SYDNEY DESALINATION PLANT PIPELINE

ASSET MANAGEMENT PLAN REVIEW

Prepared for:

SYDNEY DESALINATION PLANT PTY LTD
Suite 19, Level 17, Australia Square
264 George St, SYDNEY NSW 2000

Prepared by:

Kellogg Brown & Root Pty Ltd
ABN 91 007 660 317
Level 13, 201 Kent St, SYDNEY NSW 2000
Telephone 02 8284 2000, Facsimile 02 8284 2200

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Acknowledgments

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Revision History

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			Originated by	Checked by	Technical Approval	Project Approval
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1 Executive Summary

Sydney Desalination Plant (SDP) is the sole supplier of desalinated drinking water to Sydney with the plant, based at Kurnell, providing around 250 million litres of water per day. The drinking water is delivered from the drinking water pump station (DWPS) at the plant to Sydney Water's distribution system at Erskineville via an 18 kilometre pipeline. SDP holds the 50 year lease on the plant, including the DWPS and pipeline, and is responsible for the operation and maintenance of these assets.

SDP engaged KBR to review SDP's asset management plan (AMP) for the pipeline including the operation and capital cost forecasts (opex and capex). This report documents the review of the AMP for each of the operating modes of the pipeline, be it the current care and maintenance mode, full operating mode and when in transition from care and maintenance to operating.

The Asset Management Plan review includes a review of maintenance reports, operation and maintenance plans, asset databases including quantity and quality of data, as-built documentation, licence and operations agreements and work order examples. It also includes a physical inspection of the pipeline, a risk-based review of current pipeline maintenance activities, proposed improvements of the asset management approach and benchmarking of proposed expenditure against maintenance expenditure of similar pipelines. These reviews are made for each the defined operational modes of the pipeline.

The desalination pipeline is made up of a number of asset types including pipes, structures, appurtenances, monitoring equipment and spare parts. The asset management strategy for the pipeline determines how the pipeline and its components are operated and maintained in order to provide their agreed levels of service.

The current pipeline asset register contains 144 assets, which includes valves, corrosion protection assets, electrical assets, pipeline sections, pits and instrumentation. Based on KBR's review of the asset register, it is recommended to add a further 212 assets to the asset register, including pipe supports, anchor points, transition shafts and actuators. These assets are recommended to be included in the asset register as they are of significant financial value, are critical for the operation of the pipeline or have statutory testing requirements and are deemed important for the asset management of the pipeline.

A physical inspection of the above ground sections of the pipeline was undertaken to provide an indicative assessment of the condition of the pipeline, provide evidence of the effectiveness of the current asset maintenance regime and identify any particular defects for action. A number of observations were recorded from the inspection, particularly relating to protective coatings, corrosion and safety. A number of recommendations were made as a result of these observations mostly for corrective maintenance to be undertaken predominantly for safety and compliance reasons.

A desktop review of current maintenance activities was undertaken and, in the context of SDP's objectives, operating context and other requirements stated above, draw conclusions about potential gaps in the current maintenance regime and what risks they may pose. As a result of the desktop review as well as observations from the site inspection and workshop discussions, a number of gaps were identified. Table 1 summarises the current and proposed preventive maintenance activities for the pipeline as a result of the review of maintenance activities.

Table 1: SDP Pipeline Current and Proposed Preventive Maintenance Summary

Asset Type	Current Preventive Maintenance Summary	Recommended Preventive Maintenance Summary
Pipeline and Transition Shafts	Below Ground - Nil. Relies on CP and design Above-Ground – Annual visual inspection	5-10 yearly internal inspection Above Ground – Annual visual inspection (6 monthly in Operating Mode)
Pipe Supports (Anchor Blocks, Expansion Joints, Sliding Joints)	Included in annual pipeline inspection.	Add specific inspection tasks for pipe supports
Section Isolation Valves	Incidental with annual pipeline inspection	Annual visual inspection and exercising of section valves (6 monthly during operating mode).
Air Valves	Annual visual inspection and exercising.	Add some tasks to PM
Air Valve Isolators / risers	Annual visual inspection and exercising - combined with Air Valve PM.	Add some tasks to PM
Scour Valves	Annual visual inspection and exercising.	Add some tasks to PM
Pits and other civil structures	Annual visual inspection.	Excavate and inspect buried pits with enclosed valves every 5-10 years
Covers and surface features	Incidental with annual pipeline / scour and air valve inspections.	Add some tasks to PM
Anchor Points	Annual inspection as per AS1891.	No change
Easements	6 monthly inspection for vegetation clearing. Annual inspection for access	Additional monthly pipeline walk of above ground pipeline
Cathodic Protection Systems	6 monthly measurement of anode current outputs and potentials Annual 24 hour data logging, electrolysis testing for impressed current system	Add annual testing of SWC SOC alarms
Water Quality Monitoring Station	Quarterly visual inspection during care and maintenance mode Fortnightly/monthly calibration during normal operating mode	No change
Reverse Flow Switch (Shaft 11C)	Incidental with annual pipeline inspection	Specific annual inspection of flow switch (quarterly during operating mode)
Steel structures (e.g. Cages, Stairways, Platforms)	Incidental with annual pipeline inspection	Add specific inspection tasks for platform & stairways to annual pipeline inspection
RPZ Valve (Backflow Prevention Device)	Nil	Undertake annual testing/recertification as per Sydney Water requirements

There are a number of recommendations for changes to be made to the AMP that will improve the management of risk, provide better alignment with SDP objectives, refine opex / capex budgeting and forecasting, maximise design life and minimise whole of life cost, and reporting for performance compliance. These include adding required

levels of service, key performance indicators to monitor and measure the effectiveness of the AMP, references to manuals, drawings, Preventative Maintenance (PM) procedures, standard operating procedures and safety procedures, an audit program, guidelines for asset registers and asset replacement, details of how the Computerised Maintenance Management System (CMMS) is used to support asset management, a critical spares list, business processes, water quality monitoring regime, staffing levels, opex and capex forecasts, and future asset-related improvements.

Detailed opex forecasts have been estimated for the next six financial years 2016-17 to 2021-22, with high-level opex and capex forecasts for the subsequent 20 years (to 2041-42). Based on historical expenditure, the baseline operating and maintenance cost for the pipeline in 2015-16 is $172,300. After a review of the maintenance gaps and recommendations from the site inspection, it is recommended to increase this to $434,700 in 2016/17, $591,900 in 2017/18 (which includes restart preparation costs), and $692,500 in 2018-19 (which includes restart costs). Recommended maintenance costs continue to increase annually to $885,500 in 2041/42. The majority of the recommended additional expenditure is for the purpose of minimising risks to reliability of supply. However, some recommendations are driven by minimising risks to safety, compliance or water quality.

KBR also undertook benchmarking of pipeline maintenance expenditure against similar pipelines from other utilities. An indicative cost to return the pipe to its 100 year design life (allowing for replacement of the pipe lining, valves and instruments) of $20,000,000 was adopted for benchmarking purposes which is comparable to the cost per km of the similar pipelines. The percentage of Maintenance cost p.a. to this renewal cost is 0.9% for current maintenance expenditure and 2.3% for recommended maintenance expenditure. This compares well with the other benchmarked pipelines which had values between 1.7% and 2.5%. The percentage of preventive maintenance to total maintenance costs is 88% based on current maintenance, which is significantly higher than the benchmarked pipelines (between 19% and 65%). This is primarily a reflection of the SDP pipeline being in care and maintenance mode as well as being a relatively new pipeline. The high PM percentage is therefore acceptable given the above considerations.

Major risks associated with the operation and maintenance of the pipeline include the reduction in asset life, especially from corrosion; WHS risks due to unsafe access to easements and pits; failure to maintain reliability of supply when in operating mode; impacts on the pipeline from nearby development; water quality; and surety of operation when restarting the pipeline (including costs, delays and water quality). This report provides a number of recommended actions in regards to inspection and monitoring of the pipeline (e.g. internal inspection of the pipeline, external inspections of above-ground pipe coatings, footings and joints, and monitoring and maintenance of corrosion protection systems).

These recommendations have been made to ensure the asset management of the SDP pipeline is safe, prudent, efficient, compliant with relevant standards and licences, and in accordance with industry best practice. The overall objectives are to maintain reliability of supply (level of service) while maximising the design life of the pipeline and minimising the whole-of-life costs. These key drivers are aligned with the AMP recommendations as listed in Table 2 below.

Table 2: Key SDP Pipeline Asset Management Recommendations

Recommendation	Key Driver
Replacement of anodes at locations identified in the latest CCE report	Reliability of Supply
Review the need for permanent rated anchor points. Replacement of failed anchor points, and load testing of current anchor points prior to each use until they are replaced with an improved design	Safety / Compliance
Establish an annual PM for the six section valves	Reliability of Supply
Replace missing bird spikes on top of pipe sections at the M5/SWSOOS crossover and Alexandra Canal	Safety / Compliance
Establish a PM for internal inspection of the pipeline	Reliability of Supply
Develop an asset management plan that includes details about levels of service, key risks, safety procedures, standard operating procedures, PM procedures, KPIs, support tools, condition monitoring, spares, resourcing, opex and capex forecasts, and future improvement initiatives`	Reliability of Supply, Safety, Compliance, Cost
Add assets to the asset register as listed in Appendix B (Table 2) and add asset details to the register such as size, material, manufacturer, model	Reliability of Supply, Compliance, Cost
Collection of asset condition data during PMs using a 1-5 overall condition rating, as well as other condition data	Reliability of Supply
Develop additional asset management metrics for inclusion in monthly or annual reporting as specified in Section 8.4	Reliability of Supply, Cost
Review of Restart Procedure to include design specification for dosing equipment, pipeline configuration P&ID, treatment for toxins	Reliability of Supply

2 Background, Scope and Purpose

2.1 BACKGROUND

Sydney Desalination Plant (SDP) is the sole supplier of desalinated drinking water to Sydney. The plant is based at Kurnell and at full capacity provides around 250 million litres of water per day equivalent to approximately 15% of Sydney's drinking water. The drinking water is delivered to Sydney Water's distribution system at Erskineville via an 18 kilometre pipeline.

The Sydney Desalination Plant is owned by the Government of New South Wales. In 2012, the NSW Government entered into a 50–year lease with Sydney Desalination Plant Pty Ltd (SDP), a company jointly owned by the Ontario Teachers' Pension Plan Board (50%) and Hastings Funds Management Limited.

SDP has entered into three long-term contracts with Veolia Water Australia for the operation and maintenance of the desalination plant, drinking water pump station and the Kurnell to Erskineville pipeline. The Network Operator's Licence was transferred to Veolia in May 2013.

The contractual obligation for the SDP is for it to be switched on and producing drinking water when Sydney's overall dam levels fall to below 70% of capacity. The plant will be turned off when the dam levels reach 80% (known as the 70:80 rule).

Dam levels in Sydney have been above 70% for the past three years and the plant has been in "care and maintenance" mode since 1 July 2012. Prior to that date the plant had been in full operation for two years.

The plant is currently out of commission after sustaining significant damage as a result of a tornado event on 16 December 2015. The rectification of the plant is expected to take approximately12 -18 months.

2.2 PURPOSE

SDP is preparing for its next price reset in July 2017. IPART will determine prices SDP can charge Sydney Water for a five year period from 1 July 2017 to 30 June 2022. The determination by IPART will be based on the Terms of Reference (ToR) provided to it by the NSW Government.

A major submission is due from SDP to IPART by 24 October 2016 as part of the determination process.

In order to assist SDP in its preparation of its submission, SDP has engaged KBR to review SDP's asset management plan for the pipeline which includes forecast opex and capex. The purpose of the asset management plan is to provide guidance and direction to ensure the asset management of the SDP pipeline is efficient, safe, in

accordance with best practice, maximising design life while ensuring reliable of supply for critical water security infrastructure.

Key stakeholders in the project include SDP management and the delivery pipeline operator Veolia Australia.

2.3 SCOPE

The scope of services for the Asset Management Plan review includes:

- A review of the SDP operating license, pipeline design drawings, the pipeline maintenance contract, the existing asset management plan, spares list, the annual maintenance schedule, the annual maintenance inspection reports, historical opex and capex expenditure and Maximo asset management information system asset maintenance history
- A physical inspection of the pipeline to assess the asset condition
- A risk-based review of current maintenance activities to identify any gaps
- Proposed improvements to the asset management approach, if required, to ensure pipeline asset management is consistent with good industry practice and accommodates the required performance of the pipeline in the context of SDP's operating rules, operating modes, risks and license conditions
- Provide a revised asset management plan for SDP's pipeline that incorporates the identified improvements and includes prioritised forecast opex and capex, with detailed forecasts for 2016-17 and the 2018-2022 regulatory period, and high level forecasts over the following 20 years
- Benchmark the proposed expenditure against maintenance expenditure on similar pipeline assets of a comparable value

The scope for the asset management review is only for the SDP pipeline starting from isolation valve KUSV1, chainage 0, and ending at the point of connection into Sydney Water's (SWC) water supply system at Shaft 11C at Erskineville. The scope of the review does not include the SDP drinking water pump station, surge vessels or flow meters.

While it is has not been requested as part of the scope of this review, the suite of International Standards for Asset Management (ISO55000, 55001 and 55002) has been used as a reference for evaluating the current asset management plan for the SDP pipeline.

Veolia's "Operations Management Plan" was used to review the current maintenance activities performed on the SDP pipeline, and has been used as the starting point for review/development of the AMP. However, other documents provided by SDP and Veolia were also considered as part of the overall AMP review including the handover documentation from SWC that was used to establish the original maintenance program.

The effective asset management of the pipeline has several drivers including the nature and purpose of the organisation, its operating context, its financial constraints and regulatory requirements and the needs and expectations of its stakeholders. Asset management of the SDP pipeline should be prudent, efficient, in accordance with industry best practice, in order to maximise the design life of the pipeline and minimise whole-of-life costs. This is done in the context of maintaining reliability of

supply for a drought-based asset as well as maintaining a high standard of safety and environmental compliance.

The SDP pipeline has two operating modes: normal operation and "care and maintenance". Asset management strategies for the pipeline will change when the operating mode changes.

Normal operating mode takes effect when the available storage of Sydney's dams falls below 70% and is maintained until the available storage rises to 80%, except when the plan is in "restart" phase or due to an event outside the operator's "reasonable control".

During normal operating mode, the SDP must achieve average 250ML/d flow over a calendar year (approx. 91 GL/year) with daily scheduled output rates between 90ML/d and 290ML/d. During care and maintenance mode, no flow is delivered.

The Operating Licence also states an obligation for the licence holder to maintain pipeline in accordance with "Good Industry Practice", regardless of the operating mode.

3 Glossary

AMP Asset Management Plan

BM Breakdown Maintenance

Capex Capital Expenditure

CP Cathodic Protection. A technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell.

CCE Corrosion Control Engineering. The company that provides specialist services for CP testing and maintenance

CM Corrective Maintenance

CMMS Computerised Maintenance Management System

CPI Consumer Price Index

DBYD Dial Before You Dig

DWPS Drinking Water Pump Station

IPART Independent Pricing and Regulatory Tribunal of NSW

KPI Key Performance Indicator

Maximo CMMS used by Veolia

O&M Operations and Maintenance

Opex Operational Expenditure

P&ID Process and Instrumentation Diagram

PM Preventive Maintenance

RPZ Reduced Pressure Zone assembly (backflow prevention valve)

SACL Sydney Airport Corporation Limited

SCADA Supervisory Control And Data Acquisition

SDP Sydney Desalination Plant Pty Ltd

Sintakote® A factory applied external fusion bonded polyethylene coating for corrosion protection of steel water pipelines

SOC Sydney Water Corporation's Systems Operations Control Centre

SWC Sydney Water Corporation

SWSOOS Southern and Western Suburbs Ocean Outfall Sewer

Veolia Veolia Australia and New Zealand

WO Work Order

4 Asset Management Review Process

4.1 LIST OF REVIEWED DOCUMENTS

As per the scope of works, various documents were provided by SDP and Veolia which were included in the asset management review of the SDP pipeline. Design documentation developed by the Water Delivery Alliance which KBR was a part of was also included in the review. The following is a high-level summary of the documents reviewed as part of this process:

- As-built engineering drawings
- Asset register data
- Risk assessments
- Operating licence
- Operations and maintenance plans, schedules, procedures and agreements
- Maintenance reports, history and expenditure data

Refer to Appendix A for the full list of the documents included in the asset management review.

4.2 REVIEW PROCESS

The following process was undertaken for the SDP pipeline asset management review and is addressed in the proceeding chapters:

- A physical inspection for an indicative assessment of pipeline condition
- A desktop review of the maintenance plans, schedules, procedures, agreements, reports, history and data to assess the current maintenance activities
- A workshop to confirm and clarify current maintenance activities and prevailing asset management concerns regarding the pipeline
- A review of design documentation, maintenance manuals and discussions with specialists to determine recommended maintenance strategies for the pipeline and associated assets, including cost estimates
- A comparison of the current and recommended maintenance strategies to determine any gaps
- A review of the current asset management plan, using Veolia's "Operations Management Plan" as a starting point
- Using ISO55000 asset management standard as a benchmark to assess gaps in the current asset management plan for the pipeline and recommending improvements to be incorporated into the revision of the asset management plan subsequent to this report
- Review of historical opex and capex expenditure and estimates for future maintenance and renewals to develop detailed forecasts for the next six financial years and high-level forecasts for the next 20 years.

- A review of the current asset register against design drawings and good asset management practice to identify gaps in asset data
- A review of the current asset management reports against good asset management practice to identify gaps in reporting
- Review of historical maintenance expenditure of the pipeline benchmarked against similar pipelines using standard asset management metrics.

5 Asset Details

Table 3 summarises the types of assets installed for the SDP pipeline.

For a complete asset list for the pipeline refer to Appendix B which identifies current asset listings and those assets recommended for inclusion. A process flow diagram showing the various pipeline sections and valve locations can be found in Appendix C.

A summary of the current SDP pipeline asset list by asset type as supplied by Veolia is as follows:

- Air Valves 29
- CP - General 6
- CP - Test Points 33
- Distribution Boards 3
- Easements 6
- Electrical 1
- Flow Switch 1
- Grounds 12
- LV System 1
- Pipeline 25
- Pits 5
- Scour Valves 11
- Section Valves 6
- Water Quality 5
- **Grand Total** **144**

A summary, by asset type, of SDP pipeline assets recommended to be added to the asset list is as follows:

- Air Valve Isolators 29
- Anchor Blocks 16
- Anchor Points 68
- CP - Anodes 43
- CP - Impressed Current 1
- CP - Test Point 1
- Expansion Joints 5
- Pipe Supports 2
- RPZ Valve 1
- Sliding Joints 21
- Transition Shafts 18
- Water Meter 1
- Actuator (Section Valve) 6
- **Grand Total** **212**

5.1 ASSET CRITICALITY ASSESSMENT

Where available, asset criticality ratings in Table 3 have been taken from the asset register provided by Veolia. The remaining criticalities have been assessed based on KBR's understanding of the asset in relation to the operation of the pipeline.

The criticality rating system is 3 = High, 2 = Medium, 1 = Low.

Assets associated with supporting the pipe have been assessed as a criticality of 2 (medium) such as anchor blocks, expansion joints and sliding joints. This is because that a failure of an individual item is not likely to cause failure to the pipeline in the short term due to safety factors in the design of the pipeline.

Transition shafts have been assigned a criticality of 3 (high) because they are integral with the pipeline.

Anchor points have been assigned a criticality of 3 (high) because failure of an anchor point is a WHS risk as it has the potential to cause serious injury or death.

Air Valves and Scour Valves have been assigned a criticality of 3 (high) in the asset register provided by Veolia. This could be reduced to a criticality of 2 (medium) as failure of one of these valves would be unlikely to have significant impact on operation of the pipeline in the short term.

The Shaft 11C water quality instrumentation has been assigned a criticality of 1 (low) in the asset register provided by Veolia. This should be increased to 3 (high) as monitoring of water quality is critical for the operation of the pipeline.

Access platforms and the RPZ valve have been assigned a criticality of 2 (medium) because of the potential for WHS risk if they fail, although serious consequences from failure are considered unlikely.

Table 3: SDP Pipeline Asset Summary

Asset Type	Length (m)	Dia (mm)	Qty	Materials	External Coating	Asset Criticality	Design Life (Yrs)	Incl. in Asset Register?
Pipeline - Kurnell (Trenched, Mounded, Micro-Tunnelled and above ground)	2475	1800	1	Mild Steel Cement Lined (MSCL)	Sintakote External Coating (fusion bonded polyethylene), except for above-ground section at Pump Station which is 2mm Epoxy	3	100	Y
Pipeline - Botany Bay Marine Crossing	14130 (2 x 7,065)	Twin 1400	1	MSCL	3.5mm "tri-laminate" coating	3	100	Y
Pipeline - Rockdale (Trenched, Mounded, Micro-Tunnelled and above-ground)	2223	1800	1	MSCL	Sintakote External Coating (fusion bonded polyethylene), except for tunnelled sections which has Cementious Grouted Annulus.	3	100	Y
Pipeline - Marrickville (Trenched, Mounded and above-ground)	1597	1800	1	MSCL	Sintakote External Coating (fusion bonded polyethylene)	3	100	Y
Pipeline - Sydney South (Micro-Tunnelled)	1613	1800	1	MSCL	Cementious Grouted Annulus, except for section between Freight Rail South and North which is Sintakote	3	100	Y
Pipeline - Sydney North (Micro-Tunnelled, Trenched and Above-ground)	1915	1800	1	MSCL	Cementious Grouted Annulus, except for section between Freight Rail South and North which is Sintakote and above-ground section at Shaft 11C which is 2mm Epoxy	3	100	Y
Anchor Blocks (Above Ground)	N/A	N/A	9	Concrete		2	100	N
Expansion Joints	N/A	1800	5	Steel (with Stainless Steel Ring)		2	100	N

Asset Type	Length (m)	Dia (mm)	Qty	Materials	External Coating	Asset Criticality	Design Life (Yrs)	Incl. in Asset Register?
Above Ground Pipe Supports	N/A	N/A	2	Steel		2	100	N
Sliding Joints	N/A	1800	22	Steel		2	100	N
Transition Shafts	N/A		18			3	100	N
Rockdale Section Isolation Valves	N/A	1400	2	Steel	Fusion Bonded Epoxy	3	50	Y
Kurnell, Marrickville & Shaft 11C Section Isolation Valves	N/A	1800	4	Steel	Fusion Bonded Epoxy	3	50	Y
Air Valves	N/A	250	29	Steel	Fusion Bonded Epoxy	3	30	Y
Air Valve Isolators / risers	N/A	250	29	Steel	Fusion Bonded Epoxy	1	30	N
Scour Valves	N/A	250	11	Steel	Fusion Bonded Epoxy	3	30	Y
Pits and other civil structures	N/A	N/A	30 est	Concrete		1	100	Y (grouped, not individual)
Covers and surface features	N/A	N/A	30 est	Concrete		1	50	N
Access Equipment – Fall arrest anchor points and air valve cage lifting lugs	N/A	N/A	64	Stainless Steel Anchor in Galvanised Steel Protection Box		3	30	N
Fences, access, roads and demarcation (Easements)	Not Determined	N/A	ND			1	30	N
Cathodic Protection Systems - Sacrificial Anodes	N/A	N/A	90	62 x Magnesium 28 x Zinc	Gypsum Bentonite	2	30	N
Cathodic Protection Systems - Impressed Current (Botany Bay Crossing)	N/A	N/A	1			3	30	N

Asset Type	Length (m)	Dia (mm)	Qty	Materials	External Coating	Asset Criticality	Design Life (Yrs)	Incl. in Asset Register?
Cathodic Protection systems - Test Points	N/A	N/A	33	Galvanised post, stainless steel head		1	30	Y
Cathodic Protection systems - Corrosion Monitoring Probes (Micro-tunnelled sections)	N/A	N/A	7			1	30	N
Flange Isolating Gasket Kits	N/A	250 / 1400 / 1800	72	Klingersil C6327		1	30	N
Water Quality Monitoring Instrumentation	N/A	N/A	1			1	15	Y
Reverse Flow Switch (Shaft 11C)	N/A	N/A	1			3	15	Y
Steel structures (e.g. Cages, Stairways, Platforms)	N/A	N/A	3	Steel		2	50	N
RPZ Valve (Backflow Prevention Device) and Shaft 11C	N/A	20	1			2	30	N

6 Site Inspection

6.1 SCOPE AND METHOD OF SITE INSPECTION

A physical inspection of the above ground sections of the pipeline was undertaken at the following locations on the dates indicated below:

- Kurnell Pump Station (18/5/16)
- SWSOOS/M5 Crossover (17/5/16)
- Alexandra Canal between Chainages 340 and 1140 (17/5/16)
- Shaft 11C (18/5/16)

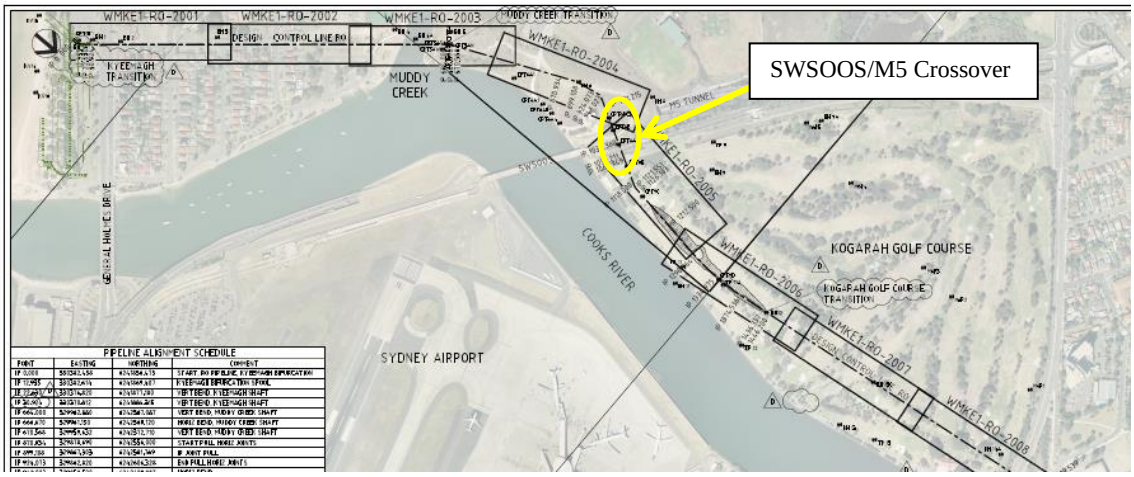


Figure 1 - Above-Ground Pipeline at SWSOOS/M5 Crossover

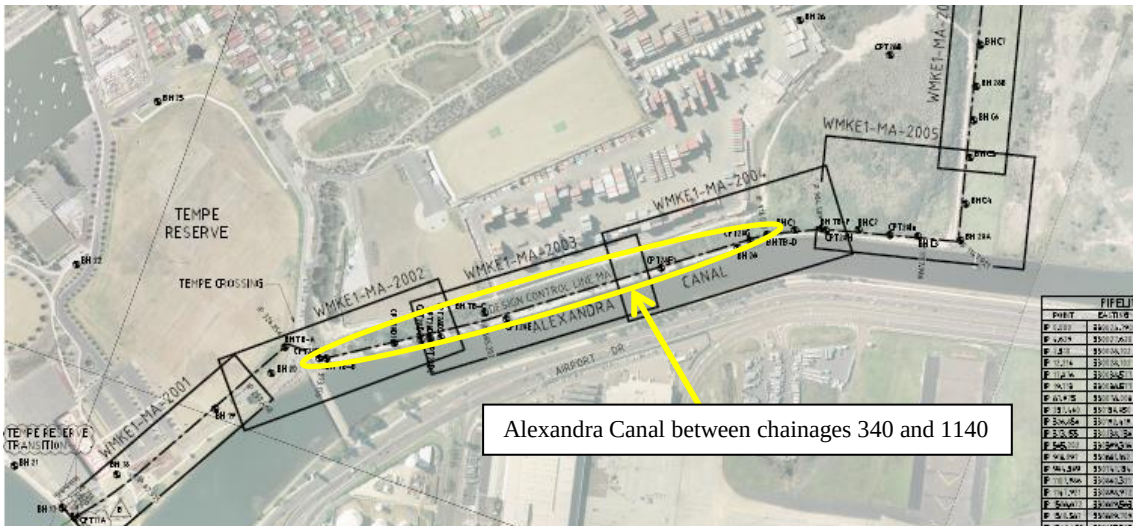


Figure 2 - Above-Ground Pipeline at Alexandra Canal

The purpose of the inspections was to assess the condition of the pipeline, provide evidence of the effectiveness of current asset maintenance regime and identify any particular defects for action. The intention was not to undertake a comprehensive assessment but rather an indicative assessment of the pipeline condition. The following elements were assessed during the inspection (in order of asset criticality - highest to lowest):

- Safety (for access, operation and maintenance of the pipeline)
- Water Quality Monitoring Equipment
- Anchor Points
- Access Roads and Tracks
- Section Valves (including actuators)
- Protective Coating
- Joint Wrapping
- Expansion Joints
- Anchor Blocks
- Pipe Supports and Sliding Joints
- Stairs and Access Platforms
- Air Valves (including associated isolation valves)
- Scour Valves
- Valve Pits and Covers
- Corrosion Protection Test Points
- Drainage around the pipe
- Pipeline Cutting / Embankment / Retaining Walls

KBR were advised that fences and gates around the above-ground sections of the pipeline are not owned by SDP (apart from at the Kurnell Plant) and therefore are not discussed in this report.

The inspection was performed by visually walking along the pipeline, taking photos and videos of the pipeline and associated assets from the ground and using a video camera attached to a pole for assets on top of the pipeline or in pits. No entry into valve pits was undertaken and no valves were operated during the inspections. No non-destructive or intrusive testing was undertaken of the pipe.

Check sheets were used to record condition ratings and observations of the condition of the pipe and associated assets. A 1-to-5 condition rating scoring system was used as follows: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable. Check sheets were completed for the following assets:

- Above-Ground Pipe KUSP0 - Kurnell Pump Station
- Above-Ground Pipe ROSP5 - Above SWSOOS
- Above-Ground Pipe MARP2 - Alexandra Canal from CH340 (start of above-ground section) to Expansion Joint # 2
- Above-Ground Pipe MARP2 - Alexandra Canal from Expansion Joint # 2 to Expansion Joint # 3
- Above-Ground Pipe MARP2 - Alexandra Canal from Expansion Joint # 3 to Expansion Joint # 4
- Above-Ground Pipe MARP2 - Alexandra Canal from Expansion Joint # 4 to CH1140 (end of above-ground section)
- Above-Ground Pipe SNP2 - Shaft 11C

- Air Valve KUAV2 - Kurnell Pump Station
- Air Valve MAAV1 - Tempe Reserve, Next to Cooks River
- Air Valve MAAV3 - Alexandra Canal - CH585
- Air Valve MAAV3A - Alexandra Canal - CH980
- Air Valve ROAV5 - SWSOOS/M5 Crossover
- Air Valve SNAV8 - Shaft 11C
- Scour Valve MASC1 - Tempe Reserve, Next to Cooks River
- Section Valve SNSV1 - Shaft 11C

Appendix C shows the locations of these assets on the process and instrumentation diagram for the pipeline.

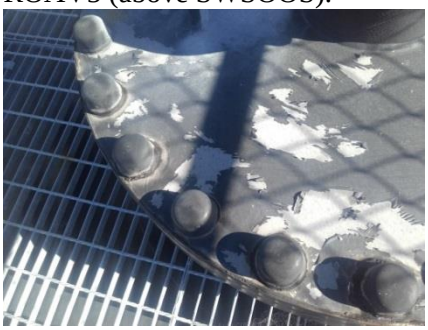
A separate check sheet was completed for the pipe joint wrapping condition assessment. This check sheet also used a 1-to-5 condition rating scoring system as described above.

Check sheets and photos are included in Appendix D.

6.2 OBSERVATIONS

The following is a summary of the significant observations from the physical inspection.

1. Water is pooling on top of the large flanges under some of the air valves. Approximately 50% of the coating has failed on the large flange under ROAV5 (above SWSOOS).




2. The scour valve MASC1 at Tempe Reserve was fully submerged in water.

3. Anchor points around the valve pits at Tempe Reserve are badly corroded, especially the hinges and underside of the lids. Anchor point pits are full of mud, dirt and water. Load testing last completed November 2015 and are therefore compliant but with the level of attack by corrosion there is the possibility of noncompliance in the foreseeable future.

4. Most bolts on pipe flanges have caps fitted. One cap was removed to reveal a bolt covered with grease.
5. A few loose fasteners and short bolts on some stairways. Not considered high risk but it is a potential WHS hazard which may increase in risk over time. Surface corrosion was observed at some points on hand rails and chain hooks.




6. Heat shrink wrapping at several pipe joints had come loose in places, especially in the area where the shrink wrapping overlaps. However what was observed of the underlying Denso tape appeared to be in good condition and no bare metal was exposed under the joint wrapping. The worst of the joint wrapping was observed at the downstream end of the above-ground pipe section along Alexandra Canal. The joint wrapping will be reviewed in more detail in a separate report.

7. No leaks were observed during the inspection, although there was some evidence of previous leaks, especially at Air Valve MAAV3 (Alexandra Canal - CH585) which Veolia advised was the result of a ball valve being left partially open after a pressure gauge was stolen from this site.

8. There are several areas where the protective coating is cracking, bulging or drummy around flanges and fasteners on the pipe at Kurnell Pump Station and Shaft 11C. The pipes with coating issues at these locations have epoxy coating, not Sintakote.

9. Several bird spikes are missing from the top of the pipe at the M5/SWSOOS crossover and Alexandra Canal. While this is not a significant risk for the pipe the bird spikes would be part of the requirement of SACL to manage and control the presence of birds in the vicinity of the airport in accordance with CASA regulations. It is assumed the bird spikes are a requirement of SACL's "Bird Hazard Management Guidelines" which is referred to in the SACL Maintenance Plan.

10. Graffiti was observed the M5/SWSOOS crossover on the pipe and anchor blocks and pipe supports and, to a lesser extent, along Alexandra Canal.

11. Some short and bent bolts were found on pipe footings along Alexandra Canal. While the risk to the pipeline is low, a short bolt means that the full design strength of the bolt is not able to be realised and thread stripping is more likely to occur if the pipe footing is subjected to stresses closer to the upper end of its design.

12. There was some overgrown vegetation in some areas, especially on the northern side of the pipe along Alexandra Canal (the side furthest from the Canal).

13. There is a longitudinal crack in the concrete encasement of the pipe where it rises from underground at Shaft 11C.

14. At Shaft 11C, there is corrosion and cracking where the flow switch is connected to the main pipe. There is also surface corrosion on the metal brackets used to secure the flow switch.

15. The protective tape wrapping on pipe flanges at Shaft 11C is in poor condition (several holes, coming loose from flange)

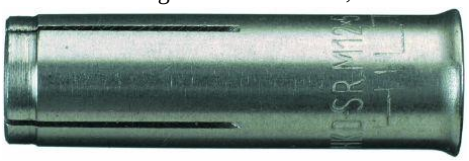
These observations, with the exception of items 1, 5 (loose & short bolts), 11 and 13, have also been noted in the sample monthly maintenance reports provided by Veolia.

For further details, refer to the check sheets and photos included in Appendix D.

6.3 RECOMMENDATIONS

Table 4 summarises KBR's recommendations arising from the site inspection, in order of priority. The recommendations are also included in Section 10 Recommended Actions and the cost estimates of these recommendations are included in Section 8.2 Opex and Capex Forecasts.

Table 4: Recommendations Arising from Site Inspection

Recommendation	Priority	Key Driver
Replace missing bird spikes on top of pipe sections at the M5/SWSOOS crossover and Alexandra Canal. Some bird spikes found on the ground nearby could be re-used.	High	Safety /Compliance
Consider whether it is appropriate to install and maintain rated fall-arrest anchor points on pits accessed occasionally, with normal opening less than 1m x 1m. Cover grates and temporary anchor points (tripod) may be more suitable.	Medium	Safety / Compliance
As anchor points fail, replace with an improved design that is not prone to being submerged in water. The new anchor points specified for the Erko Pit are recommended. These are drop-in anchors (Hilti HKD SR M16 65 or approved equivalent) 316 stainless steel / length 65mm X 16mm, to suit RUD VLBG M16 Eyebolt WLL 1.5T. 	Medium	Safety / Compliance
During the next PM, check all fasteners on stairways and platforms. Tighten any loose fasteners, replace any short bolts. Patch paint areas of corrosion on hand rails and chain hooks. Chain hooks may need to be replaced.	Medium	Safety
Repair cracking and patch paint where the flow switch at Shaft 11C is connected to the main pipe. Patch paint or replace metal brackets used to secure the flow switch.	Medium	Reliability of Supply
Blast and repaint of failed protective coating at Kurnell Pump Station, Shaft 11C and large flanges under air valves	Medium	Cost
Patch repair or epoxy pressure grout longitudinal crack in the concrete encasement of the pipe where it rises from underground at Shaft 11C.	Medium	Cost
For valves that are immersed for long periods of time, ensure that the pits are dewatered at least every 5 years and conduct a thorough inspection of the valve to assess and record its condition and plan for necessary maintenance works.	Medium	Cost
Replace defective protective tape wrapping on pipe flanges at Shaft 11C.	Low	Cost

Recommendations have not been made regarding vegetation and graffiti removal as the current arrangements as evidenced from the historical maintenance works and feedback from the workshop are considered adequate based on discussions with SDP and Veolia.

Recommendations regarding the pipe joint wrapping will be discussed in a separate report.

7 Review of Maintenance Activities

7.1 OVERVIEW

The International Standard for Asset Management (ISO55000) states that asset management translates the organisation's objectives into asset-related decisions, plans and activities, using a risk-based approach. This standard also states that the following factors can affect how assets are managed:

- The nature and purpose of the organisation
- Its operating context
- Its financial constraints and regulatory requirements
- The needs and expectations of the organisation and its stakeholders

Therefore, the following should be considered when making decisions about asset management of the SDP pipeline

- Operating mode (normal operation or care and maintenance mode)
- Operating and Capital budgets, based on IPART determinations
- SDP Operating Licence
- Needs and expectations of Sydney Water, both in relation to security of water supply and community expectations
- WHS act and regulations
- Environmental acts and regulations
- Stakeholder needs and expectations (e.g. land holders along pipeline route – SACL, Councils, Rail Corp, etc)

The following performance requirements have been extracted from the advice and documentation provided by SDP including the Network Operators Licence.

7.1.1 Normal Operating Mode

- "When the Available Storage falls below 70%, the Licence Holder must, until the Available Storage rises to 80% operate and maintain" the SDP infrastructure "with the objective of maximising the production of drinking water", except when the plan is in "restart" phase or due to an event outside the operator's "reasonable control".
- Achieve average 250ML/d flow over a calendar year (approx. 91 GL/year) with daily scheduled output rates between 90ML/d and 290ML/d. Verbal advice is that the plant operates at 266 ML/d flow with 94% availability over a calendar year. This allows approximately 3 weeks over the course of the year for planned shutdowns for maintenance purposes.
- Water quality parameters are to be within the limits set in Table 1 in the Operating Protocol (Table 1 is not included in this report)

- Immediate notification of incidents or reductions in plant capacity (with incident notification in writing to senior managers within 30 mins)
- 25 hours' notice of unscheduled flow variations
- On-line water quality monitoring plus additional sampling as required.

7.1.2 Care and Maintenance Mode

- 0 ML/d flow
- Pipe remains full of water
- Minimal water quality monitoring required, approximately twice yearly, to monitor water quality stored in the pipe for pH levels. Any increasing trend in pH over time may indicate possible leaching of the cement lining

7.1.3 Restart Mode

- When the SDP has been given notice that production is required.
- There is no flow requirements during this time but certain activities are required to prepare for production including the following:
    - Order pipeline component spares
    - Procure dosing equipment and chemicals
    - Recommission water quality instrumentation at Shaft 11C,
    - Purge pipeline (including disinfection at Shaft 11C and de-chlorination and pH treatment at Kurnell)
    - Water quality monitoring including ecotoxicity testing
    - Approvals and EPA notification

7.1.4 General Asset Management Requirements (all modes)

- Operating Licence states an obligation for the licence holder to maintain pipeline in accordance with "Good Industry Practice"
- Veolia Operations and Maintenance agreement requires Veolia to perform the services stated in the agreement in accordance with "Good Industry Practice" and ensure the pipeline will perform as required.

7.2 DESKTOP REVIEW

A desktop review of the documentation provided (as detailed in Section 4.1) was undertaken to review the current maintenance activities and, in the context of SDP's objectives, operating context and other requirements stated above, draw conclusions about potential gaps in the current maintenance regime and what risks they may pose.

The current maintenance activities for the pipeline in "care and maintenance" mode are specified in Veolia's Operations and Maintenance Agreement. This was correlated against other documents such as maintenance reports, procedures and the Operating Plan provided by Veolia

Sydney Water's 2012 "Operations and Maintenance Schedule" was used as the basis for assessing maintenance activities during normal operating mode.

7.3 STAKEHOLDER WORKSHOP

A workshop was held at the Sydney Desalination Plant on 18/5/16 to discuss asset management issues for the SDP pipeline. Present at the meeting were Gavin Ovens (Executive General Manager of Operations, Sydney Desalination Plant Pty Ltd), Rob Weidemier (Contract Coordinator, Veolia Australia and New Zealand), John Brown (KBR) and Mark Mordini (KBR).

The following agenda was prepared for the workshop:

1. Establish list of stakeholders
2. Discuss known pipeline maintenance issues
   - Access Issues (roads, tracks vegetation, landowners, etc)
   - Confirm ownership and maintenance responsibilities of fences and gates
   - Corrosion Protection
   - Pipe Joint Wrapping
   - Water in pits
   - Other
3. Discuss potential gaps in maintenance
4. WHS issues
5. Resourcing for maintenance activities
6. Maintenance works management process
7. Reporting
8. Data collection and management
9. Table of contents for final report
10. Other issues

Key outcomes from the workshop were:

- Corrosion is the main asset management concern regarding the pipeline currently.
- Anodes being passivated at a faster rate than expected (expected life 20 years, currently need replacing < 10 years at an estimated cost of $60K). Investigation is required by a corrosion protection specialist as to why this is occurring.
- Pipe joint wrapping - heat shrink wrapping on several joints are reported to be losing adhesion to pipe. Investigate what are the current risks and medium to long term risks and investments.
- Maintenance of fences and gates are not the responsibility of SDP or Veolia
- Vegetation clearing currently undertaken six monthly PM, and on an ad-hoc basis when required for non-routine works.
- Graffiti - normally painted over approx. twice yearly. The only complaints received are from SACL when the graffiti is visible to them.

- Many scour valves are submerged in pits and are designed for this environment as they have corrosion protection installed. Some air valves are submerged but are not designed for this and don't have corrosion protection installed. This needs further investigation either by Veolia or a valve specialist.
- Many in-ground anchor points have water/mud/debris which they are not designed for and some have failed load testing. New anchor points for Erko pit are a good design.
- Internal pipe inspection not currently undertaken. What is the best inspection frequency and method?
- Current "care and maintenance" mode means that only the bare basic maintenance tasks are currently performed.
- External inspection of pipeline, along with exercising scour and air valves (and their isolators) is currently undertaken annually (usually November).
- Section valves are not exercised as part of the PM program.
- There is currently no scope available for coating repairs for either Sintakote or epoxy coatings.
- Sensors for water quality instrumentation were removed once pipeline was off line (before start of Veolia Contract). Panel is still energised and is part of annual inspection. This appears to be a sensible approach while in "care and maintenance" mode.
- A monthly report is provided by Veolia to SDP listing completed tasks, active jobs, identified issues. There are no KPIs in the report.
- What KPIs can be used to measure asset management/maintenance effectiveness?
- No condition data or other data is required to be collected as part of the fixed-price PMs. CCE reports contain data of voltages measured at CTPs. General observations and comments are recorded electronically on work orders.
- Current asset list to be reviewed for potential gaps.

Minutes for the workshop are included in Appendix E.

7.4 MAINTENANCE GAP ANALYSIS

Following from the desktop review of maintenance documentation, site inspection and the workshop discussion, the following are observed gaps within the current asset management procedures for the pipeline.

The current maintenance procedures detailed in Section 5.1 of Veolia's Operations Management Plan are very broad and rely on the expertise of the contractor and the experience of the staff undertaking the inspections to ensure visual inspections are conducted in accordance with good industry practice. PM procedures are also quite broad and lacking specific details. Current PM procedures should be expanded to detail required specific tasks for inspections. This will help with providing consistency in inspections and recording observations against consistent tasks lists will enable better analysis of pipeline condition. As part of the proposed improved inspection process there will be a need to set into place analysis steps or triggers built into procedures to action findings.

The current maintenance regime does not include any internal inspection of the pipeline. The economic consequences of premature failure of the pipeline internal

linings are significant. An internal inspection regime of the pipeline is highly recommended for the following reasons:

- The internal lining includes a variety of pipe types, field welded joints, and fabricated fittings and bends. Workmanship of field joints may not be as reliable as required.
- The chemistry of the desalinated water may be more aggressive to linings than expected. The St Mary's Recycled (un-mineralised) water pipeline has recently been observed to have excessive cement lining degradation.

An initial survey is recommended within 5-10 years of commissioning to check for localised poor workmanship and confirm that there are no systemic problems. An ongoing 10-15 year inspection interval is appropriate.

The key inspection technique is visual inspection of the cement lining. Inspection should be focussed on areas with fabricated fittings and bends, as well as a sample of typical pipe segments and joints. Physical entry to the pipeline is the preferred method, as it facilitates delamination testing, pH testing and close examination of any potentially defective areas. Steel pipe wall thickness can also be measured with Magnetic Flux Leakage (MFL) or Broadband Electromagnetic (BEM) tools. There are sections where physical entry is not practical, and visual inspection can be undertaken up to 1000m with pipeline inspection tools such as Sahara, or generic underwater Remotely Operated Vehicles.

The pipeline is not currently designed or configured for "pigging" (Free flowing inspection and testing tools, and large scale pipe wall assessment requires physical entry and trolley mounted MFL or equivalent equipment). This would only be considered if there was evidence of external coating problems and pipe wall corrosion.

The pipeline is also understood to have an unexplained water loss. This should be monitored for change, and measures considered to identify the location and nature of the leaks. Inspection of accessible fittings and scour valves is the initial response. Segmentation and drawdown tests may be undertaken depending on the leakage rate and valve seals. Internal acoustic leakage assessment with Smartball or Sahara may also be considered depending on the cost of leakage. These require the pipeline to have a minimum flow to drive the tools through.

Another gap in the current maintenance regime is the absence of a PM for the six section valves. An annual PM is recommended for the section valves that includes exercising across the full operating range as well as inspection of any external visual parts of the valve and actuator.

The 2013 Veolia annual maintenance report identified a number of valve pits where valves were partially or fully submerged, and other valve pits that are buried. This was confirmed with one of the scour valve pits inspected by KBR as detailed in Section 6.2. The design of the scour valves incorporates corrosion protection assuming the valves will be submerged for a significant amount of time. In spite of this, visual inspections should still be conducted for submerged scour valves and associated assets to confirm their condition by pumping out the valve pits prior to the annual inspection. It is recommended that the buried valve pits be excavated at a frequency of around 5-10 years for a visual inspection to confirm asset condition and plan future maintenance and renewals where required.

It has been noted some air valves are partially submerged, which is not appropriate for correct operation as well as expected life given they are not part of the corrosion protection system. Further investigation is recommended to find a solution to this issue, such as installation of a sump pump in affected air valve pits.

Veolia's maintenance reports identify several anchor points with major corrosion due to water ingress, and confirmed during KBR's site inspection of the two valve pits at Tempe Reserve. Some anchor points have failed load testing during the annual PM, and have been recommended for replacement with an improved design. There is a risk however, given the condition of many of the anchor points, that they may fail during use with the potential to cause serious injury even if they have passed their most recent load test in November 2015. KBR recommend that Veolia consider whether it is appropriate to maintain fixed anchor points for occasionally accessed assets with relatively small openings. A change of work practice is recommended to manage this risk. A temporary cover grate or portable fall-arrest system may be more appropriate, as is typical for similar installations on public land. The anchor points should be load tested prior to each use (only when necessary) until such time they are replaced by improved design or an alternative approach.

It is noted the buried anchor points are not load tested during the annual PMs. KBR doesn't recommend adding these to the annual schedule as the cost of excavation for annual testing would not be justified if they are not being used at that time. It is assumed that any buried anchor points would be load tested prior to use at the time the corresponding valve pits are excavated for maintenance purposes.

A six monthly PM inspection of the pipeline easement for vegetation clearing is considered adequate, along with the annual inspection for general deterioration and graffiti. Given also that a Veolia staff member will accompany the corrosion protection specialist during the six monthly CP inspection and testing, the above-ground pipeline sections, valve pit covers and access to the pipeline will be viewed at the same time and it is assumed any obvious issues would be reported. It is also noted that pressure gauges have been installed at various points along the pipeline to monitor for potential leaks.

In between these six monthly inspections, reporting of issues is dependent on ad-hoc site visits and notification by stakeholders. However, this still leaves open the possibility that issues such as pipe leaks and damage to the pipeline may not be observed for up to 6 months. Therefore, a brief monthly walk along the above-ground pipeline sections and other parts of the pipeline visible from the surface (e.g. valve pit covers and CP panels) is recommended.

The only instrumentation included in the maintenance gap analysis is the water quality equipment and flow switch located at Shaft 11C. Flow control for the pipeline, which is undertaken by SWC System Operations Control (SOC) centre by controlling the operating mode and set points of the drinking water pump station, is not part of this review.

SWC SOC also monitors the impressed current system for the Botany Bay Marine Crossing section. It is understood that regular testing of the monitoring system is being considered which KBR fully supports, at least on an annual basis.

The gap analysis for the current maintenance regime is summarised in Table 6. Cost estimates in Table 6 are also included in the opex/capex forecasts in Section 8.2

The risk rating in Table 6 is based on the following risk matrix:

Table 5: Risk Matrix

Consequence		Likelihood				Risk
		Very Likely	Likely	Unlikely	Very Unlikely	1. Extreme
CATASTROPHIC	Permanent disability or fatality, long-term environmental damage, >$1m cost, long-term reputation impact, loss of operating licence	1	1	2	3	2. Very High
SEVERE	Multiple Lost Time Injuries, medium term environmental damage, $200k to $1M cost, medium term reputation impact	1	2	3	4	3. High
MODERATE	Offsite medical treatment or Lost Time Injury, medium term environmental damage, $10k to $200k cost, short term reputation impact	2	3	4	5	4. Medium
MINOR	First aid injury, minor environmental impact, <$10K cost, minor reputation impact	3	4	5	6	5. Low
INSIGNIFICANT	No injury, no impact on environment, cost or reputation	4	5	6	6	6. Very Low

Table 6: SDP Pipeline Maintenance Gap Analysis

Asset Type	Design Life	Current PM Summary	Current PM Frequency	Risk Rating	Recommended PM Summary	Recommended PM Frequency – Care and Maintenance Mode	Recommended PM Frequency - Operating Mode	Key Driver	Estimated Cost Incr. p.a. (±30%)
Pipeline - Kurnell (Trenched, Mounded, Micro-Tunnelled and above ground)	100	Nil. Relies on CP and design	N/A	3	Internal pipeline inspection - recommend partial physical internal inspection or ROV inspection.	5-10 yearly initially, thence 10-15 yearly, undertaken during C&M mode as much as possible	5-10 yearly initially, thence 10-15 yearly, undertaken during C&M mode as much as possible	Reliability of Supply	$1,526 (based on 10 yearly frequency)
Pipeline - Botany Bay Marine Crossing	100	Nil. Relies on CP and design	N/A	3	ROV internal inspection	Within 5-10 years of commissioning, thence 10-20 yearly, subject to continued satisfactory CP performance.	Within 5-10 years of commissioning, thence 10-20 yearly, subject to continued satisfactory CP performance.	Reliability of Supply	$4,000 (based on 10 yearly frequency)
Pipeline - Rockdale (Trenched, Mounded, Micro-Tunnelled and above-ground)	100	Trenched, Mounded, Micro-Tunnelled - Nil. Relies on CP and design Above-Ground - Visual inspection of above-ground section only for damage, deterioration and graffiti. (Sources: Veolia O&M Agreement).	Annually - Above Ground Only	3	Internal - as per Kurnell section External - Develop a procedure for the PM inspection of the above-ground pipeline. Include specific tasks for anchor blocks, expansion joints, pipe footings	Internal - 5-10 yearly initially, thence 10-15 yearly, undertaken during C&M mode as much as possible External - Annual	Internal - 5-10 yearly initially, thence 10-15 yearly, undertaken during C&M mode as much as possible External – 6 Monthly	Reliability of Supply	$1,371 (based on 10 yearly frequency)
Pipeline - Marrickville (Trenched, Mounded and above-ground)	100	Visual inspection of above-ground section only for damage, deterioration and graffiti. (Sources: Veolia O&M Agreement). Otherwise relies on CP and design	Annually - Above Ground Only	3	As per Rockdale section	As per Rockdale section	As per Rockdale section	Reliability of Supply	$985 (based on 10 yearly frequency)
Pipeline - Sydney South (Micro-Tunnelled)	100	Nil. Relies on CP and design	N/A	3	As per Kurnell Section	As per Kurnell Section	As per Kurnell Section	Reliability of Supply	$995 (based on 10 yearly frequency)

Asset Type	Design Life	Current PM Summary	Current PM Frequency	Risk Rating	Recommended PM Summary	Recommended PM Frequency – Care and Maintenance Mode	Recommended PM Frequency - Operating Mode	Key Driver	Estimated Cost Incr. p.a. (±30%)
Pipeline - Sydney North (Micro-Tunnelled, Trenched and Above-ground)	100	Nil. Relies on CP and design	Annually - Above Ground Only	3	As per Kurnell Section	As per Kurnell Section	As per Kurnell Section	Reliability of Supply	$1,181 (based on 10 yearly frequency)
Anchor Blocks (Above Ground)	100	Included in pipeline inspection. Ref PR-KDP-21-6319	Annually	3	Add specific inspection tasks for anchor blocks in pipeline inspection	Annually	Annually	Reliability of Supply	$500
Expansion Joints	100	Incidental with pipeline inspection	Annually	3	Add specific inspection tasks for expansion joints in pipeline inspection, including checks for leaks and recording remaining take-up gap (indicator of when seal need replacing)	Annually	Annually	Cost	$300
Above Ground Pipe Supports	100	Incidental with pipeline inspection	Annually	4	Add specific inspection tasks for pipe supports in pipeline inspection	Annually	Annually	Reliability of Supply	$0
Sliding Joints	100	Incidental with pipeline inspection	Annually	4	Add specific inspection tasks for sliding joints in pipeline inspection	Annually	Annually	Reliability of Supply	$0
Transition Shafts	100	Nil. Relies on CP and design	N/A	4	Internal inspection - recommend partial physical internal inspection or ROV inspection.	5-10 yearly initially, thence 10-15 yearly, undertaken during C&M mode as much as possible	5-10 yearly initially, thence 10-15 yearly, undertaken during C&M mode as much as possible	Reliability of Supply	$1,233 (based on 10 yearly frequency)
Rockdale Section Isolation Valves (2 off)	50	Incidental with pipeline inspection	Annually	2	Visual inspection and exercising of section valves.	Annually	6 Monthly	Reliability of Supply	$1,400
Kurnell (CH0 - at pump station), Marrickville & Shaft 11C Section Isolation Valves (4 off)	50	Incidental with pipeline inspection	Annually	2	Visual inspection and exercising of section valves.	Annually	6 Monthly	Reliability of Supply	$2,800
Air Valves	30	Visual inspection (check for leaks) and exercising. (Sources: Veolia O&M Agreement and PR-KDP-	Annually	4	Add some tasks to PM including loose/missing fasteners, corrosion, damage, condition of flange protection	Annually	Annually	Reliability of Supply	$0

Asset Type	Design Life	Current PM Summary	Current PM Frequency	Risk Rating	Recommended PM Summary	Recommended PM Frequency – Care and Maintenance Mode	Recommended PM Frequency - Operating Mode	Key Driver	Estimated Cost Incr. p.a. (±30%)
		21-6317)							
Air Valve Isolators / risers	30	Visual inspection and exercising - combined with Air Valve PM. (Sources: Veolia O&M Agreement and PR-KDP-21-6317)	Annually	4	Add some tasks to PM including loose/missing fasteners, corrosion, damage, condition of flange protection (assume no extra cost as it is just noting and recording tasks already occurring)	Annually	Annually	Cost	$0
Scour Valves	30	Visual inspection and exercising. (Sources: Veolia O&M Agreement and PR-KDP-21-6317)	Annually	4	Add some tasks to PM including loose/missing fasteners, corrosion, damage, condition of flange protection (assume no extra cost as it is just noting and recording tasks already occurring). For pits full of water, ensure they are pumped out during the annual PM to allow inspection of the valves	Annually	Annually	Environment, Stakeholder Relations	$0
Pits and other civil structures	100	Visual inspection. (Sources: Veolia O&M Agreement and PR-KDP-21-6317)	Annually	4	Excavate and inspect buried pits with enclosed valves	5-10 yearly	5-10 yearly	Cost	$2,240
Covers and surface features	50	Incidental with pipeline / scour and air valve inspections. Ref procedure PR-KDP-21-6317	Annually	4	Add some tasks to PM including clear vent slots, check cover lifting points. Remove, clean lid and seat, re-grease. Check rating of covers in heavy traffic areas is appropriate	Annually	Annually	Safety	$0

Asset Type	Design Life	Current PM Summary	Current PM Frequency	Risk Rating	Recommended PM Summary	Recommended PM Frequency – Care and Maintenance Mode	Recommended PM Frequency - Operating Mode	Key Driver	Estimated Cost Incr. p.a. (±30%)
Access Equipment – Fall arrest anchor points and air valve cage lifting lugs	30	Inspection as per AS1891. (Source: Veolia O&M Agreement)	Annually	2	As per current PM program	Annually	Annually	Safety	$0
Fences, access, roads and demarcation (Easements)	30	Easements inspected and cleared to ensure vegetation and other obstructions don't prevent access to the pipeline. Clear nearby drains. (Sources: Veolia O&M Agreement and PR-KDP-21-6319)	6 monthly - vegetation clearing only Annually - full inspection	3	Monthly pipeline walk of above ground pipeline sections only to check for obvious pipeline issues including safety issues, access, graffiti, vegetation, in addition to existing annual PM for the detailed inspection	Monthly - Pipeline Walk Annually - Thorough Inspection	Monthly - Pipeline Walk Annually - Thorough Inspection	Safety	$3,300
Cathodic Protection Systems - Sacrificial Anodes	30	Measure anode current outputs and potentials (Source: CCE Report & Veolia O&M Agreement)	6 Monthly	4	As per current PM program	6 Monthly	6 Monthly	Reliability of Supply	$0
Cathodic Protection Systems - Impressed Current (Botany Bay Crossing)	30	Measure pipeline CP potentials and TR unit voltage and current output Electrolysis testing for impressed current system (Source: CCE Report & Veolia O&M Agreement) System monitored by SWC SOC	6 Monthly Annually	4	Testing of SWC SOC alarms in addition to the current PM program,	Measure CP potentials and TR unit output - 6 Monthly Electrolysis testing & SOC Alarm testing - Annually	Measure CP potentials and TR unit output - 6 Monthly Electrolysis testing & SOC Alarm testing - Annually	Reliability of Supply	$400
Cathodic Protection systems - Test Points	30	Measure pipeline CP potentials and gas arrestor tubes. Visual inspection of test points and reference electrodes. (Source: CCE Report & Veolia O&M Agreement)	6 Monthly Annually only - 24 hour data logging	5	As per current PM program	CP testing - 6 Monthly 24 Hour data logging - Annually only Alarm testing - Annually	CP testing - 6 Monthly 24 Hour data logging - Annually only Alarm testing - Annually	Reliability of Supply	$0

Asset Type	Design Life	Current PM Summary	Current PM Frequency	Risk Rating	Recommended PM Summary	Recommended PM Frequency – Care and Maintenance Mode	Recommended PM Frequency - Operating Mode	Key Driver	Estimated Cost Incr. p.a. (±30%)
Cathodic Protection systems - Corrosion Monitoring Probes (Micro-tunnelled sections)	30	Inspect corrosion monitoring probes and measure corrosion rate (Source Veolia O&M Agreement)	6 monthly	5	As per current PM program	6 monthly	6 monthly	Reliability of Supply	$0
Flange Isolating Gasket Kits (10 x Transition Shafts Only)	30	Measure pipeline CP potentials and resistance across isolation kit (Source Veolia O&M Agreement)	6 monthly	4	As per current PM program	6 monthly	6 monthly	Reliability of Supply	$0
Water Quality Monitoring Station	15	Visual inspection - check interior of panel, and power-up panel to confirm analysers are powered up, check lights, RCDs. (Sources: Veolia O&M Agreement and PR-KDP-21-6320) Calibration during normal operating mode (Source: SWC O&M Schedule)	Quarterly	3	As per current PM program	Quarterly	Chlorine Analysers – Fortnightly Turbidity analyser, pH, Temperature and Conductivity - Monthly	Water Quality	$0
Reverse Flow Switch (Shaft 11C)	15	Incidental with pipeline inspection	Annually	4	Add basic inspection of flow switch to WQ PM (similar skill set). Test of correct operation of switch during pipeline re-start procedure and in operating mode	Annually	Quarterly	Reliability of Supply	$100
Steel structures (e.g. Cages, Stairways, Platforms)	50	Incidental with pipeline inspection	Annually	3	Add specific inspection tasks for stairways and access platforms into pipeline inspection	Annually	Annually	Safety	$300
RPZ Valve (Backflow Prevention Device) and Shaft 11C	30	Nil	N/A	3	Undertake testing/recertification as per Sydney Water requirements	Annually	Annually	Compliance	$200

8 Asset Management Review

The following elements of asset management have been selected for review; the asset management plan (AMP), opex and capex forecasts, data integrity and completeness, reporting and spares.

The AMP is a key document to record the actions required to manage risks associated with the operation and maintenance of the pipeline. The review of maintenance activities is already covered in Section 7 and have are only referenced briefly in this Section.

The effective asset management of the pipeline has several drivers including the nature and purpose of the organisation, its operating context, its financial constraints and regulatory requirements and the needs and expectations of its stakeholders. Asset management of the SDP pipeline should be prudent, efficient, in accordance with industry best practice, in order to maximise the design life of the pipeline and minimise whole-of-life costs. This is done in the context of maintaining reliability of supply for a drought-based asset as well as operating the pipeline to ensure the safety of all stakeholders and compliance with environmental regulations.

Apart from being a requirement in the scope of works as an input to the IPART review process, the opex and capex forecasts are a key component of an AMP. Development of opex and capex forecasts should be a risk-based process considering whole-of-life costs and business drivers. These forecasts can be used to support future funding applications and provide input into the organisation's long term financial plan.

An AMP should have a clear description of the assets being managed by the plan. Asset condition data is also a key input into asset management investment decisions.

Monitoring and measuring of asset performance is another important component of an AMP. Reporting fulfils this critical role and should be designed to align with the organisation's goals and support asset management processes.

The following items relating to asset management have been reviewed individually as sub-sections in this report as they are considered to provide considerable risk to SDP:

- Corrosion protection
- Spares management
- Risks associated with development near the pipeline
- Graffiti management
- Vegetation management
- Water Quality Monitoring

8.1 ASSET MANAGEMENT PLAN

The suite of International Standards for Asset Management (ISO55000, 55001 and 55002) has been used as a reference for evaluating the current asset management plan for the SDP pipeline.

ISO55000 states that *"the elements asset management system should be viewed as a set of tools including policies, plans, business processes and information systems which are integrated to ensure asset management activities will be delivered".* It also defines an asset management plan as *"documented information that specifies the activities, resources and timetables required for an individual asset, or group of assets, to achieve the organisation's asset management objectives."*

The level of complexity of the asset management plan should be appropriate to the asset being managed as well as the organisation's needs. In the case of the SDP pipeline, a relatively simple asset management plan would suffice. The asset management plan should also be developed to the appropriate time horizon. The AMP short term planning should also align with the five year IPART review cycle.

Elements of an AMP that align with ISO55002 are:

- Rationale for asset management activities (e.g. organisational objectives, levels of service, regulatory requirements, risks for failing to meet objectives)
- Method for evaluating risk in the asset management system
- Operational Plan
- Maintenance Plan
- Capital Investment Plan (overhauls, renewals, replacements, enhancements)
- Financial Plan
- Resource Plan (includes personnel, tools, information systems, management of change)
- Performance evaluation (e.g. KPI's and other performance measures, management reviews, audits)
- Continuous improvement (e.g. current/suggested actions)
- Review of achievements versus objectives from previous AMP

Currently, Veolia's "Operations Management Plan" is the closest document to an asset management plan for the SDP pipeline. This document contains much useful information for asset management, however the following details are recommended for addition or modification:

- Add details for levels of service and KPIs as required in the Operating Licence, the SWC water supply agreement and the Veolia O&M agreement
- Include a table of risks for operation and maintenance of the pipeline (2012 Sydney Water risk assessment is very comprehensive and could be reviewed prior to inclusion)
- Include a reference to current safety procedures
- Review and update register of stakeholders located along the pipeline especially at critical operational areas such as Shaft 11C and Sydney Airport along Alexandra Canal
- Develop and include standard operating procedures – e.g. scour valve operation, water quality instrumentation, pipeline purging procedure, pipeline configuration for various operating modes
- Add references or links to operations and maintenance manuals and drawings

- Develop new PM procedures for section valves, pipeline inspections (external and internal) and reference to the AMP
- Include a definition of an asset and what level of segmentation is required for the asset register
- Update existing PM procedures with detailed tasks as recommended in Section 7.4
- Develop KPIs to measure asset performance
- Develop a review/audit program for asset management
- Include five year opex/capex forecasts aligning with the IPART review cycle
- Develop guidelines for deciding when assets should be replaced (e.g. condition, performance or time-based criteria, cost of repair versus replacement)
- Include more detail about how the CMMS and other tools are used to support asset management.
- Include a process for monitoring asset condition and collecting and analysing the data. Condition rating data for assets can be obtained during PMs and recorded in the CMMS. A 1 to 5 condition rating is commonly used (1 = "As New", 5 = "Unserviceable")
- Detail the change control processes relating to assets – e.g. What approval process is required prior to the new or modified asset and what other changes are required e.g. updates to asset register, O&M manuals, engineering drawings, SCADA, AMP, etc.
- Specify how each section of the AMP is affected by the operating mode i.e. normal operating mode will see additional and/or more frequent PMs
- Specify any potential or known future asset-related improvement initiatives (e.g. super-chlorination at Shaft 11C)
- Specify appropriate staffing levels and skills for operations and maintenance
- Specify the business processes relating to asset management e.g. works requesting and management, asset acquisition
- Specify recommended critical spares list
- Develop a process for managing the review and approval of developments near or adjacent to the pipeline
- Document and reference the procedure of existing works completed near developments to protect the pipeline and facilitate future access, and note whether any funds have been set aside for future access e.g. (new pit at Ashmore Estate, Erskineville)
- Specify water quality monitoring regime for each mode of operation.
- Specify the level of on-line monitoring and control (e.g. water quality, alarms) that occurs for the pipeline including the role of the SWC System Operations Control centre
- Add a list of recommended service providers for various maintenance services e.g. pump overhauls, valve repairs, anchor point testing.

8.2 OPEX AND CAPEX FORECASTS

Development of opex and capex forecasts should be a risk-based process considering whole-of-life costs and business drivers. These forecasts can be used to determine the total cost of ownership of the asset, support future funding applications and provide input into the organisation's long term financial plan.

Detailed opex forecasts have been estimated for the next six financial years 2016-17 to 2021-22, with high-level opex and capex forecasts for the subsequent 20 years (to 2041-42). The forecasts are based on several sources including:

- The Veolia Operations and Maintenance Agreement with SDP. The fixed annual fee of $142,343 quoted in Schedule 4 has had CPI applied for subsequent years as per clause 43 in the agreement. A $100 per hour rate has also been used for estimating reimbursable costs, after applying the indexing as per clause 2.4 in schedule 4 to the original $80/hr contract rate, and assuming a 10% profit margin and 10% overhead
- Historical opex and capex expenditure between June 2013 and February 2016
- Sydney Water's Operations and Maintenance Schedule for the SDP Pipeline (dated October 2012)
- Equipment replacement and repair costs based on industry data and supplier information
- Estimates for additional PMs are based on the maintenance gap analysis

The latest verified total dam levels as at 9 June 2016 is 97.0%. With minimal rainfall assuming an average weekly change of -0.4%, it would be expected that total dam levels would drop to 70% by around September 2017. It is noted, that there is a 50% likelihood of La Niña forming later in 2016 (source: http://www.bom.gov.au/climate/enso/ issued 7 June 2016) which means that restarting of the plant would be unlikely before 2018 at the earliest.

Therefore, for the purposes of budget forecasting, it is assumed that the SDP will commence operations once during the next six year period (assumed to be the 2018-19 financial year). Estimated costs associated with restarting of the SDP pipeline are included in the forecasts. For the long term forecasting, it is assumed there will be ten years of normal operation from 2018-19, followed by five years in care and maintenance mode and then a restart and further ten years of normal operation.

Table 7 summarises the opex and capex forecasts between the 2016-17 and 2041-42 financial years. Please note the following assumptions and explanations regarding Table 7:

- All figures in Table 7 are non-binding estimates and exclusive of GST.
- Future annual increases are assumed at 3%.
- There is no capex expenditure forecast until 2040-41 and 2041-42, when some gate valves and air valves are expected to be replaced.
- Confidence level +/- 30%, except for restart costs which have a confidence level +/- 50%.
- Contingencies and project management costs are not included in the forecasts with the exception of the pipe joint coating remediation which includes a 30% contingency and 15% project management cost.
- A cycle of 5 years of care & maintenance, followed by 10 years of normal operation is assumed. "Restart" are assumed to occur in 2018-19 and 2033-34
- The time for restart is based on current dam levels, assumed dam level draw down rate of 0.4% per week and zero inflow to the dams. The operation period selected is a nominal 10 years. It is observed that with each catchment rainfall event that the operating cycle will change. Should SDP develop a different estimate for the operating cycle for the plant and pump station then

the provided opex and capex estimates in this report should be reset to this operating cycle. No analysis of weather forecasting patterns has been undertaken regarding the assumptions on when restart may occur beyond the earlier statement that plant operation is unlikely before 2018.

- Opex forecast figures include:
    - Existing O&M Contract fixed payments, indexed at 3% p.a.
    - Estimated cost of additional preventive and corrective maintenance recommended in this report
    - Estimated cost of corrective maintenance based on historical expenditure (e.g. graffiti removal, vegetation management, leaks)
    - Estimated cost of internal pipeline inspection based on costs for similar works undertaken by KBR
    - Estimated cost of water quality monitoring based on historical expenditure
- "Opex - Restart" forecast figures are estimated costs associated specifically with restarting the pipeline. Restart costs include a $300,000 estimate from Veolia for general restart activities based on preliminary planning (opex), a $15,000 estimate for purging the pipeline (opex), a $4,000 estimate for additional water quality monitoring (opex), and a $15,000 estimate for replacement of water quality monitoring instrumentation (capex). Forecasts also include an estimated $267,800 in 2017-18 (confidence level +/- 50%) for recommended restart preparation activities such as a trial purge.
- There are no restart costs included in the forecasts relating to SWC SOC pipeline monitoring
- Anode replacements and pipe joint coating renewals are included in the forecasts. The forecasts include $95,000 expenditure in 2016-17 to replace anodes at 12 locations as recommended by Veolia, and then anode replacements in three locations per year from 2017-18 through to 2022-23. This would cover all anode sites (approximately 30 in total) and it is assumed that no further anode replacements would be required for the remainder of the forecast period if the proposed larger anodes are installed.
- Additional water quality sampling is assumed to occur more frequently during restart and normal operation phases
- Unspecified maintenance recommendations are not included in the forecasts e.g. resolution of partially submerged air valves as solution is not yet known.
- The pipeline is assumed to be in good internal condition and that no allowance has been made for repair of the pipeline in the opex / capex forecasts
- Forecasts do not include repair or replacement of flange isolation kits. It is recommended that if corrosion protection testing identifies any issues with flange isolation kits, then replacement of the kits should be fully scoped and quoted prior to the next IPART submission period (2022-23 to 2026-27). The likelihood of failure of flange isolation kits is extremely low.

Table 7: Summary of Opex and Capex forecasts between 2016-17 and 2041-42

Year	Opex	Opex - Restart	Opex - Total	Capex	Mode
2016-17	$434,700	-	$434,700	-	Care & Maintenance
2017-18	$324,100	$267,800	$591,900	-	Care & Maintenance
2018-19	$338,200	$354,300	$692,500	-	Restart - Normal Operation
2019-20	$348,600	-	$348,600	-	Normal Operation
2020-21	$362,100	-	$362,100	-	Normal Operation
2021-22	$369,700	-	$369,700	-	Normal Operation
2022-23	$437,900	-	$437,900	-	Normal Operation
2023-24	$417,800	-	$417,800	-	Normal Operation
2024-25	$434,100	-	$434,100	-	Normal Operation
2025-26	$443,200	-	$443,200	-	Normal Operation
2026-27	$460,500	-	$460,500	-	Normal Operation
2027-28	$470,200	-	$470,200	-	Normal Operation
2028-29	$484,300	-	$484,300	-	Care & Maintenance
2029-30	$498,900	-	$498,900	-	Care & Maintenance
2030-31	$513,800	-	$513,800	-	Care & Maintenance
2031-32	$529,200	-	$529,200	-	Care & Maintenance
2032-33	$545,100	-	$545,100	-	Care & Maintenance
2033-34	$561,500	$585,600	$1,147,100	-	Restart - Normal Operation
2034-35	$578,300	-	$578,300	-	Normal Operation
2035-36	$601,000	-	$601,000	-	Normal Operation
2036-37	$613,500	-	$613,500	-	Normal Operation
2037-38	$637,500	-	$637,500	-	Normal Operation
2038-39	$650,900	-	$650,900	-	Normal Operation
2039-40	$676,300	-	$676,300	-	Normal Operation
2040-41	$690,500	-	$690,500	$163,000	Normal Operation
2041-42	$717,600	-	$717,600	$167,900	Normal Operation
TOTAL	**$13,139,500**	**$1,207,700**	**$14,347,200**	**$330,900**	

The above summary assumed commencement of progressive valve replacements or refurbishments from 2040-41, approximately 30 years from the commissioning of the SDP pipeline. However, it would be expected that replacements would be deferred until the pipeline is in care and maintenance mode to minimise disruption of supply to Sydney Water, except for emergency replacements where required. If the valves are well maintained and corrosion protection is maintained on the pipeline, industry experience shows that valves can last well beyond their 30 year design life.

Figures 3 and 4 summarises the opex and capex forecasts from Table 5 in chart format.

Refer to Appendix F for a detailed summary of opex forecasts for 2016-17 to 2021-22.

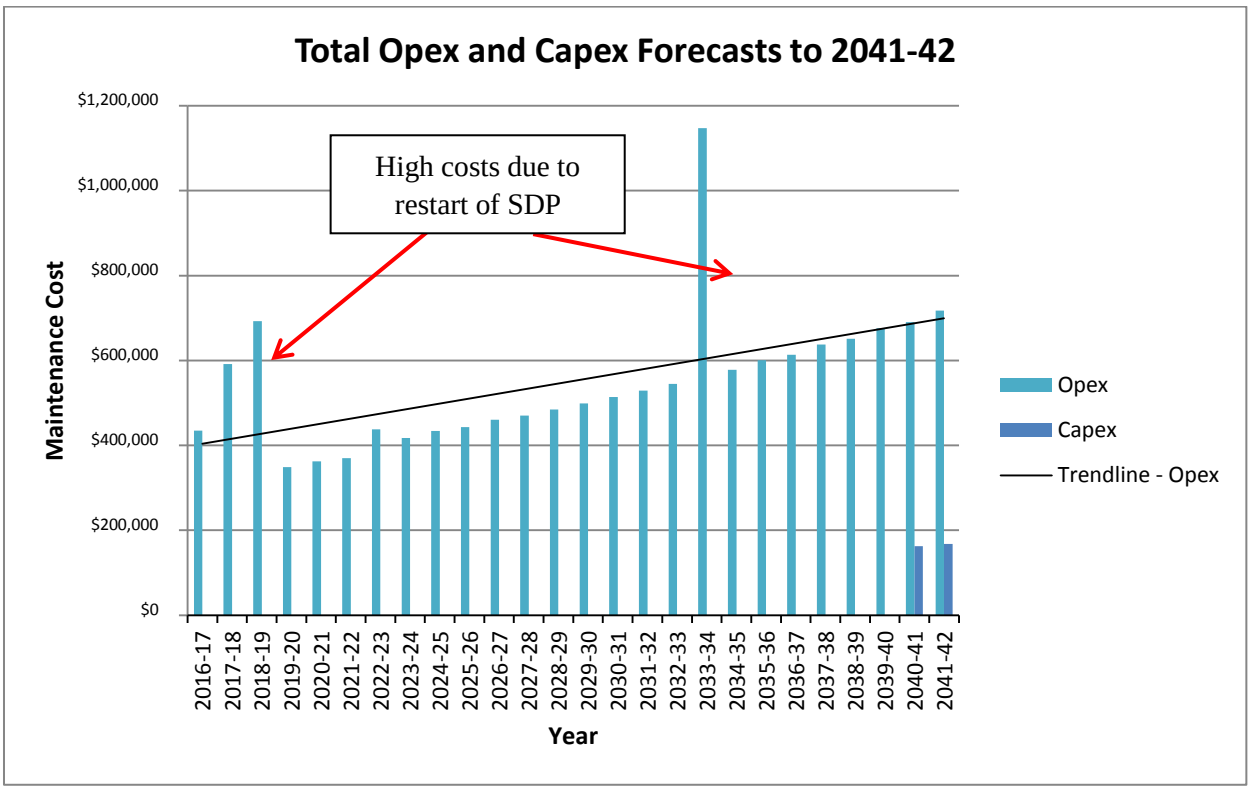


Figure 3 - Total Opex and Capex Forecasts 2016-17 to 2041-42

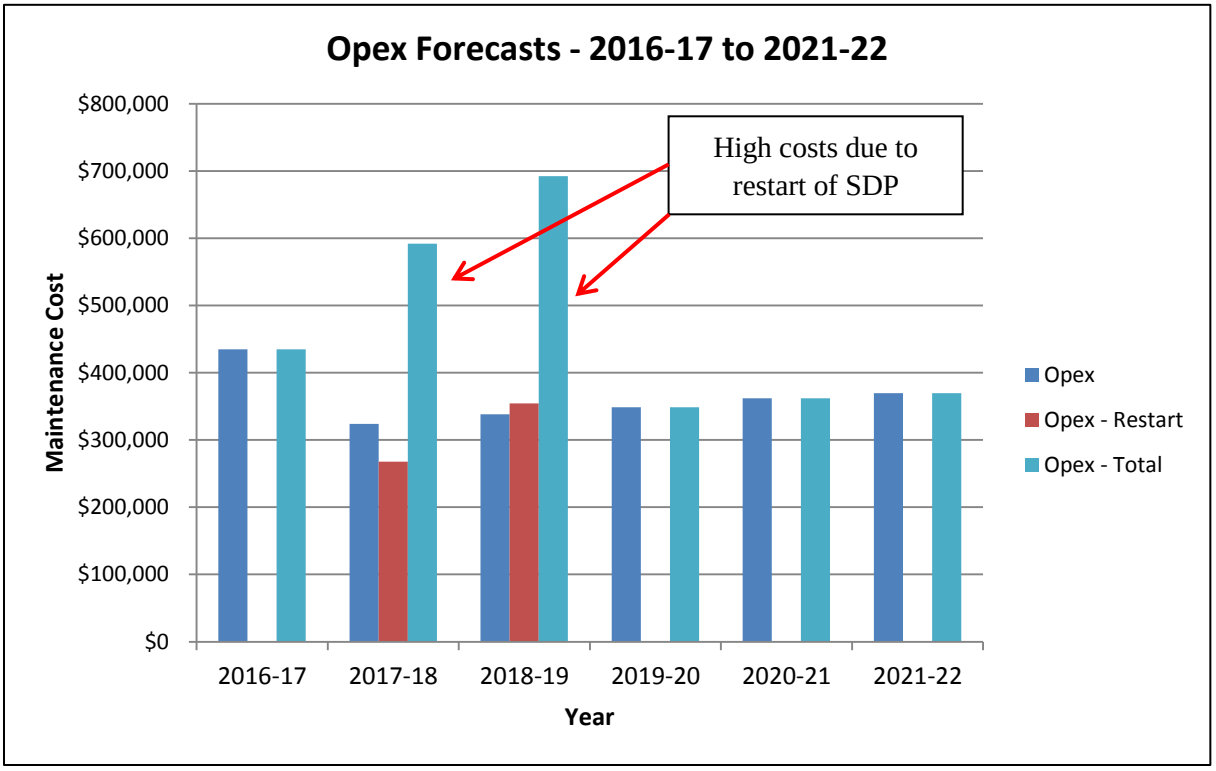


Figure 4 - Detailed Opex Forecasts 2016-17 to 2021-22

8.3 DATA INTEGRITY AND COMPLETENESS

An AMP should detail the assets being managed by the plan and what asset data will be recorded to support asset management activities. The types of asset data that should be collected are driven by required asset performance measurements such as asset availability, asset condition, and operation and maintenance costs. This data can then be used to justify asset management investment decisions.

Data integrity and completeness is important to enable users to have confidence in the data recorded in asset management systems. Lack of confidence in asset data will inevitably lead to additional resources used to verify this data prior to it being used for asset management-related decisions. The accuracy of the data is critical so that the correct asset management investment decisions are made e.g. asset replacement is made at the optimal time for lowest life-cycle cost.

From the site inspections, it was observed that not all valves are labelled in the field. Labels are recommended to include the asset number, brief description and also indicate whether they are normally open or closed. A schematic diagram at each site can also be considered which shows the general pipe and valve configuration.

A review of the Maximo location list supplied by Veolia identified several pipeline-related assets that are not currently on the asset register. Assets should be individually identified in an asset register for better asset management when recording maintenance cost or failure history against an individual asset. This data will be a source of useful information for making future asset management decisions on preventative maintenance and also asset investment decisions (e.g. renewals/replacements). Assets should also be included in an asset register if they are of a significant cost (>$3,000) and are likely to require replacement or refurbishment one or more times within the lifetime of the pipeline. Assets requiring maintenance for compliance purposes (e.g. anchor points and RPZ valves) should also be individually identified. Ensuring these assets are included in the asset register will assist with long term asset management and a whole-of-life asset approach. It will also allow failure modelling and improved PM and asset renewals planning based on risk and failure history.

For Veolia staff familiar with the pipeline this may not be an issue to maintain the current level of detail in the asset register. However, if there is a change of staff, having this information in the asset register and in field labels will greatly assist personnel not familiar with the site.

The following assets are recommended to be added to the asset register (refer to Table 2 in Appendix B for a detailed list of assets recommended to be added to the asset register):

- Air Valve Isolators
- Anchor Blocks
- Anchor Points (including four installed at the new pit at Ashmore Estate, Erskineville)
- Sacrificial Anodes
- Impressed Current System
- Expansion Joints
- Above Ground Pipe Supports

- Sliding Joints
- Transition Shafts
- RPZ Valve and Water Meter installed on ¾" line at Shaft 11C for topping up of water in the pipeline
- ETP 06 (This may already be part of DWPS asset register, but is included in the CCE report for the pipeline)
- Actuators for Section Valves

The asset register can be a useful tool for recording and referencing asset specification data. Having this data in the asset register can save a lot of time compared to looking up data in maintenance manuals or engineering drawings. The following asset details are recommended to be included in the asset register:

- Valve diameter
- Manufacturer
- Model
- Serial No.
- Installation Date
- Asset Type
- Chainages (where not already specified) and/or GPS Data
- Replacement Cost (for supply and installation, excluding existing infrastructure/foundations, etc)
- Valve/Pipe material and protective coating
- Theoretical Life
- Recent Asset Condition Score

A simple asset data specification procedure (1-2 page document) could be developed to specify the location coding structure, and minimum asset data requirements. This can be a useful tool for maintaining data integrity and training new personnel in maintaining the asset register.

The as-built drawings and operations and maintenance manual for the pipeline, as developed by the Water Delivery Alliance, were reviewed. This includes a process and instrumentation diagram for the pipeline from the pump station to Shaft 11C. The drawings and manual are considered adequate to support the asset management of the pipeline.

Collection of asset condition data is highly recommended. A simple 1-5 condition rating can be adopted which is widely used in industry (1=As New, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable). The condition can be assessed during PMs and then recorded against the asset in the asset register. Maximo can be configured to record a history of condition ratings including the date recorded and person who made the assessment, so that trends can be observed.

Other condition data can also be recorded during PMs such as pipe thickness, recording voltage, current and opening and closing times for electrically actuated valves as well as insulation resistance for actuator motor windings, remaining take-up gap for expansion joints, and pressure gauge readings. These tasks can be added to PMs and the condition data then recorded in Maximo.

Collecting asset condition data allows analysis to be undertaken in the future for better planning and justification of asset management decisions (e.g. maintenance or replacement of a valve or actuator if high current readings are recorded).

8.4 REPORTING

Reporting is an important part of an asset management system. It allows the organisation to monitor and measure asset performance using asset management metrics and indicators and provides historical evidence that can be later examined to justify asset management decisions.

The monthly reporting from Veolia to SDP currently includes a summary of maintenance works completed in the month against target, progress on approved non-routine works, and a list of issues observed during PMs. The only KPI in the example report provides is % of completed maintenance works versus target.

The following metrics are recommended to be included in the monthly report or in a separate annual report:

- Year-to-date (YTD) % of completed vs target PMs/CMs/BMs, by work priority (e.g. high, medium, low)
- Monthly and YTD maintenance expenditure totals by PM/CM/BM
- Maintenance cost as a percentage of replacement asset value
- Maintenance cost per km of pipeline
- Ratio of planned, preventative and reactive maintenance
- Safety reporting (e.g. Lost Time Injuries)
- Non-compliance reporting (e.g. quality, environmental)

The six monthly CP Test reports are very comprehensive. The only suggestion is to request CCE to provide progressive historical data in electronic (spreadsheet) format for future reference and trend analysis.

8.5 CORROSION PROTECTION

Corrosion has been identified as the main asset management concern regarding the pipeline currently based on discussions with SDP and Veolia, the site inspections and the review of provided documentation.

Six monthly CP testing is undertaken by Corrosion Control Engineering (CCE). From this testing it is known that anodes are being passivated at a faster rate than expected. The expected design life of the anodes is 25 years. However from the most recent CP testing, anodes at 12 locations are recommended to be replaced at an estimated cost of $95,000, after less than 10 years in service.

CCE has suggested that the possible reason why the anodes are working harder than expected to protect the pipeline is that the groundwater chlorine and salt content in these areas is higher than anticipated during the design of the pipeline. The following design parameters and standards were used for the design of the CP system:

- CP system design life: 25 years
- Initial coating loss: 0.1%
- Annual coating loss: 0.015%
- 25-year coating loss: 0.475%

- Initial Current Density:
  - 20 mA/m^2 for buried bare surface areas
  - 30 mA/m^2 for immersed sub—sea bare surface areas
  - 2 mA/m^2 for uncoated concrete encased pipe surface areas
- The pipeline AC mitigation design is in accordance with Category B requirements where AC electrical hazards exist.
- Relevant standards:
  - AS2832.1: 2004 Cathodic Protection of Metals—Part 1: Pipes and Cables
  - AS2239: 2003 Galvanic (Sacrificial) Anodes for Cathodic Protection
  - AS4832: 2007 Cathodic Protection, Installation of Galvanic Sacrificial Anodes in Soil
  - AS4853: 2000 Electrical Hazards on Metallic Pipelines
  - AS3000: 2007 Electrical installations
  - A82374: 2003 Power Transformers

Larger anodes are being considered to replace the existing once that have passivated to increase the service life of the anodes.

As part of the six monthly CP testing, CP potentials and resistance are measured across isolation joints only at Transition Shafts. CP testing is not set up for isolation joints at other locations however there is minimal value in undertaking tests at these locations so no changes are recommended to the current testing regime.

The heat shrink sleeves on several joints are reported to be losing adhesion to pipe and this was confirmed during the site inspection. The investigation on the risks and causes of the heat shrink sleeve failures and recommended actions are covered in a separate report.

If the six-monthly CP testing regime continues, and anodes are replaced in a timely manner once they have passivated, then future risks to the pipeline should be minimised and the required operational function should be maintained throughout its intended 100-year design life.

As part of the CP system isolation joints have been constructed typically between buried and trenched sections of the pipeline. Isolating kits have been installed on selected flanged joints. The kits include a gasket inserted between flanges and sleeves, washers and caps for the flange bolts.

In total there are 72 isolation joints on the pipeline. There are 17 gasket kits installed on the 1800 mm pipe, eight on the 1400mm pipe, 24 on the 900mm air valve / access shafts, one on the future 500mm offtake, 21 on the 250mm scour and air valves and one on the 200mm air valve at Shaft 11C.

The performance of the isolation is monitored by the CCE six monthly inspections. Verbal advice from CCE is that while failure of an isolation joint is unlikely the design life of the isolation gasket kits is assumed to be at 25 years or greater. The first order of failure would be the flange bolt sleeve followed by the joint gasket.

Replacement of all or part of the isolation kits will involve in most cases securing the site, excavation, shoring and dewatering; removing tape wrapping, locating the source of the isolation failure, replacing sleeves and if necessary the gasket (which also

requires removing, fabrication and reinstalling pipework), re-taping the joint, backfilling and surface restoration.

Further advice from CCE is that provision has been made to facilitate the installation of an impressed current CP system should failure of an isolation joint occur and joint replacement is not viable.

The opex/capex forecasts do not include repair or replacement of flange isolation kits. Replacement of flange isolation kits will require extensive works involving excavation, shoring of trenches, crane hire, pipe cutting, re-welding and wrapping. It is recommended that if corrosion protection testing identifies any issues with flange isolation kits, then replacement of the kits should be fully scoped and quoted prior to the next IPART submission period (2022-23 to 2026-27). It should be noted that there is provision for impressed current systems to be installed at other sections of the pipe so a cost-benefit analysis of this option should be undertaken as a comparison to the option of replacing the flange isolation kit.

8.6 SPARES MANAGEMENT

Procurement of critical spares is an important part of an asset management plan to manage risks of pipeline failure where other mitigation activities, such as routine maintenance, do not provide a cost-effective way to manage such risks. Currently no critical spares are held for the pipeline.

8.6.1 O&M Contract Spares Requirement

The following pipeline spares are identified in Schedule 3 of the Veolia Operations and Maintenance Agreement:

- 2 x sets of main seats for DN1800 butterfly valves
- 2 x sets of main seals for DN1400 butterfly valves
- 1 x Air Valve - DN 200 multifunction automatic air release valve (CSA Fox)
- 1 x Air Valve - 200 x 250 Taper

8.6.2 O&M Contractor Recommendations

Veolia have advised that the 200x250 air valve taper is not required. Instead they have recommended the following spares should be held for the pipeline:

- 2 x sets of main seats for DN1800 butterfly valves
- 2 x sets of main seals for DN1400 butterfly valves
- 1 x Air Valve - DN 200 multifunction automatic air release valve (CSA Fox)
- 2 x metal seated gate valves DN250 PN16 (scour valve)
- 1 x resilient seated gate valve DN250 PN16 (air/vacuum isolation valve)

8.6.3 KBR Recommendations

Based on information from Veolia and valve suppliers, the gate valves are a maximum of 2-3 weeks lead time to order, while the air valve is sourced from overseas and requires approximately a 6 month lead time. Given these lead times and after reviewing the requirements from the O&M contract and recommendations by Veolia, the following spares are recommended to be procured during the next restart phase of the pipeline:

- 2 x sets of main seats for DN1800 butterfly valves
- 2 x sets of main seals for DN1400 butterfly valves
- 1 x air valve - DN 200 multifunction automatic air release valve (CSA Fox)
- 1 x metal seated gate valves DN250 PN16 (scour valve)
- 1 x resilient seated gate valve DN250 PN16 (air/vacuum isolation valve)

There is no requirement to purchase these spares prior to the restart phase as failure of the scour valves or air valve isolators will not be of a significant consequence to SDP such that waiting up to 3 weeks to resolve would be considered acceptable. It is possible that valve suppliers may have some 250mm gate valves in their stock so 3 weeks lead-time is a worst-case scenario.

Air Valve failure is not an issue prior to restart given the pipeline is not operating. Assuming sufficient notice will be provided for restart, then procuring the air valves at this time is considered adequate.

Another option for consideration is for SDP to enter into an agreement with either or both of Sydney Water and WaterNSW to have access to their spares in an emergency situation.

8.7 RISKS ASSOCIATED WITH WORKS NEAR TO PIPELINE

There are numerous developments near or adjacent to the pipeline, such as works associated with the WestConnex, Marsh Street, and the new residential developments in and around the Erskineville precincts. Further developments are expected in the future for the full length of the pipeline. There are also land usages, investigative works and ground improvement works carried out by third parties along the pipeline which can directly impact the pipeline. These activities can include stockpiling materials, machinery and temporary buildings, and investigative works such as potholing, geotechnical coring and sampling, ground dewatering, boreholes, ground anchors, excavations, backfill, compaction works, piling and sheet piling.

Each of these activities poses a risk to the integrity of the pipeline. There is already one instance of a geotechnical/groundwater drilling contractor putting a core hole through a tunnelled section of the pipeline at Alexandria and another instance were a land owner is stockpiling large boulders along a trenched section of the pipe. These activities also create the risk of increased operations and maintenance costs due to restricted access to parts of the pipeline.

The consequences from damage to the pipeline are considerable and include health and safety, environmental, property, failure to meet supply obligations, reputational damage and increased operational and maintenance cost.

In order to manage these risks SDP need to monitor the pipeline for these activities. KBR recommend that SDP develop processes for monitoring the pipeline, provide asset information to developers and other third parties, and develop procedures and policies for managing the review and approval of developments near or adjacent to the pipeline.

For monitoring, the following actions should be implemented;

- Dial Before You Dig (DBYD)

    - Update DBYD plans to indicate SDP pipeline as owned by SDP, not Sydney Water
    - SDP to receive notification of DBYD enquiries being made that include the pipeline for SDP to investigate
- Legal
    - Include a cover letter with any plans provided by DBYD regarding working over/near SDP pipeline which indicates disclaimers, requirements, duty of care, and expectations on the company undertaking the works
    - Based on legal advice, include SDP's legal position regarding third parties working over/near SDP pipeline
- Signage
    - Investigate the installation of physical location markers and/or signage along the pipeline route
- Inspections
    - Veolia to conduct weekly inspections along the pipeline route to check for works being undertaken over/near the pipeline (approximately ½ day) to pick up obvious excavation and drilling works.
- Stakeholders
    - Prepare a key stakeholders register for authorities, land owners and users located along the pipeline including Councils, NSW Environment Protection Authority, SACL, Roads and Maritime Services, Transport for NSW, Sydney Trains, and utilities
    - Investigate the establishment of a GIS system to store and manage asset data with the above interfaces

The process for managing developers and others should include the following elements:

- Works must not prohibit full and free access to the pipeline and other SDP assets
- Works must not physically damage or weaken SDP assets, and developers are required to make good or provide financial compensation for any damage to SDP assets to ensure they are maintained or returned to at least the same condition as prior to the commencement of development works
- The developer must undertake all necessary temporary or permanent works to protect SDP assets. This may require specialist engineering advice to support the proposal for the development works such as engineering drawings, design calculations, and monitoring plans.
- The developer must reimburse the SDP for any costs incurred as a result of your proposed development. These costs may include monitoring of works, assessing impacts of the development, additional design and / or operating costs associated with the completion of the development works.
- A checklist for reviewing development works prior to acceptance.
- A standard template letter to be issued to developers. Refer to Appendix G for an example.

This procedure should be referenced in the Asset Management Plan for the pipeline.

It is also recommended an amount be allocated in the annual opex budget for technical support for reviewing development applications near to the pipeline. This cost has been included in the opex and capex forecasts in Section 8.2.

8.8 GRAFFITI MANAGEMENT

Currently, graffiti on the pipeline is managed via monitoring of the pipeline either during the annual inspections or ad-hoc site visits. Notification of graffiti on the pipeline is also made by nearby landholders such as SACL. Graffiti is then painted over using an all-weather, low sheen, water-based paint. No cleaning of the pipe is undertaken prior to painting. This activity is currently undertaken approximately twice per year.

Steel Mains, the supplier of Sintakote® pipes, have advised there should be no detrimental effect on the external coating from either the graffiti or the paint used to cover it. In the unlikely event of damage to the Sintakote® coating, repairs can be undertaken either using a Sintakote® repair patch or by applying an approved coating to the affected area such as a Denso tape or heat shrink wrap.

The current graffiti management regime is considered adequate for the pipeline.

8.9 VEGETATION MANAGEMENT

Similar to graffiti management, vegetation management is currently occurring via monitoring of the pipeline either during the annual inspections or ad-hoc site visits. Based on observations, a vegetation clearing contractor is then engaged for more significant works (e.g. tree removal) and Veolia undertake minor vegetation removal.

The current vegetation management regime leaves open the future risk of issues such as trees falling onto the pipeline or blocked drains may not be observed for up to several months. Therefore, a brief monthly walk along the above-ground pipeline sections and other parts of the pipeline visible from the surface (e.g. valve pit covers and CP panels) is recommended. This recommendation is already covered in the recommended additional maintenance Section 7.4. Use of environmentally-friendly weed killers can also be considered in known problem areas.

8.10 WATER QUALITY MONITORING

8.10.1 Care and Maintenance

During Care and Maintenance mode the six-monthly frequency of monitoring (approximately twice yearly) is considered adequate from an asset management perspective to check pH level. An increasing trend in pH may indicate possible leaching of the cement lining.

The monitoring frequency should be increased to quarterly if consecutive six-monthly monitoring reveals significant deterioration of water quality within the pipeline.

Veolia have provided Water Quality reports from February 2015 and November 2015 (refer to Appendix H). A brief assessment of recent water quality data reveals that pH levels have been relatively stable between the readings (a rise of approximately 0.2 from a pH level around 11). However there has been more significant increase in electrical conductivity (approx. 25%).

8.10.2 Water Quality Monitoring – Restart

The monitoring frequency should be increased to quarterly during the restart phase as water quality monitoring data is critical to determine some of the restart activities such as chemical dosing rates.

It is noted that Veolia have been in discussions with the EPA regarding the potential impact on water quality on the restart plan. Veolia have recommended quarterly water quality monitoring with a focus on ecotoxicology testing. If testing shows that water quality parameters are stable and within allowable limits then EPA approval for purging of the pipeline prior to restart of the SDP should be straightforward. However, if there are elevated levels or increasing levels of toxic chemicals or pH then this may require significant modification of the restart plan to satisfy EPA requirements.

8.10.3 Water Quality Monitoring – Normal Operation

During normal operation, quarterly water quality monitoring should be maintained, in addition to on-line water quality monitoring. There is no requirement for any further monitoring as water quality risks are adequately managed by this monitoring regime.

8.11 RESTART PROCEDURE

The pipeline restart activities are described in the following Veolia procedures:

- WI-KDP-19-6509 - Water Delivery Pipeline Restart Plan
- PR-KDP-19-5244 - Plant Restart Procedure
- WI- KDP-20-5254 - Botany Bay Pipeline Purge

These procedures detail certain activities that are required as the dam levels reach certain trigger points between 80% down to 70%.

80% Dam Level

- Check and order pipeline component spares
- Complete any outstanding corrective maintenance
- Prepare contracts for dosing equipment and chemicals
- Convert pump station from SWC control to SDP control

75% Dam Level

- Pipeline easement vegetation clearing
- PMs on scour valves, air valves, anchor points
- Procure dosing equipment for Shaft 11Cand Kurnell
- Issue tenders for dosing chemicals

70 % Dam Level

- Install and commission chemical dosing equipment at Shaft 11C
- Install and commission chemical dosing equipment at Kurnell
- Procure dosing chemicals
- Recommission water quality instrumentation at Shaft 11C
- Plant ready to produce desalinated water
- Purge pipeline
- Recharge pipeline

The pipeline restart activities are summarised in Table 8. Estimated costs associated with the pipeline restart have been included in the opex and capex forecasts (section 8.2).

Table 8: Pipeline Restart Activities

Location	Restart Activities
Shaft 11C	Disinfection of approx. 45ML water - equipment required to be scoped/designed and procured/hired
	Purging of the pipeline using water supply by Sydney Water from Potts Hill (water provided free of charge)
	Re-commissioning of water quality instrumentation
	Water Quality Testing of Desalinated Water prior to delivery into SWC network
Kurnell	Clean and treat high pH water from pipeline
	Set-up valve configuration in the plant and pump station for purging and discharge to ocean
	De-chlorination of pipeline water before discharging to ocean
	Monitoring discharge to ocean (flows and water quality)
Along the Pipeline	Water quality monitoring as the pipeline is returned to service (manual sampling for pH, total residual chlorine and turbidity)
	Ecotoxicity Testing before pipeline is purged
Non-specific	Approvals and EPA notification

After a high-level review of the procedures provided for restarting the pipeline and our experience with similar pipelines, the following gaps and recommendations have been identified in Table 9. Estimates of additional costs provided below are +/-50% confidence level.

Table 9: Restart Procedure Gaps and Recommendations

Gap/Recommendation Description	Additional Cost Estimate (+/- 50%)
Develop a design specification for the dosing equipment to be included as part of the restart procedure. The design specification should account for safe chemical storage and bunding to applicable standards. Skid or trailer mounted dosing systems should be suitable for the required temporary application. This would also be suitable for locating within the fenced area at Shaft 11C without causing undue visual amenity issues.	$40,000
It is not clear from the procedures how the chlorine will travel through the length of the pipeline during the 5 day contact time period prior to discharging to the ocean. It is recommended the design specification should include an option for chlorine dosing at the Kurnell end into a holding tank (potentially in batches) before being discharged to the ocean.	Incl. above
The current procedures do not specify the quantity of chemicals required for dosing, or the dosing rates. It is recommended that these be calculated and included in the procedures and design specifications.	Incl. above
The transfer of monitoring and control from SWC to SDP currently earmarked to commence at 80% dam level. This activity is expected to require significant work and lead time notification to SWC so it is recommended to commence this earlier, say at 85% or 90% dam level.	$0

Gap/Recommendation Description	Additional Cost Estimate (+/- 50%)
Include a P&ID in procedure WI- KDP-20-5254 (Botany Bay Pipeline Purge) showing the valve configuration, location of chemical dosing, and direction of flows for pipeline purging.	$5,000
The procedures do not mention what is required in the event that ecotoxity testing identifies higher than acceptable levels of toxins. The procedure needs to incorporate this. This may require scouring at Alexandra Canal into tankers to treat water before dumping. It is recommended liaising with environmental specialist to develop procedures for treating various toxins and include this in the design specification for the dosing equipment.	$10,000
It is recommended that grab samples taken during the pipeline restart are analysed on site for best accuracy.	$0
Undertake a trial pipeline purge during care and maintenance mode to confirm the procedure and dosing equipment and to confirm costs	$200,000
The plant restart procedure PR-KDP-19-5244 requires a HAZOP to be undertaken on the plant triggered when dam levels reach 80%. It is recommended that the HAZOP includes the pipeline.	$0
The plant restart procedure PR-KDP-19-5244 requires training for new staff triggered when dam levels reach 69.9%. It is recommended that the staff training includes operation and maintenance of the pipeline.	$0
Prepare PM schedules for normal operating mode during care and maintenance mode (refer to recommendations in Section 7). Modify restart procedure to include review of PM schedules at 80% dam levels and implementation of PM schedules at 70% dam levels	$0
Develop contract shells for chemical dosing equipment and supply. Structure the contracts to enable Veolia to pull out with minimal possible costs if dam levels increase due to rainfall.	$5,000
The PMs triggered at 75% dam levels do not include PMs for the section valves. It is recommended these are included (refer to recommendation from Section 7)	$0

The following assumptions have been made regarding the restart procedures:

- All necessary approvals are in place including required EPA approvals for dumping purged water
- SWC is capable of supplying the required water for purging when dams are at 70% level
- No further on-line monitoring equipment will be installed. Manual water quality sampling is considered the most cost effective option considering the restart procedure is only enacted once every several years.

Gap/Recommendation Description	Additional Cost Estimate (+/- 50%)
recommended liaising with environmental specialist to develop procedures for treating various toxins and include this in the design specification for the dosing equipment.	
It is recommended that grab samples taken during the pipeline restart are analysed on site for best accuracy.	$0
Undertake a trial pipeline purge during care and maintenance mode to confirm the procedure and dosing equipment and to confirm costs	$200,000
The plant restart procedure PR-KDP-19-5244 requires a HAZOP to be undertaken on the plant triggered when dam levels reach 80%. It is recommended that the HAZOP includes the pipeline.	$0
The plant restart procedure PR-KDP-19-5244 requires training for new staff triggered when dam levels reach 69.9%. It is recommended that the staff training includes operation and maintenance of the pipeline.	$0
Prepare PM schedules for normal operating mode during care and maintenance mode (refer to recommendations in Section 7). Modify restart procedure to include review of PM schedules at 80% dam levels and implementation of PM schedules at 70% dam levels	$0
Develop contract shells for chemical dosing equipment and supply. Structure the contracts to enable Veolia to pull out with minimal possible costs if dam levels increase due to rainfall.	$5,000
The PMs triggered at 75% dam levels do not include PMs for the section valves. It is recommended these are included (refer to recommendation from Section 7)	$0

The following assumptions have been made regarding the restart procedures:

- All necessary approvals are in place including required EPA approvals for dumping purged water
- SWC is capable of supplying the required water for purging when dams are at 70% level
- No further on-line monitoring equipment will be installed. Manual water quality sampling is considered the most cost effective option considering the restart procedure is only enacted once every several years.

9 Benchmarking

9.1 METHODOLOGY AND SOURCE DATA

Benchmarking can be a useful tool for comparing asset management performance with similar assets to determine areas for improvement. There are, however, limitations in the application of benchmarking data which should be considered in any comparison such as asset age, climate conditions, construction techniques, asset criticality to service provisions, levels of maintenance. These factors can all have an impact in benchmarking data.

Data for benchmarking has been obtained from utilities with similar sized water mains. The metrics used for benchmarking are:

- Maintenance cost per km of pipeline per annum (opex only)
- Percentage of PMs of all maintenance work orders by cost (opex only)
- Maintenance cost as a percentage of total asset renewal value

The SDP pipeline opex PM cost is based on the fixed O&M fee indexed to the 2015-16 financial year. The CM/BM costs, capex costs and numbers of work orders are based on historical maintenance records provided by Veolia between June 2013 and February 2014.

For benchmarking purposes a nominal renewal figure of $20,000,000 has been used that would return the pipeline to its design life of 100 years. This takes into account the replacement of the pipe lining as well as associated pipeline assets such as valves and instrumentation, but doesn't include any costs associated with trenching, tunnelling, foundations, concrete structures or earthworks. It is not the cost of installing a complete new pipeline but relining the existing line and assumes the basic structural integrity is maintained by the existing pipe wall material. This value (cost per metre) is comparable to other pipelines.

9.2 BENCHMARKING AGAINST OTHER UTILITIES

Table 10 summarises the metrics in 8.1 of the SDP pipeline against similar pipelines.

Table 10 also includes benchmarking data assuming forecast expenditure for 2016-17 as per Section 8.2

Table 10: Benchmarking of SDP Pipeline Maintenance Against Similar Pipelines

	SDP Pipeline (up to 2015-16)	SDP Pipeline (Forecast 2016-17)	Utility Water Main 1 - 2600mm / 3100m dia	Utility Water Main 2 - 2100mm dia	Utility Water Main 3 - 3000mm dia
Opex PM Cost $ p.a.	$147,900	$149,800	$30,100	$292,000	$250,700
Opex CM/BM Cost $ p.a.	$20,700	$219,300	$131,200	$216,400	$133,000
Capex Cost $ p.a.	$3,700	$95,000	$1,000	$81,700	$178,100
No of PM WO's p.a.	28	N/A	447	2992	2535
No of CMs/BMs p.a.	21	N/A	73	177	192
No of Capex WOs p.a.	3	N/A	1	42	40
Pipe Length (km)	24.1	24.1	4.3	27	27
Opex Cost/km p.a.	$7,100	$15,300	$37,500	$18,800	$14,200
%PMs of total WO's by Cost	88%	41%	19%	57%	65%
Total Asset Renewal Value	$20,000,000		$9,626,000	$23,149,000	$29,641,000
Total Cost p.a. / Renewal Value %	0.9%	2.3%	1.7%	2.5%	1.9%
Material / Environment	MSCL - Tunnelled, Trenched, Mounded, Sub-Sea & Above Ground		Epoxy-lined Steel Pipe	CICL. Predominately Above Ground with short tunnelled sections	CICL. Predominately Above Ground with short tunnelled sections
Asset Age (Years)	6		40	65	55

9.3 FINDINGS AND RECOMMENDATIONS

General industry targets for the maintenance benchmarking metrics in Table 10 are:

- 2% - 3% for total maintenance cost as a percentage of asset renewal value
- 80% planned maintenance to 20% reactive maintenance (planned maintenance includes PMs and some CMs that can be deferred until planned shutdowns or during PMs)

Comparing the results of the maintenance metrics in Table 10, the SDP pipeline has a high percentage of PMs to total maintenance, and a low maintenance cost as a percentage of asset renewal value. This is primarily a reflection of the SDP pipeline being in care and maintenance mode as well as being a relatively new pipeline so the high PM percentage is not considered a great concern.

The above-mentioned benchmarking targets are guidelines only. Long term monitoring of these metrics will provide a useful tool for measuring the effectiveness of the pipeline asset management plan.

As the pipeline ages, should the percentage of reactive maintenance increases to, say, 50% with a number of emergency breakdown works each year, this would be an

indication of the pipeline and associated assets being in poor condition and possibly overdue for replacement or renewal. On the other hand, if the percentage of planned maintenance remains above 90% even though the pipe is older, then this may indicate that too much preventive maintenance is being undertaken (e.g. more frequent PMs than necessary) so a reduction in the frequency or scope of PMs could be justified.

However, further investigation and analysis is recommended rather before any decision is made to change maintenance expenditure or modify the PM program.

As the pipeline ages, annual maintenance costs will be expected to increase over and above the normal increases which are attributable to inflation. Figure 5 provides a theoretical example of how maintenance costs increases with asset age.

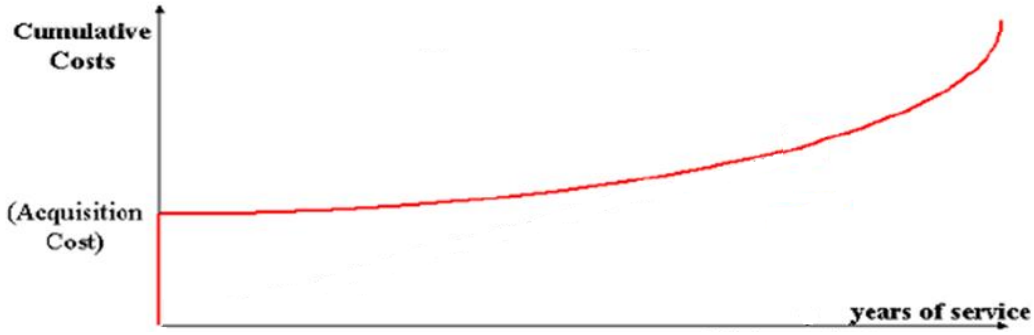


Figure 5: Theoretical Whole-of-Life Asset Cost versus Years of Service

Assuming maintenance costs for normal operating mode are as per the forecast expenditure in Section 8.2 including adoption of additional maintenance recommendations, then the total maintenance cost as a percentage of asset renewal value would be approximately 2.3%, which is comparable with the other pipelines that have been used as a benchmark in Table 10. However, the percentage of PMs compared to all work orders by cost is lower compared to two of the other pipelines. This is predominately due to the cost estimates for sacrificial anode replacements and pipe joint coating remediation works which have been included in the forecasts for 2016-17, which if completed within the next 12 months are not expected to be as high in subsequent years.

Given the age of the pipeline and the current operating context, there is no driver, based on the benchmarking data, to increase maintenance expenditure on the pipeline apart from the high priority recommendations identified in the maintenance gap analysis (Section 7.4) and the site inspection (Section 6.3).

10 Recommended Actions

The following is a summary of all recommendations stated in this report. For further details of the recommendations please refer to the relevant Sections of this report as indicated below.

10.1 SHORT TERM ACTIONS

The following maintenance actions have been identified from the site inspections and discussions with Veolia as high priority and are recommended to be completed in the short term (within six month). Each item should undergo detailed scope, design and quotation before being completed.

- Replace anodes at locations identified in the latest CCE report which are no longer providing cathodic protection of the pipeline
- Review the need for permanent rated anchor points. Replacement of failed anchor points, and load testing of current anchor points prior to each use until they are replaced with an improved design (Section 7.4)
- Establish an annual PM for the six section valves. (Section 7.4)
- Establish an annual PM for testing/recertification of the RPZ valve installed at Shaft 11C as per Sydney Water requirements (Section 7.4 Table 6)
- Replace missing bird spikes on top of pipe sections at the M5/SWSOOS crossover and Alexandra Canal. Some bird spikes found on the ground nearby could be re-used.

10.2 MAINTENANCE

The following maintenance actions have been identified from the site inspections and discussions with Veolia as a medium-to-low priority and are recommended to be completed in the medium-to-long term (1-5 years). Each item should undergo detailed scope, design and quotation before being completed. Refer to Sections 6.3 and 7.4 for further details of these recommendations.

- As anchor points fail (i.e. during testing), replace them with an improved design that is not prone to being submerged in water
- Blast and repaint locations of failed protective coating at Kurnell Pump Station, Shaft 11C and large flanges under air valves
- During the next PM, check all fasteners on stairways and platforms. Tighten any loose fasteners, replace any short bolts. Patch paint areas of corrosion on hand rails and chain hooks. Chain hooks may need to be replaced.
- Patch repair or epoxy pressure grout longitudinal crack in the concrete encasement of the pipe where it rises from underground at Shaft 11C.

- Repair cracking and patch paint where the flow switch at Shaft 11C is connected to the main pipe. Patch paint or replace metal brackets used to secure the flow switch.
- Replace defective protective tape wrapping on pipe flanges at Shaft 11C.
- Expand current PM procedures to detail required specific tasks for inspections
- Establish a PM for internal inspection of the pipeline.
- Pump out the valve pits for submerged scour valves prior to the annual inspection to allow visual inspection to be undertaken.
- Buried valve pits to be excavated at a frequency of around 5-10 years to allow for internal inspection of the pit and valves.
- Engage a valve specialist to undertake further investigation to find a solution to the issue of partially submerged air valves
- Establish a monthly walk along the above-ground pipeline sections and other parts of the pipeline visible from the surface with a focus on safety issues, access, vegetation and graffiti.

10.3 ASSET MANAGEMENT PLAN

The following recommendations have arisen from the review of the asset management plan, associated documentation and current asset management practices. Refer to Section 8.1 for further details of these recommendations.

- Add details for requirements under normal operation as stated in Operating Licence and Veolia O&M agreement
- Include a table of risks for operation and maintenance of the pipeline
- Include a reference to current safety procedures
- Review and update register of stakeholders located along the pipeline including title search along the easement approximately every 5 years.
- Develop and include standard operating procedures – e.g. scour valve operation, water quality instrumentation, pipeline purging procedure, pipeline configuration for various operating modes
- Add references or links to operations and maintenance manuals and drawings
- Include references to new PM procedures for section valves and pipeline inspections
- Include a definition of an asset and what level of segmentation is required for the asset register
- Update existing PM procedures with detailed tasks as recommended in Section 7.4.
- Develop KPIs to measure asset performance
- Develop a review/audit program for asset management
- Include five year opex/capex forecasts aligning with the IPART review cycle
- Develop guidelines for deciding when assets should be replaced (e.g. condition, performance or time-based criteria, cost of repair versus replacement)
- Include more detail about how the CMMS and other tools are used to support asset management.
- Include a process for monitoring asset condition and collecting and analysing the data. Condition rating data for assets can be obtained during PMs and recorded in the CMMS. A 1 to 5 condition rating is commonly used (1 = “As New”, 5 = “Unserviceable”)

- Detail the change control processes relating to assets – e.g. What approval process is required prior to the new or modified asset and what other changes are required e.g. updates to asset register, O&M manuals, engineering drawings, SCADA, AMP, etc.
- Specify how each Section of the AMP is affected by the operating mode i.e. normal operating mode will see additional and/or more frequent PMs
- Specify any potential or known future asset-related improvement initiatives
- Specify appropriate staffing levels and skills for operations and maintenance
- Specify the business processes relating to asset management e.g. works requesting and management, asset acquisition works approvals, works management, asset acquisition, asset disposal
- Specify the recommended critical spares list
- Develop a process for managing the review and approval of developments and other works near or adjacent to the pipeline
- Document and reference the procedure of existing works completed near developments to protect the pipeline and facilitate future access, and note whether any funds have been set aside for future
- Specify water quality monitoring regime for each mode of operation
- Specify the level of on-line monitoring and control (e.g. water quality, alarms) that occurs for the pipeline including the role of the SWC System Operations Control centre
- Add a list of recommended service providers for various maintenance services

10.4 OTHER

The following recommendations have arisen from the review of specific issues not already covered under maintenance actions or the review of the asset management plan. Refer to Sections 8.3 through to 8.13 for further details of these recommendations.

- Install asset labels stating the asset number, brief description and also indicate whether they are normally open or closed. A schematic diagram at each site can also be considered which shows the general pipe and valve configuration.
- Add assets to the asset register as listed in Appendix B (Table 2)
- Add asset details to the asset register such as size, manufacturer, model, serial number, installation date, asset type, replacement cost and material
- Develop a simple asset data specification procedure
- Collection of asset condition data during PMs using a 1-5 overall condition rating as well as other condition data such as pipe thickness, voltage, current, opening and closing times for electrically actuated valves, insulation resistance for actuator motor windings, remaining take-up gap for expansion joints, and pressure gauge readings
- Develop additional asset management metrics for inclusion in monthly or annual reporting as specified in Section 8.4
- Obtain historical data of CP testing in electronic (spreadsheet) format for future reference and trend analysis.
- Procure critical spares during the next restart phase of the pipeline as listed in Section 8.6
- Consider entering into an agreement with either or both of Sydney Water and WaterNSW to have access to their spares in an emergency situation.

- Maintain a six monthly frequency for water quality monitoring during care and maintenance mode. The monitoring frequency should be increased to quarterly during the restart phase or if consecutive six monthly monitoring reveals significant deterioration of water quality within the pipeline. During normal operation, quarterly water quality monitoring should be maintained, in addition to the on-line water quality monitoring.
- Develop a design specification for the dosing equipment to be included as part of the restart procedure, incorporating chemical storage and bunding, chemical quantity and dosing rates, option for dosing at Kurnell end.
- Commence transfer of monitoring and control from SWC to SDP earlier, say at 85% or 90% dam level.
- Include a P&ID in procedure WI- KDP-20-5254 (Botany Bay Pipeline Purge) showing the valve configuration, location of chemical dosing, and direction of flows for pipeline purging.
- Liaise with environmental specialist to develop procedures for treating various toxins and include this in the design specification for the dosing equipment.
- Analyse grab samples taken during the pipeline restart on site for best accuracy.
- Undertake a trial pipeline purge during care and maintenance mode to confirm the procedure and dosing equipment and to confirm costs
- Procedure PR-KDP-19-5244 is modified to expand the HAZOP to include the pipeline and training for new staff includes operation and maintenance of the pipeline.
- Modify restart procedure to include review of PM schedules at 80% dam levels and implementation of PM schedules at 70% dam levels
- Develop contract shells for chemical dosing equipment and supply. Structure the contracts to enable Veolia to pull out with minimal possible costs if dam levels increase due to rainfall.
- Add PMs for the section valves to the restart procedure.

11 Acknowledgements

KBR acknowledges the support of Gavin Ovens (Executive General Manager of Operations, Sydney Desalination Plant Pty Ltd) and Rob Weidemier (Contract Coordinator, Veolia Australia and New Zealand) in providing the documentation used in the asset management review as well as arranging access for the site inspection and responding to questions during the stakeholder workshop and via various emails.

12 References

ISO55000 Asset Management Series

13 Project Team

Tom Belgrove

- Tom is a Management Consultant with over 35 years' experience in local government, utility management and consulting. Tom is a qualified Lead Assessor for ISO 55001 Asset Management Standard under the Asset Management Council (AMC) endorsed scheme. His experience has covered most areas in utility management and management consulting including Asset Management, Operational Management, Program Management, Project Management and Regulatory Compliance

Mark Mordini

- Mark has over 10 years' experience as a mechanical engineer in water and wastewater asset management. Mark is skilled in the development and improvement of preventative maintenance programs, use and support of enterprise asset management systems, contract management, Root Cause Analysis (RCA), auditing, project management, maintenance works management, management of budgets, asset data collection, and asset condition assessments.

John Brown

- As a Senior Project Manager and Civil Engineer, John has more than 20 years' experience in project management, design, operations and planning in the water industry, with particular expertise in coordinating multidisciplinary teams at all stages of a project. John's comprehensive experience in the delivery of major civil and water infrastructure projects across Australia includes roles on such landmark projects as the $1.2 billion Southern Regional Water Pipeline Alliance; the $170 million Western Sydney Replacement Flows Project (Sydney's largest water recycling scheme); and the $300 million Georges River Wastewater Infrastructure Program.

Appendix A – List of Documents Provided for the Asset Management Review

No.	Document Name	Summary Description	Doc Ref	Author	Date Supplied
1	2013 Annual Pipeline Planned Maintenance Report	Details the inspection work carried out on the Sydney Desalination Pipeline during the annual inspection in November 2013.	N/A	Rob Weidemier (Veolia)	5/05/2016
2	Operation and Maintenance Plan SACL – Areas A, B and C	The purpose of this Plan is to provide Sydney Airport Corporation Limited (SACL) a list of operation and maintenance activities that SWC will be conducting during the design life of the pipeline that crosses SACL Lands.	WDA-D-D003	Water Delivery Alliance	5/05/2016
3	SDP Pipeline Hydraulic Grade Line General Arrangement	Design documentation	WMKE1-10-5110	Water Delivery Alliance	5/05/2016
4	Maximo Pipeline Asset List	Includes location code, description, status and criticality ratings	N/A	Rob Weidemier (Veolia)	5/05/2016
5	SDP Pipeline Operational Risk Assessment	List of all risks associated with operation of the SDP pipeline, with associated asset/process, details, risk rating and controls	N/A	Gavin Ovens (SDP)	5/05/2016
6	SDP Pipeline Operations and Maintenance Schedule	Table showing list of operations and maintenance tasks required, by asset type, with frequency, reporting requirements, estimated cost and status	1111162328	Sydney Water	5/05/2016
7	All Pipeline As-built Drawings	Design documentation	WMKE1-… sections KU to SN	Water Delivery Alliance	4/05/2016
8	Network Operator's Licence - Sydney Desalination Plant Pty Ltd	Licence issued to SDP for the construction, maintenance and operation of the Desal Plant and delivery pipeline	N/A	NSW Government	12/05/2016
9	Sydney Desalination Plant Pipeline Operations and Maintenance Agreement	Contract between SDP and Veolia to engage Veolia to perform services including operation and maintenance of the SDP pipeline. Includes Schedule 3 spares list (not actually supplied by SWC), Schedule 4 monthly fixed fee and Schedule 9 maintenance schedule	N/A	SDP P/L and Veolia Water	12/05/2016
10	Operations Management Plan	Describes the way Veolia plans and performs O&M tasks for the SDP pipeline	PL-KDP-21-6185-1	Veolia Water	12/05/2016
11	2015 Annual Pipeline Planned Maintenance Report	Details the inspection work carried out on the Sydney Desalination Pipeline during the annual inspection in November 2015	N/A	Rob Weidemier (Veolia)	12/05/2016
12	Additional Opex & Capex expenditure	List of additional expenditure above the monthly fixed fee (corrective maintenance and capital works)	N/A	Rob Weidemier (Veolia)	12/05/2016
13	Cathodic Protection System Routine Inspection Report Nov 2015	Details the methodology and results of the testing of the cathodic protection and AC mitigation systems of the SDP pipeline with recommendations	W12572/J900	Corrosion Control Engineering	12/05/2016

14	Work Order Details Report # 104280	Sample maintenance work order on a Turbidity Analyser (3 Monthly PM), including scheduled and actual start and finish dates, task descriptions, observations, and signatures for approval and completion of works	104280	Veolia Water	13/05/2016
15	SDP O&M Manual for Pipeline (by Sydney Water)	Documents the mechanical and electrical equipment installed in the Water Distribution Infrastructure and to describe the operation and maintenance of the Delivery Pipeline.	17388	Sydney Water	14/05/2016
16	SDP O&M Manual for Pipeline (by SDA)	As per Sydney Water O&M Manual, plus appendices	WDA-D-D001B Rev 0	Sydney Water	14/05/2016
17	Pipeline Monthly Report Aug 15	List/status of current "reimbursable" work (i.e. work outside of fixed-price component of contract), summary of completed works and activities undertaken for the month	N/A	Rob Weidemier (Veolia)	19/05/2016
18	Proposed additional pipeline PM tasks	List of additional preventive maintenance tasks recommended by Veolia which our outside of scope of pipeline Contract currently	N/A	Rob Weidemier (Veolia)	19/05/2016
19	SDP Pipeline Spares (Email)	Details of spares recommended by Veolia to SDP, including statement that spare parts listed in schedule 3 of contract were not provided at contract handover from SWC	N/A	Rob Weidemier (Veolia)	19/05/2016
20	Cathodic Protection System Minor Inspection Report May 2016	Details the methodology and results of the testing of the cathodic protection and AC mitigation systems of the SDP pipeline with recommendations	W13268/J900	Corrosion Control Engineering	19/05/2016
21	Pipeline Scour, Air Valves and Anchor Points Procedure	The purpose of the procedure is to provide guidelines to an operator for the maintenance of the desalination plant delivery pipeline scour valves and air release valves	PR-KDP-21-6317	Veolia Water	23/05/2016
22	Pipeline Cathodic Protection Test Points Procedure	The purpose of the procedure is to provide guidelines to an operator for the maintenance of the desalination plant delivery pipeline Cathodic Protection test points	PR-KDP-21-6318	Veolia Water	23/05/2016
23	Pipeline Easements Procedure	The purpose of the procedure is to provide guidelines to an operator for the maintenance of the desalination plant delivery pipeline easements.	PR-KDP-21-6319	Veolia Water	23/05/2016
24	Pipeline Water Quality Monitoring Station Procedure	The purpose of the procedure is to provide guidelines to an operator for the maintenance inspection of the desalination plant delivery pipeline water quality monitoring station. It applies when the desalination plant is under a long term plant shut down or in a Care and Maintenance state.	PR-KDP-21-6320	Veolia Water	23/05/2016
25	Pipeline Work Order Data Jan 2015 to Apr 2016	List of work orders completed by Veolia between Jan 2015 and Apr 2016 including dates, hours and comments	N/A	Veolia Water	24/05/2016

Appendix B – SDP Pipeline Asset List

Table 1 - Asset List supplied by Veolia

Location	Description	Chainage	Size	Status	Criticality
AIT01	Shaft 11 Total Chlorine Analyser			OPERATING	3
AIT02	Shaft 11 Turbidity Analyser			OPERATING	3
AIT03	Shaft 11 pH/Conductivity Analyser			OPERATING	3
BOTP0	Bifurication Pipeline 2 x DN1400 CH1660.000 to ROSV1 and ROSV2			OPERATING	3
ETP07	CP Test Point – Cathodic Protection – CH246			OPERATING	1
ETP08	CP Test Point – Captain Cook Drive – CH374			OPERATING	1
ETP09	CP Test Point – Captain Cook Drive – CH520			OPERATING	1
ETP10	CP Test Point – Captain Cook Drive – CH787	790		OPERATING	1
ETP11	CP Test Point – Captain Cook Drive – CH787 – Impressed Current Cathodic Protection			OPERATING	1
ETP12	CP Test Point – Tasman Dampier – CH1143	1143		OPERATING	1
ETP13	CP Test Point – Silverbeach – CH1665	1660		OPERATING	1
ETP14	CP Test Point – Kyeemagh – CH20			OPERATING	3
ETP15	CP Test Point – Kyeemagh – CH20 – Impressed Current Cathodic Protection			OPERATING	1
ETP16	CP Test Point – Kyeemagh – CH20			OPERATING	1
ETP17	CP Test Point – Muddy Creek – CH663	670		OPERATING	1
ETP18	CP Test Point – SWSOOS – CH994	950		OPERATING	1
ETP19	CP Test Point – Kogarah Golf Course – CH1133			OPERATING	1
ETP20	CP Test Point – Kogarah Golf Course – CH1436	1425		OPERATING	1
ETP21	CP Test Point – Marsh Street – CH2010			OPERATING	1
ETP22	CP Test Point – Tempe Reserve – CH11	8		OPERATING	1
ETP23	CP Test Point – Tempe Reserve – CH168 #1			OPERATING	1
ETP24	CP Test Point – Tempe Reserve – CH168 #2			OPERATING	1
ETP25	CP Test Point – Alexandra Canal – CH376			OPERATING	1
ETP26	CP Test Point – Alexandra Canal – CH1138			OPERATING	1
ETP27	CP Test Point – Swamp Road – CH1574			OPERATING	1
ETP28	CP Test Point – Freight Rail South – CH9	0		OPERATING	1
ETP29	CP Test Point – Freight Rail North – CH110	107		OPERATING	1
ETP30	CP Test Point – Canal Road – CH761	756		OPERATING	1
ETP31	CP Test Point – Alexandria Landfill – CH1125	1120		OPERATING	1
ETP32	CP Test Point – Euston & Campbell – CH2	8		OPERATING	1
ETP33	CP Test Point – Metromix – CH484	486		OPERATING	1
ETP34	CP Test Point – Sydney Park – CH 862	868		OPERATING	1
ETP35	CP Test Point – Maddox Street – CH1180	1174		OPERATING	1

ETP36	CP Test Point – Mitchell 1 – CH1439	1440		OPERATING	1
ETP37	CP Test Point – Mitchell 2 – CH1577	1577		OPERATING	1
ETP38	CP Test Point – WDA – CH 1818	1820		OPERATING	1
ETP39	CP Test Point – Shaft 11C – CH 1900			OPERATING	1
FS01	Shaft 11 Flow Switch			OPERATING	3
KUAV0	Kurnell Pump Station Air Valve (in valve pit)	0	250 mm	OPERATING	3
KUAV1	Cooks and Banks Estate Air Valve (trench)	244	250 mm	OPERATING	3
KUAV2	Captain Cook Drive Mound Air Valve (mounded)	520	250 mm	OPERATING	3
KUAV3	Tasman Dampier Shaft Air Valve (tunnel)	1142	250 mm	OPERATING	3
KUAV4	Silver Beach Shaft Air Valve (tunnel)	1666	250 mm	OPERATING	3
KUG1	Kurnell area general grounds			OPERATING	1
KUPIT1	Kurnell area pits, wells and chambers			OPERATING	1
KUSC1	Sir Joseph Banks Drive Scour Valve	153	250 mm	OPERATING	3
KUSC2	Captain Cook Drive Scour Valve	371	250 mm	OPERATING	3
KUSC3	Captain Cook Drive Transition Shaft Scour Valve	807	250 mm	OPERATING	3
KUSP0	Kurnell trenched pipeline DN1800 CH0.000 to CH373.800			OPERATING	3
KUSP1	Kurnell mounded pipeline DN1800 CH373.800 to CH800.000			OPERATING	3
KUSP2	Kurnell tunnelled pipeline DN1800 CH800.000 to CH1660.000			OPERATING	3
KUSV1	Kurnell Isolation Valve (in valve pit)	0	1800 mm	OPERATING	3
LPD01	Light and Power Distribution Board Cook Park Kiosk			OPERATING	1
LPD02	Light and Power Distribution Board Shaft 11 Instrumentation			OPERATING	3
MAAV1	Tempe Reserve Air Valve – Adjacent to Cooks River (trench)	169	250 mm	OPERATING	3
MAAV2	Tempe Reserve Air Valve (trench)	180	250 mm	OPERATING	3
MAAV3	Alexandra Canal Air Valve #1 (above ground)	585	250 mm	OPERATING	3
MAAV3A	Alexandra Canal Air Valve #2 (above ground)	980	250 mm	OPERATING	3
MAAV4	Tempe Swamp Road Air Valve (trench)	1565	250 mm	OPERATING	3
MAAV5	Tempe Swamp Road Air Valve – Adjacent to Freight Rail (trench)	1574	250 mm	OPERATING	3
MAG1	Marrickville area general grounds			OPERATING	1
MAPIT1	Marrickville area pits, wells and chambers			OPERATING	1
MARP0	Marrickville Trenched Pipeline DN1800 CH2222.960 to CH270.000			OPERATING	3
MARP1	Marrickville Mounded Pipeline DN1800 CH270.000 to CH340.000			OPERATING	3
MARP2	Marrickville Supported Pipeline DN1800 CH340.000 to CH1140.000		800	OPERATING	3
MARP3	Marrickville Trenched Pipeline DN1800 CH1140.000 to 1595.990			OPERATING	3
MARP4	Marrickville Tunnelled Pipeline DN1800 1595.990 to CH760.00			OPERATING	3
MASC1	Tempe Reserve Scour Valve	177	250 mm	OPERATING	3
MASC2	Tempe HIAL Zone Scour Valve	1152	250 mm	OPERATING	3
MASV1	Marrickville Isolation Valve #1 1800mm (trench)	174	1800 mm	OPERATING	3
MASV2	Marrickville Isolation Valve #2 1800mm (trench)	1570	1800 mm	OPERATING	3
P0	Finished Water Delivery System			OPERATING	1
P01	Delivery Pipeline Instrumentation			OPERATING	1
P011	Shaft 11 Instrumentation			OPERATING	1

P02	Delivery Pipeline			OPERATING	1
P021	Kurnell Pipeline Area			OPERATING	1
P022	Botany Bay Pipeline Area			OPERATING	1
P023	Rockdale Pipeline Area			OPERATING	1
P024	Marrickville Pipeline Area			OPERATING	1
P025	Sydney South Pipeline Area			OPERATING	1
P026	Sydney North Pipeline Area			OPERATING	1
P1	Electrical Hierarchy			OPERATING	1
P12	LV System			OPERATING	1
P121	Light and Power Distribution Boards			OPERATING	1
P2	General Site			OPERATING	1
P21	Grounds			OPERATING	1
P211	Kurnell Area Grounds			OPERATING	1
P213	Rockdale Area Grounds			OPERATING	1
P214	Marrickville Area Grounds			OPERATING	1
P215	Sydney South Area Grounds			OPERATING	1
P216	Sydney North Area Grounds			OPERATING	1
P22	Cathodic Protection			OPERATING	1
P221	Kurnell Area Cathodic Protection			OPERATING	1
P223	Rockdale Area Cathodic Protection			OPERATING	1
P224	Marrickville Area Cathodic Protection			OPERATING	1
P225	Sydney South Area Cathodic Protection			OPERATING	1
P226	Sydney North Area Cathodic Protection			OPERATING	1
PIPE	Desalination Delivery Pipeline			OPERATING	1
ROAV1	Kyeemagh Bifurcation Air Valve East (trench)	4	250 mm	OPERATING	3
ROAV2	Kyeemagh Bifurcation Air Valve West (trench)	4	250 mm	OPERATING	3
ROAV3	Kyeemagh Air Valve (trench)	20	250 mm	OPERATING	3
ROAV3A	Kyeemagh Transition Air Valve (tunnel)	31	250 mm	OPERATING	3
ROAV4	Muddy Creek Transition Air Valve (trench)	673	250 mm	OPERATING	3
ROAV5	SWSOOS Air Valve (above ground)	1055	250 mm	OPERATING	3
ROAV6	Kogarah Golf Course Transition Air Valve (mounded)	1436	250 mm	OPERATING	3
ROAV7	Marsh Street Interconnection Air Valve (tunnel)	2010	250 mm	OPERATING	3
ROG1	Rockdale area general grounds			OPERATING	1
ROPIT1	Rockdale area pits, wells and chambers			OPERATING	1
ROSC1	Muddy Creek Transition Scour Valve	663	250 mm	OPERATING	3
ROSC2	Kogarah Golf Course Scour Valve	1133	250 mm	OPERATING	3
ROSC3	Marsh Street Interconnection Scour	2012	250 mm	OPERATING	3
ROSP0	Rockdale trenched pipeline DN1800 ROSV1/2 to CH20.000			OPERATING	3
ROSP1	Rockdale tunnelled pipeline DN1800 CH20.000 to CH664.426			OPERATING	3
ROSP2	Rockdale trenched pipeline DN1800 CH664.426 to CH720.000			OPERATING	3
ROSP3	Rockdale mounded pipeline DN1800 CH720.000 to CH840.000			OPERATING	3
ROSP4	Rockdale trenched pipeline DN1800 CH840.000 to CH970.390			OPERATING	3

ROSP5	Rockdale Supported Pipeline (SWOOS) DN1800 CH970.390 to CH1067.619		97.229	OPERATING	3
ROSP6	Rockdale Trenched Pipeline DN1800 CH1067.619 to CH1180.000			OPERATING	3
ROSP7	Rockdale Mounded Pipeline DN1800 CH1180.000 CH1445.959			OPERATING	3
ROSP8	Rockdale Tunnelled Pipeline DN1800 CH1445.959 to CH2222.960			OPERATING	3
ROSV1	Rockdale Isolation Valve #1 1400mm (trench)	7	1400 mm	OPERATING	3
ROSV2	Rockdale Isolation Valve #2 1400mm (trench)	7	1400 mm	OPERATING	3
SNAV1	Euston & Campbell Road Air Valve (tunnel)	2	250 mm	OPERATING	3
SNAV2	Metromix Air Valve (tunnel)	484	250 mm	OPERATING	3
SNAV3	Sydney Park Road Air Valve (tunnel)	862	250 mm	OPERATING	3
SNAV4	Maddox Street Air Valve (tunnel)	1180	250 mm	OPERATING	3
SNAV5	Mitchell 2 Air Valve (tunnel)	1577	250 mm	OPERATING	3
SNAV6	WDA Shaft Air Valve (trench)	1894	250 mm	OPERATING	3
SNAV7	Sydney North Air Valve (above ground)	1898	250 mm	OPERATING	3
SNAV8	Shaft 11C Air Valve (above ground)	1900	100 mm	OPERATING	3
SNG1	Sydney North area general grounds			OPERATING	1
SNP0	Sydney North Tunnelled Pipeline DN1800 CH000.000 to CH1620.000			OPERATING	3
SNP1	Sydney North Trenched Pipeline DN1800 CH1620.000 to CH1880.000			OPERATING	3
SNP2	Sydney North Supported Pipeline DN1800 CH1880.000 to Shaft 11 Valve			OPERATING	3
SNPIT1	Sydney North area pits, wells and chambers			OPERATING	1
SNSC1	Euston & Campbell Road Scour Valve	2	250 mm	OPERATING	3
SNSC2	Sydney Park Road Scour Valve	861	250 mm	OPERATING	3
SNSV1	Sydney North Isolation Valve 1800mm (above ground)	1900	1800 mm	OPERATING	3
SSAV1	Canal Road Air Valve (tunnel)	761	250 mm	OPERATING	3
SSAV2	Alexandria Landfill Air Valve (tunnel)	1125	250 mm	OPERATING	3
SSG1	Sydney South area general grounds			OPERATING	1
SSP0	Sydney South Tunnelled Pipeline DN1800 CH760.000 to CH1612.744			OPERATING	3
SSPIT1	Sydney South area pits, wells and chambers	764		OPERATING	1
SSSC1	Canal Road Scour Valve	761	250 mm	OPERATING	3

Table 2 - List of Assets Recommended to be Added to Asset Register

Suggested Asset No	Chainage	Description
KUAIV0	0	AIR VALVE ISOLATOR
KUAIV1	247	AIR VALVE ISOLATOR
KUAIV2	520	AIR VALVE ISOLATOR
KUTS1	808	TRANSITION SHAFT - CAPTAIN COOK DRIVE
KUAIV3	1143	AIR VALVE ISOLATOR
KUAIV4	1660	AIR VALVE ISOLATOR
KUTS2	1660	TRANSITION SHAFT - SILVER BEACH
ROAIV1	10	PIPELINE 1 - AIR VALVE ISOLATOR
ROAIV2	10	PIPELINE 2 - AIR VALVE ISOLATOR
ROAIV3	13	AIR VALVE ISOLATOR
ROTS1	20	TRANSITION SHAFT - KYEEMAGH
ROAIV3A	30	AIR VALVE ISOLATOR
ROTS2	660	TRANSITION SHAFT - MUDDY CREEK
ROAIV4	674	AIR VALVE ISOLATOR
ROACB1	686	ANCHOR BLOCK
ROACB2	971	ANCHOR BLOCK
ROPS1	1040	ABOVE GROUND PIPE SUPPORT - SWSOOS CROSSING
ROAIV5	1054	AIR VALVE ISOLATOR
ROACB3	1069	ANCHOR BLOCK
ROACB4	1420	ANCHOR BLOCK
ROAIV6	1436	AIR VALVE ISOLATOR
ROTS3	1440	TRANSITION SHAFT - KOGARAH GOLF COURSE
ROAIV7	2011	AIR VALVE ISOLATOR
ROTS4	2014	TRANSITION SHAFT - MARSH STREET
MATS1	0	TRANSITION SHAFT - TEMPE RESERVE
MAAIV1	170	AIR VALVE ISOLATOR
MAAIV2	180	AIR VALVE ISOLATOR
MAACB1	322	ANCHOR BLOCK - TB-A
MAACB2	327	ANCHOR BLOCK - T1
MAACB3	338	ANCHOR BLOCK - T2
MAACB4	345	ANCHOR BLOCK - T3
MAACB5	356	ANCHOR BLOCK - T4
MAACB6	375	ANCHOR BLOCK - TB-B
MAACB7	398	SLIDING JOINT - SJ1
MAACB8	422	SLIDING JOINT - SJ2
MAACB9	446	SLIDING JOINT - SJ3
MAEJ1	470	EXPANSION JOINT - EJ1
MAACB11	494	SLIDING JOINT - SJ4
MAACB12	518	SLIDING JOINT - SJ5
MAACB13	542	SLIDING JOINT - SJ6
MAACB14	565	ANCHOR BLOCK - TB-C

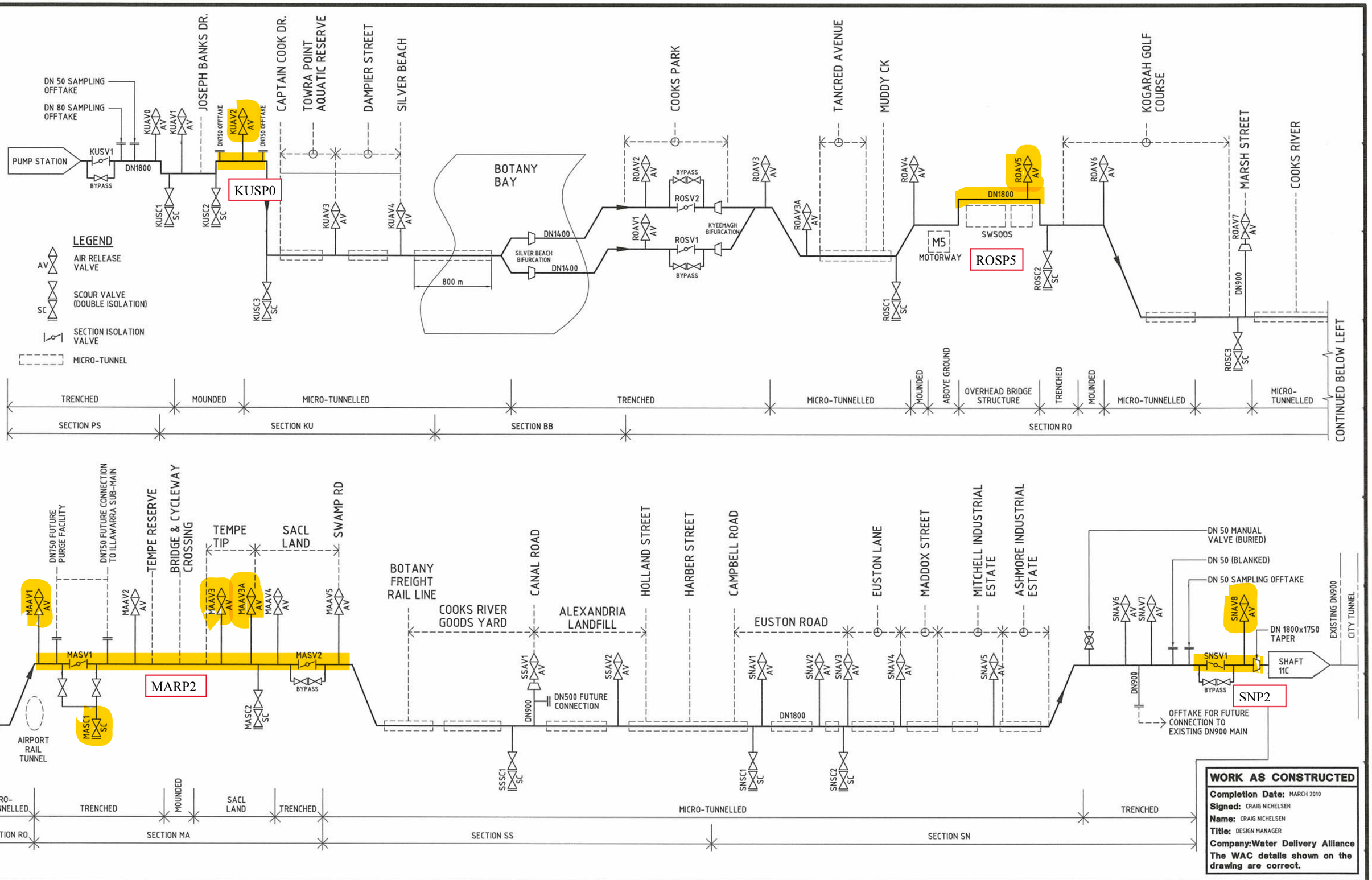
Suggested Asset No	Chainage	Description
MAACB15	589	SLIDING JOINT - SJ7
MAAIV3	590	AIR VALVE ISOLATOR
MAACB16	613	SLIDING JOINT - SJ8
MAACB17	637	SLIDING JOINT - SJ9
MAEJ2	660	EXPANSION JOINT - EJ2
MAACB19	683	SLIDING JOINT - SJ10
MAACB20	707	SLIDING JOINT - SJ11
MAACB21	731	SLIDING JOINT - SJ12
MAACB22	755	ANCHOR BLOCK - FX
MAACB23	779	SLIDING JOINT - SJ13
MAACB24	803	SLIDING JOINT - SJ14
MAACB25	827	SLIDING JOINT - SJ15
MAEJ3	850	EXPANSION JOINT - EJ3
MAACB27	870	SLIDING JOINT - SJ16
MAACB28	894	SLIDING JOINT - SJ17
MAACB29	918	ANCHOR BLOCK - TB-D
MAEJ4	942	EXPANSION JOINT - EJ4
MAACB31	961	SLIDING JOINT - SJ18
MAAIV3A	980	AIR VALVE ISOLATOR
MAACB32	985	ANCHOR BLOCK - TB-F
MAACB33	1009	SLIDING JOINT - SJ19
MAACB34	1033	SLIDING JOINT - SJ20
MAEJ5	1057	EXPANSION JOINT - EJ5
MAACB36	1081	ANCHOR BLOCK - SJ21
MAACB37	1105	ANCHOR BLOCK - TB-E
MAACB38	1330	ANCHOR BLOCK
MAAIV4	1561	AIR VALVE ISOLATOR
MAAIV5	1570	AIR VALVE ISOLATOR
SSTS1	5	TRANSITION SHAFT - FREIGHT RAIL SOUTH
SSTS2	107	TRANSITION SHAFT - FREIGHT RAIL NORTH
SSTS3	756	TRANSITION SHAFT - CANAL ROAD
SSAIV1	764	AIR VALVE ISOLATOR
SSTS4	1120	TRANSITION SHAFT - ALEXANDRIA LANDFILL
SSAIV2	1125	AIR VALVE ISOLATOR
SSTS5	1613	TRANSITION SHAFT - EUSTON AND CAMPBELL ROAD
SNAIV1	4	AIR VALVE ISOLATOR
SNAIV2	480	AIR VALVE ISOLATOR
SNTS1	486	TRANSITION SHAFT - METROMIX
SNTS2	858	TRANSITION SHAFT - SYDNEY PARK ROAD
SNAIV3	864	AIR VALVE ISOLATOR
SNTS3	1173	TRANSITION SHAFT - MADDOX STREET
SNAIV4	1176	AIR VALVE ISOLATOR
SNTS4	1440	TRANSITION SHAFT - MITCHELL ESTATE SHAFT 1

Suggested Asset No	Chainage	Description
SNTS5	1577	TRANSITION SHAFT - MITCHELL ESTATE SHAFT 2
SNAIV5	1581	AIR VALVE ISOLATOR
SNTS6	1815	TRANSITION SHAFT - WDA
SNAIV6	1894	AIR VALVE ISOLATOR
SNAIV7	1898	AIR VALVE ISOLATOR
SNAIV8	1900	AIR VALVE ISOLATOR
SNPS1	1896	ABOVE GROUND PIPE SUPPORT
KUSC1A	153	Anchor Point
KUSC1B	153	Anchor Point
KUAV1A	244	Air Valve Cage Lifting Lug
KUAV1B	244	Air Valve Cage Lifting Lug
KUSC2A	371	Anchor Point
KUSC2B	371	Anchor Point
KUAV2A	520	Air Valve Cage Lifting Lug
KUAV2B	520	Air Valve Cage Lifting Lug
KUSC3A	807	Anchor Point
KUSC3B	807	Anchor Point
KUAV3A	1142	Air Valve Cage Lifting Lug
KUAV3B	1142	Air Valve Cage Lifting Lug
KUAV4A	1666	Anchor Point
KUAV4B	1666	Anchor Point
ROAV1A	4	Anchor Point
ROAV1B	4	Anchor Point
ROAV2A	4	Anchor Point
ROAV2B	4	Anchor Point
ROAV3A	20	Anchor Point
ROAV3B	20	Anchor Point
ROAV3A1	31	Anchor Point
ROAV3A2	31	Anchor Point
ROSC1A	663	Anchor Point
ROSC1B	663	Anchor Point
ROAV4A	673	Anchor Point
ROAV4B	673	Anchor Point
ROAV6A	1436	Air Valve Cage Lifting Lug
ROAV6B	1436	Air Valve Cage Lifting Lug
ROSC3A	2012	Anchor Point
ROSC3B	2012	Anchor Point
ROAV7A	2010	Anchor Point
ROAV7B	2010	Anchor Point
MAAV1A	169	Anchor Point
MAAV1B	169	Anchor Point
MASC1A	177	Anchor Point
MASC1B	177	Anchor Point

Suggested Asset No	Chainage	Description
MAAV2A	180	Anchor Point
MAAV2B	180	Anchor Point
MAAV4A	1565	Anchor Point
MAAV4B	1565	Anchor Point
MAAV5A	1574	Anchor Point
MAAV5B	1574	Anchor Point
SSSC1A	761	Anchor Point
SSSC1B	761	Anchor Point
SSAV1A	761	Anchor Point
SSAV1B	761	Anchor Point
SSAV2A	1125	Anchor Point
SSAV2B	1125	Anchor Point
SNSC1A	2	Anchor Point
SNSC1B	2	Anchor Point
SNAV1A	2	Anchor Point
SNAV1B	2	Anchor Point
SNAV2A	484	Anchor Point
SNAV2B	484	Anchor Point
SNSC2A	861	Anchor Point
SNSC2B	861	Anchor Point
SNAV3A	862	Anchor Point
SNAV3B	862	Anchor Point
SNAV4A	1180	Anchor Point
SNAV4B	1180	Anchor Point
SNAV5A	1577	Anchor Point
SNAV5B	1577	Anchor Point
SNAV6A	1894	Anchor Point
SNAV6B	1894	Anchor Point
ETP38A	1850 (est)	Anchor Point - Ashmore Estate, Erskineville
ETP38B	1850 (est)	Anchor Point - Ashmore Estate, Erskineville
ETP38C	1850 (est)	Anchor Point - Ashmore Estate, Erskineville
ETP38D	1850 (est)	Anchor Point - Ashmore Estate, Erskineville
KUAN1	0	2 off packaged magnesium anodes c/w 10mm² tails
KUGA1	0	2 off gas arrestor
KUAN2	246	3 off packaged magnesium anodes c/w 10mm2 tails
KUGA2	246	1 off gas arrestor
KUAN3	374	3 off packaged magnesium anodes c/w 10mm2 tails
KUGA3	374	1 off gas arrestor 1off earth mat
KUAN4	520	4 off packaged magnesium anodes c/w 10mm2 tails
KUGA4	520	1 off gas arrestor 1off earth mat
KUAN5	787	3 off packaged magnesium anodes c/w 10mm2 tails
KUGA5	787	1 off gas arrestor
KUAN6	5	3 off packaged magnesium anodes c/w 10mm2 tails

Suggested Asset No	Chainage	Description
KUGA6	5	1 off gas arrestor
ROGA1	23	1 off gas arrestor
ROAN1	23	4 off packaged zinc anodes c/w 10mm2 tails
ROAN2	671	3 off packaged magnesium anodes c/w 10mm2 tails
ROGA2	671	1 off gas arrestor 2 off 25mm2 pipe cable from tunnelled pipe
ROAN3	671	4 off packaged zinc anodes c/w 10mm2 tails
ROAN4	953	3 off packaged magnesium anodes c/w 10mm2 tails
ROAN5	1169	4 off packaged magnesium anodes c/w 10mm2 tails
ROAN6	1434	4 off packaged magnesium anodes c/w 10mm2 tails
ROGA3	1434	1 off gas arrestor 2 off 25mm2 pipe cable from tunnelled pipe
ROAN7	1434	4 off packaged zinc anodes c/w 10mm2 tails
MAAN1	11	2 off packaged magnesium anodes c/w 10mm2 tails
MAGA1	11	1 off gas arrestor
MAAN2	11	4 off packaged zinc anodes c/w 10mm2 tails
MAAN3	168	4 off packed magnesium anodes c/w 10mm2 tails
MAAN4	168	2 off packed zinc anode c/w 10mm2 tail
MAAN5	376	2 off packaged magnesium anodes c/w 10mm2 tails
MAAN6	1138	3 off packaged magnesium anodes c/w 10mm2 tails
MAAN7	1581	4 off packaged magnesium anodes c/w 10mm2 tails
MAAN8	1581	2 off packaged zinc anodes c/w 10mm2 cables
MAAN9	1625	2 off packaged magnesium anodes for trenched pipe
MAAN10	1625	4 off packaged magnesium anodes for coated tunnelled pipe c/w 10mm2 tails
MAGA2	1625	1 off gas arrestor
SSAN1	110	4 off packaged magnesium anodes c/w 10mm2 tails for coated tunnel section
SSAN2	110	4 off packaged zinc anodes for uncoated tunnel 1 off coupon c/w 4mm2 tail
SSGA1	110	1 off gas arrestor
SSAN3	761	1 or 2 off packaged magnesium anodes c/w 10mm2 tails
SNAN1	1818	2 off packaged magnesium anodes c/w 10mm2 tails
SNGA1	1818	1 off gas arrestor
SNAN2	1818	4 off packaged zinc anodes c/w 10mm2 tails
SNAN3	1900	2 off packaged magnesium anodes c/w 10mm2 tails
SNGA2	1900	1 off gas arrestor 2 off 25mm2 pipe cables
BOCP1		Cathodic Protection System - Impressed Current (Botany Bay Crossing)
SNRPZ1	1900	RPZ Device 20mm Dia - Pipeline Refill Line
SNWM1	1900	Water Meter 20mm Dia - Pipeline Refill Line
KUACT1	0	Kurnell - Actuator for Isolation Valve (in valve pit)
MAACT1	174	Marrickville - Actuator for Isolation Valve #1 1800mm (trench)
MAACT2	1570	Marrickville - Actuator for Isolation Valve #2 1800mm (trench)
ROACT1	7	Rockdale - Actuator for Isolation Valve #1 1400mm (trench)
ROACT2	7	Rockdale - Actuator for Isolation Valve #2 1400mm (trench)
SNACT1	1900	Sydney North - Actuator for Isolation Valve 1800mm (above ground)
ETP06	0	CP Test Point - Kurnell - CH0

Appendix C – SDP Pipeline Process Flow Diagram Showing Assets Included in Site Inspections



WORK AS CONSTRUCTED

Completion Date: MARCH 2010
Signed: CRAIG NICHELSEN
Name: CRAIG NICHELSEN
Title: DESIGN MANAGER
Company: Water Delivery Alliance
The WAC details shown on the drawing are correct.

REV	DATE	DESCRIPTION	DRAFT	DRAFT CHK	DES	DES CHK	APPROVED
C	17.03.10	WORK AS CONSTRUCTED	BC	PG			CN
B	29.10.09	BYPASS VALVES, SAMPLING CONNS ADDED	BC	PG	BS	MR	CN
A	14.10.09	VALVES AND VALVES NUMBERS ADDED	EZ	PG	BS	MR	CN
0	15.06.09	ISSUE FOR CONSTRUCTION	GK	PG	WB	MR	CN

REVISIONS

WaterDeliveryAlliance
SYDNEY'S DESALINATION PROJECT

Bovis Lend Lease · McCONNELL DOWELL · ERM · KBR · WorleyParsons

Sydney WATER

TITLE
WATER DELIVERY ALLIANCE
SECTION PS - PUMP STATION
PUMP STATION
PROCESS FLOW DIAGRAM
FULL PIPELINE

WP0369-17

DRAWING SCALE N.T.S. @A1

REVISION C

O:\G&I\CAD\Projects\SEG717\Drawings\PS\WP0369-17.dwg Friday, 30 November 2007 10:39:40 AM

Appendix D – Site Inspection Photos and Check Sheets

KBR

AIR VALVE
CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Kurnell Section
LOCATION:	KUAV2 - Kurnell Pump Station
DIAMETER:	250mm
INSPECTED BY:	Mark Mordini
INSPECTION DATE:	18/05/2016
EXTERNAL PROTECTIVE COATING TYPE:	Fusion Bonded Epoxy

Check for the following when assessing condition:

corrosion; camage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; leak; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	2	Minor wear and tear	
Pipe Joints including Isolation Gasket (where applicable)	2	Cracking around some fasteners on large flange underneath air valve	
Isolation Valve	2		
Fasteners (loose, missing, corroded)	2		
Ease of Operation	N/A	Valve not operated	
Spindle (including surface box)	2		
Gland and seals (where applicable)	2		
Pit Cover and Seat (where applicable)	N/A		
Internal Pit Structure (where applicable)	2	Minor cracks and chips	
Stairs, Ladders and Access Platforms (where applicable)	2	Minor corrosion on handrails	
Other (specify) - Anchor Points	N/A		

KBR

AIR VALVE
CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Marrickville Section
LOCATION:	MAAV1 - Tempe Reserve, Next to Cooks River
DIAMETER:	250mm
INSPECTED BY:	Mark Mordini
INSPECTION DATE:	17/05/2016
EXTERNAL PROTECTIVE COATING TYPE:	Fusion Bonded Epoxy

Check for the following when assessing condition:

corrosion; camage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; leak; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	2	Minor wear and tear, some debris and dirt on surface	
Pipe Joints including Isolation Gasket (where applicable)	3	Water pooling on bottom flange	
Isolation Valve	2		
Fasteners (loose, missing, corroded)	2	Most fasteners are wrapped	
Ease of Operation	N/A	Valve not operated	
Spindle (including surface box)			
Gland and seals (where applicable)			
Pit Cover and Seat (where applicable)	3	Frame surface corrosion approx 90% of surface area. Moderate wear and tear	
Internal Pit Structure (where applicable)	2	Minor cracks and chips	
Stairs, Ladders and Access Platforms (where applicable)	N/A		
Other (specify) - Anchor Points	4	Badly corroded lids esp. hinge and underside of lid. Pits are full of mud, dirt and water. Testing due Nov 2016 (Compliant)	


MAAV1A
ONE PERSON
15 kN

AIR VALVE
CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Marrickville Section
LOCATION:	MAAV3 - Alexandria Canal - CH585
DIAMETER:	250mm
INSPECTED BY:	Mark Mordini
INSPECTION DATE:	17/05/2016
EXTERNAL PROTECTIVE COATING TYPE:	Fusion Bonded Epoxy

Check for the following when assessing condition:

corrosion; camage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; leak; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	2		
Pipe Joints including Isolation Gasket (where applicable)	2		
Isolation Valve	2		
Fasteners (loose, missing, corroded)	2		
Ease of Operation	N/A		
Spindle (including surface box)	2		
Gland and seals (where applicable)	2		
Pit Cover and Seat (where applicable)	N/A		
Internal Pit Structure (where applicable)	N/A		
Stairs, Ladders and Access Platforms (where applicable)	N/A		
Other (specify) - Pressure Gauge	5	Pressure gauge has been stolen. Ball valve was left partially open, which resulted in leak onto pipe (white stain from residue)	

KBR

AIR VALVE
CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Marrickville Section
LOCATION:	MAAV3A - Alexandria Canal - CH980
DIAMETER:	250mm
INSPECTED BY:	Mark Mordini
INSPECTION DATE:	17/05/2016
EXTERNAL PROTECTIVE COATING TYPE:	Fusion Bonded Epoxy

Check for the following when assessing condition:

corrosion; camage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; leak; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	2	Minor cracking around top flange	12.52pm
Pipe Joints including Isolation Gasket (where applicable)	2	Wrapping is in tact	
Isolation Valve	2	No evidence of leaks	
Fasteners (loose, missing, corroded)	2	Most fasteners are wrapped	
Ease of Operation	N/A		
Spindle (including surface box)	2		
Gland and seals (where applicable)	2		
Pit Cover and Seat (where applicable)	N/A		
Internal Pit Structure (where applicable)	N/A		
Stairs, Ladders and Access Platforms (where applicable)	N/A		
Other (specify)	N/A		

KBR

AIR VALVE
CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Rockdale Section
LOCATION:	ROAV5 - Above SWOOS
DIAMETER:	250mm
INSPECTED BY:	Mark Mordini
INSPECTION DATE:	17/05/2016
EXTERNAL PROTECTIVE COATING TYPE:	Fusion Bonded Epoxy

Check for the following when assessing condition:

corrosion; camage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; leak; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	4	Moderate cracking around flange. ~50% coating failed on large flange on bottom	6-8, 15
Pipe Joints including Isolation Gasket (where applicable)	3		
Isolation Valve	2		14
Fasteners (loose, missing, corroded)	2	Caps on most bolts	13
Ease of Operation	N/A		
Spindle (including surface box)	2		
Gland and seals (where applicable)	3		
Pit Cover and Seat (where applicable)	N/A		
Internal Pit Structure (where applicable)	N/A		
Stairs, Ladders and Access Platforms (where applicable)	2	1 x loose fastener near bottom of stairs. Minor corrosion on some hand rails. Chain hooks badly corroded	1-5
Other (specify) - Gearbox	3	Corroded fasteners, and surface corrosion on handwheel shaft	9-10
Other (specify) - Pressure Gauge	4	Broken glass	12

AIR VALVE
CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Sydney North Section
LOCATION:	SNAV8 - Shaft 11C
DIAMETER:	250mm
INSPECTED BY:	Mark Mordini
INSPECTION DATE:	17/05/2016
EXTERNAL PROTECTIVE COATING TYPE:	Fusion Bonded Epoxy

Check for the following when assessing condition:

corrosion; camage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; leak; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	3	Some minor cracking on flange	
Pipe Joints including Isolation Gasket (where applicable)	3	Tape coming loose on flanges	
Isolation Valve	2		
Fasteners (loose, missing, corroded)	2		
Ease of Operation	N/A		
Spindle (including surface box)	2		
Gland and seals (where applicable)	2		
Pit Cover and Seat (where applicable)	N/A		
Internal Pit Structure (where applicable)	N/A		
Stairs, Ladders and Access Platforms (where applicable)	N/A	Refer to pipeline condition assessment sheet	
Other (specify)	N/A		

ABOVE GROUND PIPELINE - EXTERNAL INSPECTION
CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Kurnell Section
LOCATION:	KUSP0 - Kurnell Pump Station
DIAMETER:	1800mm
INSPECTED BY:	Mark Mordini
INSPECTION DATE:	18/05/2016
PIPE MATERIAL:	Mild Steel Cement Lined (MSCL)
EXTERNAL PROTECTIVE COATING TYPE:	

Check for the following when assessing condition:

corrosion; damage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; potholes (for roads/tracks); leaks; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	3	Cracking around some flange fasteners & top of large flange below air valve	11.15am
Pipe Joints (Welded)	N/A		
Expansion Joints	N/A		
Anchor Blocks	N/A		
Pipe Cradles / Footings / Rockers / Sliding Supports	N/A		
Fasteners (loose, missing, corroded)	2		
Drainage	2		
Pipeline Cutting / Embankment / Retaining Walls	N/A		
Access Roads / Tracks	N/A		
Armco Railing	N/A		
Fences, Gates and Padlocks	N/A		
Stairs, Ladders and Access Platforms	2		
Corrosion Protection Test Points	N/A		

Other (Specify)	N/A		

ABOVE GROUND PIPELINE - EXTERNAL INSPECTION CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Rockdale Section
LOCATION:	ROSP5 - SWOOS/M5 Crossover
DIAMETER:	1800mm
INSPECTED BY:	Mark Mordini & Joel Abbott
INSPECTION DATE:	17/05/2016
PIPE MATERIAL:	Mild Steel Cement Lined (MSCL)
EXTERNAL PROTECTIVE COATING TYPE:	Sintakote

Check for the following when assessing condition:

corrosion; damage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; potholes (for roads/tracks); leaks; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	2	Some bird spikes missing. Minor wear and tear. Graffiti. Acrylic paint used to cover graffiti is flaking	1,8,13-15
Pipe Joints (Welded)	N/A	No visibility under wrapping	
Expansion Joints	N/A		
Anchor Blocks	2	Minor chips and cracks, overgrown vegetation, graffiti	9,11,12, 16-18
Pipe Cradles / Footings / Rockers / Sliding Supports	2	Graffiti, minor wear and tear	19-23
Fasteners (loose, missing, corroded)	2	Minor corrosion	
Drainage	2	No signs of pooling near anchor blocks or pipe footings	
Pipeline Cutting / Embankment / Retaining Walls	N/A		
Access Roads / Tracks	3	Overgrown vegetation in parts, but access generally OK	
Armco Railing	N/A		
Fences, Gates and Padlocks	3	Minor corrosion, some damage	11
Stairs, Ladders and Access Platforms	2	Minor spot corrosion, some corroded fasteners and chain hooks	2-7
Corrosion Protection Test Points	2		

Other (Specify)	N/A		

ABOVE GROUND PIPELINE - EXTERNAL INSPECTION CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Marrickville Section
LOCATION:	MARP2 - Alexandria Canal from CH340 (start of above-ground section) to Expansion Joint # 2
DIAMETER:	1800mm
INSPECTED BY:	Mark Mordini & Joel Abbott
INSPECTION DATE:	17/05/2016
PIPE MATERIAL:	Mild Steel Cement Lined (MSCL)
EXTERNAL PROTECTIVE COATING TYPE:	Sintakote

Check for the following when assessing condition:

corrosion; damage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; potholes (for roads/tracks); leaks; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	2		
Pipe Joints (Welded)	N/A	No visibility under wrapping	
Expansion Joints	2	EJ1 - No leaks. 23mm remaining take-up in joint	
Anchor Blocks	2	Graffiti	
Pipe Cradles / Footings / Rockers / Sliding Supports	2		
Fasteners (loose, missing, corroded)	2	2 x short bolts found	
Drainage	2		
Pipeline Cutting / Embankment / Retaining Walls	2	Some overgrown vegetation in parts	
Access Roads / Tracks	2	Some overgrown vegetation in parts	
Armco Railing	N/A		
Fences, Gates and Padlocks	N/A		
Stairs, Ladders and Access Platforms	N/A		
Corrosion Protection Test Points	N/A		

Other (Specify)	N/A		

ABOVE GROUND PIPELINE - EXTERNAL INSPECTION
CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Marrickville Section
LOCATION:	MARP2 - Alexandria Canal from Expansion Joint # 2 to Expansion Joint # 3
DIAMETER:	1800mm
INSPECTED BY:	Mark Mordini & Joel Abbott
INSPECTION DATE:	17/05/2016
PIPE MATERIAL:	Mild Steel Cement Lined (MSCL)
EXTERNAL PROTECTIVE COATING TYPE:	Sintakote

Check for the following when assessing condition:

corrosion; damage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; potholes (for roads/tracks); leaks; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	2		1.13pm
Pipe Joints (Welded)	N/A	No visibility under wrapping	
Expansion Joints	2	Expansion Joint # 2 - No leaks. 26mm take-up remaining. Minor surface corrosion. Moderate corrosion on lifting lug on bottom of expansion joint	1.32pm
Anchor Blocks	N/A		
Pipe Cradles / Footings / Rockers / Sliding Supports	2		
Fasteners (loose, missing, corroded)	2	1 x short bolt	
Drainage	2		
Pipeline Cutting / Embankment / Retaining Walls	3	Some overgrown vegetation in parts	
Access Roads / Tracks	3	Good access on canal side	
Armco Railing	N/A		
Fences, Gates and Padlocks	N/A		
Stairs, Ladders and Access Platforms	N/A		
Corrosion Protection Test Points	N/A		

Other (Specify)	N/A		

ABOVE GROUND PIPELINE - EXTERNAL INSPECTION CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Marrickville Section
LOCATION:	MARP2 - Alexandria Canal from Expansion Joint # 3 to Expansion Joint # 4
DIAMETER:	1800mm
INSPECTED BY:	Mark Mordini & Joel Abbott
INSPECTION DATE:	17/05/2016
PIPE MATERIAL:	Mild Steel Cement Lined (MSCL)
EXTERNAL PROTECTIVE COATING TYPE:	Sintakote

Check for the following when assessing condition:

corrosion; damage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; potholes (for roads/tracks); leaks; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	2		
Pipe Joints (Welded)	N/A	No visibility under wrapping	
Expansion Joints	2	Expansion Joint # 3 - No leaks. 22mm take-up remaining. Minor surface corrosion	
Anchor Blocks	2	Minor chips and cracks	
Pipe Cradles / Footings / Rockers / Sliding Supports	2		
Fasteners (loose, missing, corroded)	2		
Drainage	2	Good - water drains into canal or stormwater drains. Drain is partially overgrown with vegetation	
Pipeline Cutting / Embankment / Retaining Walls	3	There is overgrown vegetation on embankment	
Access Roads / Tracks	3	Good access on canal side	
Armco Railing	N/A		
Fences, Gates and Padlocks	N/A		
Stairs, Ladders and Access Platforms	N/A		
Corrosion Protection Test Points	N/A		
Other (Specify)	N/A		

ABOVE GROUND PIPELINE - EXTERNAL INSPECTION
CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Marrickville Section
LOCATION:	MARP2 - Alexandria Canal from Expansion Joint # 4 to CH1140 (end of above-ground section)
DIAMETER:	1800mm
INSPECTED BY:	Mark Mordini & Joel Abbott
INSPECTION DATE:	17/05/2016
PIPE MATERIAL:	Mild Steel Cement Lined (MSCL)
EXTERNAL PROTECTIVE COATING TYPE:	Sintakote

Check for the following when assessing condition:

corrosion; damage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; potholes (for roads/tracks); leaks; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	2	Minor wear and tear. Several bird spikes missing	
Pipe Joints (Welded)	N/A	No visibility under wrapping	
Expansion Joints	2	EJ4 - No leaks. 26mm take-up remaining. Minor surface corrosion EJ5 - No leaks. 23mm take-up remaining. Minor surface corrosion	
Anchor Blocks	2	Minor chips and cracks	
Pipe Cradles / Footings / Rockers / Sliding Supports	2	Minor spot corrosion	12.43pm
Fasteners (loose, missing, corroded)	2		
Drainage	2	No obvious signs of pooling. Water drains into canal or stormwater drains	
Pipeline Cutting / Embankment / Retaining Walls	2		
Access Roads / Tracks	3	Good access on canal side. Overgrown vegetation on other side	
Armco Railing	N/A		
Fences, Gates and Padlocks	2	Not owned by SDP	
Stairs, Ladders and Access Platforms	N/A		
Corrosion Protection Test Points	2		

Other (Specify)			

ABOVE GROUND PIPELINE - EXTERNAL INSPECTION CONDITION ASSESSMENT FORM

PIPELINE:	SDP Delivery Pipeline - Sydney North Section
LOCATION:	SNP2 - Shaft 11C (Bridge St, Erskineville)
DIAMETER:	1800mm
INSPECTED BY:	Mark Mordini
INSPECTION DATE:	18/05/2016
PIPE MATERIAL:	Mild Steel Cement Lined (MSCL)
EXTERNAL PROTECTIVE COATING TYPE:	

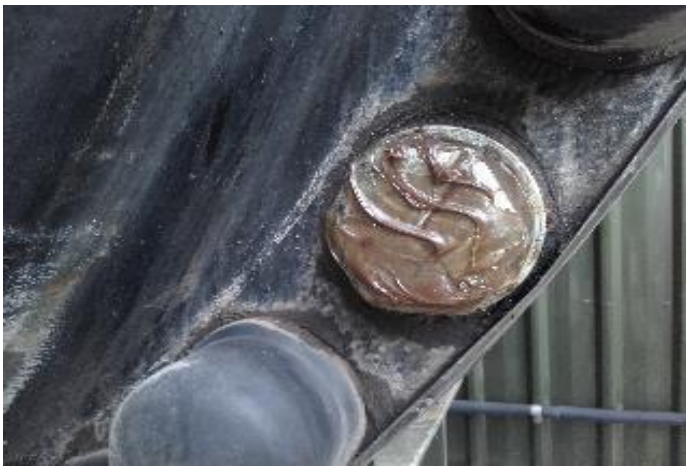
Check for the following when assessing condition:

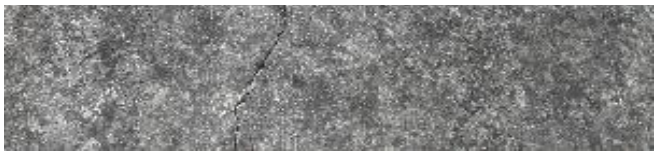
corrosion; damage; pitting (for protective coating); graffiti; vandalism; exposed steel (where applicable); cracking; spalling (for concrete); movement; missing/loose/corroded fasteners; erosion; blockage of drainage; overgrown vegetation; embankment slips; obstructions; potholes (for roads/tracks); leaks; dirt

Condition Rating: 1=As new, 2=Good, 3=Fair, 4=Poor, 5=Unserviceable

Item	Rating (1 - 5)	Comments	Photo #
External Protective Coating	4	Several locations around flanges where coating is bulging, cracking or drummy. Protective tape on flanges has several holes and is coming loose in several locations. There is a longitudinal crack in the concrete encasement of the pipe where it is coming from underground	12.30pm
Pipe Joints (Welded)	N/A		
Expansion Joints	2		
Anchor Blocks	N/A		
Pipe Cradles / Footings / Rockers / Sliding Supports	2	Minor corrosion on support footings	
Fasteners (loose, missing, corroded)	2		
Drainage	2		
Pipeline Cutting / Embankment / Retaining Walls	N/A		
Access Roads / Tracks	2		
Armco Railing	N/A		
Fences, Gates and Padlocks	2	Owned by Sydney Water	
Stairs, Ladders and Access Platforms	3	Several corroded fasteners. Some short bolts on base of stancheons. Some corrosion on handrails	
Corrosion Protection Test Points	2		
Other (Specify) - Flow Switch	3	Corrosion and cracking at weld to main pipe. Corrosion on metal holding plates	

Other (Specify) - Water Quality Monitoring Equiment	2		






GLI
Aqua 4
LOW RANGE
TURBIDIMETER
Thermo Fisher

Appendix E – Minutes from Workshop 18/5/16

KBR

PROJECT MEETING MINUTES

Client	Sydney Desalination Plant Pty Ltd	Meeting no.	1
Project	SDP Pipeline Asset Management Plan and Pipe Wrap Review	Date of meeting	18/5/16
Project no.	G459-1047-SEG604	Time meeting started	0915
Location	SDP Kurnell	Time meeting ended	1050
Recorded by	Mark Mordini		

Purpose of meeting

Discuss SDP Pipeline Asset Management Issues

Present at meeting

Name	Company
Gavin Ovens	Sydney Desalination Plant Pty Ltd
Rob Weidemier	Veolia
John Brown	KBR
Mark Mordini	KBR

Additional distribution

Chris Stainwright

Copies issued to

Signed Date

Item no.	Description of discussion	Agreed action by
1.	List of Stakeholders • Sydney Water (both as customer and land owner) • SACL • Councils - Sutherland, Rockdale, Marrickville, City of Sydney • Various land owners e.g. Caltex, Tempe Tyres, Kogarah Golf Club • Rail Corp • Developers • Public • EPA	For information
2.	Need to consider current and future development risks (e.g. West Connex). Address in report	3/6/16

Purpose of meeting

Discuss SDP Pipeline Asset Management Issues

Item no.	Description of discussion	Agreed action by
3.	Corrosion is the main asset management concern regarding the pipeline currently. Anodes being passivated at a faster rate than expected (expected life 20 years, currently $60K need replacing < 10 years). Need to investigate why this is occurring. Speak with CCE and get independent advice. Review original design.	3/6/16
4.	Impressed current system - no reported issues. Alarm connected to Sydney Water SOC. 6 monthly PM about to commence. What are the risks for the system? Address in the report.	3/6/16
5.	Pipe joint wrapping - heat shrink wrapping on several joints are reported to be losing adhesion to pipe. Investigate what are the current risks and medium to long term risks and investments. Review design specs. Address in report	3/6/16
6.	Epoxy coatings on several Air valve flanges are reported to need patch repairs.	For information
7.	Isolation joints. What is the design life? What are the flow-on effects from the anodes being passivated at a faster rate than expected? Address in report	3/6/16
8.	Maintenance of fences and gates are not the responsibility of SDP or Veolia	For information
9.	Review current asset management process/activities and maintenance program - reactive vs proactive. Is it appropriate and effective? How does it compare with other utilities? Address in report.	3/6/16
10.	Asset Management Plan must reflect the purpose of the pipeline - continuity, reliability and quality of water supply	3/6/16
11.	Vegetation clearing currently undertaken 6 monthly PM, and on an ad-hoc basis when required for non-routine works. No complaints from stakeholders. Drains located along canal section are not owned by SDP. It this frequency adequate? Address in report	3/6/16
12.	Graffiti - normally painted over approx. twice yearly. Only complaints are from SACL when visible to them.	For information
13.	Expansion Joints - what is an acceptable amount of leakage? There is definitely leakage from the pipe based on water meter data. Evidence of water leakage also from white residue (likely calcium deposits in water). What PMs should be done to monitor this?	
14.	Notification is required to access certain locations along the pipeline. SACL requires 2 weeks' notice. Permission also required to access sites where new developments are occurring.	For information
15.	Asset Management Plan must support operational issues e.g. start-up procedure and managing water quality. Where to dump water currently in pipe? Best option likely is to dump contents of whole pipe in sea, even if only a section of pipe is needed for dewatering. Scouring into Cooks River not the preferred option.	3/6/16
16.	Many Scour Valves are submerged in pits and are designed for this environment. They have CP. Address in report	3/6/16

Purpose of meeting

Discuss SDP Pipeline Asset Management Issues

Item no.	Description of discussion	Agreed action by
17.	Some Air Valves are submerged but are not designed for this and don't have CP. Address in report	3/6/16
18.	CTP's are not submerged but many are located in pits with a moist environment. Address in report	3/6/16
19.	Many in-ground anchor points have water/mud/debris which they are not designed for and some have failed load testing. New anchor points for Erko pit are a good design. Address in report	3/6/16
20.	Internal pipe inspection not currently undertaken. Review original maintenance requirements and other utilities. What is the best inspection frequency and method?	3/6/16
21.	Compare maintenance requirements specified by WDA with the Veolia Contract. Note that there are 3 separate contracts - 1 for the plant, 1 for the pump station and 1 for the pipeline. Compare current maintenance practice with other utilities	3/6/16
22.	Current "care and maintenance" mode means that only the bare basic maintenance tasks are currently performed	3/6/16
23.	External inspection of pipeline, along with exercising scour and air valves (and their isolators) is currently undertaken annually (usually November). Review current task lists and frequencies (as per Veolia Contract) and advise of any gaps or other recommendations (e.g. measure take-up gap for Expansion Joints)	3/6/16
24.	There is currently no scope available for coating repairs for either Sintakote or epoxy coatings. Investigate	3/6/16
25.	Section valves are not exercised as part of the PM program. Review if this is appropriate?	3/6/16
26.	There are no WHS issues relating to asset management that are not considered already covered by existing controls	For information
27.	Resourcing - most PMs and basic CMs are performed by Rob or Ivan. Veolia have various trades staff available at the SDP. Specialist sub-contractors are used for Corrosion Protection Systems (CCE), Fall Restraints (HSE), Graffiti removal and coating repairs. Annual inspection at some sites are done in conjunction with CCE for efficiency purposes (i.e. single use of traffic control)	For information
28.	Water Quality Instrumentation - sensors were removed once pipeline was off line (before start of Veolia Contract). Panel is still energised and is part of annual inspection. This appears sensible, but will be reviewed in the report	3/6/16
29.	Works Management Process - PMs are done as part of fixed price of Veolia contract, and are therefore pre-approved. All non-routine works need approval of SDP (Gavin). Then internal Veolia approval usually by Rob. Work orders are signed off as completed usually by the person who completes the work.	3/6/16

Purpose of meeting

Discuss SDP Pipeline Asset Management Issues

Item no.	Description of discussion	Agreed action by
30.	Reporting - a monthly report is provided by Veolia to SDP listing completed tasks, active jobs, identified issues. There are no KPIs in the report. The report covers all 3 contracts. Review AM reporting.	3/6/16
31.	What KPIs can be used to measure asset management/maintenance effectiveness?	3/6/16
32.	No condition data or other data is required to be collected as part of the fixed-price PMs. CCE reports contain data of voltages measured at CTPs. General observations and comments are recorded electronically on work orders. Review appropriateness of this.	3/6/16
33.	What is the expectation on the SDP at the end of the 100 year lease? Is the pipeline expected to be handed back in "as new" condition? Review agreement	3/6/16
34.	Compare design drawings with current asset register and advise of any data gaps. New assets associated with Erko pit not currently in the asset register. It is noted however that Veolia is content with the current asset segmentation.	3/6/16
35.	Spares - no spares supplied to Veolia by SWC even though it was specified in their contract. SWC provided funds for spares in lieu of this, but no spares have been purchased to date. Project to review what spares, if any, should be held. Recommendations on spares have been provided by Veolia. Review lead time for spares (e.g. seals are 2 week lead time, air valves are 6 month lead time)	3/6/16
36.	No requirement currently for SDP asset management to be compliant with ISO 55000	For Information

Appendix F – Detailed Opex Forecasts 2016-17 to 2021-22

2016-17 (Assume Care & Maintenance Mode) ****ALL FORECASTS ARE NON-BINDING AND EXCLUSIVE OF GST****

Description	Est Cost	Category	Notes
Operation & Maintenance Fixed Fee	$149,800	Opex	Based on Veolia O&M Agreement. Assume 3% indexation p.a.
Additional PM recommendations	$12,300	Opex	Based on Maintenance Gap Assessment
Graffiti Removal	$7,000	Opex	Based on historical maintenance costs
Internal Pipeline Inspection	$19,700	Opex	Based on Maintenance Gap Assessment
Miscellaneous Corrective Maintenance	$2,800	Opex	Based on historical maintenance costs
O&M Support for Development Works	$1,000	Opex	Based on historical maintenance costs but multiplied by 2 to account for increasing development e.g. WestConnex
Pipeline Corrective Maintenance (e.g. leaks, refilling)	$3,400	Opex	Based on historical maintenance costs
Vegetation Management	$3,000	Opex	Based on historical maintenance costs
Water Quality Sampling/Monitoring	$4,000	Opex	Based on historical maintenance costs - approx 6 monthly
Anchor Point Replacements	$2,200	Opex	Assume 7 x Anchor Points to be replaced, as identified from Veolia Reports
Pipe Joint Coating Renewal	$124,500	Opex	Assume 13 joint wrappings to be replaced
Technical Support for review of development works	$10,000	Opex	KBR estimate based on historical costs
Sacrificial Anode Replacements	$95,000	Opex	As already identified and quoted
TOTAL	**$434,700**		

2017-18 (Assume Care & Maintenance Mode) ****ALL FORECASTS ARE NON-BINDING AND EXCLUSIVE OF GST****

Description	Est Cost	Category	Notes
Operation & Maintenance Fixed Fee	$154,300	Opex	Based on Veolia O&M Agreement. Assume 3% indexation p.a.
Additional PM recommendations	$12,700	Opex	Based on Maintenance Gap Assessment
Graffiti Removal	$7,200	Opex	Based on historical maintenance costs
Internal Pipeline Inspection	$20,200	Opex	Based on Maintenance Gap Assessment
Miscellaneous Corrective Maintenance	$2,900	Opex	Based on historical maintenance costs
O&M Support for Development Works	$1,000	Opex	Based on historical maintenance costs but multiplied by 2 to account for increasing development e.g. WestConnex
Pipeline Corrective Maintenance (e.g. leaks, refilling)	$3,500	Opex	Based on historical maintenance costs
Vegetation Management	$3,100	Opex	Based on historical maintenance costs
Water Quality Sampling/Monitoring	$4,100	Opex	Based on historical maintenance costs - approx 6 monthly
Anchor Point Replacements	$300	Opex	Assume 1 x Anchor Point to be replaced
Pipe Joint Coating Renewal	$59,200	Opex	Assume 6 joint wrappings to be replaced
Technical Support for review of development works	$10,300	Opex	KBR estimate based on historical costs
Easement Management - Property Title Search	$20,600	Opex	Based on advise from SDP - assume 5 yearly
Sacrificial Anode Replacements	$24,700	Opex	Assume anodes to be replaced at 3 locations
Recommended preparation for Restart including trial purge	$267,800	Opex - Restart	Estimate only - Confidence level +-50%
TOTAL	**$591,900**		

2018-19 (Assume Restart - Normal Operation Mode) ****ALL FORECASTS ARE NON-BINDING AND EXCLUSIVE OF GST****

Description	Est Cost	Category	Notes
Operation & Maintenance Fixed Fee	$158,900	Opex	Based on Veolia O&M Agreement. 3% indexation p.a.
Additional PM recommendations	$13,100	Opex	Based on Maintenance Gap Assessment
Additional PMs for Operating Mode (e.g. instrument calibration, more frequent PMs)	$21,400	Opex	Based on Maintenance Gap Assessment
Graffiti Removal	$7,400	Opex	Based on historical maintenance costs
Internal Pipeline Inspection	$20,800	Opex	Based on Maintenance Gap Assessment
Miscellaneous Corrective Maintenance	$3,000	Opex	Based on historical maintenance costs
O&M Support for Development Works	$1,100	Opex	Based on historical maintenance costs but multiplied by 2 to account for increasing development e.g. WestConnex
Pipeline Corrective Maintenance (e.g. leaks, refilling)	$3,600	Opex	Based on historical maintenance costs
Vegetation Management	$3,200	Opex	Based on historical maintenance costs
Water Quality Sampling/Monitoring	$8,400	Opex	Increased monitoring - assume 3 monthly
Miscellaneous Restart Operating Costs (e.g. labour)	$318,300	Opex - Restart	Based on Estimate from Veolia
Purging of Pipeline	$15,900	Opex - Restart	At re-start. Source: SWC Ops and Maint Schedule, with allowance for inflation
Water Quality Sampling/Monitoring	$4,200	Opex - Restart	WQ monitoring prior to restart
Anchor Point Replacements	$300	Opex	Assume 1 x Anchor Point to be replaced
Pipe Joint Coating Renewal	$60,900	Opex	Assume 6 joint wrappings to be replaced
Purchase Critical Spares	$0	Opex	Based on KBR Recommendations and Veolia cost estimates
Technical Support for review of development works	$10,600	Opex	KBR estimate based on historical costs
WQ Instrument replacement	$15,900	Opex - Restart	At re-start. Source: SWC Ops and Maint Schedule, with allowance for inflation
Sacrificial Anode Replacements	$25,500	Opex	Assume anodes to be replaced at 3 locations
TOTAL	**$692,500**		

2019-20 (Assume Normal Operation Mode) ****ALL FORECASTS ARE NON-BINDING AND EXCLUSIVE OF GST****

Description	Est Cost	Category	Notes
Operation & Maintenance Fixed Fee	$163,700	Opex	Based on Veolia O&M Agreement. Assume 3% indexation p.a.
Additional PM recommendations	$13,500	Opex	Based on Maintenance Gap Assessment
Additional PMs for Operating Mode (e.g. instrument calibration, more frequent PMs)	$22,100	Opex	Based on Maintenance Gap Assessment
Graffiti Removal	$7,600	Opex	Based on historical maintenance costs
Internal Pipeline Inspection	$21,500	Opex	Based on Maintenance Gap Assessment
Miscellaneous Corrective Maintenance	$3,100	Opex	Based on historical maintenance costs
O&M Support for Development Works	$1,100	Opex	Based on historical maintenance costs but multiplied by 2 to account for increasing development e.g. WestConnex
Pipeline Corrective Maintenance (e.g. leaks, refilling)	$3,700	Opex	Based on historical maintenance costs
Vegetation Management	$3,300	Opex	Based on historical maintenance costs
Water Quality Sampling/Monitoring	$8,800	Opex	Increased monitoring - assume 3 monthly
Anchor Point Replacements	$300	Opex	Assume 1 x Anchor Point to be replaced
Pipe Joint Coating Renewal	$62,800	Opex	Assume 6 joint wrappings to be replaced
Technical Support for review of development works	$10,900	Opex	KBR estimate based on historical costs
Sacrificial Anode Replacements	$26,200	Opex	Assume anodes to be replaced at 3 locations
TOTAL	**$348,600**		

2020-21 (Assume Normal Operation Mode) ****ALL FORECASTS ARE NON-BINDING AND EXCLUSIVE OF GST****

Description	Est Cost	Category	Notes
Operation & Maintenance Fixed Fee	$168,600	Opex	Based on Veolia O&M Agreement. Assume 3% indexation p.a.
Additional PM recommendations	$13,900	Opex	Based on Maintenance Gap Assessment
Additional PMs for Operating Mode (e.g. instrument calibration, more frequent PMs)	$22,700	Opex	Based on Maintenance Gap Assessment
Graffiti Removal	$7,900	Opex	Based on historical maintenance costs
Internal Pipeline Inspection	$22,100	Opex	Based on Maintenance Gap Assessment
Miscellaneous Corrective Maintenance	$3,200	Opex	Based on historical maintenance costs
O&M Support for Development Works	$1,100	Opex	Based on historical maintenance costs but multiplied by 2 to account for increasing development e.g. WestConnex
Pipeline Corrective Maintenance (e.g. leaks, refilling)	$3,800	Opex	Based on historical maintenance costs
Vegetation Management	$3,400	Opex	Based on historical maintenance costs
Water Quality Sampling/Monitoring	$9,000	Opex	Increased monitoring - assume 3 monthly
Anchor Point Replacements	$400	Opex	Assume 1 x Anchor Point to be replaced
Pipe Joint Coating Renewal	$64,700	Opex	Assume 6 joint wrappings to be replaced
Technical Support for review of development works	$11,300	Opex	KBR estimate based on historical costs
WQ Instrument replacement	$3,000	Opex	2-yearly replacement during operation. Source: SWC Ops and Maint Schedule, with allowance for inflation
Sacrificial Anode Replacements	$27,000	Opex	Assume anodes to be replaced at 3 locations
TOTAL	**$362,100**		

2021-22 (Assume Normal Operation Mode) ****ALL FORECASTS ARE NON-BINDING AND EXCLUSIVE OF GST****

Description	Est Cost	Category	Notes
Operation & Maintenance Fixed Fee	$173,700	Opex	Based on Veolia O&M Agreement. Assume 3% indexation p.a.
Additional PM recommendations	$14,300	Opex	Based on Maintenance Gap Assessment
Additional PMs for Operating Mode (e.g. instrument calibration, more frequent PMs)	$23,400	Opex	Based on Maintenance Gap Assessment
Graffiti Removal	$8,100	Opex	Based on historical maintenance costs
Internal Pipeline Inspection	$22,800	Opex	Based on Maintenance Gap Assessment
Miscellaneous Corrective Maintenance	$3,200	Opex	Based on historical maintenance costs
O&M Support for Development Works	$1,200	Opex	Based on historical maintenance costs but multiplied by 2 to account for increasing development e.g. WestConnex
Pipeline Corrective Maintenance (e.g. leaks, refilling)	$3,900	Opex	Based on historical maintenance costs
Vegetation Management	$3,500	Opex	Based on historical maintenance costs
Water Quality Sampling/Monitoring	$9,200	Opex	Increased monitoring - assume 3 monthly
Anchor Point Replacements	$400	Opex	Assume 1 x Anchor Point to be replaced
Pipe Joint Coating Renewal	$66,600	Opex	Assume 6 joint wrappings to be replaced
Technical Support for review of development works	$11,600	Opex	KBR estimate based on historical costs
Sacrificial Anode Replacements	$27,800	Opex	Assume anodes to be replaced at 3 locations
TOTAL	**$369,700**		

Appendix G – Example Letter to Developers Regarding Building Over or Adjacent to SDP Pipeline

KBR

16-20 Beauchamp Road • Matraville NSW 2036 • PO Box 543 • Matraville NSW 2036 • Australia
Phone +61 2 9352 2465 • Fax +61 2 9352 2460

SEG509-C01-0003

10 June 2016

Tarun Malviya
M5 East Operations, Motorway Management
Roads and Maritime Services
Level 1, Suite C, 99 Phillip Street
Parramatta NSW 2150

Dear Tarun

Sydney Desalination Pipeline - As Built Documentation

Proposed Development Location: Cooks River Tunnel Access Track Arncliffe

In response to your proposed development Kellogg Brown & Root Pty Ltd (KBR) is responding on behalf of the Sydney Desalination Plant Pty Ltd (SDP) in concern to Desalination Plant assets located in this area. SDP owns and operates a critical water infrastructure pipeline within the vicinity of your proposed area of works. When you build adjacent or near to this pipeline SDP will not permit you to:

- Obstruct full and free access to the pipeline and other SDP assets
- Cause physical damage to SDP's assets
- Weaken SDP's assets leading to future damage

SDP will generally allow building adjacent to or close to its assets, subject to you satisfying SDP that you will do all the necessary temporary and permanent works required to protect its assets from damage. In demonstrating this to SDP you may be required to provide specialist engineering advice to support further assessment. Building over the pipeline is generally not permitted.

SDP may require you as the developer to reimburse SDP of its costs incurred as a result of your proposed development. SDP's costs may include monitoring of works, assessing impacts of the development, design and / or operating costs associated with the completion of the development works.

In reference to the proposed development at the Cooks River Tunnel Access Track Arncliffe.

The pipeline is in an easement generally 6 metres wide for those sections in tunnel and 8 metres wide for those sections in trench. The terms of the easement are available from SDP by request and restrict the use of the land while also providing SDP with unimpeded access.

Generally in this location the pipeline is a DN 1800 mm steel pipe. For the section of the pipeline within the alignment of the access track the pipe is constructed in trench. The pipe has limited to no cover and is concrete encased. Immediately to the north of the proposed access track the pipeline is constructed above ground.

Refer to attached as-built documentation for further information.

With regards to your development and any effects on SDP's assets, SDP is primarily concerned with impacts of the development on its assets, be it during construction or permanent works. SDP requires

an assessment of any loadings, settlement, construction activities and methods or changes to any other conditions that may impact the pipeline.

SDP will require the following;

- Dimensioned and to scale plan, long section and cross section drawings of your proposed works with the SDP assets clearly identified
- Details of earth works within the vicinity of SDP assets including depths to be excavated, compaction and construction methods
- An assessment supported by calculations, assumptions, modelling and other reference material identifying and assessing impacts on SDP assets completed and certified by appropriately experienced professional/s with industry recognition in their area/s of expertise addressing the following;
    - details and methodology of ground works, foundations, piling, anchors and similar
    - details and methodology of dewatering
    - details of any temporary or permanent loads that will be imposed on or adjacent to the pipeline
    - identify loads placed within the easement and within the zone of influence (including construction traffic, plant, cranes, stockpiles, fill, piles and anchors including method of installation, etc)
    - effects of vibration from the works
    - any changes to ground water
- A monitoring plan that outlines how you will monitor the impact of your building works on SDP's pipeline. The plan shall include but not be limited to:
    - identifying the location of the pipeline at all times for the duration of the works measures to be enacted to ensure the protection of the pipeline
    - method of ensuring all parties are made aware and recognise the location of the pipeline and that protection measures are implemented
    - process for warning thresholds to allow enough time to implement actions to avoid damage or failure of SDP assets and in some cases may include dilapidation surveys
    - provisions for inclusion of these requirements into your contract specification for relevant service providers. SDP and KBR request the opportunity to provide input into these specification provisions.
- A copy of the proposed construction program and key contacts so that SDP may inspect the works during construction
- SDP request access key be provided for its operations personnel to undertake its routine maintenance and monitoring at this location

Further details may be required once the above has been assessed.

In addition to this letter you will receive a transmittal with as-built drawings for this section of the pipeline.

KBR

These drawings and/or data ("materials') are provided by Sydney Desalination Plant Pty Ltd (SDP) and KBR to you for information purposes only and SDP and KBR do not accept any responsibility or liability whatsoever for or in respect of any use or reliance upon the Materials by you or any other party for any purpose. SDP and KBR makes no representation or warranty regarding the accuracy completeness currency or suitability of the Materials. Any party that uses or relies on the Materials does so entirely at its own risk. In accepting this Material from SDP and KBR, you accept the terms of this disclaimer and agree to release and indemnify SDP and KBR accordingly in respect of your or any other third party's use thereof.

In receiving these Materials you agree that these Materials remain the property of SDP and can only be used for the agreed purpose for which they have been provided.

For further enquires please contact the following;

John Brown Tel: 02 8284 2016 E: john.brown@kbr.com

Chris Stainwright Tel: 02 8284 2068 E: chris.stainwright@kbr.com

Appendix H – Water Quality Monitoring Reports - February 2015 and November 2015

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1503294**	Page	: 1 of 4
Client	: **VEOLIA WATER OPERATIONS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: ROBERT WEIDEMIER	Contact	: Shevan Mahamad
Address	: SYDNEY DESALINATION PLANT PO BOX 2891 TAREN POINT BC NSW 2229	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: robert.weidemier@veoliawater.com.au	E-mail	: shevan.mahamad@alsglobal.com
Telephone	: +61 02 9710 9700	Telephone	: +61 2 8784 8555
Facsimile	: ----	Facsimile	: +61 2 8784 8555
Project	: KUAV 0 ON 11-FEB-15 AT 9 30AM KUAV3 ON 11-FEB-15 AT 10 00AM	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 11-FEB-2015
Sampler	: ----	Issue Date	: 20-FEB-2015
Site	: ----		
		No. of samples received	: 2
Quote number	: SY/290/13 V7	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane
Sarah Axisa	Microbiologist	Sydney Microbiology
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ALS Sydney is not NATA accredited for CCPP, but holds accreditation for the analysis of conductivity, pH, calcium and alkalinity which the parameters used for CCPP calculation (Accreditation # 825);**
- **MW002 is ALS's internal code and is equivalent to AS4276.3.1.**
- **MW007 is ALS's internal code and is equivalent to AS4276.5.**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

			Client sample ID	KUAV 0 11-FEB-15 AT 9:30AM	KUAV 3 11-FEB-15 AT 10:00AM	----	----	----
			Client sampling date / time	11-FEB-2015 09:30	11-FEB-2015 10:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1503294-001	ES1503294-002	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**10.8**	**11.0**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**329**	**427**	----	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	**244**	**266**	----	----	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	<5	<5	----	----	----
EA072: Calcium Carbonate Precipitation Potential								
CCPP	----	0.1	--	**92.7**	**-1.2**	----	----	----
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**-2.4**	**-2.3**	----	----	----
pH Redox	----	0.01	pH Unit	**11.5**	**11.7**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	**46**	**68**	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**66**	**56**	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**112**	**124**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**68**	**72**	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	<1	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**2.00**	**1.76**	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.003**	**0.002**	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----
EG020T: Total Metals by ICP-MS								
Chromium	7440-47-3	0.001	mg/L	**0.003**	**0.003**	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG035T: Total Recoverable Mercury by FIMS								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Client sample ID: KUAV 0 11-FEB-15 AT 9:30AM	KUAV 3 11-FEB-15 AT 10:00AM	----	----	----
				Client sampling date / time: 11-FEB-2015 09:30	11-FEB-2015 10:00	----	----	----
				ES1503294-001	ES1503294-002	----	----	----
EG035T: Total Recoverable Mercury by FIMS - Continued								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG094T: Total metals in Fresh water by ORC-ICPMS								
Aluminium	7429-90-5	5	µg/L	**1790**	**1660**	----	----	----
Iron	7439-89-6	2	µg/L	**5**	<2	----	----	----
Antimony	7440-36-0	0.2	µg/L	<0.2	<0.2	----	----	----
Selenium	7782-49-2	0.2	µg/L	<0.2	**0.3**	----	----	----
Arsenic	7440-38-2	0.2	µg/L	**0.6**	**0.5**	----	----	----
Barium	7440-39-3	0.5	µg/L	**9.3**	**10.7**	----	----	----
Boron	7440-42-8	5	µg/L	**362**	**358**	----	----	----
Cadmium	7440-43-9	0.05	µg/L	<0.05	<0.05	----	----	----
Copper	7440-50-8	0.5	µg/L	<0.5	<0.5	----	----	----
Lead	7439-92-1	0.1	µg/L	<0.1	<0.1	----	----	----
Manganese	7439-96-5	0.5	µg/L	<0.5	<0.5	----	----	----
Molybdenum	7439-98-7	0.1	µg/L	**0.7**	**0.6**	----	----	----
Nickel	7440-02-0	0.5	µg/L	<0.5	<0.5	----	----	----
Silver	7440-22-4	0.1	µg/L	<0.1	<0.1	----	----	----
Strontium	7440-24-6	1	µg/L	**157**	**183**	----	----	----
Zinc	7440-66-6	1	µg/L	<1	<1	----	----	----
EK010/011: Chlorine								
Chlorine - Free	----	0.2	mg/L	<0.2	<0.2	----	----	----
Chlorine - Total Residual	----	0.2	mg/L	<0.2	<0.2	----	----	----
MW002: Heterotrophic Plate Count								
Heterotrophic Plate Count (36°C)	----	1	CFU/mL	<1	<1	----	----	----
MW007: Coliforms by MF								
Coliforms	----	1	CFU/100mL	<1	<1	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **ES1503301**	Page	: 1 of 3
Client	: **VEOLIA WATER OPERATIONS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: ROBERT WEIDEMIER	Contact	: Shevan Mahamad
Address	: SYDNEY DESALINATION PLANT PO BOX 2891 TAREN POINT BC NSW 2229	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: robert.weidemier@veoliawater.com.au	E-mail	: shevan.mahamad@alsglobal.com
Telephone	: +61 02 9710 9700	Telephone	: +61 2 8784 8555
Facsimile	: ----	Facsimile	: +61 2 8784 8555
Project	: KUAV 0 ON 11-FEB-15 AT 9 30AM KUAV3 ON 11-FEB-15 AT 10 00AM	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 66045		
C-O-C number	: ----	Date Samples Received	: 11-FEB-2015
Sampler	: ----	Issue Date	: 06-MAR-2015
Site	: ----		
		No. of samples received	: 2
Quote number	: SY/290/13 V7	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Uma Nagendiram	Inorganic Chemist	WRG Subcontracting

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **MM664.Holding time was not met. Therefore result may be indicative.**
- **SRB (MM654) is conducted by ALS Scoresby NATA accreditation no. 992, site no. 989. NATA accreditation does not cover performance of this method.**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**KUAV 0 11-FEB-15 AT 9:30AM**	**KUAV 3 11-FEB-15 AT 10:00AM**	----	----	----
			Client sampling date / time	11-FEB-2015 09:30	11-FEB-2015 10:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1503301-001**	**ES1503301-002**	**----**	**----**	**----**
MM654: Sulphate Reducing Bacteria by MPN								
Sulphate Reducing Bacteria	----	3	orgs/mL	<3	<3	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **ES1503453**	Page	: 1 of 4
Client	: **VEOLIA WATER OPERATIONS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR ROBERT WEIDEMIER	Contact	: Client Services
Address	: SYDNEY DESALINATION PLANT PO BOX 2891 TAREN POINT BC NSW 2229	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: robert.weidemier@veolia.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9710 9700	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: MAAV 3 ON THE 12 FEB 2015 AT 12PM & SNAV 7 ON THE 12 FEB 2015 ATY 1130AM	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 12-FEB-2015
Sampler	: ----	Issue Date	: 23-FEB-2015
Site	: ----		
		No. of samples received	: 2
Quote number	: BN/197/13	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane
Sarah Axisa	Microbiologist	Sydney Microbiology
Shobhna Chandra	Metals Coordinator	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ALS Sydney is not NATA accredited for CCPP, but holds accreditation for the analysis of conductivity, pH, calcium and alkalinity which the parameters used for CCPP calculation (Accreditation # 825);**
- **MW002 is ALS's internal code and is equivalent to AS4276.3.1.**
- **MW007 is ALS's internal code and is equivalent to AS4276.5.**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Client sample ID: MAAV 3 12-FEB-15 AT 12:00PM	SNAV 7 12-FEB-15 AT 11:30AM	----	----	----
			Client sampling date / time:	12-FEB-2015 12:00	12-FEB-2015 11:30	----	----	----
				ES1503453-001	ES1503453-002	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**10.9**	**9.91**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**422**	**208**	----	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	**245**	**121**	----	----	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	<5	<5	----	----	----
EA072: Calcium Carbonate Precipitation Potential								
CCPP	----	0.1	--	**43.3**	**35.2**	----	----	----
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**22.5**	**187**	----	----	----
pH Redox	----	0.01	pH Unit	**11.5**	**10.5**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	**60**	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**59**	**53**	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	**5**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**119**	**58**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**74**	**18**	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	**2**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**2.00**	**0.04**	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.004**	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----
EG020T: Total Metals by ICP-MS								
Chromium	7440-47-3	0.001	mg/L	**0.004**	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG035T: Total Recoverable Mercury by FIMS								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Client sample ID: MAAV 3 12-FEB-15 AT 12:00PM	Client sample ID: SNAV 7 12-FEB-15 AT 11:30AM	----	----	----
				Client sampling date / time: 12-FEB-2015 12:00	12-FEB-2015 11:30	----	----	----
				ES1503453-001	ES1503453-002	----	----	----
EG035T: Total Recoverable Mercury by FIMS - Continued								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG094T: Total metals in Fresh water by ORC-ICPMS								
Aluminium	7429-90-5	5	µg/L	**1900**	**33**	----	----	----
Iron	7439-89-6	2	µg/L	**2**	**4**	----	----	----
Antimony	7440-36-0	0.2	µg/L	**0.4**	<0.2	----	----	----
Selenium	7782-49-2	0.2	µg/L	**0.3**	**0.3**	----	----	----
Arsenic	7440-38-2	0.2	µg/L	**0.6**	**0.2**	----	----	----
Barium	7440-39-3	0.5	µg/L	**9.6**	**9.3**	----	----	----
Boron	7440-42-8	5	µg/L	**362**	**60**	----	----	----
Cadmium	7440-43-9	0.05	µg/L	<0.05	<0.05	----	----	----
Copper	7440-50-8	0.5	µg/L	<0.5	**1.2**	----	----	----
Lead	7439-92-1	0.1	µg/L	<0.1	**0.4**	----	----	----
Manganese	7439-96-5	0.5	µg/L	<0.5	**0.9**	----	----	----
Molybdenum	7439-98-7	0.1	µg/L	**1.2**	**0.4**	----	----	----
Nickel	7440-02-0	0.5	µg/L	<0.5	<0.5	----	----	----
Silver	7440-22-4	0.1	µg/L	<0.1	<0.1	----	----	----
Strontium	7440-24-6	1	µg/L	**180**	**71**	----	----	----
Zinc	7440-66-6	1	µg/L	**1**	**3**	----	----	----
EK010/011: Chlorine								
Chlorine - Free	----	0.2	mg/L	<0.2	<0.2	----	----	----
Chlorine - Total Residual	----	0.2	mg/L	<0.2	**0.3**	----	----	----
MW002: Heterotrophic Plate Count								
Heterotrophic Plate Count (36°C)	----	1	CFU/mL	<1	<1	----	----	----
MW007: Coliforms by MF								
Coliforms	----	1	CFU/100mL	<1	<1	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **ES1503471**	Page	: 1 of 3
Client	: **VEOLIA WATER OPERATIONS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR ROBERT WEIDEMIER	Contact	: Client Services
Address	: SYDNEY DESALINATION PLANT PO BOX 2891 TAREN POINT BC NSW 2229	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: robert.weidemier@veolia.com	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9710 9700	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: MAAV 3 ON THE 12 FEB 2015 AT 12PM & SNAV 7 ON THE 12 FEB 2015 ATY 1130AM	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 66045		
C-O-C number	: ----	Date Samples Received	: 12-FEB-2015
Sampler	: ----	Issue Date	: 06-MAR-2015
Site	: ----		
		No. of samples received	: 2
Quote number	: BN/197/13	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Uma Nagendiram	Inorganic Chemist	WRG Subcontracting

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

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Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ALS Sydney is not NATA accredited for CCPP, but holds accreditation for the analysis of conductivity, pH, calcium and alkalinity which the parameters used for CCPP calculation (Accreditation # 825);**
- **MW002 is ALS's internal code and is equivalent to AS4276.3.1.**
- **MW007 is ALS's internal code and is equivalent to AS4276.5.**
- **SRB (MM654) is conducted by ALS Scoresby NATA accreditation no. 992, site no. 989. NATA accreditation does not cover performance of this method.**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**MAAV 3 12-FEB-15 AT 12:00PM**	**SNAV 7 12-FEB-15 AT 11:30AM**	----	----	----
			Client sampling date / time	12-FEB-2015 12:00	12-FEB-2015 11:30	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1503471-001**	**ES1503471-002**	**----**	**----**	**----**
MM654: Sulphate Reducing Bacteria by MPN								
Sulphate Reducing Bacteria	----	3	orgs/mL	<3	<3	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **ES1535531**	Page	: 1 of 4
Client	: **VEOLIA WATER OPERATIONS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: ALL COAS	Contact	: Angelene Kumar
Address	: SYDNEY DESALINATION PLANT PO BOX 2891 TAREN POINT BC NSW 2229	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: alscoa@veoliawater.com.au	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 9710 9700	Telephone	: +61 2 8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: KUAV 0 5-NOV-15 AT 1:15 PM, KUAV3 5-NOV-15 AT 12:45PM MAAV3 5-NOVE-15 11:45 AM	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: PIPELINE	Date Samples Received	: 05-Nov-2015 19:45
C-O-C number	: ----	Date Analysis Commenced	: 05-Nov-2015
Sampler	: ----	Issue Date	: 13-Nov-2015 16:22
Site	: ----		
		No. of samples received	: 3
Quote number	: ----	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Raymond Commodore	Instrument Chemist	Sydney Inorganics
Sarah Axisa	Microbiologist	Sydney Microbiology

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- ALS Sydney is not NATA accredited for CCPP, but holds accreditation for the analysis of conductivity, pH, calcium and alkalinity which the parameters used for CCPP calculation (Accreditation # 825);
- MW002 is ALS's internal code and is equivalent to AS4276.3.1.
- MW007 is ALS's internal code and is equivalent to AS4276.5.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KUAV 0	KUAV 3	MAAV3	----	----
			Client sampling date / time	05-Nov-2015 13:15	05-Nov-2015 12:45	05-Nov-2015 11:45	----	----
Compound	CAS Number	LOR	Unit	ES1535531-001	ES1535531-002	ES1535531-003	--------	--------
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**11.1**	**11.2**	**11.2**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**414**	**527**	**546**	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	----	----	**237**	----	----
Total Dissolved Solids @180°C	----	10	mg/L	**268**	**275**	----	----	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	----	----
EA072: Calcium Carbonate Precipitation Potential								
CCPP	----	0.1	--	**97.3**	**105.7**	**102.5**	----	----
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**32.2**	**33.1**	**33.8**	----	----
pH Redox	----	0.01	pH Unit	**11.6**	**11.8**	**11.8**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	**70**	**87**	**90**	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**73**	**77**	**72**	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	<1	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**143**	**165**	**162**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**63**	**78**	**72**	----	----
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**1.51**	**1.93**	**1.86**	----	----
Chromium	7440-47-3	0.001	mg/L	**0.002**	**0.003**	**0.004**	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	----	----
EG020T: Total Metals by ICP-MS								
Chromium	7440-47-3	0.001	mg/L	**0.003**	**0.003**	**0.005**	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KUAV 0	KUAV 3	MAAV3	----	----
			Client sampling date / time	05-Nov-2015 13:15	05-Nov-2015 12:45	05-Nov-2015 11:45	----	----
Compound	CAS Number	LOR	Unit	ES1535531-001	ES1535531-002	ES1535531-003	--------	--------
				Result	Result	Result	Result	Result
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG094T: Total metals in Fresh water by ORC-ICPMS								
Aluminium	7429-90-5	5	µg/L	**1700**	**1890**	**2070**	----	----
Antimony	7440-36-0	0.2	µg/L	**0.2**	<0.2	**0.4**	----	----
Arsenic	7440-38-2	0.2	µg/L	**0.5**	**0.5**	**0.5**	----	----
Barium	7440-39-3	0.5	µg/L	**10.8**	**11.1**	**11.3**	----	----
Boron	7440-42-8	5	µg/L	**322**	**357**	**372**	----	----
Cadmium	7440-43-9	0.05	µg/L	<0.05	<0.05	<0.05	----	----
Copper	7440-50-8	0.5	µg/L	**0.8**	**0.5**	**0.9**	----	----
Iron	7439-89-6	2	µg/L	**4**	**3**	**8**	----	----
Lead	7439-92-1	0.1	µg/L	<0.1	<0.1	<0.1	----	----
Manganese	7439-96-5	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Molybdenum	7439-98-7	0.1	µg/L	**0.6**	**0.5**	**1.0**	----	----
Selenium	7782-49-2	0.2	µg/L	<0.2	<0.2	<0.2	----	----
Nickel	7440-02-0	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Silver	7440-22-4	0.1	µg/L	<0.1	<0.1	<0.1	----	----
Strontium	7440-24-6	1	µg/L	**177**	**206**	**182**	----	----
Zinc	7440-66-6	1	µg/L	<1	<1	<1	----	----
EK010/011: Chlorine								
Chlorine - Free	----	0.2	mg/L	<0.2	<0.2	<0.2	----	----
Chlorine - Total Residual	----	0.2	mg/L	<0.2	<0.2	<0.2	----	----
MW002: Heterotrophic Plate Count								
Heterotrophic Plate Count (36°C)	----	1	CFU/mL	<1	<1	<1	----	----
MW007: Coliforms by MF								
Coliforms	----	1	CFU/100mL	<1	<1	<1	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **ES1535532**	Page	: 1 of 2
Client	: **VEOLIA WATER OPERATIONS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: ALL COAS	Contact	: Angelene Kumar
Address	: SYDNEY DESALINATION PLANT PO BOX 2891 TAREN POINT BC NSW 2229	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: alscoa@veoliawater.com.au	E-mail	: angelene.kumar@alsglobal.com
Telephone	: +61 02 9710 9700	Telephone	: +61 2 8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: KUAV 0 5-NOV-15 AT 1:15 PM, KUAV3 5-NOV-15 AT 12:45PM MAAV3 5-NOVE-15 11:45 AM	QC Level	: NEPM 2013 B3 & ALS QC Standard
Order number	: PIPELINE	Date Samples Received	: 05-Nov-2015 19:45
C-O-C number	: ----	Date Analysis Commenced	: 10-Nov-2015
Sampler	: ----	Issue Date	: 25-Nov-2015 09:29
Site	: ----		
		No. of samples received	: 3
Quote number	: ----	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Tony DeSouza	Senior Microbiologist	WRG Subcontracting

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- HTEX Holding time was not met. Therefore result may be indicative.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**KUAV 0**	**KUAV 3**	**MAAV3**	**----**	**----**
			Client sampling date / time	05-Nov-2015 13:15	05-Nov-2015 12:45	05-Nov-2015 11:45	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1535532-001**	**ES1535532-002**	**ES1535532-003**	**--------**	**--------**
				Result	Result	Result	Result	Result
MM669 : Sulphate Reducing Bacteria								
Sulphate Reducing Bacteria Population Estimate	----	20	pac/mL	<20 HTEX	<20 HTEX	<20 HTEX	**----**	**----**
Aggressivity	----	1	-	**Not aggressive HTEX**	**Not aggressive HTEX**	**Not aggressive HTEX**	**----**	**----**