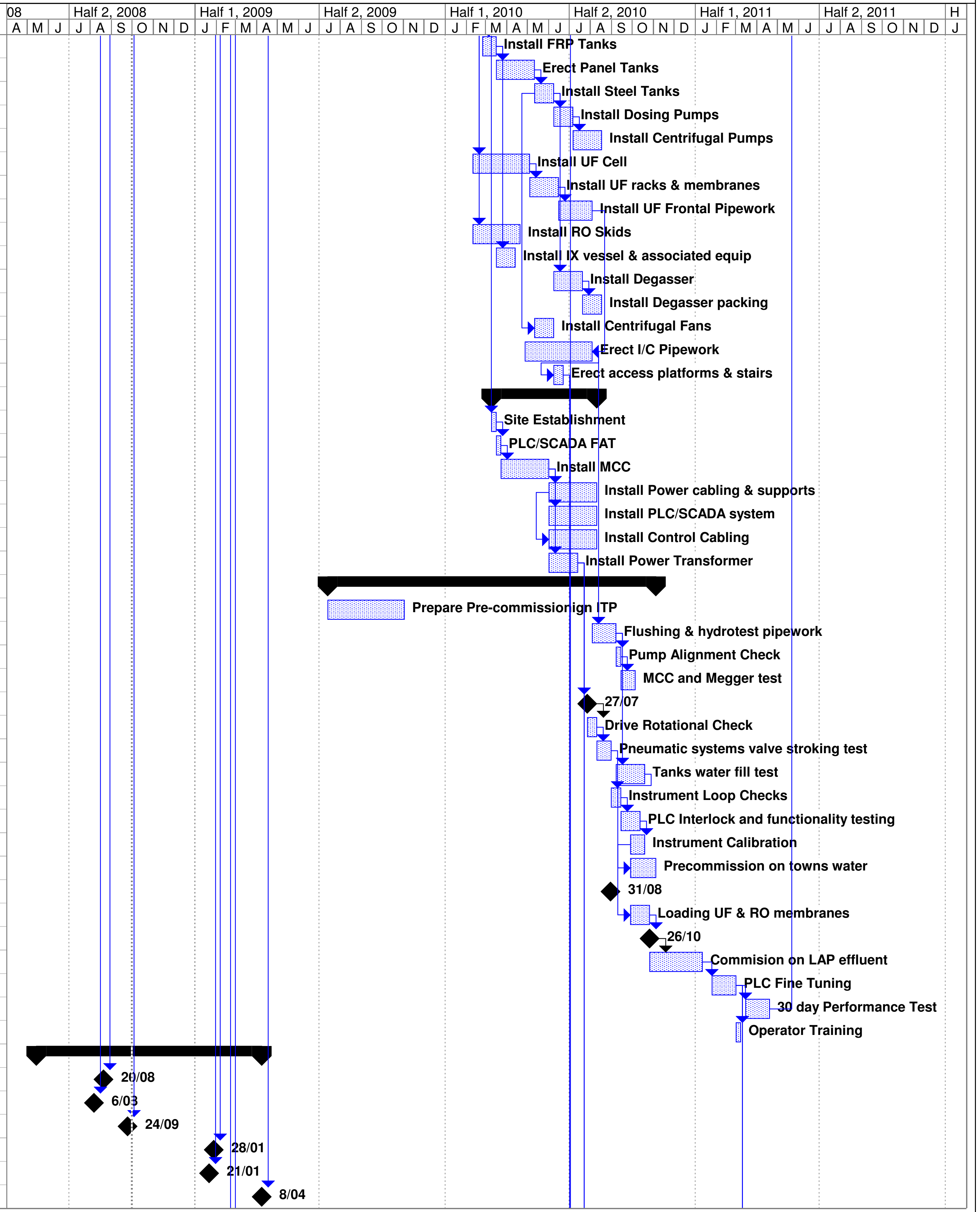
Task	Progress	Summary	External Tasks
Split	Milestone	Project Summary	External Milestone
Deadline			

ID		Task Name	Duration	Start	Finish	Predecessors
201		6.4.3.7 Excavation and Earth Work	8 wks	Thu 13/08/09	Wed 7/10/09	200
202		6.4.3.8 Sub-base construction	3 wks	Thu 8/10/09	Wed 28/10/09	201
203		6.4.3.9 Pour Pond Slab and Side Walls & Cure	6 wks	Thu 29/10/09	Wed 9/12/09	202
204		**6.4.4 Steel Erection**	**65 days**	**Thu 8/10/09**	**Wed 6/01/10**	
205		6.4.4.1 Erect Steel Columns, beams and joists	9 wks	Thu 8/10/09	Wed 9/12/09	199FS+6 wks
206		6.4.4.2 Install Miscellaneous Iron and Bracing	4 wks	Thu 10/12/09	Wed 6/01/10	205
207		**6.4.5 Form and Pour Concrete - Floors**	**60 days**	**Thu 27/08/09**	**Wed 18/11/09**	
208		6.4.5.1 Form Floor	3 wks	Thu 27/08/09	Wed 16/09/09	199
209		6.4.5.2 Install Rebar and In-floor Services	3 wks	Thu 17/09/09	Wed 7/10/09	208
210		6.4.5.3 Pour Slab and Cure	4 wks	Thu 8/10/09	Wed 4/11/09	209
211		6.4.5.4 Strip form from Floor Slab	2 wks	Thu 5/11/09	Wed 18/11/09	210
212		**6.4.6 Carpentary and Masonry Work**	**45 days**	**Thu 7/01/10**	**Tue 9/03/10**	
213		6.4.6.1 Install Exterior Sheathing and Metal Studs	3 wks	Thu 7/01/10	Wed 27/01/10	204,207
214		6.4.6.2 Rough In Plumbing and Masonry Walls	3 wks	Thu 28/01/10	Wed 17/02/10	213
215		6.4.6.3 Install Exterior Masonry Work	3 wks	Thu 18/02/10	Tue 9/03/10	214
216		6.4.6.4 Install Roof Drains	2 wks	Thu 18/02/10	Tue 2/03/10	215SS
217		**6.4.7 Roofing**	**40 days**	**Thu 24/12/09**	**Wed 17/02/10**	
218		6.4.7.1 Install Roof Flashings	2 wks	Thu 24/12/09	Wed 6/01/10	204FS-2 wks
219		6.4.7.2 Install Roof / Pour Concrete	4 wks	Thu 7/01/10	Wed 3/02/10	218
220		6.4.7.3 Set Roof Top Equipment	2 wks	Thu 4/02/10	Wed 17/02/10	219
221		**6.4.8 Windows and Front Closures**	**20 days**	**Wed 3/03/10**	**Tue 30/03/10**	
222		6.4.8.1 Install Windoms and Glazings	4 wks	Wed 3/03/10	Tue 30/03/10	216,217
223		6.4.8.2 Install Interior Stud Walls and Drywalls	4 wks	Wed 3/03/10	Tue 30/03/10	222SS
224		6.4.8.3 Install Interior Doors and Hardware	4 wks	Wed 3/03/10	Tue 30/03/10	223SS
225		6.4.8.4 Install Roller Doors	4 wks	Wed 3/03/10	Tue 30/03/10	224SS
226		**6.4.9 Building Services**	**91 days**	**Thu 19/11/09**	**Wed 24/03/10**	
227		6.4.9.1 Rough In Mechanical Services	10 wks	Thu 19/11/09	Wed 27/01/10	211
228		6.4.9.2 Rough In Electrical Services	8 wks	Thu 19/11/09	Wed 13/01/10	211
229		6.4.9.3 Install Overhead Crane	10 wks	Thu 7/01/10	Tue 16/03/10	206
230		6.4.9.4 Install Lighting	8 wks	Thu 14/01/10	Tue 9/03/10	228
231		6.4.9.5 Install ELV	6 wks	Thu 14/01/10	Wed 24/02/10	230SS
232		6.4.9.6 Building Services Complete	1 day	Wed 24/03/10	Wed 24/03/10	231FS+4 wks
233		**6.4.10 Building Finishes**	**50 days**	**Wed 31/03/10**	**Tue 8/06/10**	
234		6.4.10.1 Paint Walls and Woodwork	6 wks	Wed 31/03/10	Tue 11/05/10	221
235		6.4.10.2 Install Ceiling Grid	6 wks	Wed 31/03/10	Tue 11/05/10	234SS
236		6.4.10.3 Fit Out Laboratory	10 wks	Wed 31/03/10	Tue 8/06/10	225
237		6.4.10.4 Fit Out Workshop	10 wks	Wed 31/03/10	Tue 8/06/10	225
238		**6.4.11 Road Work and Landscaping**	**130 days**	**Wed 31/03/10**	**Tue 28/09/10**	
239		6.4.11.1 Construct Roads & Drains	10 wks	Wed 31/03/10	Tue 8/06/10	221
240		6.4.11.2 Construct Fences	6 wks	Wed 9/06/10	Tue 20/07/10	239
241		6.4.11.3 Install Main Doors	4 wks	Wed 21/07/10	Tue 17/08/10	240
242		6.4.11.4 Landscaping Work	6 wks	Wed 18/08/10	Tue 28/09/10	241
243		**6.4.12 Perform Local Building Inspection**	**2 wks**	**Wed 9/06/10**	**Tue 22/06/10**	**226,233**
244		**6.4.13 Perform Fire Services Inspection**	**2 wks**	**Thu 25/03/10**	**Wed 7/04/10**	**232**
245		**6.4.14 Final Cleanup and Occupancy**	**2 wks**	**Thu 8/04/10**	**Wed 21/04/10**	**244**
246		**6.4.15 Final Building Documentation**	**2 wks**	**Thu 8/04/10**	**Wed 21/04/10**	**244**
247		**6.4.16 Practical Completion of Building Work**	**1 day**	**Wed 23/06/10**	**Wed 23/06/10**	**243**
248		**6.5 Mechanical Works**	**140 days**	**Thu 4/02/10**	**Tue 17/08/10**	
249		6.5.1 Mech Work Site Establishment	1 wk	Thu 4/02/10	Wed 10/02/10	219
250		6.5.2 Install PD Blowers & Air Compressors	2 wks	Thu 11/02/10	Wed 24/02/10	249



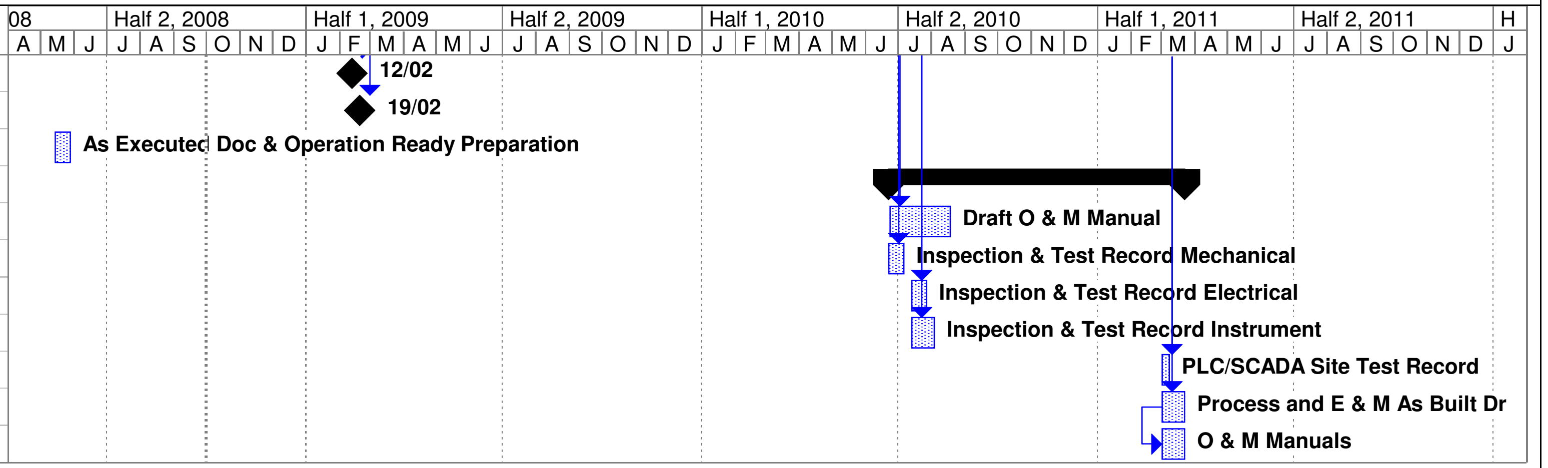
Project: Porject Program (rev 1) Date: Tue 30/09/08	Task		Progress		Summary		External Tasks		Deadline	
	Split		Milestone		Project Summary		External Milestone			

ID		Task Name	Duration	Start	Finish	Predecessors
251		6.5.3 Install FRP Tanks	3 wks	Thu 25/02/10	Tue 16/03/10	250
252		6.5.4 Erect Panel Tanks	8 wks	Wed 17/03/10	Tue 11/05/10	251
253		6.5.5 Install Steel Tanks	4 wks	Wed 12/05/10	Tue 8/06/10	252
254		6.5.6 Install Dosing Pumps	4 wks	Wed 9/06/10	Tue 6/07/10	253
255		6.5.7 Install Centrifugal Pumps	6 wks	Wed 7/07/10	Tue 17/08/10	254
256		6.5.8 Install UF Cell	12 wks	Thu 11/02/10	Tue 4/05/10	249
257		6.5.9 Install UF racks & membranes	6 wks	Wed 5/05/10	Tue 15/06/10	256
258		6.5.10 Install UF Frontal Pipework	7 wks	Wed 16/06/10	Tue 3/08/10	257
259		6.5.11 Install RO Skids	10 wks	Thu 11/02/10	Tue 20/04/10	249
260		6.5.12 Install IX vessel & associated equip	4 wks	Wed 17/03/10	Tue 13/04/10	251
261		6.5.13 Install Degasser	6 wks	Wed 9/06/10	Tue 20/07/10	253
262		6.5.14 Install Degasser packing	4 wks	Wed 21/07/10	Tue 17/08/10	261
263		6.5.15 Install Centrifugal Fans	4 wks	Wed 12/05/10	Tue 8/06/10	253SS
264		6.5.16 Erect I/C Pipework	14 wks	Wed 28/04/10	Tue 3/08/10	258FF
265		6.5.17 Erect access platforms & stairs	2 wks	Wed 9/06/10	Tue 22/06/10	264FS-8 wks
266		**6.6 Electrical Works**	**110 days**	**Wed 10/03/10**	**Tue 10/08/10**	
267		6.6.1 Site Establishment	1 wk	Wed 10/03/10	Tue 16/03/10	249FS+4 wks
268		6.6.2 PLC/SCADA FAT	5 days	Wed 17/03/10	Tue 23/03/10	267
269		6.6.3 Install MCC	10 wks	Wed 24/03/10	Tue 1/06/10	268
270		6.6.4 Install Power cabling & supports	10 wks	Wed 2/06/10	Tue 10/08/10	269
271		6.6.5 Install PLC/SCADA system	10 wks	Wed 2/06/10	Tue 10/08/10	269
272		6.6.6 Install Control Cabling	10 wks	Wed 2/06/10	Tue 10/08/10	270SS
273		6.6.7 Install Power Transformer	6 wks	Wed 2/06/10	Tue 13/07/10	269
274		**7 TESTING & COMMISSIONING**	**344 days**	**Tue 14/07/09**	**Thu 4/11/10**	
275		7.1 Prepare Pre-commissionign ITP	4 mons	Tue 14/07/09	Mon 2/11/09	
276		7.2 Flushing & hydrotest pipework	5 wks	Wed 4/08/10	Tue 7/09/10	264
277		7.3 Pump Alignment Check	1 wk	Wed 8/09/10	Tue 14/09/10	276
278		7.4 MCC and Megger test	3 wks	Wed 15/09/10	Tue 5/10/10	277
279		7.5 Power up	0 days	Tue 27/07/10	Tue 27/07/10	273FS+2 wks
280		7.6 Drive Rotational Check	2 wks	Wed 28/07/10	Tue 10/08/10	279
281		7.7 Pneumatic systems valve stroking test	3 wks	Wed 11/08/10	Tue 31/08/10	280
282		7.8 Tanks water fill test	6 wks	Wed 8/09/10	Tue 19/10/10	276
283		7.9 Instrument Loop Checks	2 wks	Wed 1/09/10	Tue 14/09/10	281
284		7.10 PLC Interlock and functionality testing	4 wks	Wed 15/09/10	Tue 12/10/10	283
285		7.11 Instrument Calibration	3 wks	Wed 29/09/10	Tue 19/10/10	284FS-2 wks
286		7.12 Precommission on towns water	5.4 wks	Wed 29/09/10	Thu 4/11/10	285SS
287		7.13 Precommissioning complete/Mechanical Completion	0 days	Tue 31/08/10	Tue 31/08/10	
288		7.14 Loading UF & RO membranes	4 wks	Wed 29/09/10	Tue 26/10/10	282FS-3 wks
289		7.15 LAP Effluent made available to VWS by VWA	0 days	Tue 26/10/10	Tue 26/10/10	288
290		**8 Commision on LAP effluent**	11 wks	Wed 27/10/10	Tue 11/01/11	289
291		**9 PLC Fine Tuning**	5 wks	Wed 26/01/11	Tue 1/03/11	290FS+2 wks
292		**10 30 day Performance Test**	5 wks	Wed 16/03/11	Tue 19/04/11	291FS+2 wks
293		**11 Operator Training**	1 wk	Wed 2/03/11	Tue 8/03/11	291
294		**12 Key Design Submissions**	**235 days**	**Thu 15/05/08**	**Wed 8/04/09**	
295		12.1 Pilot Plant Design Document Complete	0 days	Wed 20/08/08	Wed 20/08/08	12
296		12.2 Design Brief for Building	0 days	Wed 6/08/08	Wed 6/08/08	34
297		12.3 Preliminary Design Prior to 1st Design review	0 days	Wed 24/09/08	Wed 24/09/08	41
298		12.4 Building Design Complete	0 days	Wed 28/01/09	Wed 28/01/09	54
299		12.5 Architectural Design Complete	0 days	Wed 21/01/09	Wed 21/01/09	63
300		12.6 Building Services Design Complete	0 days	Wed 8/04/09	Wed 8/04/09	68



Project: Porject Program (rev 1) Date: Tue 30/09/08	Task	Progress	Summary	External Tasks	Deadline
	Split	Milestone	Project Summary	External Milestone	

ID	Task Name	Duration	Start	Finish	Predecessors
301	12.7 Process Design Complete	0 days	Thu 12/02/09	Thu 12/02/09	78
302	12.8 E & M Process Design Complete	0 days	Thu 19/02/09	Thu 19/02/09	98
303	12.9 As Executed Doc & Operation Ready Preparation	2 wks	Thu 15/05/08	Wed 28/05/08	
304	**13 Inspection and Test Records for Civil & Building**	**195 days**	**Wed 23/06/10**	**Tue 22/03/11**	
305	13.1 Draft O & M Manual	2 mons	Thu 24/06/10	Wed 18/08/10	247
306	13.2 Inspection & Test Record Mechanical	2 wks	Wed 23/06/10	Tue 6/07/10	265
307	13.3 Inspection & Test Record Electrical	2 wks	Wed 14/07/10	Tue 27/07/10	273
308	13.4 Inspection & Test Record Instrument	3 wks	Wed 14/07/10	Tue 3/08/10	273
309	13.5 PLC/SCADA Site Test Record	1 wk	Wed 2/03/11	Tue 8/03/11	291
310	13.6 Process and E & M As Built Drawings	3 wks	Wed 2/03/11	Tue 22/03/11	291
311	13.7 O & M Manuals	3 wks	Wed 2/03/11	Tue 22/03/11	310SS



Project: Porject Program (rev 1)
Date: Tue 30/09/08

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

APPENDIX 2c - Risk analysis and management

VWA Risk Management Policy

VWA Risk Management Procedure

Incident and Emergency Management Plan (as tendered)

Project Specific risk assessment (from VWA PMP)

Preliminary Operational risk assessment (as tendered)

Risk Management Policy

Veolia Water, representing the water division of the environmental services group Veolia Environnement (VE), is the world leader in water services. Veolia Water Australia (VWA) designs, constructs and operates water and wastewater treatment systems for municipal and industrial customers.

This policy applies to VWA and General Water Australia (GWA).

The Board, Management and Employees of VWA and GWA are committed to adopting a co-ordinated approach to the management of risk throughout the company's operations, to ensure that any issues which could affect the company's performance, value, or reputation, are identified and addressed. We are committed to:

- the safety and well-being of our people, customers, contractors and the general public, which must not be compromised under any circumstances;
- the environment in which we operate;
- the company's performance and shareholder value; and
- our reputation as the world leader in water and wastewater services.

Management is responsible for implementing the Risk Management System and for developing a culture of risk management within VWA. All necessary human and financial resources and facilities will be applied to ensure that this commitment is fulfilled, that the optimum balance between risk and reward is achieved in a way appropriate to each of our operations, and that risks are managed in accordance with the highest standards.

Risk management is a standing item at board, executive committee, operations and project meetings. Regular risk management reports shall be submitted to the Board and will include reports on the implementation and continuing application of the Risk Management System.

This policy will be implemented through a documented and continually improved Risk Management System in accordance with the Australia Standard for Risk Management AS 4360.

This policy will be reviewed annually and will be prominently displayed at all VWA places of work.

P McVean 14/2/06

Peter McVean Date
CEO – Veolia Water Australia

PROCEDURE Risk Management

1. PURPOSE

The purpose of this Procedure is to define the responsibilities, authorities and process for conducting risk management.

The objective of risk management is to protect as priorities:

- The safety and well being of our staff, customers, contractors, and the general public, which must no be compromised under any circumstances;
- The environment in which we operate;
- The company's performance and shareholder value; and
- Our reputation as a leading provider of water and wastewater services.

2. SCOPE

This procedure applies to Veolia Water Australia Pty Ltd (VWA) and General Water Australia Pty Ltd (GWA) herein referred to as the Company.

3. REFERENCES

- PO-VWA-PYR-202 Risk Management Policy
- WI-VWA-PYR-202 How to conduct a risk assessment workshop and use the templates
- WI-VWA-PYR-305 Conducting a Job Safety and Environmental Analysis (JSEA)
- WI-VWA-PYR-301 How to Conduct a Working From Home Assessment
- FM-VWA-PYR-211 Strategic & Operations Risk Assessment & Register Template
- FM-VWA-PYR-702 Project Risk Assessment & Register Template
- FM-VWA-PYR-401 Environmental Risk Assessment & Register Template
- FM-VWA-PYR-301 OH&S Risk Assessment & Register Template
- FM-VWA-PYR-302 Manual Handling Risk Assessment
- FM-VWA-PYR-300 Chemical Risk Assessment
- FM-VWA-PYR-312 Hazard Identification and Risk Assessment Form
- FM-VWA-PYR-319 Home Office Assessment Form

- AS/NZS 4360 Risk Management
- HB 203:2004 Environmental Risk Management – Principles and processes
- AS/NZS 4801:2001 OH&S Management Systems – 4.4.6 Hazard Identification, hazard/risk assessment and control of hazards/risks
- NSW OH&S Regulation
- NSW Code of Practice for Risk Assessment
- VIC OH&S Act 1985
- QLD Risk Management Advisory Standard 2000
- QLD Workplace Health and Safety Regulation

4. DEFINITIONS

Consequence

The outcome or impact (positive or negative) of an event expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. There may be a range of possible outcomes associated with an event.

Control

An **existing** process, policy, device, practice or other action that acts to minimise negative risk or enhance positive opportunities.

Control assessment

Systematic review of processes to ensure that controles are still effective and appropriate. Periodic line management review of controls is often calles 'control self assessment'.

Environmental aspect

Element of an organisation's activities, products or services that can interact with the environment.

Environmental impact

Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.

Hazard

A source of potential harm or a situation with a potential to cause loss.

Job Safety and Environmental Analysis (JSEA)

Systematic breakdown of a job into tasks/steps in order to identify hazards, risk control measures, and responsibility for implementation of controls.

Likelihood

A qualitative or quantitative description of probability or frequency.

OH&S Risk

Is the likelihood that death, injury or illness might result because of the hazard.

Risk

The chance of an event and the consequences that may flow from it having an impact upon objectives. It is measured in terms of a combination of consequence and likelihood.

Risk acceptance

An informed decision to accept the consequences and the likelihood of a particular risk.

Risk assessment

The overall process of risk identification, risk analysis and risk evaluation.

Risk avoidance

A decision not to become involved in, or to withdraw from, a risk situation.

Risk criteria

Terms of reference by which significance of risk is assessed.

Risk identification

The process of determining, what, where, when, why and how something could happen.

Risk management

The culture, processes and structures that are directed towards realising potential opportunities whilst managing adverse effects.

Risk reduction

Actions taken to lessen the likelihood, negative consequences, or both, associated with a risk.

Risk sharing

Sharing with another party the burden of loss, or benefit of gain from a particular risk.

Risk treatment

Process of selection and implementation of measures to modify risks.

Significant Environmental Impact

An environmental impact assessed as having a risk of 12 or higher are deemed to be significant. The executive committee or Risk Manager may determine an aspect to be significant regardless of the calculated risk.

Source of risk

An incident, event, hazard, environmental aspect etc. which may cause a risk.

5. RESPONSIBILITIES AND AUTHORITIES

5.1 General

5.1.1 Risk Managers are:

Risk Category	Risk Manager	Reporting to
Reputation	CEO	Director, Asia
Business	COO	CEO
Business Development	COO	CEO
Financial	CFO	CEO
Human Resources	HR Manager	CEO
Projects	Contracts Manager	CEO
Operations	GMO	CEO
Information Technology	IT Manager	GMO
Specific Operating Contracts	Operations Managers	GMO
Individual Projects	Project Manager	COO / GMO or Project Director
OH&S	Operations Manager / COO	GMO / CEO
Environmental	Operations Manager	GMO

5.1.2 Authorities regarding the acceptance or treatment of risk are detailed in Table 6-3.

5.2 Business Systems Manager

5.2.1 The Business Systems Manager is responsible for:

- Providing and continually improving the risk management system compliant to AS/NZS 4360, ISO 9001; ISO 14001 and AS/NZS 4801;
- Facilitating risk management workshops as required;
- Providing training in this procedure; and
- Maintaining the corporate risk register.

5.3 Board

5.3.1 The Board is authorised to:

- Approve and endorse the risk management policy;
- Approve risk limits;
- Approve risk tolerance.

5.3.2 The Board is responsible for providing oversight of the risk management process.

5.4 Executive Committee

5.4.1 The Executive Committee is authorised to:

- accept high level risks;
- approve risk treatment for high and moderate risks;
- approve the Risk Management Procedure and therefore the methodology and the Risk Management Criteria.

5.4.2 It is the responsibility of the Executive Committee to:

- Conduct an annual review the risk management process;
- Report to the board.

5.5 Risk Managers

5.5.1 Risk Managers are responsible for:

- Identifying, assessing, and controlling risk in accordance with this procedure;
- Maintaining and reviewing their specific risk registers annually;
- Implementing risk treatment compliant with statutory requirements;
- Reporting on risk in accordance with this procedure; and
- Ensuring their employees have had adequate training in Risk Management as per the requirements of this procedure.

5.5.2 Risk Managers are authorised to:

- Conduct risk assessments;
- Accept / Reject risk; and
- Identify and implement control measures.

5.6 Employees

5.6.1 It is the responsibility of all employees to:

- Report new risks to their line management;
- Adhere to this procedure;
- Follow the procedures relating to the identification of hazards;
- Implementing risk treatments as required; and
- Participating in Risk Assessments.

6. ACTIONS

6.1 General

6.1.1 VWA operates to a standard risk management process to control strategic, operations, compliance, OH&S and environmental risk, in accordance with AS 4360, ISO 14001 and AS4801.

6.1.2 VWA conducts risk management through:

- Risk assessment workshops documented on risk registers;
- Ad-hoc and monthly risk reporting;
- Specific risk assessments (eg. On a project or a newly identified hazard);
- Job safety and environmental assessments (for routine or non-routine tasks which involve hazards).

6.1.3 The risk assessment process used is in accordance with AS 4369 and is shown in Figure 6-1. Each step is explained within this procedure.

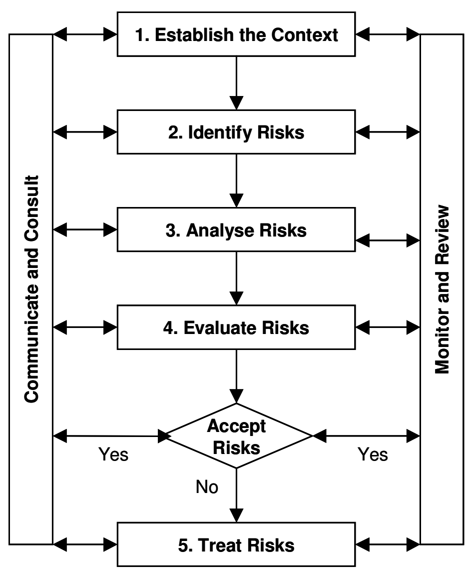


Figure 6-1 Risk Management Process

6.1.4 Please refer to specific work instructions on how to conduct a risk assessment workshop and how to use the templates.

6.1.5 Strategic / operations risk assessments are identify risks that the company is regularly exposed to.

6.2 Risk Identification

6.2.1 It is the responsibility of the Risk Manager to consider categories and types of risks that may have an impact on the achievement of objectives, and to identify specific risks within these categories by asking:

- What can happen, where and when; and
- Why and how can it happen?

6.2.2 The following strategic risk categories have been identified.

- Reputation
- Business
- Business Development
- Financial
- Human Resources
- Information Technology
- Projects
- Operations & Project

6.2.3 The following operations and project risk categories have been identified:

- OH&S
- Environmental
- Access & Security
- Compliance
- Finance
- IT Systems & Security
- Natural Disaster

6.3 Risk Criteria

6.3.1 Risk Criteria have been established to provide a risk management framework and guidance to risk managers.

6.3.2 The Risk Criteria are provided as Attachments and include the following:

- Likelihood Descriptors
- Consequence Descriptors
- Level of Risk and Corresponding Authorities

6.3.3 It is the responsibility of the Executive Committee to review and approved these Risk Criteria.

6.4 Risk Assessment & Review Workshops

6.4.1 Risk assessment and risk reviews will be conducted in workshops with representatives from the area(s) being assessed. This is to ensure all risks are identified and to ensure that assessment is representative of the Company, and not the opinions of an individual.

6.4.2 Risk assessments will be conducted on the relevant risk register eg. an OH&S risk assessment will be conducted on the OH&S Risk Assessment and Register Template.

6.4.3 A risk assessment is conducted by determining the magnitude of the consequences of an event, should it occur, and the likelihood of the event and its associated consequences, **in the context of the effectiveness of the existing controls.**

6.4.4 It is the responsibility of the relevant Risk Manager to maintain the Risk Register and to conduct an annual review of risk registers.

- It is the responsibility of the COO to ensure that the following Risk Registers are developed and maintained for VWA Head Office:
  - Strategic & Operations Risk Register
  - OH&S Hazard and Risk Register
- It is the responsibility of the Operations Manager to ensure that the following Risk Registers are developed and maintained for each operating contract:
  - Strategic & Operations Risk Register
  - OH&S Risk Register
  - Environmental Aspects, Impacts & Risk Register.

6.5 Strategic / Operations Risk Assessment

6.5.1 The purpose of Strategic / Operations Risk Management is to identify the risks the Company is exposed to across the different functions and levels of the company.

6.5.2 It is the responsibility of the Operations Manager to conduct an annual Strategic / Operations Risk Assessment for their operation involving as a minimum the following:

- Operations Manager
- A Supervisor; and
- An Operator.

- It is the responsibility of the COO to conduct an conduct an annual Strategic / Operations Risk Assessment for VWA involving as a minimum the following:
  - Manager of each department;
  - CEO;
  - COO.

6.6 OH&S Risk Assessment

6.6.1 The purpose of OH&S Risk Management is to conduct **safe work methods** in a **safe workplace**.

6.6.2 The assessment of the **work place** is by identifiying the hazards present in the work place, assessing the risk and implementing controls. This is done by conducing a risk assessment either in a workshop or on a Hazard Report and Risk Assessment Form.

6.6.3 The assessment of the **work method** is by breaking the task into steps, identifying the hazards and risks, and implementing controls. This is done by completing a Job Safety and Environmental Assessment.

6.6.4 It is the responsibility of the Operations Manager to conduct an annual OH&S Risk Assessment Workshop for their operation involving as a minimum the following:

- Operations Manager,
- A Supervisor,
- An Operator,
- An administration person, and
- The OH&S Representative (if applicable).

6.6.5 It is the responsibility of the COO to conduct an annual OH&S Risk Assessment Workshop for VWA involving as a minimum the following:

- A Manager,
- A representative from each function,
- An administration person, and
- The OH&S Representative (if applicable).

6.6.6 Hazards (or the source of risk) may be identified through one or a combination of the following:

- Casual observation;
- Hazard identification audits;
- Other audits (1st, 2nd, or 3rd party);
- Workplace inspections;
- Hazard reporting (OFIs, NCRs etc);
- Incident reporting; and
- OH&S meetings (or similar).

6.6.7 The outcome of the OH&S Risk Assessment Workshop shall be communicated to all staff for the site.

6.6.8 Where high risk manual handling or chemicals are identified the following risk assessments will also be conducted:

- Manual Handling Risk Assessment - for all tasks involving hazardous manual handling a Manual Handling Risk Assessment will be conducted.
- Chemical Risk Assessment - for all Hazardous Substances, Dangerous Goods and any other chemicals for which a risk assessment is deemed necessary a Chemical Risk Assessment will be conducted.

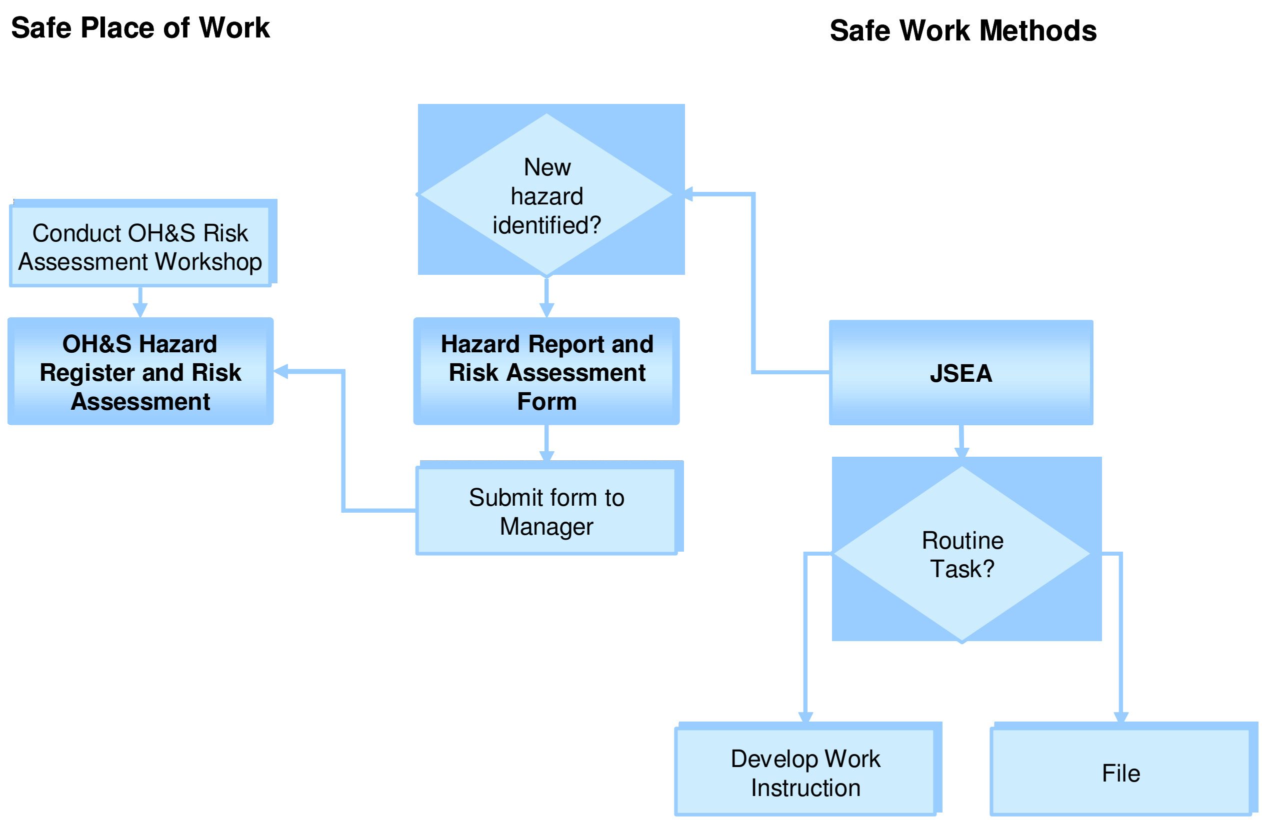
6.6.9 Outside of a risk assessment workshop it is the responsibility of all employees to:

- report any issue, which is perceived to be an actual or potential hazard using a Hazard Report and Risk Assessment Form, in order that management can address the issue;
- ensure that hazards are isolated and persons are made aware of the hazard eg. erecting barricades and posting warning signs.

6.6.10 The Hazard Report and Risk Assessment Form can be used to report new hazards or to conduct a specific risk assessment for a new site or project (or for work from home in conjunction with a Work From Home Assessment Form).

6.6.11 The Hazard Report and Risk Assessment Form shall be used to conduct risk assessments for confined space entry.

Figure 6-2 OH&S Risk Management



6.7 Environmental Risk Management

6.7.1 The purpose of Environmental Risk Management is to identify the company's environmental aspects and potential impacts and to implement controls to minimise the impacts of our operations on the environment.

6.7.2 The first step in Environmental Risk Management is to identify the environmental aspect (an element of an organisation's activities, products or services that can interact with the environment) and then to determine the potential environmental impact.

6.7.3 It is the responsibility of the Operations Manager to conduct an annual Environmental Risk Assessment Workshop for their operation involving as a minimum the following:

- Operations Manager,
- A Supervisor, and
- An Operator.

6.7.4 The outcome of the Environmental Risk Assessment Workshop shall be communicated to all staff.

6.7.5 High risks will be deemed “Significant Environmental Aspects”.

6.7.6 The Company shall ensure that the significant environmental aspects are taken into account in establishing, implementing and maintaining its environmental management system.

6.8 Job Safety and Environmental Analysis (JSEA)

6.8.1 The purpose of a JSEA is to plan a task and to implement risk control measures for the hazards and risks associated with that task.

6.8.2 JSEA’s will be conducted on routine and non-routine tasks which involve hazards and have potential environmental impacts to ensure a safe work method is developed.

6.8.3 Refer to the Work Instruction on Conducting a JSEA for specific instructions.

6.8.4 The selection of controls for the completion of a JSEA should be from the existing management system (developed through the risk assessment process).

6.8.5 Where a new hazard or environmental aspect is identified through the JSEA, the hazard will be reported on a Hazard Report and Risk Assessment Form for incorporation onto the risk register.

6.8.6 The form will be submitted to the Manager for review and the results will be entered onto the relevant Risk Register and the form will be filed in accordance with the Records Management Procedure.

6.9 Risk Evaluation & Treatment

6.9.1 The purpose of risk evaluation is to make decisions, based on the outcomes of risk analysis, about which risks need treatment and treatment priorities.

6.9.2 Risks may be accepted because:

- The level of the risk is so low that specific treatment is not appropriate within available resources;
- The risk is such that there is no treatment available. For example, the risk that a project might be terminated following a change of government is not within the control of an organisation.
- The cost of treatment, including insurances costs, is so manifestly excessive compared to the benefit that acceptance is the only option. This applies particularly to lower ranked risks.

- The opportunities presented outweigh the threats to such a degree that risk is justified.

6.9.3 In general High or Moderate Risks with inadequate or no existing controls, must be treated.

6.9.4 It is the responsibility of the Risk Manager to evaluate risks and to identify risk treatments.

6.9.5 It is the responsibility of the GMO and the CEO to review and approve risk evaluations and risk treatments.

6.9.6 Where risk treatment options are assigned, it is the responsibility of the risk manager to ensure timely close out of these actions and to report on the status of risk treatment actions to line management.

6.9.7 For OH&S Risk Assessments risks will be controlled by working through the list shown below and using the first appropriate method.

1. **Eliminate**. This may mean discontinuing dangerous work practices or removing dangerous substances or equipment.
2. **Substituting** a less hazardous material or equipment.
3. **Redesigning** a workplace or work processes so work can be done differently.
4. **Isolating** the hazard from the person, or the person from the hazard.
5. Introduce **Administrative Controls** which involve using procedures or instructions eg. Job rotation, supervision.
6. Use **Personal Protective Equipment** (PPE) as the final barrier between people and the hazard.

6.9.8 For OH&S Risk Assessments Administrative controls and PPE should only be used:

- as a last resort when there are no other practical control measures available, and/or
- as temporary measures while a more permanent solution is found, and/or
- to supplement existing controls.

6.10 Reporting

6.10.1 Risks and opportunities will be reported monthly.

6.11 Risk Assessment Templates

6.11.1 There are five templates for conducting risk assessment. One is the Hazard Report and Risk Assessment Form and the other four are the Risk Register excel spreadsheets. The Hazard Report and Risk Assessment Form can be used to report and assess a newly identified hazard or to conduct a risk assessment on a new work area or project.

6.11.2 The Risk Register excel worksheets contain macros and calculations. It is therefore important not to delete columns, and to ensure calculations are copied into inserted rows. Should you encounter any difficulty with using the templates, contact the Business Systems Manager.

- The **Strategic & Operations Risk Assessment & Register Template** covers strategic and operations risk.
- The **Project Risk Assessment & Register Template** is similar to the Strategic and Operations Risk Template, however it contains project specific risk categories as prompts for the risk assessment process.
- The **Environmental Risk Assessment & Register Template** is designed to comply with ISO 14001 and its terminology and it used to identify environmental aspects and impacts.
- The **OH&S Risk Assessment & Register Template** is designed to comply with AS 4801 and its terminology and it used to identify specific OH&S hazards and risks.

6.11.3 Note: The Strategic and Operations Risk Template is a generic template than can be used for a specific function or site. The Environmental and OH&S templates are formatted differently and have different terminology.

6.12 Evaluating the Effectiveness of Controls

6.12.1 Identification of controls is a central component to risk management, and the Company relies on these controls to reduce exposure to risk. It is therefore essential that effectiveness of these controls is assessed to ensure that they are providing the protection implied in the risk assessment process:

eg. if an alarm is listed as a control, there must be a process in place to check that the alarm will actually activate and alert people as required. A control that is not regularly checked and tested cannot be relied upon.

6.12.2 It is the responsibility of Risk Managers to monitor the effectiveness of controls.

6.12.3 Methods of monitoring the effectiveness of controls include:

Evaluation	Examples
Visual inspection	Workplace Inspection Checklists Operator Duty Checklists
Authorisation	Permits Expenditure authorisation

	limits
Incident investigation	Documented review of controls and responsibilities etc.
Training evaluation	Documented competency assessment Documented observation of work activity
Physical monitoring	Documented noise measurements
Health surveillance	Medicals
Documented scheduled review of outputs	Documented review of workorders, permits, JSEAs, risk assessments, induction records
Register review	Documented review of ladder register, noise register, hazard register
Internal audits	Compliance audits System audits

7. RECORDS

- Risk Registers
- JSEAs
- Hazard Report and Risk Assessment Forms
- Risk Assessment Forms

8. ATTACHMENTS

- Table 8-1 Likelihood Descriptors
- Table 8-2 Level of Risk and Corresponding Authorities
- Table 8-3 Consequence Descriptors

Table 8-1 Likelihood Descriptors

Likelihood Level	Descriptor	Description
5	Almost certain	Almost certain / daily or more frequently / 90-100% The event will occur in most circumstances
4	Likely	Probable / Likely to occur at some time / 50-90% The event will probably occur at least once
3	Moderate	Possible / Might occur at some time / 10–50% The event may occur at some time
2	Unlikely	Unlikely / Could occur at some time / 5-10% The event is not expected to occur
1	Rare	Rare / May occur only in exceptional circumstances / 0-5% The event may occur only in exceptional circumstances

Table 8-2 Level of Risk – Authorities

		VWA			GWA		
Symbol	**Title**	**Authority to accept**	**Treatment required**	**Approval of treatment**	**Authority to accept**	**Treatment required**	**Approval of treatment**
H **12-25**	High risk	COO / CEO	Management attention needed immediately	COO / CEO	GMO	Management attention needed immediately	GMO
M **4-11**	Moderate risk	Risk Manager	Management responsibility must be specified	COO / GMO	Risk Manager	Management responsibility must be specified	GMO
L **1-3**	Low risk	Risk Manager	Manage through routine procedures	Risk Manager	Risk Manager	Manage through routine procedures	Risk Manager

Table 8-3 Consequence Descriptors

Consequence Category → Risk Category ↓	Insignificant 1	Minor 2	Moderate 3	Major 4	Extreme 5
Operations	No interruption to service	Some disruption manageable by altered operational routine	Disruption to a number of operational areas within a location or region & possible flow on to other locations / regions	All operational areas of a location or region compromised. Other locations/regions may be affected	Total system dysfunction. Total shutdown of operations.
Environmental	No lasting detrimental effect on the environment i.e. Noise, fumes, odour or dust emissions of a short duration.	Short term, local detrimental effect on the environment or social impact, eg. Significant discharge of pollutants within the local neighbourhood	Serious, local discharge of pollutant or source of community annoyance within general neighbourhood that requires remedial action. Moderate breach of environmental statue	Long term detrimental environmental or social impact i.e. Chronic &/or significant discharge of pollutant. Major breach of environmental statutes	Extensive detrimental long term impacts on the environment and community i.e. Catastrophic &/or extensive discharge of persistent hazardous pollutant. Shut down of operations because of environmental breach
OH&S	Minor injury – no medical treatment other than first aid required	Medical treatment injury	Lost time injury – no hospitalisation	Lost time injury resulting in hospitalisation	Fatality (not natural causes)
Financial	<5% of budget and /or $10,000 limit	<15% of budget and /or $50,000 limit	15%<30% of budget and /or $100,000 limit	30%<50% of budget and /or $500,000 limit	>50% of budget and /or >$500,000
Image	Minor adverse publicity in particular locations	Adverse publicity in local press.	Adverse publicity in state press.	Adverse publicity in national press.	Adverse publicity in international press.
Legal / Regulatory	Fine <$10K	Fine $10K - $100K	Fine $100K - $1M	Imprisonment of staff	Shut down of operations.
Property	<$10K	$10K - $100K	$100K - $1M	$1M - $10M	>$10M
Liability	<$10K	$10K - $100K	$100K - $1M	$1M - $10M	>$10M
Corporate Management	Staff and management dissatisfaction – localised	Staff and management dissatisfaction – broader basis	D-G's dissatisfaction. Likelihood of legal action	CEO and Board dissatisfaction. Legal action.	General Manager's / Regional Manager's and/or CEO's resignation / removal.
Operational management	Staff & Supervisor dissatisfaction within part of local unit	Dissatisfaction disrupts production	Significant disruption to operations	Qualified Audit report to board naming particular managers	Location management resignation / removal
Security	No notifiable or reportable incident	Localised incident. No effect on operations	Localised incident. Significant effect on operations	Significant incident affecting multiple locations.	Extreme incident affecting organisation's survival.
Positive Consequences	Small benefits, low financial gain	Minor improvement to image, some financial gain	Some enhancement to reputation, high financial gain	Enhanced reputation, major financial gain	Significantly enhanced reputation, huge financial gain

9.10f

INCIDENT
AND
EMERGENCY
PLAN

(PLANT AND NETWORK)

CONTENTS

1. INTRODUCTION

The purpose of this document is to outline the plan AVA will invoke in the event of an Incident involving the Recycled Water Treatment Plant or Network under AVA's management.

Should an Incident occur, this plan will provide the following:

- An efficient, safe and coordinated plan of action in response to a incident
- Detail and log the appropriate responses to an incident with the sole intention to control and minimise the impact severity to the Plant or Network
- Define the roles and responsibilities of all Incident response personnel. Log actions and monitor the location of all personnel involved in the Incident management
- Ensure effective communications are implemented and reporting of all vital information is completed as soon as practically possible
- Facilitate resumption of normal operations when appropriate
- Provide a basis for training personnel in the safe handling of incidents
- Create awareness in the workplace regarding Incident situations and how they are managed

1.1. GLOSSARY OF TERMS

1.1.1. AN INCIDENT

An incident is any event that has the potential to adversely affect the health and safety of employees, the community, the environment or the normal operation of the Plant and/or Network. It may include:

- Critical power failure
- Customer complaint
- Emergency evacuation
- Major damage
- Major fire
- Spillages

1.1.2. INCIDENT LOG

This plan utilises several logs to document the actions of key personnel activities during the course of an Incident. The Response Centre at Parramatta is responsible for collating these logs during an Incident, disseminating this information and creating a central Incident Log. AVA will utilise a software (computer) application to effectively communicate the status of an Incident to nominated stakeholders during the course of an Incident. The Incident Log is available "on line" for real-time written communication that provides simultaneous access to multiple viewers.

1.1.3. INCIDENT MANAGEMENT STRATEGY

This is a documented strategy that AVA has created to outline a variety of response protocols. Within this document are comprehensive descriptions of the Incident Classifications, titles for Incident Personnel Roles and their respective responsibilities. It is within this document that the basis for training of personnel is derived and practically completed.

1.1.4. INCIDENT RESPONSE MANUAL

This is a document that is created by professional personnel in the management of AVA assets. This document contains information that may assist with an effective decision making process for management of Plant or Network Incident. It contains technical data, asset characteristics and properties, pipeline information, Plant information and operating pressures etc.

2. PURPOSE

The purpose of this plan is to:

- Reduce the risk of incidents occurring
- Reduce the impact of incidents on AVA personnel, clients and customers, the community, the environment and AVA assets & systems
- Promote and support the maintenance of effective incident management processes

This plan is intended to provide guidance to the operations team on the correct response to an incident that occurs on, or near to, the Plant or Network. This plan is not intended to be a voluminous set of instructions but more a document that gives insight into and guidance on the various aspects of incident management, before, during and after any incident that may occur on or around the operating facility.

This document is to be used in conjunction with the SWC incident management and reporting requirements. It also strongly relates to the Plant and Network Stakeholder Management Plans – Schedule 9.10i and the overarching Project Management Plan Schedule 9.1.

3. SCOPE

This plan applies to the operation and maintenance of the Plant and Network, for the Camellia Recycled Water Project.

3.1. ABBREVIATIONS

AVA	AVA Water Consortium
CEO	Chief Executive Officer
CMP	Crisis Management Plan
CMT	Crisis Management Team
CRWP	Camellia Recycled Water Project
COO	Chief Operating Officer
EPA	Environmental Protection Authority
IMT	Incident Management Team
Veolia	Veolia Water Australia (VWA)

GMO	General Manager Operations
IMP	Incident Management Plan
IRT	Incident Response Team
MSDS	Material Safety Data Sheet
SCADA	Supervisory Control and Data Acquisitions or Integrated Instrumentation Control Automation & Telemetry System
SPS	Sewage Pumping Station
SWC	Sydney Water Corporation

4. BACKGROUND

The aim of this plan is to ensure alignment with specific incident management plans and consistency with all other incident management plans and practices.

These key principles, which underpin AVA's approach to crisis and incident management, include:

- **Risk Analysis**
  The identification of hazards and risks which could impact AVA and/or Sydney Water Corporation (SWC) through various customer, community, environmental and operational implications.

- **Prevention**
  The planning and documentation of prevention and mitigation activities for all major hazards, and allocation of responsibility for their implementation.

- **Preparedness**
  The development, implementation and review of specific incident management plans and processes to manage identified risks, the training of staff, and establishment of facilities to ensure AVA can respond effectively to an incident.

- **Response**
  The issue of warnings and establishment of processes for effective notification of incidents, and mobilisation of resources to combat the incident or threat.

- **Recovery**
  The return to normal operations, management of debriefs, and implementation of lessons from the response process.

These principles are supported by:

- A commitment to the safety of all AVA employees, contractors, agents and visitors

- Adoption of an all hazards approach and consideration of the total impacts of an incident or crisis; and

- Adoption of the following priorities when combating an incident / crisis

  - ♦ Protection of human life and welfare
  - ♦ Maintenance and safety of the system.
  - ♦ Protection of the environment
  - ♦ Protection of assets, commercial arrangements, reputation, and image

4.1. THE HAZARDS AND THREATS

An integral part of effective incident management is the prior identification of all hazards which can reasonably be expected to initiate, or contribute to, an incident. This involves identifying hazards of two different types:

- The hazards arising from the scheduled materials and other hazardous materials associated with the facility; and
- Other types of hazards and threats (as listed below) that could impact upon the operation of the facility

The key hazards and threats that will typically result in the activation of this incident management plan include a potential or actual:

- Communication and control failure (SCADA, SCADA hardware and software)
- Accident resulting in serious injury or fatality to staff, contractor or member of public
- Loss of power supply or other critical community infrastructure (e.g. telephone, water etc)
- Major storm / flood events (including lightning strike, hail storm, severe wind storm etc)
- Earthquake
- Raw water quality problems
- Treated water quality problems
- Treated water quantity failures
- Failure of Recycled Water Plant
- Pipeline failures
- Pumping station failure
- Failure of valves / gates / penstocks
- Major equipment failure affecting plant operation
- Fire outbreak
- Chemical leaks, spills or release
- Bush fire
- Non-availability of chemicals and spare parts
- Inability of contractors and suppliers to provide required service
- Drought
- Long term industrial dispute

- Damage due to terrorist attack
- Vandalism affecting plant operation
- Other criminal activity (e.g. theft, extortion, kidnap, sabotage, protest group action, etc)
- Any other incident that affects AVA's ability to deliver service

4.2. THE CONSEQUENCES

Inclusion of the consequences in the Incident Management Plan can enable the Integrated Operations Team to better plan for mitigation of any incidents.

Key consequences that may arise from an incident are:

- Interruption of service to our customers
- Threat to life, health and safety
- Threat to the environment
- Customer complaints
- Threat to our business operation and contract validity and viability
- Threat to community infrastructures
- Damage to private or public property
- Threat of prosecution or fine
- Threat of litigation
- Threat to our business's public image

It is important that the Integrated Operations Team is aware of these consequences and well trained and prepared to respond to such outcomes from any incident, to minimise or mitigate the extent of the incident consequences.

4.3. RESPONSE CENTRE (NORTH PARAMATTA)

The notification of a potential Incident should be directed to the Response Centre on 131 909 or 132 909. Upon receipt of the notification, the Response Centre will initiate the Incident Response Plan to effectively and safely manage the Incident.

For all Incidents involving the Camellia Recycled Water Project, the Response Centre will assume the role of Incident Management Centre. This will ensure there is one central point of communication and dissemination of information to relevant stakeholders. The Centre's responsibilities include and may not be limited to:

- Confirm that an Incident exists
- Implementation of the "Incident Response Plan"

- Notifying key personnel to initiate and implement repair procedures as directed by the Incident Management Team (IMT)
- The initial notification to relevant statutory authorities of the Incident
- The communication of decisions and actions (via logs) to the Centre; and
- Implement all necessary actions required to ensure the safety of people, the environment and control the Incident until normal operations can take place.

5. ORGANISATIONAL STRUCTURE

The following diagram indicates the structure and roles of the Site IMT, which is directly responsible for managing all aspects of operational and/or technical response to an incident which threatens safety of personnel and/or the community, threatens the integrity or ongoing safe operation of the facility, or threatens the environment, including:

- Assessment of operational implications and development of an overall site response strategy
- Handling site communications with media, the customer, stakeholders, internal staff, etc
- Provision and coordination of technical support, resources and materials required to bring the incident under control

For general working methods and individual roles and responsibilities, see following sections.

Site Incident Management Team/Emergency Response Team

Incident Manager

Operations Officer

- Technical Advisors
- Assessment of operational impacts
- Strategy and action plan
- Emergency services liaison
- Emergency response co-ord.
- Plant operations co-ord.
- Sampling
- Systems management planning co-ord.
- Service providers co-ord.

Communications Officer

- Site media relations manager
- Site internal communications manager
- Site customs manager
- Site stakeholder manager, eg. Health and EPA officers

Support Officer

- Incident room facilities
- Risk
- HSE
- HR
- Laboratory services
- External experts
- Administration

6. RESPONSIBILITIES

6.1. INCIDENT MANAGER

Performed By: System Manager

Reporting To: AVA Project Control Group

Responsibilities: Coordination of AVAs response to a *Major Incident* at an operating facility

- Provide high level coordination of IMT activities and ensure the response is managed with the following priorities:
    - Protection of human life
    - Maintenance of site and process safety
    - Protection of the environment, assets, commercial arrangements, and image
- Ensure swift approval for any specialist resources required by Incident Management Team
- Consider the following aspects of the incident:
    - All impacts
    - Back up support personnel
    - Resources Coordination
    - Financial/budget requirements
- Liaise with state level external agencies
- Coordinate request for State/Federal support to AVA
- Coordinate resources between AVA business units and facilities
- Coordinate resources from contractors when across AVA coordination is required
- Coordinate communication, information and financial matters
- Support personnel managing major or multiple incidents when issues arise which require corporate level resolution
- Coordinate the provision of hazard intelligence and AVA situation reports
- Coordinate AVA support units such as Media, Risk and Insurance, Legal, OHS&R
- Provide regular updates and briefing sessions for the Project Control Group
- Protect morale of staff and welfare of IMT
- Ensure team operating rules and decision-making processes are defined and the major issues to be addressed are identified and agreed

- Assess need for senior management presence at the incident site, and action as appropriate
- Ensure Site Incident Log is maintained - log sheets, incident notification forms and Incident Manager handover briefing form are included in this manual.
- Oversee Incident debrief after stand down and approve final debrief report

6.2. OPERATIONS OFFICER

Performed By: Operations Supervisor / Network Supervisor

Reporting To: Incident Manager

Responsibilities: Management of all operations directly related to the resolution of a *Major Incident*

- Determine scale of incident and initial response required
- Establish clear command and communications
- Coordinate all AVA and contractor teams on site
- Supervise and ensure operations are implemented as directed by the Incident Manager
- Liaise with external agencies on a plan of action for all damages to be repaired with the minimum disruption to SWC
- Liaise with AVA and external expert technical personnel on site
- Provide update information to the Incident Manager to ensure information flow to AVA stakeholders is maintained
- Control access to site for all AVA employees and contractors
- Up/down grade incident as situation changes and advise Incident Manager of appropriate action
- Assist Incident Manager in determining longer term response strategy
- Determine needs and request additional resources
- Provide or facilitate the arrangement of specialist technical advice to the Site Response Team
- Expedite internal and external resources required to assist site response
- Monitor and address any additional resource or support requirements of the Site Team
- Maintain a Site Incident Log and provide effective management of the Incident Room information boards and logs - log sheets, incident notification forms and Incident Manager handover briefing form are included in this manual.
- Act as IMT contact for Emergency Services and site specialist resources

- Brief and update IMT on site response developments
- Ensure any media, community or stakeholder interaction on site is directed to and managed by Incident Manager or Communications Officer
- Coordinate engineering expertise and input
- Ensure safety and welfare of all personnel
- After incident is declared over, participate in Incident Debrief

6.3. COMMUNICATIONS OFFICER

Performed By: AVA representative

Reporting To: Project Control Group

Responsibilities: Coordination of all aspects of communications in relation to management of response to a resolution of a *Major Incident*

- Ensure that clear communication channels have been established
- Act as site communications coordinator for:
    - Media – ensuring approval is received from Head Office prior to any release of information or direct contact with the media
    - SWC liaison
    - Internal AVA communications with Head Office and staff
    - Key stakeholders e.g. Health, EPA, WorkCover or Workplace Health and Safety, etc
    - Community liaison
- Develop key messages to be used during the incident and determine the requirement for, and timing of, press releases and media interviews
- Provide media liaison (with Head Office and SWC approval) and control
- Handle all incoming calls
- Provide reports to corporate stakeholders
- Ensure effective information and data collection and distribution
- Advise on the communications implications and coordinate customer, internal, government / regulatory and media communications in relation to the incident
- Facilitate communications support to the Site response team
- After incident is declared over, participate in Incident Debrief
- Coordinate Emergency Services as required

6.4. SUPPORT OFFICER

Performed By: Plant / Network Operator

Reporting To: Incident Manager

Responsibilities: Management of provision of facilities, support services and materials during a Major Incident

- Ensure the required facilities, services and materials are available to combat the incident
- Coordinate activation of Incident Room
- Estimate future service and support capabilities
- Coordinate specialist support and provision of technical advice to IMT from advisers such as:
    - Specialist Engineering
    - Industrial Relations
    - Legal
    - Financial
    - Insurance
    - OH&S
    - Human Resources
    - Risk
    - Environment
    - Laboratory Services
    - IT
    - Relatives response
- Assess and manage effective deployment of specialist resources and personnel
- Monitor welfare of all staff and arrange for specialist resources (e.g. counsellors, masseurs, etc) if necessary
- Set up and maintain central records system for collation and storage of all incoming information and date
- Coordinate shift change-overs
- Ensure that suitable meal breaks and rest periods are adhered to

- Ensure that quality of food and drink is suitable and appropriate for the staff, particularly in a prolonged event
- Ensure information is stored for post incident reviews
- After incident is declared over, participate in Incident Debrief

7. INCIDENT DEFINITIONS

An incident is defined as an occurrence, which will cause or have the potential to cause any of the following:

- An interruption of service to our client / customers (see also Physical Threats)
- A threat to life, health and safety
- A threat to the environment
- A serious customer complaint (quality, quantity, duration, damage, social inconvenience)
- A threat to our business operations (infrastructure, staffing, major suppliers, contract termination)
- A threat to community infrastructure (electricity, gas, telephone, rail, road, footpaths)
- A threat to public or private property
- The theft or vandalism of AVA property.
- The requirements for urgent action under legislation
- A threat to our business's public image or reputation
- A threat to the financial viability of the business
- A threat of prosecution or fines
- Physical threats to the operating facility potentially affecting performance such as:
    - Flood
    - Fire
    - Storm (wind, hail, lightning, torrential, cyclone rain etc)
    - Major spill or chemical release
    - Loss of power, water, gas, telephone
    - Major asset or equipment failure
    - Criminal activity (e.g. sabotage, terrorist act, etc)
- Loss of operating staff due to industrial dispute, serious widespread illness, external group action (e.g. protest group blockage)

7.1. INCIDENT CATEGORIES

Incidents are categorised based on the level at which they can be readily managed with consideration as to their potential to grow. They are not categorised on their current status and/or level of impacts.

The escalating levels of incidents that may be experienced in the daily operations of AVA can be defined as follows:

7.1.1. MINOR INCIDENT

An event causing or with the potential to cause any of the following:

- Minor interruption to services
- Minor interest by the local media
- Minor damage or injury

can be managed as part of routine operations under the control of either a Site Manager or Incident Manager. Minimal assistance and input may also be required from Communications Coordinator and/or functional support/specialists.

7.1.2 MAJOR INCIDENT

An event causing or with the potential to cause any of the following:

- A serious injury
- An interruption to services for more than 4 hours
- An impact on a large employer or industry
- An interest by major daily newspaper, radio or TV
- A demand for action by Regulatory Authorities (eg. EPA, WorkCover)
- Interest by environmental interest groups
- A threat to community infrastructure
- A threat to public, private or the Company's property
- A threat of fines, prosecution or litigation

which requires off site coordination through an incident headquarters with support from Communications Coordinator and or functional support/specialists.

7.1.2. CRISIS

An event causing or with the potential to cause any of the following (the top 5 are those which are a mandatory trigger of AVA's alert procedure):

- Death or serious risk of injury to a person (employee, third party)
- Serious impact on the environment caused by the malfunctioning of a facility or a service
- Serious act of wilful misconduct (threat, blackmail, attack)
- Possibility of legal action taken by a third party against the reputation of AVA
- Possible impact on AVA's parent companies
- Threat to public health and continuity of supply
- A significant impact on business operations and continuity
- A threat to AVA operations
- A threat to the financial viability of AVA
- Adverse attention by national media and financial institutions
- A regulatory authority to direct the actions of AVA under their legislative authority
- Litigation threatened or initiated against AVA

which requires the mobilisation of a Crisis Controller and Crisis Management Team with support from Communications Coordinator and or functional support/specialists.

7.2. EMERGENCY FINANCIAL ARRANGEMENTS

During a declared incident, procurement of necessary resources is to be carried out by the nominated Incident Manager by the most expeditious means available, which may not allow sufficient time to follow the Procurement Policy.

There may be insufficient time for the development of a written brief, a detailed specification, the calling of tenders or the implementation of a normal evaluation and selection process.

In such circumstances, prior verbal approval must be obtained from the AVA Representative or delegate, followed by subsequent written confirmation of the approval. A full report covering all details of such procurement is to be made as soon as practicable after the event, and retrospectively covering approvals obtained.

Exceptional operating costs are to be segregated and documented to enable claiming of reimbursements during natural disasters under State / Commonwealth Natural Disaster Relief Funding Arrangements.

8. INCIDENT PREVENTION AND PREPAREDNESS

A number of initiatives shall be used at the operating facility to prevent incidences that could affect the ability of plant and equipment to deliver services to customers, cause injury to people or damage to equipment or the environment. Initiatives for the identification and control of hazards should include:

- Planned inspections of the operating facility
- Appropriate and regularly refreshed training
- Appropriate incident management arrangements with Contractors
- Comprehensive Induction training for new staff and all contractors and visitors
- Suitable Work Permit System
- Preventative measures and corrective actions

8.1. WORKPLACE INSPECTIONS

Workplace inspections of the operating facility shall be carried out to ensure satisfactory working condition of all equipment, detection of any hazards and proper adherence to all site standards and conditions. More specifically inspections shall include (but not be limited to):

- Walk through operating facility inspection
- Frequent inspection of process and control equipment in the operating facility and major nearby assets (e.g. inlet pumping station and pipework, penstocks and valves etc)
- Periodic calibration of water quality / dosing level monitoring equipment
- Preventive maintenance of plants and equipment
- Regular planned OH&S inspections to ensure that the identified hazards are controlled as effectively, efficiently, and expediently as possible
- Site perimeter inspections (i.e. site security assurance)
- Auditing of Work permits and Daily Safe Work Plans

Any adverse findings shall be reported and addressed immediately. The Operations Supervisor shall be notified if there are wider implications of any findings from plant inspections (e.g. security threats, longer term operational implications, inappropriate contractor performance or behaviour, etc) so that higher level action may be taken to address the situation if necessary.

In the process of normal daily operations and planned inspections, all AVA operators and contractors shall ensure that improvement notes are completed and returned to the Supervisor in the event of anything deemed to require action being found. A register of improvement notes or requests shall be kept and progress of rectification against this list shall be checked on a regular (not more than monthly) basis by senior operations staff. This will help to ensure that the catalyst for incidents, in many cases, is removed.

Other processes that should ensure that the potential for incidents is minimised include (but not limited to):

- Mechanical and electrical preventative maintenance
- Daily procedure check sheets (e.g. chlorine equipment chemical delivery and dosing etc)
- Training e.g. manual handling, SCBA, self rescue, personal protective equipment etc
- Quality assurance and audits
- Operational awareness
- Vigilance

This operating facility will have a comprehensive set of Incident Response Plans, which provide detailed instructions on how to respond to specific operational incidents. A full set of Incident Response Plans will be developed prior to the start of the project.

8.2. INDUCTION TRAINING

All new employees and contractors commencing work with AVA on operating facilities will receive a formal Induction. This induction process involves safety and incident management issues and other items including geographic information, contractor arrangements and requirements. No new AVA operations personnel shall be allowed to carry out unsupervised tasks unless the appropriate induction and site specific training has been undertaken. Site inductions are to be carried out for all new staff, contractors or visitors.

The Operations Supervisor will introduce new staff to the contents of this Plan, with induction training being organised for new starters prior to commencement of active duties on AVA facilities.

8.3. TRAINING AND DEVELOPMENT

Incident Management Training shall be provided as a minimum for those who will assume the following roles:

- Site Manager – usually the Operations Manager
- Incident Manager – usually the Supervising Operator
- Key Incident Team roles in the areas of operations, planning, logistics and support

This training is intended to enable AVA employees to:

- Effectively manage incidents within the operating facility
- Effectively coordinate incident response with our customers and other contact agencies
- Recognise the diversity of functions within incident management
- Describe the concept of comprehensive incident management
- Obtain a perspective of their own role and functions
- Accept the roles and functions of other organisations during major incidents

Training shall be provided to all existing and new staff, with refresher and scenario training being provided at scheduled appropriate intervals (period between refresher / scenario training should be no greater than 12 months). Incident Management Training is an integral part of operational staff training and development program and will be competency based to ensure the principles and concepts of effective incident management are well and truly understood and absorbed by operations staff and their managers.

Scenarios will be used as a regular tool for training staff in, and reviewing this Plan. It is the responsibility of the Operations Manager to organise the preparation and conduct of scenarios based on both the hazards, plans and procedures identified in this Plan.

8.4. INCIDENT MANAGEMENT ARRANGEMENTS WITH CONTRACTORS

All contractors involved in the operation and maintenance of AVA's assets will be effectively integrated into the management of incidents.
The following arrangements will be made for critical contractors to effectively support AVA during incidents:

- 24 hour contact arrangements for contractors
- Priority telephone access through to critical contractor contact numbers
- Mobile communication from contractor management personnel to their field staff
- 24 hour contact arrangement for contractors to obtain spares, repairs and additional equipment
- Preparedness by major contractors to provide a liaison officer to AVA incident control points
- Involve major contractors in scenario training and exercises
- Regular briefing on incident management plans, exercises for long term contractors on work sites
- Submission of incident management plan for major work or contracts
- Briefing on criticality of assets
- Invitation to participate in incident debriefs

8.5. SCENARIOS

Arrangements will be made for the Operations Team as well as the AVA Management Team to conduct regular scenario exercises and training. However, this plan will be tested at least once a year through actual incidents or scenarios.

In addition, AVA would participate in inter-agency scenarios, if requested, where there are deemed of benefit to AVA and its operations staff.

Inter-agency scenarios may include major floods, bushfire events, spillage events, rescue events, etc.

The scenarios will be used to achieve beneficial process and people outcomes. Some examples of beneficial process outcomes include:

- Reviewing existing processes, plans and procedures
- Increasing awareness of processes, plans and procedures
- Identifying resource shortfalls/limitations
- Improving ability of coordination
- Clarifying roles and responsibilities
- Exercising processes, plans and procedures
- Increasing cooperation between operating personnel and external resources
- Increasing awareness of proficiencies and needs

Some examples of beneficial people outcomes include, among others:

- Motivating staff members
- Developing team work
- Developing skills
- Providing opportunities to apply skills in unusual situations
- Developing problems/issue resolution strategies
- Developing analytical skills
- Developing leadership skills
- Improving individual performance
- Improving individual and team OHS&R behaviour and performance

It is recommended that the following incident management program be followed by the Operations Team:

Exercise/training type	To be undertaken by:	Frequency
Minor Incidents Drills and testing of alarms and evacuation processes	Operations Team lead by Supervising Operator	2 per annum (minimum)
Major Incidents Desktop exercise to test interfaces and understanding	Operations Team led by Operations Supervisor	1 per annum

9. INCIDENT MANAGEMENT

9.1. MINOR INCIDENT

Managed by: Supervisor or above

Report immediately to: System Manager

Actions:

- Ensure that all staff and contractors are safe
- Deal with the incident immediately to limit any impact on staff, the plant, the community or the environment
- Ensure the best qualified operator or contractor responds to the incident (e.g. for small fire employ operator with most recent fire fighting training, for minor mechanical breakdown use contract fitter etc)
- Notify the Response Centre as soon as possible. Response should take precedence over notification unless operator or contractor is unsure of correct response
- Ensure normal incident notification and reporting procedures are followed

9.2. MAJOR INCIDENT

Managed by: Site Incident Management Team with external assistance as required

Report immediately to: AVA Project Control Group

Remember: It is always better to over-react to an incident. An incident can be de-escalated with much less impact (e.g. stand-down of a fire service who has been called to the site) than can an incident that has got out of control due to indecisive action by the plant personnel.

In the event of an incident requiring the extensive use of specialist external resources, then the Operations Team, led by the Supervising Operator, shall provide a technical support role and physical response role as required by the specialist service provider. The Operations Team shall ensure that the external resources are assisted to safely carry out their response e.g. they don't stray into areas of the plant that are dangerous to them or their equipment.

Actions:

- Activate the Site Incident Management Team (if necessary)
- Ensure that all staff and contractors are safe
- Deal with the incident immediately to limit any impact on staff, the plant, the community or the environment to the extent of the capabilities of the Operations Team. Do not risk injury by going beyond the Team's capabilities. Evacuate site if necessary to maintain safety of staff, contractors and visitors
- Advise Response Centre at North Parramatta

- Ensure the best qualified external resources are called to respond to the incident by calling 000 (e.g. for large fire ensure the local Fire Service is quickly dispatched to the plant. For a major toxic chemical spill ensure HAZMAT Team is called to the site immediately)

- In the event of a fire, toxic chemical spill or other incident that may impact on the surrounding community, ensure early evacuation procedures are activated. This will, more than likely, be handled by the Police or Fire Service

- For a major plant failure that can be dealt with by staff and contractors, the IMT should quickly assess the actual or potential impact of the incident and develop an overall response strategy to minimise the impact of the incident

- Instructions for response to major incidents are available for the majority of potential events. The plant's set of Incident Response Plans will provide guidance on the steps to take to deal with the technical aspects of the incident. Refer to the plant's IMS Document Register for the relevant specific IRP

- Notify AVA representative as soon as possible and assess need for any specialist external support

- The IMT shall handle all aspects of communications during the major incident. They shall keep the Head Office (COO, CEO and support staff) and SWC informed as well as notifying appropriate government departments, authorities, relatives of injured workers, contractor groups and pressure groups. The media should only be dealt with after approval from Head Office. Tips on handling the media are outlined in Section 10 – Client, Stakeholder and Media Handling of this document.

- The IMT shall coordinate specialist internal (e.g. legal, insurance, OHS&R, risk, media, government liaison, etc) and external resources (e.g. Emergency Services, specialist contractors etc) to ensure an efficient response to the incident

- Ensure a detailed log of the incident is maintained

- Ensure normal incident notification and reporting procedures are followed

After the incident is brought under control and clean up can begin it is essential that an incident debrief is carried out. Feedback from the debrief shall be used to improve this Incident Management Plan and the individual Incident Response Plans, as well as training packages for operations personnel and contractors.

9.3. CRISIS

For all incidents with the potential to be a crisis, refer to the AVA Incident and Security Management Plans.

Corporate crises can be defined as physical or non-physical emergency incidents which:

- Seriously injure or harm multiple people or expose them to risk

- Cause substantial physical damage to property or the environment

- Attract sustained negative media attention nationally

- Impact seriously on the health, business activity or amenity of the community in general

- Seriously damage AVA's ability to conduct business and/or expose the organisation to liability or legal action

- Seriously damage the organisation's reputation and brand, profitability, or shareholder value

9.4. GENERAL WORKING METHODS

After the Incident Management Team has been mobilised and their individual roles confirmed, and the Incident Headquarters facilities and equipment activated and tested; the following general working methods and response actions will be required to be undertaken by all members of the Incident Management Team. The methods adopted and actions taken include:

- Commence and maintain group logs and information boards – log sheets, incident notification forms and Incident Manager handover briefing form are included as Attachments to this Plan

- Ensure the all key officers have been briefed and ongoing communication protocols established and implemented

- Establish and maintain regular liaison with a designated operator at the incident site

- Ensure appropriate functional support / specialists have been briefed and are operational.

- Determine and continually review operating rules and decision-making processes for the IMT, including support resources

- Under the direction of the Incident Manager, conduct regular reviews (every 2 hours or better) and assess the issues identified, provide updates and progress reports on actions taken, and contribute to the development and implementation of the overall response strategies

- Ensure that all members of the IMT reconvene as and when major new developments occur to be briefed on the latest situation

- Establish and continually reassess the requirements and expectations of stakeholders, regulators, community groups and interested parties including ongoing communication requirements and strategies at executive, operational and technical levels

- Continually monitor the response performance and requirements of SWC

- Monitor the morale and welfare of the IMT and AVA staff and ensure all necessary support, counselling, and relief is organised

- Develop, continually review and implement communications with staff regarding the emergency

- Make arrangements for team member breaks every four hours, and, in the event of prolonged emergency, relief shifts every twelve hours

- Ensure that support arrangements such as staff provisions, materials, transport and accommodation, are effectively organised through the Support Officer

These team working methods and response actions are complimented by detailed roles and responsibilities for each of the IMT members set out in the following pages.

9.5. INCIDENT RESPONSE PLANS

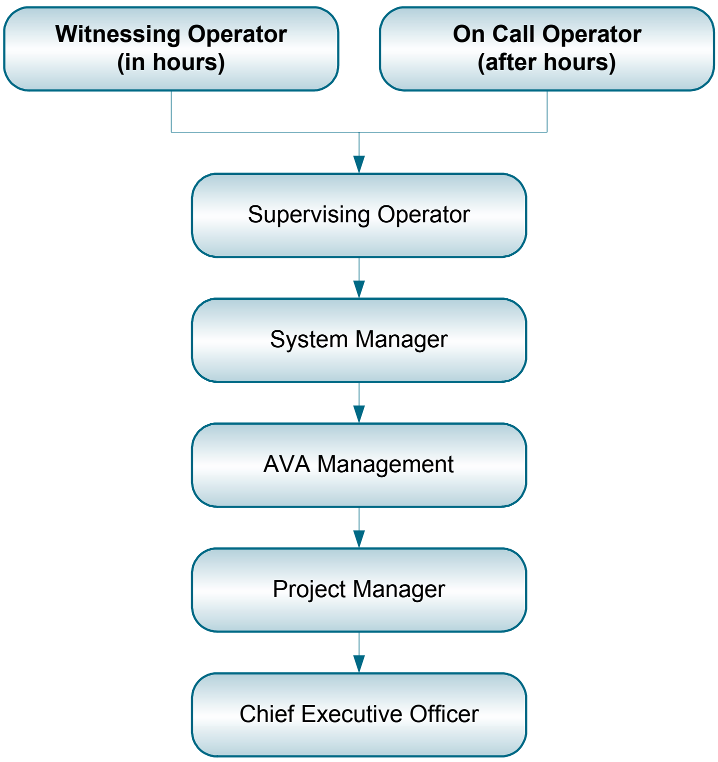
This operating facility will have a comprehensive set of Incident Response Plans which provide detailed instructions on how to respond to various different operational incidents.

9.6. INCIDENT ESCALATION

At the onset of the incident and as it develops, the Operations Supervisor, System Manager and, in the case of more severe incidents, the AVA Representative shall decide the level of an incident and when it has escalated to the next level. The escalation trigger table in the following section may be useful in determining if an incident has escalated and a higher level of response is required. The incident escalation process is given as an Attachment.

9.7. INCIDENT REPORTING CHAIN

In the event of an incident occurring on or around the operating facility, the following chain of command shall apply. As incident severity increases, responsibility for key decision-making will lie with those further along (in seniority) the chain of command within AVA. SWC shall also be kept informed of developments and will have a role to play in the decision-making process.



9.8. MOBILISATION AND EARLY ACTIONS

In the event of the Incident Management Team being activated to respond to a major incident, it is crucial that the team is mobilised quickly and some key immediate actions are carried out.

10. CLIENT, STAKEHOLDER AND MEDIA HANDLING

When an incident occurs at the operating facility, there will be mandatory reporting requirements and courtesy notifications. The Project Agreement with SWC has requirements to report incidents to SWC Operations Managers and Contract Administrators. These requirements must be adhered to. This would normally be required for more serious incidents that have the potential to affect the proper function of the plant. However it is not unreasonable to notify SWC even in the event of minor incidents. This promotes open and honest communications and enhanced trust between the parties. Refer to the Stakeholder Management Plan (SMP) for details of Stakeholders.

The main stakeholders other than SWC that may require notification depending upon the severity of the incident are:

- WorkCover/Workplace Health and Safety
- EPA
- State Health Department
- Local Council
- Recycled water customers
- Local community
- Media
- Suppliers and Contractors

Some of these notifications are mandatory (e.g. EPA, WorkCover, Health) while others are more courtesy but should be encouraged to foster an environment of trust. The following principles should be used as a guide in dealing with stakeholders in the wake of an incident:

- The welfare of the public is our number one priority
- Communicate openly, honestly, and regularly with staff, customers and all key stakeholders, treating them as we would wish to be treated ourselves
- Consider the consequences of planned actions from the perspective of all stakeholders, but with public welfare as the overriding concern
- Demonstrate concern, from the top, for all affected parties, and for rectifying the issue
- As a priority, do whatever is reasonable to take control and resolve the situation swiftly
- Base decisions on facts not speculation and develop appropriate key messages
- No surprises; ensure relevant managers are fully briefed in advance, and that staff are briefed of developments before they hear them in the media
- Build close working relationships with stakeholder groups and get to know contacts face to face. Listen carefully to their points of view so we can respond to their concerns

11. RECOVERY

11.1. DEBRIEF INSTRUCTIONS

- Formal debriefs will be conducted for all major incidents
- Informal debriefs will be conducted for routine incidents
- The Incident Debrief process involves a four-stage approach

11.1.1. INCIDENT INVESTIGATION

Information is gathered from all personnel involved in the incident by carefully working through the whole scenario to ensure the correct sequence of events is recorded. All events within the incident should be recorded chronologically.

In the case of a serious incident, where potential exists for prosecution or litigation, an assessment will be made to determine whether a formal investigation will be undertaken.

11.1.2. ANALYSIS PHASE

Information gathered is analysed to obtain an understanding of factors which led to the incident, its causes and lessons to be learnt. Such analysis would normally take place in a debrief workshop with input from the Operations Team as well as external experts.

11.1.3. RECOMMENDATION PHASE

Actions are then recommended which will minimise risk of re-occurrence or impact of such incidents. These actions or outcomes should also be used to critically review this Incident Management Plan and individual Incident Response Plans.

11.1.4. IMPLEMENTATION PHASE

The recommendations coming out of the debrief process should be submitted to the AVA Management for approval and an implementation program devised and executed as soon as possible.

The Incident Manager will normally manage stages 1, 2 and 3.

The System Manager will assign responsibility for management of Stage 4 to an individual (probably a member of the affected Operations Team). Recommendations that can be implemented as part of normal plant project work or part of the daily work plan should be carried out as a matter of priority. If some or all of the recommendations apply to all AVA operating facilities then the Project Manager Operations should oversee progress of program implementation. Progress of the Implementation stage should be reported on during normal Operations Team production meetings. The Chief Operating Officer may also wish to be informed of progress of implementation of recommendations.

The implementation phase for each debrief will contain actions designed to share the lessons learnt from the incidents across AVA operating facilities.

11.2. DEBRIEF REPORT FORMAT

It is suggested that the Debrief Report be layout in the following format:

- **Event** Title, Date of Occurrence, Date of Debrief

- **List of Attendees** - Their normal work position, and their role in the incident

- **Description of Incident** including location, each event in chronological order and their impact, as well as the overall impact of the incident on personnel, the community, the plant, the environment and the Company

- **Issues and Recommendations** - Issue Summary, Recommended Actions or Proposed Course of Action, Person Responsible for Following Up Action and, if applicable, the Time Frame to follow up. This section should cover as a minimum:

  - Overall speed / effectiveness of response
  - External perceptions
  - Personnel – well-being and welfare – training
  - Equipment
  - Processes and procedures including availability and usefulness of a relevant specific Incident Response Plan
  - Deficiencies - lessons learned

- **Distribution -** Distribution should be to all Debrief attendees. Distribution outside the debrief attendees should be discussed at the debrief and approved. A list of all who will receive a copy should be listed on the distribution list. The AVA Project Manager and, if requested, the Project Director should receive a copy of all debriefs

- **Annexes** - Annexes should include the Time Log (usually the Incident Manager's Log) or an event schedule of the Incident

11.3. CRITICAL INCIDENT STRESS DEBRIEF

Any incident that involves the death or serious injury of an employee or other traumatising event may require the provision of counselling or critical stress debriefing. This is to allow a traumatised witness to discuss the impact that the event has had on them and provide the counsellor with an opportunity to give valuable advice in how to overcome the stress the person is feeling. Counselling services can be obtained through community groups such as the Salvation Army, the Family Support Service and Lifeline.

11.4. SHARING OF DEBRIEF OUTCOMES

It is crucial that any lessons learnt from the incident and subsequent debrief process are shared across AVA. As such the Project Manager shall ensure that the findings of the debrief are distributed to all Operations Teams and instructions given to implement on any recommendation that may minimise the risk of a similar incident occurring at other operating facilities.

11.5. RESTORATION AND RECONSTRUCTION

Any restoration, reconstruction and/or clean up required after the incident has been declared over, shall be carried out as soon as resources and funds allow. All restoration and clean up work is to dealt with in the following order of priority:

- Work that ensures the safety of personnel and the community
- Work that restores plant process and the protects the environment
- Work that protects the Commercial performance of AVA

12. ATTACHMENTS

Incident Escalation Process

Site Incident Management Team Escalations

Incident Manager's Hand-Over Brief

Incident Report Form

12.1. INCIDENT ESCALATION PROCESS

CRISIS

Crisis Management Team (CMT) activated when...

- There is a real potential for an incident to have a broader impact on the Company
- There are multiple injuries/fatalities, threats to life, significant damage to property, environment, or major potential impact on financial results
- Site resources cannot cope and specialist advice and support are (perceived to be) required
- Major interest is shown by customer, authorities and media, or potential for public outrage
- There is a threat to AVA's reputation, with potential implications for relations with key stakeholders
- A major incident is not site-specific and there is no obvious response team to manage it

Crisis Management Team is...

- Led by the Chief Operating Officer as Crisis Controller, with designated support teams handling operations, communications, planning, support and administration issues
- Based at the designated crisis room in the main office, or other location determined specialists and other advisors as appropriate
- Supplemented by designated functional specialists and other advisors as appropriate

Crisis Management Team shall...

- Determine if a Crisis Alert has been triggered and act accordingly
- Assess the impact on the business and develop an overall response strategy
- Provide support to the site in form of advice, resources and assess need for further input
- Handle major external communications, eg. With client or customer, Govt. depts., authorities, councils, media, "relatives", contractors, pressure groups, etc
- Co-ordinate corporate functional inputs such as legal, insurance, safety and environment
- Notify key stakeholders and staff

MAJOR

Site Incident Management Team activated when...

- There are multiple injuries/fatalities, threats to life, significant damage to property, environment, or major potential impact on plant performance
- Site resources cannot cope and specialist advice and support are (perceived to be) required
- Major interest is shown by authorities and media, or potential for public outrage
- There is a threat to the project's/AVA's reputation, with potential implications for relations with key stakeholders
- A major incident is not off-site but nearby and there is no obvious response team to manage it
- When an incident cannot be controlled quickly by normal staff
- Specialist resources or equipment are required
- The emergency services are called to assist
- Outside parties are, or could be, affected, including neighbours, community, customers

Incident Management Team is...

- Led by the Operations Manager as Site Incident Manager, with designated support officers handling operations, communications, planning, support and administration issues
- Based at the designated incident room in the main office, or other location as nominated by the Site Incident Manger or GM Operations
- Supplemented by designated functional specialists and other advisors as appropriate
- Specially trained and equipped for spill containment, first aid, fire-fighting, etc.

Incident Management Team shall...

- Assess the actual/potential impact on the plant and develop an overall response strategy
- Provide support to the site in form of advice, resources and assess need for further input
- Handle major external communications, eg. With client Govt. depts., authorities, coucils, "relatives", contractors, pressure groups, etc. Deal with media only with approval of HO
- Co-ordinate functional inputs such as legal, insurance, safety and environment
- Keep GM Operations informed
- Treat direct incident, with the emphasis on human life
- Assist emergency services
- Restore control and effect recovery
- Deal with local issues such as neighbours, media and authorities

MINOR

Individual response required when...

- An incident can be controlled quickly by normal staff
- No specialist resources or equipment is required
- No emergency services assistance is required
- There is no effect on outside parties including neighbours, community, contractors, other stakeholders

Individual response is...

- Handled by most qualified individual, eg. First aid attendant, operator, fitter, etc
- Based on site
- No specialist training or equipment required in response

Individual shall...

- Handle the incident on site, co-ordinating internal resources for response
- Notify the Supervising Operator and ensure normal incident reporting procedures are followed

12.2. SITE INCIDENT MANAGEMENT TEAM ESCALATION

Assembly

- Convene in the Incident Room as soon as possible, or at the time specified (ALL)
- Advise own operators of contact number and arrange for delegation of key normal duties (ALL)

↓

Activation

- Ensure Incident Room is correctly configured and telephones and faxes are functional (SUPPORT OFFICER/FIRST ARRIVALS)
- Allocate lines and advise all interested groups (including switchboard) of the numbers being used (INCIDENT MANAGER)
- Issue role checklists, reference material, and stationery

↓

Organisation

- Check attendance of all mobilised resources (IM)
- Confirm key roles, i.e. IMT Officers (IM)
- Organise team-seating arrangements (IM)
- Consider need for additional specialist and support resources (SUPPORT OFFICER)
- Consider need for additional equipment and catering (SUPPORT OFFICER)

↓

Communications

- Establish contact with incident site and obtain latest situation report (OPERATIONS OFFICER)
- Begin developing key messages (COMMUNICATIONS OFFICER)
- Notify authorities and key stakeholders, giving facts only (COMMUNICATIONS OFFICER)

↓

Response

- Log and assess the known facts, consider the key issues and implications, and arrange for provision of any immediate site support needs (TEAM)
- Develop initial response strategy and consider immediate next steps, including priority tasks for each group (IM/TEAM)
- Commence team operations/set schedule for next review session

12.3. INCIDENT MANAGER'S HAND-OVER BRIEF

Location:
Original Site Manager:
Situation (Brief Outline)
Potential Hazards/Safety Problems
Technical Actions To Date **How Shut Off - (List actions including location of valves or pumps opened/closed)**
By-pass/Alternate Service By
Impact on Customers/Industry to Date
Other Agencies/Authorities Involved and Tasks

Departing Incident Manager Details		
Contact details	**Telephone:**	**Mobile:**
On site at		
Departed at		
Will Return at		
Information passed to Client and stakeholders		

AVA
Water Consortium

12.4. INCIDENT REPORT FORM

Example Incident Report Form:

PLEASE FAX COMPLETED FORM TO HR WITHIN 24 HOURS

Location

Site:.. Date:......................... Report No.:........................

Company: AVA ☐ Alinta ☐ GWA ☐ Other:..

Details of Injured Person

Give Names:.. Surname:..

Residential Address...

....

Home No.: .... Mobile No.:...

D.O.B:.. Sex: Male ☐ Female ☐

Basis of Employment

Full Time ☐	Casual ☐	Work Experience ☐	Member of Public ☐
Part Time ☐	Contractor ☐	Volunteer ☐	Self Employed ☐

Type of Incident

Near Miss ☐	First Aid Injury ☐	Medical Treatment ☐	Lost Time Injury ☐
Disease ☐	Notifiable Injury/Illness ☐	Notifiable Event ☐	Property Damage ☐

Notify Statutory Authority: Yes ☐ No ☐

What is the Injury or Illness?

Nature of work injury or work-caused illness:...

....

....

Alinta VEOLIA WATER

Injury or Illness and Accident Details

Date of Injury .... Time of Injury .... am/pm

Date of Employer Notified..................................... Time .... am/pm

Date Ceased Work .... Time .... am/pm

Date Resumed Work .... Time .... am/pm

Medical Treatment: Yes ☐ No ☐

Time Lost to Date .... Yes ☐ No ☐

Describe how the injury occurred: ....

....

....

Description of injury, e.g. laceration left arm: ....

....

....

Previous related injuries: ....

....

....

Address where incident occurred: ....

....

Incident Likely to Become Claim: Yes ☐ No ☐ Unsure ☐

Is Employee Currently?

At work, performing normal duties ☐ At work on reduced hours ☐

At work, normal hours, performing suitable alternative duties ☐ Off work ☐

Circumstances of Injury

Whilst at work ☐ Travelling to or from work ☐

Away from work during a recess period ☐

Treating Doctor or Hospital

Name of treating doctor or name of hospital if hospitalised: ....

....

Telephone No.: .... Facsimile No.: ....

Address of treating doctor or hospital..

.... Postcode:..............................

Name of Injured Person:	**Name of supervisor/principal contractor:**
Print Name:..	Print Name: ....
Signature:	Signature:..
Date:	Date:..

PRELIMINARY RISK REGISTER

Risk No.	Risk Category	Risk Title	Description of Risk	Proposed Controls	Adequacy of proposed controls 1 = Excellent 3 = Adequate 5 = Inadequate 7 = None	Consequence 5 = Extreme 4 = Major 3 = Moderate 2 = Minor 1 = Insignificant	Likelihood 5 = Almost certain 4 = Likely 3 = Moderate 2 = Unlikely 1 = Rare	Level of Risk = Likelihood x Consequence	Risk Rating	Accept?	Risk Treatment Options Elimination Treatment Transfer Acceptance	Further Action	Resp	Due By	Status
AS01	Access & security	Access to site including RWTP, reservoirs, interface points, etc…	Restricted access to site due to Flood / Storm / Fire / Road accident / Chemical spill / etc	More than one access to sites where feasible Remote dial up to RWTP SCADA	3	2	2	4	Moderate	Yes	Acceptance				
AS02	Access & security	Infrastructure	Damage of assets due to fire, explosion or vandalism or risk to operations (RWTP and network)	Intruder alarms 24/7 monitored security Security perimeter patrols Perimeter fencing Fire protection systems	3	4	2	8	Moderate	Yes	Acceptance				
AS03	Access & security	High level security / terrorism / sabotage	The impact of any criminal act, terrorist attack or sabotage on the integrity of the recycled water supply provided by the company's operation.	Intruder alarms 24/7 monitored security Security perimeter patrols (at RWTP & network reservoirs) Procedures for managing increased security threat levels Perimeter fencing	3	5	1	5	Moderate	yes	Acceptance				
C1	Compliance	Regulatory reporting	Failure to submit reports on time or in the event of an incident - EPA, Workcover.	Training Management Systems Good relationship with authorities	3	3	2	6	Moderate	yes	Acceptance				
C2	Compliance	IMS - Quality / Safety / Environment	Loss of certification.	Internal audits Training / awareness Commitment of staff Dedicated Management System resources (Head Office)	3	3	2	6	Moderate	Yes	Acceptance				
C3	Compliance	Contract non-compliance - recycled water quality	Risk of non-compliance with quality parameters.	On-line monitoring at RWTP and network Sampling with on site & independent analysis (NATA certified) Robust & flexible design Operating procedures Training SCADA alarms Maintenance Management System Good relationship with the client & customers Shutdown of RWTP supply to customers with potable back up	1	4	3	12	High	No	Treatment	Pilot plant trials on combined Liverpool / Glenfield effluent to confirm design and operational performance	VWS (VWA to assist)	Prior to finalising detailed design	Included in AVA program
C4	Compliance	Contract non-compliance - recycled water quantity	Risk of non-compliance with minimum required recycled water quantity.	On-line instrumentation Computerised Maintenance Management System (CMMS) Robust & flexible design Operating procedures Training SCADA alarms Good relationship with the client & customers Potable water top up in network Potable water back up for customers	1	4	3	12	High	No	Treatment	Pilot plant trials on combined Liverpool / Glenfield effluent to confirm design and operational performance	VWS (VWA to assist)	Prior to finalising detailed design	Included in AVA program
C4	Compliance	Company licences	Loss of licences - Notification of major hazard facility, dangerous goods, radio transmittal, pressure vessels, etc	CMMS scheduled reminders	3	2	2	4	Moderate	Yes	Acceptance				
C5	Compliance	Contract non-compliance - reporting requirements	Risk of not meeting reporting requirements including quality, incident and monthly reporting	Training Good relationship with client Agreed Communication Protocol with SWC & customers	3	3	3	9	Moderate	Yes	Acceptance				
C6	Compliance	Staff licence	Loss of staff licences - motor vehicle registration, motor vehicle licence, tickets including electrical, confined space	Training register Copies of original licences Staff integrity	3	4	1	4	Moderate	yes	Acceptance				
C7	Compliance	Non-compliance - EPA, Workcover	The impact of any failure by AVA to comply with regulations of the government's supervisory agencies	Lawlex subscription - for legislation updates Change notification process Training Management system Audits	3	4	2	8	Moderate	Yes	Acceptance				
HR1	HR	Loss of key staff	Loss of key staff due to resignation	Staff culture Work environment Staff development / training Multiskilled staff Succession plan Remuneration	1	2	2	4	Moderate	Yes	Acceptance				
HR2	HR	Competency	Staff not fully qualified or competent to carry out duties	Training (including competency development) Recruitment process	1	3	2	6	Moderate	Yes	Acceptance				
HR3	HR	Staff shortage	Shortage if one operator away and one or more operators ill or injured	Multiskilled staff Roster Internal transfer Head Office support from VWA	1	3	3	9	Moderate	Yes	Acceptance				
HR4	HR	Industrial relations	Industrial action	Staff culture Work environment EBA and remuneration	1	4	1	4	Moderate	Yes	Acceptance				

Risk No.	Risk Category	Risk Title	Description of Risk	Proposed Controls	Adequacy of proposed controls 1 = Excellent 3 = Adequate 5 = Inadequate 7 = None	Consequence 5 = Extreme 4 = Major 3 = Moderate 2 = Minor 1 = Insignificant	Likelihood 5 = Almost certain 4 = Likely 3 = Moderate 2 = Unlikely 1 = Rare	Level of Risk = Likelihood x Consequence	Risk Rating	Accept?	Risk Treatment Options Elimination Treatment Transfer Acceptance	Further Action	Resp	Due By	Status
HR5	HR	Loss of key staff	Loss of key staff due to non-work related illness/injury	Safety culture Multiskilled staff Internal transfer Routine medicals Head Office support from VWA	3	2	2	4	Moderate	Yes	Acceptance				
HSE1	HSE	Emergency / crisis plans	The potential impact on operations and corporate reputation due to inadequate management of an emergency or crisis	Crisis Management Plan Emergency / Incident Management Plan Training	3	4	2	8	Moderate	Yes	Acceptance				
HSE2	HSE	Chemical spills	The business cost of dealing with an accidental spill of chemicals, whether contained or not within the company's operational site	SCADA alarms and monitoring equipment Locked bunds Spill kits Training Neutralisation pit Use of preferred suppliers / contractors Emergency / incident procedures	3	3	3	9	Moderate	Yes	Acceptance				
HSE3	HSE	Public health scare	The possibility of any perceived or actual threat to customers or public health stemming from the company's operations	On-line monitoring Sampling and independent analysis Compliance with National Recycled Water Guidelines Training SCADA alarms Good relationship with the client & customers Emergency / incident procedures	3	4	1	4	Moderate	Yes	Acceptance				
HSE4	HSE	Safety incident	The human impact and business cost of a significant safety incident	Training Safety culture Management system Audits Emergency / incident procedures	3	4	2	8	Moderate	Yes	Acceptance				
HSE5	HSE	Environment pollution - noise, odour etc.	The business cost and threat to the company's reputation of any adverse impact on the environment caused by the company's operations	SCADA alarms and monitoring equipment Locked bunds Spill kits Training / awareness Neutralisation pit Use of preferred suppliers / contractors Noise survey Management system Emergency / incident procedures	1	4	1	4	Moderate	Yes	Acceptance				
ITC1	IT systems & Communication	Loss of telephone and fax	Loss of telephone, fax and/or mobile phone communication for more than a day	Mobility of staff Other methods of communication	3	2	3	6	Moderate	Yes	Acceptance				
ITC2	IT systems & Communication	Complaints	Risk of continual or large number of complaints.	Communications protocol with Sydney Water Management system	3	3	1	3	Low	Yes	Acceptance				
ITC3	IT systems & Communication	Client Management	The risk of not meeting client and/or customer expectations	Training Maintaining good relationship / communication protocol with client & customers	3	3	2	6	Moderate	Yes	Acceptance				
ITC4	IT systems & Communication	PLC/SCADA	Loss of PLC/ SCADA system - inability to operate automatically	Spare parts Available storage in the network also top-up and back-up potable water SCADA backup Schneider Electrics (Supplier) Internal & External Training of operators	3	4	2	8	Moderate	Yes	Acceptance				
ITC5	IT systems & Communication	Data loss	IT systems failure leading to a loss of historic operational data	Backups (located on and off site) Routine backup procedure	3	4	2	8	Moderate	Yes	Acceptance				
ND1	Natural Disaster	Flood / Storm	The impact of a flood or storm on the company's operations	Building regulations Building maintenance (especially drainage) Clean site (workplace inspections / grounds maintenance)	3	3	2	6	Moderate	Yes	Acceptance				
ND2	Natural Disaster	Earthquake	The impact of an earthquake on the company's operations	Building regulations Building maintenance	3	5	1	5	Moderate	Yes	Acceptance				
ND3	Natural Disaster	Fire	The impact of an internal fire or external fire on the company's operations.	Fire fighting equipment / protection Hot Works Permit system Radio for notification Fire fighting training for Operators Emergency / Incident response procedures	3	4	2	8	Moderate	Yes	Acceptance				
ND4	Natural Disaster	Lightning	The impact of lightning on the company's operations.	Lightning protection Surge protection on instrumentation	3	4	2	8	Moderate	Yes	Acceptance				
O01	Operations	Power outage	The impact of any significant power outage at the RWTP for more than one day (internal or external failure)	4 hour UPS 3 ML recycled water storage (on site) & 7 ML in network Communications with power supplier Training Incident response procedure	3	4	2	8	Moderate	Yes	Acceptance				

Risk No.	Risk Category	Risk Title	Description of Risk	Proposed Controls	Adequacy of proposed controls 1 = Excellent 3 = Adequate 5 = Inadequate 7 = None	Consequence 5 = Extreme 4 = Major 3 = Moderate 2 = Minor 1 = Insignificant	Likelihood 5 = Almost certain 4 = Likely 3 = Moderate 2 = Unlikely 1 = Rare	Level of Risk = Likelihood x Consequence	Risk Rating	Accept?	Risk Treatment Options Elimination Treatment Transfer Acceptance	Further Action	Resp	Due By	Status
O02	Operations	Feed Effluent quality	Feed Effluent quality deterioration	Routine sampling / analysis for Plant & network (including LAP) On-line monitoring and alarms for Plant & network Notification from Sydney Water Communications Protocol Good relationship with client	3	4	2	8	Moderate	Yes	Acceptance				
O03	Operations	Failure of critical network equipment	Failure of network pumping station pump	Scheduled maintenance Monitoring of flows and pressures Duty / standby pumping arrangement	3	4	2	8	Moderate	yes	Acceptance				
O04	Operations	Failure of critical network equipment	Pumping station outage at Fairfield	Scheduled maintenance Monitoring of flows and pressures Duty / standby pumping arrangement Reservoir storages as back up (short term) Augmented by "top-up" potable water Potable water "back up" supply at customer sites	3	4	2	8	Moderate	yes	Acceptance				
O05	Operations	Failure of critical network equipment	Pumping station outage at Camellia	Scheduled maintenance Monitoring of flows and pressures Duty / standby pumping arrangement Reservoir storages as back up (short term) Augmented by "top-up" potable water Potable water "back up" supply at customer sites	3	4	2	8	Moderate	yes	Acceptance				
O06	Operations	Failure of critical network equipment	Recycled water main failure or burst	Isolations at 1km intervals Scheduled maintenance Monitoring of flows and pressures Reservoir storages as back up (short term) Emergency fittings retained at each pumping station for quick repairs Augmented by "top-up" potable water Potable water "back up" supply at customer sites	3	4	2	8	Moderate	yes	Acceptance				
O07	Operations	Failure of critical plant	Feed Effluent supply pipeline & feed tank	Scheduled maintenance (valves & instruments) Monitoring of flows and pressures	3	4	2	8	Moderate	yes	Acceptance				
O08	Operations	Failure of critical plant	Micro-screens	Bypass Scheduled maintenance Spares Reduce production (for limited duration)	3	2	3	6	Moderate	Yes	Acceptance				
O09	Operations	Failure of critical plant	Dosing system & coagulation tank	Duty / Standby dosing pumps Scheduled maintenance SCADA monitoring Service contract	3	3	2	6	Moderate	Yes	Acceptance				
O10	Operations	Failure of critical plant	CMF-S / CMF system (including membranes, blowers, filtration and backwash pumps…)	Membrane integrity testing & autopsies if required Duty / Standby units Design low flux Process Engineer support from Head Office Service contract with supplier	3	4	2	8	Moderate	Yes	Acceptance				
O11	Operations	Failure of critical plant	CIP system	Service contract for CIP system	3	3	2	6	Moderate	Yes	Acceptance				
O12	Operations	Failure of critical plant	RO system	RO permeate on-line conductivity measurement & autopsies if required Duty / Standby units Ability to return permeate to RO feed tank (dilute feed) Process Engineer support from Head Office Service contract with supplier	3	4	2	8	Moderate	Yes	Acceptance				
O13	Operations	Failure of critical plant	Ion Exchange system	Duty / Standby Ion Exchange units Scheduled maintenance SCADA monitoring Service contract	3	3	2	6	Moderate	Yes	Acceptance				
O14	Operations	Failure of critical plant	Recycled water storage / pumping (on RWTP site)	Internal inspection (infrequent) Maintenance and cleaning External inspection	3	4	2	8	Moderate	Yes	Acceptance				
O15	Operations	Failure of critical plant	Compressed air system	Service contract Duty / Standby	3	4	2	8	Moderate	Yes	Acceptance				
O16	Operations	Failure of critical plant	Service water	Spares and Maintenance Back-up potable supply (normally rain water or recycled water)	3	3	3	9	Moderate	Yes	Acceptance				
O17	Operations	Failure of critical plant	Control instrumentation	Spares Trained operators Service contract	3	4	2	8	Moderate	Yes	Acceptance				

Risk No.	Risk Category	Risk Title	Description of Risk	Proposed Controls	Adequacy of proposed controls 1 = Excellent 3 = Adequate 5 = Inadequate 7 = None	Consequence 5 = Extreme 4 = Major 3 = Moderate 2 = Minor 1 = Insignificant	Likelihood 5 = Almost certain 4 = Likely 3 = Moderate 2 = Unlikely 1 = Rare	Level of Risk = Likelihood x Consequence	Risk Rating	Accept?	Risk Treatment Options Elimination Treatment Transfer Acceptance	Further Action	Resp	Due By	Status
O18	Operations	Failure of critical plant	Electrical components / Switchboards	Cleaning Inspections (including thermography) Spares Spare VSDs Electrical operators	3	4	2	8	Moderate	Yes	Acceptance				
O19	Operations	Partial or full loss of supply of chemicals	Lab equipment and reagents.	Alternative suppliers Alternative methodologies External labs	1	2	1	2	Low	Yes	Acceptance				
O20	Operations	Partial or full loss of supply of bulk chemicals	Sodium Hypochlorite	Alternative suppliers Adequate storage	3	4	2	8	Moderate	Yes	Acceptance				
O22	Operations	Partial or full loss of supply of bulk chemicals	Sodium bisulphite	Alternative suppliers Adequate storage	3	2	2	4	Moderate	Yes	Acceptance				
O23	Operations	Partial or full loss of supply of bulk chemicals	Antiscalant	Alternative suppliers Adequate storage	3	2	2	4	Moderate	Yes	Acceptance				
O24	Operations	Partial or full loss of supply of bulk chemicals	Caustic	Alternative suppliers Adequate storage	3	3	2	6	Moderate	Yes	Acceptance				
O25	Operations	Partial or full loss of supply of bulk chemicals	Sulphuric acid	Alternative suppliers Adequate storage	3	3	2	6	Moderate	Yes	Acceptance				
O26	Operations	Partial or full loss of supply of bulk chemicals	Sodium - DDS	Alternative suppliers Adequate storage	3	2	2	4	Moderate	Yes	Acceptance				
O27	Operations	Partial or full loss of supply of bulk chemicals	Citric acid	Alternative suppliers Adequate storage	3	2	2	4	Moderate	Yes	Acceptance				
O28	Operations	Partial or full loss of supply of bulk chemicals	Chemical quality out of specification	Long term contract with supplier (with quality specifications) Good relationships Alternative supplier Routine checks on quality of chemicals	3	3	3	9	Moderate	Yes	Acceptance				
O29	Operations	Loss of critical contractors	Risk to operations due to loss of key outsourced services or suppliers	Service contracts Good relationships Alternative contractors Schneider progressive in house training	3	3	2	6	Moderate	Yes	Acceptance				
O30	Operations	Asset management	The impact of an inadequate asset management process	CMMS Training Asset management condition reporting Service contracts Project budget	3	4	2	8	Moderate	Yes	Acceptance				
O31	Operations	Inadequate supply of spares	Spares	Stocks Alternative suppliers for most spares Critical supply arrangement with membrane suppliers	3	3	3	9	Moderate	Yes	Treatment				
O32	Operations	Inadequate supply of OH&S equipment	PPE	Stocks Alternative suppliers Service contract Safety committee Training	3	4	2	8	Moderate	Yes	Acceptance				
Note:	Operations	Failure of critical plant	The following controls apply to all the Failure of critical plant listed	Training Regular inspections Standard operating procedures / work instructions Scheduled maintenance Spares SCADA monitoring / PLC control											

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Date: 18.10.05

DRAFT - Project Risk Assessment & Register

Project: Camellia RWP

Date updated	Risk No.	Risk Category	Risk Title	Description of Risk	Existing Controls	Monitoring of Controls *Methods of checking that the controls are implemented and effective*	Adequacy of existing controls 1 = Excellent 3 = Adequate 5 = Inadequate 7 = None	Consequence 5 = Extreme 4 = Major 3 = Moderate 2 = Minor 1 = Insignificant	Likelihood 5 = Almost certain 4 = Likely 3 = Moderate 2 = Unlikely 1 = Rare	Level of Risk = Likelihood x Consequence	Risk Rating	Risk Ranking	Accept? Yes or No	Risk Treatment Options Elimination Treatment Transfer Acceptance	Actions	Resp	Due By	Status	Legal and Other Requirements	Comments
4/07/2008	S1	Strategic	New project evaluation	New project evaluation - Risk of signing loss making contracts.	COO or CEO sign off on pricing. COO and CFO review of pricing models. Asia sign off on all tenders.	Sign off must occur on tender pricing	1	4	2	8	Moderate	17	Y	Accept	Tender price to be signed off as required	CE	25/03/2007	Closed. Tender submitted August 07 after Approval papers signed off		
4/07/2008	S2	Strategic	Over allocation of projects from Sydney Water	Sydney Water may not want to award too many contracts to the one Operator. There are several projects currently being developed by Sydney Water which VWA is bidding for, including Replacement Flows, Sydney Desalination and Camellia RWP.	Re-structure to allow allocation of required resources. Identifying and recruiting additional resources to ensure sufficient resources to manage multiple projects. Re-assure Sydney Water of VWA capability and adequacy of resourcing.	Review of resourcing progress.	3	4	4	16	High	3	Y	Accept		CE		Closed. Announced preferred tenderer Nov 07.		
4/07/2008	RES1	Resourcing	Inadequate resourcing	Insufficient resources dedicated to the tender result in poor quality submission. Insufficient resources to convince client that VWA can deliver the project.	Development of project plan identifying resource requirements. Forward notice to those resources required. Identifying and recruiting additional resources to manage multiple projects Project tracking to identify any resource defficiencies.	Review progress at weekly meetings	3	4	3	12	High	5	N	Treat	Identify new resources when available	CE	ongoing	PM and PE appointed for D&C delivery stage to manage this risk.		
4/07/2008	PP2	Project Planning	Sub-contractor gap	Risk that there is a "gap" in the sub-contract agreements with VWS that results in either omission of details required in the tender and/or VWA carrying additional risk.	Regular meetings between VWA and VWS. Drafting of sub-contract agreements prior to tender submission. Where possible, pass risks up to Alinta/SWC. VWA to review potential scope creep VWS/VWA. LD's to step down from Project & Plant Agreements to D&C Agreement.	Review progress at weekly meetings. D&C negotiation.	3	4	3	12	High	5	Y	Transfer	VWA to pass risks to VWS or Alinta	SB/S Mc	1/08/2008	D&C negotiation currently taking place (July 08).		
4/07/2008	PM1	Project Management	Project delivery	Failure to deliver the scope - exceed / not meet requirements.	VWA project manager, project engineer and project director assigned to project. Regular project meetings at all levels eg with Aquanet, internal, VWS and Alinta Asset Management. ISO-9001 accreditation.	Independent Verifier will monitor progress against commitment in tender and Agreements. Internal audits.	3	3	2	6	Moderate	14	Y	Accept	Manage project	LC	ongoing			
4/07/2008	PM2	Project Management	Approvals risks	Inability to attain approvals required to deliver project. This includes VW approval for BOO, agreement with Alinta, agreement with VWS on deliverables and D&C contract, site construction / planning approvals.	Forthnightly review by BD Management Team and/or project team progress meetings. Regular meetings with VWS. Project team copied on all project correspondence to ensure team is across issues. ExCo informed as issues arise as well as in monthly reports.	Monthly report	3	4	3	12	High	5	N	Transfer	VWA to keep Head Office informed of project. Planning and approvals to be managed by Alinta and VWS (for site and construction approvals)	LC	ongoing			
4/07/2008	PR1	Process	Process and Raw water quality	Process proposed cannot meet the performance requirements due to raw water (effluent) quality or process performane	Effluent quality information provided by SWC. Pilot study to be undertaken to verify process design and amend as required.	Pilot plant results report. Progress reported in regular project meetings with VWS and in VWS monthly report. Design review process	5	3	3	9	Moderate	1	N	Treat	Pilot plant trials allow validation of the design. Assess impact of fluctuations in effluent quality.	VWS	31/03/2009			
4/07/2008	D1	Design	Poor design	Poorly designed plant leads to inability to meet contractual performance requirements and/or increases operational costs. Nb chemical and power consumption data provided by VWS. VWA assumed risk on ongoing operational costs. (Chemical costs assumed escalate by CPI (assumed in finmodel @ 2.8%) Power costs assumed escalate at CPI + 4% YoY ie 6.8%.)	VWS to assume design risk. VWA to review design. Pilot plant trials will indicate adequacy of design. Regular project meetings with VWS to review design progress.	VWA to review design.	5	3	3	9	Moderate	1	N	Treat	Establish cooperative relationship to manage design issues as occur rather than waiting for formal design reviews.	LC	31/03/2009			
4/07/2008	C1	Contract	Initial contract terms & conditions	The impact on the company's ability to deliver a profitable project through a failure to successfully negotiate appropriate initial contract terms and conditions eg. Accepting too much risk or failing to have agreements adequately reviewed.	Copy of contract proposed issued with tender documents. Regional HO sign-off on new contracts Legal Counsel responsible for contract negotiation.	Tender review prior to submission. Ongoing contract negotiation by Legal Counsel.	3	4	2	8	Moderate	9	Y	Accept	Continue contract negotiation	SB/S Mc	1/08/2008			
4/07/2008	L1	Legal	Regulation changes	Changes to regulations which impact on licences and performance parameters which are not covered by "changes in law clause" and will therefore impact financially.	Good relationship with Sydney Water and govt authorities. Notification of changes in laws through LAWLEX.	Maintain LAWLEX membership. Review by PD, PM and legal cousel.	3	3	2	6	Moderate	14	Y	Accept		LC/SB	ongoing			
4/07/2008	L2	Legal	Contamination risk	VWA potentially exposed by taking a portion of risk on contamination	Plant Agreement and D&C Agreement. Step-down any risk from Plant Agreement to D&C Agreement	D&C negotiation	3	4	2	8	Moderate	9	y	Transfer	Pass on risk to VWS through D&C Agreement	SB/S Mc	1/08/2008			
4/07/2008	F1	Financial	Project delivery - budget	Failure to control budget	Controls built-in iPOS (electronic procurement system) CUBE to generate financial performances	Monthly tracking of project against budget. Variations/ potential variations monitored monthly.	3	2	3	6	Moderate	16	Y	Accept	PM to monitor budget and report monthly	LC	ongoing			
4/07/2008	F2	Financial	Project Finance	Unable to attain finance for project delivery.	Financing arrangements to be approved by CEO. Asia signoff required.	Financial memorandum sent to Head Office.	3	5	2	10	Moderate	4	N	Treat	Finance project on balance sheet	CE	Project Approval	Closed. Project approved. VWA funding internally		
4/07/2008	F3	Financial	Project operates at loss	Inaccurate estimates in OPEX (eg. Power, chemicals, labour) results in tender price below actual costs.	Engineering Manager and Technical Directors review pricing with financial input. Risk and opportunities matrix to be included with OPEX. COO or CEO sign off on pricing. COO and CFO review of pricing models. Head office sign off on all tenders. Refer to D1.	Regular meetings and tender sign off.	3	4	3	12	High	5	N	Treat	Develop risk and opportunity matrix to attempt to quantify risks for senior management	CE	12/03/2007	Closed. Final financial model accepted for contract signing.		
4/07/2008	I1	Insurance	Issues related to insurances	Excessive insurance requirements specified in the tender.	Legal Counsel review of insurance needs to comply with tender.	Plant and D&C Agreements	3	4	2	8	Moderate	9	Y	Accept	Legal Counsel confirm insurance requirements and confirm whether to take out joint policy or VW policy.	SB/S Mc	31/08/2008			
4/07/2008	IM1	Image	Reputational damage (internal & external)	Internal reputation damage from project failure.	Asia approval on tenders and new projects. Project specific roles.	Tender sign off. Monthly reporting throughout D&C and Operations phases.	3	4	2	8	Moderate	9	Y	Accept	Regular communication with extended project team and management	projec t team	ongoing			
4/07/2008	IM2	Image	Contract performance	Contract performance - impact on reputation with immediate client and within broader industry base in Australia.	IMS, partnership approach. Project specific roles.	Review at weekly project team meetings. Monthly project control group meetings.	3	4	2	8	Moderate	9	Y	Accept	Regular communication with extended project team and management	projec t team	ongoing			

Project Agreement
In a Project Agreement dated 11 August 2008, AquaNet Sydney Pty Limited ABN 11 131 235 124 of AXXESS Park, 321 Ferntree Gully Road, Mount Waverley Victoria 3149 (**AquaNet**) has agreed to finance, plan, design, construct and commission and then own, operate, maintain and repair facilities necessary to provide recycled water to Sydney Water Corporation in accordance with that agreement. The facilities include a recycled water treatment plant and associated works and the distribution network which is the subject of this licence application and its associated works.

Plant Agreement
Under a Plant Agreement dated 11 August 2008 between AquaNet (as agent for the Rosehill Project Joint Venture, an unincorporated joint venture made up of SPI Rosehill Pty Limited and Rosehill Water Pty Limited) and Veolia Water Australia Pty Ltd (**Veolia**), Veolia will design, construct, own and operate recycled water treatment plant. In the Plant Agreement AquaNet is known as the "Project Company".

The relationship between and responsibilities of the parties to the Plant Agreement are summarised in the background to the Plant Agreement as follows:

"Background

A. The Project Company has agreed to finance, plan, design, construct and commission the Project Works and to own, operate, maintain and repair the Plant, the Pipelines and to provide Recycled Water to Sydney Water in accordance with the terms and conditions of the Project Agreement.

B. The Project Company has agreed to appoint the Veolia Company and the Veolia Company agrees to perform the Project Company's obligations under the Project Agreement to finance, plan, design, construct and commission the Plant Works and to own, operate, maintain and repair the Plant and to provide Recycled Water to the Project Company to enable Sydney Water to provide the Recycled Water to the Foundation Customers, and to enable the Project Company to provide the Recycled Water to the Additional Customers, in accordance with the terms and conditions of this Agreement."

Under clause 16.3 ("Availability of Effluent") of the Plant Agreement, "the Veolia Company acknowledges that Sydney Water has undertaken in clause 16.3 of the Project Agreement to allow the Project Company to access Effluent in the LAP, and to supply Effluent in the LAP for the purposes of the Veolia Company commissioning the Plant…"

"LAP" means the Liverpool to Ashfield Pipeline to be constructed, completed and commissioned by Sydney Water.

Pipelines Agreement
In a separate Pipelines Agreement executed on 8 August 2008, AquaNet has contracted with Rosehill Water Network Pty Limited (ACN 132 481 077) and SPI Rosehill Network Pty Limited (ACN 131 213 691) (together the Rosehill Asset Joint Venture) to finance, plan, design, construct and commission the network, and then to own, operate, maintain and repair the network and its associated works.

The initial term of each of the three agreements (Project Agreement, Plant Agreement and Pipelines Agreement) is 20 years.

APPENDIX 2d - Management systems

Draft Community Consultation Management Plan (as tendered)

Draft Stakeholder Management Plan (as tendered)

WCWRP Communication Protocol (example from similar project)
VWA Environmental Policy

VWA Quality Policy

VWA OH&S Policy

Approvals Management Plan (as tendered)

WCWRP Performance and Verification Plan (example from similar project)

9.8

COMMUNITY CONSULTATION MANAGEMENT PLAN

CONTENTS

1. OVERVIEW

AVA recognises the vital role that community consultation plays in the successful implementation of any infrastructure project. We recognise that the management of community relations is a specialised skill and will be enlisting professional support to augment the skills, processes and learnings already developed by each of our consortium members. AVA also recognise that when it comes to community relations there is a need to devise and implement a plan that deals with the specific issues of the project – while previous learnings are important, it is not enough to simply replicate previous practices.

We are committed to ensuring that the *Camellia Recycled Water Project* is delivered with minimal impacts on the community and the environment.

2. ORGANISATION

With extensive experience in the infrastructure industry, AVA has expertise ranging from determining effective community and stakeholder management strategies to the implementation of community relations activity, consultation programs, field staff training, issues management, media relations and employee communications.

The stakeholder management plan developed for all phases of the project will encompass the activities of all parties involved in the planning, approval, construction and operation of the proposed recycled water scheme. The good neighbour policy proposed as part of the operation phase of the project, will specifically focus on the water treatment facilities, but will also develop protocols for managing maintenance activities for the distribution network.

The specialist services of Elton Consulting will be engaged early in the planning phase of the project to undertake a stakeholder risk analysis and facilitate workshops with key stakeholders, including SWC. A stakeholder engagement strategy will then be developed by Elton utilising the information obtained from the analysis and workshops. This strategy will outline stakeholder engagement objectives, target audiences, key issues, stakeholder impact/sensitivity analysis, required activities and the sharing of roles and responsibilities between Elton, AVA and Sydney Water.

The Community Relations Manager would have the key responsibility for implementation of the stakeholder engagement strategy and would establish a direct working relationship with their SWC counterpart as outlined in the strategy to ensure coordination between the two organisations and escalation or review of materials and issues as they arise. The Project Community Relations Team will report to the Project Manager, but take advice from other areas of the Alinta or Veolia organisations for expert advice as required.

The project's Community Relations Manager and Officers will be responsible through the planning, approvals and construction phases of the project for ensuring:

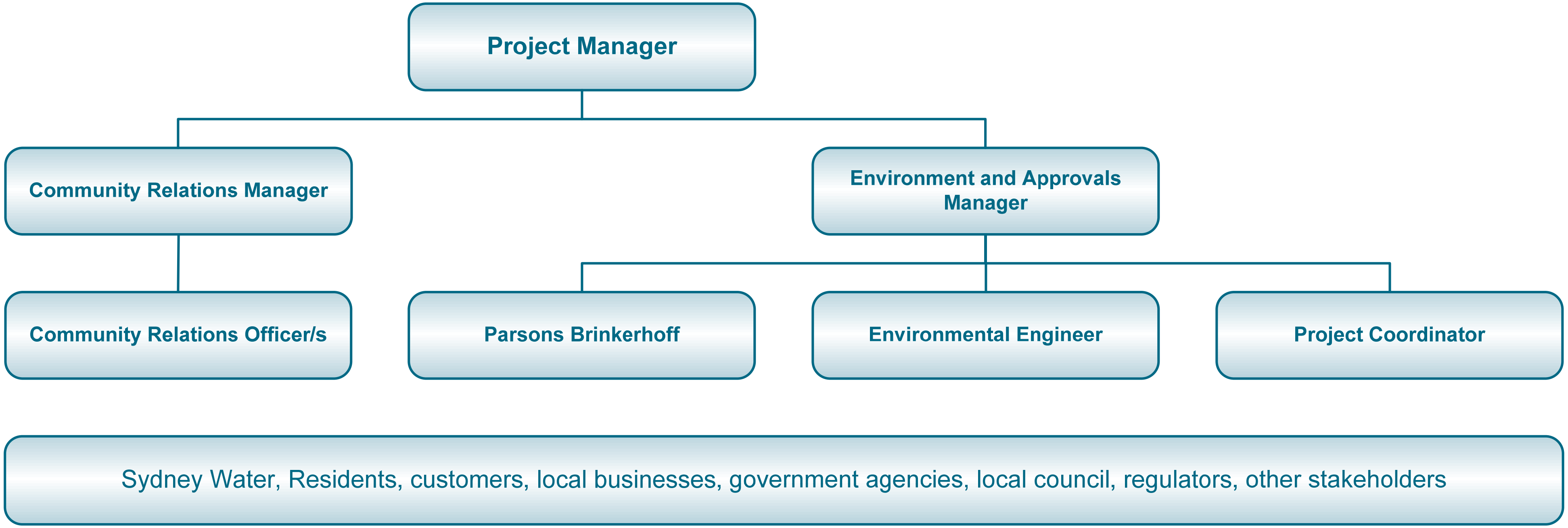
- Overall implementation of the stakeholder engagement strategy;
- Appropriate communication/consultation with relevant stakeholders occurs in a timely manner;
- Community issues are dealt with promptly and in accordance with agreed procedures
- Relationships with community members and local council representatives are managed effectively
- A pro-active approach is taken to minimise all of the issues
- Records are kept of communication occurrences.

To ensure the community relations team understands and addresses all concerns of local community members, the team will consult with local government stakeholders (schools, local councils and members of parliament), chambers of commerce and industry/business organisations, landowners, environment and special interest groups.

There is an expectation that the community relations team will work closely with the SWC Community Relations Team to keep SWC informed about progress, activities and any issues which arise.

COMMUNITY AND ENVIRONMENTAL TEAM STRUCTURE

Planning, Approvals and Construction



Operation and Maintenance Phase: Community relations will be managed by field officers in charge of maintaining the facility, consistent with the Company's operational community relations protocol.

3. PLANNING AND APPROVALS STAKEHOLDER MANAGEMENT

While all statutory requirements for community consultation will be met during the planning and approval phase, it will be supplemented by a broader communications and stakeholder engagement strategy that will be established to smoothly feed into the construction phase of the project. We propose establishing a clear understanding of the working relationship with SWC at the inception of the project, based on its previous experience and its existing understanding of the community issues.

We have developed an approach to communications and stakeholder engagement that is a practical, effective and robust strategy for engaging with stakeholders, including the community, during the option assessment and planning approvals phase of the project. The approach is outcomes-focussed and provides for pre-lodgement consultations. It has been designed to supplement the exhibition process that the Department of Planning will lead. The objectives of communications and stakeholder engagement for the Assessment and Planning Approvals Phase are:

- Meet requirements under the *Environmental Planning and Assessment Act 1979* and comply with SWC's Community Consultation Policy and Guidelines
- Create, maintain and/or increase stakeholder awareness of the issue (water supply and management) and the need outlined in the NSW Metropolitan Water Plan, for the government to provide a diversified portfolio of water supply and demand options
- Create working relationships based on trust with a range of stakeholders, including the community
- Provide information to stakeholders in a timely and meaningful format to enable them to provide informed feedback on the project
- Create, maintain and/or increase stakeholder understanding of the constraints and opportunities relating to the project
- Incorporate stakeholder feedback into the concept design process to assist (where possible) with avoidance or mitigation of environmental, social and economic impacts
- The stakeholder consultation and social impact assessment at this stage of the project will be fed into the Environmental Assessment report and will form the basis of the stakeholder management during the construction phase of the project

4. CONSTRUCTION STAKEHOLDER MANAGEMENT

The objectives of communications and stakeholder engagement during the construction and commissioning phase of the project are:

- Thorough and appropriate communication with affected communities so the project can continue unhindered
- Provide effective complaints management procedures to quickly respond to complaints and resolve them, and
- Provide the reporting SWC will require in order to monitor the project's success.

The community relations team that will work as part of the project team will be at the interface of construction activity. On this basis, other members of the Elton Consulting team will work alongside the Community Relations Team to provide peer support, technical review and manage the coordination of approvals and sign off for all communication materials.

Activities during this phase of the project will include a stakeholder survey of the construction route, provision of a website, newsletters, a process for notification of affected residents and stakeholders and issue management.

5. OPERATION AND MAINTENANCE STAKEHOLDER MANAGEMENT

After the project has been commissioned a good neighbour policy will be implemented. This will outline protocols and processes for mitigating impacts on adjoining properties, should they occur, managing complaints and contributing to the local community. Site managers and field officers will be responsible for the day to day management of the good neighbour policy, with escalation protocols in place should an issue arise.

6. PROPOSED CUSTOMER COMPLAINTS MANAGEMENT PROCESS FOR THIS PROJECT

In our experience, the most effective way to minimise complaints is to ensure our key stakeholders and the community are well informed of the construction/repair process as early as possible, particularly when there are direct impacts involved.

We are committed to maintaining a high standard in customer service and community relations. To achieve this consistently and in the quest for continual performance improvement, a customer complaint management process is implemented on all projects. For day-to-day issues the site controller will be responsible for this to occur. Alinta also manages a 24/7 Response Centre for matters relating to the NSW Gas Network.

This Response Centre (located in North Parramatta) handles in excess of 50,000 calls a year from the public, the emergency services, and clients. This also plays an integral in our proposed complaints management system for the *Camellia Recycled Water Project*.

A customised complaint procedure would be developed upon commencement of the Project and will be included in all site induction training. The key activities that will ultimately make up our complaint management process is to:

- Prepare and implement a community liaison and action plan
- Manage a 24 hour inquiry/complaints phone line
- Record, monitor and manage a register of community enquiries and complaints
- Prepare and distribute public and communication materials such as letterbox drops, newsletters, advertisements, signage
- Liaise with residents and stakeholders as required

The key elements of the complaint procedure include:

- Record complaint notifying relevant team members
- Customer assistance cards
- Action and investigation
- Report back
- Documentation
- Closure within 24 hours.

Our contact centre is available 24 hours a day to respond to community concerns about Alinta's infrastructure and will therefore be available for this Project as well. We also support, contribute to and promote the national 'Dial Before You Dig' service that provides the community with information about the location of underground infrastructure before excavation activity starts.

9.10i

STAKEHOLDER MANAGEMENT PLAN

(PLANT AND NETWORK)

CONTENTS

1. OVERVIEW

The Camellia Recycled Water Project will provide recycled water initially to key industrial customers within the Smithfield, Rosehill and Camellia areas.

Building positive external relationships is a key to success for most organisations. AVA Water Consortium's (AVA) values underpin all our relationships.

Internal relationships will also be developed and will occur concurrently with the project.

Our goal is to develop relationships and build trust and credibility with Sydney Water Corporation (SWC) and our stakeholders. This will take time and commitment to have relationships that promote our integrity and open communications.

Stakeholder Management applies to the Plant as well as to the Network. Reference to the Communication and Consultation Management Plan (CCMP) should occur as many of the relationships will be formed at the early stage of the project as part of the approval process.

The focus for this plan will be on the operations and asset management elements of the project.

2. OBJECTIVES

Effective stakeholder relations will bring improved outcomes for AVA.

The objectives of this plan include:

- To position, build and maintain positive stakeholder relationship, and help deliver the project outcomes
- To achieve a more consistent, efficient and effective approach to stakeholders by clarifying roles and accountabilities
- List the key stakeholders for the operations and asset management of the project and their contact details
- To improve information sharing by introducing processes and systems to collect, store, analyse and maintain knowledge about external stakeholders
- To ensure that the appropriate stakeholders are notified whether it be day to day operational matters or an emergency situation
- To identify clear directions and strategies for improving relationships with some key stakeholders

3. STAKEHOLDER RELATIONSHIPS

3.1. WHAT IS A STAKEHOLDER?

Stakeholders can include any party who may be (or perceives itself to be) affected by, or can affect, AVA's clients' activities. This may include shareholders, SWC, federal, state and local government agencies, politicians, community groups, peak lobby groups, suppliers, industry bodies, professional associations and customers.

Should there be an event at the Plant or at a number of locations along the Network this may require a number of agencies to be involved. These include NSW Police, NSW Fire Brigades etc.

Because of the sensitive nature of the recycled water our Licence conditions may determine that additional stakeholders are notified. For example AVA may have to notify NSW Health as well as Local Councils about the quality of the water for a period of time.

A stakeholder of AVA may have one or more of the following characteristics:

- Is a key shareholder of AVA
- Represents a key customer group
- Is a key regulator of AVA's operations
- Has ability to influence or control AVA's decisions about major capital expenditure
- Is a government agency (Federal, State or Local) with interests in AVA's activities
- Has ability to strongly influence political opinion / direction / decision making on key strategic issues

Stakeholder relations are just one component of the external relations process, which includes all communications activities. Consultation is an integral part of maintaining stakeholder relations.

Relationships that work well can provide a 'buffer' of goodwill (or 'social capital') when issues arise, keeping projects on track by preventing lengthy delays and reducing the long-term impact on corporate reputation. The value of investing in social capital is that AVA can improve its products and services by ensuring that we deliver a quality solution, on time, at cost, that guarantees safety, protects the environment and builds trust within the community.

4. BUILDING AND MAINTAINING STAKEHOLDER RELATIONSHIPS

AVA needs to direct its efforts to build or maintain trust and credibility in certain ongoing stakeholder relationships that are most critical to the achievement of key projects as well as the corporate objectives of each of the members of AVA. This involves identifying who our key stakeholders are, documenting what we know about them, and what we need to know, and clarifying key contacts within AVA for continuing the relationship with them.

4.1. IDENTIFYING STAKEHOLDERS

The following external stakeholders have been identified as important to AVA for this project.

This list is a living document and will grow over time. It is possible that Department of Planning as part of our part 3A approval will advise other stakeholders to be included. In addition as part of our licence conditions there may be other stakeholders you will need to be included.

Stakeholder Entity	Stakeholder Relatedness
SWC	SWC is responsible for the delivery of major water recycling projects in its Sydney operating area. This project will be a major part of this program. In addition, the project will be commissioned by SWC, and therefore they will be the main contract point. There will be many areas within SWC that will need to be involved, including their SOC and call centre. SWC will review project plans, review changes and advise approval.
AVA	Principal for the delivery of the scheme for D&C and O&M periods. AVA will hold the contracts and commercial agreements and will be the key link to the client – SWC.
AVA - Alinta	Alinta is responsible for the provision of the Network for the project. This includes all pipes, pumps and connections entering and exiting the Recycled Water Treatment Plant. Alinta are responsible for the long term operations and maintenance of the network, and will be a member of the Integrated Operations Team.
AVA - Veolia	Veolia is responsible for the Plant operation and maintenance. Veolia holds responsibility for delivery of the project plant, and its successful long term operation. Veolia will have a strong communication path to both SWC and GWA (the operating arm of Veolia) day-to-day over many years as the project is implemented, as well as with Alinta via the proposed Integrated Operations Team.
Minister for Planning (NSW Department of Planning (DOP))	Part 3A of the NSW Environment Planning and Assessment Act 1979 addresses projects that are of state and regional environmental planning significance. A Part 3A project must be referred to the Minister for Planning for determination. AVA will consult and submit to DOP an application under Part 3A of the EP&A Act once awarded the project by SWC. It is anticipated that the Part 3A approval process could take from 6 to 12 months from the date of submission of the application.
Minister for the Environment (NSW Department of the Environment and Conservation (DEC))	AVA will liaise with the DEC to determine potential environmental impacts under the Protection of the Environment and Operations Act. Once a Part 3A approval has been obtained for the project, the AVA will submit an application for a environmental protection licence (EPL). A major facet of DEC's portfolio is management of water quality.
IPART	AVA will require one or more licences under the NSW Water Industry Competition Act 2006 (WICA) before it can construct, operate and maintain the recycled water production plant, reticulation network, and in order to retail recycled water. IPART has the responsibility under the WICA for receiving and assessing licence applications. AVA will submit an application for the required licence(s) as soon as practicable after being awarded the project by SWC.
Foundation and Non-Foundation Customers	AVA will supply recycled water to 7 Foundation Customers and 6 Non-Foundation Customers. These customers will be serviced by AVA's network, and

Stakeholder Entity	Stakeholder Relatedness
	continual correspondence will be required to communicate supply aspects, water quantity and water quality.
Minister for Energy and Utilities (DEUS)	DEUS may review sections of the WICA with regard to the AVA licence application for regulations covering quality, and safety and operating plans associated with the project. AVA will liaise with DEUS for guidelines. As this is a major urban water project of Sydney, DEUS linkage will be strong but relatively informal. The project is related to the metropolitan water plan to which DEUS are also strongly related.
NSW Health	Responsible for the protection of human health in NSW. Notification of any effluent discharge events that may not meet the desired specifications, particularly related to biological hazards that can impact human health.
Western Sydney Region of Councils (WSROC)	The mission of WSROC is to secure - through research, lobbying and the fostering of cooperation between councils - a sustainable lifestyle for the people of Western Sydney and the provision of infrastructure such that no one should have to leave the region to have access to the sorts of amenities, services and opportunities others in urban Australia take for granted. Member councils include those local councils above plus Hawkesbury, Parramatta, Bankstown, Blue Mountains, Blacktown and Holroyd.
Department of Primary Industries (DPI)	NSW Department of Primary Industries acts in partnership with industry and other public sector organisations to foster profitable and sustainable development of primary industries in New South Wales. Notification of project progress will be provided to the DPI, however it is not anticipated that any more formal involvement will be required with this Department.
NSW Department of Natural Resources (DNR)	The NSW Department of Natural Resources (DNR) is responsible for the sustainable and equitable management of water, soil and native vegetation resources across the state. DNR are particularly interested in providing water for the environment, which is the sound basis of this Project. Notification of project progress and outcomes will be regularly reported to the DNR.
Local Councils	The Camellia Recycled Water Project (CRWP) will be constructed through four local council areas namely Fairfield, Parramatta, Bankstown and Holroyd. AVA will seek to establish close working relationships with these councils during the design, construction and operation of the project. Issues of road access and restoration, traffic disruptions, noise, community complaints or concerns will be discussed and a methodology developed.
RailCorp	AVA will meet with RailCorp and submit applications for each of the proposed rail crossings. The applications will be in accordance with RailCorp guidelines under AS 4799. RailCorp will be advised of a submission to the DOP for a Part 3A approval for the project.
NSW Roads and Traffic Authority (RTA)	AVA will meet with the RTA and submit an application for the proposed network. The submission will be in accordance with RTA guidelines under Roads Act 1993. The RTA will be advised of a submission the DOP for a Part 3A approval for the project.
NSW Police	AVA will submit a 'Lane Closure Permit' and traffic management plans to the Police for roads that will be affected during construction.
General Community	The General Community may also be an interaction point when the recycled water system is operating. In particular, new customers may approach AVA or SWC in a request to receive recycled water. Another major point of community interaction can be pipe-bursts which impact property, infrastructure or roads.
Suppliers (Pipes, Pumps, Fittings, Electrical, etc.)	All suppliers are critical in the delivery of projects. AVA will build relationships with these groups. Regular communication will occur aimed at mitigating any issues that may occur later in the project. AVA's approach will be "best for project".
Contractors	All contractors play an important role in the delivery of this project. AVA will insure the communication is two-way, which is a foundation block for effective relationships now and in the future.

A list of stakeholders is shown in Appendix A.

Stakeholders have interests in AVA for a variety of reasons, and have varying levels of influence on strategic decisions. Particular attention should be directed to identify those critical stakeholders, and to understand their views and expectations about their relationship with AVA.

5. CONTACT WITH STAKEHOLDERS

Contact with stakeholders can be undertaken a number of ways.

5.1. COMMUNICATIONS

The Community Consultation Management Plan (CCMP) outlines how AVA will communicate, approach and manage stakeholders throughout the project period. The Transition Plan will outline how AVA will manage stakeholders and customers when the customer contracts are novated to AVA. Key stakeholders will be managed in a professional manner and in line with SWC's requirements.

5.2. NOTIFICATIONS

During the construction and commissioning phases of the project a number of stakeholders will be notified. The following are some examples of where notifications will occur:

- AVA will be monitoring the system with its SCADA system at North Parramatta. This information will in turn be forwarded onto SWC
- SWC may interrupt the flow of secondary effluent whenever needed when it is considered necessary for the purpose of LAP maintenance, replacement or repair of the LAP.
- SWC may also interrupt the flow if they feel there is insufficient volume or flow of secondary effluent for the proper operation of the LAP
- Monitoring information as determined by our licence regulator and outlined in any conditions of approval for the project
- An emergency and or an incident
- Product effluent quality event impacting on a Foundation Customer
- Plant failures
- Pumping station failures
- Network pipe failures
- Energy outages

The appropriate stakeholder representative will be notified of the key event that has occurred – remembering that this may be routine or an emergency.

A flowchart outlining the notification process will be developed closer to the approvals being finalised and well before the construction commences. This will also provide for escalation of issues that may occur as a result of the work notifications.

6. SUPPORTING SYSTEMS AND PROCESSES

AVA will utilise the ‘solve it’ approach to find solutions to issues.

AVA will capture all stakeholder issues and this information will be available to all team members 24/7 through a web base interface system known as ‘Consultation Manager’.

SWC will also have access to this information 24/7.

Consultation Manager ensures that stakeholder issues are identified and tracked as they arise. Straightforward analytical tools help prioritise consultation activities so that proactive response to stakeholder concerns can be made.

7. EVALUATION AND REVIEW

In order to remain relevant, the Stakeholder Management Plan will be reviewed on a regular basis by members of both AVA and SWC

In addition the plan should be evaluated at a number of hold points including:

- At the conclusion of any stakeholder consultation
- At the conclusion of the planning & approvals phase
- At the end of the construction phase
- At the end of the commissioning phase
- After 1 month of operation
- After 6-12 months of operation
- As required after 12 months of operation

APPENDIX A : CAMELLIA RECYCLED WATER PROJECT STAKEHOLDERS

Organisation	Address	Suburb	Postcode	Phone	Fax	Contact
Sydney Water Corporation	Bathurst St	Sydney	2000	93506124	93505333	Ian Hammerton
Minister for Planning (DOP)	22 – 33 Bridge St	Sydney	2000	92286111	92286455	Chris Wilson
Minister for Climate Change, Environment & Water (DECC)	59 -61 Goulburn St	Sydney	2000	99955000	99955999	Simon Smith
IPART	44 Market Street	Sydney	2000	92908000	92902061	Colin Reid
Minister for Water & Energy (DWE)	227 Elizabeth Street	Sydney	2000	82817739	82817355	Peter Lansdown
Fairfield City Council	Avoca Rd	Wakeley	2176	418694730	97254249	Mike Hanrahan
Parramatta City Council (Depot)	1 Morton St	Parramatta	2124	88394025	88394050	Craig Haywood
Parramatta City Council (Council Chambers)	30 Darcy St	Parramatta	2124	98065720	98065953	Neville Davis
Holroyd City Council	16 Memorial Ave	Merrylands	2160	87248658	96320237	Luke Harvey
Bankstown City Council	66-72 Rickard Rd	Bankstown	2200	97079999	97079400	Colin Baker
C'wlth Depart of the Environment and Water Resources	King Edward Terrace	Parkes ACT	2600	62741111	62741666	Switch
RailCorp	Level 16 /55 Market St	Sydney	2000	92242357	92244805	Chris Bailey
Sydney Buses	219-241 Cleveland St	Strawberry Hills	2012	92451327	92451330	Ray Carroll
Heritage Council	3 Marist Pl	Parramatta	2150	98738500	98738599	Vince Sicari
Roads and Traffic Authority	83 Flushcombe Rd	Blacktown	2148	88142114	88142111	Suppiah Thillainandesan
Roads and Traffic Authority TMC	25 Garden St	Eveleigh	2012	83961444	83961530	Bob Mashford
Police	6 Miller St	Merrylands	2160	98974899	98974866	Sgt Grant Norman
Dept. of Housing	PO Box K100	Haymarket	2000	92683564	92683575	Rita Metsina
Local Member of Parliament Fairfield	1 Farrer Pl	Sydney	2000	92285451	92285466	Joe Tripodi
Local Member of Parliament Granville	160 Merrylands Rd	Merrylands	2160	96371656	98971434	David Borger
Local Member of Parliament Parramatta	90 George St	Parramatta	2150	98914722	98915618	Tanya Gadiel
NSW Fire Brigade	189 Wyndam St	Alexandria	2015	95886230	93184380	Graham Webb
Bus & Coach Association	27 Villers St	North Parramatta	2150	88399500	96831465	Vic Bowden

PROCEDURE — Communication Protocol

1. PURPOSE

The purpose of this procedure is to describe the communications process between Veolia Water Australia (VWA), Western Corridor Recycled Water (WCRW), Ipswich Water (IW) and CS Energy (CSE) for the operation of Western Corridor Recycled Water Project (WCRWP).

2. SCOPE

The scope of this procedure is to clearly define the process to be followed by WCRW, VWA, IW and CSE when communicating on the following matters:

- Operational activities impacting on each interface.
- Breach of Critical Control Points (CCPs) and Quality Control Points (QCPs).
- Contractual and performance related issues.
- Safety incidents.
- Environmental incidents.
- Emergency incidents
- The interface between VWA / WCRW / IW and CSE

3. REFERENCES

PL-VWA-PYR-900 Crisis Management Plan

PL-GWA-WC-90X Incident and Emergency Response Plan

PR-GWA-WC-90X Incident Reporting and Investigation Procedure

PR-GWA-WC-2001 Incident Report

Treated Wastewater Supply Agreement between Ipswich Water and WCRW

Interim Recycled Water Delivery Contract between CS Energy and WCRW

EPA Licence

4. DEFINITIONS

VWA – Veolia Water Australia Pty Ltd

WCRW – Western corridor Recycled Water Pty Ltd

CSE – CS Energy

IW – Ipswich Water

Incident categories – As defined in the Crisis Management Plan

5. ACTIONS

5.1 Communication Flow

5.1.1 The flow of information regarding the operation of the WCRWP between the various interfaces is shown in the diagram in Figure 5.1.

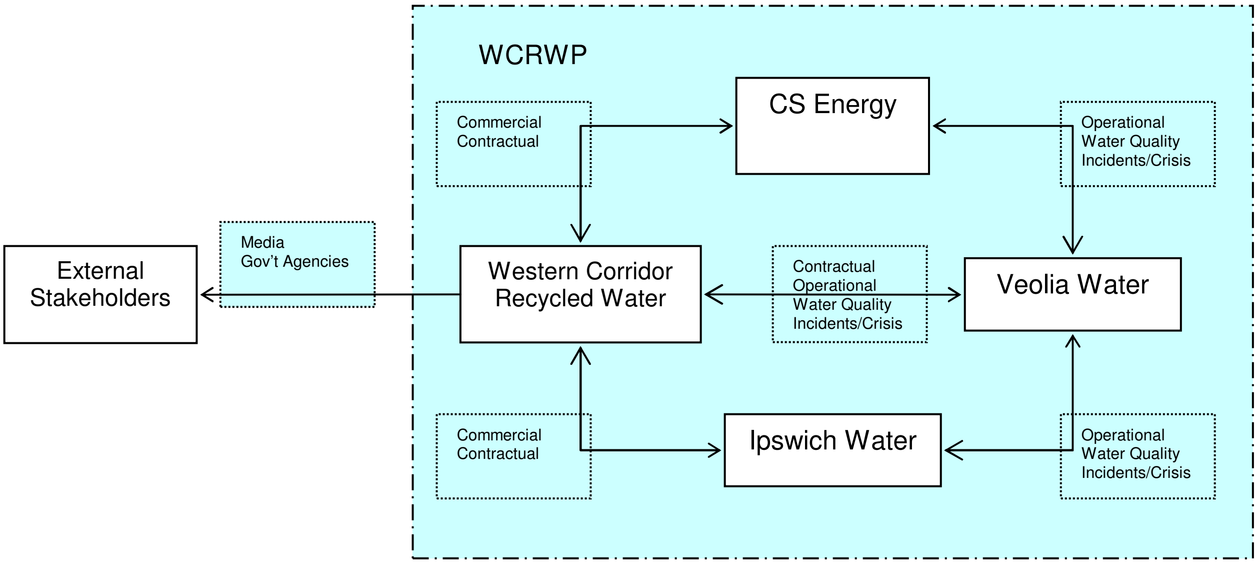


Figure 5.1: WCRWP Operations Communication Flow

5.2 Form of Communication

5.2.1 The communication process is designed to ensure that information transfer is undertaken in a clear and efficient manner and that the most appropriate response is implemented to address a specific request and / or potential / acknowledged issue.

5.2.2 The forms of communications available to be used include the following:

- Verbal
- Face to face meetings (minutes of meeting)
- Hard copy transmittals (fax, letters)
- Electronic transmittals (emails, electronic document control)

5.3 Communications – Roles and Responsibilities

5.3.1 An overview of the type of communication that is undertaken by VWA on the WCRWP is provided in Table 5.1. The table highlights the key personnel, acceptable methods, forums, frequency and representatives involved to communicate specific information.

5.4 Contact Details

5.4.1 The contact details for each party are detailed in Table 5.2.

6. REPORTING TO CS ENERGY

6.1 Long Term Arrangements

6.1.1 The contract between CS Energy and WCRW provides that certain on line data is transferred in real time and other data is transferred on a daily weekly and monthly basis as required.

6.1.2 The following data will be provided via a secure web interface:

- On line Water Quality Data including Post Reverse Osmosis: Total Organic Carbon (TOC) and Conductivity.Treated Water (post treated water tank): conductivity, turbidity, total chlorine residual and pH
- Plant status: AWTP status (running/stopped/not available), treated water pump status (running/stopped/not available), treated water tank volume (ML), treated water tank level (%)
- Flow rates: instantaneous treated water flow rate (ML/day), Cumulative flow delivered for month to date (ML), Cumulative flow delivered calendar year to date (ML)
- It is envisaged that in the future as the page(s) is/are developed the function to load manually sampled water quality data onto the webpage via a file/data transfer protocol. The function to also load pdf documents would also be required.

6.2 Temporary Measures

6.2.1 During the commissioning, performance test and proving periods the web interface is not envisaged to be operational and therefore temporary measures will be implemented to transfer the required data to CS Energy. All temporary data transfer will be via the Manager Water Quality and Environment to the relevant CS Energy officer.

6.2.2 On line SCADA data, via a CSV file, will be transferred on a daily basis to CSE Energy via an excel spreadsheet with the relevant trends graphed. Where available a pdf of "print screen" of the relevant trend will also be provided.

6.2.3 Grab sample data including verified on site and external laboratory data will be emailed daily in an excel spreadsheet. It should be noted that there will be a lag between some onsite tests and externally tested samples.

6.2.4 CS Energy will provide via email to VWA's Manager - Environment and Water Quality a copy of grab sample water quality testing undertaken by CS Energy on a daily basis.

7. INCIDENT AND CRISIS MANAGEMENT

7.1 Incident Notification

7.1.1 The process for notification of incidents is outlined in the Incident Reporting and Investigation Procedure (PR-GWA-WC-90X).

7.1.2 An incident declaration and initial notification will be in accordance with the various parties Incident Management systems. An initial incident notification will generally be made by phone depending on the urgency of the situation.

7.1.3 All VWA incident notifications will be followed up in writing by the issue of and Incident Report.

7.1.4 Communications during incidents will be as detailed in the various parties Incident Management systems.

7.2 Incident Management

7.2.1 The VWA WCRWP Incident and Emergency Response Plan is in place to:

- reduce the risk of incidents occurring;
- reduce the impact of incidents on personnel, clients and customers, the community, the environment, assets & systems;
- promote and support the maintenance of effective incident management processes; and
- provide guidance to the Operations Team on the correct response (including communications procedures) to an incident that occurs on, or near to, the operating facility.

7.3 Crisis Management

7.3.1 This VWA Crisis Management Plan documents the practices and procedures employed by the VWA Crisis Management Team

(CMT) to effectively manage an escalating incident, which poses a serious threat to the operation, viability and/or image of VWA and its clients.

7.3.2 The plan will be used by all VWA executives and senior management to guide their actions and clarify roles and responsibilities during a crisis.

8. MEDIA REPORTING

8.1 Media approach to incidents

8.1.1 The media are generally looking for an 'angle' or 'hook' that makes the story dramatic or sensational. They are highly skilled at finding the angle and we need to attempt to anticipate the angle when it may not always be obvious. Anticipating the angle allows us to develop considered and accurate responses to expected questions.

8.2 Guiding principles

8.2.1 In the event of a nominated incident the WCRWP Media Liaison team must be notified.

8.2.2 Issues or incidents may not reach the media until sometime after they occur but early notification to management is always the best approach.

8.2.3 **All** media related matters are to be directed to the WCRWP Media Liaison team.

8.2.4 As a general rule VWA staff should not make any statements to the **media** without prior approval of Veolia Water Australia management. However, statements like "no comment" should be avoided, as they tend to give the impression that the Company has something to hide. It would be better to say something like:

"We are here to help but for official comment you really need to talk to Head Office. Can I give you the number?"

8.2.5 Statements to the media by the WCRWP Media Liaison team would include:

- What we know
- What we don't know
- What we are doing
- What we need you (the audience) to do

8.2.6 The development of a media response must not be linked to any formal investigation or blame chase. It must be focussed on solutions.

8.2.7 All spokespeople including from Government must speak from a unified response.

8.3 What incidents will draw media attention?

8.3.1 While there are very effective reporting systems for incidents such as safety or environmental matters, there may occasionally be matters which may at first seem minor but which may later become significant media issues and therefore a risk to the project's reputation.

- When an incident occurs….ask yourself…
- Do the media know about the incident?
- If the media knew, would the story be run? If in doubt, assume it would.

These include:

- operational malfunction impacting on water delivery or quality
- any major incident (particularly those involving evacuations, fatalities or a major response from Emergency Services or other agencies such as the EPA)
- unfair dismissal claim highlighted in media
- localised low-level industrial action
- accident involving serious injury or death
- a security incident sparking media speculation of criminal or terrorist activity
- any spill of fuel/chemical regardless of whether it requires reporting to the EPA

Table 5.1: Communications – Roles and Responsibilities

Area	Information to be communicated (examples)	Method of Communication	Frequency	Point of Contact			
				VWA	WCRW	Ipswich Water	CS Energy
Day to Day Operational Matters	▪ Operational and process changes that may impact on contractual / licence / licence performance; ▪ Relay of specific operational information between VWA and IW/CSE that may impact on either parties operations;	▪ Telephone; ▪ Email; ▪ Fax; ▪ Face to face verbal;	As required	▪ Plant Manager ▪ Operations Supervisor; ▪ Duty Operator (after hours); ▪ Maintenance Supervisor; ▪ Process Engineer;	GM-Operations	▪ Production Manager ▪ Treatment Coordinator ▪ Operator-Bundamba WWC ▪ Duty Operator (after Hours)	Operational Issues ▪ Shift Team Leader Contractual/legislative Issues ▪ Operations Superintendent External Impacts ▪ Operations Superintendent
Water quality characteristics	▪ Changes to raw water quality and the possible final treated water impacts; ▪ Treated water quality changes due to incident or breakdown. ▪ Changes to raw water supply source	▪ Email; ▪ Verbal discussions in person or via telephone; ▪ Fax;	As required	▪ Plant Manager ▪ Operations Supervisor; ▪ Manager, Environment and Water Quality	GM-Operations	▪ Production Manager ▪ Treatment Coordinator ▪ Operator-Bundamba WWC ▪ Duty Operator (after Hours)	After Hours ▪ Shift Team Leader Business hours ▪ Operations chemical Specialist
Water Production Requirements	▪ WCRW forecasts. ▪ CSE demand forecasts and orders ▪ IW forecasts.	▪ Email; ▪ Verbal discussions in person or via telephone; ▪ Fax;	As required	▪ Plant Manager ▪ Operations Supervisor; ▪ Manager, Environment and Water Quality	GM-Operations	▪ Production Manager ▪ Treatment Coordinator ▪ Operator-Bundamba WWC ▪ Duty Operator (after Hours)	▪ Resource Administrator ▪ Environmental Specialist

PROCEDURE — Communication Protocol

Area	Information to be communicated (examples)	Method of Communication	Frequency	Point of Contact			
				VWA	WCRW	Ipswich Water	CS Energy
Incident Notification	Communication of incidents including: ○ early warnings, ○ CCP/QCP breach, ○ environmental incident ○ OHS incident ○ Security issue ○ Asset damage	▪ Formal written incident report submitted – faxed/emailed (as per IBMS procedures; ▪ CCP/QCP Breach must be reported immediately via phone to DNRW ▪ EPA Licence breaches immediate telephone call to EPA	For every incident that occurs	▪ Plant Manager ▪ Operations Supervisor; ▪ Duty Operator (after hours); ▪ Maintenance Supervisor; ▪ Process Engineer; ▪ Operations Director, ▪ Project Director	▪ GM-Operations ▪ Chief Executive Officer ▪ Media Liason	▪ Production Manager ▪ Treatment Coordinator ▪ Operator-Bundamba WWC ▪ Duty Operator (after Hours) ▪ Operations Manager ▪ Chief Operating Officer	After hours ▪ Shift Team Leader Business hours CCP/QCP breach ▪ Operations Chemical Specialist Environmental ▪ Environmental & Chemical Specialist OHS &security ▪ Safety Officer Assets & other issues ▪ Engineering Superintendent

PROCEDURE Communication Protocol

Area	Information to be communicated (examples)	Method of Communication	Frequency	Point of Contact			
				VWA	WCRW	Ipswich Water	CS Energy
Incident Debrief / Investigations	Communication of causative factors / corrective / preventative actions and review of incident report.	Formal written incident investigation.	Incident investigations carried out as directed by Operation Director/Plant Manager.	▪ Plant Manager ▪ Operations Supervisor; ▪ Duty Operator (after hours); ▪ Maintenance Supervisor; ▪ Process Engineer; ▪ Manager, Environment and Water Quality ▪ Process Manager ▪ Operations Director	▪ GM-Operations ▪ Chief Executive Officer ▪ Media Liason	▪ Production Manager ▪ Treatment Coordinator ▪ Operator-Bundamba WWC ▪ Duty Operator (after Hours) ▪ Operations Manager ▪ Chief Operating Officer	Engineering Superintendent
Contractual / Operational Performance	▪ A meeting arranged with representatives from all parties in attendance to discuss issues in each area or at the interface. ▪ Monthly report submitted.	▪ Face to face scheduled routine meeting (minuted); ▪ Formal report generated and submitted as either a hardcopy or electronic form;	Monthly	▪ Plant Manager ▪ Operations Supervisor; ▪ Duty Operator (after hours); ▪ Maintenance Supervisor; ▪ Process Engineer; ▪ Manager, Environment and Water Quality ▪ Process Manager ▪ Operations Director	▪ GM-Operations ▪ Chief Executive Officer	▪ Production Manager ▪ Treatment Coordinator ▪ Operator-Bundamba WWC ▪ Duty Operator (after Hours) ▪ Operations Manager Chief Operating Officer	▪ Engineering Superintendent ▪ Operations Superintendent

PROCEDURE **Communication Protocol**

Area	Information to be communicated (examples)	Method of Communication	Frequency	Point of Contact			
				VWA	WCRW	Ipswich Water	CS Energy
Planned Maintenance / Shutdowns	Details of activities to take place, when, where, any possible risks etc. (inc. both sides of the interface points)	▪ Email; ▪ Verbal discussions in person or via telephone; ▪ Fax;	As required	▪ Plant Manager ▪ Operations Supervisor; ▪ Duty Operator (after hours); ▪ Maintenance Supervisor; ▪ Process Engineer;	▪ GM-Operations	▪ Production Manager ▪ Treatment Coordinator ▪ Operator-Bundamba WWC ▪ Duty Operator (after Hours)	▪ Engineering Superintendent
Unplanned Maintenance / shutdowns	Details of activities to take place, when, where, any possible risks etc. (inc. both sides of the interface points)	▪ Email; ▪ Verbal discussions in person or via telephone; ▪ Fax;	As required	▪ Plant Manager ▪ Operations Supervisor; ▪ Duty Operator (after hours); ▪ Maintenance Supervisor; ▪ Process Engineer;	▪ GM-Operations	▪ Production Manager ▪ Treatment Coordinator ▪ Operator-Bundamba WWC ▪ Duty Operator (after Hours)	After hours ▪ Shift Team Leader Business hours ▪ Engineering Superintendent

PROCEDURE — Communication Protocol

Area	Information to be communicated (examples)	Method of Communication	Frequency	Point of Contact			
				VWA	WCRW	Ipswich Water	CS Energy
Site access to assets	Examples of sites that might require communication regard E.g. access to raw water pump station(s), access to discharge channel	▪ Email; ▪ Verbal discussions in person or via telephone; ▪ Fax;	As required	▪ Plant Manager ▪ Operations Supervisor; ▪ Duty Operator (after hours); ▪ Maintenance Supervisor;	▪ GM-Operations	▪ Production Manager ▪ Treatment Coordinator ▪ Operator-Bundamba WWC ▪ Duty Operator (after Hours)	▪ Engineering Superintendent ▪ Operations Superintendent
Update of documentation	▪ Reissuing of the IBMS documentation (including this document) ▪ Updating of drawings with modifications etc;	▪ Submission of hardcopies; ▪ Provided on CD electronically;	As required	▪ Plant Manager (or nominated representative);	▪ GM-Operations	▪ Production Manager	▪ Engineering Superintendent

VEOLIA WATER

Table 5.2: Key Personnel Contact Details.

Western Corridor Recycled Water Pty Ltd		**Address:**	**Level 2, 95 North Quay Brisbane 4000**		
Name	**Position**	**Business Hours**	**Fax**	**Mobile**	**Email**
Keith Davies	CEO	07 03159700	07 30159799		keith.davies@westerncorridor.qld.gov.au
John MacKillop	General Manager - Operations	07 30159749	07 30159799	0418 899 099	john.mackillop@westerncorridor.qld.gov.au
Brad Perry	Media Liason	07 03159700	07 30159799	0422 061 763	brad.perry@westerncorridor.qld.gov.au
Helen Presdee	Media Liason	07 03159700	07 30159799	0448 877 522	helen.presdee@westerncorridor.qld.gov.au
Peter Rekers	Media Liason	07 03159700	07 30159799	0412 022 396	peter.rekers@westerncorridor.qld.gov.au
Veolia Water Australia Pty Ltd		**Address:**	**Level 2, 95 North Quay Brisbane 4000**		
Name	**Position**	**Business Hours**	**Fax**	**Mobile**	**Email**
Jean-Michel Seillier	Project Director	07 03159722	07 30159799	0448 473 423	jean-michel.seillier@veoliawater.com.au
Ben Bowen	Operations Director	07 03159721	07 30159799	0413 984 520	ben.bowen@veoliawater.com.au
Troy Walker	Process Manager	07 03159771	07 30159799	0438 880 64	troy.walker@veoliawater.com.au
Annalie Roux	Manager, Environment and Water Quality	07 03159705	07 30159799	0437 573 280	annalie.roux@veoliawater.com.au
Ray Farley	Plant Manager- Bundamba			0409 984 092	ray.farley@veoliawater.com.au
Jason Krzcuik	Operations Supervisor - Bundamba			0408 210 807	jason.krzcuik@veoliawater.com.au
Alan Dickfos	Maintenance Supervisor - Bundamba			0419 297 041	alan.dickfos@veoliawater.com.au
Alban Delpey	Process Engineer - Bundamba			0409 825 168	alban.delpey@veoliawater.com.au
Bundamba AWTP Control Room					
Ipswich Water		**Address:**			
Name	**Position**	**Business Hours**	**Fax**	**Mobile**	**Email**
Barry Jeppeson	Chief Operating Officer	07 3810 6884		0419 791753	

PROCEDURE — Communication Protocol

Nimish Chand	Operations Manager	07 3810 7369		0400 025 798	
Brian Hester	Production Manager	07 3810 7946		0419 642 558	
Neil Tite	Treatment Coordinator	07 3810 7937		0419 024 380	
Bundamba WWC		07 32822550	32822550	0439 737 395	
Duty Operator				0429 000 746	
CS Energy		**Address:**	**Mail Service 460 IPSWICH QLD 4306**		
Name	**Position**	**Business Hours**	**Fax**	**After Hours**	**Mobile**
	Shift Team Leader	07 38108742 / 741	07 38108844	07 38108742	
John James	Power Station Manager	07 38108801	07 38108777	07 32025282	0408980250
Darren Kendrick	Engineering Superintendent	07 38108720	07 38108777	07 32793214	0419669426
Steve Watterston	Operations Superintendent	07 38108802	07 38108777		0419029463
John Green	Environmental & Chemical Specialist	07 38108817	07 38108777	07 32783973	0417603475
Richard Bianchi	Chemical Services Specialist	07 38108852	07 38108777	07 38483350	0407156695
Graham Maloney		07 38108892	07 38108777		0448951280
Environment Protection Authority		**Address:**			
Name	**Position**	**Business Hours**	**Fax**	**Mobile**	**Email**
Pollution hotline	First call for incidents	1300 130 372			
Steven Tarte	Project Manager WCRWP	3872 0993	3225 8723		Steven.tarte@epa.qld.gov.au
Department of Natural Resources		**Address:**			
Name	**Position**	**Business Hours**	**Fax**	**Mobile**	**Email**
Lynne Dixon	Manager: Water Industry Regulation	3227 6592	3224 7887		Lynne.Dixon@nrw.qld.gov.au

9. AMENDMENTS TO THE COMMUNICATIONS PROTOCOL

9.1.1 WCRW, IW, CSE or VWA can suggest amendments for review / consideration to the Communications Protocol and changes may be incorporated subject to the approval of the other parties.

9.1.2 Each organisation is responsible for reporting any changes to the details contained within this document to VWA.

9.1.3 VWA shall be responsible for issuing revisions to the organisations. Each organisation is responsible for ensuring that the most recent revision is available for use within the organisation.

10. RECORDS

- Various minutes from meetings (e.g. Interface Meetings)
- Incident Report Form

VEOLIA WATER

Environmental Policy

Veolia Water, representing the water division of the environmental services group Veolia Environnement (VE), is the world leader in water services. Veolia Water Australia (VWA) designs, constructs and operates water and wastewater treatment systems for municipal and industrial customers.

This policy reflects the Sustainability Charter of Veolia Environnement, Veolia Water's Environmental Commitments, Veolia Water Asia's Environmental Policy and Veolia Water Australia's Sustainability Policy. This policy applies to VWA and General Water Australia (GWA).

The Board, Management and Employees of VWA and GWA are committed to minimising the environmental impacts of our operations and to continually improve our environmental performance within a framework of sustainable development. We are committed to:

- minimising direct and indirect emissions to land, air and water, and the use of natural resources;
- considering local environmental conditions and community requirements;
- complying with all relevant environmental, contractual, legal, licence and other requirements;
- ensuring our suppliers and contractors comply with our environmental requirements;
- training staff in environmental awareness and to competently execute their duties;
- being prepared for and promptly responding to environmental incidents and mitigating impacts; and
- striving to achieve continual improvement in Environmental Management by establishing objectives and targets and regularly reviewing progress.

This policy will be implemented through a documented and continually improved Environmental Management System in accordance with the International Standard for Environmental Management ISO 14001.

It is VWA policy to certify all operational sites (with operating contracts over five years) to ISO 14001 within two years of commencement of operations.

This policy will be reviewed annually and will be prominently displayed at all VWA places of work.

P. McVean 14/2/06

Peter McVean
CEO – Veolia Water Australia

Date

VEOLIA
WATER

Quality Policy

Veolia Water, representing the water division of the environmental services group Veolia Environnement (VE), is the world leader in water services. Veolia Water Australia (VWA) designs, constructs and operates water and wastewater treatment systems for municipal and industrial customers.

This policy reflects the Vision and Company Values of Veolia Environnement and applies to VWA and General Water Australia (GWA).

Our vision is to strengthen our position as a leader in municipal and industrial water and wastewater services by anticipating needs and providing effective solutions that combine economic efficiency and technological excellence, taking into account our social responsibilities.

The Board, Management and Employees of VWA and GWA are committed to providing high quality and reliable services to meet the requirements of our clients and the expectations of the community. We are committed to:

- expanding further by remaining selective and prudent in our growth;
- focusing on our customers at all times, demonstrating our discipline and professionalism, to anticipate and adapt to their needs and build solid and lasting relationships;
- complying at all times with our legal, contractual, licence and other obligations;
- operating with the common good in mind;
- continuously improve our business, our quality of service and add value for customers and employees alike; and
- working in synergy with Veolia Environnement companies in Australia.

We will pursue our commitments by:

- striving to achieve continual improvement in Quality Management by establishing objectives and targets and regularly reviewing progress;
- providing a safe work environment and safe systems of work; and
- operating in an environmentally responsible manner and adhering to a policy of sustainable development.

This policy will be implemented through a documented and continually improved Integrated Business Management System in accordance with the International Standard for Quality Management ISO 9001.

We are committed to our vision and our objectives and allow our managers to assume full responsibility for the decisions they are called upon to make in carrying out their duties, and expect them to fulfill that responsibility.

It is VWA policy to certify all operational sites (with operating contracts over five years) to ISO 9001 within two years of commencement of operations.

This policy will be reviewed annually and will be prominently displayed at all VWA places of work.

P. McVean | 14/2/06

Peter McVean
CEO – Veolia Water Australia

Date

VEOLIA WATER

OH&S Policy

Veolia Water, representing the water division of the environmental services group Veolia Environnement (VE), is the world leader in water services. Veolia Water Australia (VWA) designs, constructs and operates water and wastewater treatment systems for municipal and industrial customers.

This policy reflects the Veolia Water OH&S Commitment and Veolia Water Asia's Health and Safety Corporate Policy and applies to VWA and General Water Australia (GWA).

The Board, Management and Employees of VWA and GWA are committed to providing a safe work environment and safe systems of work by:

- demonstrating leadership and commitment to occupational health and safety;
- conducting occupational health and safety (OH&S) risk management activities to prevent the occurrence of work related injury and disease;
- complying with all applicable statutory health and safety requirements as a minimum;
- involving all employees in OH&S management through a consultation process and encouraging staff contribution to the identification, assessment and control of hazards;
- developing safety awareness throughout the organisation by initial and ongoing education and training;
- developing, monitoring and reporting against an annual OH&S Plan;
- implementing and continually improving a Contractor Management system to effectively manage the risks associated with subcontracting;
- striving to achieve continual improvement in OH&S management by establishing objectives and targets and regularly reviewing progress;
- ensuring all incidents are reported and investigated as required and corrective action is implemented so as to prevent recurrence; and
- assisting staff to achieve full recovery through effective injury management and rehabilitation should injury or illness occur.

This policy will be implemented through a documented and continually improved Occupational Health and Safety Management System in accordance with the Australian Standard for Occupational Health and Safety Management AS 4801.

It is VWA policy to certify all operational sites (with operating contracts over five years) to AS4801 within two years of commencement of operations.

This policy will be reviewed annually and will be prominently displayed at all VWA places of work.

14/2/06

Peter McVean
CEO – Veolia Water Australia

Date

9.3

APPROVALS MANAGEMENT PLAN

CONTENTS

1. INTRODUCTION

1.1. SCOPE AND APPLICATION

AVA is responsible for obtaining all licences, approvals and authorisations that are required for the construction of the proposed water recycling plant, distribution network and the supply of recycled water to selected customers.

1.2. PURPOSE OF THE APPROVALS MANAGEMENT PLAN

The purpose of the Approvals Management Plan is to indicate the guidelines and requirements of the approvals associated with the successful completion of the project. It describes the detail associated with achieving approvals and covers the role of AVA and SWC in achieving the necessary approvals in a timely manner.

1.3. OBJECTIVE OF THE APPROVALS MANAGEMENT PLAN

The objective of the Approvals Management Plan is to reflect:

- Compliance with all legislative requirements
- Compliance with all statutory and local requirements
- Scope of approvals necessary for construction to commence
- Successful approval management

2. ENVIRONMENTAL, LEGISLATIVE COMPLIANCE AND PROPERTY APPROVALS

2.1. LEGAL COMPLIANCE

All activities associated with the project must comply with relevant legislation and regulations. State legislation includes, although not limited to:

- Environmental Planning and Assessment Act 1979
- Protection of the Environment Operations Act 1997
- Water Industry Competition Act 2006
- Sydney Harbour Foreshore Authority Act 1998
- Threatened Species Conservation Act 1995
- Soil Conservation Act 1938
- Waste Avoidance and Resource Recovery Act 2001
- Contaminated Land Management Act 1997
- Environmentally Hazardous Chemicals Act 1985
- Occupational Health and Safety Act 2000
- Dangerous Goods Act 1975
- Roads Act 1993

State regulatory authority guidelines, although not limited to:

- DEC (1999) Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes
- DEC (2000) Industrial Noise Policy
- NSW Department of Housing (2006) Managing Urban Stormwater – Soil and Conservation (the 'Blue Book')

Commonwealth legislation includes, although not limited to:

- Environment Protection and Biodiversity Conservation Act 1999

Australian Standards and Codes including, although not limited to:

- AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- AS 1940-2004 The Storage and Handling of Flammable and Combustible Liquids
- AS 4373-1996 Pruning of Amenity Trees
- Australian Code for the Transport of Dangerous Goods by Road and Rail
- Australian Dangerous Goods Code

Additional requirements for this project include:

- Management and mitigation measures as specified in the project Environmental Assessment, the condition of all statutory approvals and presented in the site specific Environment Management Plan (EMP)
- Community and Stakeholder Engagement Strategy (planning phase) and the Community Relations Plan (construction phase)

AVA is responsible for identifying any changes to legislation and policies that are relevant to the CRWP, ensuring that the necessary approvals are obtained and updating the Construction Management Plan (CMP) to reflect these changes

Various approvals, licences, permits and consents will be required for the project under both State and Federal legislation. Some of these are outlined in Section 2.3 below. The Environmental Impact Assessment (EIA) will be undertaken for the project in accordance with the NSW Environmental Planning and Assessment Act 1979 in consultation with the NSW Department of Planning. The assessment will be placed on public display and distributed for comment as required. A suite of project plans, including a Construction Environmental Management Plan and Community Consultation Management Plan, will be developed to ensure that all compliance conditions are met.

2.2. KEY STAKEHOLDERS

Key stakeholders that must be consulted include:

- Sydney Water Corporation (SWC)
- Department of Planning (DOP)
- IPART
- Department of Environment and Climate Change (DECC) – including the NSW Environmental Protection Authority (EPA), National Parks and Wildlife Service (NPWS) and Department of Natural Resources (DNR)
- Department of Water and Energy (DWE)
- RailCorp
- Roads and Traffic Authority (RTA).
- Relevant local councils (Fairfield, Holroyd, Parramatta and Bankstown)
- Local members of Parliament
- NSW Police
- NSW Ambulance
- NSW Fire Brigades
- Local bus companies
- State Transit
- Department of Housing
- Affected schools
- Heritage Office of NSW (Discretionary)
- Commonwealth Department of the Environment and Water Resources (Discretionary)
- Service providers – Electricity, Gas, Water, Telecommunications
- Foundation and Non-Foundation Customers

CAMELLIA RECYCLED WATER PROJECT – STAKEHOLDERS						
Organisation	**Address**	**Suburb**	**Postcode**	**Phone**	**Fax**	**Contact**
Sydney Water Corporation	Bathurst St	Sydney	2000	93506124	93505333	Ian Hammerton
Minister for Planning (DOP)	22 – 33 Bridge St	Sydney	2000	92286111	92286455	Chris Wilson
Minister for Climate Change, Environment & Water (DECC)	59 -61 Goulburn St	Sydney	2000	99955000	99955999	Simon Smith
IPART	44 Market Street	Sydney	2000	92908000	92902061	Colin Reid
Minister for Water & Energy (DWE)	227 Elizabeth Street	Sydney	2000	82817739	82817355	Peter Lansdown
Fairfield City Council	Avoca Rd	Wakeley	2176	418694730	97254249	Mike Hanrahan
Parramatta City Council (Depot)	1 Morton St	Parramatta	2124	88394025	88394050	Craig Haywood
Parramatta City Council (Council Chambers)	30 Darcy St	Parramatta	2124	98065720	98065953	Neville Davis
Holroyd City Council	16 Memorial Ave	Merrylands	2160	87248658	96320237	Luke Harvey
Bankstown City Council	66-72 Rickard Rd	Bankstown	2200	97079999	97079400	Colin Baker
C'wlth Depart of the Environment and Water Resources	King Edward Terrace	Parkes ACT	2600	62741111	62741666	Switch
RailCorp	Level 16 /55 Market St	Sydney	2000	92242357	92244805	Chris Bailey
Sydney Buses	219-241 Cleveland St	Strawberry Hills	2012	92451327	92451330	Ray Carroll
Heritage Council	3 Marist Pl	Parramatta	2150	98738500	98738599	Vince Sicari
Roads and Traffic Authority	83 Flushcombe Rd	Blacktown	2148	88142114	88142111	Suppiah Thillainandesan
Roads and Traffic Authority TMC	25 Garden St	Eveleigh	2012	83961444	83961530	Bob Mashford
Police	6 Miller St	Merrylands	2160	98974899	98974866	Sgt Grant Norman
Dept. of Housing	PO Box K100	Haymarket	2000	92683564	92683575	Rita Metsina
Local Member of Parliament Fairfield	1 Farrer Pl	Sydney	2000	92285451	92285466	Joe Tripodi
Local Member of Parliament Granville	160 Merrylands Rd	Merrylands	2160	96371656	98971434	David Borger
Local Member of Parliament Parramatta	90 George St	Parramatta	2150	98914722	98915618	Tanya Gadiel
NSW Fire Brigade	189 Wyndam St	Alexandria	2015	95886230	93184380	Graham Webb
Bus & Coach Association	27 Villers St	North Parramatta	2150	88399500	96831465	Vic Bowden
Taxi Council	152 Riley St	East Sydney	2000	93321266	93601675	Dianne

2.3. KEY APPROVAL NEGOTIATIONS

2.3.1. IPART

AVA will require one or more licences under the NSW Water Industry Competition Act 2006 (WICA) before it can construct, operate and maintain the recycled water production plant, reticulation network, and in order to retail recycled water. IPART has responsibility under the WICA for receiving and assessing licence applications.

AVA intends to make an application for the required licence(s) as soon as practicable after being awarded the project by SWC and the necessary administrative arrangements for receiving and assessing licence applications are established by IPART. Taking IPART's current arrangements for the processing of gas authorisations and electricity licences as a guide, it is anticipated that it will take between three and six months from the date of application for a licence to be granted. This includes an allowance of at least 40 days for public consultation. Given that the AVA's application(s) will be among the first, if not the first, processed under the WICA, six months is allowed in the Plan.

AVA has extensive experience in all aspects of obtaining, and operating under, licences and authorisations that are required in connection with owning, managing and operating utility infrastructure. Alinta and its associated entities presently hold licences/authorisations to reticulate and, in some cases supply gas and/or electricity in New South Wales, Victoria, Western Australia, and the ACT. Alinta entities also hold (gas) pipeline licences in New South Wales, Victoria, Queensland, Western Australia and Tasmania and electricity generation licences in several States.

AVA, in its role as a service provider to infrastructure owners, manages compliance with relevant conditions of licences held by the owners, and with other applicable regulatory requirements. The compliance systems employed by Alinta can be readily scaled to accommodate the obligations that will apply to AVA.

2.3.2. NSW DEPARTMENT OF PLANNING

Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (the 'EP&A Act') addresses projects that are of state and regional environmental planning significance. Schedule 1 to the *State Environmental Planning Policy (Major Projects) 2005* (the 'Major Projects SEPP') lists development classes to which Part 3A of the EP&A Act applies (Part 3A Projects). Clause 26 identifies waste water treatment plants with a capital investment value in excess of $30 million as projects to which Part 3A applies. As the proposed treatment plant will have a capital cost in excess of this trigger level, Part #A of the EP&A Act applies. If Part 3A applies to part of a project, then the legislation provides that all components of the project must be considered as one project under Part 3A. Consultation has occurred with the Department of Planning and the project has been formally referred to the Minister for Planning. AVA are currently awaiting authorisation to submit an application for the project under Part 3A of the EP&A Act.

Assessment of a project under Part 3A of the EP&A Act removes the need to obtained separate permits, consents, licences etc under a suite of other NSW legislation, including (but not limited to):

- NSW Fisheries Management Act 1994
- NSW Rivers and Foreshores Improvement Act 1948
- NSW Threatened Species Conservation Act 1995
- NSW National Parks and Wildlife 1974
- NSW Roads Act 1993
- NSW Heritage Act 1977

Landowner consent authorising the submission of a Part 3A Project application must be obtained for all properties (excluding road reserves and public reserves) that would be affected by the project. However, the D-G can designate a project to be 'linear infrastructure', whereby landowner consent is not required prior to submission of an application for approval under Part 3A of the EP&A Act. An operator's licence under the WICA would grant the holder specific powers to construct reticulation assets in public roads and reserves. The proposal affected only public roads and reserves. Therefore the need to obtain landowner consent to lodge an application under Part 3A is unduly onerous. Hence, AVA has formally requested that the project be designated as 'linear infrastructure'.

AVA will consult with and submit to DOP an application under Part 3A of the EP&A Act once awarded the project by SWC.

It is anticipated that the Part 3A approval process could take from between 6-12 months from the date of submission of the application.

AVA has engaged the services of Parson Brinckerhoff (PB) to undertake the environmental assessment of the proposal and manage the planning approvals process. PB has a wealth of experience in the environmental assessment of major infrastructure projects and all forms of approval under the EP&A Act. PB has been selected on the basis of their proven track record in the planning approval and environmental impact assessment of major infrastructure projects.

AVA has engaged the services of Elton Consulting (Elton) to develop and implement a Community and Stakeholder Engagement Strategy to support the planning approvals process and to provide valuable input into the environmental assessment process. Elton has an in depth understanding of the community and stakeholder consultation requirements of the Part 3A planning approval process and has successfully delivered many community and stakeholder consultation programs for a wide variety of different project including major infrastructure. Elton has worked on previous projects with members of AVA with excellent results.

2.3.3. NSW DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE

Schedule 1 to the NSW *Protection of the Environment Operations Act 1997* (the 'POEO Act') lists activities that require environmental protection licences (EPL). EPLs are issued by the NSW Department of Environment and Climate Change (DECC) for activities appearing in the Schedule. Schedule 1 to the POEO Act includes sewage and related waste water treatment plants that process in excess of 750 kilolitres of effluent per day. As the treatment plant will process well in excess of this amount, an EPL will be required for the plant. As the network is ancillary to the plant and it is a Part 3A Project, it is likely that the EPL will cover construction, operation and maintenance of both under Part 3A approval.

DECC can not issue an EPL for the project until approval has been granted under Part 3A of the EP&A Act. However, once a Part 3A approval has been obtained for the project then an application for an EPL cannot be refused by the EPA and must be granted on terms substantially consistent with the Part 3A approval. AVA will liaise with the NSW Department of Environment and Conservation (DECC) to determine potential environmental impacts under the Protection of the Environment and Operations Act.

This activity will be undertaken prior to work commencing.

2.3.4. SYDNEY WATER CORPORATION

Under the NSW *Sydney Water Act 1994* a trade waste agreement is required by any party who discharges substances into the sewers. As the brine from the treatment plant will be discharged back into the sewers, a trade waste agreement is required for the treatment plant.

2.3.5. COMMONWEALTH DEPARTMENT OF THE ENVIRONMENT AND WATER RESOURCES

Under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (the 'EPBC Act') actions that impact upon 'matters of national environmental significance' (defined by the EPBC Act may be declared as 'controlled actions'. Such actions require consent from the Department of the Environment and Water Resources (DEWR) under Part 6 of the EPBC Act. Matters of national environmental significance that might be affected by the project could include EPBC listed endangered ecological communities (for example Cumberland Plain Woodland), threatened species and RAMSAR wetlands amongst others. If any such matters of national environmental significance are identified that might be impacted by the project the project must be referred to DEWR for assessment. Given the linear nature of the network, it is unlikely that the project would be declared a 'controlled actions, requiring consent under Part 6 of the EPBC Act.

AVA will consult with DEWR to determine if the project has any impacts under the EPBC Act as identified through the Environmental Assessment process.

2.3.6. RAILCORP

The project will require the approval of RailCorp for the crossing of RailCorp's rail corridor at four locations;

- Yennora – Railway St
- Yennora – Military Rd
- Clyde – Berry St
- Camellia – Grand Ave

AVA has met with RailCorp and submitted applications for each of the proposed rail crossings. The applications and design plans for the four crossings are in accordance with RailCorp guidelines and AS 4799. RailCorp was also advised of a submission by AVA to the Minister for Planning for a Part 3A approval for the project as a matter of courtesy.

RailCorp has provided preliminary guidelines, a RailCorp Project Plan and will undertake a full assessment of the applications prior to either approval or rejection and advise AVA of the outcome. An agreement, Individual Access Deed (IAD) between Alinta and RailCorp will be required for each of the proposed crossings prior to works commencing on site.

2.3.7. AFFECTED LANDOWNERS

Provisions of the NSW Water Industry Competition Act 2006 allows construction of a recycled water network in road reserves and public reserves without the need for landowner consent. However, access to other land potentially affected by the project will require negotiation on a case-by-case basis. As mentioned previously, landowner authorisation application under Part 3A of the EP& A Act may be required prior to submission of that application. Clarification of this will be sought from DOP.

The land to be accessed will predominantly be parks or reserves owned or vested with councils or in the RailCorp rail corridor. If designated as Part 3A, a decision will be made on the need for easements.

2.3.8. LOCAL COUNCILS

The Camellia Recycled Water Project will be constructed through four local Government areas namely Fairfield City Council, Holroyd City Council, Parramatta City Council and Bankstown City Council. AVA will seek to establish a close working relationship with these councils during the design, construction and operation stages of the project.

The affected councils are the road authority for all local roads within their areas and land owner or land administrator under delegated authority for the majority of parks and reserves. Under the WICA, the holder of a network operator's licence has powers to construct a network for recycled water in road reserves and public reserves provided that 40 days notice is given to the appropriate Council and all submissions by Council are considered. AVA has held preliminary meetings with the four councils and submitted route design plans . Future meeting will be held with council officers to provide further detail of the project and discuss hours of work, identify potential clash with council proposed works, obtain backfill and restoration guidelines, need for any permits and appropriate council contacts. Councils will be advised of a submission by AVA to the Minister for Planning for a Part 3A approval for the project.

The DOP will also consult with the relevant Local Council throughout the Part 3A Project approval process. In particular, Council input will be sought by DOP determining and issuing the Director Generals Requirements (DGRs) for the project to the proponent and also to evaluate the Environmental Assessment prepared by the proponent. Council's requirements will be issued by DOP through Part 3A approval conditions.

2.3.9. ROADS AND TRAFFIC AUTHORITY

The NSW Roads and Traffic Authority as road authority for classified state and regional roads will require a formal notification submitted at the planning phase. The submission will be reviewed and a response provided with guidelines and conditions. The Authority will be advised of a submission by AVA to the Minister for Planning for a Part 3A approval for the project as a matter of courtesy.

Section 58 of the WICA provides that permits under section 138 of the NSW *Roads Act 1993* are not required for works undertaken in accordance with a network operator's licence granted under Part 2 of the WICA. Similarly, approval of a project under Part 3A of the EP&A Act removes the need for separate permits under the *Roads Act 1993*. Hence no approval is required for the project under the *Roads Act 1993*. However, DOP consults directly with the RTA throughout the Part 3A Project approval process and appropriate RTA requirements are addressed in the project Environmental Assessment and approval conditions, including issues such as backfill and restorations, traffic management and road occupancy licences.

AVA will meet with the local RTA engineer with respect to backfill and restorations which are generally in accordance RTA specification M209. A 'Road Occupancy Licence' will be submitted to the RTA Traffic Management Centre with traffic management plans (TMP) for approval of hours of work.

2.3.10. POLICE APPROVAL

NSW Police will require a 'Lane Closure Permit' submitted with traffic management plans for work on roads. This is to be submitted to the Traffic Officer for the appropriate region.

3. APPROVAL METHODOLOGY

Authority	Approval	Relevant Legislation	Timing	Duration	Cost	Risk	Measures
IPART	Licences (3) to produce, distribute and supply recycled water.	Water Industry Competition Act 2006	July 2007	6 months	$4.5k	Low	• Submit licence application(s) • Follow up • Obtain Licence(s)
Minister for Planning (NSW Department of Planning (DOP)	Part 3A Project Approval	Part 3A of the NSW Environmental Planning and Assessment Act 1979	July 2007	6 -12 months	$92k	High	• Liaise with Minister/DOP concerning project • Prepare and Submit Part 3A Application • Undertake Environmental Assessment • Address Public submissions • Issue of Approval
Minister for the Environment (NSW Department of the Environment and Conservation) (DEC)	Environmental Protection Licence	NSW Protection of the Environment (Operations) Act 1997	July 2008 (post Part 3A Approval)	6 months	$20K	Low	• Likely required for construction, operation and maintenance of plant and network. • Apply after granting of Part 3A Project Approval • Licence cannot be refused under Part 3A Approval
RailCorp	Rail Corridor Access Permit	RailCorp	July 2007	12 months	$268k	high	• Meet with RailCorp • Submit Application for 4 crossings in accordance with RailCorp guidelines and AS 4799 • Follow Up • Obtain approval •
Affected Landowners	Landowner consent to lodge Part 3A Approval (not required for roads and public reserves, or if designated 'linear infrastructure'')	Part 3A Environmental Planning and Assessment Act 1979	October 2007	6 months	Nil	High	• Approach landowners and • Liaise with DOP to have project designated as 'linear infrastructure' (no landowner consent required for submission of Part 3A Application)
Affected Landowners	Landowner consent to construction	N/A	Prior to construction	6 months	$250k	High	• Approach appropriate landowners and negotiate access on case-by-case basis

Authority	Approval	Relevant Legislation	Timing	Duration	Cost	Risk	Measures
Fairfield City Council	No Council Approval required for Part 3A Approval Possible easement negotiation	N/A	July 2007	12-18 months	Nil	Low	• Early consultation regarding intention to submit Part 3A Project Application • DOP engages directly with Council as part of Part 3A Process • Council submissions to DOP regarding project at various stages. • Council requirements issued through Part 3A Approval conditions
Parramatta City Council	No Council Approval required for Part 3A Approval Possible easement negotiation	N/A	July 2007	6 months	Nil	Low	• Early consultation regarding intention to submit Part 3A Project Application • DOP engages directly with Council as part of Part 3A Process • Council submissions to DOP regarding project at various stages. • Council requirements issued through Part 3A Approval conditions
Holroyd City Council	No Council Approval required for Part 3A Approval Possible easement negotiation	N/A	July 2007	6 months	Nil	Low	• Early consultation regarding intention to submit Part 3A Project Application • DOP engages directly with Council as part of Part 3A Process • Council submissions to DOP regarding project at various stages. • Council requirements issued through Part 3A Approval conditions

Authority	Approval	Relevant Legislation	Timing	Duration	Cost	Risk	Measures
Bankstown City Council	No Council Approval required for Part 3A Approval Possible easement negotiation	N/A	July 2007	6 months	Nil	Low	• Early consultation regarding intention to submit Part 3A Project Application • DOP engages directly with Council as part of Part 3A Process • Council submissions to DOP regarding project at various stages. • Council requirements issued through Part 3A Approval conditions
NSW Roads and Traffic Authority	No consent required under Part 3A Approval and Water Industry Competition Act 2006	NSW Roads Act 1993	N/A	3 months	Nil	Low	• Permits under Roads Act 1993 not required for Part 3A Project • Consultation with RTA to be undertaken by Alinta SPV prior to submission of Part 3A Approval as matter of courtesy • DOP liaises directly with RTA through Part 3A Approval process • RTA requirement issues via Part 3A Approval Conditions
Police	Temporary lane closure permit	Section 186 Law Enforcement Act 2002	July 2007	1 month	Nil	Low	• Submit TMP with lane closure application

Western Corridor Recycled Water Project

PERFORMANCE AND VERIFICATION MANAGEMENT PLAN

PL-GWA-WC-2002-1

Veolia Water Australia
Western Corridor Recycled Water Project
L2, 95 North Quay, Brisbane 4001

Table of Contents

1. INTRODUCTION

1.1 Purpose

1.1.1 The purpose of this document is to describe the process performance and verification monitoring systems that are used to monitor and report the operation and management of Stage 1A of the Western Corridor Recycled Water Project (WCRWP).

1.1.2 The document describes the following:

- Processes that will be monitored continuously via the plant supervisory control and data acquisition system (SCADA) and associated field instruments.
- Onsite laboratory analysis and daily visual inspections that will be used to verify field instruments.
- External laboratory verification of purified water quality and external laboratory verification of onsite tests and instrument readings.
- Reports that will be generated for plant operations staff, process manager and the Project Owner to review and assess plant and operations performance.

1.1.3 This document provides the background to the external and operational verification required in the Recycled Water Management Plan (PL-GWA-WCB-2000).

2. SCOPE

2.1.1 This Plan applies to Veolia Water Australia (VWA) Pty Ltd in relation to Western Corridor Recycled Water Project for the operation and maintenance of the WCRWP and associated facilities including the Bundamba Advanced Water Treatment Plant (AWTP) (located within Ipswich City Council);

3. REFERENCES

- MN-GWA-WC-200: VWA IBMS Manual for the Western Corridor Recycled Water Project
- PL-GWA-WC-2000: Recycled Water Management Plan
- BUN1A-Z-PX-0013-04: Bundamba 1A AWTP commissioning Procedure (Thiess Black and Veatch)
- Bundamba 1A AWTP Performance Test (Thiess Black and Veatch)

- FM-GWA-WCB-2021: External Laboratory Verification Schedule
- FM-GWA-WCB-2022: Operational Verification Schedule

4. DEFINITIONS

AWTP – Advanced Water Treatment Plant

Raw Water - Treated Wastewater feeding into the AWTP process, also known as WWTP effluent.

Treated Water – Final treated water from the AWTP, referred to as purified recycled water or PRW

WCRWP – Western Corridor Recycled Water Project.

WWTP – Wastewater Treatment Plant, also known as Water Reclamation Plant or Wastewater Centre

5. PERFORMANCE TARGETS

5.1 Treated Water Quality

5.1.1 The Treated Water Quality requirement for supply of water to CS Energy is outlined in Table 5-1 Additional water quality requirements have been set by the Western Corridor Recycled Water Pty Ltd and is also included in Table 5-1,

Table 5-1: Purified Water Quality required to be produced by the Advanced Water Treatment Plant

Water Quality Parameter	Units	Purified Water Requirement
CS Energy specifications		
E. Coli (95th percentile)	cfu/100 mL	<10
Clostridium perfringes (95th percentile)	cfu/100 mL	<10
Somatic Coliphages (95th percentile)	pfu/100 mL	<10
F-RNA Coliphages (95th percentile)	pfu/100 mL	<10
Turbidity	Ntu	5
Total Residual Chlorine	mg/L	0.2-0.8
pH	-	6.0 - 8.5
Total dissolved solids (maximum)	mg/L	250
Alkalinity(21 day average)	mg/l	40-100
Hardness as $CaCO_3$(21 day average)	mg/l	>50
Total Nitrogen	mg/L	1.5
Total Phosphorous	mg/L	0.15

Manganese	mg/L	<0.05
Total Organic Carbon	mg/L	1
Copper	mg/L	<0.1
Aluminium	mg/L	<0.1
Zinc	mg/L	<0.1
Iron	mg/L	<0.1
Additional specifications		
Calcium Carbonate Precipitation Potential (CCPP)	mg/L	0 to -5
Nitrosodimethylamine (NDMA)	nano-g/l	10
Estrone	nano-g/l	3
17-beta estradiol (E2)	nano-g/l	1
Ethinylestradiol (EE2)	nano-g/l	0.1
Total PNEC	nano-g/l	1
Nonlyphenol (NP)	nano-g/l	7

5.2 Reverse Osmosis Concentrate Quality

5.2.1 The reverse osmosis Concentrate is to comply with the conditions specified by the EPA in the Development Approval which is outlined in **Table 5-2**. This includes the water quality, guarantees and monitoring frequency.

Table 5-2: Reverse Osmosis Concentrate Water Quality required by EPA Discharge Licenses

ROC Quality Parameter	Units	ROC Quality Requirement
5-day Biochemical Oxygen Demand (inhibited)	mg/l	10 mg/L
Suspended Solids	mg/L	15
Suspended Solids	mg/l	20
Suspended Solids	mg/l	30
pH		6.5-8.5
Enterococci	35 organisms per 100 mL as a median value (minimum of 5 samples taken at not less than half-hourly intervals in any one day, with all samples containing less than 100 organisms per 100 mL).	
Arsenic (III) (sol)	ug/L	94
Arsenic (V) (sol)	ug/L	42

Barium (sol)	ug/L	680
Cadmium (sol)	ug/L	0.4
Chromium (III) (sol)	ug/L	27.4
Chromium (IV) (sol)	ug/L	6
Cobalt (sol)	ug/L	1.0
Copper (sol)	ug/L	1.8
Lead (sol)	ug/L	5.6
Manganese (sol)	ug/L	2500
Mercury (inorganic) (sol)	ug/L	1.9
Nickel (sol)	ug/L	13
Selenium (sol)	ug/L	18
Silver (sol)	ug/L	0.1
Zinc (sol)	ug/L	15

(Trigger values for toxicity investigation)

6. SCADA MONITORING

6.1.1 The Supervisory control and data acquisition (SCADA) system is a software computer system that collects and interprets data from and sends control instructions to the programmable logic controllers (PLC's) used to control the majority of equipment used in the AWTP. An operator will be able to obtain information on the AWTP operational condition and control the AWTP processes via the "Human machine interface" (HMI) of the SCADA system.

6.1.2 The SCADA system will enable 24-hour process surveillance by plant operations staff and will have the capability to initiate alarms ensuring prompt corrective action by the on-call operator. The SCADA system alarms will be set during commissioning and then optimised with experience gained in operating the plant.

6.1.3 This will allow all critical process control points to be monitored and controlled via the SCADA system. This capability will exist via computer terminals within the plant or remotely via laptops and modem connections.

6.1.4 The SCADA system provides time-based trending of process parameters. This data can be downloaded to generate process reports on plant performance parameters such as membrane rejection and fouling rates.

6.1.5 This process information will be used to verify the performance of the AWTP, along with onsite and external laboratory testing. The online information that will be used for operational process verification is summarised in the Operational Verification Schedule (FM-GWA-WCB-2022).

6.1.6 The important process trends relevant to each unit process are outlined in Section 9.

7. LABORATORY TESTING

7.1 External Laboratory Verification

7.1.1 A sampling and analysis program will provide verification data for assessing process performance and compliance with the Purified Water Quality requirements. Process sampling and analysis additional to that required for verification of Purified Water Quality will be undertaken to enable complete process monitoring and provide key performance data for process optimisation.

7.1.2 All external laboratory verification will be done at facilities registered by the National Association of Testing Authorities (NATA) for the tests required unless no suitable facility can be found that has this accreditation for required tests. In such cases, the laboratory facility must demonstrate that it has NATA accreditation for similar procedures, are using methods accredited by the USEPA or WHO or similar organisation and has initiated the process of obtaining NATA accreditation provided it is economically justifiable to do so.

7.1.3 The Manager: Environment and Water Quality will routinely examine data and key performance parameters to re-assess process and water quality risks. The external verification schedule will be reviewed at least annually and may be expanded, reduced, or sampling frequencies adjusted in consultation with customers and the Regulator in accordance with the risk assessment.

7.1.4 The parameters that will be verified through external laboratory testing are listed in tables under each process description in Section 8 of this document.

7.1.5 All external laboratory verification is summarised in the External Laboratory Verification Schedule (FM-GWA-WCB-2021) and the Environmental Test Schedule (FM-GWA-WCB-402).

7.2 Onsite Laboratory Analyses

7.2.1 A sampling and analyses program for onsite analyses will provide quick results for process control and verification of online analysers. The on-site laboratory will be capable of analysing a range of water quality parameters. Onsite tests will be conducted in accordance with the 20th Edition of “Standard Methods for the Examination of Water and Wastewater”, unless otherwise approved by the Manager: Environment and Water Quality.

7.2.2 The parameters that will be tested onsite are listed in tables under each process description in Section 8 of this document.

7.2.3 All onsite laboratory testing is summarised in the Operational Verification Schedule (FM-GWA-WCB-2022).

8. OPERATING PROCEDURES

8.1.1 Detailed work instructions, response plans and operating procedures will provide the detail on how operations of the plant will be conducted.

8.1.2 These operating procedures and the operations and maintenance manuals are provided within the WCRWP Integrated Business Management System (IBMS).

9. PROCESSES AND MONITORING REQUIREMENTS

9.1 Raw Water (Treated Wastewater) pumpstation

9.1.1 Raw water will be monitored in the Raw Water pipeline to detect major variation in median concentrations of parameters that could affect the AWTP treatment process and product water quality. The AWTP feed quality will be monitored continuously using on-line instruments and sampled regularly for other non-online monitored parameters.

9.1.2 Changes in Turbidity, Phosphorous (PO_4), Nitrate (NO_3) and Ammonia (NH_3) will require adjustments to and optimisation of the pre-treatment, and chloramination stages. These parameters will be monitored with in-line analysis downstream of the raw water pumps. The online analysers will be verified with a weekly onsite laboratory test and calibrated at a frequency determined by the consistency of these verification tests.

9.1.3 Raw water will also be monitored according to the external laboratory verification program to monitor changes in other parameters that may affect purified water quality or impact operational efficiency.

The parameters and type of monitoring on the raw water are summarised in Table 9-1.

Table 9-1 : Raw Water Monitoring

Parameter	Unit	Monitoring
Flow	L/s	On-line FIT0611
Pressure	bar	On-line PIT0612
pH/Temperature		On-line/weekly onsite tests
Ammonia	mg/L	On-line /weekly onsite tests
Nitrate	mg/L	On-line/weekly onsite tests
Phosphorous	mg/L	On-line/weekly onsite tests
Turbidity	NTU	In-line AIT0623/weekly onsite tests
F-RNA Coliphages	pfu/100 mL	External Laboratory Quarterly
Somatic Coliphages	pfu/100 mL	External Laboratory Quarterly

E-Coli	cfu/100 mL	External Laboratory	Quarterly
Clostridium perfringes	cfu/100 mL	External Laboratory	Quarterly
Total Chlorine	mg/L	External Laboratory	Monthly
Arsenic (III) -sol	mg/L	External Laboratory	Monthly
Boron - sol	mg/L	External Laboratory	Monthly
Cadmium - sol	mg/L	External Laboratory	Monthly
Chromium (III) - sol	mg/L	External Laboratory	Monthly
Copper - sol	mg/L	External Laboratory	Monthly
Lead - sol	mg/L	External Laboratory	Monthly
Manganese - sol	mg/L	External Laboratory	Monthly
Nickel - sol	mg/L	External Laboratory	Monthly
Selenium - sol	mg/L	External Laboratory	Monthly
Silver sol	mg/L	External Laboratory	Monthly
Zinc-sol	mg/L	External Laboratory	Monthly
Mercury (inorganic) - sol	mg/L	External Laboratory	Monthly
Aluminium - sol	mg/L	External Laboratory	Monthly
Iron - sol	mg/L	External Laboratory	Monthly
Sulphate	mg/L	External Laboratory	Monthly
BOD/COD	mg/L	External Laboratory	Monthly
TOC	mg/L	External Laboratory	Monthly
Total Nitrogen	mg/L	External Laboratory	Monthly
Ammonia	mg/L	External Laboratory	Monthly
Total inorganic nitrogen	mg/L	External Laboratory	Monthly
Total Phosphorous	mg/L	External Laboratory	Monthly
Turbidity	mg/L	External Laboratory	Monthly
Suspended solids	mg/L	External Laboratory	Monthly
TDS	mg/L	External Laboratory	Monthly

9.1.4 Parameters that are measured online will be trended on the SCADA system. Flow and temperature will be monitored daily by the duty operator and a daily totalised flow and average temperature will be calculated and reported in the monthly process report. On-line analyser trends will be reviewed by the operator on a daily basis and a monthly report will be prepared by the process engineer showing weekly minimum, maximum, 50th and 95th percentile values along with onsite and external laboratory test results. Longer term trends will be created using these calculated values in order to assist in longer term plant optimisation.

9.1.5 High levels of nitrate or ammonia in the raw water may result in reduced production of treated water or a plant shut down to ensure compliance with purified water and ROC discharge quality requirements. High levels of phosphorous will influence the coagulant dose rate. Very high levels of turbidity may also result in a plant shut down due to excessive fouling of MF membranes.

9.1.6 The response to the changes in the feed water quality is outlined in the Treated Wastewater QCP response procedure. Should alert limits on the online instruments be reached it will trigger a notification to the WWTP which will warn it of a possible reduction or ceasing the take of treated wastewater.

9.2 Chloramination

9.2.1 Sodium hypochlorite and ammonium sulphate are dosed to the raw water into two inline mixers ahead of the raw water storage tanks. Chloramine is formed to act as a disinfectant to control biological fouling in the raw water tanks, MF membranes and RO membranes. It is essential to control the dose of sodium hypochlorite to prevent the formation of free chlorine and to control the ammonium sulphate dose rate to prevent high concentrations of ammonia. The presence of free chlorine in the feedwater to the RO process units could cause catastrophic failure to the RO and high ammonia could result in a breach of treated water or ROC quality specifications.

9.2.2 Sodium hypochlorite dosing is controlled via an operator entered setpoint and flowpaced to the raw water flowmeter (FIT0611). Ammonium sulphate dosing is controlled via a proportion of the hypochlorite dosing and flowpaced to the raw water flowmeter. An online ammonia analyser monitors ammonia after chlorine addition in the second inline mixer. This reading can be used by the operator to establish whether the ammonium sulphate dose should be adjusted. This could occur when there is a change of ammonia concentration in the raw water.

9.2.3 An online chloramine analyser (AIT1123 – see section 9.3) on discharge of the microfiltration feed pumps provides the operator with information on whether the required chloramine concentration is being maintained. An online oxidation-reduction (redox) potential (ORP) meter on the discharge of the MF feed pumps provides an indication of the likely presence of free chlorine.

9.2.4 The parameters and type of monitoring on chlorine and ammonia dosing are summarised in Table 9-2.

Table 9-2: Chloramination Process Monitoring

Parameters	Unit	Frequency
Ammonia	mg/L	Online AIT0623/ daily onsite checks

Ammonium sulphate flow rate	L/hr	On-line (FIT4821)
NaOCl flowrate	L/hr	On-line (FIT 4333)

9.2.5 The chemical dose rates and ammonia analyser readings will be trended on the SCADA system. An ammonia high alarm signal will be generated by the PLC and shown on the SCADA system. Alarms will also be generated on low flow on the chemical dosing lines. Chemical consumption rates can also be monitored via chemical tank levels which are trended on the SCADA system.

9.2.6 On-line ammonia trends will be reviewed by the operator on a daily basis and a monthly report will be prepared by the process engineer showing weekly minimum, maximum, 50^{th} and 95^{th} percentile values along with onsite test results. Longer term trends will be created using these calculated values in order to assist in longer term plant optimisation.

9.2.7 High levels of ammonia in the raw water may result in rating down production of treated water or a plant shut down to ensure compliance with purified water and ROC discharge quality requirements.

9.2.8 The response to a high ammonia alarm on the online analyser or low chemical flow alarms are outlined in the CCP response procedure and work instructions.

9.3 MF Feed Pumps and Strainers

9.3.1 The Microfiltration feed pumps provide pressure to pump the water through two 200 micron strainers (installed in parallel with full redundancy). A pressure setpoint required by the MF will be provided by the MF PLC and the MF pumps will supply pressure to meet this setpoint. Online pressure indicator and flow meter are installed on the discharge header of the MF feed pumps.

9.3.2 A turbidity meter on the discharge header of the MF feed pumps provides information on the solids loading to the strainers and Microfiltration system.

9.3.3 An online chloramine and ORP analyser on discharge of the MF feed pumps provides the operator with information on the efficiency of the chloramination process (see section 9.2).

9.3.4 An online pH/temperature analyser on the discharge header of the MF feed pumps provides information to set the rate of addition of sulphuric acid for pH adjustment for coagulation (see section 9.4).

9.3.5 An Online phosphate meter on the discharge header of the MF feed pumps provides information to the operator to calculate the correct coagulant dose rate.

9.3.6 The inline strainers are installed on the MF feed line to remove gross solids to protect the MF membranes. They will be controlled through local strainer control panels with “strainers running” and “strainer differential pressure high” status indicators appearing on the SCADA control system.

9.3.7 The parameters and type of monitoring on chlorine and ammonia dosing are summarised in Table 9-3.

Table 9-3: Monitoring on MF feed pumps and strainers

Parameters	Unit	Frequency
Pressure (MF feed pump header)	Bar	Online PIT1111
Flow	L/s	Online FIT1111
pH		Online AIT1121/daily onsite tests
Temperature	°C	AIT1121
Turbidity	Ntu	on-line AIT1122/weekly onsite tests
Chloramine	mg/L	Online AIT 1123/daily onsite tests
Phosphate	mg/L	Online AIT 1124/daily onsite tests
ORP (Redox potential)	mV	Online AIT 1125/daily onsite tests

9.3.8 All online instrument readings will be trended and totalised flow will be displayed and recorded by the SCADA system. High and low chloramine, high phosphate, high and low ORP and high and low pH alarms will be generated and displayed/recorded by the SCADA system.

9.3.9 On-line Chloramine, phosphorous and ORP trends will be reviewed by the operator on at least a daily basis to control chemical dose rates. A monthly report will be prepared by the process engineer showing weekly minimum, maximum, 50th and 95th percentile values along with onsite test results. Longer term trends will be created using these calculated values in order to assist in longer term plant optimisation.

9.3.10 Low levels of chloramine in the MF feed water may result in increased fouling on the MF and RO membranes and the operator may have to adjust the hypochlorite and ammonium sulphate dosing on the raw water. High levels of ORP will indicate the possible presence of free chlorine and the operator would need to take immediate action to correct the hypochlorite dosing. Both the chloramine and ORP analysers will trigger an alert and alarm that will result in a critical control point response procedure being initiated by the operator.

9.4 Coagulation and pH adjustment

9.4.1 The coagulation stage is important to reduce high phosphorous concentration which could lead to increased scaling on the reverse osmosis membranes. This will increase CIP frequency and reduce plant capacity in the short term with increased CIP frequency ultimately resulting in reduced membrane life.

9.4.2 The optimum pH for coagulation will be obtained by dosing sulphuric acid into inline mixer MIX1151 with feedback control from the pH analyser downstream of MIX1151.

9.4.3 The coagulant will be dosed into inline mixer MIX1152. The on-line phosphorous analyser on the MF pump discharge header (section 9.3) provides the information to the operator to determine the coagulant dose rate. Coagulant dose rate will be flowpaced to the MF feed flow meter (FIT1111) according to this operator entered setpoint.

9.4.4 The pH will be corrected to the setpoint for the MF and RO feed by dosing Sodium Hydroxide into inline mixer MIX1153 with feedback control from the pH analyser downstream of MIX1153 (sodium hydroxide dosing).

9.4.5 Coagulation will produce flocs which may contain elevated levels of iron. High amounts of iron floc may cause fouling of microfiltration membranes. The amount of floc generated by the inline coagulation step will be monitored by a daily settling test performed by the operator.

9.4.6 Overdose of iron-based coagulants could also cause high levels of dissolved iron in the filtrate which could lead to fouling of RO membranes. This will be monitored daily through an onsite dissolved iron test on the MF filtrate (see section 9.6)

9.4.7 Jar testing will be performed periodically to verify the optimum coagulant dose rate and pH at measured phosphate concentrations in the MF feed. The online instrumentation will be verified with daily or weekly routine grab samples tested in the onsite laboratory.

9.4.8 The monitoring for the optimisation and management of the coagulation and pH correction stage will involve the parameters outlined in Table 9-4.

Table 9-4 Coagulation Process Monitoring

Parameters	Unit	Frequency
Coagulant flow rate	L/hr	On-line(FIT4021)
Sulphuric acid flowrate	L/hr	On-line (FIT4421)
Sodium Hydroxide flowrate	L/hr	On-line (FIT6735)
pH (downstream of MIX 1152)		On-line (AIT1161)/ weekly onsite
Temperature (downstream of MIX 1152)	°C	On-line (AIT1162)
pH (downstream of MIX 1153)		On-line (AIT1163)/ weekly onsite
Temperature (downstream of MIX 1153)	°C	On-line (AIT1163)
Settled solids volume	g/L	Daily onsite tests

9.4.9 All online instrument readings will be trended and recorded by the SCADA system. High and low pH alarms will be generated and displayed/recorded by the SCADA system.

9.4.10 The chemical dose rates will be recorded on the SCADA system. Alarms will also be generated on low flow on the chemical dosing lines unless overridden when dosing is not required. Chemical consumption rates can also be monitored via chemical tank levels.

9.5 Micro-filtration

9.5.1 Micro-filtration is a pre-treatment step that ensures reliable performance of the Reverse Osmosis membranes. Micro-filtration will remove most particles from the RO feed and is designed to reduce the Silt Density Index (SDI) in the RO feed to the design value. Micro filtration will also remove any coagulant floc produced.

9.5.2 The integrity of the membranes is monitored by a daily integrity test, recording the pressure decay over time across the membranes. When this value drops below the set point, the MF rack would be taken out of service and the defective membrane identified and pinned.

9.5.3 The MF filtrate water quality from each rack in service is monitored on a sequential basis by online analysers for turbidity, pH/temperature, conductivity, monochloramine, free chlorine and ORP. The combined MF filtrate is monitored continuously by online analysers for turbidity, pH/temperature, conductivity, monochloramine and free chlorine. SDI tests are performed daily on site. Turbidity and SDI supplies information on the operational efficiency of the MF system and the other parameters provide information on the RO pre-conditioning requirements.

9.5.4 The micro-filtration process is controlled by feed flow and pressure to the membranes and by maintaining differential pressure across the membranes below reasonable levels.

9.5.5 The microfiltration are be backwashed approximately every 30 minutes using RO permeate accompanied by air scouring. The length and interval of backwashing will be operator set through the plant supervisory control system and will be automatically controlled via PLC.

9.5.6 A chemically enhanced backwash (CEBW) will also be conducted at least daily on each rack in operation. The CEBW will simulate a normal backwash with the addition of sodium hypochlorite and heat.

9.5.7 An effective and efficient Clean-In-Place (CIP) process is required to maintain long-term membrane performance. CIP's are triggered when the differential pressure across the membrane racks increase beyond a set point value. CIP's may also be conducted prior to and following an extended shutdown.

9.5.8 CIP's can be initiated either automatically or by operator intervention. A CIP will generally consist of the sequential circulation of heated citric acid and sodium hypochlorite solutions through the raw water side of the MF membranes.

9.5.9 Operators are able to control the sequence set-points before each CIP commences. The correct CIP sequence will be determined through investigation of fouling trends and CIP effectiveness throughout the life of the AWTP.

9.5.10 The monitoring for the optimisation and management of the Micro-filtration will involve the parameters outlined in Table 9-5.

Table 9-5: Micro-filtration Process Monitoring

Parameters	Unit	Frequency
Trans membrane pressure	bar	PIT1211-1&2, PIT1221-1&2, PIT1231-1&2, PIT1241-1&2, PIT 1251-1&2
Rack feed flow	L/s	FIT1211-1, FIT1221-1,FIT1231-1, FIT1241-1, FIT 1251-1
Rack filtrate flow	L/s	FIT1211-1, FIT1221-1,FIT1231-1, FIT1241-1, FIT 1251-1
Flux	Lmh	Using flows and membrane area
Permeability	Lmh/bar	Using flux and pressures
Combined Filtrate Flow	L/s	Sum of rack filtrate flows.
Turbidity (sequenced rack filtrate)	ntu	On-line (AIT1911), weekly onsite test
Conductivity (sequenced rack filtrate)	uS/cm	On-line (AIT1912) weekly onsite test
Monochloramine (sequenced rack filtrate)	mg/L	On-line (AIT1913), daily onsite test
pH/Temperature (sequenced rack filtrate)		On-line (AIT1914) daily onsite test
Free Chlorine (sequenced rack filtrate)	mg/L	Online (AIT1915), daily onsite test
ORP (sequence rack filtrate)	mV	On-line (AIT1916), daily onsite test
Turbidity (combined filtrate)	ntu	On-line (AIT1921), daily onsite test
Conductivity (combined filtrate)	uS/cm	On-line (AIT 1922), weekly onsite test
Monochloramine (combined filtrate)	mg/L	On-line (AIT 1923), daily onsite test
pH/temperature (combined filtrate)	units	On-line (AIT1924), daily onsite test
Free Chlorine (combined filtrate)	mg/L	Online (AIT1925), daily onsite test
SDI (combined filtrate)		Daily on site test

Phosphorous (combined filtrate)	mg/L	Daily onsite test
Various CIP and Backwash flows, pressures and online analysers		Online pressure, flow, temperature, pH and chlorine measurement provide specific information for operators during CIP and backwash sequences as well as record information on sequences used for use in the analyses of cleaning efficiency.

9.5.11 The individual rack filtrate and combined filtrate analyser readings will be trended and recorded on the SCADA system. Each analyser PLC will generating high/ high-high and low/ low-low alarms. Flows and pressures will be recorded and trends of transmembrane pressure in bar, Flux in lmh and permeability (temperature-normalised specific flux) in lmh/bar will be generated and displayed.

9.5.12 Graphs will be generated showing when CIP's were conducted and cumulative filtrate volume generated between CIP's. Backwash conditions, CEBW conditions, intervals between CIP's and the results of integrity verificatioin tests will be recorded and displayed.

9.5.13 pH, monochloramine and Free chlorine is monitored to provide information for the control of chloramination and coagulation. Conductivity monitoring provides information for the control of the downstream RO process and temperature provides information for the optimisation of both MF and RO process units, and particularly for producing normalised pressure, flow and salt transport graphs used for monitoring RO performance.

9.6 Reverse Osmosis

9.6.1 Reverse osmosis is the process of forcing water from a high concentration of dissolved ions through a membrane to produce water (permeate) of a low dissolved ion concentration by applying pressure to overcome the natural tendency of water to flow from a low concentration to a high concentration. The membranes used consist of dense layers of polymer barrier which allows the passage of water but not of most soluble contaminants such as salt ions and completely prevents the passage of particulate or colloidal contaminants. A high pressure needs to be exerted on the high concentration side of the membrane, usually 8-18 bar for treated wastewater, to overcome the osmotic pressure generated by the dissolved ions in wastewater.

9.6.2 The spiral wound RO membranes will be installed in 4 trains of 65 membranes each. Each train will consist of 3 stages with concentrate generated by each stage cascading to the feed to the next stage. Permeate from all three stages is combined for further processing and the final reverse osmosis concentrate (ROC) generated by stage 3 is treated and discharged.

9.6.3 Water from the RO feed tank is drawn by the RO feed pumps through a common header. Chemicals such as anti-scalant, sodium bi-sulfite and acid will be added to the water in the common RO pumps suction header. Antiscalant addition is paced with the combined output of the RO system to achieve desired concentration in the feed flow. Sodium bi-sulfite and acid doses are paced to achieve zero free chlorine residual and a set-point pH, respectively.

9.6.4 The RO will be operated at constant permeate flow recovery rates. As far as possible, all the trains will be in operation to minimise the RO feed pressure and reduce the number of starts and stops. The stop sequence of each RO train will include flushing the concentrate side with permeate which will extend the run time between CIP cleans.

9.6.5 The RO membranes can be damaged catastrophically by exposure to free chlorine over a relatively short period. To ensure that membranes are protected at all times, free chlorine is monitored via on-line analysers on the MF filtrate (see Table 9-5) and on the RO feed (AIT2001). Provision for dechlorination via dosing of sodium metabisulphite dosing is provided into the chemical mixers (MIX2002,2003) on the common suction header to the RO pumps. Another free chlorine analyser (AIT2004-4) is provided after the SMBS dosing point.

9.6.6 The chloramine concentration can also be boosted at this point by addition of sodium hypochlorite. The same chlorine analysers can be used by the operator in setting the dose rate. When required, the operator can start NaOCl dosing which will then be dosed according to an operator setpoint proportional to the total MF product water flow.

9.6.7 The rectification action required when free chlorine is detected in the MF filtrate or RO feed is detailed in the CCP1 response work instruction.

9.6.8 Turbidity, pH/temperature and conductivity is monitored via online analysers (AIT2004-1-3) on the combined RO feed header after the SMBS dosing point and conductivity is monitored on the RO permeate from each stage in each train and on the concentrate from each train.

9.6.9 A number of key operational parameters will need to be monitored, controlled and assessed for the efficient operation of the RO system. Normalisation software calibrated to the specific membranes and developed in conjunction with the membrane supplier is used to derive the operational parameters from the online monitoring of pressure, temperature, flow and conductivity on RO feed and permeate.

9.6.10 Anti-scalant dosing and pH adjustment is used to reduce scaling caused by phosphorous and other inorganic contaminants in the RO feed and to reduce permeability of certain ions. The frequency of scaling events needs to be controlled to ensure plant capacity is maintained, reduce the frequency of cleaning in place and reduce membrane degradation.

9.6.11 An effective Clean-In-Place (CIP) process is required to maintain long-term membrane performance. The triggers for a CIP of an RO train or stage in a train would include

- The longitudinal differential normalised pressure over a stage in a train increases above the membrane vendor’s recommended level;

- Salt passage through a stage in a train increases by more than the membrane vendor's recommended level;
- prior to and following an extended shutdown.

9.6.12 The operator will start the CIP sequence manually when one of these events has triggered a CIP. A CIP will consist of circulation of an acid solution for a predetermined period on the concentrate side of the membrane, or alternatively a caustic solution which may be augmented with biocide or EDTA when required. Both processes may be used in sequence. A CIP could be applied to each stage in a train in isolation of the other stages. The operator will set the parameters of a CIP sequence which will then run automatically. The duration of a CIP may vary from 2-8 hours.

9.6.13 After each CIP the effectiveness of the CIP will be reviewed. This assessment will be used to optimise the cleaning frequency, duration and cleaning solutions. This will also be dependent on the membrane performance and type and the nature of the fouling.

9.6.14 Spent CIP solution will be collected in the CIP waste tanks and neutralised with sodium metabisulphite, sulphuric acid and sodium hydroxide. Online pH, dissolved oxygen and chlorine analysers are used to determine dose rates for neutralisation.

9.6.15 The critical parameters to be monitored on the RO system are outlined in Table 9-6.

Table 9-6: Reverse Osmosis Performance Parameters

Parameter	Unit	Location
Antiscalant dose rate	L/Hr	Online (FIT 4521)
$Na_2S_2O_3$ dose rate	L/Hr	Online (FIT 6862)
NaOCl dose rate	L/Hr	Online (FIT4334)
Free chlorine RO feed header before MIX2002/03	mg/L	Online (AIT2001)
Free chlorine RO feed header after MIX 2002/03	mg/L	Online (AIT2004-4)
pH/temperature RO feed header after MIX 2002/03	°C	Online (AIT2004
Trans-Membrane Pressure – 3 stages (Train 1)	Bar	Online (PIT2201-01/02, PIT2201-03/04, PIT2201-05/06)
Trans-Membrane Pressure – 3 stages (Train 2)	Bar	Online (PIT2202-01/02, PIT2202-03/04, PIT2202-05/06)
Trans-Membrane Pressure – 3 stages (Train 3)	Bar	Online (PIT2203-01/02, PIT2203-03/04, PIT2203-05/06)
Trans-Membrane Pressure – 3 stages (Train 4)	Bar	Online (PIT2204-01/02, PIT2204-03/04, PIT2204-05/06)
Permeate Flow (Train 1) – 3 stages	Bar	Online (FIT2201-01, FIT2201-02, FIT2201-03)
Permeate Flow (Train 2) – 3 stages	Bar	Online (FIT2202-01, FIT2202-02, FIT2202-03)

Permeate Flow (Train 3) – 3 stages	Bar	Online (FIT2203-01, FIT2203-02, FIT2203-03)
Permeate Flow (Train 4) – 3 stages	Bar	Online (FIT2204-01, FIT2204-02, FIT2204-03)
Permeate Conductivity (Train1) – 3 stages	μS / cm	Online (AIT2201-01, AIT2201-02, AIT2201-03) weekly onsite tests
Permeate Conductivity (Train2) – 3 stages	μS / cm	Online (AIT2202-01, AIT2202-02, AIT2202-03) weekly onsite tests
Permeate Conductivity (Train3) – 3 stages	μS / cm	Online (AIT2203-01, AIT2203-02, AIT2203-03) weekly onsite tests
Permeate Conductivity (Train4) – 3 stages	μS / cm	Online (AIT2204-01, AIT2204-02, AIT2204-03) weekly onsite tests
Permeate Temperature (trains 1-4)	°C	Online (TIT2201, TIT2202, TIT2203, TIT2204)
Permeate Conductivity(trains 1-4)	μS / cm	Online (AIT2201-05, AIT2202-05, AIT2203-05, AIT2204-05)/ weekly onsite tests
ROC flow (trains 1-4)	L/s	Online (FIT2201-04, FIT2202-04, FIT2203-04, FIT2204-04)
ROC pressure (trains 1-4)	Bar	Online (PIT2201-07, PIT2202-07, PIT2203-07, PIT2204-07)
ROC conductivity (trains 1-4)	μS / cm	Online (AIT2201-04, AIT2202-04, AIT2203-04, AIT2204-04) weekly onsite tests
Various CIP flows, pressures, temperatures and online analysers		Online pressure, flow, temperature and pH measurement provide specific information for operators during CIP sequences as well as record information on sequences used for use in the analyses of cleaning efficiency.
Calcium (MF filtrate - AIT2004 and permeate – new sample point required before MIX4853))	mg/L	External laboratory 2/week
Sodium (MF filtrate – AIT2004)	mg/L	External laboratory 2/week
Potassium (MF filtrate- AIT2004)	mg/L	External laboratory 2/week
Aluminium (MF filtrate – AIT2004)	mg/L	External laboratory 2/week
Iron (MF filtrate – AIT2004)	mg/L	External laboratory 2/week
Manganese (MF filtrate – AIT2004)	mg/L	External laboratory 2/week
Silica (MF filtrate – AIT2004)	mg/L	External laboratory 2/week
Fluoride (MF filtrate – AIT2004)	mg/L	External laboratory 2/week
Chloride (MF filtrate – AIT2004 and permeate – new sample point required before MIX4853)	mg/L	External laboratory 2/week
Sulphate (MF filtrate – AIT2004)	mg/L	External laboratory 2/week
TOC (MF filtrate – AIT2004)	mg/L	External laboratory 2/week

Total Nitrogen (MF filtrate – AIT2004)	mg/L	External laboratory 2/week
Ammonia (MF filtrate – AIT2004 and permeate – new sample point required before MIX4853)	mg/L	External laboratory 2/week
Total Inorganic Nitrogen (MF filtrate – AIT2004)	mg/L	External laboratory 2/week
Total Phosphorous (MF filtrate – AIT2004)	mg/L	External laboratory 2/week

9.6.16 As detailed in previous sections, the influence of the feed water quality to the RO system can be significant and as such detailed online and manual monitoring will be required. The general hydraulic performance of the RO system including the flows, recovery rates for each stage, feed water pressure range, and run time for each train will be monitored and trended online to ensure the most efficient operating regime is selected.

9.6.17 The most significant impact on the performance of the membrane system will be premature or unanticipated fouling. A number of parameters relating to the fouling and ageing of the membranes will be monitored including:

- Permeability to salinity (g/h/m2/bar): to monitor the effect of ageing of the membranes on the salt passage as well as fouling for each individual train;
- Differential pressure (bar) normalised to temperature and flow to check the fouling of the membranes;
- Permeability to water (l/h/m2/bar): to monitor the effect of ageing of the membranes on the flow and pressure;
- CIP Frequency: the time between two consecutive CIP's will be monitored as well as CIP efficiencies;
- Permeate water quality: the conductivity of the permeate will be monitored and reported for each individual train.

9.6.18 To monitor the integrity of the RO membranes, the operators will conduct a probing program on each train once per year. This procedure will allow locating a problem within a pressure vessel while online without unloading elements. Probing involves the insertion of plastic tube (approx. ¼ inch (6mm) in diameter) into the full length of the permeate tube in order to measure the permeate conductivity at different locations inside the pressure vessel and establish a conductivity profile. Probing will be conducted when any increase in conductivity or TOC on the permeate streams are noted or just after any replacement of membranes.

9.6.19 The location of each membrane will be known for its entire life and will be managed using a membrane module map. The map will record serial numbers of each module and its location in the RO skids. This will be a key component of the trouble shooting and membrane replacement process. The module map will allow suspect modules or other process upsets affecting the membranes to be linked to the process performance at any particular day or point in time.

9.7 Advanced Oxidation

9.7.1 The advanced oxidation process is designed to oxidise any remaining small organic compounds that may have passed through the RO membranes.

9.7.2 The system consists of hydrogen peroxide dosing to an inline mixer (MIX4853) in the combined RO permeate line followed by two inline ultra violet disinfection systems in parallel.

9.7.3 The UV and hydrogen peroxide doses will be adjusted to obtain optimum conditions for the destruction of any NDMA and endocrine disruptors and other small organic molecules that may have passed through the RO membranes.

9.7.4 The Hydrogen peroxide dosing will be flowpaced to the combined permeate flow. The UV dose will be adjusted to the setpoint by monitoring the UV intensity in the two reactors.

9.7.5 The combine RO permeate is also monitored by

9.7.6 The critical parameters to be monitored on the advanced oxidation system are outlined in Table 9-7

Table 9-7 Advanced Oxidation Online Monitoring

Parameters	Unit	Location
H_2O_2 flow	L/hr	On-line (FIT6421)
UV reactor 1 intensity (transmittance)	%	Online (XT4851-1, XT4851-2)
UV reactor 1 intensity (transmittance)	%	Online (XT4852-1, XT4852-2)
UV reactor 1 permeate flow	L/s	Online (FIT4851)
UV reactor 2 permeate flow	L/s	Online (FIT4852)
Total organic carbon (downstream of UV)	ug / L	Online (AIT5104-5) (six monthly calibration)
pH/temperature (downstream of UV)		Online (AIT5101) (daily onsite tests)
GCMS scan MIX4853 feed (new sample point required on inlet to MIX4853)		External Laboratory - Quarterly
GCMS scan UV product (AIT5104 sample point)		External Laboratory - Quarterly

9.8 Remineralisation and Chlorination

9.8.1 The remineralisation stage is provided to buffer and provide corrosion protection. Carbon dioxide and lime will be dosed to the combined RO permeate.

9.8.2 Carbon dioxide dosing is flowpaced to the plant effluent (UV flow FIT4851+FIT4852) and the dosage controlled by feedback from the pH analyser downstream of the CO_2 dosing Mixer (MIX5101) (PID control). The pH setpoint will be adjustable by the operator in the range of 4-9.

9.8.3 Lime slurry will be made up in the lime slurry tanks by the lime silo screw conveyor speed and make-up water valve set to achieve an operator set concentration (manual mode) or calculated concentration (auto mode) in the slurry tanks.

9.8.4 Lime slurry dose is flowpaced to the plant effluent (UV flow FIT4851+FIT4852) based on an operator adjustable dose rate and a selectable pH trim mode, based on feedback from the pH analyser downstream of the lime dosing mixer (MIX5102)

9.8.5 The calcium carbonate precipitation potential values will be used to monitor and optimise the remineralisation process using onsite testing of alkalinity, calcium hardness and pH. These parameters will be calculated regularly and the lime and carbon dioxide dosing optimised to maintain the correct remineralisation level and final treated water pH. The treated water turbidity will be monitored on-line and the effect of remineralisation, lime doses, on turbidity reviewed.

9.8.6 Chlorination provides the final disinfection stage and provides for maintaining a residual for required contact time in the treated water tank for primary disinfection and for maintaining a residual in the network to maintain water quality.

9.8.7 The sodium hypochlorite dose will be proportional to plant effluent flow (UV flow meters FIT4851+FIT4852) using feedback control (PID) from an on-line residual chlorine meter downstream of chlorine addition (AIT5104-4). The required chlorine dose concentration will be set by the operator and will depend on the concentrationXtime (residence time in treated water tank) required and the chlorine residual required in the distribution system.

9.8.8 The critical parameters to be monitored on the remineralisation and chlorination system are outlined in Table 9-8.

Table 9-8 Remineralisation and Chlorination Monitoring

Parameters	Unit	Location
CO_2 dose	mg/L	PID controller output
CO_2 concentration		Adjusted by operator

CO_2 Density	g/L	Adjusted by operator
CO_2 Feedrate	Kg/hr	DosageXFlowrate
pH/temp downstream of CO_2 addition		Online AIT5102, daily onsite test
Lime discharge flow	L/s	FIT 4132 and FIT4133
Lime Dosage	mg/L	Adjusted by operator
Lime concentration	mg/L	Adjusted by operator (used for automatic control of screwfeeders)
Density	g/L	Adjusted by operator
Feed rate	L/hr	Calculated – (treated water flowrateXdosage)/(concXdensity)
pH/temp downstream of Lime addition		Online AIT5103 - daily onsite test
Sodium Hypochlorite flow rate	L/s	Online FIT4335
pH/temp -treated water tank inlet		Online AIT5104-1 – daily onsite test
Turbidity -treated water tank inlet		Online AIT5104-2 – daily onsite test
Conductivity – treated water tank inlet	uS/cm	Online AIT5104-3 – daily onsite test
Total Chlorine – treated water tank inlet	mg/L	Online AIT5104-4 – daily onsite test
Alkalinity (AIT5104 sample point)	mg/L	Daily Onsite laboratory /weekly external laboratory
Calcium hardness (AIT5104 sample point	mg/L	Daily Onsite laboratory/weekly external laboratory
Calcium carbonate precipitation potential		Weekly onsite calculation

9.9 Treated (purified) Water Quality Monitoring

9.9.1 The treated water tank provides supply storage, chlorine residual contact time and hydraulic head to the high pressure supply pumps to the customer sites. The treated water tank level is controlled by the overall system control.

9.9.2 The on-line monitoring and other parameters monitored on the treated water tank and on the treated water delivery pumps are outlined in Table 9-9

Table 9-9 Treated Water Tank and Delivery Pump Monitoring

Parameters	Unit	Location
Turbidity (tank)	NTU	Online (AIT5403-3, AIT5406-3), daily onsite test
Chlorine free (tank)	mg / L	Online (AIT5403-2, AIT5406-2), daily onsite test
pH/temperature (tank)		Online (AIT5403-1, AIT5406-1), daily onsite test
Conductivity (tank)	uS/cm	Online (AIT5403-4, AIT5406-4), daily onsite test
Turbidity (Swanbank discharge)	ntu	Online (AIT5407-3), daily onsite test
Chlorine free (Swanbank discharge)	mg / L	Online (AIT5407-2), daily onsite test
pH/temperature (Swanbank discharge)		Online (AIT5407-1), daily onsite test
Conductivity (Swanbank discharge)	uS/cm	Online (AIT5407-4), daily onsite test
F-RNA Coliphages	pfu/100 mL	External Laboratory Weekly
Somatic Coliphages	pfu/100 mL	External Laboratory Weekly
E-Coli	cfu/100 mL	External Laboratory Weekly
Clostridium perfringes	cfu/100 mL	External Laboratory Weekly
Total Chlorine	mg/L	External Laboratory Weekly
Arsenic (III) -sol	mg/L	External Laboratory Weekly
Boron - sol	mg/L	External Laboratory Weekly
Cadmium - sol	mg/L	External Laboratory Weekly
Chromium (III) - sol	mg/L	External Laboratory Weekly
Copper - sol	mg/L	External Laboratory Weekly
Lead - sol	mg/L	External Laboratory Weekly
Manganese - sol	mg/L	External Laboratory Weekly
Nickel - sol	mg/L	External Laboratory Weekly
Selenium - sol	mg/L	External Laboratory Weekly
Silver sol	mg/L	External Laboratory Weekly
Zinc-sol	mg/L	External Laboratory Weekly
Mercury (inorganic) - sol	mg/L	External Laboratory Weekly
Aluminium - sol	mg/L	External Laboratory Weekly
Iron - sol	mg/L	External Laboratory Weekly
Sulphate	mg/L	External Laboratory Weekly
TOC	mg/L	External Laboratory Weekly

Total Nitrogen	mg/L	External Laboratory	Weekly
Ammonia	mg/L	External Laboratory	Weekly
Total inorganic nitrogen	mg/L	External Laboratory	Weekly
Total Phosphorous	mg/L	External Laboratory	Weekly
Turbidity	mg/L	External Laboratory	Weekly
Suspended solids	mg/L	External Laboratory	Weekly
TDS	mg/L	External Laboratory	Weekly

9.10 Water Quality Monitoring at Customer sites

9.10.1 Treated water quality will be monitored at the agreed delivery points at Swanbank Power station. The samples will be collected and tested by the customer with duplicate testing performed by Veolia Water Australia. Results will be supplied to both parties via monthly reports and immediate reporting will occur in the case of a critical control exceedence.

9.10.2 The on-line monitoring and other parameters monitored on the treated water tank and on the treated water delivery pumps are outlined in Table 9-10.

Table 9-10: Customer Site Water Quality Monitoring

Parameters	Unit	Location
Flow	L/s	Supply delivery point
Total Chlorine	mg / L	Weekly – Onsite (Swanbank)
pH		Weekly – Onsite (Swanbank)
Turbidity	NTU	Weekly –External laboratory
E Coli	MPN	Weekly - External laboratory
Clostridium Perfringes	Cfu/ 100 mL	Weekly - External laboratory
F-RNA Coliphages	pfu/100 mL	Weekly - External laboratory
Coliphages	pfu/ 100 mL	Weekly - External laboratory
Ammonia	mg/L	Weekly - External laboratory

9.11 CIP Waste Treatment

9.11.1 All waste from MF and RO CIP's to two CIP waste tanks. The tank is level controlled and will be emptied via a pump to the connection to the municipal sewer to maintain level between a low and high set point.

9.11.2 Before the waste tanks are drained the pH is corrected and any oxidizing agents neutralised by dosing sodium metabisulphite. The tanks are provided with mixers to expedite the neutralisation before discharge.

9.11.3 The on-line monitoring on the CIP waste tank is outlined in Table 9-13.

Table 9-11: CIP Waste Tank Monitoring

Parameters	Unit	Frequency
Tank Level	m	On-line (LIT6902)
CIP waste tank pH/temperature		Online (AIT6914-1)/monthly onsite test
CIP waste tank free chlorine analyser	mg/L	Online (AIT6914-2)/monthly onsite test
CIP waste tank Dissolved oxygen analyser	mg/L	Online (AIT6914-3)

9.12 MF lamella thickener

9.12.1 The MF backwash water will contain relatively high amounts of suspended solids. The MF lamella thickener is designed to remove the solids from the backwash water to allow the supernatant to be recycled to the raw water tank. Coagulant and polymer are added to the backwash to aid settling and remove phosphorous.

9.12.2 The feed to the backwash settler are dosed with coagulant and polymer as well as sulphuric acid and sodium hydroxide to control the pH. The coagulant and polymer dosing set points are manually entered by the operator and flowpaced to the MF backwash recovery flow. The pH correction is automatically controlled by a feedback signal from the on-line pH analyser on the settler feed.

9.12.3 The sludge is abstracted to a solids holding tank, from where it is pumped to trade waste based on level control in the holding tank.

9.12.4 The on-line monitoring on the MF backwash lamella thickener is outlined in Table 9-12.

Table 9-12MF Backwash Lamella thickener Monitoring

Parameters	Unit	Frequency
MF backwash recovery flow	L/s	On-line (FIT1703)
pH (settler feed)		On-line (AIT6124)/ weekly onsite test
Coagulant flow rate	L/Hr	On-line (FIT4022)
Polymer feed rate	L/Hr	Calculated from pump speed, stroke

		length and density
NaOH flow rate	L/hr	On-line (FIT6733)
H_2SO_4 flow rate	L/hr	On-line (FIT4443)
Sludge flow rate (to solids holding tank influent)	L/s	On-line (FIT6401)
Solids holding tank level transmitter		Online (LIT6401)
Turbidity (supernatant)	Ntu	Online (AIT6101 and 6102) Weekly onsite test

9.13 ROC Waste Tank, Solids Contact Clarifier and Denitrification

9.13.1 The concentrate from the RO and the backwash from the denitrification filters are collected in the ROC waste tank where the flow is balanced to provide a controlled flow rate to the ROC solids contact clarifier. The ROC waste tank will have a high level alarm which will stop the plant if unattended to prevent ROC tank overflow to the environment

9.13.2 Breakpoint chlorination will be used to remove any ammonia and combined chlorine from the ROC. Sodium hypochlorite will be dosed to the influent to the ROC waste tank into MIX3803. Sodium hypochlorite dosing is controlled with feed forward control from the ammonia and total chlorine analysers and ROC flow (totalised from the ROC flows from RO trains) with feedback trimming from free chlorine analyser downstream of MIX3803. The aim is to dose enough sodium hypochlorite to oxidise all ammonia and nitrogen combined chlorine to nitrogen gas, monitored by generating a small amount of free chlorine.

9.13.3 Any free chlorine remaining after contact time in the ROC waste tank will be reduced by dosing sodium metabisulphite into MIX0004. The Sodium metabisulphite dosing is controlled with an operator setpoint and flowpaced to the ROC SC clarifier inlet flow.

9.13.4 The Coagulant dosing is designed to remove phosphorous from the ROC prior to discharge to the environment to ensure the conditions set by the EPA is met. Coagulant dose rate is operator set, and flowpaced to the ROC clarifier flow.

9.13.5 The optimum pH for coagulation is controlled with sodium hydroxide and sulphuric acid dosing using a PID loop from pH analyser on the ROC SC clarifier upstream of the chemical addition in MIX0005.

9.13.6 The denitrification filter is designed to remove nitrate from the ROC to meet the EPA conditions for discharge to the environment. The denitrification filters remove nitrate through biological reduction of nitrate to nitrogen gas which requires the addition of methanol or other easily biodegradable organic compound to allow the biological reaction to proceed. The denitrification filters are backwashed using uses ROC solid contact clarifier supernatant, to remove excess biological mass to allow for the throughput to be maintained.

9.13.7 Methanol (or other carbon source) is dosed to the denitrification filter feed according to an operator entered set point and flowpaced to the denitrification filter feed flowrate.

9.13.8 The on-line monitoring on the CIP waste tank is outlined in Table 9-13.

Table 9-13 ROC Waste Tank, SC clarifier and Denitrification Monitoring

Parameters	Unit	Frequency
Level in Waste tank	M	On-line (LIT3802)
ROC waste tank influent ammonia upstream MIX3803	Mg/L	On-line (AIT TBA) daily onsite test
ROC waste tank influent total chlorine upstream MIX3803	Mg/L	On-line (AIT TBA) daily onsite test
ROC waste tank influent ammonia downstream MIX3803	Mg/L	On-line (AIT TBA) daily onsite test
ROC waste tank influent free chlorine downstream MIX3803	Mg/L	On-line (AIT TBA) daily onsite test
ROC SC clarifier inlet flow	L/s	On-line (FIT6201-1 and 6202-1)
ROC SC clarifier sludge flow	L/s	On-line (FIT6201-2 and 6202-2)
ROC SC clarifier inlet free chlorine		Online (AIT6200-1)/ daily onsite test
ROC SC clarifier inlet turbidity	Ntu	Online (AIT6200-3)/ weekly onsite test
ROC SC clarifier inlet phosphorous	Mg/L	Online (AIT6200-4)/ weekly onsite test
ROC SC clarifier inlet pH/temp		Online (AIT6200-5)/ weekly onsite test
ROC SC clarifier inlet chloramine/ammonia	Mg/L	Online (AIT6200-6)/ daily onsite test
ROC SC clarifier discharge phosphate	Mg/L	Online (AIT6201-1, 6202-1) weekly onsite test
ROC SC clarifier discharge turbidity	Ntu	Online (AIT6201-2, 6202-2) weekly onsite test
ROC SC clarifier discharge pH/temp		Online (AIT6201-3, 6202-3) weekly onsite test
ROC SC clarifier discharge Free Chlorine		Online (AIT6201-4, 6202-4) Daily onsite test
Coagulant flow rate	L/Hr	On-line (FIT4023)

NaOH flow rate	L/hr	On-line (FIT6734)
H_2SO_4 flow rate to ROC clarifier	L/hr	On-line(FIT4422)
$Na_2S_2O_5$ flow rate	L/hr	On-line (FIT6833)
Nitrate (denitrification influent and effluent)	Mg/L	On-line (AIT6307)/weekly onsite test
Methanol dosing	L/Hr	Online (FIT4721 and 4722)
Flowrate to denitrification filters	L/s	Online (FIT 6311-1 and 6312-1 and 6313-1)
5-day Biochemical Oxygen Demand (inhibited)	mg/l	Weekly, external laboratory
Suspended Solids	mg/L	Weekly, external laboratory
Suspended Solids	mg/l	Weekly, external laboratory
Suspended Solids	mg/l	Weekly, external laboratory
pH		Weekly, external laboratory
Enterococci	Organisms/100 mL	Weekly, external laboratory (minimum of 5 samples taken at not less than half-hourly intervals in any one day).
Arsenic (III) (sol)	ug/L	Weekly, external laboratory
Arsenic (V) (sol)	ug/L	Weekly, external laboratory
Barium (sol)	ug/L	Weekly, external laboratory
Cadmium (sol)	ug/L	Weekly, external laboratory
Chromium (III) (sol)	ug/L	Weekly, external laboratory
Chromium (IV) (sol)	ug/L	Weekly, external laboratory
Cobalt (sol)	ug/L	Weekly, external laboratory
Copper (sol)	ug/L	Weekly, external laboratory
Lead (sol)	ug/L	Weekly, external laboratory
Manganese (sol)	ug/L	Weekly, external laboratory
Mercury (inorganic) (sol)	ug/L	Weekly, external laboratory
Nickel (sol)	ug/L	Weekly, external laboratory
Selenium (sol)	ug/L	Weekly, external laboratory
Silver (sol)	ug/L	Weekly, external laboratory
Zinc (sol)	ug/L	Weekly, external laboratory
Calcium Carbonate Precipitation Potential (CCPP)	mg/L	Weekly, external laboratory
Nitrosodimethylamine (NDMA)	nano-g/l	Weekly, external laboratory
Estrone	nano-g/l	Weekly, external laboratory
17-beta estradiol (E2)	nano-g/l	Weekly, external laboratory

Ethinylestradiol (EE2)	nano-g/l	Weekly, external laboratory
Total PNEC	nano-g/l	Weekly, external laboratory
Nonlyphenol (NP)	nano-g/l	Weekly, external laboratory

9.14 Trade Waste Monitoring

9.14.1 All floor drains, domestic waste and the CIP waste tanks drain to the municipal sewer via a trade waste pumping station. The sludge holding tank is also pumped to trade waste via a separate line.

9.14.2 The trade waste pump sump will be monitored for pH and pH can be manually adjusted if outside the specification of the trade waste permit.

9.14.3 A composite sampler will take flow integrated composite samples from the trade waste pump sump on a daily basis and some onsite tests will be conducted. External laboratory analyses will be performed on a weekly basis.

9.14.4 The monitoring on trade waste is shown in Table 9-14

Table 9-14 Trade waste pump sump and sludge holding tank monitoring

Parameters	Unit	Frequency
pH (trade waste sump)		On-line (AIT6124)/ weekly onsite test
COD		Daily Onsite test/ weekly external lab test
pH		Daily Onsite test/ weekly external lab test
Turbidity		Daily Onsite test/ weekly external lab test
Total and soluble Phosphorous		weekly external lab test
Total Nitrogen		weekly external lab test

10. OPERATIONAL AND EXTERNAL LABORATORY VERIFICATION SCHEDULES

10.1.1 Three schedules describe the process verification.

10.1.2 The Environmental test schedule (FM-GWA-WC-401) shows the external laboratory analyses that will be performed on the treated ROC and receiving water to comply with the requirements of the discharge conditions set by the EPA as set out in section 5 of this document.

10.1.3 The Operational Verification Schedule (FM-GWA-WC-2021) shows the online monitoring that will be used for process verification as well as the onsite tests required to verify online analyser accuracy. All locations and purpose of online monitoring is described in Section 9 of this document.

10.1.4 The External Laboratory Verification Schedule (FM-GWA-WC-2022) shows the analyses that will be performed by NATA accredited laboratory facilities to verify that the purified water quality complies with the required quality as set out in section 5 of this document as well as all the requirements of the Recycled Water Management Plan (PL-GWA-WC-2000).

11. REPORTING

11.1 Process Reporting

11.1.1 Effective collation and communication of key process performance data will be essential to the efficient operation of the treatment process. The process reports will be used daily by the operations staff for process optimisation and decision making.

11.1.2 Reports will be collated manually using data trended on the plant SCADA system in addition to automatic reports provided by the SCADA system as well as data generated by onsite testing.

11.1.3 The process reporting function will be managed by the process engineer and process manager. The Process Engineer's role will include:

- monitoring and reporting the process performance using daily/weekly reporting and preparing the monthly process report
- optimisation of plant operations
- work on projects for process improvement and optimisation
- provision of advice and assistance to the operators
- management of on-site R&D projects..

11.1.4 Daily Reporting

The daily report will include:

- daily onsite laboratory water quality;
- key on-line measurements;
- chemical dose rates, usage and stocks;

- flow rates for raw and treated water, wastewater discharge and various stages through the plant;
- key performance parameters from the each treatment stage;
- recovery rate;
- plant efficiency;
- energy consumption;
- process alarms and event log data;
- operational issues.
- lost time

11.1.5 Monthly Reporting

A monthly process meeting will be held and attended by the process engineer, plant manager, compliance manager and process manager and other key operations staff. The meeting will review the plant performance through the process report and discuss process and optimisation issues.

In addition the process engineer will prepare a detailed monthly process report. It will focus on:

- AWTP feed water quality - Main raw water quality parameters recorded daily. Review of monthly and annual variations in AWTP feed water quality. Any comments, significant changes or issues related to the raw water quality.
- Plant production - Total production of treated water, treatment efficiency.
- Process – Covering each step of the treatment process: Chemical dose rates, filter runtimes, RO performance, waste production etc.
- Final treated water quality.
- Power consumption & operating costs.

•

11.2Compliance Reporting

Swanbank Power Station, Ipswich City Council and the EPA require compliance reporting. The manager Environment and Water Quality will compile and submit the compliance reports. Compliance reports would include the following:

- Purified Recycled Water quality reporting to Swanbank (Monthly).
- AWTP feed water characterisation and regular risk assessment reporting to Ipswich City Council (Monthly).
- EPA water quality reporting (Annually).
- Trade waste quality reporting to Ipswich City Council (Monthly).
- Water quality reporting to DNRW and QH (Quarterly)

APPENDIX 2f - How will you protect public health, water quality and the environment?

Preliminary risk assessment – HACCP Analysis

Preliminary risk assessment - Risk register

Details on waste disposal/management from Exhibit O

VEOLIA
WATER

WATER QUALITY MANAGEMENT & CCP ANALYSES												
Activity or Process Step	Decision Tree					CCP/QCP	Potential Hazards	Monitoring	Critical Limits	Corrective Actions	Supporting programs	Records
	Q1	Q2	Q3	Q4	Q5							
Wastewater Treatment	Y	Y	Y			CCP	BOD	(DO)				
Diversion of untreated and poorly treated wastewater	Y	Y	Y			CCP	Wet weather event causes Micro organisms, organic pullutants, heavy metals.					
Treated wastewater offtake on LAP online measurement and shutdown at WRP	Y	Y	N	N		QCP	Micro organisms, organic pullutants, heavy metals					
Chemical dosing (chloramine)	N			N		No	Free chlorine and chloramine - not a health hazard					
Micro filtration	Y	Y	Y			CCP	Bacteria and Protozoa and viruses					
Reverse Osmosis	Y	Y	Y			CCP	Ammonia, phosphorus, organic pollutants, heavy metals, micro organisms					
Ion exchange	Y	Y	Y			CCP*	Ammonia. (may not be health or environmental hazard)					
Chlorination and 1 hour retention	Y	Y	Y			CCP	Bacteria and Protozoa and viruses	Monitoring on distribution system				
Treated recycled water offtake point monitoring	Y	Y	N	N		QCP	Ammonia, phosphorus, organic pollutants, heavy metals, micro organisms					
Distribution line chlorine boosting	N						Bacteria and Protozoa and viruses					
Irrigation practices												
Discharge - unintentional							Erosion from mains breaks					
Storage in lakes							Ammonia, phosphorus, nitrogen,chlorine					
Cooling tower uses												

Explanation for selection of control parameters

VEOLIA WATER

Risk Assessment Conducted On (Date): 15/09/08
Risk Assessment Recorded By: Annalie Rou
Risk Assessment Conducted By: Annalie Rou
Next Risk Review Due:
Context of the Risk Workshop Raw Sewag

Ref No.	Risk Category	Assessment Category	Risk Title	What could go wrong?	Describe the impact if this negative event eventuate.	Do you own this risk? If not, then who is the owner?	Location or Name the application used	Likelihood 5 = Almost certain 4 = Likely 3 = Moderate 2 = Unlikely 1 = Rare	Consequence 4 = Extreme 3 = Major 2 = Moderate 1 = Minor	Inherent Risk Level = Likelihood x Consequence	Current Risk Rating	Describe how existing control activities can mitigate the likelihood or consequence. *(NB: More than 1 controls attached to one risk is allowed. Insert new row to separate control activities)*	Is it a Preventative or Monitoring control?	Control Frequency (Continuous, Daily, Weekly, Monthly, Quarterly, Half-Yearly, Yearly)	Is it a key control? (Y/N) (Critical control)	Is it an automatic (system or application) or manual control?	Who is the owner of this control?	How do you rate the effectiveness of the current control? 1.5 = Very Effective 2 = Effective 4.5 = Ineffective 9 = Very Ineffective 0 = No Control	Likelihood 5 = Almost certain 4 = Likely 3 = Moderate 2 = Unlikely 1 = Rare	Consequence 4 = Extreme 3 = Major 2 = Moderate 1 = Minor	Mitigated Risk Level = Likelihood x Consequence	Mitigated Risk Rating
	Public Health	Water Quality - chemical	Ammonia	Legionaire's disease infection resulting from poorly disinfected cooling tower water (ammonia in recycled water exceed specification of 1 mg/L (raw sewage can contain up to 40 mg/L)	Cooling tower disinfection processes compromised. - one or more cases per year of legionaire's disease	WRP		3	3	9	High	Existing WWTP do not have any ammonia remoal Reverse osmosis will remove 80% of ammonia	Preventative	Continuous	Y	Automatic		1.5	1	3	3	Low
												Ion exchange remove additional ammonia to reach <1 mg/L of ammonia in recycled water	Preventative	Continuous	Y	Automatic						
												Chlorination -dose to free chlorine setpoint break - some ammonia	Preventative	Continuous	N	Automatic						
	Environmental	Water Quality - Chem	Phosphorus	High phosphorus in Rosehill racecourse dam could cause proliferation of blue green algae (around 9 mg/L in raw sewage)	High level of algae could block up irrigation system - blue green algae toxins could cause health impacts on ingestion	WRP		2	2	4	Medium	No P-removal at WWTP Reverse Osmosis - 99% removal	Preventative	Continuous	Y	Automatic		1.5	**1**	2	2	Low
	Public Health	Water Quality - Biological	Viruses	Pathogenic viruses present in raw sewage can cause illness when ingested. Exposure assessment revealed the maximum log removal required for viruses from raw sewage is 6.5.	Ingestion of recycled water through exposure to use of recycled water in industry and irrigation	WRP		4	3	12	High	WWTP Delivery of diversion system to ensure only secondary treated effluent is discharged into LAP Montoring on LAP - can decide to take or not based on surrogates such as SCAN	Preventative	Continuous	Y	Automatic		1.5	1	3	3	Low
												Microfiltration	Preventative	Continuous	Y							
												Reverse Osmosis	Preventative	Continuous	Y							
												Chlorination at plant - residual 0.7-5 mg/L, 95 percentile 3 mg/L.- 1 hour contact time	Preventative	Continuous	Y							
	Public health	Water Quality - Biological	Viruses in pipeline	Contamination occur in treated recycled water pipeline, mains break, huge amount of dirt - pumped system - pressure system	Illness caused in population exposed to water used in industry and irrigation	Aquanet/Jemena		1	3	3	Low	Maintaining chlorine residual In pipeline Backflow prevention and air gaps at customer end										
	Public Health	Water Quality - Biological	Bacteria	Pathogenic bacteria present in raw sewage can cause illness when ingested. Exposure assessment revealed the maximum log removal required for viruses from raw sewage is 5.3	Illness caused by ingestion of pathogens in recycled water through exposure to use of recycled water in firefighting, industry and irrigation			4	3	12	High	WWTP Delivery of diversion system to ensure only secondary treated effluent is discharged into LAP Montoring on LAP - can decide to take or not based on surrogates such as SCAN	Preventative	Continuous	Y	Automatic		1.5	1	3	3	Low
												Microfiltration	Preventative	Continuous	Y							
												Reverse Osmosis	Preventative	Continuous	Y							
												Chlorination at plant - residual 0.7-5 mg/L, 95 percentile 3 mg/L.- 1 hour contact time	Preventative	Continuous	Y							
												Treated water spec requires protoxzoa indicators to be <1/50 L.	Monitoring	Monthly	N							
	Public health	Water Quality - Biological	Bacteria in pipeline	Regrowth or Contamination occur in treated recycled water pipeline (short retention, covered storages and plastic pipes reduce inherent likelihood	Illness caused in population exposed to water used in idnustry and irrigation	Aquanet/Jemena		2	3	6	Medium	Maintaining chlorine residual - chlorine boosting in pipeline (this does not impact entire pipeline)	Preventative	Continuous	N	Automatic			2	3	6	Moderate
	Public Health	Water Quality - Biological	Protozoa	Pathogenic protozoa present in raw sewage can cause illness when ingested. Exposure assessment revealed the maximum log removal required for viruses from raw sewage is 5.1.	Illness cause by Ingestion of protozoa in recycled water through exposure to use of recycled water in industry and irrigation			4	3	12	High	WWTP Delivery of diversion system to ensure only secondary treated effluent is discharged into LAP Montoring on LAP - can decide to take or not based on surrogates such as SCAN	Preventative	Continuous	Y	Automatic		1.5	1	3	3	Low
												Microfiltration	Preventative	Continuous	Y							
												Reverse Osmosis	Preventative	Continuous	Y							
												Chlorination at plant - residual 0.7-5 mg/L, 95 percentile 3 mg/L.- 1 hour contact time (not for cryptosporidium)	Preventative	Continuous	Y							
												Treated water spec requires protozoa indicators to be <1/50 L.	Monitoring	Monthly	N							
	Public health	Water Quality - Biological	Protozoa in pipeline	Contamination occur in treated recycled water pipeline (refer to virus assessment) - covered storages would prevent recontamination	Illness caused in population exposed to water used in idnustry and irrigation	Aquanet/Jemena						Maintaining chlorine residual In pipeline	Preventative	Continuous	Y	Automatic			2	3	6	Moderate
	Public health	water Quality Chemical	Heavy metals	Ingestion of heavy metals could lead to long term health effects.	Levels in treated waste water generally below health guideline values for drinking water - no risk at levels of exposure assessed			1	1	1	Low	Reverse osmosis removal >99% for all heavy metals (divalent)	Preventative	Continuous	Y	Automatic		1.5	1	1	1	Low
	Public health	water Quality Chemical	Organic micro pollutants (herbicides, pesticides, pharmaceuticals, hormones, THMS)	Ingestion of micro pollutants could lead to long term health effects.	Levels in treated waste water generally below health guideline values for drinking water - no risk at levels of exposure assessed			1	1	1	Low	Reverse Osmosis	Preventative	Continuous	Y	Automatic		1.5	1	1	1	Low
	Environmental	Water Quality - chemical	Salinity	High saline water is irrigated onto racecourse	High salinity in irrigation water can lead to sodificatioin of soil and limit plant growth			3	2	6	Medium	Reverse Osmosis removes TDS	Preventative	Continuour	Y	Automatic		1.5	1	2	2	Low
	Environmental	Water Quality - chemical	Boron	Boron > 1 could impact certain plants used by irrigation customer	Boron can impact grasses used in golf courses					0	Low										0	Low
										0	Low										0	Low
										0	Low										0	Low
										0	Low										0	Low
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										0	Low										0	Low
										0	Low										0	Low
										0	Low										0	Low

x

x, Troy Walker, Viviann Zavlanos, Vince Edmondstone, Kate Browning, Craig Balthes

e is assessed as source

						Not Mandatory				
Accept? (Y/N)	**If the mitigated risk level is rated high or extreme and is accepted, justification must be provided and required Senior Management's approval.**	**Describe the action to be taken to further mitigate (likelihood or consequence) and ensure that the mitigated risk level is within the Company risk appetite.**	**Action by Name**	**Action Due Date**	**Action Status**	**Likelihood** 5 = Almost certain 4 = Likely 3 = Moderate 2 = Unlikely 1 = Rare	**Consequence** 4 = Extreme 3 = Major 3 = Moderate 2 = Minor	**Projected Risk Level =** Likelihood x Consequence	**Projected Risk Rating**	**Comments**
Y								0	Low	
								0	Low	
								0	Low	
								0	Low	
								0	Low	
		Obtain records of salt rejection properties of membranes and supplier specification						0	Low	
		Obtain records of salt rejection properties of membranes and supplier specification						0	Low	
								0	Low	
								0	Low	
								0	Low	
								0	Low	
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								0	Low	
								0	Low	
								0	Low	

TABLE OF CONTENTS

List of Tables

List of Figures

Attachments

Attachment 1 – Process Flow Diagram
Attachment 2 – Plant Site Layout

Exhibit O –Specification

1. Recycled Water Plant Process Description

Figure 1 summarises the process elements to be included as part of the recycled water treatment plant.

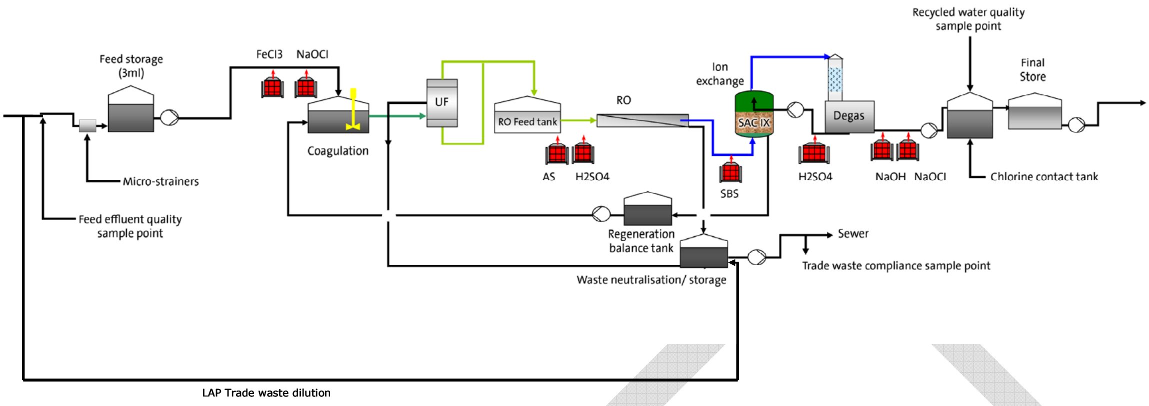


Figure 1 Recycled Water Process Description

See **Attachment 1** for a more detailed overall process flow diagram.

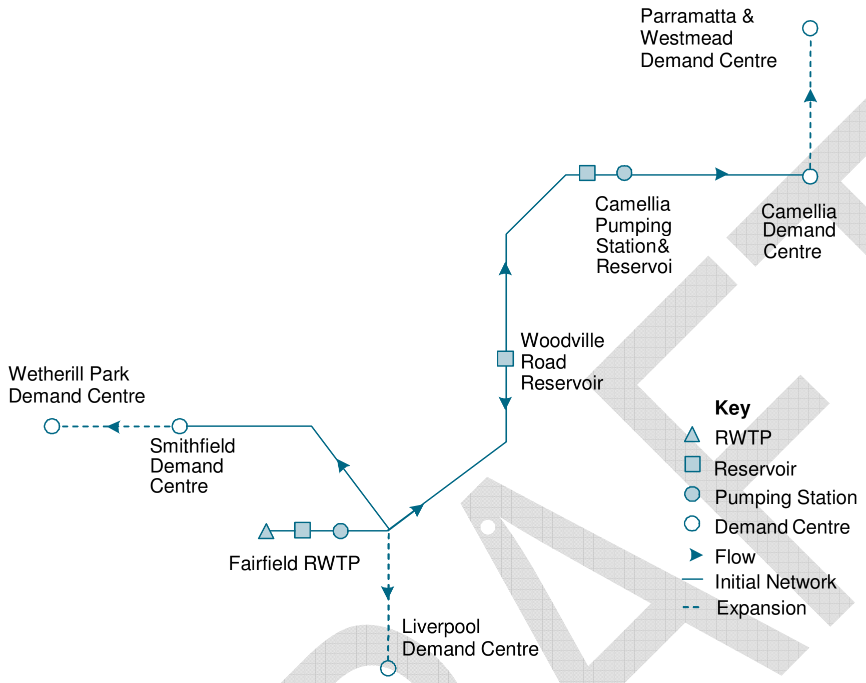
The Plant is designed for 24-hour/day operation and includes:

- A 3 ML/d effluent storage tank to the inlet of the plant in order to maintain effluent supply in the event of short-term excursions in effluent quality, and to buffer some of the diurnal flows which may be present in the LAP.
- A 3ML recycled water storage tank at the outlet of the plant
- Submerged UF system.
- Basket strainers.
- Cation Exchange Unit.
- Degasser tower.
- A detention tank with 1 hour detention time. The monitoring point for recycled water quality will be at the outlet of the detention tank, which is after all chemical dosing, including pH adjustment.
- Automatic operation, including start-up and shutdown procedures.
- Coagulation and flocculation for oil & grease and phosphorus removal. This will also result in some reduction in the TOC and BOD of the incoming effluent.
- Submerged UF membranes.
- Two-stage RO process.
- Cation exchange for polishing of RO permeate.
- Degassing, pH control and chlorination.
- Automatic control of RO recovery and flow.
- Automatic UF Clean In Place (CIP) including CIP solution batching (with ability to change the concentrations of the chemical cleaning solutions).
- Semi-automatic batching of RO CIP solutions.
- Automatic control of dosing pumps in response to process flow and measured process parameters.
- Data-logging and on-line normalisation of RO operating data.
- Multilevel access to plant control settings and set-point adjustment.
- Diagnostic plant alarms to detect possible faults before they compromise plant operation.
- A high level of instrumentation for process monitoring and control.

2. Recycled Water Network Description

The network consists of approximately 20km of mains, two pumping stations and two water storage locations within the network. Additional recycled water storage is provided at the Fairfield treatment plant. The distribution system will be split into two key zones based on the demand centres of Smithfield and Camellia/Rosehill.

A schematic diagram of the distribution network (and the potential for future network expansion) is provided below.



3. Recycled Water System Capacity

The Plant has been designed to produce a net continuous output of 20 ML/d of nominal 50mg/L TDS grade recycled water.

The Plant capacity is as follows:

- Design continuous production rate – 20,000 kL/day and;
- The initial design capacity of the plant during full normal operation is 20 ML/d, it will be possible to run the plant for short periods of time at a higher peak capacity, the exact value of this peak capacity will be confirmed during detailed design (with average or better feedwater quality).

The Plant is to be designed to be readily upgradeable to a capacity of 25 ML/d to cater for further expansion of the market. Veolia will achieve this by:

- Designing the Plant layout to accommodate a 25 ML/d Plant;
- Designing the Plant hydraulics to accommodate a 25 ML/d Plant;
- Where required, providing pipework with blank flanges for the addition of process units, thereby ensuring minimal disruptions to existing Operations during any upgrade works;
- Designing the initial RO trains with the capacity to expand from a 20 ML/d plant to a 25 ML/d plant;

- Sizing chemical storage facilities for 24 + 7-day storage capacity at 25 ML/d production;
- Sizing the feed effluent tank, all intermediate tanks and the chlorine detention tank to have sufficient capacity to handle the increase in flow; and
- Sizing the degasser tower for the 25 ML/d production.

3.1 LAP Effluent Volume Requirements

The maximum volume of LAP effluent required is 32 ML/d for a maximum plant production capacity of 20ML/d.

4. Recycled Water Reliability

4.1 Recycled Water Plant Reliability

The methodologies and key features that contribute to the robustness, operability, flexibility and maintainability are explained in detail in the Operations and Asset Management Plan. The key features are described below.

4.1.1 Operating Life and Outage Rates

The Plant has been designed with the following operating life:

- Civil works 50 years
- Mechanical Equipment 15 to 20 years
- Major Electrical Equipment 15 to 20 years
- Ultrafiltration (UF) membranes 7 years
- Reverse Osmosis (RO) membranes 5 years.

4.1.2 Robustness, Operability, Flexibility and Maintainability

There are several important aspects of the Plant design that provide flexibility and contribute to the robust nature of the design. These include:

- Turn down – the Plant will be capable of operating at discrete production rates ranging from one RO train on-line to all RO trains on-line (for a limited duration).

- Redundancy –the Plant will have significant equipment and process redundancy including a spare UF and RO train and redundancy in key ancillary systems such as electrical (HV feeders, transformers, switchgear), pumps, chemical dosing pumps, blowers, control system (PLC/SCADA including UPS).

- Recycling – provision of internal recycling capability for the RO permeate to provide flexibility in operations. This will assist in situations where feed effluent is above normal design limits or where plant performance is reduced. The recycling of a portion of permeate will ensure that in-specification recycled water continues to be produced during poor feed quality or poor membrane performance events (this will have an obvious reduction in the plant output capacity).

- Design basis – the selection of the 90%ile feed effluent quality as the plant design basis ensures that normally the plant will be treating effluent that is of better quality than it is capable of treating. This will provide a more robust plant with increased operability and flexibility for 90% of the operations.

- Storages –included for both feed effluent from the LAP and for recycled water including:

- 3 ML feed storage tank to provide approximately 2.5 hours of continued plant operation at the design production of 20 ML/d without the need for any feed from the LAP. At average customer demand this would extend to almost 5 hours of uninterrupted plant operation; and

- On-site storage supplemented with network storages to provide for up to 24 hours of Plant outage (at average daily demand) before the supply to customers would be affected.

- Instrumentation and controls will be provided to allow all important plant parameters to be continuously monitored. All on-line instruments will be monitored by the Plant SCADA system so that the operators are continuously aware of the water quality and plant reliability issues.

4.1.3 Membrane Processes – reliability, interchangeability and spares availability

Two key components of the Plant are the UF and RO membranes.

The UF membranes will be the Siemens Memcor S10V system.

The RO membranes will be standard eight-inch TFC membranes which are well proven in the water treatment industry. Most RO membrane manufacturers are offering a five-year pro-rata warranty when UF pre-treatment is used. Final selection of the RO membrane supplier will be made after validation of performance in the pilot trials.

4.1.4 Power Supply Reliability

The Plant will be provided with the capability for a diesel generator to be connected to provide power in the event of long term power outages (greater than 24 hours). This will ensure that the plant will be able to operate (if required) to supply recycled water to customers in this situation. The network pumping stations will also be capable of being powered by portable generators if required. Testing of the plant under diesel generator power supply will be conducted as part of emergency scenario training.

4.1.5 Key equipment Mean Time Before Failure (MTBF) and Mean Time To Repair (MTTR)

The Operations and Asset Management Plan for the Plant provides details on the maintenance strategies that will be employed to maximise the reliability of the Plant. The Plant is a membrane plant and therefore as noted above the key components of the process are the ultra-filtration and reverse osmosis membranes.

5. Use of Potable Water

Where AquaNet requires potable top-up water at the Plant site, the required flow rate, pressure and approximate location AquaNet will use are:

- 3.1 ML/d at a minimum pressure of 43 m head from the 200 mm main which is located in East Parade Fairfield, near the entrance to Fairfield Storm Sewerage Treatment Plant (SSTP).

Table 1: Use of Potable Water

Proposed Design - Use of Potable Water					
ID	**Project Phase (eg construction, operation)**	**Description/Purpose (eg Plant process supply, Plant domestic supply, top-up supply)**	**Location (eg Plant, reservoir location)**	**Flow Rate Required (ML/d)**	**Pressure Required (m)**
PW3	Operation	Top up Water	Fairfield Reservoir	3.1 max	10
PW4	Operation	Plant Domestic Supply	Plant	~ 0.001 (1kL/day)	Standard

6. RWTP & Facility Waste Management During all Phases –

6.1 Plant Waste Management During Commissioning

During the wet commissioning all effluent or potable water that is used will be discharged at a low rate to the sewer. Temporary and permanent recycle lines will be utilised during the wet commissioning period to minimise the use of potable water and/or effluent and to reduce the quantity to be discharged to the sewer.

To prove the Plant, a 10 day proof test will be conducted. The Plant will be operated normally during this proofing period with the recycled water that is produced returned to the LAP via a temporary connection downstream of the feed effluent off-take. The recycled water pipeline transferring water from the Plant to customers will be cross-connected to the LAP during the proofing period to allow discharge of recycled water produced during the commissioning phase of the Plant. The cross connection pipe work will be sized to deliver the 20ML/d produced by the Plant into the LAP. Upon completion of the commissioning, the cross-connection will be shut-off and sacrificed. For a short period of the proof test the recycled water may be pumped into the network, but no recycled water will be supplied to the customers. Any recycled water pumped into the network will be discharged to the sewer via the scour valves. During the proof test a rigorous sampling and analysis program will be implemented to ensure that the recycled water meets the requirements of Tables 1 and 2 in Exhibit M and complies with the National Guidelines for Water Recycling.

6.2 Plant Waste Management During Operations

Process wastes from the water recycling process will form the majority of wastes discharged from the Plant site during Operations. These wastes will be discharged to sewer in accordance with a trade waste consent. In accordance with SWC's Trade Waste Management Plan for Industrial Customers, AquaNet will pay a fee only for the additional load of substances discharged back to the sewer. However, SWC has advised AquaNet that regardless of whether any additional load is added, there are limits to the quality and quantity of trade waste that SWC can accept.

The Plant is to be designed to minimise the volume of waste discharged to the sewer without threatening membrane life or the Plant's ability to treat effluent of varying quality. LAP effluent may be used to dilute the Plant waste stream in order to meet the trade waste discharge limits, specifically the ammonia discharge limit of 100mg/L. The volume of dilution water and ultimately the volume of waste discharged to the sewer must be minimised at all times to avoid jeopardising SWC's ability to achieve its target overflow levels of a maximum of 40 overflow events per ten years.

A maximum volume of 4ML/d of LAP effluent may be used for waste dilution, based on a LAP effluent 90%ile ammonia concentration of 33mg/L at maximum plant production of 20ML/d. The total volume of waste discharged to sewer under these circumstances is 12.2ML/d. When the concentration of ammonia in the LAP is less than or equal to its 50%ile level of 28 mg/L, no dilution will be required and 8.2 ML/d will be discharged to sewer at 20 ML/d production.

Other contaminants in the trade waste stream are anticipated to be well below their respective acceptance standards. Monitoring for these contaminants will be determined in conjunction with SWC when Veolia and SWC negotiate the Trade Waste consent to discharge industrial trade wastewater. SWC will use a risk index to determine the terms of the consent and frequency of ongoing monitoring.

An example of a possible trade waste monitoring program is shown below in Table 2.

Table 2: Example of possible trade waste monitoring program

Analyte	Type	Frequency
Suspended solids	Composite	Quarterly
BOD5	Composite	Quarterly
Grease	Composite	Quarterly
Ammonia	Composite	Quarterly
Nitrogen	Composite	Quarterly
Phosphorus	Composite	Quarterly
Aluminium	Composite	Quarterly
Arsenic	Composite	Quarterly
Barium	Composite	Quarterly
Benzene	Composite	Quarterly
Boron	Composite	Quarterly
Bromine	Composite	Quarterly
Cadmium	Composite	Quarterly
Chlorinated phenolics	Composite	Quarterly
Chlorine	Composite	Quarterly
Chromium	Composite	Quarterly
Cobalt	Composite	Quarterly
Copper	Composite	Quarterly
Cyanide	Composite	Quarterly
Fluoride	Composite	Quarterly
Formaldehyde	Composite	Quarterly
General pesticides	Composite	Quarterly
Herbicides and defoliants	Composite	Quarterly
Iron	Composite	Quarterly
Lead	Composite	Quarterly
Manganese	Composite	Quarterly
Mercaptans	Composite	Quarterly
Mercury	Composite	Quarterly
Molybdenum	Composite	Quarterly
Nickel	Composite	Quarterly
Organoarsenic compounds	Composite	Quarterly
Phosphorus	Composite	Quarterly
Petroleum hydrocarbons (flammable)	Composite	Quarterly
Phenolic compounds (non-chlorinated)	Composite	Quarterly
Polynuclear aromatic hydrocarbons	Composite	Quarterly
Selenium	Composite	Quarterly
Silver	Composite	Quarterly
Sulphide	Composite	Quarterly
Sulphite	Composite	Quarterly
Thiosulphate	Composite	Quarterly
Tin	Composite	Quarterly
Uranium	Composite	Quarterly
Volatile halocarbons	Composite	Quarterly
Zinc	Composite	Quarterly

6.2.1 Neutralisation Pit

The Plant will include a neutralisation pit. All chemical waste from the Plant including UF and RO CIP waste, tank bund drains and chemical unloading bay drains will be discharged to the neutralisation pit. The chemical wastes will be recirculated and neutralised by batch dosing of either sulphuric acid or caustic soda. Once the waste solution has been neutralised, it will be transferred at a slow rate to the wastewater pit.

6.2.2 Wastewater Pit

The wastewater pit receives UF backwash effluent, neutralised waste and RO concentrate for subsequent disposal. It also receives intermittent transfers from the neutralisation pit.

Table 3 summarises the residual and waste streams at the design recycled water production of 20 ML/d. These flows do not include any required dilution water to meet the trade waste acceptance standards.

Table 3: Residual and waste streams frequencies and volumes

Stream	Estimated volume	Frequency	Total estimated annual volume	Average daily volume
Basket strainer backwash water	1.4 L/s	Continuous	66.2 ML	181.4 kL
UF backwash water		1 backwash per 28 minutes	1040 ML	2.95 ML
UF chemically-enhanced backwash residual	19/1 kL	1 CEB per 2 days per unit	17.43 ML	47.75 kL
Used UF clean-in-place solution	38.1 kL	1 clean per 21 days per unit	3.32 ML	9.1 kL
RO concentrate	5.0 ML/d	Continuous	1829 ML	5.0 ML
Used RO clean-in-place solution (acid)	7.0 kL	1 CIP per 70 days per train	0.29 ML	0.8 kL
Used RO clean-in-place solution (alkaline)	7.0 kL	1 CIP per 70 days per train	0.29 ML	0.8 kL
RO flush water	25 kL	3.5 trains flushed daily	31.9 ML	87.5 kL

The combined waste that is pumped from the waste water pit will be maintained below the trade waste acceptance standard for ammonia by dilution with secondary treated effluent taken directly from the LAP, as outlined above or through another method agreed between AquaNet and SWC.

From time to time, neutralised chemical waste will be transferred from the neutralisation pit at a controlled rate to afford maximum dilution with the other waste streams. On such occasions, an increase in chloride and sulphate concentrations will occur for short periods of time. The combined wastewater discharge will have an average dissolved solid content of 2 g/L. The combined wastewater water is pumped by one of 2 x 100% wastewater pumps to the nearby sewer connection.

6.2.3 Disposal of Out-of-Specification Recycled Water

There may be occasions during the operation of the Plant when the recycled water quality does not meet the specification detailed in Tables 1 and 2 of the Service Delivery Outcome Specification.

Out of specification recycled water falls into two categories:

1. Failure to meet the recycled water quality specification as set out in Table 1 of the Service Delivery Outcome Specification.
2. A recycled water product failure incident, defined as the failure to meet the recycled water limits set out in Table 2 of the Service Delivery Outcome Specification.

In the event that the water quality is out of specification but does not exceed the critical criteria defining a recycled water product failure incident, AquaNet will follow pre-determined protocols during and following these events to ensure proper management of the event, rapid rectification of the recycled water quality and ongoing management to prevent reoccurrence of the event. These protocols will be detailed in the Recycled Water Management Plan.

In most circumstances as soon as a quality excursion is confirmed, the recycled water will be immediately diverted to the wastewater pit for discharge to the sewer (with the concentrate) or recycled internally for further treatment.

As the sewer has a limited capacity, the Plant production will immediately be reduced to the minimum operating rate (1 RO train on-line).

Scours at the Plant will discharge to sewers at locations as specified by SWC on 28 February 2007 and described under Schedule 13 of the Project Agreement,

Table 4 summarises the expected waste characterisation.

Table 4: Expected Waste Characterisation

	Project Phase (eg pilot plant if used, commissioning, operation)	Description of Waste (eg WAS, brine reject filter backwash)	Load (kg/d)	Concentration (% solids)	Flow Rate	Waste Treatment	Waste Storage Required (ML)	Waste Disposal Location	Meet Trade Waste Approval Requirements (ie TSS<600 mg/L)
Conforming Design – Waste Management									
Provide a description of the proposed waste management methodology for all waste streams from the Plant, for all phases of the Recycled Water System from construction to operation, including but not limited to domestic waste, waste activated sludge, brine reject and filter backwash streams									
	Plant Operation	UF backwash and RO	455	37 mg/ L TSS	12.2 ML/d	Neutralisation	TBA	Sewer	Yes
	Plant Operation	Domestic Sewage	<5	Raw Sewage (~280 mg/L TSS)	<10 kL/d	None	None	Sewer	Yes

7. Interfaces and Interconnections

7.1 Plant-Network Connections

7.1.1 High Voltage Connection

Plant HV Installation Provisions – Veolia Scope
The Recycled Water Treatment Plant will be provided with HV switchgear and HV cabling network as per the proposed Power Distribution System Overall Single Line Diagram of Drawing No.B0223-E-1000-01, provided in the RDP Tender Schedule 6 Attachment 3.

Plant HV Switchgear Description – Veolia Scope
Schneider Electric SM6 Merlin Gerlin or equivalent circuit breakers will be installed in the proposed indoor substation comprising of the following switchgear:

- 2 x DM1-W withdrawable circuit breaker panels with S20 relay for protection.
- 2 x DM1-W withdrawable circuit breaker panels with S40 relay for protection and metering, including VTs for incomers.
- 1 x DM1-W withdrawable circuit breaker panel with S40 relay for protection and metering, including VTs for incomers. (Note: this forms part of the network scope and will be the responsibility of the RAJV)

Each switchgear unit will be fitted with a Sepam 1000 Protection and power monitoring system. Each unit will be connected via an Ethernet to Modbus gateway to the PLC system.

Each main HV feeder unit will be fitted with kWh power consuming meters for recording and monitoring the power consuming of the overall Plant operation.
The equipment proposed in this offer has been designed, manufactured and tested in compliance with IEC recommendations.

Plant Feeder Power Transformers Supply and Installation – Veolia Scope
Two off 2 MVA 11/.433 kV TESA oil-filled, ground-mounted transformers for the power supply to the Plant Main 415 V MCC's will be provided as per the proposed HV & LV Single Line Diagram Drawing No.B0223-E-1000-01.

The transformers will be installed in two separate outdoor transformer bays constructed with two-hour rated fire walls as indicated on Drawing No. B0223-C-0001- 01 Site Layout Plan, provided in Attachment 3 of Schedule 6 or the RDP Tender Document.

The two 2 MVA transformers have been selected and arranged so that one transformer is able to service the Plant total power demand requirements, with the unlikely condition if one of the two transformers failed. This transformer arrangement in combination with HV distribution network will provide the best practice redundant power supply to the Recycled Water Treatment Plant.

Fairfield Pumping Station – RAJV Scope
Power supply to Fairfield Pump Station site will be connected to the Plant high voltage supply. A new high voltage supply to the pump station from the high voltage switchroom at the Plant will be provided. This will include provision of an 11kV indoor ring main unit (RMU) complete with isolating switches, earthing switches and circuit breaker for the pump station high voltage supply. The RMU is to be located in the Plant high voltage switchroom adjacent to the RMUs provided for the Plant. The RMU is to be connected by Plant RMUs by busbar or other suitable method.

Separate metering will be provided for the Fairfield recycled water pump station and the Plant. Rosehill Asset Joint Venture (RAJV) will be responsible for the maintenance of the high voltage supply from the switch room to the recycled water pumps. Veolia Water will be responsible for the maintenance of all other HV systems at the Plant.

The HV connection and distribution between the Plant and the RW Pumping Station will be finalised during detailed design and subject to Integral Energy's connection requirements.

7.1.2 Feed Effluent Pipeline

RAJV is responsible for the construction, operation and maintenance of the feed effluent pipeline leading from the LAP offtake to the flange at the Plant site boundary. Veolia is responsible for construction, operation and maintenance of the feed effluent pipeline from the Plant property boundary flange onwards. From that point, Veolia is responsible for all pipework within the Plant site, with the following exceptions:

- the section of pipe which runs from the outlet of the pumping station to the Plant site boundary
- All pipework within the network pumping station at Fairfield

7.1.3 Recycled Water Delivery Pipeline

Veolia is responsible for construction of the recycled water pipe running between the Recycled Water Storage Tank to the Recycled Water Pumping Station, which will terminate with a flange at the building wall or floor inside the Recycled Water Pumping Station. RAJV is responsible for the O&M of this pipeline.

RAJV is responsible for the construction, operation and maintenance of the section of the Recycled Water Delivery Pipeline which runs from the outlet of the Recycled Water Pumping Station to the Plant property boundary

7.1.4 Recycled Water Pumping Station

RAJV is responsible for the construction, operation and maintenance of the pumping station and associated pipework from the flange described in section 7.1.3. This includes all mechanical and electrical equipment associated with the recycled water pumping station.

7.1.5 Trade Waste Discharge line

Veolia is responsible for the construction, operation and maintenance of this pipeline to the Plant property boundary. RAJV is responsible for construction, operation and maintenance of the pipeline from the Plant property boundary to the SWC sewer connection point.

7.1.6 Other Pipework

Veolia is responsible for all other pipework within the Plant site

7.2 Connection to Potable Water System

A potable water supply will be required at the Plant for domestic use. This includes the Plant admin building and safety facilities such as eyewash stations and showers. Veolia is responsible for this connection.

The Plant will also be connected to the existing SWC potable water supply network to provide the system with top-up water supply. The Potable top up connection will be built and maintained by RAJV. The potable connection will run from the 200 mm main, located in East

Parade Fairfield, near the entrance to Fairfield Storm Sewerage Treatment Plant (SSTP and connect to the reservoir

The potable top-up connection will pass through an approved air-gap to prevent back-flow of recycled water into the potable water system. Potable water top-up requirements are detailed in Section 6 of this document.

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7.3 Connection to Liverpool to Ashfield Pipeline (LAP)

The pipeline transferring effluent from the LAP to the Plant (feed effluent pipeline) will be connected to the LAP at the 600 mm off-take nominated by Sydney Water. It has been confirmed by Sydney Water that a connection and double valving will be provided on the LAP for this purpose. RAJV will build, operate and maintain the pipeline between the LAP connection point and the Plant site property boundary. Veolia will build, operate and maintain the pipeline from the Plant site boundary to the Plant.

Veolia also intends to install an on-line instrument into the LAP (or in a sample off-take from the LAP) just upstream of the point where the feed effluent to the Plant is taken. The installation of this instrument will be done in consultation with Sydney Water.

7.3.1 Temporary connection during commissioning

It is proposed that the recycled water pipeline transferring water from the Plant to customers will be cross-connected to the LAP during the proofing period to allow discharge of recycled water produced during the commissioning phase of the Plant. The connection offtake will include an isolation valve and blank flange. The cross connection pipe work will be sized to deliver the 20ML/d produced by the Plant into the LAP. Upon completion of the commissioning, the cross-connection will be shut-off and sacrificed.

7.4 Connection to Sewerage System

The Plant will require connection to the sewer in two locations. The first for the combined process waste stream which will be discharged as trade waste and the second for domestic waste from the amenities building.

As described in Section 7.1.5 Veolia is responsible for the construction, operation and maintenance of the waste discharge pipeline to the Plant property boundary. RAJV is responsible for construction, operation and maintenance of the pipeline from the Plant property boundary to the discharge point at the Sydney Water manhole.

8. Instrumentation and Measurement

8.1 Plant Instrumentation and Control

8.1.1 General Controls and Description

The Plant will be equipped with on-line instrumentation to monitor all areas of the water recycling treatment and plant status information. Measured variables will be logged and stored on the PC-based Supervisory Control and Data Acquisition (SCADA) systems based on the Citect SCADA™ platform.

Configured alarms will be logged and available for display via the native Citect SCADA™ alarm logger which will display the alarm and time of alarm. Alarms may also be configured according to process groups. An alarm paging system will be incorporated into the SCADA system to alert personnel to any plant failures.

The SCADA workstation will provide the following features:

- Current day and previous day flow totalisers
- Operational information to assist operators in collection of daily plant operating data
- Ability for operators to adjust plant set points within predefined limits
- Real time trends and trend histories of instrument readings for review of plant operation or trouble shooting
- Alarm indication and configuration where any plant warnings or alarms which occur are displayed
- Manual initiation of most plant functions

8.1.2 Plant Influent Quality

The influent quality will be monitored on-line as indicated in Table 5 below.

Table 5: Plant Influent Quality Monitoring

Process Stream	Parameter Measured	Purpose for Measuring
Secondary Effluent (within the LAP)	Various (including BOD, TSS and other organic contaminants)	Monitoring and alarm (to warn of contaminants for membrane protection)
Feed	Turbidity	Monitor only
	pH	Monitor only
	Conductivity	Monitor only
	Oxidation reduction potential	Control of chemical dose, in conjunction with total chlorine ensures there is no risk to membranes
Feed post-strainers	Total Chlorine	Control of chemical dose
	Ammonia	Monitor only
	Oxidation reduction potential	In conjunction with total chlorine ensures there is no risk to membranes
	pH	Control of chemical dose
Feed balance tank outlet	Total Chlorine	In conjunction with ORP ensures there is no risk to membranes
	Oxidation reduction potential	In conjunction with total chlorine ensures there is no risk to membranes
	pH	Control

8.1.3 Recycled Water Quality

The recycled water quality will be monitored on-line as indicated in

Table 6 below.

Table 6: Online Recycled Water Quality Monitoring

Process Stream	Parameter Measured	Purpose for Measuring
Recycled Water	Turbidity	Monitor, contract need
	pH	Monitor, contract need
	Residual Chlorine	Monitor, contract need
	Conductivity	Monitor as TDS indicator, contract need

	Ammonia	Monitor
	TOC	Monitor, contract need

8.1.4 On-site routine Monitoring During Normal Operations

The monitoring proposed for the on site laboratory during normal operations is summarised for the Plant in the table below.

Table 7 - Plant Related Routine Monitoring – On-site Laboratory

Analyte	Type	Frequency
Recycled Water		
Alkalinity	Composite	Weekly
Aluminium	Composite	Weekly
Ammonia	Composite	Weekly
Chloride	Composite	Weekly
Iron (Total and soluble)	Composite	Weekly
Manganese	Composite	Weekly
Zinc	Composite	Weekly
Calcium	Composite	Weekly
pH	Online	Online
Hardness	Composite	Weekly
TDS	Online	Online
Turbidity	Online	Online
Free residual chlorine	Online	Online
TOC	Online	Online
Silica	Composite	Weekly
Suspended solids	Composite	Daily
COD	Composite	Daily
Total nitrogen	Composite	Daily
Total phosphorus	Composite	Daily
Influent		
pH	Online	Online
TDS	Online	Online
Turbidity	Online	Online
Free residual chlorine	Online	Online
Suspended solids	Composite	Daily
COD	Composite	Daily
Total nitrogen	Composite	Daily
Total phosphorus	Composite	Daily
Total Organic Carbon (TOC)	Composite	Weekly
Silica	Composite	Daily
Aluminium	Composite	Weekly
Ammonia	Composite	Weekly
Chloride	Composite	Weekly
Iron	Composite	Weekly
Manganese	Composite	Weekly
Sodium	Composite	Weekly
Zinc	Composite	Weekly
Calcium	Composite	Weekly
NOx	Composite	Weekly

Analyte	Type	Frequency
Alkalinity	Composite	Weekly

The onsite laboratory will also be used for routine network monitoring on behalf of RAJV. An indicative testing programme is shown in the table below.

Table 8 Network Related Routine Monitoring - On-site Laboratory

Analyte	Type	Frequency
Delivered water - customer A to G		
Alkalinity	Composite	Weekly
Aluminium	Composite	Weekly
Ammonia	Composite	Weekly
Chloride	Composite	Weekly
Iron	Composite	Weekly
Manganese	Composite	Weekly
Zinc	Composite	Weekly
Calcium	Composite	Weekly
pH	Online	Weekly
hardness	Composite	Weekly
TDS	Online	Weekly
Turbidity	Online	Weekly
Free residual chlorine	Online	Weekly
Suspended solids	Composite	Weekly
COD	Composite	Weekly
Total nitrogen	Composite	Weekly
Total phosphorus	Composite	Weekly
Network storages - 3 sites		
Suspended solids	Composite	Monthly
COD	Composite	Monthly
Total nitrogen	Composite	Monthly
Total phosphorus	Composite	Monthly

8.1.5 Off-site Laboratory Monitoring During Normal Operations

In addition to the monitoring performed at the on-site laboratory a monitoring regime will be undertaken at an external, independent NATA certified laboratory. This is detailed in Table 9, Table 10 and Table 11 below.

Table 9: Plant Related Routine Monitoring – External Laboratory

Analyte	Type	Frequency
Recycled Water		
Alkalinity	Composite	Monthly
Aluminium	Composite	Monthly
Ammonia	Composite	Monthly
Chloride	Composite	Monthly
Iron (total and soluble)	Composite	Monthly
Manganese	Composite	Monthly
Zinc	Composite	Monthly
Calcium	Composite	Monthly
pH	Online	Monthly grab
Hardness	Composite	Monthly

Analyte	Type	Frequency
TDS	Online	Monthly grab
Turbidity	Online	Monthly grab
Free residual chlorine	Online	Monthly grab
BOD_5	Composite	Monthly
Total nitrogen	Composite	Monthly
Total phosphorus	Composite	Monthly
E coli	Grab	Monthly
Total coliforms	Grab	Monthly
Viruses (suite of 6)	Grab	Quarterly
Parasites (cryptosporidium and giardia)	Grab	Quarterly
Silica	Composite	Quarterly
TOC	Composite	Quarterly
EDCs (GCMS scan)	Composite	Twice yearly
Pharmaceuticals	Composite	Twice yearly
PCPs	Composite	Twice yearly
Pesticides	Composite	Twice yearly
THMs	Grab	Twice yearly
Helminths	Grab	Twice yearly
Influent		
Alkalinity	Composite	Twice yearly
Aluminium	Composite	Twice yearly
Ammonia	Composite	Quarterly
Chloride	Composite	Twice yearly
Iron	Composite	Twice yearly
Manganese	Composite	Twice yearly
Zinc	Composite	Twice yearly
Calcium	Composite	Twice yearly
pH	Online	Monthly
Hardness	Composite	Twice yearly
TDS	Composite	Twice yearly
Total Organic Carbon (TOC)	Composite	Quarterly
Silica	Composite	Quarterly
Turbidity	Composite	Twice yearly
Free residual chlorine	Grab	Twice yearly
BOD_5	Composite	Twice yearly
Total nitrogen	Composite	Twice yearly
Total phosphorus	Composite	Twice yearly
E coli	Grab	Twice yearly
Total coliforms	Grab	Twice yearly
Viruses (suite of 6)	Grab	Twice yearly
Parasites (cryptosporidium and giardia)	Grab	Twice yearly
EDCs (GCMS scan)	Composite	Twice yearly
Pharmaceuticals	Composite	Twice yearly
PCPs	Composite	Twice yearly
Pesticides	Composite	Twice yearly
THMs	Grab	Twice yearly
Helminths	Grab	Twice yearly
Faecal Coliforms	Grab	Weekly
Oil & Grease	Composite	Weekly

Table 10: Trade Waste Monitoring – External Laboratory

Analyte	Type	Frequency
Trade Waste Concentrate		
Suspended solids	Composite	Quarterly
BOD_5	Composite	Quarterly
Grease	Composite	Quarterly
Ammonia	Composite	Quarterly
Nitrogen	Composite	Quarterly
Phosphorus	Composite	Quarterly
Aluminium	Composite	Quarterly
Arsenic	Composite	Quarterly
Barium	Composite	Quarterly
Benzene	Composite	Quarterly
Boron	Composite	Quarterly
Bromine	Composite	Quarterly
Cadmium	Composite	Quarterly
Chlorinated phenolics	Composite	Quarterly
Chlorine	Composite	Quarterly
Chromium	Composite	Quarterly
Cobalt	Composite	Quarterly
Copper	Composite	Quarterly
Cyanide	Composite	Quarterly
Fluoride	Composite	Quarterly
Formaldehyde	Composite	Quarterly
General pesticides	Composite	Quarterly
Herbicides and defoliants	Composite	Quarterly
Iron	Composite	Quarterly
Lead	Composite	Quarterly
Manganese	Composite	Quarterly
Mercaptans	Composite	Quarterly
Mercury	Composite	Quarterly
Molybdenum	Composite	Quarterly
Nickel	Composite	Quarterly
Organoarsenic compounds	Composite	Quarterly
Phosphorus	Composite	Quarterly
Petroleum hydrocarbons (flammable)	Composite	Quarterly
Phenolic compounds (non-chlorinated)	Composite	Quarterly
Polynuclear aromatic hydrocarbons	Composite	Quarterly
Selenium	Composite	Quarterly
Silver	Composite	Quarterly
Sulphide	Composite	Quarterly
Sulphite	Composite	Quarterly
Thiosulphate	Composite	Quarterly
Tin	Composite	Quarterly
Uranium	Composite	Quarterly
Volatile halocarbons	Composite	Quarterly
Zinc	Composite	Quarterly

Table 11: Network Related Routine Monitoring – External Laboratory

Analyte	Type	Frequency
Delivered water - customer A to G		
Alkalinity	Composite	Monthly
Aluminium	Composite	Monthly
Ammonia	Composite	Monthly
Chloride	Composite	Monthly
Iron	Composite	Monthly
Manganese	Composite	Monthly
Zinc	Composite	Monthly
Calcium	Composite	Monthly
pH	Composite	Monthly grab
Hardness	Composite	Monthly
TDS	Composite	Monthly grab
Turbidity	Composite	Monthly grab
Free residual chlorine	Grab	Monthly grab
BOD_5	Composite	Monthly
Total nitrogen	Composite	Monthly
Total phosphorus	Composite	Monthly
E coli	Grab	Monthly
Total coliforms	Grab	Monthly
Viruses (suite of 6)	Grab	Yearly
Parasites (cryptosporidium and giardia)	Grab	Yearly
EDCs (GCMS scan)	Composite	Yearly
Pharmaceuticals	Composite	Yearly
PCPs	Composite	Yearly
Pesticides	Composite	Yearly
THMs	Grab	Yearly
Helminths	Grab	Yearly
Network storages - 3 sites		
Alkalinity	Composite	Twice yearly
Aluminium	Composite	Twice yearly
Ammonia	Composite	Twice yearly
Chloride	Composite	Twice yearly
Iron	Composite	Twice yearly
Manganese	Composite	Twice yearly
Zinc	Composite	Twice yearly
Calcium	Composite	Twice yearly
pH	Composite	Monthly grab
hardness	Composite	Twice yearly
TDS	Composite	Monthly grab
Turbidity	Composite	Monthly grab
Free residual chlorine	Grab	Monthly grab
BOD5	Composite	Twice yearly
Total nitrogen	Composite	Twice yearly
Total phosphorus	Composite	Twice yearly
E coli	Grab	Twice yearly
Total coliforms	Grab	Twice yearly
Scours Discharge to Sewer		
Suspended solids	Composite	When occur
BOD_5	Composite	When occur

Analyte	Type	Frequency
Grease	Composite	When occur
Ammonia	Composite	When occur
Nitrogen	Composite	When occur
Phosphorus	Composite	When occur
Aluminium	Composite	When occur
Arsenic	Composite	When occur
Barium	Composite	When occur
Benzene	Composite	When occur
Boron	Composite	When occur
Bromine	Composite	When occur
Cadmium	Composite	When occur
Chlorinated phenolics	Composite	When occur
Chlorine	Composite	When occur
Chromium	Composite	When occur
Cobalt	Composite	When occur
Copper	Composite	When occur
Cyanide	Composite	When occur
Fluoride	Composite	When occur
Formaldehyde	Composite	When occur
General pesticides	Composite	When occur
Herbicides and defoliants	Composite	When occur
Iron	Composite	When occur
Lead	Composite	When occur
Manganese	Composite	When occur
Mercaptans	Composite	When occur
Mercury	Composite	When occur
Molybdenum	Composite	When occur
Nickel	Composite	When occur
Organoarsenic compounds	Composite	When occur
Phosphorus	Composite	When occur
Petroleum hydrocarbons (flammable)	Composite	When occur
Phenolic compounds (non-chlorinated)	Composite	When occur
Polynuclear aromatic hydrocarbons	Composite	When occur
Selenium	Composite	When occur
Silver	Composite	When occur
Sulphide	Composite	When occur
Sulphite	Composite	When occur
Thiosulphate	Composite	When occur
Tin	Composite	When occur
Uranium	Composite	When occur
Volatile halocarbons	Composite	When occur
Zinc	Composite	When occur

8.2 Distribution Network Control System Methodology

An integrated control system will be provided for the Plant and distribution network. One RTU will be provided at the Plant control for communications to all remote distribution network sites including the Woodville Rd Reservoir, Camellia pump station and reservoirs, foundation customers and non-foundation customer sites. A second RTU will be provided at the Plant control for communications to Alinta's network control room.

A SCADA System will be provided for operator interface for control, monitoring, alarms and trending of the Recycled Water Distribution Network. SCADA terminals will be located in the Plant Control Room. No SCADA terminals or other screen based operator interface will be provided at the distribution network pump stations, reservoirs, metering stations or actuated valve stations. The SCADA Server and SCADA display hardware will be supplied complete with Citect and the Plant SCADA application by Veolia.

The recycled water distribution network, pump stations, reservoir, actuated valve stations and metering stations will be fully automated and suitable for unsupervised control and operation of the process on a 24 hour a day, 7 day a week basis. The pump station, reservoir, actuated valve station and metering station sites will typically be unmanned and a minimum of operator intervention is required to maintain distribution network and pump station operation. The control system will be capable of automatically restarting the distribution network, pump stations, reservoirs, actuated valve stations and metering stations after any interruption to site power supplies without operator intervention. All control functions will be implemented in local programmable controllers (PLCs or RTUs). No control functions will be implemented in the remote SCADA terminals.

All RTUs will be Serck eNet series. All RTUs will be configured for ethernet local communication and provided with a GSM modem for communication with remote sites. All RTUs will be provided with power supply and security monitoring similar to SWC IICATS standard.

To maintain commonality between the Plant and the network, all PLCs will be Schneider Quantum and where possible instrumentation will be Endress+Hauser.

8.2.1 Reservoirs

Fairfield Recycled Water Storage Tank

The recycled water storage tank at the Fairfield site will be equipped with low low and high high level switches as well as level transmitters.
The recycled water storage tank will be operated and maintained by Veolia, including all associated instrumentation. The instrumentation required on the recycled water storage tank will be finalised in the detailed design phase. Sufficient instrumentation will be required for both recycled water plant control and recycled water pump protection.

Woodville Road Elevated Reservoir

Woodville Rd Reservoir will be provided with an RTU for water quality monitoring, control of the top up water actuated valve and for communications to the SCADA System

Camellia Surface Reservoir

Camellia Pump Station and Reservoirs will be controlled by a PLC. On-line water quality monitoring will also be provided at this site. The optional chemical dosing plant would also be controlled from this PLC. An RTU will be provided for communications to the SCADA System.

8.2.2 Pumping Stations

Pumps will be controlled from the SCADA system, sited in the Fairfield Plant, via telemetry link. Recycled water flow rate and transferred volume will be monitored by an electromagnetic flow meter on the pumps discharge line.

8.2.3 Network monitoring data collection

An RTU will be provided at each flow and/or water quality monitoring station to collect, average and forward the data to the Plant SCADA System and to Alinta's North Parramatta Control Centre.

On-line water quality data will be collected continuously as an analogue signal and stored as 15 minute averages in the RTU.

On-line flow meter data will be collected continuously as an analogue signal and stored as 15 minute averages in the RTU in megalitres per day (to three decimal places).

On-line totalised flow meter data will be collected as a pulsed signal and stored in the RTU in megalitres (to three decimal places).

Once every twenty-four hours the on-line monitoring data stored in each RTU will be transferred to the Plant SCADA System via a GMS telemetry network.

This data will be stored in the Plant SCADA System and presented in the daily report.

8.3 Plant Metering

8.3.1 Influent Meter

The flowmeter at the inlet of the Plant to measure the volume of effluent extracted from the LAP. Veolia is responsible for the installation and O&M of this meter

8.3.2 Plant Trade Waste Discharge Flow Meter

Veolia is responsible for the installation and O&M of this meter.

8.3.3 Output Meter

As defined in Project Agreement and Schedule 10. The Output Meter is located on the inlet of the Fairfield recycled water storage tank. Veolia is responsible for the installation & O&M of this meter.

8.3.4 Storage Tank Output Meter

The flowmeter on the discharge of the recycled water pumps at the Fairfield pumping station. This is used to measure the Daily Recycled Water Volume to Network. RAJV is responsible for installation, operation and maintenance of this meter.
.

8.4 Instrument Calibration

Calibration certificates will be provided for instruments such as magnetic flow meters, pressure transmitters, pressure switches and the elements for turbidity and pH elements.

All other instruments, including ultrasonic level transmitters, float level switches, chlorine residual analysers, pH analysers and turbidity analysers, will require configuration or calibration on site after installation.

Chlorine residual analysers, pH analysers and turbidity analysers will require regular calibration and replacement of sensor elements in accordance with the instrument manufacturer's recommendations.

Records will be kept of as commissioned calibration data and on-going records for regular calibration checks.

8.5 Technical Design Characteristics – Pumping Stations, Reservoirs and Valves

Table 12: Proposed Design Characteristics – Pumping Stations

Proposed Design Characteristics – Pumping Stations										
ID	**Location**	**Current Land Zoning**	**Site Area Required (ha)**	**Pump Type**	**Flow Delivered (ML/d)**	**Pressure Delivered (m Head)**	**Power (Installed kW)**	**Pump Control (eg reservoir level, HGL)**	**Pump Unit Configuration (Duty/ Standby**	**Pump Centreline (m AHD)**
PS1	Fairfield	WWTW	TBC	Booster	28	75	555	Reservoir level, System Pressure	Duty/Assist/ Standby	10
PS2	Rosehill	TBA	TBA ha[2]	Booster	17	50	180[3]	System Pressure	Duty/Assist/Assist/ Standby	6

Note 1: Total area required for Plant, Reservoir and Pumping Station

Note 2: Total area required for Reservoir and Pumping Station

Note 3: This is the ultimate capacity of the Camellia Pumping Station. The initial Pumping Station will only have 3 pumps

Table 13: Proposed Characteristics – Pipelines

Proposed Characteristics – Pipelines								
ID	**Purpose (eg, RSTP inlet, sewer connections, distribution, potable top-up)**	**Route Description**	**Route Alignment (eg road, footpath, reserve)**	**Nominal Diameter (mm)**	**Length (m)**	**Construction Method (eg trenching)**	**Material)**	**Easement Required (Y/N)**
S1	Plant inlet	From LAP in Orchard Rd via North St to Plant site	Road/ Nature strip	600	400	Open cut	GRP	N – Public Highway/ WWTW site
S2	Plant waste pipeline	From Plant SE across the WWTW site to the sewer discharge point	Nature strip	300	300	Open cut	GRP	N – WWTW site
M1	Plant Outlet Main	Fairfield Plant to Smithfield Take-off via Fairfield Park to	Road/ Nature strip/ Park	450	1998	Open cut	PVC-M	N – Public highway

Proposed Characteristics – Pipelines								
ID	**Purpose (eg, RSTP inlet, sewer connections, distribution, potable top-up)**	**Route Description**	**Route Alignment (eg road, footpath, reserve)**	**Nominal Diameter (mm)**	**Length (m)**	**Construction Method (eg trenching)**	**Material)**	**Easement Required (Y/N)**
		Tangerine Street						

Table 14: Proposed Design Characteristics - Reservoirs

Proposed Design Characteristics – Reservoirs										
ID	**Location**	**Current Land Zoning**	**Site Area Required (ha)**	**Type (eg surface, elevated)**	**Full Supply Level (m AHD)**	**Depth (m)**	**Total available Volume (ML)[3]**	**Reserve Volume (ML)**	**Operating Volume (ML)**	**Top-up Req'd (Y/N)***
R1	Fairfield	WWTW	TBC	Surface	16	6.6	3	2.3	0.7	Y
R2	Woodville Road Golf Course	Golf Course	0.14 ha	Elevated	58.5	3.5	0.7	-	0.7	Y
R3	Camellia	TBA	TBA ha[2]	Surface	12	6	6	5.3	0.7	Y

* potable top-up requirements to be entered into Table 6.5

Note 1: Total area required for Plant, Reservoir and Pumping Station

Note 2: Total area required for Reservoir and Pumping Station

Note 3: Total available volume does not include dead volume or free board

8.6 Data Reporting to AquaNet

Process data is collected through on-line monitoring, in-house laboratory testing, external laboratory testing and process logs. The integrity of the information measured, calculated or observed is ensured through:

- Calibration of on-line instrumentation at pre-determined intervals. These calibrations are carried out by trained staff according to documented and approved methods or are carried out by qualified and approved subcontractors.

- Pre-determined sampling regimes which are designed to represent the characteristics of the process as well as possible by:

  - Taking composite samples where appropriate
  - Conducting a 6-day rolling sampling program for weekly testing to avoid measuring recurring characteristics which occur on a given day of the week (for example compounds due to trade waste discharges to sewer which may be subject to a manufacturing site's production program) and/or
  - Conducting sampling over three days and taking the geometric mean of the results.

- Training of staff to carry out internal laboratory testing according to documented and approved methods. Placement of a Water Quality Officer on-site to coordinate and manage all sampling and analysis in the on-site and off-site laboratory.

- Ensuring that the external laboratories used are NATA-accredited for the tests carried out or where a NATA-accredited laboratory is not available, that the laboratory has provided evidence of using proper laboratory methods.

- Central management of water quality monitoring (on-site, off-site, on-line) at the Plant site.

- A well-designed operator log system which is used with discipline.

- Laboratory quality control and quality assurance as outlined in Chapter 4 of the Plant Operations Management Plan - Laboratory, Sampling, Analysis.

On-line instrument data will also be managed by the Water Quality Officer. This will also be data reviewed and statistically alarmed to show outlier data points. Any recycled water quality incidents or effluent quality events will be formally reported within 24 hours to Sydney Water of the analysis being performed and the result obtained. This will trigger an incident report investigating the cause and rectification measures implemented. The Water Quality Officer will inform the Operations Supervisor of any such events promptly. This will be reported to SWC according to the Incident Reporting System.

An "early warning" system will be proposed by AquaNet to keep both Sydney Water and customers informed of any potential threats to recycled water quality or quantity. This system will be developed in consultation with SWC and the recycled water customers and it will become a part of the communication protocols in addition to being reported in the monthly report. All data will be maintained in the Plant Sydney Water and IT systems at the site. Laboratory data management will be in accordance with the NATA accreditation to be held for the site.

AquaNet will develop, in consultation with Sydney Water, a fully detailed monthly client report that describes all aspects of the Recycled Water Scheme's performance. A similar report will also be made available to all customers.

The monthly report will cover as a minimum:

a) the daily and monthly aggregate of Recycled Water manufactured at the Plant;
b) a review of the performance of the O&M Services and compliance with the performance requirements;
c) any issues associated with the provision of the O&M Services along with strategies implemented or proposed to overcome issues;
d) details of safety-related issues, including lost-time injury records;
e) industrial relations issues affecting, or which may affect, the O&M Services;
details of quality assurance activities during the month including a summary of all calibration activities related to payment or environmental compliance;
f) a summary of maintenance, repair or Renewal activities carried out in the month, including itemised sums spent on Asset replacement;
g) details of any reductions due to failure to meet the performance requirements;
h) a summary of the monthly payments claimed for the O&M Services; and
i) any other matter material to the work and compliance with the Agreement.

All process data sets (such as feed effluent and recycled water quality) will include commentary as noted in Table 15 below.

Table 15: Items to addressed in monthly reporting

Item	Comment
Data Quality Objectives Status	Discuss spikes, blanks, duplicates data for on-site and off-site lab
Issues	Discuss any issues with poor quality, outlier data, sample collection, "early warning" notifications
Network samples	Discuss any extraneous data
Plant samples	Discuss any extraneous data
Recycled Water quality	See Table below

An indicative Recycled Water Quality monthly results table is provided Table 16 below.

Table 16: Indicative table for Recycled Water Quality monthly results

Parameter	95%ile Limit	No. of Samples	Min	Avg	Max	95%ile for the Month *(On-site Lab data)*	95%ile for the Month *(Off-site Lab data)*
Aluminium (mg/L)	<0.1						
Ammonia (mg/L)	<1						
Chloride (mg/L)	<20						
Iron (mg/L) (soluble)	<0.05						
Manganese (mg/L)	<0.05						
Zinc (mg/L)	<0.1						
Calcium (mg/L as $CaCO_3$)	<10						
pH (pH units)	6.5 – 8.5						
Hardness (mg/L as $CaCO_3$)	< 20						
Total Dissolved Solids (mg/L)	<50						
Turbidity (NTU)	<2						
Free Residual Chlorine (mg/L)	1						

Parameter	95%ile Limit	No. of Samples	Min	Avg	Max	95%ile for the Month *(On-site Lab data)*	95%ile for the Month *(Off-site Lab data)*
Biochemical Oxygen Demand (mg/L)	<2						
Total Nitrogen (mg/L)	<10						
Total Phosphorous (mg/L)	<2						
E. coli Coliforms	<1 in 100 mL						
Total Coliforms	<10 in 100 mL						
Viruses	<1 in 50 L						
Parasites	<1 in 50 L						

9. Site Requirements

9.1 Fairfield Plant

The proposed Plant is to be located on a parcel of land adjacent to Sydney Water's Fairfield SSTP.

9.1.1 General Layout

The overall general layout arrangement is provided in Figure 2.

Figure 2: Site General Layout

A more detailed site layout is shown in Attachment 2.

Attachment 1 – Process Flow Diagram

Attachment 2 – Plant Site Layout

APPENDIX 2g - Do you have prior experience in the construction, maintenance and operation of water infrastructure or a utility business?

Project Sheets for:

- Wyuna
- United Water
- Aqua
- Western Corridor
- Gold Coast Desalination
- Sydney Desalination
- Kwinana Water Reclamation Plant

Kwinana Water Reclamation Project

Location: Perth, Western Australia

Client:	The Water Corporation of Western Australia		
Contract Type:	D&C	**Contract Value:**	$28.3M
Start Date:	March 2003	**End Date:**	October 2004

PROJECT DESCRIPTION:

As rainfall and runoff have significantly decreased throughout Western Australia during the past 25 years, Water Corporation needed to create alternative sources of water to avoid the potential loss of important industrial customers, such as BHP and Rio Tinto. The Kwinana Water Reclamation Plant, which officially opened in November 2004, met this industrial need by providing high quality treated water derived from wastewater using Micro Filtration (MF) and Reverse Osmosis (RO). The plant is reducing the volume of potable water supplied to industry by 6GL/y, which is equivalent to about 2% of Perth's water use.

The Kwinana Water Reclamation plant treats about 24ML/d of secondary treated wastewater from the Woodman Point WWTP which it continuously produces 16.7ML/d of high quality industrial grade water stream (50mg/L Total Dissolved Solids) through MF and RO membrane systems.

The second element of the project involves the receipt of treated industrial wastewater from the Woodman Point WWTP for offshore disposal through the Sepia Depression Ocean Outlet into Cockburn Sound. The plant facilitates a reduction in effluent discharged by about 6ML/d as industrial customer use some of this treated wastewater. The project has resulted in significant environmental benefit. Ongoing monitoring and reporting of environmental effects is undertaken to ensure that there is no harm to the marine and coastal ecosystem.

Owned and operated by the Water Corporation of Western Australia, Kwinana was built by a Veolia Water Systems Australia John Holland joint venture. The major scope of the work included the installation of dual membrane technology and the construction of plant buildings, civil, mechanical and electrical works. Water treatment at Kwinana Water Reclamation Plant involves filtration to remove coarse particles, MF, RO and chlorine disinfection with sodium hypochlorite. Since the plant's successful operation is reliant on the efficiency of its MF and RO membranes, the facility was designed so the two systems would have sufficient capacity to allow for full treatment independently should one of them be off-line. The plant is currently able to recycle 17ML/d of water, but with the installation of additional filtration modules has the potential to process 27ML/d.

Key Project Achievements:

- Australia's largest water reclamation scheme for industrial reuse in 2004
- Highly commended in the 2005 Global Water Awards, the plant was described by judges as "the most important wastewater recycling project in the southern hemisphere"
- The plant forms part of the State Government's strategic drive to achieve 20% reuse of treated wastewater by 2012
- Won the national 'Australian Water Association Water Environment Merit Award' 2005. The project which won the 2005 Environmental Merit Award from the State branch of the Australian Water Association, cost $28.5M

Kwinana Water Reclamation Project

Key Project Innovations:

- Size of skids, compact layout, ease of maintenance for changing membranes on a large size plant
- First significant use of submerged MF as pre-treatment to reverse osmosis on a large scale
- Operation of an RO system with appropriate chemical pre-treatment to avoid scaling at high concentrations of calcium phosphate
- Plant reliability in terms of nameplate capacity, availability / outage, degree of plant automation

Key Project Lessons Learnt:

- The constructor, designer and technology supplier worked closely for the commencement of the project to completion of commissioning for successful delivery
- Design and Operation optimisation for control of phosphate scaling by combination of pH, antiscalants and RO recovery
- Identification of industrial derived RO membrane foulants from detailed membrane analysis
- Managing membrane filtration system under extreme high solids loading following upstream wastewater plant upsets
- Optimisation and correct selection of anti-scaling chemicals and pH control were essential to minimise RO membrane scaling

Performance Outcomes:

Safety: No Lost Time Incidents

Environment: No environmental breeches

Quality: All KPIs met of exceeded

Time: Project was delivered on time

Cost: Project was delivered on budget

Client Referee:

Name: Steve MacKenzie

Job Title: Project Officer

Company: The Water Corporation of Western Australia

Contact No: +61 8 9420 3057

Email: steven.mackenzie@watercorporation.com.au

VEOLIA WATER

South East Queensland Desalination Project

Location: Tugun, Queensland

Client:	The Queensland Government		
Contract Type:	Alliance	**Contract Value:**	$1.1B (D&C)
Start Date:	September 2006	**End Date:**	D&C - November 2008 O&M - November 2023

PROJECT DESCRIPTION:

The South East Queensland (SEQ) Desalination plant will be the first large-scale desalination facility on Australia's eastern seaboard. When completed it will provide 45GL/y of drinking water each day to South East Queensland or approximately 15% of its current water needs.

The project is being delivered by the Gold Coast Desalination Alliance (GCDA) which comprises Veolia Water, John Holland and SKM in an Alliance contract with SureSmart Water, the Queensland Government's vehicle for the delivery of the project. Veolia Water, John Holland and SKM are working closely together to design, construct and commission the plant by November 2008. Following completion of the plant, Veolia Water will provide operations and maintenance for 10 years plus the option for a further 5 years.

The project comprises a desalination plant, marine intake and outlet tunnels and a 35km pipeline, built in urban zones, to connect the plant to the SEQ Water grid.

Desalination Plant

The desalination plant consists of pre-treatment, sea water reverse osmosis (SWRO), re-mineralisation and residuals treatment. The sea water is first pumped from the intake shaft into 3mm drum screens, where larger suspended solids from the sea such as seaweed are removed.

Flocculation and dual media gravity filtration are then used to further remove suspended solids from the water and to reduce the Silt Density Index (SDI) of the water, in preparation for treatment in the SWRO. Cartridge filtration is the last pre-treatment process before SWRO. Five micron cartridge filters are used to "polish" the SWRO feed water and ensure that the SWRO membranes are protected from fouling agents.

The SWRO treatment consists of two passes. The first pass SWRO is fed by HP pumps using a pressure centre arrangement. 97% of energy is recovered from the first pass SWRO brine and transferred to the SWRO feed by Calder DWEER energy recovery units. The first pass SWRO has a recovery of around 45%. The second pass Brackish Water Reverse Osmosis (BWRO) unit is primarily used to achieve the Boron and Bromide specifications of the final water quality. Second pass alkalisation, where the pH of the water is raised to 10 by caustic addition, is used for Boron removal. The second pass has two stages and a recovery of around 85%.

After reverse osmosis, water is very reactive as most of its minerals have been removed. Therefore the water is then remineralised with lime and carbon dioxide to ensure that it is stable for carriage in the network pipe. Sodium hypochlorite is also added as a disinfectant.

Backwash water from the dual media gravity filters is treated using lamella settling and centrifuges. The supernatant water is discharged with the sea water concentrate and the sludge will be sent to landfill. Investigations are continuing into recycling and reuse options for the sludge.

The most suitable site option for the location of the SEQ Desalination plant's construction happened to be on landfill. As a legacy to the local community the GCDA rehabilitated the site to build the plant. GCDA also relocated a soccer field so that the Tugun soccer team could continue playing soccer whilst the plant was under construction.

Tunnelling and Marine Works

Extensive tunnel and marine works were required for this project. They included the design and construction of twin 9m diameter, 40m deep intake/outlet shafts; twin 2,800mm ID, segmentally lined tunnels (2.2km inlet, 2.0 km outlet); intake and outfall risers and the connection to risers and tunnels at 65m depth under the sea.

Excavations were undertaken using two full face slurry tunnel boring machines, which met challenges posed by adverse hydro-geological conditions. Marine risers are being installed to depths of 65m below sea level by driving a sleeve through 20m of sand, then drilling through rock before inserting a liner and making-good the riser connections to the deep tunnels under the sea.

The intake is located in about 20m of water and will collect the seawater by gravity. The outlet uses a diffuser, designed to disperse the brine using the energy of the ocean. The diffuser is a 1m diameter pipeline some 180m long, with 8 dispersion outlets spaced evenly to distribute the brine within a very small mixing zone. Within an area of 120m by 225m from the outlet, the water will be dispersed to normal background salinity levels.

Power Supply

The SEQ Desalination plant project has involved detailed planning and close coordination with the local power reticulation company, Energex, to determine the best way to supply 33kV power within an 18 month period. The strategy developed will provide power to the site in a cost-effective and timely manner, whilst allowing Energex to more efficiently supply the local area.

The critical aspects of the high voltage power supply system design included supply to the High Pressure RO pumps (4 off @ 4.8MW each). Variable Speed Drive controllers were selected to meet start-up power requirements and to provide operating efficiency and operational flexibility. A thorough analysis of the harmonic effects of this system has also been carried out.

The project also involved transformation of the 33kV power supply to 11kV via two 35MVA transformers, and reticulation of the 11kV supply around the desalination plant site through 11kV switch gear. Design of low voltage distribution systems (690V and 415V) included the adoption of environmentally friendly dry-type 3500kVA, 2500kVA and 1000kVA transformers. The system involves two stand-alone high voltage substations and five low voltage substations, Motor Control Centre (MCC) design, earthing system design, power supply for all site services and emergency power supply.

Community, Stakeholder and Environmental Aspects

Community engagement commenced at the start of the project, during the site selection process. A series of consultation techniques (including displays, surveys and discussion groups) identified community values, which were used in a multi-criteria analysis of short-listed sites. The most important community issues were minimisation of power use, greenhouse gas reduction and controlling the impacts of the brine stream on the marine environment. Having established these values, the engagement process for the development of the project was tailored to focus on ensuring these issues were debated in community forums to provide effective and open consultation. Many focus groups, reference group meetings and public forums have been held to generate community support for the project philosophies.

The project was subject to local, state and commonwealth legislation. The approvals for the project required substantial environmental assessment. No formal EIS process was required because of the agreed approvals pathway. The approvals team studied the legislation in detail and determined that through the strategic use of State legislation (the Integrated Planning Act, the State Development and Public Works Organisation Act and the Water Act), approval times could be shortened by more than 12 months. The Commonwealth Department of Environment & Heritage determined the project was unlikely to have an impact on any commonwealth responsibilities, thus negating the need for an EIS.

Many approvals were required through different authorities. Forty environmental, design and development studies were undertaken over a short timeframe to enable the Alliance to submit approvals applications covering: remediation of the landfill site and provision of approval for the site establishment works program; approval of associated works to support the project (access roads, access to surrounding land, creek crossings); approval to construct tunnels by working 24 hours a day; development in the marine environment; approval to construct the site plant facility; approval of power upgrades and purchase strategies; approval to construct the network pipeline (vegetation clearing, easements, resource entitlements) and approval to operate the plant facility.

South East Queensland Desalination Project

Key Project Achievements:

- Project delivery occurs in a very short timeframe, the site was selected on 4 January 2006 and the whole approval, design and construction process is on target to deliver first water on 30 November 2008
- Project safety record is setting the standard for the industry – 2.75 million man hours LTI free as of June 2008
- Community acceptance of the project

Key Project Innovations:

- Development of the concept of tunnel and marine intakes and outlets for desalination plants due to community and environmental and engineering considerations. This is the first of its kind in the world
- On site assembly of RO skids outside the building. Skids were then rolled into place, allowing building construction to continue uninterrupted
- Inclusion of residuals treatment process to ensure discharge of the highest quality into the environment – this was not an EPA requirement
- Membrane Management Tool for the management of a membrane inventory of over 17,000 membranes
- MERAM, a database developed as an asset register storing all technical specifications for equipment, including cable schedule, pipe schedule, etc. Maintenance budget and power consumption estimates calculated automatically from MERAM
- Automatic Maintenance Manuals creation tool
- Spares criticality automatic assessment tool
- Link between SCADA and Computerised Maintenance Management System (CMMS) / Plant Operations Management System (POMS) / Membrane Management Tool
- GRP Cartridge filter housings

Key Project Lessons Learnt:

- Early and positive involvement of operations team during design and construction phases
- Operations team is integral to the commissioning phase
- Effective communication within a large design team is critical to the success of the project. On this project the design team was located away from the construction site, this created challenges. Video conferencing overcame some of this challenge
- A dedicated communications team, which engaged the public and media with as much project information as possible, had a positive impact on community perception of the project
- Full-time paramedic team onsite was proactive in the management of injuries. Lifestyle assessment of employees (skin cancer checks, cholesterol checks) helped reduce injuries
- Durability issues must be focused on early in the design phase, especially for concrete and pipe materials
- For successful quality control, specifications need to be very detailed and be followed through to the manufacturing of equipment (eg issues with GRP pipes)
- Using experienced desalination professionals is crucial

Performance Outcomes:

Safety: Over 3 million man hours with just one Lost Time Injury

Environment: Zero reportable environmental incidents

Quality: Dedicated Quality Control team have identified and resolved all quality issues to date

Time: The project is on track to be delivered on time

Cost: The project is on track to be delivered on budget

Client Referee:

Name: David Stewart

Job Title: Director General, Queensland Transport

Company: Queensland Government

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Aqua Project (Advanced Water Treatment Plants)

Location: Bendigo, Castlemaine & Kyneton, Victoria

Client:	Coliban Regional Water Authority		
Contract Type:	BOOT / D&C	**Contract Value:**	$100M D&C
Start Date:	2000	**End Date:**	2027

PROJECT DESCRIPTION:

In February 2000, Bendigo Water Services signed a BOOT contract for 25 years to treat and distribute drinking water to approximately 100,000 residents of the greater Bendigo area. The project involved construction of three advanced water treatment plants. In addition, trunk mains and major storages were acquired under the contract and are owned and operated under the BOOT agreement.

Veolia Water was responsible for the overall delivery of the BOOT scheme, including network planning, environmental approvals, design, build, operation and maintenance. SKM provided detailed design services, including all civil, structural, architectural and building services for the new plants. The firm also provided mechanical and process engineers to set up pre-commissioning procedures and assist with commissioning the new plants.

The Aqua Project is comprised of five components:

- Bendigo Water Treatment Plant (126ML/d submerged microfiltration technology (CMF-S), Ozone & BAC filters)
- Castlemaine Treatment Plant (18ML/d CMF Ozone & BAC filters)
- Kyneton Treatment Plant (8ML/d CMF Ozone & BAC filters)
- 40 km trunk pipelines with comprehensive interface points (quality, quantity at the delivery point)
- 5 storage reservoirs totalling 110ML in capacity

The water treatment plants use microfiltration (CMF-S and CMF), ozone and Biologically Activated Carbon (BAC) filtration technologies. The main plant in Bendigo has a capacity of 126ML/d and features submerged Micro-Filtration (MF) technology (CMF-S). The Kyneton 8ML/d plant and Castlemaine 18ML/d plant use conventional CMF designs. MF guarantees removal of cryptosporidium and giardia contamination from unprotected rural catchments.

All plants use ozone and BAC filtration to remove taste and odour compounds and blue green algae toxins. The plants are operated and continuously monitored using a PLC / SCADA control system.

Key Project Lessons Learnt:

- Experience in optimisation of membrane performance and membrane life
- Extensive pilot plant program to confirm process design and chemical dosing parameters
- Experience in optimisation of ozone and BAC to remove Total Organic Carbon (TOC)

VEOLIA WATER

Aqua Project (Advanced Water Treatment Plants)

Key Project Achievements:

- Innovation in the large-scale use of immersed membrane technology for water treatment
- Excellent contractual performance in meeting a demanding treated water specification
- Provision of safe, reliable and consistent treated water to a major regional centre and surrounding communities
- High commendation for “Infrastructure Project Exceeding $10M”, 2002 Engineering Excellence Awards (VIC)

Key Project Innovations:

- At the time of commissioning, the Bendigo Water Treatment Plant was the largest submerged continuous microfiltration plant in the world. Submerged membranes have lower operating costs, (primarily reduced energy requirements) as compared to conventional membranes

Performance Outcomes:

Safety: No lost time injuries over 390,000 work hours

Environment: No environmental incidents throughout the life of the contract

Quality: Water quality is monitored to ensure water quality is maintained, approximately 12,000 tests per year

Time: The project was delivered on time

Cost: The project was delivered on budget

Client Referee:

Name: Neil Burns

Job Title: Executive Manager Operations

Company: Coliban Water

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Sydney Desalination Project

Location: Kurnell, New South Wales

Client:	Sydney Water Corporation		
Contract Type:	DBOM	**Contract Value:**	$977M (D&C only)
Start Date:	July 2007	**End Date:**	February 2011 (D&C), 2031 (O&M)

PROJECT DESCRIPTION:

The Sydney Desalination Project forms part of the Sydney Water Corporation's (Sydney Water) Metropolitan Water Plan. This plan aims to make sufficient water available over time to meet the needs of a growing city, to protect river health, and have the ability to withstand current and future droughts and the impacts of climate change. Water supplied from the desalination plant will increase the total volume of water available to customers across the whole Sydney Water area including the Blue Mountains, the Illawarra and Sydney. This equates to approximately 15% of Sydney's total water supply.

The Blue Water Joint Venture has been chosen to design, build, operate and maintain the desalination plant at Kurnell Blue Water is an integrated, unincorporated Joint Venture (JV) between Veolia Water Australia and John Holland for construction with Veolia Water responsible for operations and maintenance for 20 years. Veolia Water Solutions and Technologies is responsible for the process design, and international procurement with their staff also taking leading roles in overall design management and construction management for the desalination plant.

Treated water will be delivered to Sydney's existing drinking water distribution system by means of a pumping station, pipelines and tunnels constructed under another separate alliance contract. A separate operations contract is being let to Veolia Water Australia for the operation of the pumping station.

The project offers Sydney Water a flexible operating regime that allows the State to vary the water production and even to mothball the plant, under a cost-effective tariff system. Blue Water offered Sydney Water Corporation value for money solutions when it came to shutting down the plant. For example, Blue Water negotiated with the membrane suppliers so that when the RO membranes are in preservation, the membrane warranty is extended by six months for every year the membranes are in preservation.

The scope of the project is to design, construct, commission, operate and maintain a 250ML/d (expandable to 500ML/d) desalination plant based in Kurnell, with associated deep water ocean intake and outlet tunnels and marine structures. When completed, the desalination plant will include: the seawater reverse osmosis facility; pre and post-treatment plants; drinking water storage tanks; stormwater retention basins; a wastewater treatment and sludge management facility; intake pump station and screening plant; administration building; and underwater tunnels and outlet diffusers approximately 300m offshore in the Tasman Sea.

Key Project Lessons Learnt:

- Close collaboration with the client during the tender phase resulted in maximum benefit from potential innovations
- Prior approvals for marine works created an area in which the intake and outfalls had to be constructed. This is proving to be a constraint on construction, as the area is very close inshore

Sydney Desalination Project

This challenging and complex urban infrastructure project will require:

- Twin 3.4m internal diameter, 2,500m long outfall tunnels (suitable for 500ML/d plant size)
- Four ocean inlets and four outlets (suitable for 500ML/d plant size)
- Placement of 60,000m3 of concrete and 9,000 tonnes of reinforcing steel
- Fabrication and erection of 3,000 tonnes of structural steel
- Supply and installation of more than 3,000 mechanical items
- 150,000m3 of earthworks and 40,000m of CFA piles
- Construction of more than 16km of pipe work
- Supply and installation of 200 pumps
- Installation of more than 480km of electrical cables and 94km of data cables

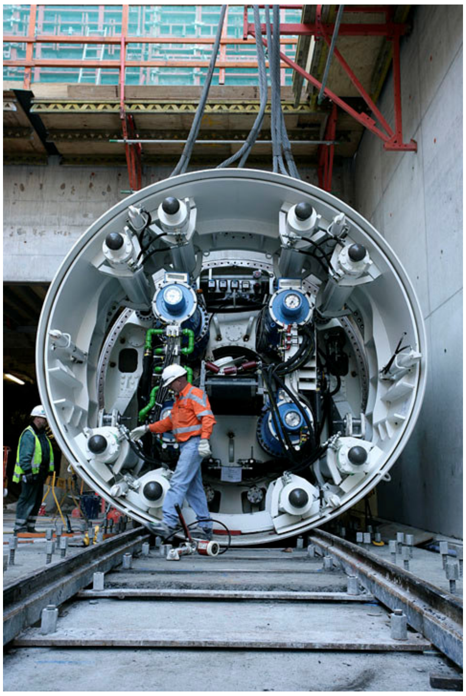
Energy was a major consideration for the optimisation of the whole-of-life cost, to achieve Sydney Water's target of 4.2kWhr/kL (under the worst conditions). To improve energy efficiency without increasing capital cost, a detailed assessment of the impact of equipment selection on overall power usage was conducted during design. This impact was assessed on a Net Present Value basis, taking into consideration the capital costs and ongoing power costs over the entire life of the contract.

Equipment selection also has a significant impact on the whole-of-life cost of the plant. The upfront capital cost, as well as the ongoing maintenance and replacement cost, was considered during equipment selection. This enabled the Blue Water team to select every equipment item based on its impact on the Net Present Value of the project.

The Sydney Desalination plant will be powered by renewable energy, under a separate contract let by Sydney Water Corporation. This is under final negotiation and it appears the plant will be powered by wind energy offsets.

Key Project Innovations:

- By making use of the subsurface rock profile, the team proposed the use of a large, 20m deep 'box cut' and downhill tunnel in place of the twin 60m deep shafts and uphill tunnel. This reduced cost and time and made the Tunnel Boring Machine (TBM) erection and operation simpler and safer. Sydney Water was pleased that dewatering would take place offshore and that both tunnels could be dewatered simultaneously. The box cut allowed excavation to be combined with that of the Intake Pumping Station, which enabled mechanical installation of the Intake Pumping Station to proceed in parallel with the tunnel construction, providing a significant time saving
- By combining the two 125ML/d train RO buildings and using a shared central trench, the extent and complexity of overhead pipe work in the building was greatly reduced. All valves were located at ground level, which will make operation simple, reduce the extent of access ways required and also simplify OH&S requirements
- The plant is being delivered in an environmentally and community sensitive area in Kurnell, with Blue Water managing stakeholder issues on behalf of the State. The site plan includes a conservation area with ongoing monitoring and management of native fauna. By-products of the desalination process will be reused to positively benefit the environment, for example, lime sludge will be utilised by a biogas facility in Sydney and raw water screenings will be used for green fertiliser. Additionally, the plant has been architecturally designed to minimise its impact on the natural landscape



Sydney Desalination Project

Key Project Achievements:

- Despite considerable community objections initially, the construction site was established in November 2007 and has been running since that time with little community objection
- The establishment of an integrated team on-site has forged strong and open relationships between all parties, including designers. The integrated team initiative means that design, procurement and construction teams understand each other's challenges to a level rarely experienced. This collaborative measure was also employed on the SEQ Desalination project
- The majority of earthworks were completed during a very wet summer with no impact on the adjacent environmental reserve or Ramsar Wetland downstream. This was achieved by clever construction methods planning, using CFA piling from the surface rather than piling from a deep excavation

Performance Outcomes:

Safety: Safety initiatives program has delivered over one million man-hours with only two Lost Time Incidents

Environment: No environmental breaches have occurred

Quality: There have not been any significant issues raised by either the client or the Independent Verifier

Time: The project is being delivered on time

Cost: The project is being delivered on budget

Client Referee:

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Wyuna Contract Water Filtration Plants

Location: Sydney

Client:	Sydney Catchment Authority, Sydney Water		
Contract Type:	BOO	**Contract Value:**	$185M (D&C)
Start Date:	1994	**End Date:**	2019

PROJECT DESCRIPTION:

Established in 1991, Wyuna Water is a Veolia Water led, special purpose company including KBR, among others. The consortium was awarded a contract to finance, design, construct and subsequently operate two water filtration plants under a 25-year BOO contract. Wyuna Water outsourced the plant design to Veolia Water Systems Australia and KBR. The O&M functions were undertaken by General Water Australia Pty Ltd (GWA), a 100 per cent Veolia Water subsidiary for the 25-year O&M. The plants were constructed under a D&C joint venture.

The Illawarra and Woronora Water Filtration Plants provide high quality drinking water to more than 500,000 residents on behalf of Sydney Water, serving the southern part of Sydney and the Illawarra region. Delivered for $185 million, the two plants have a combined production capacity of 370ML/d and can be upgraded to provide an ultimate capacity of 534ML/d.

The Woronora development involved constructing a water filtration plant (WFP) at Woronora Dam, to filter water supplied from the Woronora Reservoir. The WFP was designed with a maximum capacity of 160ML/d. The Illawarra development involved constructing a WFP to treat water from the Avon Dam. This plant has a production capacity of 210ML/d.

The two plants operate using similar treatment processes, a flocculation stage followed by direct filtration on dual media filter blocks (sand and anthracite). The treatment is completed by oxidation of iron and manganese, pH saturation by lime and carbon dioxide, disinfection using chloramination and fluoridation to comply with health regulations.

The main difference is Illawarra's hydro-electric facility which allows the plant to be entirely self-sufficient in electricity and to export renewable energy to the grid.

These two new plants have provided safe, reliable, high quality drinking water. Before the water filtration plants were established, Sydney's drinking water was only subject to screening, disinfection by chlorination, pH buffering and fluoridation. Customer complaints in the Woronora and Illawarra systems have fallen dramatically largely due to the removal of dissolved iron and manganese and the low turbidity outputs being achieved by the water filtration plants.

Key Project Achievements:

- Very high level of contractual compliance including full compliance with Australian Drinking Water Standards achieved each year for the Woronora and Illawarra systems
- Excellent workplace relations: The operators of the two WFPs are affiliated with the Australian Workers' Union and Wyuna, through GWA, has enjoyed a good relationship with the union to date. There has been no lost time due to industrial action. The operators are remunerated in accordance with a certified agreement.

VEOLIA WATER

Wyuna Contract Water Filtration Plants

Key Project Innovations:

For the mid-1990s the project was innovative in a number of financial and contractual areas including:

- Refinancing resulted in increased returns to both Wyuna Water and Sydney Water through a profit-sharing arrangement
- The agreement provides for sale of the WFPs back to Sydney Water at the end of the contract. Sydney Water may instead choose to extend the contract with Wyuna for another term. Under both scenarios there is a strong incentive for Wyuna and Veolia Water to ensure the WFPs are appropriately maintained.

Continual improvement has been implemented as company culture. The Illawarra WFP has an operational pilot plant where trials are run to optimise the performance of the plant. The pilot testing has included:

- Studies to achieve 0.1NTU (original compliance limit was <0.3NTU). This was changed during the contract to <0.1NTU and 100 per cent compliance for this is now being achieved at both plants
- Manganese removal (original compliance limit was 0.03mg/L). This was changed during the contract and 100 per cent compliance is now being achieved for <0.01mg/L at both plants
- Particle counting for cryptosporidium removal
- Taste and odour removal by granular activated carbon
- Stress test studies where poor quality raw water is simulated and tested to evaluate the effect on the contact filtration process.

Key Project Lessons Learnt:

- In a long-term contract providing an essential service where the private sector is part of a complex delivery system to the final customer, it is vital to establish and maintain a strong partnering relationship.

Performance Outcomes:

Safety: No safety breaches

Environment: No environmental breaches

Quality: Full compliance with Australian Drinking Water Guidelines for both plants

Time: Project delivered on time

Cost: Project delivered and operated on budget

Client Referee:

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VEOLIA WATER

Western Corridor Recycled Water Project

Location: Brisbane, Queensland

Client:	Western Corridor Recycled Water Pty Ltd on behalf of the State of Queensland		
Contract Type:	Operations and Maintenance	**Contract Value:**	$2.4B (D&C)
Start Date:	2006	**End Date:**	2025

PROJECT DESCRIPTION:

The Western Corridor Recycled Water Project is a key element of the Queensland Government's $9B South East Queensland Water Grid. It is the largest advanced recycled water project in Australia and the third largest in the world.

The project involves treating wastewater to the highest standard, resulting in purified recycled water. The purified recycled water is supplied to power stations, industry and agricultural customers and to Wivenhoe Dam through a network of pipes and supporting infrastructure.

This involves more than 200km of large diameter pipeline, 3 advanced treatment plants incorporating membrane technology (at Bundamba, Gibson Island and Luggage Point), 8 storage tanks and 9 pumping stations. When complete, the project will have the capacity to deliver up to 232ML/d of purified recycled water to end users.

Veolia Water has been engaged as the Scheme Operator to initially assist with the development of the project assets and infrastructure. Once construction is complete, Veolia Water will operate the advanced water treatment plants and associated pipelines comprising the Scheme. The project is being delivered by five construction Alliances with Veolia Water as the Scheme Operator embedded into the project to provide advice on the delivery of the scheme and interface between contractor and operator prior to operating the assets under a long term operation and maintenance agreement.

Key Project Innovations:

- In addition to the role of being embedded into the D&C Alliances, Veolia Water assisted Western Corridor Recycled Water and the State in the development of the Recycled Water Management Plan and regulatory framework that will be used to manage the quality of water supplied from the scheme. Veolia Water is also managing the validation and verification of the scheme to meet the requirements of the regulator and Queensland Health
- Veolia Water has worked closely with Western Corridor Recycled Water on compliance with requirements of the newly established water grid and is a key participant in the water grid operations

Western Corridor Recycled Water Project

Key Project Achievements:

- The Western Corridor Recycled Water Project has delivered a number of key industry milestones so far, including the delivery of 20ML/d of purified recycled water to Swanbank Power Station and a further 20ML/day to Tarong Power Station including 90km of transfer pipeline and pump stations in 12 months from commencement
- Practical Completion for the first plant, Bundamba 1A, was granted on 11 July 2008 and handed over formally to Veolia Water at that time. The project is on track to deliver water into the regions drinking water supplies in February 2009
- As the Scheme Operator, Veolia Water mobilised an international team, with experience on all major MF/UF and RO recycled water projects worldwide, within a few weeks of being appointed and has since recruited a high quality multi-skilled team of over 50 staff

Key Project Lessons Learnt:

- Operator involvement from the outset of a project is essential to achieve outstanding results. Integration of the Scheme Operator into the project at an early stage has meant that the operators' point of view and requirements have been designed into the assets from the start of the project (where possible in consideration of the fast tracked nature of the project). This has led to efficiency in design, cost savings and assets that have been optimised on the basis of whole of life cost

Performance Outcomes:

Safety: No Lost Time Incident experienced

Environment: No Environmental breaches

Quality: No non-conformances

Time: Program on time

Cost: Program on schedule

Client Referee:

Name: Mr Keith Davies

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Adelaide Water Management Contract

Location: Adelaide, South Australia

Client:	SA Water		
Contract Type:	PPP/O&M	**Contract Value:**	$70M pa
Start Date:	1996	**End Date:**	2011

PROJECT DESCRIPTION:

The Adelaide Water Management Contract is a 15.5 year PPP agreement between Veolia Water Australia, the South Australian Government and SA Water. The scope is to manage, operate and maintain Adelaide's water and wastewater system, including asset management and management of SA Water's ongoing capital program.

SA Water remains responsible for collecting revenue, managing customer relationships, managing catchments and setting service standards. SA Water owns the infrastructure and controls the capital expenditure.

The contract scope includes:

- O&M of six water treatment plants; five wastewater treatment plants; over 400,000 service connections; 8,850km of water mains and 7,070km of wastewater mains; over 300 wastewater and 50 water pumping stations; 2,000 wastewater vent pipes and 130 water storage tanks
- Manage and operate a customer call centre receiving over 100,000 calls per year
- Design and delivery of SA Water's metropolitan capital works program (more than $50 million pa)
- Development of annual asset management plans for over $7 billion of water and wastewater assets.

This is the largest water outsourcing contract in Australia. To ensure South Australians receive a high standard of service delivery, the Government has set industry leading performance standards. The contract specifies 181 individual performance standards covering water and wastewater quality, water pressure and flow, and response to customers' problems. Substantial financial penalties are imposed for failure to perform. These standards are subject to further development over the term of the contract to keep pace with changes in public health, environmental and community standards and technology improvements.

A United Water engineering group based in Adelaide offers proven expertise in delivering small capital works programs through designing and project managing multimillion-dollar treatment plant upgrades. Each year this group undertakes projects to improve and maintain the operation of water and wastewater treatment plants and networks. An example is the $240 million Environmental Improvement Program.

VEOLIA WATER

Adelaide Water Management Contract

Key Project Achievements:

- Successful transfer of 400 state government employees with no impact on services
- Delivered a 20 per cent saving when the contract starts with total contract savings estimated at $200 million
- Consistently achieved more than 99 per cent compliance against the contract KPIs which were considerably more onerous than pre-contract
- Improved water quality:
  - Customer taps free of coliform bacteria increased from 88 per cent (1995) to 98 per cent (today)
  - Adelaide is now compliant with the Australian National Drinking Water Guidelines
  - Turbidity of water reduced from 0.16 NTU (1995) to less than 0.10 NTU (today)
- Improved wastewater treatment:
  - Sea discharge reduced from 850 total nitrogen (1995) to 250 total nitrogen (today)
- Facilitated water related business exports of $720 million from 1996 to 2005
- Established an R&D node in Adelaide
- With SA Water established a Water Industry Alliance which supports over 200 companies
- The first private water company in Australia operating WTP and WWTP to achieve ISO 9001 for core operations, ISO 14001 for wastewater treatment activities as well as AS/NZS 4801.

Key Project Innovations:

- World-first trials into aquifer storage and recovery for reclaimed water and potable stormwater treatment
- Introduced innovative employment initiatives such as work-life-balance and attraction and retention of graduates.

Key Project Lessons Learnt:

- Long term contracts need to achieve a balance between certainty and flexibility to provide a solid basis to allow for market changes and technological developments.

Performance Outcomes:

Safety: Eight hours per million hours worked lost to injury 1996-2007

Environment: No major environmental breaches incurred

Quality: All quality performance standards achieved – KPI compliance rate >99.9%

Time: Consistently satisfy all time measures

Cost: Consistently deliver below or on budget

Client Referee:

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