Sydney Metro North West

Design and Construction of Surface and Viaduct Civil Works

Construction Soil & Water Management Plan

NWRLSVC-ISJ-SVC-PM-PLN-120203

Revision 9.0

5 June 2017

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Document Revision History

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7.0	Updated to address Soil & Water Management Plan – Implementation audit actions and update of Water Quality Monitoring Program	D. Wonson	S. Fermio	I Stuart	23-Jun-2016
8.0	General Update	J. Burgin	B Tucker	G. Perdikaris	28 Feb 2017
9.0	Update in response to TfNSW comments	J. Burgin	B Tucker	G. Perdikaris	5 June 2017
Signature					

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ACRONYMS & GLOSSARY

ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BMS	Impregilo S.p.A. (Australia) – Business Management System
CEMF	Construction Environmental Management Framework (Submissions Report, Section 3)
CEMP	Construction Environmental Management Plan
COA	Conditions of Approval
DP&E	Department of Planning and Environment
EIS	Environmental Impact Statement
EC	Electrical Conductivity
EM	Environment Manager (ISJV)
Emission	A discharge of a substance (e.g. dust) into the environment
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ER	Independent Environmental Representative
ESCs	Erosion and Sediment Controls
ESCP	Erosion and Sediment Control Plan
IC	Independent Certifier
Incident	Any unplanned or undesired event which results in or has potential to result in injury, ill health, damage, to or loss of property, interruption to operations or environmental impairment. An incident also includes a near miss, breach of procedure, quality failure, injuries to employees, contractors or members of the public and any other statutorily reportable occurrence. Incidents specific to this Plan are further described in section 10.
ISJV	Impregilo S.p.A. (Australia) and Salini (Australia) Joint Venture / Principal Contractor
Mitigation Measures	Measures employed to reduce (mitigate) an impact
NOW	NSW Office of Water, Department of Primary Industries
OEH	Office of Environment and Heritage
PESCP	Progressive Erosion and Sediment Control Plan
PIRMP	Pollution Incident Response Management Plan
POEO Act	Protection of the Environment Operations Act 1997
Pollution	The alteration of air, soil, or water as a result of human activities such that it is less suitable for any purpose for which it could be used in its natural state
REMM	Revised Environmental Mitigation Measures (Submissions Report, Section 7)
SMNW	Sydney Metro North West
SSI	State Significant Infrastructure
SVC Works	Surface Viaducts and Civil Works, for the North West Rail Link Project
SWTC	Scope of Work and Technical Criteria
TfNSW	Transport for New South Wales

INTRODUCTION

The SMNW project is a key priority for the NSW Government. The SMNW will deliver a new high frequency single deck train system initially operating as a shuttle between Cudgegong Road and Chatswood. The project includes eight new stations, approximately 15.5km of tunnels from Epping to Bella Vista, an elevated 'skytrain' (viaduct) between Bella Vista and Rouse Hill, and conversion of the Epping to Chatswood Rail Link to deliver high frequency rapid transit services.

Stations are planned at Cherrybrook, Castle Hill, Showground, Norwest, Bella Vista, Kellyville, Rouse Hill and Cudgegong Road. Bus, pedestrian, cycling and easy access facilities will be provided at all stations, with approximately 4000 'Park and Ride' spaces spread across five sites.

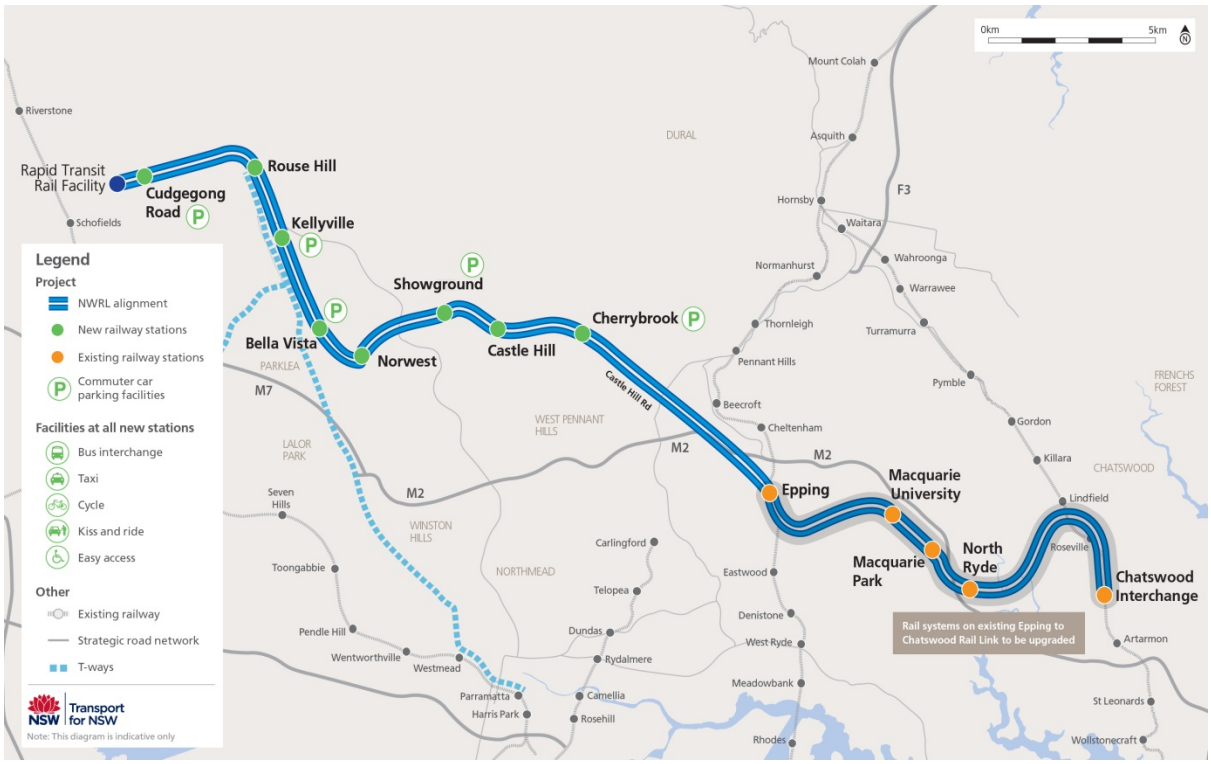


Figure 1: The North West Rail Link service proposed alignment

The scope of the SVC Project works consists of the detailed design, construction and handover of the viaducts, bridges and associated civil works required for the NWRL between Bella Vista and Cudgegong Road and includes establishment and reinstatement of worksites, spoil removal and disposal and all required utility relocations and adjustments at construction worksites.

The 6.3 km length of permanent infrastructure to be delivered includes:

- Approximately 4.5 km of viaduct between Balmoral Road and Rouse Hill Station including crossings over Memorial Avenue, Samantha Riley Drive, Windsor Road, Sanctuary Drive and White Hart Drive
- Bulk earthworks requirements including all cut, fill and embankments between Balmoral Road and Cudgegong Road
- A bridge over Windsor Road / Rouse Hill

- A bridge over Second Ponds Creek
- Allowance for station structures to be incorporated onto the viaduct at the Kellyville and Rouse Hill station sites
- Adjustments to existing infrastructure and roads within the construction site and / or otherwise affected by ISJV activities
- Safe, secure personnel access / egress into site areas including necessary temporary support services and site facilities, with hoardings, fencing and so on around worksites to be left in place upon completion
- Construction traffic and transport management including temporary and permanent traffic management works
- Removal of all temporary work and site facilities not otherwise required for handover to subsequent contractors.

Activities associated with the temporary and SVC Contractor works required in order to complete construction include:

- Safe, secure personnel access / egress into site areas including necessary temporary support services and site facilities, with hoardings, fencing and the like around work sites to be left in place upon completion
- Construction traffic and transport management including temporary and permanent traffic management works
- Removal of all temporary work and site facilities not otherwise required for handover to subsequent contractors.
- Construction of temporary T-way car parking at Rouse Hill and Kellyville
- Construction, removal and transportation of the gantry along the SVC construction zone
- Temporary changes to site personnel access/egress
- Signage, fencing and hoarding
- Construction environmental management activities
- Construction traffic management activities
- Interface and communications within SVC Contractor team and across NWRL team
- Stakeholder liaison activities
- Adherence to NWRL protocols and procedures.

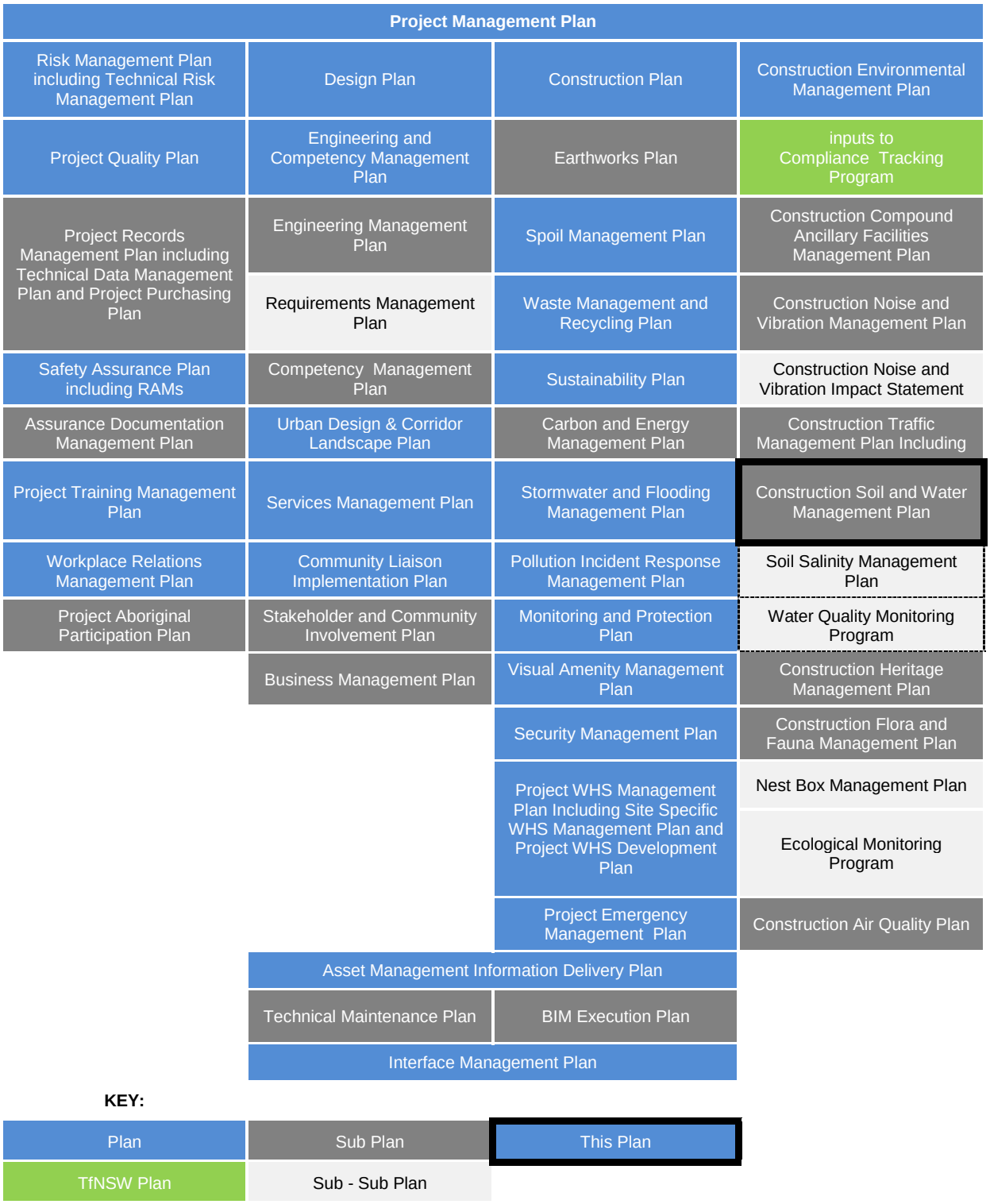
1 GOALS, OUTCOMES, KEY ISSUES

Scope	This Construction Soil & Water Management Plan has been prepared to manage surface and groundwater impacts during construction of the Surface Viaducts and Civil (SVC) Works component of the North West Rail Link. The scope of this Plan includes construction sites along the 6.3 km above ground section of the route from Bella Vista to Rouse Hill, which is a combination of viaduct, embankment, at grade and cutting. This plan is based on identified environmental aspects and impacts to soil and water quality from construction activities in each of the SVC construction sites, and identified guidelines and standards to be achieved. This plan forms part of the Impregilo S.p.A. (Australia) and Salini (Australia) Joint Venture (ISJV) Business Management System and should be read in conjunction with plans shown below in Figure 2.
Goals	Soil & Water (CEMF Section 15.1): • Prevent pollution of surface water through appropriate erosion and sediment control. • Maintain existing water quality of surrounding surface watercourses. • Source construction water from non-potable sources, where feasible and reasonable. Ground Water (CEMF Section 7): • Reduce potential for drawdown of surrounding groundwater resources • Prevent pollution of groundwater through appropriate controls • Reduce potential impacts on groundwater dependent ecosystems.
Intended Outcomes	• Erosion and sediment controls are to be effective and properly maintained at all times. • Compliance with the MCoA • Achieve water quality statutory requirements of the Environment Protection Licence related to the project.
Key Issues and Sensitive Areas	Key issues relating to surface and ground water are: **Flooding** A number of sites for the SVC works lie within flood affected areas, and as such are at risk from flood effects. CoA conditions require consideration of flood effects on the work site and the impact of the proposed works, temporary, permanent and any relevant compensatory works, on existing flood characteristics. This condition is separately addressed in the *Stormwater and Flooding Management Plan*. **Erosion and Sediment Control** Works within the 6.3 km route vary in nature and scale given the proposed route is within a viaduct, on an embankment, at grade or within a cutting. Sedimentation impacts could result from earthworks such as material stockpiles and piling works, silt and dust on site, unstable haul roads, embankment construction and vehicular mud tracking. Erosion and sedimentation could also result from works at or near water bodies and creeks. Erosion and sediment control plans will be prepared to consider the varying environments and scenarios in which the works take place. Appendix 6 contains the *Primary Erosion and Sediment Control Plan* (ESCP), which provides the framework to manage risks from erosion and sediment during the works. The Plan is consistent with the requirements of CoA conditions, and the guideline Managing Urban Stormwater – Soils and

	Construction Volumes 1 and 2 4th Edition (Landcom, 2004 and DECC, 2008). The Primary Erosion and Sediment Control Plan (sets the basis for Progressive Erosion and Sediment Control Plan (PESCP) which are prepared on a site by site basis. **Soil Salinity** The CoA conditions require a *Soil Salinity Report* detailing the outcomes of geotechnical monitoring, to determine the presence, extent and severity of soil salinity within the construction areas, and impacts on groundwater resources and hydrology. The recommendations of the report will be incorporated into this Plan when it is completed prior to the commencement of bulk earthmoving activities (activities > 300mm below soil-surface). **Water Quality Monitoring Program** The CoA conditions require a *Water Quality Monitoring Program* be prepared and implemented to monitor impacts on surface and groundwater quality resources and wetlands. The Water Quality Monitoring Program is contained in Appendix 1 to this plan, prepared in consultation with the EPA, DPI (Fisheries) and NOW (NSW Office of Water, Department of Primary Industries). The Water Quality Monitoring Program includes both ground water and surface water monitoring, including groundwater monitoring locations that have been established by TfNSW. **Groundwater Management Plan** Section 7.2 of the *Construction Environmental Management Framework* (CEMF) requires a Groundwater Management Plan. The required content of the Groundwater Management Plan has been incorporated into this CSWMP. **Dewatering Work Instruction** Section 15.2 of the CEMF requires that no water be discharged without written approval of the Environmental Manager (or their delegate), and is a Hold Point. The Dewatering Work Instruction will be used to fulfil that requirement, and is referenced in Section 9. **Use of Water on Site** The CEMP objectives re water resources are to minimise demand for, and use of potable water; and to maximise opportunities for water re-use from captured stormwater, wastewater and groundwater. A water balance, along with measures to minimise water demand, and maximise water reuse, are included in Appendix 3. **Acid Sulfate Soils** If PASS is encountered during excavation works, the Acid Sulfate Soils Contingency Plan attached in Appendix 4 would be followed. **Contaminated Soils** If suspected contaminated materials, other than asbestos, are encountered during excavation or demolition works, follow Section 4.4.7 of the *Contaminated Land Management System Procedure* (MSF22X) attached in Appendix 5. For suspected asbestos contaminated materials follow the safety *Contaminated Materials Risk Management Procedure* (MSP22C). **Sensitive Areas** Sensitive areas along the length of the SVC works are contained in Sensitive Area Maps and included in Work Procedures and Progressive Erosion and Sediment Control Plans to be developed as works progress. Note that other constraints might trigger an area being considered as “sensitive” (e.g. contaminated lands, or the presence of high groundwater tables).
Statutory Requirements	*Protection of the Environment Operations Act 1997 (NSW) (POEO Act)* • Section 120 of the Act provides that it is illegal to pollute or cause or permit pollution of waters. • Under the Act, ‘Water Pollution’ includes introducing litter, sediment, oil, grease, wash water and debris into waters or placing such material where

	it is likely to be washed or blown into waters or the stormwater system or percolate into groundwater. *Protection of the Environment Operations (General) Regulation 2009* • The Regulation contains provisions relating to environment protection licences, the issuing of penalty notices under the Act and certain related environmental legislation, the appropriate regulatory authority for certain type of activities, and notification of pollution incidents. Other applicable legislation are the *Water Act 1912, Water Management Act 2000* and *Contaminated Land Management Act 1997.*
Relationship to Other Plans	• Stormwater and Flooding Management Plan. • Water Quality Monitoring Program (Appendix 1). • Soil Salinity Report. • Spoil Management Plan. • Construction Compound & Ancillary Facilities Management Plan. • Earthworks Plan. • Project Emergency Management Plan All environment-related plans are shown in Figure 2 below.
Environmental Aspects & Impacts	Refer to environmental aspects and impacts identified in the CEMP, Appendix 5.
Licence & Permit Requirements	The requirements of EPL 20454 for SVC works has been included in Section 5 of this plan. These requirements will be updated with each relevant licence variation issued by EPA. I

Figure 2: Environment Document Structure



2 COA REQUIREMENTS

2.1 Major Civil Construction Works – North West Rail Link (SSI-5100)

No.	Ref.	Relevant Requirement	Reference
1.	C6	Except as may be provided by an EPL, the SSI shall be constructed and operated to comply with section 120 of the Protection of the Environment Operations Act 1997, which prohibits the pollution of waters.	As per measures in Section 6
2.	C9	A **Soil Salinity Report** detailing the outcomes of geotechnical investigations and groundwater monitoring, to determine the presence, extent and severity of soil salinity within the SSI area and impacts to groundwater resources and hydrology, shall be prepared and submitted to the Director General prior to the commencement of bulk earth activities, or as otherwise agreed by the Director General. The report shall be prepared in consultation with OEH (Office of Environment and Heritage) and NOW and detail, where relevant, that the SSI minimises, avoids and/or mitigates impacts on local/regional salinity processes, impacts on groundwater systems, and receiving environments. The recommendations of the Soil Salinity Report shall be incorporated into the Construction Soil and Water Quality Management Plan (condition E46(d)).	Recommendations of Soil Salinity Report included in Section 6
3.	C12	The Proponent shall design and construct the SSI, as far as is feasible and reasonable, in a manner that minimises impacts to groundwater hydrology including capture, drawdown and quality.	Section 6, SW42 to SW45
4.	C15	The following documents shall be submitted to the Director General, within the identified timeframes, unless otherwise agreed by the Director General: (a) reports detailing Stage 2 Contamination Site Investigations in areas identified as having a moderate to high risk of contamination, and a Site Auditor endorsed Remediation Action Plan (or similar), where required, prior to site preparation or construction; and (b) Certification by a Site Auditor that any contaminated land and/or groundwater, identified in (a) has been remediated to a standard consistent with the intended land use, prior to the use of the land. Note: Terms used in this condition have the same meaning as in the *Contaminated Land Management Act 1997.*	Section 6, SW34
5.	C16	Where the investigations identify that the site is suitable for the intended operations and that there is no need for a specific remediation strategy, measures to identify, handle and manage potential contaminated spoils, materials and groundwater shall be incorporated into the Construction Environmental Management Plan (condition E46).	Section 6, SW36
6.	C21	Dangerous goods, as defined by the *Australian Dangerous Goods Code,* shall be stored and handled strictly in accordance with: a) all relevant Australian Standards; b) for liquids, a minimum bund volume requirement of 110% of the volume of the largest single stored volume within the bund; and c) the Environment Protection Manual for Authorised Officers: Bunding and Spill Management, technical bulletin (EPA, 1997). In the event of an inconsistency between the requirements listed from (a) to (c) above, the most stringent requirement shall prevail to the extent of the inconsistency.	Section 6, SW21 to SW26

No.	Ref.	Relevant Requirement	Reference
7.	E33	Soil and water management measures consistent with *Managing Urban Storm water Soils and Construction Vo/s* 1 *and* 2, *4th Edition* (Landcom, 2004) shall be employed during the construction of the SSI to minimise soil erosion and the discharge of sediment and other pollutants to land and/or waters.	Primary ESCP – Appendix 6 Section 6, SW1-3
8.	E34	Where available, and of appropriate chemical and biological quality, subject to a health risk assessment, stormwater, recycled water, groundwater inflows to tunnels or other water sources shall be used in preference to potable water for construction activities, including concrete mixing and dust control.	Section 6, SW41 Appendix 3
9.	E45(e)	Details of how environmental performance would be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the construction of the SSI). In particular, the following environmental performance issues shall be addressed in the Plan: (iv) soil and water quality and spoil management; (v) groundwater management and discharge; (ix) soil contamination, groundwater contamination, hazardous material and waste management;	Section 6
10.	E46(d)	A **Construction Soil and Water Management Plan** to manage surface and groundwater impacts during construction of the SSI. This plan will be consistent with other documents and shall be developed in consultation with the EPA and NOW. It will include, but not necessarily be limited to:	
		(i) details of construction activities and their locations, which have the potential to impact on water courses, storage facilities, stormwater flows, and groundwater;	Appendix 2
		(ii) details of proposed extraction, use and disposal of groundwater, and measures to mitigate potential impacts to groundwater sources, incorporating monitoring, impact trigger definition and response actions for all groundwater sources potentially impacted by the SSI;	N/A – no groundwater to be used
		(iii) surface water and ground water impact assessment criteria consistent with the principles of the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines;	Water Quality Monitoring Program
		(iv) management measures to be used to minimise surface and groundwater impacts, including identification of water treatment measures and discharge points, details of how spoil and fill material required by the SSI will be sourced, handled, stockpiled, reused and managed; erosion and sediment control measures; salinity control measures and the consideration of flood events;	Section 6 Appendix 1 Appendix 7 Spoil Management Plan
		(v) a contingency plan, consistent with the *Acid Sulfate Soils Manual,* to deal with the unexpected discovery of actual or potential acid sulfate soils, including procedures for the investigation, handling, treatment and management of such soils and water seepage;	Appendix 4
		(vi) management measures for contaminated material and a contingency plan to be implemented in the case of unanticipated discovery of contaminated material during construction;	Section 6, SW34 to SW37

No.	Ref.	Relevant Requirement	Reference
			Appendix 5 MSP22C Contaminated Materials Procedure
		(vii) a description of how effectiveness of these actions and measures would be monitored during proposed works, clearly indicating how often this monitoring would be undertaken, the locations where monitoring would take place, how the results of the monitoring would be recorded and reported, and, if any exceedance of the criteria is detected how any non-compliance can be rectified; and	Section 7 Water Quality Monitoring Program
		(viii) mechanisms for the monitoring, review and amendment of this plan.	Section 9

2.2 Stations, Rail Infrastructure and Systems – North West Rail Link (SSI-5414)

No.	Ref.	Relevant Requirement	Reference
11.	C32	Except as may be provided by an EPL, the SSI shall be constructed and operated to comply with section 120 of the Protection of the Environment Operations Act 1997, which prohibits the pollution of waters.	As per measures in Section 6
12.	C35	A **Soil Salinity Report** detailing the outcomes of geotechnical investigations and groundwater monitoring, to determine the presence, extent and severity of soil salinity within the SSI area and impacts to groundwater resources and hydrology, shall be prepared and submitted to the Director General prior to the commencement of bulk earth activities, or as otherwise agreed by the Director General. The report shall be prepared in consultation with OEH and NOW and detail, where relevant, that the SSI minimises, avoids and/or mitigates impacts on local/regional salinity processes, impacts on groundwater systems, and receiving environments. The recommendations of the Soil Salinity Report shall be incorporated into the Construction Soil and Water Quality Management Plan (condition E34l). The Soil Salinity Report, prepared to meet condition C9 of State Significant Infrastructure approval SSI-5100, may be revised, if necessary and resubmitted.	As per measures in Section 6
13.	C38	The Proponent shall design and construct the SSI, as far as is feasible and reasonable, in a manner that minimises impacts to groundwater hydrology including capture, drawdown and quality.	N/A – no groundwater to be used
14.	C45	Dangerous goods, as defined by the *Australian Dangerous Goods Code*, shall be stored and handled strictly in accordance with: (a) all relevant Australian Standards; (b) for liquids, a minimum bund volume requirement of 110% of the volume of the largest single stored volume within the bund; and (c) the Environment Protection Manual for Authorised Officers: Bunding and Spill Management, technical bulletin (EPA, 1997). In the event of an inconsistency between the requirements listed from (a) to (c) above, the most stringent requirement shall prevail to the extent of the inconsistency.	Section 6, SW21 to SW26
15.	E27	Soil and water management measures consistent with *Managing Urban Stormwater – Soils and Construction Vols 1 and 2, 4th Edition* (Landcom, 2004) shall be employed during the construction of the SSI to minimise soil erosion and the discharge of sediment and other	Appendix 6 Section 6, SW1 to

No.	Ref.	Relevant Requirement	Reference
		pollutants to land and/or waters.	SW3, SW6 to SW20
16.	E28	Where available, and of appropriate chemical and biological quality, subject to a health risk assessment, stormwater, recycled water, groundwater inflows to tunnels or other water sources shall be used in preference to potable water for construction activities, including concrete mixing and dust control.	Section 6, SW41 Appendix 3
17.	E33(e)	Details of how environmental performance would be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the construction of the SSI). In particular, the following environmental performance issues shall be addressed in the Plan: (iv) soil and water quality and spoil management; (v) groundwater management and discharge; (ix) soil contamination, groundwater contamination, hazardous material and waste management;	Section 6 Section 7 Section 10 Appendix 4 Appendix 5 Appendix 6
18.	E34(d)	A Construction Soil and Water Management Plan to manage surface and groundwater impacts during construction of the SSI. This plan will be consistent with other documents and shall be developed in consultation with the EPA and NOW. It will include, but not necessarily be limited to:	
		(i) details of construction activities/locations, having potential to impact on watercourses, storage facilities, stormwater, groundwater;	Appendix 2
		(ii) details of proposed extraction, use and disposal of groundwater, and measures to mitigate potential impacts to groundwater sources, incorporating monitoring, impact trigger definition and response actions for all groundwater sources potentially impacted by the SSI;	N/A – no groundwater to be used
		(iii) surface water and ground water impact assessment criteria consistent with the principles of the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines;	Appendix 1: Water Quality Monitoring Program
		(iv) management measures to be used to minimise surface and groundwater impacts, including identification of water treatment measures and discharge points, details of how spoil and fill material required by the SSI will be sourced, handled, stockpiled, reused and managed; erosion and sediment control measures; salinity control measures and the consideration of flood events;	Section 6 Appendix 1 Appendix 7 Spoil Management Plan
		(v) a contingency plan, consistent with the Acid Sulfate Soils Manual, to deal with the unexpected discovery of actual or potential acid sulfate soils, including procedures for the investigation, handling, treatment and management of such soils and water seepage;	Appendix 4
		(vi) management measures for contaminated material (soils, water and building materials) and a contingency plan to be implemented in the case of unanticipated discovery of contaminated material, including asbestos, during construction;	Section 6, SW34 to SW37 Appendix 5 MSP22C Contaminated

No.	Ref.	Relevant Requirement	Reference
			Materials Procedure
		(vii) a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be undertaken, the locations where monitoring would take place, how the results of the monitoring would be recorded and reported, and, if any exceedance of the criteria is detected how any non-compliance can be rectified;	Section 7 Water Quality Monitoring Program
		(viii) mechanisms for the monitoring, review and amendment of this plan.	Section 9

3 REVISED ENVIRONMENTAL MITIGATION MEASURES

3.1 Stage 1 Submissions Report (SSI-5100)

No.	Original Ref.	Relevant Requirement	Reference
19.	SG13	An accredited Site Auditor would endorse the documentation of site contamination and any Remediation Action Plan or similar.	Section 6, SW35
20.	SG14	In the event of discovery of previously unidentified area(s) of potentially contaminated material, all work would cease in the vicinity of the discovery and not recommence until the extent of contamination has been assessed and if necessary, a Remediation Action Plan or similar has been prepared and endorsed by an accredited Site Auditor.	Section 6, SW36 Appendix 5
21.	SG15	A Site Auditor would be required to certify that any contaminated areas have been remediated to a standard consistent with the intended land use prior to operation of the remediated site(s).	Section 6, SW35
22.	SG16	Bunds around fuel depots and stockpile areas would be installed to minimise the risks of contaminants reaching the water table.	Section 6, SW21
23.	SG20	Groundwater quality would be subject to testing. Where it does not meet license requirements it would be treated prior to discharge.	N/A – no groundwater to be used
24.	SG24	A groundwater water supply from the Hawkesbury Sandstone for construction purposes would be used where feasible and reasonable. Negotiations with the NSW Office of Water (NOW) would be undertaken regarding impacts and applicable licenses.	N/A – no groundwater to be used
25.	SG25	If Acid Sulfate Soils are encountered, they would be managed in accordance with the Acid Sulfate Soil Management Advisory Committee Manual.	Appendix 4
26.	SW14	Water quality mitigation measures would be implemented in accordance with relevant requirements of: • Landcom Managing Urban Stormwater – Soils and Construction Volumes 1 and 2 (Blue Book, 2004 and 2008). • NOW Guidelines for Controlled Activities. • ANZECC Guidelines for Fresh and Marine Water Quality, ANZECC Guidelines for Water Quality Monitoring and Reporting. • Water Management Act 2000. • Applicable Environment Protection Licences.	Section 5 Section 6 Appendix 1 Appendix 7 Section 9
27.	SW15	Treatment measures would be applied to water collected in sediment basins, including settling of coarse sediments, the use of flocculation for finer sediments and pH correction.	Section 6, SW2, SW7
28.	SW16	As a first preference, treated surface water collected in sediment basins would be reused onsite, e.g. for dust suppression. Additional opportunities for re-using water on site or for construction would be investigated and implemented where feasible and reasonable.	Section 6, SW41 Appendix 3 Appendix 6
29.	SW17	Exclusion zones would be designated on construction sites to limit disturbance.	Section 6, SW2

No.	Original Ref.	Relevant Requirement	Reference
30.	SW18	Re-vegetating or stabilising disturbed areas would occur as soon as feasible.	Section 6, SW14
31.	SW19	Cleared native vegetation would be mulched for use in erosion and sediment control where feasible and reasonable.	Section 6, SW2
32.	SW20	Prior to commencement of earthworks / construction appropriate erosion control measures would be installed such as sediment fencing, check dams, temporary ground stabilisation, diversion berms or site regrading.	Section 6, SW7
33.	SW21	Clean water runoff would be diverted away from the works or disturbed areas wherever possible.	Section 6, SW2
34.	SW22	Temporary sediment basins would be installed as appropriate. The exact size and layout of sediment basins would be determined as part of the CEMP in accordance with the requirements of the ”Blue Book (Landcom, 2004).	Section 6, SW2 Appendix 6
35.	SW23	Appropriate measures would be implemented where spoil handling occurs outside acoustic sheds. This would include diversion drains and sediment basins.	Section 6, SW2
36.	SW24	Works staging would be undertaken to maintain flows in undisturbed or stable remediated areas.	Section 6
37.	SW25	Specific activity procedures would be implemented for vegetation clearing/access track creation, such as minimising clearing, all weather access track creation, keeping to formed tracks where feasible and reasonable and fencing of retained vegetation.	Section 6, SW6
38.	SW26	Surface controls to promote ground stability, limit run-off lengths and reduce run-off velocities within work sites would be implemented.	Section 6, SW2
39.	SW27	Ground stability would be re-established as soon as practicable following the completion of construction.	Section 6, SW14
40.	SW28	Installation of any permanent scour protection measures required for the operational phase would occur as soon as practical.	Section 6, SW28
41.	SW29	The detailed design of viaduct and bridges spanning the waterways of Elizabeth Macarthur Creek, Caddies Creek and Second Ponds Creek would provide for minimal encroachment of piers within the main creek channel to minimise disturbance and impacts to creeks during construction and operation.	Section 6, SW29
42.	SW30	Temporary haul roads required to construct the bridge and viaduct would be designed to minimise the extent of encroachment within creek channels.	Section 6, SW30
43.	SW31	Monitoring of weather forecasts would be undertaken with commencement of in channel works when dry weather is forecasted.	Section 7
44.	SW32	Where water is released into local creeks, outlet scour protection and energy dissipation would be implemented. The discharge point would be at the upstream end of a large pool where feasible and reasonable, to allow for slowing of water.	Section 6, SW2
45.	SW33	Any work platforms or access tracks required through waterway areas would be constructed of large clean rock material wrapped or underlain with geofabric (or equivalent).	Section 6, SW27
46.	SW34	Temporary waterway crossings would be provided in preference to creek diversions. These temporary waterway crossings within key fish habitat would be designed to allow for the continuance of fish passage.	Section 6, SW27
47.	SW35	Temporary waterway crossings and associated scour protection would be installed to control scour to the downstream waterway due	Section 6, SW27

No.	Original Ref.	Relevant Requirement	Reference
		to increases in localised water velocity while minimising disturbance within the riparian area.	
48.	SW36	Permanent diversion of small channels in localised areas would be considered for situations where the permanent works (such as bridge piers) may be required to remain adjacent to or partially obstructing the waterway in order to better facilitate construction methods and reduce potential erosion/scour problems.	Section 6, SW28
49.	SW37	Temporary stockpile locations for both site establishment and earthworks operations would be specified prior to the commencement of construction activities. Diversion drains and erosion and sediment control measures would be in place prior to the commencement of any stockpiling activities. Material would only be stockpiled in designated stockpiling areas.	Section 6, SW2
50.	SW38	Site specific controls would be developed to reduce the potential for environmental releases of potentially harmful chemicals and to reduce the risk of any such releases entering local waterways. Storage of hazardous materials such as oils, chemicals and refuelling activities would occur in bunded areas.	Primary ESCP – Appendix 6 Section 6, SW21 to SW26
51.	SW39	Appropriate mitigation measures including stockpiling and management of potentially contaminated material would be undertaken at building demolition sites to prevent movement of material into receiving waters.	Section 6, SW21 to SW26 Appendix 5
52.	SW40	A qualified environmental officer would be employed to advise on appropriate controls and to monitor the implementation and maintenance of mitigation measures.	Section 8
53.	SW41	All site staff would be engaged through toolbox talks or similar with appropriate training on soil and water management practices.	Section 8
54.	SW42	A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring programme would commence prior to commencement of any construction works and would build on available water quality data.	Appendix 1: Water Quality Monitoring Program
55.	SW43	Surface water and water quality monitoring would be carried out periodically and after rainfall events. Monitoring would examine a range of appropriate indicators in accordance with standard guidelines.	Appendix 1: Water Quality Monitoring Program
56.	SW44	Inspection of water quality mitigation controls (eg sediment fences, sediment basins) would be carried out regularly and following significant rainfall to detect any breach in performance.	Section 7
57.	E20	The areas identified as ‘likely’ or ‘potential’ Groundwater Dependent Ecosystems (GDEs) would be considered in development of the groundwater monitoring plan. Any groundwater monitoring undertaken within these areas would include monitoring of water quality and levels.	Appendix 1: Water Quality Monitoring Program

3.2 Stage 2 Submissions Report (SSI-5414)

No.	Original Ref.	Relevant Requirement	Reference
58.	OpSG11	Any contaminated areas directly affected by the project would be investigated and remediated prior to the commencement of construction works. All remediation works would be undertaken in accordance with the requirements of the Contaminated Land Management Act 1997 and Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (EPA, 1997b).	Section 6, SW34 to SW37 Appendix 5 MSP22C Contaminated Materials Procedure
59.	OpSG12	Prior to commencement of site preparation or construction in potentially contaminated areas, a summary of soil contamination would be prepared detailing outcomes of Stage 2 contamination site investigations. The summary would detail, where relevant, whether or not soil is suitable for intended land use or can be made suitable for reuse through of a Remediation Action Plan (or similar).	Section 6, SW34
60.	OpSG13	An accredited Site Auditor would endorse the documentation of site contamination and any Remediation Action Plan or similar.	Section 6, SW35
61.	OpSG14	In the event of discovery of previously unidentified area(s) of potentially contaminated material, all work would cease in the vicinity of the discovery and not recommence until the extent of contamination has been assessed and if necessary, a Remediation Action Plan or similar has been prepared and endorsed by an accredited Site Auditor.	Section 6, SW36 Appendix 5
62.	OpSG15	A Site Auditor would be required to certify that any contaminated areas have been remediated to a standard consistent with the intended land use prior to operation of the remediated site(s).	Section 6, SW35
63.	OpSG16	Bunds around fuel depots and stockpile areas would be installed to minimise the risk of contaminants reaching the water table.	Section 6, SW21 to SW26
64.	OpSG20	Groundwater quality would be subject to testing. Where it does not meet license requirements it would be treated prior to discharge.	Water Quality Monitoring Program
65.	OpSG24	A groundwater water supply from the Hawkesbury Sandstone for construction purposes would be used where feasible and reasonable. Negotiation with the NOW would be undertaken regarding impacts and applicable licenses.	N/A – no groundwater to be used
66.	OpSG25	If ASS are encountered, they would be managed in accordance with the Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998)	Appendix 4
67.	OpSG26	All feasible and reasonable opportunities for groundwater reuse for construction purposes or recycling nearby would be utilised in the first instance. Should groundwater inflows and required treatment volumes outstrip potential for water reuse for construction purposes, options for discharge would be investigated.	N/A – no groundwater to be used
68.	OpSG34	Appropriate soil salinity mitigation measures would be adopted in accordance with Draft Salinity Code of Practice (Western Sydney Regional Organisation of Councils, 2004) and Guidelines to Accompany Map of Salinity Potential in Western Sydney (DIPNR 2002). These mitigation measures would be included within Sub-Plans to the CEMP at all sites within areas of known risk of soil salinity.	Section 6
69.	OpSG35	A soil salinity assessment would be undertaken for each high risk site in accordance with the Site Investigations for Urban Salinity	Section 6

No.	Original Ref.	Relevant Requirement	Reference
		(DLWC 2002), including Phase 2 and Phase 3 investigation. This assessment would enable site specific mitigation measures to be developed to ensure saline soils are appropriately managed and damage to the environment and infrastructure is minimised. These investigations would be informed by the completed groundwater monitoring program.	
70.	OpSG39	Bella Vista to Rouse Hill (Open Cutting for Bella Vista Dive and skytrain). If excavation for offsite disposal is to take place, additional assessments for waste classification may be required as low TPH and heavy metals impacts were reported in fill samples. Further assessment in this area may be required if disturbance is to take place in this area.	Section 6, SW34 Appendix 5 Spoil and Waste Management Plan
71.	OpSG40	Rouse Hill to Cudgegong Road (Earthworks and Bridges). Should excavation for offsite disposal take place, additional assessments for waste classification may be required as low TPH and phenol impacts were reported in fill samples. Not all of the Areas of Environmental Concern in this area have been specifically targeted, ie individual above-ground storage tanks, farm dams and asbestos in buildings. Additional assessment and waste classification may be required.	Section 6, SW34 Appendix 5 Spoil and Waste Management Plan
72.	OpSG41	Rouse Hill to Tallawong Stabling (On grade works). Not all of the Areas of Environmental Concern in this area were specifically targeted, ie individual above-ground storage tanks, farm dams and asbestos in buildings. Additional assessment and waste classification may be required.	Section 6, SW34 Contaminated Materials Contingency Plan (Appendix 5) MSP22C Contaminated Materials Procedure
73.	OpSG46	Bella Vista to Rouse Hill (Open Cutting for Bella Vista Dive and skytrain). If groundwater is to be disturbed, groundwater management may be required due to low concentrations of TPH and PAH reported in this area.	Water Quality Monitoring Program
74.	OpSG47	Soil and land remediation is to occur as soon as practicable following construction. This is to include remediation in stages as the construction process allows.	Section 6, SW35
75.	SW17	Exclusion zones would be designated on construction sites to limit disturbance.	Section 6, SW2
76.	SW18	Re-vegetating or stabilising disturbed areas would occur as soon as feasible.	Section 6, SW14
77.	SW20	Appropriate erosion control measures would be installed such as sediment fencing, check dams, temporary ground stabilisation, diversion berms or site regrading.	Section 6, SW2
78.	SW21	Clean water runoff would be diverted away from the works or disturbed areas wherever possible.	Section 6, SW2
79.	SW22	Temporary sediment basins would be installed as appropriate. The exact size and layout of sediment basins would be determined as part this sub-plan and in accordance with the Blue Book.	Section 6, SW2 Appendix 6
80.	SW26	Surface controls to promote ground stability, limit run-off lengths, reduce run-off velocities within the work sites would be implemented.	Section 6, SW2

No.	Original Ref.	Relevant Requirement	Reference
81.	SW27	Ground stability would be re-established as soon as practicable following the completion of construction.	Section 6, SW14
82.	SW28	Installation of any permanent scour protection measures required for the operational phase would occur as soon as practical.	Section 6, SW28
83.	SW32	Where water is released into local creeks, this would be controlled through pump flow control and supervision of discharge or, where necessary, outlet scour protection and energy dissipation would be implemented. The discharge point would be at the upstream end of a large pool where feasible and reasonable, to allow for slowing of water.	Section 6, SW2
84.	SW37	Temporary stockpile locations for both site establishment and earthworks operations would be specified prior to the commencement of construction activities. Diversion drains and erosion and sediment control measures would be in place prior to the commencement of any stockpiling activities. Material would only be stockpiled in designated stockpiling areas.	Section 6, SW2
85.	SW38	Site specific controls would be developed to reduce the potential for environmental releases of potentially harmful chemicals and to reduce the risk of any such releases entering local waterways. Storage of hazardous materials such as oils, chemicals and refuelling activities would occur in bunded areas.	Section 6, SW21 to SW26 Appendix 7
86.	SW40	A qualified environmental officer would be employed to advise on appropriate controls and to monitor the implementation and maintenance of mitigation measures.	Section 8
87.	SW41	All site staff would be engaged through toolbox talks or similar with appropriate training on soil and water management practices.	Section 8
88.	SW42	A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring programme would commence prior to commencement of any construction works and would build on available water quality data.	Water Quality Monitoring Program, Appendix 1
89.	SW43	Surface water and water quality monitoring would be carried out periodically and after rainfall events. Monitoring would examine a range of appropriate indicators in accordance with standard guidelines.	Water Quality Monitoring Program
90.	SW44	Inspection of water quality mitigation controls (eg sediment fences, sediment basins) would be carried out regularly and following significant rainfall to detect any breach in performance.	Section 7

4 DEED REQUIREMENTS

4.1 Deed Requirements

No.	Original Ref.	Relevant Requirement	Reference
91.	Deed 3.11(a)	(a) In addition to the requirements of the Environmental Documents and without limiting clause 3.6 (but subject to clause 3.11(b)), the SVC Contractor bears the risk of all Contamination: (i) on, in, over, under or about the Construction Site or any Extra Land which is disturbed by or interfered with in the carrying out of the SVC Contractor's Activities; or (ii) which otherwise arises out of or in connection with the SVC Contractor's Activities, and, to the extent clause 3.11(a)(i) or 3.11(a)(ii) applies, the SVC Contractor must: (iii) dispose of, or otherwise deal with, such Contamination in accordance with Law and the Environmental Documents; (iv) remediate the Construction Site and any Extra Land to the extent to which: A. it is in any way degraded by such Contamination; and B. the Contamination is of such a nature that an Authority could issue a statutory notice requiring it to be remediated; and (v) except to the extent prohibited by Law, indemnify the Principal from and against any claims against the Principal, or Loss suffered or incurred by the Principal, arising out of or in any way in connection with such Contamination or any failure by the SVC Contractor to comply with any obligation under this deed in connection with Contamination.	Section 6, SW34

4.2 SWTC Requirements

No.	Original Ref.	Relevant Requirement	Reference
92.	SWTC 7.16	7.16 Acid Sulphate Soils and Rocks (a) Without limiting requirements of deed, the SVC Contractor must treat and dispose of acid sulphate soils/rocks in accordance with: (i) Guidelines for Management of Acid Sulphate Materials: Acid Sulphate Soils, Acid Sulphate Rock & Monosulfidic Black Ooze, RTA; (ii) Department of Environment, Climate Change and Water requirements; (iii) Acid Sulphate Soil Manual, NSW Acid Sulphate Soils Management Advisory Committee, August 1998; (iv) NSW Environmental Protection Authority - Assessing and Managing Acid - Sulphate Soils; and (v) Environment Protection Authority, Victoria Information Publication 655 - Acid Sulphate Soil and Rock.	Section 6, SW33
93.	SWTC 7.17	Without limiting the requirements of the deed, the SVC Contractor must treat and dispose of any contaminated material, including soil and groundwater encountered during the performance of the SVC Contractor's Activities, in accordance with the Contaminated Land Management Act 1997, the requirements in the Department of Urban Affairs and Planning & Environment Protection Authority Managing Land Contamination Planning: Guidelines SEPP55 Remediation of Land, 1998,the Environmental Documents and the	Section 6, SW34

No.	Original Ref.	Relevant Requirement	Reference
		requirements of relevant Authorities.	
94.	SWTC, App 10.8 (a)	The SVC Contractor must undertake a water balance study that describes the sources, uses and estimated quantities of potable and non-potable water which will be created and used in the performance of the SVC Contractor's Activities.	Appendix 3, This Plan
95.	SWTC, App 10.8 (b)	Potable water must not be used as a substitute for non-potable water where on-site or local sources of non-potable water that are suitable for construction activities are available.	This Plan, Appendix 3 (Indicative Water Balance Table),
96.	SWTC, App 10.8 (c)	The SVC Contractor must identify initiatives that will be implemented to maximise water re-use, including from captured stormwater, groundwater and wastewater and minimise total water consumption and demand for potable water.	Section 6, SW39 to SW41, Appendix 3
97.	SWTC, App 10.8 (d)	The SVC Contractor must minimise total water consumption and potable water consumption by: (i) Using water efficient controls, fixtures and fittings; (ii) Collecting, treating and reusing process water; (iii) Using recycled water or treated water; (iv) Harvesting and reusing rainwater; (v) Using water from recycled water networks; and (vi) Collecting, treating and reusing groundwater and stormwater.	Appendix 3, This Plan
98.	SWTC, App 10.8 (e)	The SVC Contractor must meter and record water consumed within temporary site facilities and used by all major plant or process equipment within the Construction Site.	This Plan, Appendix 3 (Metering and Monitoring)
99.	App 24.4, (g)(iv)	The Construction Environmental Management Plan must include, as sub-plans, the following plans that are required by the Project Planning Approvals: • Construction Soil and Water Management Plan;	This plan.
100.	App 24.4, (h)	In addition to the requirements identified in the Project Planning Approvals, the Construction Soil and Water Management Plan must: (i) include a water balance study that describes the sources, uses and estimated quantities of potable and non-potable water which will be created and used in the performance of the SVC Contractor's Activities. The estimated quantities of potable and non-potable water must also be expressed as percentages of total demand; (ii) identify initiatives that will be implemented to maximise water re-use, including from captured stormwater, wastewater and groundwater; and (iii) identify initiatives that will be implemented to minimise total water consumption and demand.	Appendix 3 Section 6, SW41, Appendix 3 Section 6, SW39 to SW41, Appendix 3

4.3 CEMF Requirements

No.	Original Ref.	Relevant Requirement	Reference
101.	7.1(a)	The following groundwater management objectives will apply to the construction of the project: i. Reduced the potential for drawdown of surrounding groundwater resources. ii. Prevent the pollution of groundwater through appropriate controls. iii. Reduce the potential impacts of groundwater dependent ecosystems.	Appendix 1
102.	7.2(a)	NWRL Principal Contractors will develop and implement a Groundwater Management Plan for their scope of works. The Groundwater Management Plan will include as a minimum:	This plan
		i. The groundwater mitigation measures as detailed in the environmental approval documentation.	Section 6, Appendix 1
		ii. The requirements of any applicable licence conditions. The NSW Office of Water will be consulted during the development of the Groundwater Management Plan in relation to dewatering and licensing arrangements.	Section 5, if required
		iii. The responsibilities of key project personnel with respect to the implementation of the plan.	CEMP
		iv. Procedures for the treatment, testing and discharge of groundwater from the site.	Appendix 1: Water Quality Monitoring Program
		v. A groundwater monitoring plan.	Appendix 1: Water Quality Monitoring Program
		vi. Compliance record generation and management.	Appendix 1: Water Quality Monitoring Program
103.	7.2(b)	The Groundwater Monitoring Plan will: i. Outline the parameters to be monitored (field parameters and laboratory parameters) and the sample frequency. ii. Include details of a groundwater monitoring network to monitor groundwater levels and groundwater quality throughout the construction phase. The groundwater monitoring network will contain monitoring wells along the whole NWRL route intersecting groundwater in both the Ashfield Shale and Hawkesbury Sandstone.	Appendix 1: Water Quality Monitoring Program
104.	7.2I	NWRL Contractors will retain compliance records of all groundwater monitoring undertaken.	Appendix 1: Water Quality Monitoring Program
105.	7.3	Examples of groundwater mitigation measures include:	Appendix 1: Water Quality Monitoring

No.	Original Ref.	Relevant Requirement	Reference
		• Implementing all feasible and reasonable measures to limit groundwater inflows to stations and crossovers. • Undertaking groundwater monitoring during construction (levels and quality) in areas identified as 'likely' and 'potential' groundwater dependent ecosystems.	Program
106.	15.1(a)	The following soil and water management objectives will apply to the construction of the project: i. Prevent pollution of surface water through appropriate erosion and sediment control. ii. Maintain existing water quality of surrounding surface watercourses. iii. Source construction water from non-potable sources, where reasonable and feasible.	Section 6 Appendix 1 Appendix 3 Appendix 6 Appendix 7
107.	15.2(a)	NWRL Principal Contractors will develop and implement a Soil and Water Management Plan for their scope of works. The Soil and Water Management Plan will include as a minimum: i. The surface water and flooding mitigation measures as detailed in the environmental approval documentation. ii. The requirements of any applicable EPL conditions. iii. The responsibilities of key project personnel with respect to the implementation of the plan. iv. Procedures for the development and implementation of progressive erosion and sediment control plans. v. Identification of locations where site specific Stormwater and Flooding Management Plans are required. vi. Procedures for the treatment, testing and discharge of water from the site. vii. Procedures for spill response. viii. Soil and water monitoring requirements. ix. Compliance record generation and management.	This plan
108.	15.2(b)	NWRL Principal Contractors will develop and implement progressive erosion and sediment control plans (ESCPs) for all active worksites in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) (known as the "Blue Book"). The ESCPs will be approved by the Contractor's Environmental Manager (or delegate) prior to any works commencing (including vegetation clearing) on a particular site. Copies of the approved ESCP will be held by the relevant Contractor personnel including the Engineer and the Site Foreman. ESCPs will detail all required erosion and sediment control measures for the particular site at the particular point in time and be progressively updated to reflect the current site conditions. Any amendments to the ESCP will be approved by the Contractor's Environmental Manager (or delegate).	Section 6 Appendix 6
109.	15.2(c)	NWRL Principal Contractor's will develop and implement Stormwater and Flooding Management Plans for the relevant construction sites. These plans will identify the appropriate design standard for flood mitigation based on the duration of construction, proposed activities and flood risks. The plan will develop procedures to ensure that threats to human safety and damage to infrastructure are not exacerbated during the construction period.	Stormwater and Flooding Management Plan

No.	Original Ref.	Relevant Requirement	Reference
110.	15.2(d)	NWRL Principal Contractors will undertake the following soil and water monitoring as a minimum: i. Weekly inspections of erosion and sediment control measures. Issues identified would be rectified as soon as practicable. ii. Additional inspections will be undertaken following significant rainfall events (greater than 20 mm in 24 hours). iii. All water will be tested (and treated if required) prior to discharge from the site in order to determine compliance with the parameters of the EPL. No water will be discharged from the site without the written approval of the Contractor's Environmental Manager (or delegate). This is to form a HOLD POINT.	Section 7 Water Quality Monitoring Program
111.	15.2(e)	The following compliance records will be kept by the NWRL Principal Contractors: i. Copies of current ESCPs for all active construction sites; ii. Records of soil and water inspections undertaken; iii. Records of testing of any water prior to discharge. iv. Records of the release of the hold point to discharge water from the construction site to the receiving environment.	CEMP
112.	15.3	Examples of surface water and flooding mitigation measures include: • Clean water will be diverted around disturbed site areas, stockpiles and contaminated areas. • Control measures will be installed downstream of works, stockpiles and other disturbed areas. • Exposed surfaces will be minimised, & stabilised/revegetated as soon as feasible/reasonable upon completion of construction. • Dangerous goods/hazmat storage will be within bunded areas with capacity of 110% of the maximum single stored volume. • Spill kits will be provided at the batch plants, storage areas and main work sites.	Section 6 Appendix 6
113.	15.4	The following water resources management objectives will apply to the construction of the project: • Minimise demand for, and use of potable water. • Maximise opportunities for water re-use from captured stormwater, wastewater and groundwater. Examples of measures to minimise potable water consumption include: • Water efficient controls, fixtures and fittings in temporary facilities. • Collecting, treating and reusing water generated in tunnelling operations, concrete batching and casting facility processes. • Using recycled water or treated water from onsite sources in the formulation of concrete. • Harvesting and reusing rainwater from roofs of temporary facilities. • Using water from recycled water networks. • Collecting, treating and reusing groundwater and stormwater. • Using water efficient construction methods and equipment. • Providing designated sealed areas for equipment wash down.	Section 6, SW39 to SW41 Appendix 3

5 LICENCE AND PERMIT REQUIREMENTS

5.1 EPA Licence 20454

<table>
<tr><th>No.</th><th>Original Ref.</th><th>Relevant Requirement</th><th>Reference</th></tr>
<tr><td>114.</td><td>P1
P1.1</td><td>Location of monitoring/discharge points and areas
The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.</td><td></td></tr>
<tr><td>115.</td><td>P1.2</td><td>The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation.
Water and land
<table>
<tr><th>EPA Identi-fication no.</th><th>Type of Monitoring Point</th><th>Type of Discharge Point</th><th>Location Description</th></tr>
<tr><td>1</td><td>Discharge and monitoring at the outlet of sediment basins</td><td>Discharge and monitoring at the outlet of sediment basins</td><td>the outlet from sediment basins referred to in condition P1.3 of this licence</td></tr>
</table></td><td></td></tr>
<tr><td>116.</td><td>P1.3</td><td>The location of discharge points is defined by the most recently approved discharge point register held on the EPA Electronic File EF13/6603.</td><td></td></tr>
<tr><td>117.</td><td>P1.4</td><td>The location of discharge points is defined by the most recently approved discharge point register held on the EPA Electronic File EF13/6603.</td><td></td></tr>
<tr><td>118.</td><td>P1.5</td><td>The discharge point register must be submitted to the EPA no later than 5 business days prior to any proposed changes to the register.</td><td></td></tr>
<tr><td>119.</td><td>L1
L1.1</td><td>Pollution of Waters
Except as may be expressly provided in any other condition of this licence, the licensee must comply with Section 120 of the Protection of the Environment Operations Act 1997.</td><td>This Plan</td></tr>
<tr><td>120.</td><td>L2
L2.1</td><td>Concentration limits
For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.</td><td></td></tr>
<tr><td>121.</td><td>L2.2</td><td>Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.</td><td></td></tr>
<tr><td>122.</td><td>L2.3</td><td>To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.</td><td></td></tr>
</table>

<table>
<tr><td>123.</td><td>L2.4</td><td>Water and/or Land Concentration Limits

POINT 1
<table>
<tr><th>Pollutant</th><th>Units of Measure</th><th>50 Percentile concentration limit</th><th>90 Percentile concentration limit</th><th>3DGM concentration limit</th><th>100 percentile concentration limit</th></tr>
<tr><td>Oil and Grease</td><td>Visible</td><td></td><td></td><td></td><td>not visible</td></tr>
<tr><td>pH</td><td>pH</td><td></td><td></td><td></td><td>6.5-8.5</td></tr>
<tr><td>Total suspended solids</td><td>milligrams per litre</td><td></td><td></td><td></td><td>50</td></tr>
</table></td><td></td></tr>
<tr><td>124.</td><td>L2.5</td><td>Exceedance of the limits specified in Condition L2.4 of this licence for pH and total suspended solids (TSS) for discharges from the sediment basins identified in Conditions P1.2 and P1.3 of this licence is only permitted if:
(a) the discharge occurs solely as a result of rainfall measured at the Premises exceeding 24.6mm over any consecutive five (5) day period immediately prior to the discharge occurring from these basin(s); and

(b) The sediment basins and other erosion and sediment controls on the site have been designed, constructed, installed, maintained and managed in accordance with best management
principles and practices described in the guideline “Managing Urban Stormwater – Soils and Construction – Volume 1, 4th edition, 2004” produced by Landcom.</td><td></td></tr>
<tr><td>125.</td><td>L2.6</td><td>If the licensee uses turbidity (NTU) in place of TSS to determine compliance with Condition L2.4, the licensee must develop a statistical correlation which identifies the relationship between NTU and TSS for water quality in the sediment basin/s in order to determine the NTU equivalent of 50 mg/L TSS before its use.</td><td></td></tr>
<tr><td>126.</td><td>L2.7</td><td>The licensee must provide the EPA with a copy of the statistical correlation assessment methodology and results before using NTU in place of TSS.</td><td></td></tr>
<tr><td>127.</td><td>L2.8</td><td>The licensee must develop and implement a method to enable the ongoing verification of the relationship between NTU and TSS.</td><td></td></tr>
<tr><td>128.</td><td>L2.9</td><td>The licensee must provide the EPA with any amendments the licensee makes to the statistical correlation as a result of the ongoing</td><td></td></tr>
</table>

		verification required by Condition L2.7 before using the revised statistical correlation.	
129.	**O4** O4.1	**Processes and management** **Polymer-Based Flocculant** The licensee must ensure that any polymer based flocculants used to treat water before discharge from the premises has a 48-hour EC50 (immobilisation) for water fleas and a 96-hour EC50 (imbalance) for fish, greater than 100 milligrams per litre. Note: In accordance with the EPA Approved Methods Publication any analysis should be undertaken by a laboratory accredited to perform those analyses by an independent accreditation bod acceptable to the EPA, such as the National Association of testing Authorities (NATA) or equivalent.	
130.	**O6** O6.1	**Other operating conditions** Erosion and sediment control The licensee must, before undertaking any construction work (including any earthmoving or vegetation removal works), implement all soil and water management works required to minimise pollution of waters.	This Plan
131.	O6.2	The licensee must inspect the operation of soil and water management works installed on the premises and undertake any works required to repair and/or maintain these controls: a) at least weekly during normal construction hours outlined in condition L4.1; b) prior to any major rainfall event forecasted; c) daily following a major rainfall event in any 24 hour period, if safe to do so; and d) prior to any site closure of greater than 24 hours.	
132.	O6.3	The licensee must record all such inspections, including observations and works undertaken to repair and/or maintain soil and water management works.	
133.	O6.4	The licensee must ensure the design storage capacity of the sediment basins installed on the premises is reinstated within 5 days of the cessation of a rainfall event that causes runoff to occur on or from the premises.	
134.	**M2** M2.1	**Requirement to monitor concentration of pollutants discharged** For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:	
135.	M2.2	Water and/ or Land Monitoring Requirements **POINT 1**	

Pollutant	Units of measure	Frequency	Sampling Method
Oil and Grease	Visible	Daily during any	Visual Inspection

					discharge	
			pH	pH	Daily during any discharge	In situ
			Total suspended solids	milligrams per litre	Daily during any discharge	Grab sample
136.	**M3** M3.1	**Testing methods - concentration limits** Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.				
137.	**M4** M4.2	**Weather monitoring** The rainfall monitoring data collected in compliance with M4.1 can be used to determine compliance with condition L2.5.				
138.	**R4** R4.4	**Other reporting conditions** **Monthly non-compliance and discharges report** The licensee must provide the EPA with a monthly report containing the following information: a) Details of all non-compliances with the conditions of this licence and measures taken, or proposed, to prevent a recurrence of such a non-compliance; and b) Details of all discharges from the sediment basins where the water quality results exceed the limits prescribed in condition L2.4, including the results of the rainfall measurements, to demonstrate compliance with condition L2.5; and The report referred to in this condition must be received by the EPA within 10 working days of the end of the month.				

6 MITIGATION MEASURES

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	General						
SW1.	Develop a Primary Erosion and Sedimentation Control Plan (ESCP) that addresses site specific conditions and specific risks for the SVC project (eg dispersible soils, topography, waterways, etc). ESCP contained in Appendix 6.	■		Entire project	COA SSI-5100 E33, E46d(iv), COA SSI-5414 E27, E34d(iv)	Environment Manager, Soil Specialist	Prior to construction
SW2.	Develop Progressive ESCPs for discrete areas of the project prior to any substantial works in the area which they cover, identifying the specific controls to be installed. Include key management strategies specified in the Primary Erosion and Sediment Plan as required, such as: • exclusion zones to limit disturbance, • clean water diversion drains, • sediment basins, including outlet scour protection/energy dissipation, • sediment fences, • rumble grids, and sprayers if necessary, for vehicles to pass through prior to leaving the site and accessing public roads, • use of cleared/mulched native vegetation where feasible and reasonable. • re-vegetating or stabilising disturbed areas would occur as soon as feasible. • check dams • rip-rap • biodegradable matting, geotextile matting, concrete, hydromulch, soil binders, etc. Maintain a register of ESCPs used through the project. As Progressive ESCPs (PESCPs) are superseded or become redundant they will be moved to a separate “inactive” section of the ESCP register. Regular inspections (see Section 7) will note when PESCPs require updating and appropriate action will be taken to ensure PESCPs are maintained and implemented effectively. Hand drawn markups may be used to update. Examples of ESCPs are contained in Appendix 10.	■	■	Entire project	COA SSI-5100 E33, E46d COA SSI-5414 E27, E34d(iv) CEMF 15.2(b), 15.2(c) REMM SSI-5100 SW17-32, REMM SSI-5414 SW20-32	Environment Manager, Soil Specialist, Environmental Coordinator	Prior to work activities, throughout construction

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
SW3.	Develop a Water Quality Monitoring Program to ensure that any water moved offsite meets relevant water quality requirements and to allow for adequate and timely onsite response in the event that offsite water quality is adversely affected by the project. Program at Appendix 1.	■	■	Entire project	COA SSI-5100 E46d SSI-5414 E34d(iii)(vii) REMM SSI-5100 SW14, 15, SG20, SW42/43, E20 REMM SS1-5414 OpSG20,27-30, SW42-43 CEMF 7.2(a)(iv)(v)(vi), 7.2(b), 7.21, 15.2(d)	Environment Manager	Prior to work activities, throughout construction
SW4.	Develop a procedure for managing potential Acid Sulphate Soils if found, to ensure there is minimal risk of acid runoff impacting offsite lands or waters. Procedure contained in Appendix 4.	■		Entire project	COA SS1-5100 E46d(v) COA SS1-5414 E34(d)(v), REMM SSI-5100 SG25.	Environment Manager	Prior to construction
SW5.	Develop a procedure for the identification and management of any contaminated material or potentially contaminated material, if identified during construction. Procedure contained in Appendix 5. Information to assist personnel identify potential contamination to be included in inductions. **IND**	■		Entire project	COA SSI-5100 E46d(vi) COA SSI-5414 E34d(vi) REMM SSI-5100 SG13,SG14, SG15 REMM SSI-5414 OpSG11-15, OpSG39-41, OpSG47..	Environment Manager	Prior to construction
	Erosion & Sediment Control Measures						
SW6.	Limit as far as practicable the total area disturbed at any one time. Minimise clearing for construction sites, the haul road and access tracks. Mark exclusion zones on PESCPs and on the ground. **IND**	■	■	Entire project	REMM SSI-5100 SW17, SW24,SW25 REMM SSI-5414 SW17 CEMF 15.3	Construction / Environment Manager	Throughout construction
SW7.	Install and maintain temporary erosion and sedimentation controls identified by PESCPs prior to commencing works in each area. Treat water collected in sediment basins by pH correction, settling coarse sediments, and/or flocculating finer sediments. Discharge will be in	■	■	Entire project	COA SSI-5100 E33 COA SSI-5414 E27 REMM SSI-5100 SW15, SW16, SW19, SW20,	Site Supervisor / Engineer / Environment Co-ordinator	Throughout construction

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	accordance with the license.				SW22, SW26, REMM SSI-5414 SW222, SW26 CEMF 15.3		
SW8.	Maintain temporary erosion and sediment controls so that sediment storage capacity is maximised at all times. Excess sediment to be cleaned out and incorporated into the earthworks.		■	Entire project	COA SSI-5100 E33 COA SSI-5414 E27 REMM SSI-5100 SW44 REMM SSI-5414 SW44	Site Supervisor / Engineer / Environment Co-ordinator	Throughout construction
SW9.	Cover or stabilise temporary soil stockpiles (or parts thereof) using cover crop, polymer binder, erosion control matting or similar, if deemed required by environmental-coordinator or soil specialist, Stockpiles will have sediment fencing around their lower edge, if deemed required by environmental-coordinator or soil specialist, and be sited above the 20-year ARI flood level unless they are short-term (i.e. less than 10 days) and significant rainfall is not likely. Include details in PESCPs.		■	Stockpile areas	REMM SSI-5414 SW37	Site Supervisor / Engineer / Environment Co-ordinator	Throughout construction
SW10.	Divert stormwater approaching worksites from external using clean water drains and diversion berms, considering any impacts on adjacent land users to ensure that localised flooding or excessive run-on does not occur. Include in PESCPs.		■	Entire project	REMM SSI-5100 SW21, SW36, SW37 REMM SSI-5414 SW21 CEMF 15.3	Site Supervisor / Engineer / Environment Co-ordinator	Throughout construction
SW11.	Notwithstanding that in-series on-site sediment controls should be implemented, wherever possible, use sediment basins as the primary end-of-line control for all construction worksites. Size basins as per Blue Book requirements, which equates to approximately 350m^3 of basin capacity per hectare of construction catchment. Ensure discharge points at sediment basins are stabilised by using scour protection and/or /dissipation. This applies equally to discharges from piped and siphoned outlets. Implement the *Dewatering Work Instruction* in Appendix 7 for any discharges from sediment basins.		■	Entire project	COA SSI-5100 E33 COA SSI-5414 E27 REMM SSI-5100 SW14, SW15,SW16, SW22 REMM SSI-5414 SW22 CEMF 15.1(a), 15.2(a),15.2(b)	Environment Manager / Coordinator	Throughout construction

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	Include details in PESCPs.						
SW12.	Where sediment basins or sediment sumps cannot reasonably be constructed to standard Blue Book requirements, use undersized structures or alternatives such as sediment fence, rock check dams, or mulch bunds. Use these in series and supplement them with an enhanced focus on erosion control. Include details in PESCPs.		■	Entire project	COA SSI-5100 E33 COA SSI-5414 E27 E34(d)(iv) REMM SSI-5100 SW14, SW26, SW27 REMM SSI-5414 SW20, SW26, SW27 CEMF 5.1(a)(i)15.2(a)(iv) 15.2(b), 15.3	Environment Coordinator / Site Supervisor / Engineer	Throughout construction
SW13.	Stabilise work areas not secured by a sediment basin (sized to standard Blue Book requirements) when significant rainfall (> 20mm in 24 hrs forecast) is imminent with a biodegradable soil stabilising polymer (or equivalent) to reduce the amount of fine (<0.02 mm) sediment potentially eroded.		■	Entire project	REMM SSI-5100 SW27 REMM SSI-5414 SW18, SW27	Environment Coordinator / Site Supervisor / Engineer	Throughout construction
SW14.	Progressively revegetate, stabilise or seal disturbed areas when works in the area are complete to reduce dust emissions and the total erodible surface. Aim to achieve rehabilitation of completed areas at the required level of cover dictated by the Blue Book (generally 70% minimum) within the nominated timeframe (generally 20 days).		■	Entire project	COA SSI-5100 E33 COA SSI-5414 E27 REMM SSI-5100 SW14, SW26, SW27 REMM SSI-5414 SW18, SW20, SW26, SW27 CEMF 15.1(a)(i), 15.2(a)(iv), 15.2(b), 15.3	Environment Coordinator / Site Supervisor / Engineer	Throughout construction
SW15.	Mulch and reuse native vegetation removed during site clearing and preparation works for erosion and/or sediment control purposes. Include details in PESCPs.		■	Entire project	COA SSI-5100 E46(d)(iv) COA SSI-5414 E34(d)(iv) REMM SSI-5100 SW19, SW20, REMM SSI-5414 SW20, SW26 CEMF 15.3	Environment Coordinator / Site Supervisor / Engineer	Throughout construction

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
SW16.	Retain weed-free topsoil onsite where space permits and use for rehabilitation to promote successful seed growth and landscaping. During placement on rehabilitation areas, topsoil will be lightly scarified to promote infiltration and assist with seed germination.		■	Entire project	REMM SSI-5100 SW18, SW27, REMM SSI-5414 SW18, SW27	Environment Coordinator / Site Supervisor / Engineer	Throughout construction
SW17.	Control water flows onto and through work areas using stabilised temporary berms, drains or chutes and directed to appropriate locations. Include details in PESCPs.		■	Entire project	REMM SSI-5100 SW21 SW23 REMM SSI-5414 SW21 CEMF 15.3	Environment Coordinator / Site Supervisor / Engineer	Throughout construction
SW18.	Use lining or armouring in areas of concentrated water flow to minimise erosion of drains and channels. Include details in PESCPs		■	Entire project	REMM SSI-5100 SW28, SW32, SW35 REMM SSI-5414 SW28, SW32	Environment Coordinator / Site Supervisor / Engineer	Throughout construction
SW19.	Provide washdown bays, rumble grids and/or stabilised laybacks at vehicle access points from project worksites onto public roads to minimise risk of sediment tracking onto public roads. Include details in PESCPs		■	Entire project	COA SSI-5100 E33	Environment Coordinator / Site Supervisor / Engineer	Throughout construction
SW20.	Provide designated concrete washout bays or use a Concrete Waste Separation Unit (CWSU) to manage concrete waste. Include details in PESCPs		■	Entire project	REMM SSI-5414 SW38	Environment Coordinator / Site Supervisor / Engineer	Throughout construction
	Dangerous Goods, Chemicals, Bunding & Spill Management						
SW21.	Store all fuels, oils and chemicals in secure bunded areas at least 40m from waterways and as per *Dangerous Goods Storage* requirements where applicable. Cover all permanent bunded areas. The bund capacity is to be capable of storing 110% of the capacity of the largest tank stored (DECC, 2007).	■	■	Entire Site	COA SSI-5100 C21 COA SSI-5414 C45 REMM SSI-5100 SG16, SW38, REMM SSI-5414 SW38 CEMF 15.2(a)(vii),15.3.	Environment Manager / Coordinator	Throughout construction
SW22.	Use temporary bunds for short term periods of up to two weeks where		■	Entire Site	COA SSI-5100 C21	Environment	Throughout

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	required.					Manager / Coordinator	construction
SW23.	Provide spill kits at all key construction areas, including any refuelling areas, temporary creek crossings and near permanent fuel/chemical storage areas. Use mobile spill kits if and as required. Induct staff into location and use of kits **IND**		■	Entire Site	ISJV procedures	Environment Manager / Coordinator	Throughout construction
SW24.	Report any spills immediately to the Site Supervisor who in turn is to immediately notify the Environmental Manager or Environmental Co-ordinators. **IND**		■	Entire Site	ISJV procedures	All personnel	Throughout construction
SW25.	Report any spill likely to cause material harm to the environment to EPA via the EPA Pollution Line (131 555), and other authorities as per the *Pollution Incident Response Management Plan* (Appendix 5 of CEMP). **IND** Environment Manager, in consultation with TfNSW, to notify the DPI Director General of an incident with significant off-site impacts on people or the biophysical environment as identified by the Environmental Representative within 48 hours of becoming aware of the incident. Provide full written details of the incident to the Director General within seven days of the date on which the incident occurred		■	Entire Site	ISJV procedures COA SSI-5100 D6	Environment Manager	Throughout construction
SW26.	Implement measures in the *Project Emergency Management Plan* in the event of a land-based or water based fuel, oil or chemical spill.		■	Entire Site	ISJV procedures	Environment / Safety / Construction Manager / Project Director	Throughout construction
	Riparian Areas						
SW27.	Construct temporary creek crossings rather than creek diversions. Ensure design of temporary creek crossings comply with NOW and NSW Fisheries guidelines (as per Section 9). Provide for fish passage where possible, and scour protection.	■	■	Creek crossings	REMM SSI-5100 SW33-35	Design Manager Environment Manager / Engineers	Prior to creek crossings

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	Construct temporary creek crossings of large clean rock material wrapped or underlain with geofabric (or equivalent). Include temporary design details in PESCPs.						
SW28.	Permanently divert small channels in localised areas where permanent works (such as bridge piers) remain adjacent to or obstructing creeks in order to facilitate construction and reduce potential erosion/scour problems. This will be through temporary works design for creek crossing.	■	■	Riparian areas	REMM SSI-5100 SW36	Design Manager	Prior to riparian works
SW29.	Design viaducts and bridges spanning Elizabeth Macarthur Creek, Caddies Creek and Second Ponds Creek to minimise encroachment of piers within the main creek channel.	■		Riparian areas	REMM SSI-5100 SW29	Design Manager	Prior to bridge construction
SW30.	Design temporary haul roads to minimise encroachment within creek channels. Include temporary design details in PESCPs	■		Riparian areas	REMM SSI-5100 SW30	Design Manager / Environment Coordinator	Prior to road construction
SW31.	Bund work sites susceptible to flooding, providing bunds do not negatively impact flood levels or flows on external lands. This might involve constructing low earth bunds or using sheet piling or similar. Alternatively, develop action plans for potential flooding of work sites to remove any potential contaminants or materials that might float away. Include temporary design details in PESCPs		■	Riparian areas or flood zones	COA SSI-5414 E34(d)(iv) CEMF 15.2(e)	Environment Coordinator / Engineer	Throughout construction
SW32.	Stage works within watercourses or in flood-prone areas to minimise time and extent of disturbance. In the event of predicted flows or significant rainfall, cease works and move construction equipment to higher ground. Use temporary ground covers (e.g. geo-fabric, soil binder/stabiliser, hydro-mulch) to lock-down high-risk areas whenever significant rain (>20mm in 24 hours forecast) is imminent.		■	Riparian areas or flood zones	COA SSI-5100 E46(d)(iv) COA SSI-5414 E34(d)(iv) REMM SSI-5100 SW24, SW31, REMM SSI-5414 SW20, SW26 CEMF 15.3	Environment Coordinator / Site Supervisor / Engineers	Throughout construction
	Acid Sulfate Soils						
SW33.	If Potential Acid Sulfate Soils (PASS) are encountered during excavation works, apply measures in the Acid Sulfate Soils Contingency Plan attached		■	Entire Site	COA SSI-5100 E46d(v), COA SSI-5414 E34d(v)	Environment Manager	When PASS located

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	in Appendix 4.				REMM SSI-5100 SG25, REMM SSI-5414 OpSG25		
	Contaminated Materials						
SW34.	Conduct Stage 2 contamination site investigations of newly identified contamination, if required (in consultation with TfNSW), to determine whether or not site is suitable for the intended land use, or can be made suitable for reuse through the application of a Remediation Action Plan (or similar).	■		Potentially contaminated areas	REMM SSI-5414 OpSG12, OpSG39-41, OpSG46	Environment Manager (in consultation with TfNSW)	Prior to construction in potentially contaminated areas
SW35.	Specialist advice will be sought in relation to the management of any soil contamination encountered which requires investigation and remediation prior to the commencement of construction works in accordance with the requirements of the Contaminated Land Management Act 1997 and Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (EPA, 1997).	■		Identified contaminated areas	COA SSI-5100 C15, REMM SSI-5414, OpSG11, OpSG47, Deed 3.11a, Deed SWTC 7.17	Environment Manager (in consultation with TfNSW)	Prior to construction in identified contaminated areas
SW36.	If suspected contaminated materials are encountered, follow Section 4.4.7 of the *Contaminated Land Management System Procedure* (MSF22X) attached in Appendix 5. If contamination material is suspected to be asbestos refer to *Contaminated Materials Risk Management Procedure (MSP22C).* Cease work in the immediate area until contamination type and extent is assessed by contamination specialist and required management measures implemented. **IND**		■	Entire Site	COA SSI-5100 E46d(vi), COA SSI-5414 E34d(vi) REMM SSI-5100 SG13-15, REMM SSI-5414 OpSG13-15	Environment Manager (in consultation with TfNSW)	When unexpected find located
SW37.	Separately stockpile potentially contaminated material during building demolition for waste classification and appropriate disposal off-site.		■	Building demolition areas	REMM SSI-5100 SW39	Site Superintendent	During building demolition
	Soil Salinity						

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
SW38.	Prepare a soil salinity report to determine the presence, extent and severity of soil salinity. Appropriate soil salinity mitigation measures in the report will be included in this plan and PESCPs as required. See mitigation measures SW46-SW50 below.	■	■	Entire Site	COA SSI-5100 C9, COA SSI-5414 C35 REMM SSI-5100 OpSG35, REMM SSI-5100 OpSG34	Environment Manager / Coordinator	Prior to construction / Prior to excavation of sub-soil along main alignment
	Source water management						
SW39.	Incorporate water efficient appliances and water storage tanks into the site establishment design. Monitor or meter water consumption at the site offices and onsite to allow for reporting or estimation of water use.	■	■	Construction compounds	CEMF 15.4	Construction Manager / Sustainability Manager	Throughout construction
SW40.	Purchase & use water efficient appliances (eg. dual flushing toilets, waterless urinals, taps, showers, washing machines)	■	■	Construction compounds	CEMF 15.4	Construction Manager	Throughout construction
SW41.	Recycle collected stormwater (e.g. collected in sediment basins) on-site for non-potable use such as dust suppression. Use in preference to potable water whenever possible.	■	■	Construction compounds, sediment basins	COA SSI-5100 E34, COA SSI-5414 E28	Construction Manager	Throughout construction
	Groundwater						
SW42.	Develop a groundwater monitoring plan (part of Appendix 1).	■		Entire Site	CEMF 7.2(a)	Environment Manager	Prior to construction
SW43.	Where possible, limit groundwater inflows to stations and cross-overs	■	■	Entire Site	CEMF 7.3	Construction Manager	Throughout construction
SW44.	Manage groundwater as per the environmental approval documentation and in accordance to relevant licenses.		■	Entire Site	CEMF 7.2(a)	Construction / Environment Manager	Throughout construction
SW45.	Maintain records of groundwater discharge and compliance as required in any relevant licences		■	Entire Site	CEMF 7.2(a)	Environment Manager	Throughout construction
	Soil Salinity						

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
SW46.	**Management of Potential Infiltration** Excess infiltration of water; e.g. from excessive irrigation, infiltration of stormwater, leaking stormwater basins/ponds, will be managed by applying the following: • Sediment basins will be de-watered within 5 dry (rain-free) days of a rainfall event that caused inflow. • Dust suppression using water carts will avoid over-watering and only use sufficient water to manage dust rise. Surface ponding will be avoided during dust suppression. • Irrigation of rehabilitated or landscaped areas will utilize low-water-use fixtures such as drippers, sub-surface irrigation or similar, where practicable. Water will be applied sparingly and only in quantities sufficient to promote plant growth. Subsoil moisture will be physically checked (through visual observation) regularly during irrigation to ensure watering rates are not excessive. • Wherever possible, effluent from ablutions onsite will be connected to existing sewer or will use portable systems that are regularly pumped-out or replaced. If this is not possible and an onsite wastewater treatment system is used, disposal of treated effluent must use a surface or near-surface system that relies mainly on evaporation. Infiltration systems (e.g. trenches) are not recommended. • Water used for construction purposes (e.g. to achieve adequate compaction rates) will be applied sparingly and carefully to minimise the potential for infiltration. • Any stockpiles of potentially-saline material (refer to Section 5.2 of Soil Salinity Report) are to be covered with impermeable material (e.g. builders' plastic) to minimise the risk of saline water leaching from the stockpile. Alternatively, stockpiles are to be completely bunded to minimise runoff and collected water evaporated or treated prior to release.		■	Per Soil Salinity Report (Appendix 8) All areas between: - Chainage 42660 to 43600 - Chainage 43920 to 44080 - Chainage 46480 to 46610; and - Chainage 45800 to 46000	COA SSI-5100 C9, COA SSI-5414 C35 REMM SSI-5100 OpSG35, REMM SSI-5100 OpSG34	Construction Manager	Throughout construction
SW47.	**Management During Excavations** Interception of saline subsoil by earthworks (cuttings, trenches, piers) will be		■	As prescribed in Table 8 of the Soil Salinity Report	COA SSI-5100 C9, COA SSI-5414 C35	Environment Manager / Construction	Throughout construction

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	managed by applying the following: Soil testing as prescribed in Table 8 of the Soil Salinity Report (App. 8). If Electrical Conductivity (EC) < 3 dS/m, the soil may be considered non-saline to slightly saline and may be managed without mitigation. If the field EC value is more than 3 dS/m, the soil must be considered saline and should be separated from non to slightly-saline material for the purpose of spoil management. Options for management include (but are not limited to): • Disposed at landfill; or • Re-buried onsite (e.g. in a fill); or • Shandied with non-saline material (note that expert advice from a soil scientist is recommended prior to undertaking this); or • Stockpiled and covered with non-permeable material such as builders' plastic for later re-use or while management options are determined. In that case a soil scientist can be engaged to determine other potential options for managing saline material.			(App 8).	REMM SSI-5100 OpSG35, REMM SSI-5100 OpSG34	Manager	
SW48.	**Management of Saline Groundwater** The following management measures will be adopted during ISJV's works: • If groundwater is encountered during excavations it will be tested for salinity using a calibrated, good-quality probe. • If the salinity reading is below 800 µS/cm, no specific management measures are required. Water can be pumped out to the receiving environment or onto well vegetated lands or used as required (subject to the Project's discharge procedure(s) and other water quality requirements being met such as turbidity and pH). • If the salinity exceeds 800 µS/cm then it could exceed the salinity of the nearest receiving water (Table 7 of Soil Salinity Report). In that case, options include (but are not limited to): o The receiving waters can be tested and, if they have higher salinity than was recorded onsite, site water can be pumped to the receiving waters; or o Saline water can be disposed of via a trade waste agreement		■	Entire site	COA SSI-5100 C9, COA SSI-5414 C35 REMM SSI-5100 OpSG35, REMM SSI-5100 OpSG34	Environment Manager	Throughout construction

ISJV Ref.	Mitigation Measure	Design	Construction	Relevant Location / Activity	Relevant Approval Conditions	Responsibility	Timing
	with Sydney Water (i.e. drain to sewer). Note that a permit is required; or o Saline water can be pumped to shallow, lined ponds or bunds for evaporation; or o Saline water can be shandied with fresh water elsewhere onsite (e.g. in sediment basins), providing this would not compromise the requirements to have basins emptied within 5 days of rainfall ceasing (note that expert advice from a water scientist is recommended prior to undertaking this); or o Saline water can be treated using a proprietary water treatment system (e.g. Enviss or Ultraclear) prior to discharge from site; or o Engage an environmental specialist with experience in the management of soil and water to advise on potential options.						
SW49.	**Soil Compaction** As explained in section 5.5 of Soil Salinity Report, earthworks will not proceed in the section from Chainage 45800 to 46000 until a Phase 2 and Phase 3 investigation (in accordance with DLWC, 2002) is undertaken.	■	■	Chainage 45800 to 46000	COA SSI-5100 C9, COA SSI-5414 C35 REMM SSI-5100 OpSG35, REMM SSI-5100 OpSG34	Construction Manager / Environment Manager	Prior to construction / Throughout construction
SW50.	**Bulk earthmoving activities** will not commence in untested areas (see borehole and chainage location in adjacent column) unless: • The outstanding soil analyses have been undertaken and this assessment report has been updated and submitted to the Director General; or • An alternative plan for managing any potential salinity issues is prepared for those areas, a copy of which must be submitted to the Director General.	■	■	Boreholes BH677(Chainage 44140)	COA SSI-5100 C9, COA SSI-5414 C35 REMM SSI-5100 OpSG35, REMM SSI-5100 OpSG34	Environment Manager / TfNSW	Prior to construction / Throughout construction

7 MONITORING

Item	Frequency	Standards	Action/Reporting	Responsibility
As per Water Quality Monitoring Plan (Appendix 1).	-	-	-	-
Condition and capacity of chemical and fuel storage areas.	Daily	No leaks or damage, no rainwater within bunds	Immediately rectify, if required	Site Supervisor
Condition of erosion and sediment controls (ESCs) and chemical and fuel storage areas.	Weekly during construction Additional inspections following significant rainfall events (greater than 20 mm in 24 hours) Additional inspections prior to site closure of 24 hours or more	ESCs: >70% capacity	Immediate if required ISJVSVC-PMS MSF43-2 Environmental Inspection Checklist	Environmental Co-ordinator Soil Conservationist, if required
Ongoing monitoring of soil salinity mitigation measures is recommended to verify the effectiveness of the adopted management measures	Weekly	Visual Inspection	The management plan contained in Section 5 of the Soil Salinity Report should be reviewed and updated, as required.	Environmental Co-ordinator Soil Conservationist, if required
Maintain record of licence discharge points	As required	EPL 20454 Condition s P1.3 and P1.4	SVC Discharge Register	Environmental Co-ordinator
Monitor water prior to discharge	As required	EPL 20454 Conditions M, M2 and M3	Dewatering Management System Form MSF 22P-1	Environmental Co-ordinator
Records of Erosion & Sediment Control Plans	As required		Erosion & Sediment Control Plan Register MSR220-1	Environmental Co-ordinator
Environmental Monitoring Data Report	Monthly	POEO Act Section 66(6)	ISJV Website	Environment Manager

Item	Frequency	Standards	Action/Reporting	Responsibility
EPL Non-compliance and Discharge Report	Monthly	EPL 20454 Condition R4.4	To EPA	Environment Manager
Weather forecasts	Prior to commencement of works in riparian areas	Forecast storms, flooding, heavy rain or forecast of >20mm in one day.	The site will be inspected to ensure all erosion and sediment control measures are in place and working effectively; and The Environment Manager or Coordinator will communicate the perceived risk of environmental harm to construction personnel so they can take appropriate action.	Environmental Co-ordinator

8 TRAINING AND RESOURCES

Training
Inductions are required and are to address: Matters identified by the term "**IND**" ("Induction") in the mitigation measures section 6. • Requirements for sediment and erosion control; • Spill containment and management procedures; • Water re-use and discharge procedures. Site Inductions are recorded in the Projects' on-line system (Damstra), checked with MSF15-7 induction assessment form and maintained in Damstra. The MSF15-6 Site Induction Form and MSR15-3 Site Induction Register have been superseded by Damstra even though a lot of the information requirements from these documents have been retained in Damstra. Specific soil and water requirements for each work area will also be raised each work day as part of the daily prestart assessment procedure and be recorded on a SEA Card (MSF22-6). Toolbox talks will be used to reinforce and reiterate key information from the project induction as well as to address new or changed procedures for environmental management. This might include (but is not limited to): • Erosion and sediment control installation and maintenance; • Road cleanliness with regard to trucks leaving the site; • Site de-watering; • Concrete and chemical washout; • Storage, transport and use of potential contaminants; • Contents and use of spill kits. If required, soil conservation training for personnel with special responsibilities will be provided. This may include training in sediment basin flocculation and water quality management.
Resources
• Temporary erosion and sediment controls (eg. geotextile, polymer sprays, sandbags, silt socks etc); • Water treatment and flocculation products (e.g. gypsum, hydrated lime etc.); • Water monitoring equipment such as pH meters, turbidity meters, sample bottles etc. Note that all testing equipment will be calibrated as per manufacturer's recommendations; • Ongoing testing of water quality through a registered laboratory (i.e. set up an account to enable fast turnaround); • Excavators; • Rumble grid/shakers; • Street sweeper available/accessible;

- IBCs/tanks plus pumps available/accessible to enable water treatment or spraying of erosion control products;
- Bunded areas, with spill kits;
- Labour – Dedicated crew of 2 to 3 people to maintain erosion and sediment controls, following topsoil stripping along the main alignment and maintained until the risk of erosion decreases as lands are stabilised;
- Soil Conservation Specialist to conduct regular inspections and provide ongoing expertise, as required. Initially these will be fortnightly during topsoil stripping along the main alignment and main civil works, but will decrease in frequency as the risk of erosion decreases as lands are stabilised.

9 REFERENCES AND REVISIONS

Related Documents
Dewatering Form PSF22P-1
Dewatering Work Instruction PWI22P-2
ISJV Management System - MSP22H Hazardous Chemicals Risk Management Procedure
ISJV Management System - MSP22P Water Quality Management Procedure
ISJV Management System - MSP22Q Soil Conservation Management Procedure
Note: Access to ISJV Management System procedures will be made available through iTwoCx.
References
ANZECC & ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.
ANZECC & ARMCANZ (2000) *Australian Guidelines for Water Quality Monitoring and Reporting.*
NSW Department of Housing/Landcom (2004) *Managing Urban Stormwater: Soils and Construction* (the 'Blue Book').
DECC (2007) *Storing and Handling Liquids: Environmental Protection: Participants Manual*.
NTC (2011) *Australian Dangerous Goods Code, 7th Edition.*
EPA (1997) *Environment Protection Manual for Authorised Officers: Bunding and Spill Management*, technical bulletin.
NSW Office of Water (July 2012) *Guidelines for Instream Works on Waterfront Land*.
NSW Office of Water (July 2012) *Guidelines for Outlet Structures on Waterfront Land*.
NSW Office of Water (July 2012) *Guidelines for Watercourse Crossings on Waterfront Land*.
EPA (1997) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*.

Acid Sulfate Soil Management Advisory Committee (1998) *Acid Sulfate Soil Manual*.

Revision, Control & Amendment

Review of this Plan will be undertaken in accordance with section 6.5 of the CEMP and any revisions to this Plan will be made as required in section 4.2.3 of the CEMP and in accordance with MSP18 'Document and Data Control'. The Environmental Manager will review outstanding issues and comments provided by the ER (Independent Environmental Representative), IC (Independent Certifier), Principal's Representative or authorities and address these either:

- in time to be endorsed by the IC and reviewed by the Principal's Representative prior to commencement of any related activities or work; or
- at the next Management Review of the plan as outlined in the Project Management Plan.

10 INCIDENT PLANNING AND RESPONSE

Incident Planning & Response
Environmental incidents will be reported immediately as per ISJV's SVC Environmental Incident Management Procedure (MSP42B) to a Site Supervisor who will contact either the Project Manager or Environmental Manager. All incidents will be investigated and appropriate actions taken to address the issue. Environmental incidents that cause or threaten material harm will be reported to EPA and other authorities in accordance with the ISJV's Pollution Incident Response Management Plan (PIRMP). Details will also be reported to the ER, DP&E, and TfNSW, as per the PIRMP and SVC Incident Management Procedure. Any water quality monitoring in response to an incident will be undertaken as required or in response to authority directions. Potential incidents that could arise during the works include the following: • Unauthorised discharge of water from the project that does not meet EPL criteria. • Oil or fuel spill (e.g. hydraulic hose burst). • Damage to environmental controls. • Damage to sediment basin. • Discovery or accidental disturbance of contaminated (or potentially contaminated) material.

No.	Situation	Response	Responsibility
1	Unauthorised discharge of water that does not meet EPL criteria	**Discharge, or relevant part of discharge, to immediately cease and the Environment Manager contacted.** **Implement Pollution Incident Response Management Plan** Plans, processes and procedures to be reviewed by the Environment Manager and relevant construction personnel to determine the cause of the incident, potential for re-occurrence and appropriate management or mitigation measures to prevent re-occurrence. Plans, processes or procedures are to be updated or modified as required and the workforce advised of the changes or updates via toolbox training or similar.	Environment Manager
2	Oil or fuel spill (eg. hydraulic hose burst)	**Machinery or process to cease, if safe to do so. Spill kit to be used to contain and clean up spill. Machinery or process responsible for the spill is not to start operation until a full inspection and necessary repairs / corrective action has been implemented.** **Implement Pollution Incident Response Management Plan** Plans, processes and procedures to be reviewed by the Environment Manager and relevant construction personnel to determine the cause of the incident, potential for re-occurrence and appropriate management or mitigation measures to prevent re-occurrence.	Environment Manager/Site Superintendent

		Plans, processes or procedures are to be updated or modified as required and the workforce advised of the changes or updates via toolbox training or similar.	
3	Temporary erosion and sediment controls are damaged or rendered ineffective	Control to be repaired or replaced within 24 hours of detection or prior to next rainfall (whichever is sooner). Plans, processes or procedures are to be updated or modified, as required. If required, toolbox session conducted to reinforce the importance of maintaining and preserving environmental controls.	Environmental Manager
4	Damage to (or failure of) sediment basin	**Water in damaged sediment basin to be pumped to another sediment basin, or discharged if it meets the EPL criteria. Damage to be repaired ASAP.** **Implement Pollution Incident Response Management Plan** Repairs to be monitored over the next rain event. Plans, processes or procedures are to be updated or modified as required.	Environmental Manager/Site Superintendent
5	Accidental discovery or disturbance of contaminated (or potentially contaminated material).	**Machinery or process to cease, if safe to do so. All personnel to clear the area and medical treatment made available if necessary.** **Implement *Contaminated Materials Contingency Plan* (Appendix 5)** **If asbestos, implement *Contaminated Materials Risk Management Procedure (MSP22C*)** No work is to occur in the area until it is deemed safe. Plans, processes or procedures are to be updated or modified as required. Toolbox training to be provided to relevant personnel regarding contaminated materials, If required.	Environmental Manager/Site Superintendent

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APPENDIX 1 - **Water Quality Monitoring Program**[1]

[1] The WQMP is required under a separate CoA and is included in this CSWMP for convenience, rather than necessity

Sydney Metro North West

Design and Construction of Surface and Viaduct Civil Works

Water Quality Monitoring Program

NWRLSVC-ISJ-SVC-PM-PLN-120204

Revision 10.0

28 February 2017

Document Control

A controlled copy of the Water Quality Monitoring Program will be distributed to the Principal's Representative, Independent Certifier and other relevant stakeholders and will be available to all ISJV employees in soft copy format through the digital document control management system.

The Water Quality Monitoring Program if printed will be uncontrolled and it will be the responsibility of each user to confirm the currency of the plan through the digital document control management system.

Document distribution will be controlled in accordance with ISJV-SVC-PMS procedure MSP18 Document & Data Control.

Document Revision History

Doc No **NWRLSVC-ISJ-SVC-PM-PLN-120204**

Revision	Description	Prepared by	Reviewed by	Approved by	Date
1.0	Initial Plan	WSP Environmental	Steve Fermio		
2.0	Issued for Approval			S Turnbull	14-Apr-14
3.0	Updated Plan	WSP Environmental	Steve Fermio	S Turnbull	3-Jun-14
4.0	Updated Plan	WSP Environmental	Steve Fermio	Graeme Tait	6-Jun-14
5.0	Revised in response to DP&E Review	T. Austin	Steve Fermio	Graeme Tait	25-Jun-14
6.0	Revised in response to TfNSW comments	R.Pollard	S.Fermio	Graeme Tait	2-Sep-14
7.0	Plan Updated (added licence conditions, ID groundwater piezometers, clarify reporting arrangement, App B modified,	R.Pollard	T.Austin	M. Alpini	16-Apr-15

8.0	Plan updated with outcomes from Annual Water Report.	D. Malysiak	T.Austin	I. Stuart	02-Mar-16
9.0	Revised in response to TfNSW comments	J. Burgin	B. Tucker	G. Perdikaris	25-Oct-16
10.0	Revised in response to TfNSW comments	J. Burgin	B. Tucker	G. Perdikaris	**28 February 2017**
Signature					

Contents

ACRONYMS & GLOSSARY

Ambient Level	Existing level of a phenomenon without the influence of construction activities
ANZECC	Australian and New Zealand Environment Conservation Council
BoM	Bureau of Meteorology
CEMF	Construction Environmental Management Framework (Submissions Report, Section 3)
CEMP	Construction Environmental Management Plan
CM	Construction Manager(s) (ISJV)
COA	Conditions of Approval
DP&E	Department of Planning and Environment (formerly DP&I)
DPI	Department of Primary Industries (Fisheries)
DP&I	Department of Planning and Infrastructure
EIS	Environmental Impact Statement
EM	Environment Manager (ISJV)
Emission	A discharge of a substance (e.g. dust) into the environment
EMS	Environmental Management System
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ER	Independent Environmental Representative
IC	Independent Certifier
IMP-BMS	Impregilo S.p.A. (Australia) – Business Management System
Incident	Any unplanned or undesired event which results in or has potential to result in injury, ill health, damage, to or loss of property, interruption to operations or environmental impairment. An incident also includes a near miss, breach of procedure, quality failure, injuries to employees, contractors or members of the public and any other statutorily reportable occurrence. Water quality incidents are further described in section 4.9
ISJV	Impregilo S.p.A. (Australia) and Salini (Australia) Joint Venture / Principal Contractor
Mitigation Measures	Measures employed to reduce (mitigate) an impact
NOW	NSW Office of Water, Department of Primary Industries
NWRL	North West Rail Link
OEH	Office of Environment and Heritage
PIRMP	Pollution Incident Response Management Plan
PMS	Project Management System
POEO Act	Protection of the Environment Operations Act 1997
Pollution	The alteration of air, soil, or water as a result of human activities such that it is less suitable for any purpose for which it could be used in its natural state
REMM	Revised Environmental Mitigation Measures (Submissions Report, Section 7)
RMS	Roads and Maritime Service (formerly RTA)
SSI	State Significant Infrastructure
SVC Works	Surface Viaducts and Civil Works, for the North West Rail Link Project
SWTC	Scope of Work and Technical Criteria
TfNSW	Transport for New South Wales

1 INTRODUCTION

The NWRL project is a key priority for the NSW Government. The NWRL will deliver a new high frequency single deck train system initially operating as a shuttle between Cudgegong Road and Chatswood. The project includes eight new stations, approximately 15.5km of tunnels from Epping to Bella Vista, a 4.5km elevated 'skytrain' (viaduct) between Bella Vista and Rouse Hill, and conversion of the Epping to Chatswood Rail Link to deliver high frequency rapid transit services.

Stations are planned at Cherrybrook, Castle Hill, Showground, Norwest, Bella Vista, Kellyville, Rouse Hill and Cudgegong Road. Bus, pedestrian, cycling and easy access facilities will be provided at all stations, with approximately 4000 'Park and Ride' spaces spread across five sites.

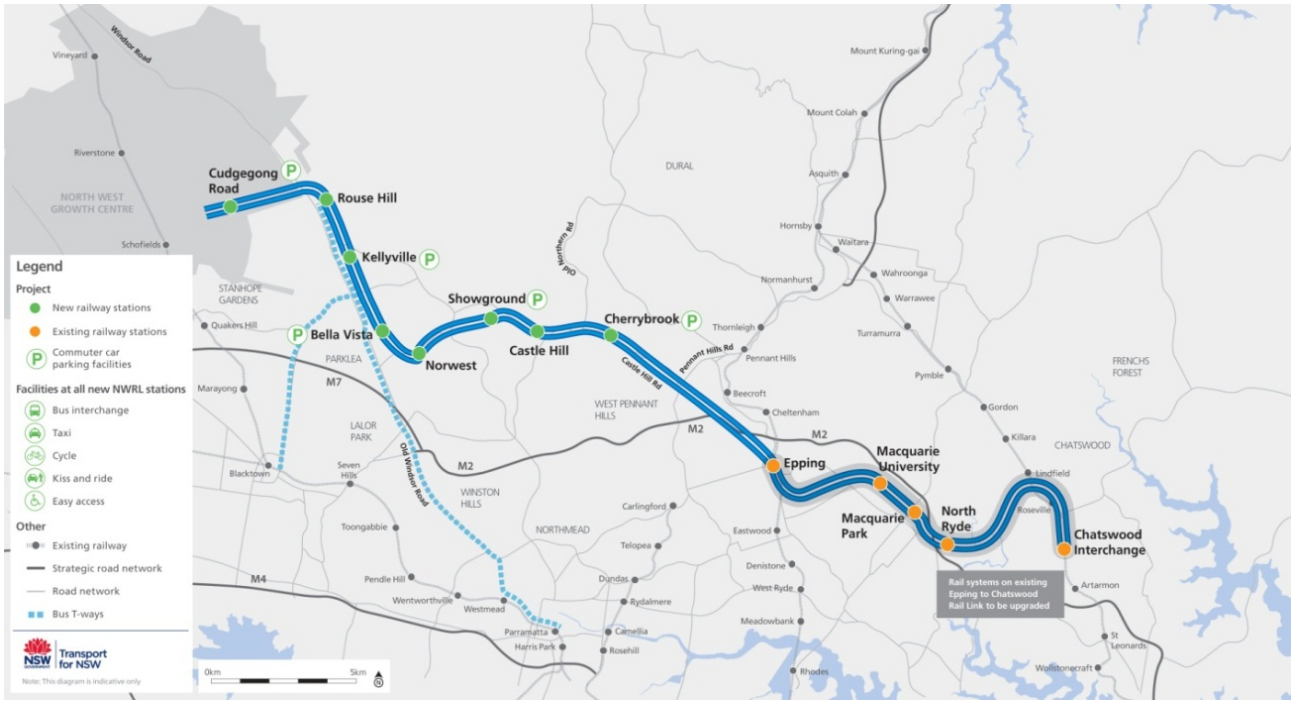


Figure 1: The North West Rail Link service proposed alignment

The scope of the SVC Project works consists of the detailed design, construction and handover of the viaducts, bridges and associated civil works required for the 6.3km of the NWRL between Bella Vista and Cudgegong Road and includes establishment and reinstatement of worksites, spoil removal and disposal and all required utility relocations and adjustments at construction worksites.

The 6.3 km of permanent infrastructure to be delivered includes:

- Approximately 4.5 km of viaduct between Balmoral Road and Rouse Hill Station including crossings over Memorial Avenue, Samantha Riley Drive, Windsor Road, Sanctuary Drive and White Hart Drive
- Bulk earthworks requirements including all cut, fill and embankments between Balmoral Road and Cudgegong Road
- A bridge over Windsor Road / Rouse Hill
- A bridge over Second Ponds Creek

- Allowance for station structures to be incorporated onto the viaduct at the Kellyville and Rouse Hill station sites
- Adjustments to existing infrastructure and roads within the construction site and / or otherwise affected by ISJV activities
- Safe, secure personnel access / egress into site areas including necessary temporary support services and site facilities, with hoardings, fencing and so on around worksites to be left in place upon completion
- Construction traffic and transport management including temporary and permanent traffic management works
- Removal of all temporary work and site facilities not otherwise required for handover to subsequent contractors.

Activities associated with the temporary and SVC Contractor works required in order to complete construction include:

- Safe, secure personnel access / egress into site areas including necessary temporary support services and site facilities, with hoardings, fencing and the like around work sites to be left in place upon completion
- Construction traffic and transport management including temporary and permanent traffic management works
- Removal of all temporary work and site facilities not otherwise required for handover to subsequent contractors.
- Construction of temporary T-way car parking at Rouse Hill and Kellyville
- Construction, removal and transportation of the gantry along the SVC construction zone
- Temporary changes to site personnel access/egress
- Signage, fencing and hoarding
- Construction environmental management activities
- Construction traffic management activities
- Interface and communications within SVC Contractor team and across NWRL team
- Stakeholder liaison activities
- Adherence to NWRL protocols and procedures.

2 GOALS, OUTCOMES, KEY ISSUES

Scope	This Water Quality Monitoring Program has been prepared to monitor the extent and nature of potential impacts to surface and ground water quality during construction of the Surface Viaducts and Civil (SVC) Works component of the North West Rail Link (NWRL). The scope of the SVC Works' water quality monitoring program relates to construction sites along the 6.3 km above ground section of the NWRL route from Bella Vista to Rouse Hill, which is a combination of viaduct, embankment, at grade and cutting. This program is based on identified environmental aspects and potential impacts to surrounding watercourses from construction activities in each of the SVC sites, and identifies guidelines and standards to be adhered to. The monitoring program covers pre-construction and construction stages, but does not cover the post-construction/operation phase. Monitoring requirements following construction of the SVC works will be agreed in consultation with TfNSW. Any recommendations on groundwater monitoring in the Soil Salinity Report (CoA C9) will be included in this Program, if relevant. This plan forms part of the Impregilo S.p.A. (Australia) and Salini (Australia) Joint Venture (ISJV) Business Management System and should be read in conjunction with plans shown below in Figure 2. It is an attachment to the *Construction Soil and Water Management Plan*.
Goals	Implement a comprehensive management and monitoring regime to assess the extent and nature of any potential impacts to local water quality
Intended Outcomes	Implementation of the Water Quality Monitoring Program to monitor impacts on surface water and groundwater quality, resources and wetlands
Key Issues and Sensitive Areas	The SVC construction works involves disturbance and exposure of the underlying soils that has the potential to lead to increased erosion and sediment transport and ultimately sedimentation in downstream water bodies. The potential for sediment transport and sedimentation issues is influenced by factors such as severity of storm events and rainfall, the slope and footprint of the disturbed/exposed soil area and the mitigation and management controls that are implemented on site. Potential impacts on water quality could also result from erosion and sedimentation generated during excavation and spoil handling, and from spills from plant and machinery. The SVC corridor crosses a number of named and unnamed tributaries of the Hawkesbury River. There is a mix of undisturbed sites that may contain sensitive ecological areas and impacted riparian zones associated with the waterways. Impacts include existing modification to the drainage path, clearing, drainage off agricultural areas and flow impediments (e.g. dams, culverts). Waterways potentially impacted from Bella Vista Station to Tallawong Stabling Facility: • Caddies Creek (tributary of Cattai Creek). • Caddies Creek Tributary 5. • Caddies Creek Tributary 4. • Caddies Creek Tributary 3. • Second Ponds Creek (tributary of Caddies Creek).
Statutory Requirements	Key legislation relevant to water quality monitoring includes:

	• *Protection of the Environment Operations Act 1997* • *Water Management Act 2000* Additional guidelines and standards relating to water quality monitoring include: • *NOW Guidelines for Controlled Activities.* • *ANZECC Guidelines for Fresh and Marine Water Quality.* • *ANZECC Guidelines for Water Quality Monitoring and Reporting.* • *Policy and Guidelines for Fish Habitat Conservation and Management 2013 (NSW Fisheries).* • *Landcom Managing Urban Stormwater - Soils and Construction Volumes 1 and 2 (referred to as the Blue Book, 2004 and 2006).*
Relationship to Other Plans	The Water Quality Monitoring Program is an attachment of the **Construction Soil and Water Management Plan**, which includes the following: • Acid Sulfate Soil Contingency Plan • Contaminated Materials Contingency Plan • Primary Erosion and Sediment Control Plan • Dewatering Work Instruction • Soil Salinity Report Related management plans include: • Sustainability Plan • Spoil Management Plan • Flora and Fauna Management Plan • Construction Environmental Management Plan
Environmental Aspects & Impacts	Refer to environmental aspects and impacts identified in the Environmental Risk Register, for example refer to CEMP Appendix 5.
Licence & Permit Requirements	The requirements of EPL 20454 for SVC works have been included in Section 3.6 of this plan. These requirements will be updated with each relevant licence variation issued by EPA. There are no current permit requirements.

CEMP	CEMP interface plans
Construction Environmental Management Plan	Project Management Plan
	Design Plan
	Construction Plan
	Risk Management Plan
	Quality Plan
	Project Training Management Plan
	Community Liaison Implementation Plan
	Earthworks Plan
	Site Specific Emergency Response Plan
	Interface Plan
	Sustainability Plan
	Training Plan
	inputs to Compliance Tracking Procedure

Environmental Management Plans	Attachments
Construction Noise and Vibration Management Plan	
Construction Soil and Water Management Plan	Soil Salinity Report
	Water Quality Monitoring Program
Construction Heritage Management Plan	
Construction Flora and Fauna Management Plan	Nest Box Management Plan
	Ecological Monitoring Program
Construction Air Quality Plan	
Construction Compound Ancillary Facilities Management Plan	
Construction Traffic Management Plan Including	
Pollution Incident Response Management Plan	
Monitoring and Protection Plan	
Sustainability Plan	Carbon and Energy Management Plan
	Spoil Management Plan
	Waste Management and Recycling Plan
Visual Amenity Management Plan	
Stormwater and Flooding Management Plan	

KEY:

CEMP	Plan Interface
EMP	Interface with TfNSW Plan
Attachment	

Figure 2: ISJV CEMP Structure

Note: Site Specific Emergency Response Plan now called Project Emergency Plan

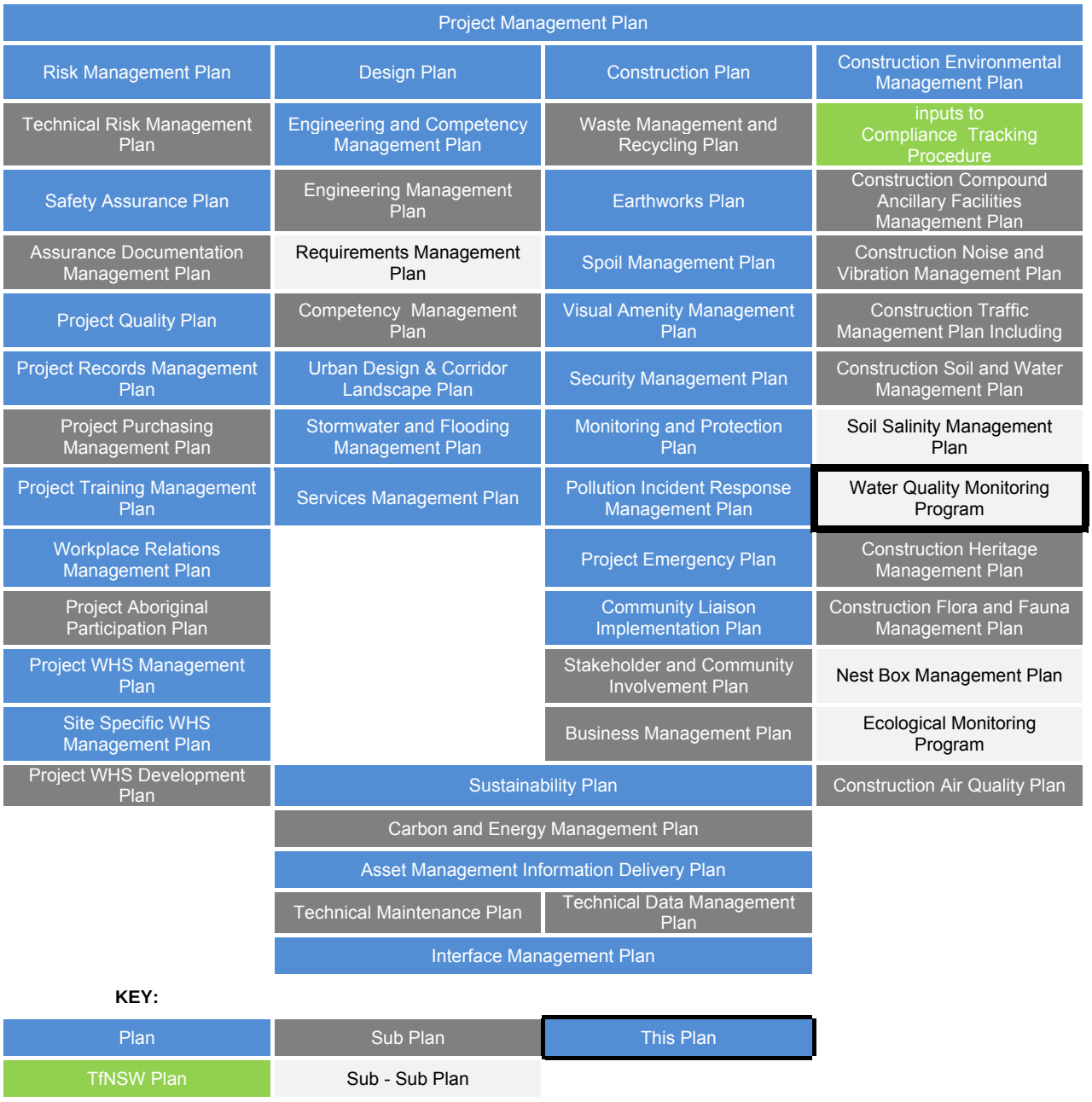


Figure 3: Water Quality Monitoring Program within the Project Management System

3 STATUTORY REQUIREMENTS

3.1 COA - Major Civil Construction Works (SSI-5100)

No.	Ref.	Relevant Requirement	Reference
1.	C11	A Water Quality Monitoring Program shall be prepared and implemented to monitor impacts on surface and groundwater quality resources and wetlands. The Program shall be developed in consultation with the EPA, DPI (Fisheries) and NOW and shall include but not necessarily be limited to:	This Program. Consultation in Appendix C
	C11 (a)	identification of surface and groundwater quality monitoring locations which are representative of the potential extent of impacts from the SSI;	Appendix B
	C11 (b)	identification of the water quality parameters to be monitored at each location;	Section 6
	C11 (c)	identification of works and activities during construction of the SSI, including emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways;	Sections 5 and 8
	C11 (d)	presentation of parameters and standards against which any changes to water quality will be assessed, having regard to the principles of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC, 2000), and identification of 'trigger points' for further investigation or action to be taken;	Section 6
	C11 (e)	representative background monitoring of surface and groundwater quality parameters, to establish baseline water conditions, unless otherwise agreed by the Director General;	Sections 4 and 6
	C11 (f)	identification of the frequency of water sampling during background, and construction monitoring periods;	Section 6
	C11 (g)	a minimum monitoring period of three years following the completion of construction or until the affected waterways and/ or groundwater resources are certified by an independent expert as being rehabilitated to an acceptable condition;	N/A – see Section 2
	C11 (h)	contingency and ameliorative measures in the event that adverse impacts to water quality relevant to the SSI are identified; and	Sections 7 and 8
	C11 (i)	reporting of the monitoring results to the Department, EPA, DPI and NoW.	Section 7
2.	E46(d)	A **Construction Soil and Water Management Plan** to manage surface and groundwater impacts during construction of the SSI. This plan will be consistent with other documents and shall be developed in consultation with the EPA and NOW. It will include, but not necessarily be limited to:	
		(iii) surface water and ground water impact assessment criteria consistent with the principles of the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines;	Section 6
		(vii) a description of how effectiveness of these actions and measures would be monitored during proposed works, clearly indicating	Sections 6 and 7

No.	Ref.	Relevant Requirement	Reference
		how often this monitoring would be undertaken, the locations where monitoring would take place, how the results of the monitoring would be recorded and reported, and, if any exceedance of the criteria is detected how any non-compliance can be rectified; and	

3.2 COA - Stations, Rail Infrastructure and Systems (SSI-5414)

No.	Ref.	Relevant Requirement	Reference
3.	C37	A Water Quality Monitoring Program shall be prepared and implemented to monitor impacts on surface and groundwater quality resources and wetlands during construction and operation. The Program shall be developed in consultation with the EPA, DPI (Fisheries), NOW and relevant Councils and shall include but not necessarily be limited to:	This Program. Consultation in Appendix C
	C37 (a)	identification of surface and groundwater quality monitoring locations which are representative of the potential extent of impacts from the SSI. This should include representative locations near the discharge point of the Lady Game Drive Water Treatment Plant;	Appendix B
	C37 (b)	identification of the water quality parameters to be monitored at each location;	Section 6
	C37 (c)	identification of works and activities during construction and operation of the SSI, including emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways;	Sections 5 and 8
	C37 (d)	presentation of parameters and standards against which any changes to water quality will be assessed, having regard to the principles of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC, 2000), and identification of 'trigger points' for further investigation or action to be taken;	Section 6
	C37 (e)	representative background monitoring of surface and groundwater quality parameters, to establish baseline water conditions, unless otherwise agreed by the Director General;	Sections 4 and 6
	C37 (f)	identification of the frequency of water sampling during background, and construction monitoring periods;	Section 6
	C37(g)	a minimum monitoring period of three years following the completion of construction or until the affected waterways and/ or groundwater resources are certified by an independent expert as being rehabilitated to an acceptable condition;	N/A – see Section 2
	C37 (h)	contingency and ameliorative measures in the event that adverse impacts to water quality relevant to the SSI are identified; and	Sections 7 and 8
	C37 (i)	reporting of the monitoring results to the Department, EPA, DPI and NoW.	Section 7
		The Program shall be submitted to the Director General for approval prior to the commencement of construction of the SSI, or as otherwise agreed by the Director General. A copy of the Program shall be submitted to the EPA, DPI (Fishing and Aquaculture) and NOW prior to its implementation. The Water Quality Monitoring Program, prepared to meet condition C11 of State Significant Infrastructure approval SSI-5100, may be revised, if necessary and resubmitted.	
4.	E34(d)	A **Construction Soil and Water Management Plan** to manage surface and groundwater impacts during construction of the SSI. This	

No.	Ref.	Relevant Requirement	Reference
		plan will be consistent with other documents and shall be developed in consultation with the EPA and NOW. It will include, but not necessarily be limited to:	
		(iii) surface water and ground water impact assessment criteria consistent with the principles of the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines;	Section 6
		(vii) a description of how effectiveness of these actions and measures would be monitored during proposed works, clearly indicating how often this monitoring would be undertaken, the locations where monitoring would take place, how the results of the monitoring would be recorded and reported, and, if any exceedance of the criteria is detected how any non-compliance can be rectified; and	Sections 6 and 7

3.3 REMMs - Major Civil Construction Works (SSI-5100)

No.	Ref.	Relevant Requirement	Reference
5.	SW42	A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring programme would commence prior to commencement of any construction works and would build on available water quality data.	Section 6
6.	SW43	Surface water and water quality monitoring would be carried out periodically and after rainfall events. Monitoring would examine a range of appropriate indicators in accordance with standard guidelines.	Section 6
7.	E20	The areas identified as ‘likely’ or ‘potential’ Groundwater Dependent Ecosystems (GDEs) would be considered in development of the groundwater monitoring plan. Any groundwater monitoring undertaken within these areas would include monitoring of water quality and levels.	Section 6

3.4 REMMs - Stations, Rail Infrastructure and Systems (SSI-5414)

No.	Ref.	Relevant Requirement	Reference
8.	OpSG20	Groundwater quality would be subject to testing. Where it does not meet license requirements it would be treated prior to discharge.	Section 6
9.	SW42	A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring programme would commence prior to commencement of any construction works and would build on available water quality data.	Section 6
10.	SW43	Surface water and water quality monitoring would be carried out periodically and after rainfall events. Monitoring would examine a range of appropriate indicators in accordance with standard guidelines.	Section 6

3.5 CEMF Requirements

No.	Original Ref.	Relevant Requirement	Reference
11.	7.2(a)	NWRL Principal Contractors will develop and implement a Groundwater Management Plan for their scope of works. The Groundwater Management Plan will include as a minimum:	
		v. A groundwater monitoring plan.	Section 6
		vi. Compliance record generation and management.	Section 7
12.	7.2(b)	The Groundwater Monitoring Plan will: i. Outline the parameters to be monitored (field parameters and laboratory parameters) and the sample frequency. ii. Include details of a groundwater monitoring network to monitor groundwater levels and groundwater quality throughout the construction phase. The groundwater monitoring network will contain monitoring wells along the whole NWRL route intersecting groundwater in both the Ashfield Shale and Hawkesbury Sandstone.	Section 6

3.6 LICENCE AND PERMIT REQUIREMENTS

3.6.1 EPA Licence 20454

No.	Original Ref.	Relevant Requirement	Reference
13.	**P1** P1.1	**Location of monitoring/discharge points and areas** The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.	
14.	P1.2	The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation. ***Water and land***	

			EPA Identification no.	**Type of Monitoring Point**	**Type of Discharge Point**	**Location Description**	
			1	Discharge and monitoring at the outlet of sediment basins	Discharge and monitoring at the outlet of sediment basins	the outlet from sediment basins referred to in condition P1.3 of this licence	
15.	P1.3	The location of discharge points is defined by the most recently approved discharge point register held on the EPA Electronic File EF13/6603.					
16.	P1.4	The location of discharge points is defined by the most recently approved discharge point register held on the EPA Electronic File EF13/6603.					
17.	P1.5	The discharge point register must be submitted to the EPA no later than 5 business days prior to any proposed changes to the register.					
18.							
19.	**L1** L1.1	**Pollution of Waters** Except as may be expressly provided in any other condition of this licence, the licensee must comply with Section 120 of the Protection of the Environment Operations Act 1997.					This Plan
20.	**L2** L2.1	**Concentration limits** For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.					
21.	L2.2	Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.					
22.	L2.3	To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.					
23.	L2.4	**Water and/or Land Concentration Limits** **POINT 1**					

Pollutant	**Units of Measure**	**50 Percentile concentration limit**	**90 Percentile concentration limit**	**3DGM concentration limit**	**100 percentile concentration limit**
Oil and Grease	Visible				not visible

			pH	pH	6.5-8.5	
			Total suspended solids	milligrams per litre	50	
24.	L2.5	Exceedance of the limits specified in Condition L2.4 of this licence for pH and total suspended solids (TSS) for discharges from the sediment basins identified in Conditions P1.2 and P1.3 of this licence is only permitted if: (a) the discharge occurs solely as a result of rainfall measured at the Premises exceeding 24.6mm over any consecutive five (5) day period immediately prior to the discharge occurring from these basin(s); and (b) The sediment basins and other erosion and sediment controls on the site have been designed, constructed, installed, maintained and managed in accordance with best management principles and practices described in the guideline "Managing Urban Stormwater – Soils and Construction – Volume 1, 4th edition, 2004" produced by Landcom.			
25.	L2.6	If the licensee uses turbidity (NTU) in place of TSS to determine compliance with Condition L2.4, the licensee must develop a statistical correlation which identifies the relationship between NTU and TSS for water quality in the sediment basin/s in order to determine the NTU equivalent of 50 mg/L TSS before its use.				
26.	L2.7	The licensee must provide the EPA with a copy of the statistical correlation assessment methodology and results before using NTU in place of TSS.				
27.	L2.8	The licensee must develop and implement a method to enable the ongoing verification of the relationship between NTU and TSS.				
28.	L2.9	The licensee must provide the EPA with any amendments the licensee makes to the statistical correlation as a result of the ongoing verification required by Condition L2.7 before using the revised statistical correlation.				
29.	**O4** O4.1	**Processes and management** **Polymer-Based Flocculant** The licensee must ensure that any polymer based flocculants used to treat water before discharge from the premises has a 48-hour EC50 (immobilisation) for water fleas and a 96-hour EC50 (imbalance) for fish, greater than 100 milligrams per litre. Note: In accordance with the EPA Approved Methods Publication any analysis should be undertaken by a laboratory accredited to perform those analyses by an independent accreditation bod acceptable to the EPA, such as the National Association of testing Authorities (NATA) or equivalent.				
30.	**O6**	**Other operating conditions**				

<table>
<tr><td></td><td>O6.1</td><td>Erosion and sediment control
The licensee must, before undertaking any construction work (including any earthmoving or vegetation removal works), implement all soil and water management works required to minimise pollution of waters.</td><td>This Plan</td></tr>
<tr><td>31.</td><td>O6.2</td><td>The licensee must inspect the operation of soil and water management works installed on the premises and undertake any works required to repair and/or maintain these controls:
a) at least weekly during normal construction hours outlined in condition L4.1;
b) prior to any major rainfall event forecasted;
c) daily following a major rainfall event in any 24 hour period, if safe to do so; and
d) prior to any site closure of greater than 24 hours.</td><td></td></tr>
<tr><td>32.</td><td>O6.3</td><td>The licensee must record all such inspections, including observations and works undertaken to repair and/or maintain soil and water management works.</td><td></td></tr>
<tr><td>33.</td><td>O6.4</td><td>The licensee must ensure the design storage capacity of the sediment basins installed on the premises is reinstated within 5 days of the cessation of a rainfall event that causes runoff to occur on or from the premises.</td><td></td></tr>
<tr><td>34.</td><td>M2
M2.1</td><td>Requirement to monitor concentration of pollutants discharged
For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:</td><td></td></tr>
<tr><td>35.</td><td>M2.2</td><td>Water and/ or Land Monitoring Requirements
POINT 1
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Oil and Grease</td><td>Visible</td><td>Daily during any discharge</td><td>Visual Inspection</td></tr>
<tr><td>pH</td><td>pH</td><td>Daily during any discharge</td><td>In situ</td></tr>
<tr><td>Total suspended solids</td><td>milligrams per litre</td><td>Daily during any discharge</td><td>Grab sample</td></tr>
</table></td><td></td></tr>
<tr><td>36.</td><td>M3
M3.1</td><td>Testing methods - concentration limits
Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.</td><td></td></tr>
<tr><td>37.</td><td>M4</td><td>Weather monitoring</td><td></td></tr>
</table>

	M4.1	The licensee must monitor hourly temperature, humidity, wind velocity and rainfall at the Nearest Australian Bureau of Meteorology weather station or the project weather station.	
38.	M4.2	The rainfall monitoring data collected in compliance with M4.1 can be used to determine compliance with condition L2.5.	
39.	**R4** R4.4	**Other reporting conditions** **Monthly non-compliance and discharges report** The licensee must provide the EPA with a monthly report containing the following information: a) Details of all non-compliances with the conditions of this licence and measures taken, or proposed, to prevent a recurrence of such a non-compliance; and b) Details of all discharges from the sediment basins where the water quality results exceed the limits prescribed in condition L2.4, including the results of the rainfall measurements, to demonstrate compliance with condition L2.5; and The report referred to in this condition must be received by the EPA within 10 working days of the end of the month.	

4 Background

4.1 Waterways

The *Environmental Impact Statement Stage 2 – Stations, Rail Infrastructure and Systems (Chapter18 – Surface Water),* October 2012 identifies the major waterways along the SVC project corridor. This has been reproduced in Figure 4-1below.

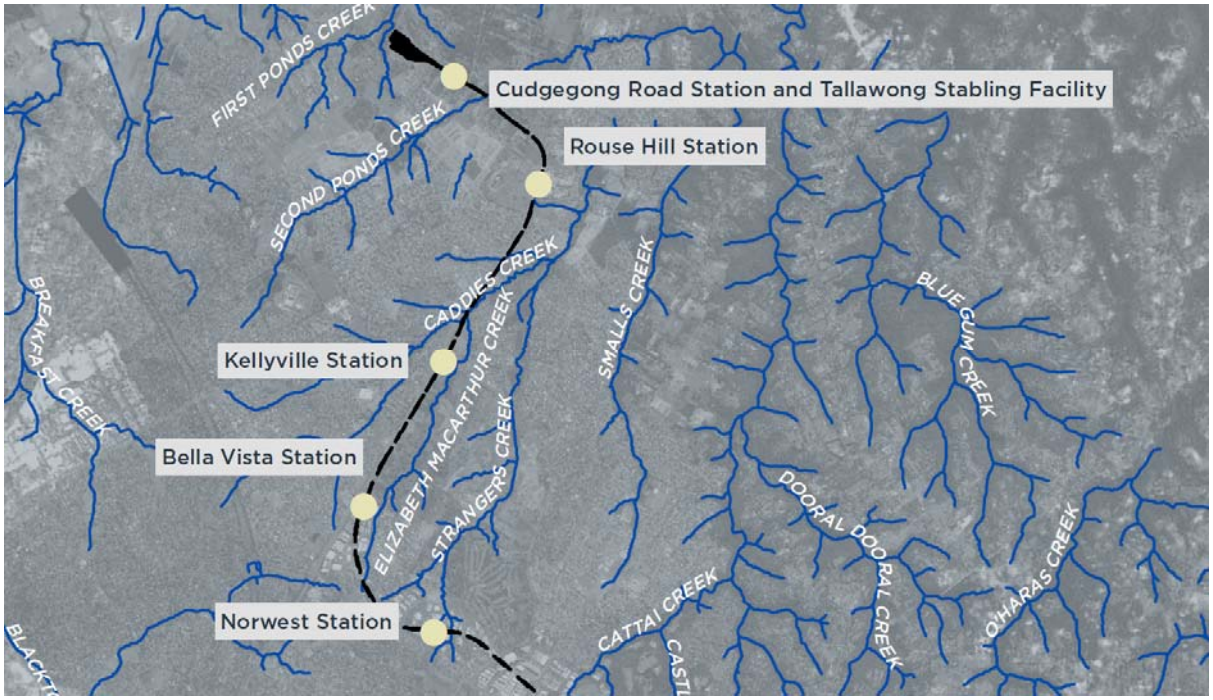


Figure 4-1 Major Waterways along the SVC Project Corridor (Source: EIS2, October 2012)

The waterways adjacent or proximate to SVC construction sites are:

- mostly ephemeral (intermittent flows/not permanent);
- highly modified (urbanised and disturbed catchment); and
- highly variable, with hydrology and water quality changing according to prevailing weather patterns and day-to-day during rainfall.

4.2 Surface Water Quality Baseline Data Summary

The *Environmental Impact Statement Stage 2 – Stations, Rail Infrastructure and Systems (Chapter 18 – Surface Water),* October 2012 provided the following summary of baseline data for surface water monitoring conducted by Blacktown City Council and the Hills Shire Council. For further information on timeframes and frequency of testing, test parameters and map of water quality monitoring locations, refer to Appendix E which contains relevant extract *from EIS 2 Technical Paper on Surface Water and Hydrology*.

Bella Vista Station to Rouse Hill Station

Elizabeth Macarthur Creek

Two monitoring sites operated by The Hills Shire Council:

- Elizabeth Macarthur Creek, off Celebration Drive upstream of Bella Vista Station; and
- Elizabeth Macarthur Creek, off Clovelly Crescent, upstream of the confluence with Caddies Creek.

The former site has generally shown readings within acceptable limits for secondary contact recreation under the ANZECC guidelines. Slightly more than half the samples showed elevated Total Nitrogen levels.

Results at the other monitoring site indicate poorer quality, with elevated levels of Total Nitrogen and Total Phosphorous in nearly all the samples taken, along with elevated *E. coli* in approximately half the samples. Dissolved Oxygen at this location was below recommended levels within the ANZECC guidelines.

Caddies Creek (including Tributaries 3, 4 and 5)

Two monitoring sites operated by The Hills Shire Council:

- approximately 1km downstream of Rouse Hill Station; and
- approximately 2.5km downstream of Rouse Hill Station.

Results from both sites indicate *E. coli* and nutrients Total Nitrogen and Total Phosphorous are above the ANZECC guidelines in over half the samples, with dissolved oxygen readings below recommended guidelines.

Rouse Hill Station to Tallawong Stabling Facility

Second Ponds Creek

One monitoring site operated by The Hills Shire Council approximately 2.5 km downstream of the project corridor, and therefore not suitable to provide a direct indication of the existing runoff quality relevant to the SVC works.

First Ponds Creek

Blacktown City Council has two water quality monitoring sites in First Ponds Creek. The nearest of these is approximately 2.3 km downstream of the project corridor and is therefore not suitable to provide a direct indication of the existing runoff quality relevant to the SVC works.

The historical surface water data will be used in preparation of the background water quality monitoring review.

4.3 Groundwater Quality Baseline Data Summary

The Environmental Impact Statement Stage 2 – Stations, Rail Infrastructure and Systems (Chapter 8 – Soils and Groundwater), October 2012 provided the following summary of baseline data for groundwater monitoring conducted for the EIS.

The groundwater monitoring network established for NWRL investigations consisted of 57 monitoring wells. Groundwater sampling was undertaken in each monitoring well to identify any groundwater contamination and characterise groundwater quality.

Monitoring found that groundwater within Hawkesbury Sandstone is typically of low to moderate salinity, with electrical conductivity (EC) generally between 500 microsiemens per centimeter (µS/cm)

and 2000µS/cm and pH generally varying between 4.5 and 6.5. The sandstone tends to have naturally elevated iron concentrations.

The quality of groundwater in shale of the Wianamatta Group (the geology for SVC works) tends to be inferior to groundwater in sandstone, with EC varying between 2000µS/cm to in excess of 10,000µS/cm in this part of the Sydney Basin.

The pH and TDS results indicate that salinity of groundwater along the alignment is high overall, and pH is near neutral. Sandstone underneath the Wianamatta Group has slightly higher salinity and a lower pH than the overlying shale.

Samples were tested for the following:

- Major cations.
- Total Nitrogen.
- Sulfate.
- Chloride.
- Magnesium & Calcium.
- Carbonate, Bicarbonate, and Total Alkalinity as CaCO3.
- Dissolved Iron.
- Sulfate Reducing Bacteria Count.

Selected samples were also analysed for TPH, BTEX, PAH, Phenols, Metals (dissolved), and OCP.

The historical groundwater data will be used in preparation of the background water quality monitoring review.

5 Potential Impacts

5.1 Activities Impacting Surface Water Quality

Activities that could result in water quality impacts are detailed in the Construction Soil and Water Management Plan. These include:

- Rainfall events
- Use of access tracks
- Clearing/removal of vegetation
- Discharges from sedimentation basins / pump out of accumulated sediments and fines
- Erosion of dispersive soils
- Truck movements to and from site
- Crossing and disturbance of drainage lines
- Rumble grids – management of sedimentation and wheel cleaning
- Stockpiled materials (mulch, soil, concrete products)
- Heavy equipment traversing soft soil/riparian areas and haul routes causing compression impacts
- Water cart management – overwatering causing runoff.

5.2 Activities Impacting Groundwater Quality

Activities that could result in groundwater quality impacts are detailed in the Construction Soil and Water Management Plan. These include:

- Leaching of tannins from mulch used in ERSED controls
- Spills of fuels and chemicals.

6 Water Quality Monitoring

The Water Quality Monitoring Program has two key phases:

- Pre-construction SVC Work's water quality monitoring (baseline phase[1]); and
- SVC Work's construction stage water quality monitoring (construction phase).

Monitoring of water to be undertaken during the Pre-construction and Construction phases are addressed in the following sections. Monitoring requirements following construction of the SVC works will be agreed in consultation with TfNSW. Monitoring will continue for a minimum monitoring period of three years following the completion of construction or until the affected waterways and/or groundwater resources are certified by an independent expert as being rehabilitated to an acceptable condition.

Water quality monitoring will be undertaken generally in accordance with Australian Standards and ISJV Management System Environmental Procedures, such as:

- MSP22P Water Quality;
- WI22P-1 Water Sampling & Testing;
- PWI22P-3 Water Treatment;
- MSF22P-2 Water Testing Chain of Custody Form (attached in Appendix A); and
- Australian Standard AS/NZS 5667.1 1998 – Water quality – Sampling - Guidance on the design of sampling programs, sampling techniques and preservation and handling of samples.

6.1 Surface Water Monitoring

Surface water monitoring has been undertaken at locations on the main waterways crossed by the SVC works, both upstream and downstream of each related worksite, as indicated in Appendix D. Monitoring locations are indicative and may require adjustment based on access, stream flow and WH&S issues. If an alternate location should be required, consideration will be given to Environment Protection Licence requirements, and areas with similar characteristics, no external inflows and homogenous flow will be sought.

6.1.1 Pre-Construction

Pre-construction surface water monitoring has being carried out at the locations as identified in Appendix D on a monthly basis from 30 July 2014. Data from the four existing monitoring sites operated by The Hills Shire Council, and from Thiess John Holland Dragados (TJHD) was used to supplement the pre-construction monitoring data.

The range of parameters tested for pre-construction water quality monitoring of surrounding waterways was:

- Temperature;
- Dissolved Oxygen;
- Turbidity;
- Visible Oil and Grease;

[1] This period has encompassed activities such as site compound establishment, geotechnical investigations etc and the early stages of main construction in limited areas.

- pH;
- Salinity (Electrical Conductivity); and
- Total Suspended Solids.

All samples collected by ISJV were tested at a NATA registered laboratory. All results collected for the pre-construction surface water monitoring period have been included in the Annual Water Quality Monitoring Report July 2014 – June 2015 (NWRLSVC-ISJ-SVC-EN-RPT-602501). Water monitoring results for the ongoing construction phase has been covered in the Annual Water Quality Monitoring Report July 2015 – June 2016 (NWRLSVC-ISJ-SVC-EN-RPT-602502).

Surface water quality monitoring results of the receiving environment prior to construction have not defined suitable standards or benchmarks for water quality given that:

- Waterways along the SVC alignment are mostly ephemeral;
- Waterways along the SVC alignment are highly modified; and
- Water quality from urban areas as occurs along the SVC alignment is highly variable and changes according to prevailing weather patterns and also day-to-day during rainfall.

6.1.2 Construction

Construction surface water monitoring has been undertaken based on the parameters prescribed for the pre-construction monitoring period. Monitoring has been undertaken monthly at upstream and downstream locations, and in response to heavy rainfall. The same criteria used for the pre-construction monitoring has been adopted for the construction period.

From December 2015 ISJV ceased routine dry weather monitoringand continued wet weather monitoring by sampling surface water quality after six rainfall events ranging between 10-15mm over a 24 hour period at existing monitoring locations. Ph, turbidity, salinity and visible oil and grease parameters were monitored and recorded in the field. Water samples collected during routine monitoring after rainfall were sent for laboratory (NATA accredited) analysis. From July 2016, three wet weather events will be monitored for rain events over 10-15mm in a 24 hour period. Where possible, monitoring will be undertaken in different seasons. The project already has an extensive wet weather dataset from monitoring to date on the project (minimum of 6 times per year) and construction activities are declining approaching project completion. Water quality monitoring required by the Environmental Protection License will continue as set out in the license.

Disturbance during construction has not occurred simultaneously across all the construction sites, due to the staging of construction works. Monitoring at defined locations commenced prior to works at the related work site commencing, and will cease after works at the related site have been completed and the area is stabilised.

Proactive monitoring of water quality testing onsite has been undertaken where possible. Monitoring has been conducted offsite in the receiving waters as set out below and has been a supplementary mechanism to trigger investigations or the review management process and verify that site processes and procedures have performed as expected.

Inspections undertaken at the same frequency as construction monitoring to assess any impacts to riparian areas, banks and vegetation. Photographic records of these inspections will be undertaken at logged photo-points to enable comparison of the pre- construction and construction conditions.

All data collected for the construction surface water monitoring period and analysis of results have been included in the Annual Water Quality Monitoring Report July 2014 – June 2015 (NWRLSVC-ISJ-SVC-EN-RPT-602501).

6.2 Groundwater Monitoring

Groundwater piezometers have been installed at the following locations along the viaduct:

- One location north of Balmoral Road, in the Balmoral Road site (BH517),
- Two locations north and one location south of Windsor Road/Old Windsor Road (BH663 and BH656 respectively),
- Four locations between Windsor Road and Cudgegong Road (BH670A, BH714, & BH726). .

6.2.1 Pre-Construction

Pre-construction groundwater monitoring has been carried out at the locations as identified as well as historical groundwater data has been used in the preparation of the background groundwater quality monitoring for review.

The original groundwater quality monitoring program was set out so that during a sampling event, water samples were collected and sent to a NATA accredited laboratory for an analysis of the following parameters:

- pH;
- Soluble Sulfate;
- Major Cations (Ca, Mg, Na, K);
- Salinity (µS/cm);
- Total Dissolved Solids;
- Total Alkalinity as CaCO3;
- Total Petroleum Hydrocarbons; and
- BTEX (Benzene, Toluene, Ethylbenzene, Xylene).

The pre-construction groundwater monitoring criteria adopted after consultation with TfNSW and ER was the criteria for the Hawkesbury Sandstone and Shale of Wianamatta Group from EIS 2. All results collected for the pre-construction groundwater monitoring period have been included in the Annual Water Quality Monitoring Report July 2014 – June 2015 (NWRLSVC-ISJ-SVC-EN-RPT-602501).

6.2.2 Construction

Construction groundwater monitoring has been undertaken based on the parameters prescribed for the pre-construction monitoring period. The pre-construction groundwater monitoring criteria as well as the EIS 2 criteria for Hawkesbury Sandstone and Shale of Wianamatta Group was been adopted for the construction period. Monitoring has been undertaken monthly at the same piezometers as mentioned above, or in some circumstances alternate piezometers because the original piezometers were destroyed as a result of construction activities.

All results collected for the construction groundwater monitoring period and discussions have been included in the Annual Water Quality Monitoring Report July 2014 – June 2015 (NWRLSVC-ISJ-SVC-EN-RPT-602501). Test results indicate the groundwater along the SVC alignment is highly variable, and doesn't permit the definition of a suitable benchmark. It is noted that groundwater movement is complex and variations in water quality can occur due to irrigation or rain, water movement in the ground, hydraulic properties of the ground, the change in the soil profile between the different layers of shale and sandstone, and the position of the samples collected in the piezometers. As the bulk of the SVC works are above ground and piles are poured as soon as possible after drilling, there is

minimal opportunity for surface water to flow directly into the groundwater. Therefore from December 2015 ISJV will cease routine groundwater monitoring.

Some of the boreholes used for pre-construction groundwater monitoring were destroyed as a result of construction activities and therefore no longer could be used during the construction monitoring period. Alternate boreholes were identified and used for the construction groundwater monitoring. As advised in the Soil Salinity Report, if groundwater is encountered during excavations it will be tested for salinity using a calibrated, good-quality probe. If the salinity reading is below 800 µS/cm, no specific management measures are required. If salinity is above 800 µS/cm, refer to mitigation measure SW48 (section 6 of the CSWMP) or Section 5.3 of the Soil Salinity Report for the management of saline groundwater.

6.3 Water Monitoring – Knights Syndicate Quarry

Reporting of surface and groundwater discharges from Knights Syndicate Quarry (Lot 105 Schofields Road) during the remediation phase has been included in the Annual Water Quality Monitoring Report July 2014 – June 2015 (NWRLSVC-ISJ-SVC-EN-RPT-602501). The treatment and discharge of water was managed in accordance with Enviropacific Services Work Procedures for Surface Water and Groundwater Treatment.

Backfill of the remediated quarry has now commenced and fill water monitoring and management is being carried out in accordance with the KSQ Water Monitoring and Management Proposal by SMEC Australia and the Trigger Action Response Plan. Upon handover there is no further requirement for ISJV to undertake water quality monitoring of surface or fill water given the completion of construction and remediation of the corridor.

6.4 Sediment Basin Management

ISJV continues to monitor water quality prior to any planned discharges from sediment basins to ensure compliance with the parameters listed within the Environmental Protection Licence (No. 20454), and to minimize any potential impacts to surrounding waterways. In accordance with Condition L2.6 of EPL No. 20454, ISJV has developed a statistical correlation between NTU and TSS for water quality in the sediment basin/s. All sediment basin management and discharges are completed in accordance with ISJV's Dewatering Work Instruction (Appendix 7 of the Construction Soil and Water Management Plan). Location specific statistical correlations between TSS and NTU have been developed. The correlations to date have been submitted to the EPA for comment, with no comments received. The correlations to date are subject to ongoing verification and ISJV will comply with EPL condition L2.8.

Table 1 –Surface Water Quality – Sampling Methods & Monitoring Parameters

Parameter	Unit	Criteria	Sampling Method	Analytical Method	Trigger Values	Action
Surface Water Quality						
***Turbidity**	NTU	0.44 – 33	Probe & Grab samples (retained)	Field measurement	Downstream results are > than upstream results by 20% in rainfall events ranging between 10-15mm over a 24 hour period. (Refer Appendix 6, Construction Soil and Water Management Plan)	Environment Coordinator to re-sample to confirm results and inspect adjacent SVC works and propose actions where required. Potential ameliorative actions could include: 1. Temporary suspension of works. 2. Additional water quality treatment measures (e.g. settlement fences, membrane filters, sediment traps). 3. Expediting rehabilitation works to stabilise exposed surfaces. 4. Enhanced use of soil stabilisers and agents to minimise erosion. 5. Review and/or revision of ISJV environmental processes and procedures. 6. Review of design and construction procedures to minimise ongoing impact. 7. Additional training and/or awareness for ISJV staff and sub-contractors.
Oil and Grease		n/a	Visual Analysis (grab sample retained)	Visual assessment.		
***pH**	pH units	6.5 - 8.5	Probe & Grab samples	Field measurement.		
***Salinity (EC)**	µs/cm	125 - 2200	Probe & Grab samples	Field measurement		

*ANZECC (2000) values

7 Management Response

7.1 Trigger Points and Response

Table 1 provides detail on 'trigger values' and associated 'actions' that would be undertaken in the event there is the potential that SVC works have impacted on water quality within each of the creeks.

Proposed measures and controls aimed at mitigating water quality impacts are detailed in Section 6 of the Construction Soil and Water Management Plan, including:

- Temporary suspension of works
- Increase storage capacity of sedimentation basins
- Additional water quality treatment measures (e.g. settlement fences, membrane filters, sediment traps)
- Expediting rehabilitation works to stabilise exposed surfaces
- Enhanced use of soil stabilisers and agents to minimise erosion
- Review and/or revision of ISJV environmental processes and procedures
- Review of design and construction procedures to minimise ongoing impact
- Additional training and/or awareness for ISJV staff and sub-contractors
- Utilising experience with site conditions to update the progressive erosion and sediment control plans

7.2 Adaptive Management

Water quality monitoring frequency in any particular area/zone could be extended if potential impacts attributable to the SVC Works are identified. The work method and management practices will be assessed and revised or adapted if considered necessary.

7.3 Reporting

The results of the pre-construction and construction water quality monitoring have been recorded along with the Soil Salinity Report and used to establish baseline water conditions.

Water quality monitoring results will be documented in the environmental documents register or nominated BMS library until the end of the project.

In accordance with COA, monitoring results will be reported to the DP&E, NOW, DPI (NSW Fisheries), the EPA, ER and TfNSW by the Environment Manager. This will be undertaken annually as specified in Appendix 10 of the CEMP.

In accordance with the EPL, water quality data from sediment basin discharges are published monthly on the ISJV website: www.isjv.com.au.

8 Incident Planning and Response

Incident Planning & Response			
Environmental incidents will be reported immediately as per ISJV's SVC Environmental Incident Management Procedure (MSP42B) to a Site Supervisor who will contact either the Project Manager, or Environmental Manager. All incidents will be investigated and appropriate actions taken to address the issue. Environmental incidents that cause or threaten material harm will be reported to EPA and other authorities in accordance with the ISJV's Pollution Incident Response Management Plan. Details will also be reported to the ER, DP&E, and TfNSW, as per the PIRMP and SVC Incident Management Procedure. Any water quality monitoring in response to an incident will be undertaken as required or in response to authority directions. Response to emergency situations will be undertaken in accordance with the *Project Emergency Plan* and any water quality monitoring will be undertaken as required or in response to authority directions. Potential incidents that could arise during the works that could impact on water quality include the following:			
No.	Incident	Response	Responsibility
1	Spillage of special, hazardous, liquid or restricted wastes during transport within and to/from site that may affect the local environment.	• Stop work and ensure safety of site personnel. • Follow process in PIRMP.	SS / CM / EM
2	Unanticipated discovery of contaminated water requiring handling and off-site disposal.	• Stop work and ensure safety of site personnel. • Follow process in Appendix 5 (Contaminated Materials Contingency Plan) of Construction Soil and Water Management Plan.	SS / CM / EC / EM
3	Extensive rainfall event or prolonged wet period.	• Management of discharges from sedimentation ponds in accordance with *Dewatering Work Instruction* (Appendix 7 of CSWMP). • Restricting travel on unsealed surfaces. • Extension of erosion and sedimentation control measures.	SS / EC / EM
4	Fish kill in waterways adjacent to creek crossings or construction sites.	• Stop work and ensure safety of site personnel and people who may be in contact with water. • Follow process in PIRMP. • Notify Fisheries NSW via email to: wollstonecraft.fisheries@dpi.nsw.gov.au	SS / CSM / EM
Responsibility Key: EM – Environment Manager, PM – Project Manager, CM – Construction Manager, CSM – Community and Stakeholder Manager, EC – Environment Co-ordinator, SS - Site Supervisor			

Appendix A. WATER TESTING CHAIN OF CUSTODY FORM

WATER TESTING CHAIN OF CUSTODY FORM

Management System Form

Project:	Laboratory:
Address:	Address
Contact Person:	Contact Name
Phone:	Phone
Sampled by:	

Special Instructions:							Tests Required						
							Total Suspended Solids	pH	Oil & Grease				Sample Notes
Sample Information													
Sample ID	Sample Location	Date Sampled	Time Sampled	Matrix[#]	Container[*]	Size							

Sample relinquished by:					Sample Received by:					
Name	Company	Date	Time	Signature	Name	Company	Date	Time	Signature	Sample Condition
Sampler					Courier					
Courier					Laboratory					

[#]. Soil, Water etc
[*] Glass, PVC, PET etc

Appendix B. SURFACE WATER MONITORING LOCATION AND FREQUENCY

Surface Water Monitoring Location and Frequency SVC Works

		Construction	
Receiving water & related site	**Monitoring location**	**Routine**	**Sampling type**
Elizabeth Macarthur Creek Receiving waters for Bella Vista Construction Compound discharge	EMC1 - Upstream	Three rain events[1]	Field
	EMC2 – Site sediment basin/s	Prior to discharge[2]	Field & Lab
	EMC3 - Downstream	Three rain events[1]	Field
Elizabeth Macarthur Creek Receiving waters for Kellyville Station Construction Site discharge	EMCa1 - Upstream	Three rain events[1]	Field
	EMCa2 – Site sediment basin/s	Prior to discharge[2]	Field & Lab
	EMCa3 - Downstream	Three rain events[1]	Field
Caddies Creek Receiving waters for Caddies Creek Construction Waterway Crossing	CC1 - Upstream	Three rain events[1]	Field
	CC2 – Site sediment basin/s	Daily during creek crossing works[3]	Field & Lab
	CC3 - Downstream	Three rain events[1]	Field
Caddies Creek Receiving waters for Construction Waterway Crossing (second crossing)	CCa1 - Upstream	Three rain events[1]	Field
	CCa2 – Site sediment basin/s	Daily during creek crossing works[3]	Field & Lab
	CCa3 - Downstream	Three rain events[1]	Field
Strangers Creek Receiving waters for Rouse Hill Station Construction Site discharge	SC1 - Upstream	Three rain events[1]	Field
	SC2 – Site sediment basin/s	Three rain events[1]	Field & Lab
Second Ponds Creek Receiving waters for Cudgegong Road Construction Site discharge and Construction Waterway Crossing	SPC1 - Upstream	Three rain events[1]	Field
	SPC2 – Site	Prior to discharge[2]	Field & Lab
	SPC3 - Downstream	Three rain events[1]	Field

Notes: 1. 'After rain' is after a wet weather event (10-15mm of rain over a 24 hour period) - sampling will be undertaken during construction hours - when it is safe to do so.
2. Sediment basin discharge monitoring, as per Appendix 7 of the Construction Soil & Water Management Plan.
3. Samples should be taken upstream and downstream adjacent to works at the boundary points of the immediate site.

Appendix C. AGENCY COMMENTS & ISJV RESPONSE

Letter and email responses from NOW, EPA, NSW Fisheries and The Hills Shire Council to the request for comments are attached.

Comments raised by these agencies (if any), and ISJV's response, are summarised below.

PLAN & REVISION No: Water Quality Monitoring Plan NWRLSVC-ISJ-SVC-PM-PLN-120204 Rev 2		
REVIEWER: Craig Bourke / The Hills Shire Council		
SECTION / PAGE	**COMMENT**	**HOW ADDRESSED**
General	All reporting of the monitoring and of any pollution incidents are only provided to the EPA. It is requested that results and reports of pollution incidents be provided to Council also.	This is included in the PIRMP prepared as an EPL holder. The PIRMP requires that Council be advised of pollution incidents within their LGA in accordance with POEO Act amendments.
General	The program report does not have sampling frequency listed and it is expected that the identified sites will only be inspected and sampled when there is particular activities or rain events. Request that there is also regular monitoring of the sites (in addition to event related monitoring) regardless of work activities or rain events to monitor day to day activities.	Regular monitoring, at least monthly, is proposed at all monitoring sites (see Appendix B) for the duration of construction.
General	The proposed parameters to be tested are considered appropriate.	Noted.
General	The procedure for treatment and release of any accumulated rain water is considered appropriate and satisfactory.	Noted.

PLAN & REVISION No: Water Quality Monitoring Plan NWRLSVC-ISJ-SVC-PM-PLN-120204 Rev 2		
REVIEWER: NSW Fisheries		
SECTION / PAGE	**COMMENT**	**HOW ADDRESSED**
Page 9	Replace the 1999 and 2004 Fisheries references with : Policy and Guidelines for Fish Habitat Conservation and Management 2013	Amendment made in Section 1.
Page 23	The plan needs to identify the potential for fish kills during the project. In the event of a fish kill, the EPA is the Appropriate Regulatory Authority and is to be notified immediately via 131 555. Fisheries NSW should also be advised of any incidents via email to: wollstonecraft.fisheries@dpi.nsw.gov.au	Added to Section 8.

PLAN & REVISION No: Water Quality Monitoring Plan NWRLSVC-ISJ-SVC-PM-PLN-120204 Rev 2		
REVIEWER: NSW EPA		
SECTION / PAGE	**COMMENT**	**HOW ADDRESSED**
	No comments.	

PLAN & REVISION No: Water Quality Monitoring Plan NWRLSVC-ISJ-SVC-PM-PLN-120204 Rev 2		
REVIEWER: NSW Office of Water		
SECTION / PAGE	**COMMENT**	**HOW ADDRESSED**
General	The Office of Water has reviewed the plans provided and is satisfied that they adequately address the conditions of approval and are sufficient to mitigate potential impacts to surface and groundwater resources.	Noted.
General	It is noted that no groundwater is proposed to be used during the works, however dewatering of groundwater may be required from excavations to facilitate construction. Such dewatering may require authorisation under the Water Act 1912. ISJV should liaise with the Office of Water to determine any licensing requirements prior to dewatering activities commencing.	Noted. This is included in Section 3.5 of the CEMP, and Section 2 of the Construction Soil & Water Management Plan (under 'Licence & Permit Requirements')

Our reference: DOC14/67813

Salini Impregilo
Suite 1 Level 7
100 Walker Street
North Sydney NSW 2060

Attention: Sam Turnbull

Dear Mr Turnbull,

I refer to your letter of 7 April 2014 seeking input from the Environment Protection Authority (EPA) to the Environmental Management Plans for the Surface and Viaduct Civil Works section of the North West Rail Link.

Thank you for the opportunity to provide input to the management plans. The EPA does not generally comment on, approve or endorse environmental management plans. The EPA utilises a range of regulatory tools such as environment protection licences and pollution reduction programs to help achieve positive environmental outcomes.

Construction of the North West Rail Link project is licenced by the EPA under the *Protection of the Environment Operations Act 1997*. The environmental performance of the project's licence holders and sub-contractors is regulated through compliance with the relevant licences and legislation.

If you have any questions regarding this letter please contact Mark Jansons, Regional Operations Officer, EPA on (02) 9995 6829 or mark.jansons@epa.nsw.gov.au.

Yours sincerely

13.05.2014

MARK HANEMANN
Unit Head Infrastructure
Environment Protection Authority

From:	Marcel Green
To:	steve.fermio@isjv.com.au
Cc:	Miriam Kodesch; Lauren Ramshaw; Carla Ganassin; Simone Winchester
Subject:	RE: TRIM: Fisheries consultation on NWRL (Surface Viaduct) Environmental Plans
Date:	Friday, 2 May 2014 11:41:03 AM

G'day Steve,

I have reviewed the two Plans and provide the following comments:

Construction Flora and Fauna MP

1. p6 - delete reference to the NSW Fisheries Management Amendment Act 1997...similarly, delete the Rivers and Foreshores Improvement Act as it was repealed by the Water Mgmt Act
2. p32 Aquatic Flora and Fauna - this section needs to identify the potential for fish kills during the project and appropriate mitigation measures. As a minimum, iIn the event of a fish kill, the EPA is the Appropriate Regulatory Authority and is to be notified immediately via 131 555. Fisheries NSW should also be advised of any incidents via email to: wollstonecraft.fisheries@dpi.nsw.gov.au . Fish kills should also be referred to in Section 8 - Incident Planning and Response and in Section 9 under tool box talks.
3. p33 FF39 & p34 FF45 & p36 FF56 - replace the 2003 Fisheries references with this one: *Policy and Guidelines for Fish Habitat Conservation and Management 2013*
4. p46 - replace the old Fisheries References with the 2013 reference

Water Quality MP

1. p9 - replace the 1999 and 2004 Fisheries references with this one: *Policy and Guidelines for Fish Habitat Conservation and Management 2013*
2. p23 - I'm not sure if this is the appropriate place but as above this plan needs to identify the potential for fish kills during the project. In the event of a fish kill, the EPA is the Appropriate Regulatory Authority and is to be notified immediately via 131 555. Fisheries NSW should also be advised of any incidents via email to: wollstonecraft.fisheries@dpi.nsw.gov.au

If you have any further queries please call me on 8437 4986, or via email to ahp.central@dpi.nsw.gov.au and CC to me.

Cheers,
Cel

Marcel Green | Senior Environmental Assessments Officer
Fisheries NSW | NSW Department of Primary Industries
Locked Bag 1 Nelson Bay 2315
T: 02 8437 4986 | M: 0410 459 959
E: marcel.green@dpi.nsw.gov.au | W: www.dpi.nsw.gov.au

Internal Memorandum

TO: Manager Health & Environment

FROM: Environmental Health Coordinator

SUBJECT: Review of the Proposed Water Monitoring Program for the Northwest rail

DATE: 02 May 2014

COPIES TO:

The Water Quality Monitoring Program for the Northwest Rail has been reviewed.

Overall the program is considered adequate and no objections are raised.

Of note from the report is that the project is licenced by the EPA who are therefore the Appropriate Regulatory Authority (ARA).

All reporting of the monitoring and of any pollution incidents are only provided to the EPA.

- It is requested that results and reports of pollution incidents be provided to Council also.

The program report does not have sampling frequency listed and it is expected that the identified sites will only be inspected and sampled when there is particular activities or rain events.

- Request that there is also regular monitoring of the sites (in addition to event related monitoring) regardless of work activities or rain events to monitor day to day activities.

The proposed parameters to be tested are considered appropriate.
The procedure for treatment and release of any accumulated rain water is considered appropriate and satisfactory.

Craig Bourke
ENVIRONMENTAL HEALTH COORDINATOR

Department of Primary Industries
Office of Water

Contact Rohan Macdonald
Phone 02 4904 2642
Email rohan.macdonald@water.nsw.gov.au

ISJV

Suite 701, Level 7

NORTH SYDNEY NSW 2060

Our ref ER21676

BY EMAIL: steve.fermio@isjv.com.au

Attention: Steve Fermio

Dear Steve

NWRL (Surface Viaduct) Environmental Plans

NSW Office of Water consultation

I refer to your request for comment regarding the Construction Soil and Water Management Plan, Construction Flora and Fauna Management Plan and Water Quality Monitoring Program for the North West Rail Link (NWRL) Surface Viaduct construction works. The Office of Water has reviewed the plans provided and is satisfied that they adequately address the conditions of approval and are sufficient to mitigate potential impacts to surface and groundwater resources.

It is noted that no groundwater is proposed to be used during the works, however dewatering of groundwater may be required from excavations to facilitate construction. Such dewatering may require authorisation under the *Water Act 1912*. ISJV should liaise with the Office of Water to determine any licensing requirements prior to dewatering activities commencing.

Yours sincerely

Mitchell Isaacs
Manager Strategic Stakeholder Liaison
7 May 2014

Appendix D. WATER QUALITY MONITORING LOCATION MAP

REV	DATE	BY	DESCRIPTION	CHK	APD
D	30/07/14	BH	Revised Issue following site works	JM	-
C	24/06/14	BH	Revised Issue	SF	SF
B	13/05/14	BH	Revised Issue	SF	SF
A	31/03/14	BH	Draft Issue for comment	SF	SF

DRAWING STATUS: **DRAFT**

northwestraillink
salini impregilo
SVC WORKS

Legend

Surface Water Monitoring
- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN-DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link Surface and Viaducts Civil Works Site 9: Celebration to Balmoral

SCALE: 1:3,000 @ A3

0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 1

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

REV	DATE	BY	DESCRIPTION	CHK	APD
D	30/07/14	BH	Revised Issue following site works	JM	-
C	24/06/14	BH	Revised Issue	SF	SF
B	13/05/14	BH	Revised Issue	SF	SF
A	31/03/14	BH	Draft Issue for comment	SF	SF

DRAWING STATUS: **DRAFT**

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN-DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link
Surface and Viaducts Civil Works
Site 9/10: Balmoral to Memorial

SCALE: 1:3,000 @ A3

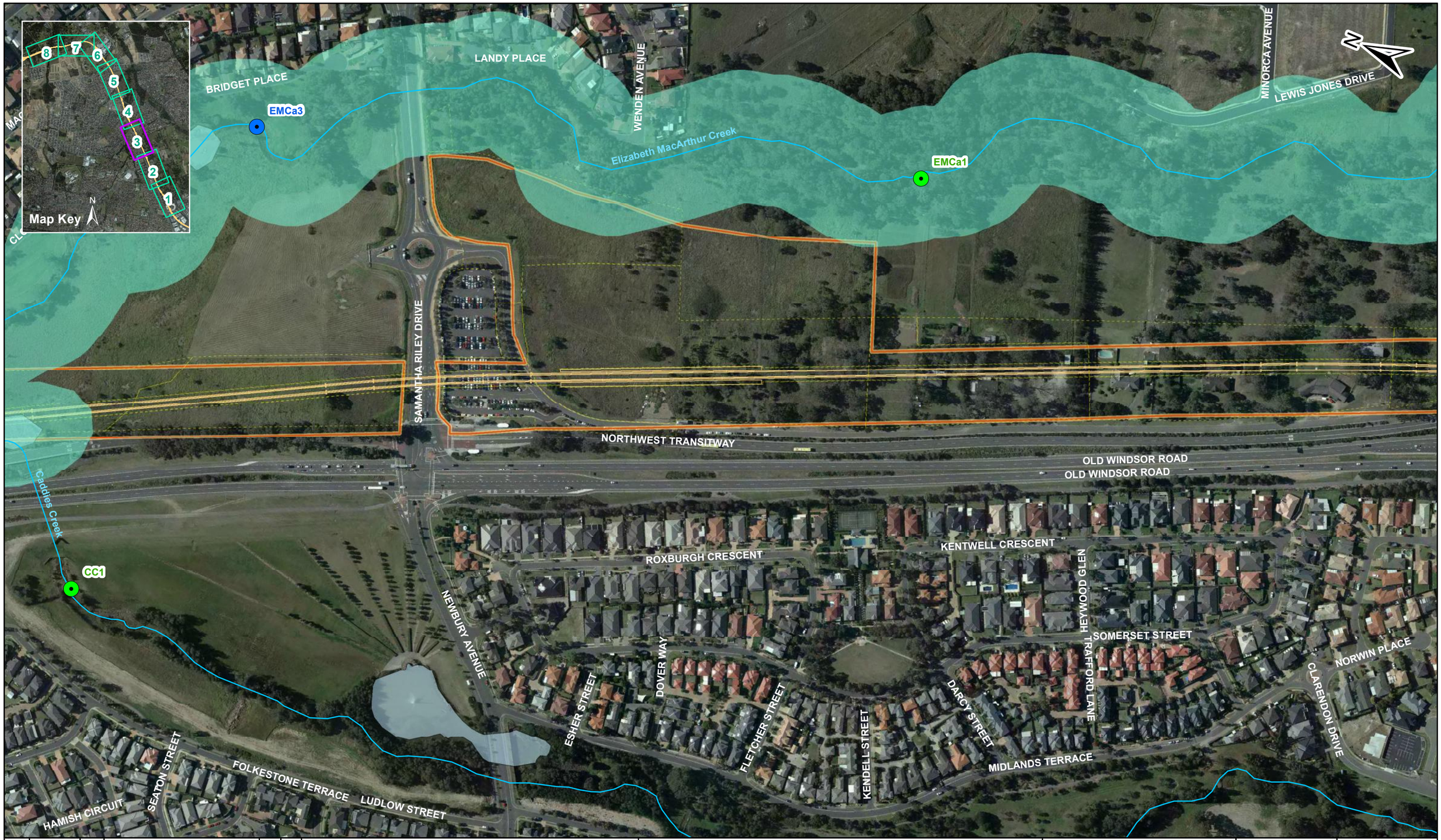
0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 2

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd



REV	DATE	BY	DESCRIPTION	CHK	APD
D	30/07/14	BH	Revised Issue following site works	JM	-
C	24/06/14	BH	Revised Issue	SF	SF
B	13/05/14	BH	Revised Issue	SF	SF
A	31/03/14	BH	Draft Issue for comment	SF	SF

DRAWING STATUS:

DRAFT

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN-DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link Surface and Viaducts Civil Works Site 11: Kellyville

SCALE: 1:3,000 @ A3

0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 3

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

REV	DATE	BY	DESCRIPTION	CHK	APD
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C	24/06/14	BH	Revised Issue	SF	SF
B	13/05/14	BH	Revised Issue	SF	SF
A	31/03/14	BH	Draft Issue for comment	SF	SF

DRAWING STATUS: **DRAFT**

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN-DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link Surface and Viaducts Civil Works Site 12: SR Drv to Windsor Rd

SCALE: 1:3,000 @ A3

0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 4

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

REV	DATE	BY	DESCRIPTION	CHK	APD
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C	24/06/14	BH	Revised Issue	SF	SF
B	13/05/14	BH	Revised Issue	SF	SF
A	31/03/14	BH	Draft Issue for comment	SF	SF

DRAWING STATUS: **DRAFT**

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN-DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link
Surface and Viaducts Civil Works
Site 13: Old Windsor Rd to WHD

SCALE: 1:3,000 @ A3

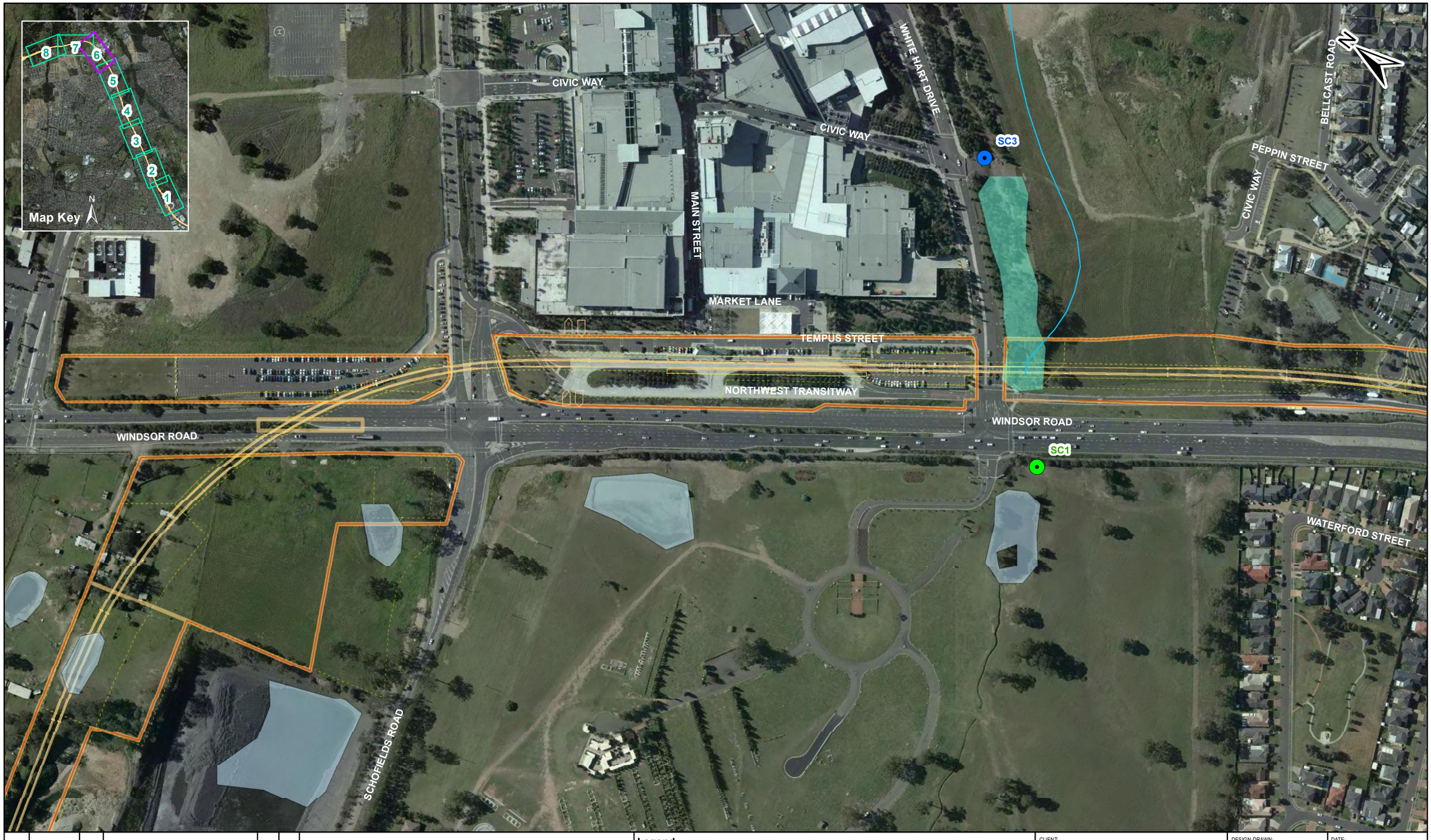
0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 5

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd



REV	DATE	BY	DESCRIPTION	CHK	APD
D	30/07/14	BH	Revised Issue following site works	JM	-
C	24/06/14	BH	Revised Issue	SF	SF
B	13/05/14	BH	Revised Issue	SF	SF
A	31/03/14	BH	Draft Issue for comment	SF	SF

DRAWING STATUS:

DRAFT

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN-DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link
Surface and Viaducts Civil Works
Site 14: Rouse Hill

SCALE: 1:3,000 @ A3

0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 6

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

REV	DATE	BY	DESCRIPTION	CHK	APD
D	30/07/14	BH	Revised Issue following site works	JM	-
C	24/06/14	BH	Revised Issue	SF	SF
B	13/05/14	BH	Revised Issue	SF	SF
A	31/03/14	BH	Draft Issue for comment	SF	SF

DRAWING STATUS: **DRAFT**

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN-DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link Surface and Viaducts Civil Works Site 15: Windsor Rd Viaduct

SCALE: 1:3,000 @ A3

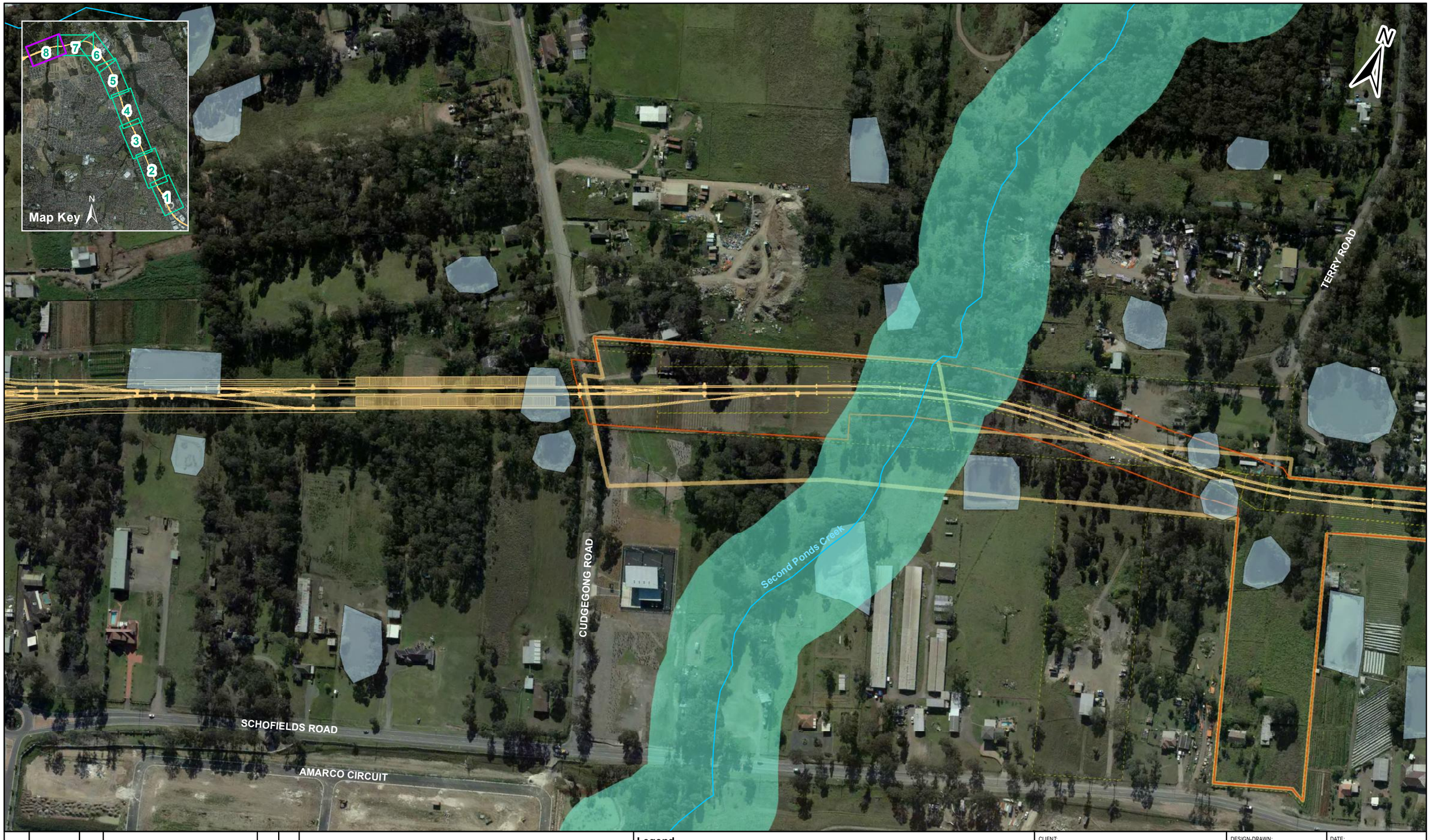
0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 7

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd



REV	DATE	BY	DESCRIPTION	CHK	APD
D	30/07/14	BH	Revised Issue following site works	JM	-
C	24/06/14	BH	Revised Issue	SF	SF
B	13/05/14	BH	Revised Issue	SF	SF
A	31/03/14	BH	Draft Issue for comment	SF	SF

DRAWING STATUS: **DRAFT**

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN-DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link
Surface and Viaducts Civil Works
Site 16: WR Via to Cudgegong Rd

SCALE: 1:3,000 @ A3

0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 8

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

Appendix E. EXTRACT FROM EIS2 TECHNICAL PAPER 7 – SURFACE WATER AND HYDROLOGY

4.1.2.4 Strangers Creek – Norwest Station (Site 7)

Norwest Station is located on Norwest Boulevard, west of Strangers Creek. Strangers Creek in the vicinity of Norwest Boulevard is a highly modified system consisting of a series of ponds interconnected with drainage culverts, draining a catchment area of approximately 36 hectares. In larger flood events the ponds would overtop and flows would travel across Norwest Boulevard. The precinct is elevated above Strangers Creek and is not affected by mainstream flooding. However, the local road drainage system runs along the precinct from the west via Norwest Boulevard and Brookhollow Avenue. The existing road drainage network layout is shown in Figure 8, including local overland flows for the 20 and 100 year ARI, and the PMF.

4.1.3 Bella Vista Station to Rouse Hill Station

4.1.3.1 Elizabeth Macarthur Creek – Bella Vista Station (Site 8) to Kellyville Station (Site 11)

The rail alignment between Bella Vista Station (Site 8) and Kellyville Station (Site 11) runs parallel and in close proximity to Elizabeth Macarthur Creek. Development in the upstream catchment (south of Celebration Drive) is well established, consisting of a mixture of residential and commercial development. The catchment draining to Elizabeth Macarthur Creek between Celebration Drive and Samantha Riley Drive is currently largely undeveloped. However, significant urbanisation is currently underway and ongoing as part of the North West Growth Centres. A particular area of future development is the Balmoral Release Area.

Flood extent mapping for Elizabeth Macarthur Creek is provided in Figure 9 for the 20 and 100 year ARI events and PMF. As shown, Sites 8, 9 and 10 are typically located clear of the Elizabeth Macarthur Creek floodplain, with a relatively small eastern fringe of Sites 8 and 9 being flood affected. A portion of Site 10 in the north lies within the defined flood extents of both the 100 year and PMF.

4.1.3.2 Caddies Creek (including Tributaries 3, 4 and 5) – Windsor Road/Old Windsor Road (Site 12) to Windsor Road Viaduct (Site 15)

Within Sites 12 and 13 the project consists of rail viaduct that spans the broad floodplain of Caddies Creek, including its confluence with Elizabeth Macarthur Creek and Caddies Creek Tributaries 3, 4 and 5. The creek lines in this area are moderately incised with well vegetated main channel and overbank areas. Flood extent mapping for Caddies Creek is provided in Figure 10 for the 20 and 100 year ARI events and PMF.

Site 14 (Rouse Hill Station) is located north of Caddies Creek Tributary 3 and would be susceptible to inundation from flows overtopping Windsor Road at the Tributary 3 culverts. Detailed modelling undertaken for Tributary 3 shows that the Tributary 3 culvert crossing has in excess of a 100 year ARI capacity. Consequently, Site 14 is not expected to be affected by flooding up to the 100 year ARI event, apart from runoff from the local drainage network. Windsor Road overtops in the PMF and the southern edge of Site 14 could therefore be affected by flooding in the PMF. Flood extent mapping for Caddies Creek Tributary 3 is provided in Figure 11 for the 20 and 100 year ARI events and the PMF.

Site 15 is located immediately north of Rouse Hill Station. In this area the project crosses over Windsor Road on an elevated viaduct. Site 15 is located within the Caddies Creek catchment but outside the floodplain of mainstream flooding. A small drainage line crosses Windsor Road immediately north of the Rouse Hill Station Precinct.

4.1.4 Rouse Hill Station to Tallawong Stabling Facility

4.1.4.1 Second Ponds Creek – Windsor Road Viaduct to Cudgegong Road (Site 16)

Second Ponds Creek at the NWRL alignment has an upstream catchment area in the order of 620 hectares. The catchment has undergone significant urban development over recent years. Parts of the catchment, particularly in the immediate vicinity of the Project corridor, are largely undeveloped and consists mainly of rural residential. Urban development in the catchment is ongoing. Existing areas of rural development are earmarked for urbanisation as part of the Area 20 Precinct.

Flood extent mapping for Second Ponds Creek is provided in Figure 12 for the 20 and 100 year ARI events, as well as the PMF. Site 16 is located to the east of Second Ponds Creek and is not located within the defined flood extents.

4.1.4.2 First Ponds Creek – Cudgegong Road and Tallawong Stabling Facility (Site 17)

The western edge of Site 17 borders a tributary of First Ponds Creek. The tributary drains a catchment area of approximately 55 hectares to the Project corridor. The junction with First Ponds Creek is approximately 150m further downstream (to the north) at which location the catchment area draining to First Ponds Creek is approximately 300 hectares.

The First Ponds Creek catchment is currently largely undeveloped, consisting of rural residential development. Future urbanisation is proposed as part of the Alex Avenue Precinct.

Flood extent mapping for First Ponds Creek is provided in Figure 13 for the 20 and 100 year ARI events and the PMF. The western edge of the Site 17 bordering the First Ponds Creek tributary is partially flood affected.

4.2 Water Quality

4.2.1 General

A considerable amount of water quality monitoring has been undertaken within the catchments traversed by the project. Local Councils within the area (namely Hornsby Shire Council, The Hills Shire Council and Blacktown City Council) have extensive water quality monitoring and reporting programmes. Water quality monitoring data is or has previously been collected by various government agencies including Sydney Water, the former Department of Land and Water Conservation (DLWC), the Environment Protection Authority, the Sydney Catchment Authority and the Hawkesbury Nepean Catchment Management Trust.

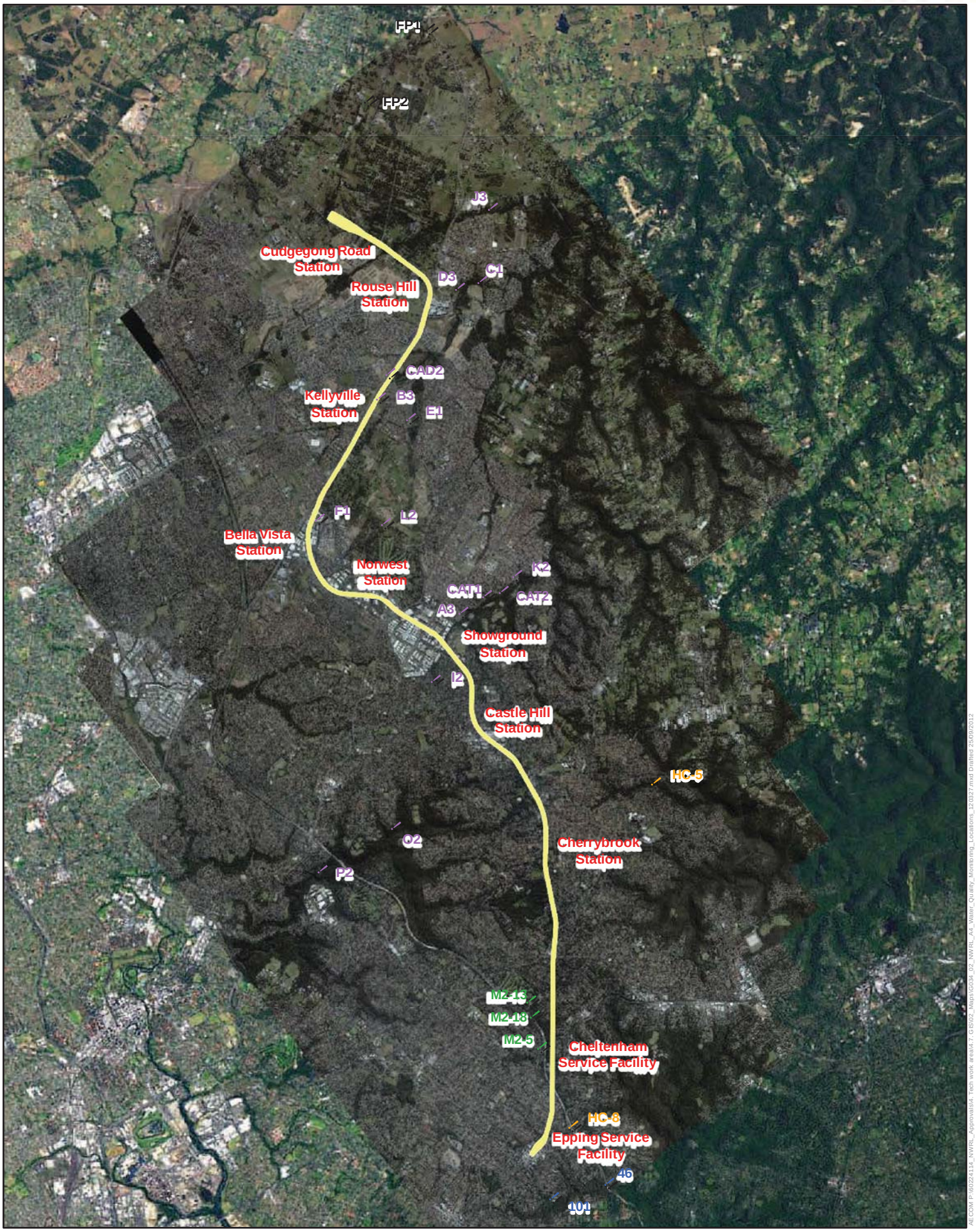
As part of the original approval conditions for the M2 Motorway a water quality monitoring program was established in 1997-98 following the commencement of operation in May 1997. The aim of the program was to monitor water quality in the receiving systems to check for conformance with recommended quality limits and identify any long term impacts associated with the M2 Motorway. Since that time, water quality data has been collected and analysed by HLA-Envirosciences at 16 locations on waterways upstream and downstream of the M2 Motorway corridor. Four of these sites are relevant to the NWRL Project. These are located on Devlins Creek in the vicinity of the Epping Service Facility (Site 1) and Cheltenham Services Facility (Site 3).

Hornsby Shire Council established a water quality monitoring program in 1994 to assess the impact of land use on waterways within the Council area and assess the performance of Council's Catchments Remediation Rate program. Hornsby Shire Council publishes an annual water quality report, which is made available to the community and interested authorities through the Council's web site. Monitoring includes Devlins Creek and Pyes Creek.

The Hills Shire Council's Health and Environmental Protection Team routinely monitors the water quality of major creek systems in the Council area. This includes monitoring sites upstream and downstream of the Project Area within:

- Cattai Creek
- Strangers Creek
- Elizabeth Macarthur Creek
- Caddies Creek
- Second Ponds Creek

These monitoring locations are presented in Figure 14. At each location Council officers test water samples for a range of parameters including Dissolved Oxygen (DO), temperature, pH and conductivity. Samples are also collected at each site and sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis of Faecal Coli forms, E.coli, Total Nitrogen, Total Phosphorous, Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS). Caddies Creek, being situated downstream of a former landfill site, is also tested for heavy metals. All results are compared to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000).



Water monitoring locations by council

! Baulkham Hill Council

! Blacktown Council

! Hornsby Council

! M2 Locations

! Ryde City Council

North West Rail Link EIS

WATER QUALITY MONITORING LOCATIONS

0 0.75 1.5 3 km

25 SEP 2012

60224114

Fig **14**

Blacktown City Council has an ongoing water quality monitoring program that was established in 2008 covering significant watercourses in the Council area. While monitoring sites are located on First Ponds Creek, they are situated at Riverstone Road and Windsor Road and therefore are not directly applicable to the project area.

4.2.2 Epping Station to Bella Vista Station

4.2.2.1 Devlins Creek (including Beecroft Road Tributary) – Sites 1 and 3

Hornsby Shire Council has established a monitoring station on Devlins Creek, approximately 200m downstream of the Cheltenham Services Facility. The monitoring station is shown on Figure 14 (referred to as location HC-8) and is adjacent to Sutherland Road at Cheltenham. The catchment draining to this monitoring site is approximately 823 hectares with about 8% falling in the Parramatta City Council area. Approximately 77% of the catchment is zoned residential with the remaining area consisting of a mix of special uses and open space, with a smaller proportion of commercial/industrial and business. Monitoring commenced in October 1994. Results of Council's monitoring are presented in Hornsby Shire Council (2009 and 2010).

At location HC-8 occasional high levels of faecal coliforms have been encountered, particularly after storms. The source of elevated levels is reported to be from stormwater runoff and/or sewer pipe overflows. Results exceeded the ANZECC Guidelines for Ammonium Nitrogen (NH_3) and phosphorous concentrations in the majority of samples taken. However, because faecal coliforms were low sewer leaks were not suspected. The levels of turbidity and suspended solids in urban sites were generally acceptable. Test results showed typically low DO levels, especially at low flow conditions when the pools tend to turn black.

The M2 Motorway monitoring sites for Devlins Creek sites are labelled M2-13, M2-18, M2-5 and M2-8 on Figure 14. These sites are located upstream of the Cheltenham Services Facility. Samples are collected following storm events where rainfall is greater than 10mm in the 24 hour period prior to sampling and are analysed for Total Suspended Solids (TSS). Suspended solids loadings are used as an important indicator in relation to nutrient transport and aesthetic appearance. AECOM (2011) tabulated the sampling data obtained for numerous events dating from January 1998 for the M2 project. The calculated long term average and median values for each of the sites are also included.

Comparison of the M2 Motorway monitoring results for pre and post construction of the Motorway indicates that construction of the existing motorway has not had any significant impact on the water quality of the downstream receiving systems.

4.2.2.2 Pyes Creek – Site 4

Hornsby monitoring location HC-5 is located on Pyes Creek at Cherrybrook (refer Figure 14). The catchment draining to the monitoring site is approximately 380 hectares of which 79% is zoned residential. The monitoring site is located in a section of creek that has extensive patches of exposed bedrock. Monitoring by Hornsby Shire Council commenced in October 1994.

The monitoring site is located approximately 3km downstream of Cherrybrook Station and is therefore not suitable to provide a direct analysis of potential changes in runoff quality from the Project. However, results do provide a useful background to the nature of the broader downstream receiving system.

Monitoring results exceeded the ANZECC guidelines for Ammonium Nitrogen (NH3) and phosphorous concentrations in the majority of samples taken. The levels of turbidity and suspended solids in Pyes Creek were generally acceptable. Sewer leaks were not suspected due to low faecal coliform readings.

4.2.2.3 Cattai Creek – Sites 5 and 6

The Hills Shire Council operates three monitoring locations on Cattai Creek (referred to as locations A3, I2 and K3) as shown on Figure 14. Location I2 is located upstream of the Showground Station (Site 6), location A3 is approximately 200m downstream of the site on Showground Road and location K2 is a further 1.2km downstream. Additional monitoring locations have previously been operated by the EPA, SCA, Sydney Water, DLWC and the Hawkesbury Nepean Catchment Management Trust.

In general, *E. coli* and nutrients Total Nitrogen and Total Phosphorous were found to be above the ANZECC guidelines in over half the samples, with dissolved oxygen readings below recommended guidelines.

4.2.2.4 Strangers Creek – Site 7

The Hills Shire Council operates two monitoring locations on Strangers Creek (referred to as locations E1 and L2) as shown on Figure 14. Location L2 is approximately 1.5km downstream of the Norwest Station (Site 7). Location E1 is a further 2.5km downstream and is therefore not suitable to provide a direct analysis of runoff quality from the Project.

Results of monitoring at location L2 indicate nutrient levels below ANZECC guidelines, with dissolved oxygen readings below recommended guidelines.

4.2.3 Bella Vista Station to Rouse Hill Station

4.2.3.1 Elizabeth Macarthur Creek – Sites 8 to 11

Two monitoring sites operated by The Hills Shire Council are located on Elizabeth Macarthur Creek (locations F1 and B3 in Figure 14). Sampling location F1 is off Celebration Drive upstream of the proposed Bella Vista Station. Location B3 is off Clovelly Crescent, upstream of the confluence with Caddies Creek.

Location F1 has generally shown readings within acceptable limits for secondary contact recreation under the ANZECC guidelines. Slightly more than half the samples showed elevated Total Nitrogen levels. Results at the downstream monitoring site (location B3) indicate poorer quality, with elevated levels of Total Nitrogen and Total Phosphorous in nearly all the samples taken, along with elevated *E. coli* in approximately half the samples. Dissolved Oxygen at this location was below recommended levels within the ANZECC guidelines.

4.2.3.2 Caddies Creek (including Tributaries 3, 4 and 5) – Sites 12 to 15

The Hills Shire Council's Health and Environmental Protection Team operate two monitoring sites on Caddies Creek (Hills D3 and Hills C1 on Figure 14). Hills D3 is located approximately 1km downstream of the proposed Rouse Hill Station, with Hills C1 located a further 500m downstream.

Results from both sites indicate E. coli and nutrients Total Nitrogen and Total Phosphorous are above the ANZECC guidelines in over half the samples, with dissolved oxygen readings below recommended guidelines.

4.2.4 Rouse Hill Station to Tallawong Stabling Facility

4.2.4.1 Second Ponds Creek – Site 16

The Hills Shire Council's Health and Environmental Protection Team operate one monitoring site on Second Ponds Creek (Hills J3 on Figure 14). Hills J3 is located approximately 2.5km downstream of the Project corridor and therefore not suitable to provide a direct indication of the existing runoff quality relevant to the Project.

4.2.4.2 First Ponds Creek – Site 17

Blacktown City Council has two water quality monitoring sites in First Ponds Creek. The nearest of these is approximately 2.3km downstream of the Project and is therefore not suitable for use as a monitoring location.

5.0 Impacts

5.1 Flooding

5.1.1 General

Flooding of the creeks and waterways which traverse the project corridor has the potential to inundate the rail infrastructure, station precincts and ancillary facilities during the construction and life of the project, cause damage to the rail infrastructure and precincts and pose a safety risk to the public and rail workers. Furthermore, any proposed works within the floodplain have the potential to change existing flood behaviour and adversely impact on the surrounding environment. It is therefore necessary to manage the nature and extent of works within the floodplain in order to minimise the flood risk to the Project and surrounding environment.

Assessment has been made of flood risks and impacts relating to the construction and operation of the stations, rail infrastructure and systems defined under the scope of EIS 2. Each key component is described in the following sections in the context of potential flood impacts.

Construction impacts of the major civil works and operational impacts of major civil structures (bridges and viaducts) are addressed in the EIS 1. In assessing impacts on the surrounding environment consideration has been made to the cumulative impacts of EIS 1 and EIS 2 works. Refer to Section 5.1.3.

5.1.2 Impacts on Project Works

5.1.2.1 Station Precincts (Sites 4 to 8, 11, 14 and 16)

Each station will include a surrounding precinct that consists of a range of existing and future facilities including:

- Commercial/retail space.
- Transport interchanges/drop off/taxi facilities.
- Car and bicycle parking.
- Public domains and station plazas.
- Station access for emergency, delivery and maintenance vehicles.
- Pedestrian access.

As a minimum, railway stations are required to have 100 year ARI flood immunity. However, in accordance with the principles of the NSW Floodplain Development Manual (2005) a higher level of protection is needed where flows in excess of 100 year ARI have the potential to cause significant damage and/or risk to life. This is particularly relevant to underground stations where ingress of floodwaters has the potential to cause significant damage to critical services/infrastructure and where safe evacuation of rail users and staff may be difficult, particularly where there may be limited warning.

Underground stations are to be located at Cherrybrook, Castle Hill, Showground, Norwest and Bella Vista. Due to the potential consequences of flooding to these stations a PMF flood standard will be required against mainstream and significant overland flooding.

Based on the current concept design each station has been located above the PMF level of mainstream flooding. For above ground stations it is possible to adopt a lesser (100 year ARI) standard providing a flood risk assessment and flood evacuation plan is developed to identify how flood risks are managed for events greater than the 100 year ARI. Above ground stations are to be located at Kellyville, Rouse Hill and Cudgegong Road.

A summary of flooding potential at each station precinct, including PMF levels adopted for the Concept Design is provided in Table 4. Flood levels provided relate to mainstream flooding. At some stations, drainage collection systems will be required to manage the potential for local stormwater runoff to enter the stations. This is particularly relevant to Cherrybrook and Bella Vista Stations. Local issues and potential impacts relevant to each station are identified in Table 4 which also outlines mitigation measures to reduce the potential flood impacts.

The planning approach being adopted for the NWRL recognises that development in the precincts around the stations would occur over time, but that measures must be taken now to provide a robust framework within which this development can occur. In this context, the key flooding constraints and opportunities relevant to the broader station precincts have been assessed and key floodplain management requirements are summarised in Table 4.

5.1.3.1 Devlins Creek Tributary (Epping Services Facility)

The Epping Services Facility is located adjacent to the Devlins Creek tributary (referred to herein as the Beecroft Road tributary) that runs parallel to and between Edensor Street and Beecroft Road before joining Devlins Creek downstream of the Beecroft Road and Kandy Avenue intersection. Refer to Figure 3 for a locality map of the creek, including flood extent mapping for the 20 and 100 year ARI and PMF events.

There is considerable existing development on the floodplain in the vicinity of the project corridor, consisting mainly of medium density residential development and commercial development. These areas of existing development would be sensitive to changes in flood behaviour.

Given the sensitive nature of the surrounding development the Epping Services Facility has been designed to locate works outside the 100 year ARI flood extent and therefore negate any potential flood impacts on adjacent development up to the 100 year ARI flood. However, part of the proposed services facility is located within the PMF extent. Flood modelling results show that in a PMF flood levels could increase by up to 0.3m along the tributary between the facility site and Raby Road. Under existing conditions the area experiences widespread flooding in the PMF with properties along the tributary, including Raby Road already flood affected. No new properties would be affected as a result of the proposed works. Consequently the increase in flood levels is not considered to be significant in the context of the nature of existing flooding in the PMF.

5.1.3.2 Cattai Creek (Showground Station)

During the development of the concept design the Showground Station has been relocated outside the PMF extent to reduce the risk of flooding to the station, and potential impacts on adjacent development.

The broader Showground Station precinct area is located outside the 100 year ARI flood extent. A portion of the western access road off Carrington Road would be located within the PMF extent. Due to the conceptual nature of the precinct layouts there is currently limited information on finished design levels. However, given the extent of encroachment on the floodplain it is expected that impacts on the surrounding environment, and particularly Carrington Road can be managed in future design development.

5.1.3.3 Strangers Creek (Norwest Station)

Norwest Station is located on Norwest Boulevard, west of Strangers Creek. Strangers Creek in the vicinity of Norwest Boulevard is a highly modified system consisting of a series of ponds interconnected with drainage culverts, draining a catchment area of approximately 36 hectares. In larger flood events the ponds would overtop and flows would travel across Norwest Boulevard.

Norwest Station is elevated above Strangers Creek and located outside an area of mainstream flooding. However, significant overland flow from a tributary to Strangers Creek would travel down Brookhollow Road and Norwest Boulevard in larger events (along the western and northern boundaries to the precinct).

Adverse impacts on the surrounding area can be minimised through the provision of overland flowpaths to manage local runoff around and through the site. Such measures would need to be incorporated into the layout of the station precinct during future design development.

5.1.3.4 Elizabeth Macarthur Creek (Bella Vista Station to Kellyville Station)

Between Bella Vista Station and Kellyville Station the rail alignment runs parallel and to the west of Elizabeth Macarthur Creek. A locality map of the creek including flood extents for the 20 and 100 year ARI and PMF events is shown in Figure 9.

Development in the upstream catchment (south of Celebration Drive) is well established, consisting of a mixture of residential and commercial development. The catchment draining to Elizabeth Macarthur Creek between Celebration Drive and Samantha Riley Drive is currently largely undeveloped. However, significant urbanisation for the area is underway and ongoing as part of the North West Growth Centres. A particular area of future development is the Balmoral Release area.

During the concept design development the rail alignment has been shifted between Bella Vista and Kellyville Stations to run immediately east of Old Windsor Road, and thus outside of the Elizabeth Macarthur Creek floodplain. Flood modelling indicates that the rail corridor is clear of the PMF extent and therefore, impacts on flooding are expected to be negligible.

The Bella Vista Station Precinct is located outside the PMF extent for Elizabeth Macarthur Creek and therefore is not expected to have any adverse impacts on flooding.

Parts of the Kellyville Station Precinct are affected by flooding from Elizabeth Macarthur Creek in the 100 year ARI and greater. Based on the current concept layout the area that encroaches on the floodplain consists of roads and future development. Due to the conceptual nature of the precinct layouts, there is currently limited information on finished design levels. Consequently, in order to determine an upper limit of potential impacts the extent of proposed works has been assumed to be elevated above existing flood levels. The modelled arrangement is shown in Figure 15.

Flood Level Impacts

Modelled flood level impacts are shown in Figure 16 and Figure 17 for the 100 year ARI and PMF events respectively. The model results show that based on full development of the assumed precinct footprint there would be some localised impacts on the properties on the opposite side of the creek that are currently sensitive to flooding. These results indicate that it will be necessary to ensure that the precinct works are designed to ensure that existing flood storage and conveyance are maintained to ensure that there are no adverse impacts on adjacent properties.

In the PMF the modelled precinct footprint would result in flood level impacts of up to 0.5m along the precinct boundary immediately upstream (south) of Samantha Riley Drive. Further upstream (south) of Samantha Riley Drive impacts would generally in the order of 0.1 to 0.15m. Properties along Elizabeth Macarthur Creek, as well as Samantha Riley Drive would experience increases in flood level of up to 0.15m. However, these properties are already flooded in the PMF under existing conditions. While no additional properties will be affected

by the proposed works along Elizabeth Macarthur Creek, the intersection of Old Windsor Road and Samantha Riley Drive will be flooded.

Flow Velocity Impacts

Under existing conditions 100 year ARI peak flow velocities along the Elizabeth Macarthur Creek main channel are generally in the order of 1 – 1.5m/s but can be up to 3m/s in isolated locations (refer Figure 18). In overbank areas peak velocities are typically less than 1m/s. Peak flow velocities would be slightly higher in the PMF, especially around Samantha Riley Drive due to overtopping of the road (refer Figure 20).

The model results show that there would be no discernible changes to flow velocities in the 100 year ARI event (refer Figure 19). However, peak flow velocities in the PMF could increase significantly at some locations, particularly around Samantha Riley Drive (refer Figure 21). This is because the precinct arrangement assumed in the modelling would reduce the flow area by almost 50% near Samantha Riley Drive.

Conclusion

Overall, the model results show that it would not be feasible to raise the levels across the entire precinct above existing flood levels without having adverse impacts on the surrounding environment. During the development of the precinct layouts it will therefore be necessary to provide surface grading that maintains existing flood storage and conveyance.

APPENDIX 2 - **Construction Site Information**

Construction Site Information

The following table summarises SVC construction sites, and attributes relating to soil and water. Note that sites 1 through 8 relate to the NWRL TSC project so are excluded from this table.

Construction Site	Construction activities	Catchment	Water course impact?	Flooding impact?	Groundwater impact?
9. Balmoral Road	Dive excavation, bridge construction & aboveground civil works	Elizabeth Macarthur Creek	Elizabeth Macarthur Creek adjacent	Small area subject to 20 year ARI	Low during dive excavation
10. Memorial Avenue	Viaduct construction & aboveground civil works	Elizabeth Macarthur Creek	Elizabeth Macarthur Creek adjacent	Small area subject to greater than 100 year ARI	No
11. Kellyville Station	Viaduct construction & aboveground civil works	Elizabeth Macarthur Creek	Elizabeth Macarthur Creek adjacent	Small area subject to 20 year ARI	No
12. Windsor Road/Old Windsor Road	Viaduct construction	Caddies Creek (& Tributaries 3, 4 and 5)	Caddies Creek through site	Extensive portions flood affected by Caddies Ck, Elizabeth Macarthur Ck and Caddies Ck Tributary 5.	No
13. Old Windsor Road/ Whitehart Drive	Storage and Laydown	Caddies Creek (& Tributaries 3, 4 and 5)	Caddies Creek through site	Small area susceptible to frequent flooding by Caddies Ck	No
14. Rouse Hill Station	Viaduct construction	Caddies Creek (& Tributaries 3, 4 and 5)	No	Subject to stormwater runoff, and flooding greater than 100 year ARI.	No
15. Windsor Road Viaduct	Viaduct construction	Caddies Creek (& Tributaries 3, 4 and 5)	No	Outside the floodplain	No
16. Windsor Road Viaduct to Cudgegong Road	Bridge construction & aboveground civil works	Second Ponds Creek	Second Ponds Creek through site	Small area subject to flooding	No

Note: Northern end of Site 16 has reached construction completion and has been successfully handed over to the next contractor. ISJV no longer have access and area has been removed from EPL 20454.

APPENDIX 3 - **Source Water Balance & Management**

Appendix 3 -Source Water Management'

ISJV will minimise its potable water consumption through demand management and use of recycled water derived from the *Rouse Hill Recycled Water Scheme (RHRWS)*, treated water from sedimentation basins, captured rainwater and any other opportunities that are identified during the Project. Opportunities to minimise potable water usage follow the following hierarchy of steps:

1. Reduce potable demand and maximise efficiency
2. Utilise alternative water sources
3. Recycle
4. Disposal

Step 1 - Reduce demand and maximise efficiency

- Water efficient fixtures and fittings will be utilised in temporary amenities and facilities. Where possible, mechanical means will be used to clean (e.g. a broom instead of water) or where necessary, water saving tools will be utilised (e.g. a high pressure cleaner).
- Taps, hoses and hose connections will be regularly checked for leaks and inefficiencies and will be fixed where required.
- Minimise exposed areas to suppress dust and reduce the need for water use in dust suppression, for example:
  - Checking of wind direction prior to positioning dust suppression equipment.
  - Dust suppression carried out in cooler times of the day to minimise evaporation, and the use of covers to prevent wind erosion

Step 2 – Utilise alternative water sources

Where practicable and subject to quality control requirements, water will be collected, treated and reused in concrete batching and curing processes. An evaluation of potential reuse/recycling opportunities has been undertaken and is provided in the table below.

Location	Opportunity/Source	Commentary	Likelihood of being implemented
Concrete batching	Use of existing 1.0 megalitre (ML) underground storage tank (UGST) at offsite concrete facility to capture rainwater from site		Certain
	Capture of rainwater from adjacent sites	Agreements could be set up with adjacent buildings. Access, financial agreements, etc. to be agreed.	Low
	Installing a recycled water supply from nearby industrial uses such as a sewage treatment plant	Water from adjacent Bettergrow facility utilised.	Certain
	Use of wastewater from nearby industrial uses	No suitable industrial uses currently identified.	Low
Concrete curing	Sewer mining	Technically viable, but requires approval and access	Low
	Recycling of water used for concrete curing		Medium
Site compounds, construction area and surrounds	Rainwater tank to capture rainwater from compound and reused for local landscaping irrigation and toilet flushing	In line with industry best practice.	low
	Water obtained from sediment basins	Treated sediment basin water could be used for dust	Certain

Location	Opportunity/Source	Commentary	Likelihood of being implemented
		suppression, adjusting soil moisture in soils to be placed, watering of landscaped areas etc.	
	Blacktown Council Shale Quarry (off Schofields Road)	Subject to suitable water quality testing water could be used for dust suppression, adjusting soil moisture in soils to be placed, watering of landscaped areas etc. Hydrants available near Windsor Rd/Sanctuary Dve, Windsor Rd/Old Windsor Rd, Pier 19	Low
	Recycled water from RHRWS	RHRWS water could be used for uses such as dust suppression, cleaning of tools, vegetation areas etc.	low

Step 3 – Recycle
A water treatment system will be installed at the offsite concrete production site to treat recycled process water to a sufficient standard for use in concrete curing.

Step 4 - Disposal
All wastewater from site offices and compounds will be discharged to a combination of an onsite effluent management system and pump-out.

Water Demand Summary
By adopting the opportunities identified above, an estimation of the daily water usage required for the construction activities has been generated in the Indicative Water Balance table below. Note that the actual figures could vary significantly depending on weather and construction requirements, and the indicative figures below include the following assumptions:

- Water tanker capacity of 20,000L, refilling three times per day.
- Construction compounds will have a demand based on 350 people per day.
- Moisture control will integral in achieving earthworks compaction.
- Concrete placement is assumed at 50m^3 per day with a 0.4 w/c ratio
- 80 weeks of operations at the offsite concrete and pre-cast yard facility
- 95% of water used for concrete agitator washdown will be reclaimed and reused
- Potable water may be used to top up supply when required e.g. due to weather patterns, etc.

Indicative Water Balance

Use	Location	Category	Water Source	Estimated Total Quantity (kL)
Dust suppression - water tanker		Non potable	Sediment basins, Schofields Road Shale Quarry and recycled water network	30000
		Non potable	*Sediment basins*	*18000*
		Non potable	*Recycled water network*	*12000*

		Potable		*12000*
Concrete batching	Concrete batching plant	Non potable	Rainwater collected from concrete curing roof and rainwater collected from concrete batching plant. Potable water top-up when required.	13260
Concrete curing	Concrete curing plant	Non potable	Concrete will be chemically cured. Potable water top-up if required.	0
Concrete agitator washdown	Concrete batching plan	Non potable	Rainwater from 1 megalitre U/G storage tank and concrete agitator wash-down. Potable water top-up when required.	2380
		Potable		2380
Concrete plant washdown	Concrete batching plant	Non potable	Rainwater from 1 megalitre U/G storage tank	150
Formwork yard washdown	Concrete curing plant	Non potable	Rainwater from 1 megalitre U/G storage tank	480
Site office facilities	Sam Riley	Potable (drinking, washing etc)	Town water	2600
		Non potable (toilets)	Recycled water	200
Site shed facilities	Sam Riley	Potable (drinking, washing)	Town water	40
		Non potable (toilets)	Rainwater tank/recycled water	200
Landscaping		Non potable (Watering)	On site rainwater tanks	3
Tools and Equipment - e.g. concrete cutter, high pressure hoses	Likely to be three areas near to RW connections	Non potable	Recycled water outlet	20
Adjusting moisture content of soil for placement	Water tanker	Non potable	Sediment basins with recycled water top up	2000
		Non potable	*Sediment basins*	*988*
		Non potable	*Schofields Road Shale Quarry*	*12*
		Non potable	*Recycled water network*	*1000*

Washing of vehicles and plant	Likely to be three areas near to RW connections	Non potable	Recycled water	10
Addition of water to concrete piles and construction materials	Water to be tanked and transported to clean rigs.	Non potable	Recycled water network	13
		Non potable	Schofields Road Shale Quarry	7
Road sweepers		Non potable	Sediment basins with recycled water top up	5
		Non potable	*Sediment basins*	*1*
		Non potable	*Recycled water network*	*4*
			TOTAL	**65560**

Metering and Monitoring

Appropriate meters will be installed to monitor and record volumes of:

- Potable mains supply
- RHRWS water
- Reclaimed water at the offsite concrete production facility

Volumes of water used from sediment basins would be estimated by counting the number and volume of trucks.

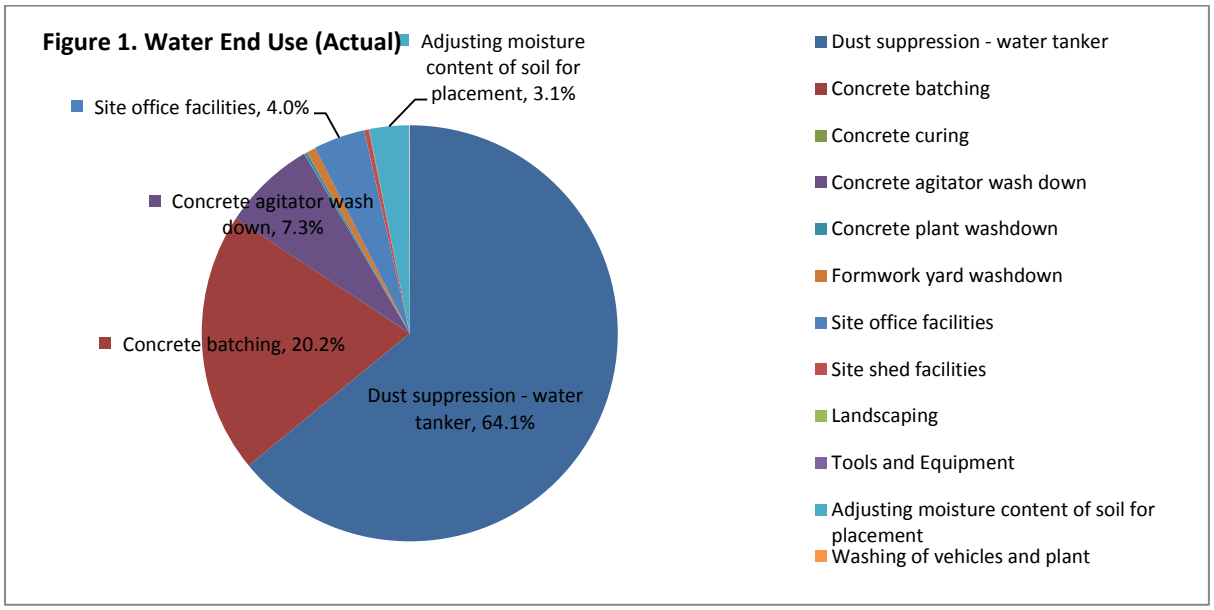
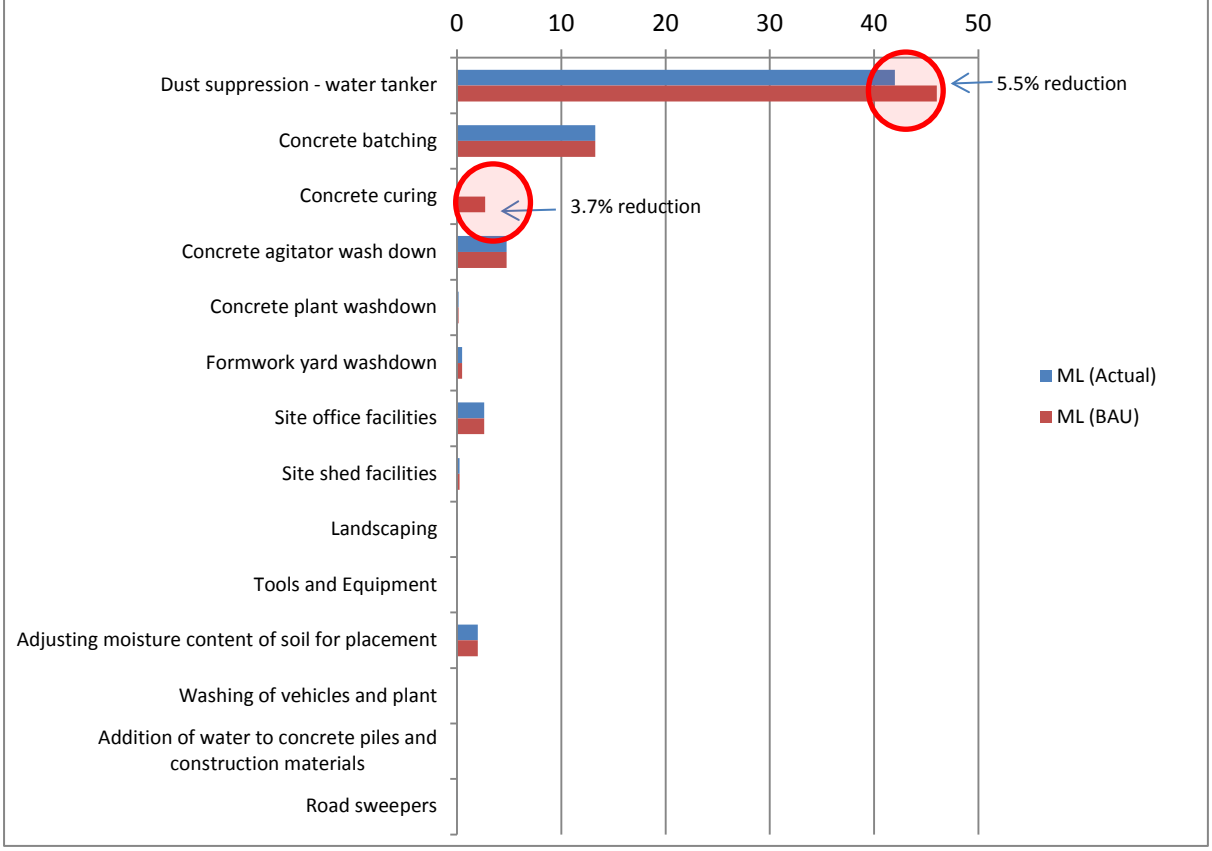


Figure 2. Water End Use (BAU vs. Actual)



APPENDIX 4 - **Acid Sulfate Soils Contingency Procedure**

Form:	Acid Sulfate Soils Contingency Procedure	salini impregilo
Revision:		
Approved:		

Purpose: To minimise the risk of disturbing Potential Acid Sulfate Soils (PASS) during construction works, which might lead to oxidisation of pyritic materials, with subsequent generation of acid runoff.

Relationship to Other Plans: This is a procedure under the SWMP.

Procedure:

ONSITE MANAGEMENT	RESPONSIBILITY
Work Activity Excavation or exposure of materials from below 10m AHD (Australian Height Datum) or from the previously underwater zone of a water body.	Construction Supervisor Site Engineer Environment Manager/Coordinator
Evidence of PASS Exposure Exposure of any obviously wet muds (clayey or silty material, not sandy or gravelly). See identification and photo examples at right	Construction Supervisor and Site Engineers to monitor during works. Advise Environment Manager or Coordinator if PASS identified.
Immediate Action • Stop work if suspected PASS is exposed. • Avoid exposure of material to oxygen by keeping it wet. • If material must be stockpiled, bund it to ensure no runoff escapes from and keep the stockpiled material wet. • Contact the project Soil Conservationist or qualified soil scientist to assess the material.	Construction Supervisor Site Engineer Environment Manager or Coordinator Soil Conservationist
Management Strategy • Soil Conservationist to prepare a report detailing management options (if PASS) in accordance with ASSMAC (1998) guidelines or give the all-clear. • If required, options for lime treatment or offsite disposal to be determined and appropriate action taken.	Construction Supervisor Environment Manager or Coordinator Soil Conservationist
Re-Commence Work Once appropriate action taken, Construction Manager to approve re-commencing earthworks.	Construction Supervisor

RECOGNISING POTENTIAL ACID SULFATE SOILS

Acid sulfate soils are naturally occurring, and are those formed under specific environmental conditions (typically mangrove swamps or similar inter-tidal areas). They typically only occur in Eastern Australia below 10m AHD elevation.

Acid sulfate soils contain significant amounts of Iron Sulfide (FeS_2). When exposed to oxygen by excavating or when water tables are lowered, sulfates (SO_4^{2-}) are released. When these mix with water they create H_2SO_4 (Sulfuric Acid).

Before being exposed to oxygen they are referred to as Potential Acid Sulfate Soils (PASS). After oxidation they become Actual Acid Sulfate Soils (AASS).

Key features of PASS:

- Moist or wet muds, often soft clays and silts. Rarely gravelly or sandy.
- Colour can range from brown to grey or even black depending on the amount of organic material present. Mangrove muds are prime examples.
- Often buried well below the ground surface and/or below the natural water table or in the intertidal zone.
- They will smell like a swamp.



MANAGEMENT OPTIONS FOR PASS

Avoidance	Avoid disturbing or exposing PASS materials.
Reburial	Re-bury PASS in an anaerobic environment, ideally below the water table.
Minimise	Minimise the amount of acid produced through careful management and handling. Alternatively, minimise environmental impacts by controlling the rate and/or runoff of acid.
Treatment	Neutralise PASS by treating with lime. Note that this is normally the

APPENDIX 5 - **Contaminated Land System Management Procedure**

1.0 Purpose & Scope

The purpose of this procedure is to ensure that the risk assessment & guidance process are in place to properly identify, segregate, handle, track, treat and/or dispose of contaminated materials[i] found on a site as part of work activities and to meet statutory and local authority requirements.

2.0 References (Standards, Guidelines, Legislation)

- ISO AS/NZS 14001:2004 Clause 4.4.6.
- Various Australian States & Territories Environmental legislation, guidelines and industry standards.
- Various Australian States & Territories Governments Guidelines.
- NSW Environmental Planning and Assessment Act 1979
- NSW Protection of the Environment Operations Act 1997
- NSW Contaminated Land Management Act 1997
- NSW EPA Environmental Guidelines: Assessment, Classification and Management of Non-liquid Wastes.
- NSW DECC Waste Classification Guidelines 2009.
- RTA (RMS) Contaminated Land Management Guideline 2005.
- Project/Contract specifications.

3.0 Definitions

Contamination: the presence in, on or under the land of a substance at a concentration above the concentration at which the substance is normally present in, on or under (respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment

Supplier: Product and service providers including subcontractors, suppliers, consultants.

VENM: Virgin Excavated Natural Material

4.0 Process

Who is Responsible	Sub-Process Description	Reference (Forms, Registers & Doc's)
	4.1 Risk Management Process The environmental risk management process will be managed in accordance with MSP22 Risk management, this procedure will provide a guidance for the management of contaminated land risk (pre, during & post works) which includes: ▪ Stockpiling of contaminated materials. ▪ Tracking material from contaminated areas into uncontaminated areas ▪ Contaminated mud tracking onto roads. ▪ Dewatering operations. ▪ Contaminated subsurface water. ▪ Contaminated surface water.	

Who is Responsible	Sub-Process Description	Reference (Forms, Registers & Doc's)
	4.2 Potential Risk (con't) The previous site usage history should be researched to assist in the identification of potential sources of contamination in site soils, ground water or existing structures. Some of the more common sources of contamination include: ▪ Businesses such as foundries, metal plating works, dry cleaners, service stations etc; ▪ Leakage from underground or above ground storage tanks used for chemicals, fuels, etc; ▪ Leakage from containers stored on unsealed or in unbunded areas; ▪ Contaminated soils brought to the site as land fill; ▪ Leaching from inappropriate waste water; disposal, buried wastes, septic tanks, etc; ▪ Migrating pollution deposited through soil, water or air from adjacent or neighbouring sites; ▪ Coal tar in pavements; and ▪ Illegal dumping.	
Client Project Manager	**4.3 Site Survey & Assessment** It would be expected that an initial site assessment would be performed by the client as part of the planning approvals or environmental impact process and the Company's role will be limited to on-site management, treatment and/or disposal. However, where this has not been done and it is considered that more than a cursory assessment is necessary a more detailed site survey may be necessary. This may involve several or all of the following: ▪ Site Inspection - Initial examination may show evidence of old structures and filling or dumping of materials. Signs of soil discolouration or surface depressions might indicate former lagoons or land fill settlement. Adjacent industry or land-usage that may lead to migration onto the site should be noted. ▪ Data Search - It is essential to know the former use of the property prior to setting up a programme for any monitoring. This may be found through state and local government planning records. Other authorities may have ground water records for the area.	Site Specific Contamination Assessment Report Site Specific Contamination Assessment Report WI22W-4 Waste Classification & Testing (NSW)

Who is Responsible	Sub-Process Description	Reference (Forms, Registers & Doc's)
	▪ Drilling and Sampling - If positive confirmation of soil or ground water contamination is required there may be a need to obtain and analyse samples. Samples may be obtained by: - core sampling - samples should retain the vertical structure of the soil so that the analysis can be mapped against depth. - test pits - installation of ground water monitoring bores - installation of gas probes	
	4.4 Control Measures **4.4.1 Prior to Removal**	
Project Manager	▪ Engage an accredited Hygienist/suitably qualified personnel to: - Prepare Site Specific Remediation Strategy and Remedial Action Plan, - Assess suitability of the material for reuse - Determine waste classification - Determine method and location of disposal or other appropriate remedial options - Supervise remediation and validation works - Prepare a validation report following remediation.	
Site Supervisors /ESR	▪ Prior to the start of any works, the location and extent of any contaminated materials should be physically and clearly identified to prevent inadvertent disturbance, mixing or unauthorised disposal. Suitable methods include: - bunting; parawebbing, spray paint, pegs and/ or signs - displaying a marked site plan at prominent locations	Site Specific Remediation Strategy
Site Supervisors	▪ Place signs indicating the contaminated status of the materials in the vicinity of earthworks **4.4.2 During Removal**	
	When working in areas containing contaminated soils, and removing impacted material for disposal (in accordance with the recommendations of the contaminated land Hygienist/consultant and relevant statutory requirements) implement the following precautions:	Site Specific Remediation Strategy

Who is Responsible	Sub-Process Description	Reference (Forms, Registers & Doc's)
Engineers/Site Supervisors	▪ Plan excavation for a period when rainfall is not imminent to minimise the generation of leachate or runoff.	
Engineers/Site Supervisors	▪ Provide cut-off drains, banks or bunds around the excavation to help control the ingress of surface and ground water, minimise the generation of leachate, and contain contaminated sediment.	Site Specific Remediation Strategy
Engineers/Site Supervisors	▪ Contain any leachate generated and treat and/or dispose of in accordance with legal requirements for that contaminant.	Site Specific Remediation Strategy
Engineers/Site Supervisors	▪ Consider odour emissions and if possible plan excavation on days where wind will not transfer odour or potentially contaminated dust material directly to off-site residential areas and businesses.	Site Specific Remediation Strategy
Site Supervisors	▪ Apply Biosolve or alternative commercially available odour suppressant to excavated areas and stockpiles to assist with odour control (where required).	
Site Supervisors	▪ Control fugitive dust emissions during excavation by an on-site water cart to keep material slightly moist in accordance with MSP22R Air Quality.	
Site Supervisors	▪ Keep work areas and stockpiles moist (but not overly wet) or covered to minimise dust generation in accordance with MSP22R Air Quality.	
Engineers/Site Supervisors /Operators	▪ Limit the excavation/working surface of the area so that the work can be promptly re-covered to help minimise odour and dust emissions.	
Engineers/Site Supervisors	▪ Isolate validated areas from contaminated areas by physical means including signage, temporary fencing and bunds/diversions as required to manage stormwater runoff.	
	4.4.3 Transportation on Site	
Site Supervisors /Suppliers/Operators	▪ Decontaminate all equipment and vehicles prior to moving from contaminated areas to clean areas or off site in order that contaminated materials are not spread. Use dry cleaning	

Who is Responsible	Sub-Process Description	Reference (Forms, Registers & Doc's)
	methods to prevent creating contaminated runoff.	
Site Supervisors	▪ Collect material from decontamination and store with other contaminated material for safe off-site disposal.	MSR22W-1 Waste Register
Site Supervisors /Truck Drivers	▪ Ensure for on-site transportation of contaminated materials, trucks are covered and decontaminated before leaving the excavation area, and proceed directly to the location of stored contaminated materials along established routes. Keep records of movement of any contaminated materials on site.	
Site Supervisors /Truck Drivers	▪ Trucks will not be permitted to travel over areas of the site that have been previously excavated, validated or reinstated, and must return from the stockpile area on predetermined routes	
	▪ Carry out remediation of the works as soon as possible. The excavation should be backfilled with clean fill and reinstated to specification requirements. If the back material is imported from external source to the project; record details in MSR22X-1 Imported Materials Register.	MSR22X-1 Imported Material Register
Engineers/ESR /Hygienist	▪ Ensure soils used for backfill have been tested and comply with the requirements of the relevant regulatory Authorities.	Site Specific Remediation Action Plan
	4.4.4 Temporary Stockpiles of Contaminated Material	
Engineers/Site Supervisors	▪ Temporarily stockpile materials pending validation of the excavated area and classification of the stockpiled material.	
Engineers/Site Supervisors	▪ Manage temporary stockpiling of potentially contaminated materials as follows: - Locate stockpile on existing concrete slabs /hardstand area where possible, or polythene or low-density polyethylene sheet (at least two layers of 0.25mm thickness) - Install controls to prevent access by unauthorised personnel - Cover stockpile with polythene sheets or tarpaulins and anchoring objects (with no sharp edges) - Install straw bales and/or silt fences around	

Who is Responsible	Sub-Process Description	Reference (Forms, Registers & Doc's)
	the perimeter of the stockpile - Install identifying signage at each stockpile - Establish buffer areas around each stockpile	
Engineers/Site Supervisors	▪ Determine the location of any stockpiles of contaminated material in consultation with the Hygienist/contamination consultant and ensure the same precautionary measures as listed above, are taken to minimise leachate generation or runoff.	
	4.4.5 Disposal	
Engineers/Site Supervisors/ESR	▪ Remediate impacted soils or dispose of off-site at a suitably licensed waste facility as appropriate.	
Hygienist/Site Supervisors/ESR /Engineers	▪ For off-site disposal refer to MSR22X Waste Management: - ensure that licensed operators, transporters and land fills are used for the particular types of contaminated materials being removed; - limit leachate generation by minimising infiltration or ingress of water into the site - establish and maintain appropriate material tracking records. Refer to MSP22W Waste Management.	MSR22X Waste Management
Engineers/Site Supervisors /Suppliers/Truck Drivers	▪ Cover and decontaminate transportation trucks prior to leaving site. Trucks must have watertight liquid seals, inspected daily prior to commencement of haulage works in accordance with MSP31 Plant & Equipment.	MSP22W Waste Management MSR22W-1 Waste Register MSF31-5 Daily Plant Inspections
Site Supervisors /Suppliers/Truck Drivers	▪ Trucks will exit the site via predetermined exit points and will follow a predetermined route to the disposal facility in accordance with MSP22W Waste Management.	
	4.4.6 Material Tracking	
Hygienist/Site Supervisors/ESR /Engineers	▪ The Materials Tracking Procedure will include: - Waste tracking registers in accordance with the regulatory Authorities requirements will be established and maintained. - Records for excavation/stockpiling/transport/ and disposal including date, material type, origin, quantity, transporter, disposal destination and sign off by the hygienist that material meets disposal requirements.	MSR22W-1 Waste Register MSR22W-1 Waste Register

Who is Responsible	Sub-Process Description	Reference (Forms, Registers & Doc's)
	- An imported fill form for all materials imported to the site including the date, material type, quantity, point of origin, intended use and suitability of the material for use as backfill at the site (i.e. validated VENM).	MSR22X -2 Imported Material Register
	4.4.7 Unexpected Finds	
Engineers/Site Supervisors	▪ If suspected contaminated materials are encountered, complete MSF22X-1 Contamination Stop Work/Permission to Proceed Form and cease work in the immediate area until the extent, concentration and type of contamination has been assessed and the required management measures are implemented.	MSF22X-1 Contamination Stop Work/Permission to Proceed Form
Engineers/Site Supervisors	▪ Restrict access to the area of suspected contamination to prevent further disturbance and exposure to the contamination. If possible cover area with plastic and fence.	
Project Manager /ESR	▪ Refer to WI22W-4 Waste Classification & Testing (NSW) for investigation/sampling/testing requirements.	WI22W-4 Waste Classification & Testing (NSW)
Project Manager /Engineers/Site Supervisors	▪ Do not recommence work until instruction to do so is given by the Hygienist/suitably qualified personnel and the 'permission to proceed' section of MSF22X-1 Contamination Stop Work/Permission to Proceed Form has been signed off.	MSF22X-1 Contamination Stop Work/Permission to Proceed Form
	4.4.8 Complaints	
ESR/Community Liaison Officer	▪ Record all complaints in accordance with MSP44A Complaint Management.	MSF44A-1 Complaint Form
	4.5 Monitoring & Inspection	
Site Supervisors /ESR/Visiting Senior Managers	Undertake routine inspections of contamination control measures and records including movement of materials on and off site, validation results, transporters and disposal destinations in accordance with MSP43 SHE Inspections using MSF43-2 Environmental Inspection Checklist and MSF43-3 SHE Inspections - Visiting Senior Managers.	MSF43-2 Environmental Inspection Checklist MSF43-3 SHE Inspections - Visiting Senior Managers.
Business Systems Manager or	The Project/Site Specific Remediation Strategy and Remedial Action Plan implementation will be	MSR51-1 Audit Schedule

Who is Responsible	Sub-Process Description	Reference (Forms, Registers & Doc's)
Environmental Consultant	audited for compliance by the Business Systems Manager or an environmental consultant during the course of the project (refer to the project audit schedule) in accordance with MSP51 Auditing.	
ESR	**4.6 Non Conformance** Any non-conformance related to contaminated land (generated from complaints, monitoring, site inspections and internal or external audits) and subsequent corrective actions to be resolved in accordance with MSP44 Non-conformance & MSP45 Improvement Opportunities, Corrective & Preventive Action	MSP44 Non-Conformance MSP45 Improvement Opportunities, Corrective and Preventative Actions
ESR/Site Supervisors	**4.6 Training** Ensure all relevant site personnel are aware of the Project/Site Specific Remediation Strategy and Remedial Action Plan including information on legal obligations under the relevant legislation prior to commencement of onsite activities and upon detection of contaminated materials in accordance with MSP15 Training Management and MSP22 Risk Management through: ▪ Site Inductions. ▪ Regular Toolbox (Consultation) Meetings. ▪ Safety & Environmental Hazard Analysis (SEA Card). ▪ Environmental awareness/training sessions.	
Engineers/ESR	**4.7 Records** Records will be managed in accordance with MSP50 Control of Records & Archiving and will include: ▪ MSF15-5 Toolbox (Consultation) Records. ▪ MSF15-6 Site Induction Form. ▪ MSR15-1 Training Record. ▪ MSF22-6 SEA Card. ▪ MSR22W-1 Waste Register ▪ MSR22X -1 Imported Material Register ▪ MSF22X–1 Contamination Stop Work/ Permission to Proceed Form ▪ Site Specific Contamination Assessment Report ▪ Project/Site Specific Remediation Strategy and Remedial Action Plan ▪ MSF43-2 Environmental Inspection Checklist. ▪ MSF43-3 SHE Inspections - Visiting Senior Managers. ▪ Internal/External Audits. ▪ SWMS's/Work Method Statements.	

Who is Responsible	Sub-Process Description	Reference (Forms, Registers & Doc's)

5.0 Documentation

Forms, Registers & Work Instructions

MSF22X-1 Contamination Stop Work-Permission to Proceed Form
MSR22X-1 Imported Material Register

Associated Documentation

MSP15 Training Management
MSP22 Risk Management
MSP22R Air Quality
MSP22W Waste Management
MSP31 Plant & Equipment
MSP41 Monitoring & Measurement
MSP43 SHE Inspections
MSP44 Non-Conformance
MSP44A Complaint Management
MSF44A-1 Complaint Form
MSP45 Improvement Opportunities, Corrective and Preventative Actions
MSP50 Control of Records & Archiving
MSP51 Auditing

[i] Contaminated materials excludes asbestos, asbestos contaminated materials (ACM's), lead paint, coal tar & other atmospheric contaminants as these are managed under Contaminated Materials (Hazardous Materials) Procedure MSP22X

APPENDIX 6 - **Primary Erosion and Sediment Control Plan**

APPENDIX 6: Primary Erosion and Sediment Control Plan

<table>
<tr><td>Scope and Context</td><td>This Appendix is a Primary Erosion and Sediment Control Plan (ESCP) and should be read in conjunction with the Construction Soil and Water Management Plan (CSWMP). This ESCP has been prepared in accordance with:
The NSW “Blue Book” Volumes 1 and 2D (Landcom, 2004 and DECC, 2008).
Environmental Conditions of Approval (CoA), Deed requirements and Revised Environmental Mitigation Measures (REMM) for the project (refer to Sections 2, 3 and 4 of the CSWMP).
This plan sets out the primary goals for erosion and sediment control, including fundamental principles to be adopted for the entire project. It precludes a series of Preliminary Erosion and Sediment Control drawings.
A series of Progressive ESCPs detailing the erosion and sediment controls for various parcels or stages of work will be prepared before any construction work commences on that particular section. In particular, these will detail specific requirements for environmental protection in high-risk areas such as watercourses.</td></tr>
<tr><td>Receiving Environment</td><td>The project site is mainly brownfield and comprises a mixture of urban, open space and rural residential land.
The majority of the project lies in the catchments of Elizabeth Macarthur, Second Ponds and Caddies Creeks, which all flow into Cattai Creek and eventually to the Hawkesbury River. A very small portion of the project site west of Cudgegong Road drains into First Ponds Creek, part of the South Creek catchment.
The receiving waters in and around the project site are heavily degraded and have been modified as a result of urbanisation.</td></tr>
<tr><td>Background Information - Soils</td><td>According to the latest soil landscape mapping for the Penrith 1:100 000 mapsheet (Bannerman and Hazelton, 1990) the project site traverses two soil landscapes. The majority of the alignment is on the residual Blacktown Soil Landscape with small areas found on the alluvial South Creek Soil Landscape where the project alignment crosses Caddies Creek, at a small tributary of Caddies Creek near Merriville Road and at the very end of the project alignment near First Ponds Creek.
<table>
<tr><th>The Blacktown Soil Landscape</th><th>The South Creek Soil Landscape</th></tr>
<tr><td>Residual soil landscape formed on Wianamatta Shale. It typically comprises of clay loam topsoil over medium to heavy clay subsoil. The shale bedrock tends to restrict the flow of infiltrated water and so it concentrates there.</td><td>Alluvial soil landscape. It typically comprises loamy topsoils over medium to heavy clay subsoil.</td></tr>
<tr><td>The landscape is Hydrological Group C.</td><td>The landscape is Hydrological Group C/D.</td></tr>
<tr><td>Soils can be significantly dispersible (Type D). Wet-type (total storm capture) sediment basins are required.</td><td>Soils are fine grained (Type F). Wet-type (total storm capture) sediment basins are required. Dispersible soils occur intermittently and should be allowed for.</td></tr>
<tr><td>The erodibility of topsoil and subsoil is taken as 0.038 (moderate) (Landcom, 2004).</td><td>The erodibility of topsoil & subsoil is taken as 0.05 (moderate/high) (Landcom, 2004).</td></tr>
<tr><td>The shale bedrock, residual soils and groundwater can all be saline.</td><td>The soils and groundwater can be saline.</td></tr>
<tr><td>Soils are generally infertile; particularly the subsoil.</td><td>The A2 horizon and the subsoil are generally infertile.</td></tr>
<tr><td>Topsoil acidity varies from strongly acidic to neutral. The subsoil is strongly to very</td><td>Topsoil acidity varies from strongly to slightly acidic. The subsoil is highly variable –</td></tr>
</table></td></tr>
</table>

	strongly acidic.	from extremely acidic to neutral.
	Soils are often hard-setting.	Soils are often hard-setting.
	Subsoil can be sodic (dispersible).	Soils are prone to waterlogging.
	Subsoil can have low available water holding capacity.	Deep subsoils are prone to sodicity (dispersible).

Background Information – Topography

The rail alignment traverses land with very low relief; slope gradients are less than 5%, usually 3% or 4%. Significant cut and fill is not required, batters will be low.

Design Assumptions, Soil Loss Class and Erosion hazard.

The following table summarises the soil management properties calculated or adopted for this project.

Characteristic	Calculated or adopted value
Soil texture	Type D (dispersible)
Soil hydrologic group	Group D (assumed due to compacted surfaces during construction). Adopted Cv (Volumetric Runoff Coefficient): 0.9
Rainfall depth	5-day, 85th percentile (Blacktown) of 32.2mm (Landcom, 2004)
RUSLE R-factor	2500 (Landcom, 2004)
RUSLE K-factor	0.05
RUSLE LS-factor	0.91 - Maximum assumed slope <=4%. Maximum 80m slope length assumed.
RUSLE P-factor	1.3 (Compacted and smoothed) (Landcom, 2004)
RUSLE C-factor	1.0 (No cover assumed) (Landcom, 2004)
RUSLE Erosion Hazard	148 t/ha/yr (for the majority of the site). This is classified as Soil loss Class 1 (Very low).
Approximate sediment basin sizing	310 m^3 per hectare of catchment (20 m^3 storage zone and 290 m^3 settling zone)

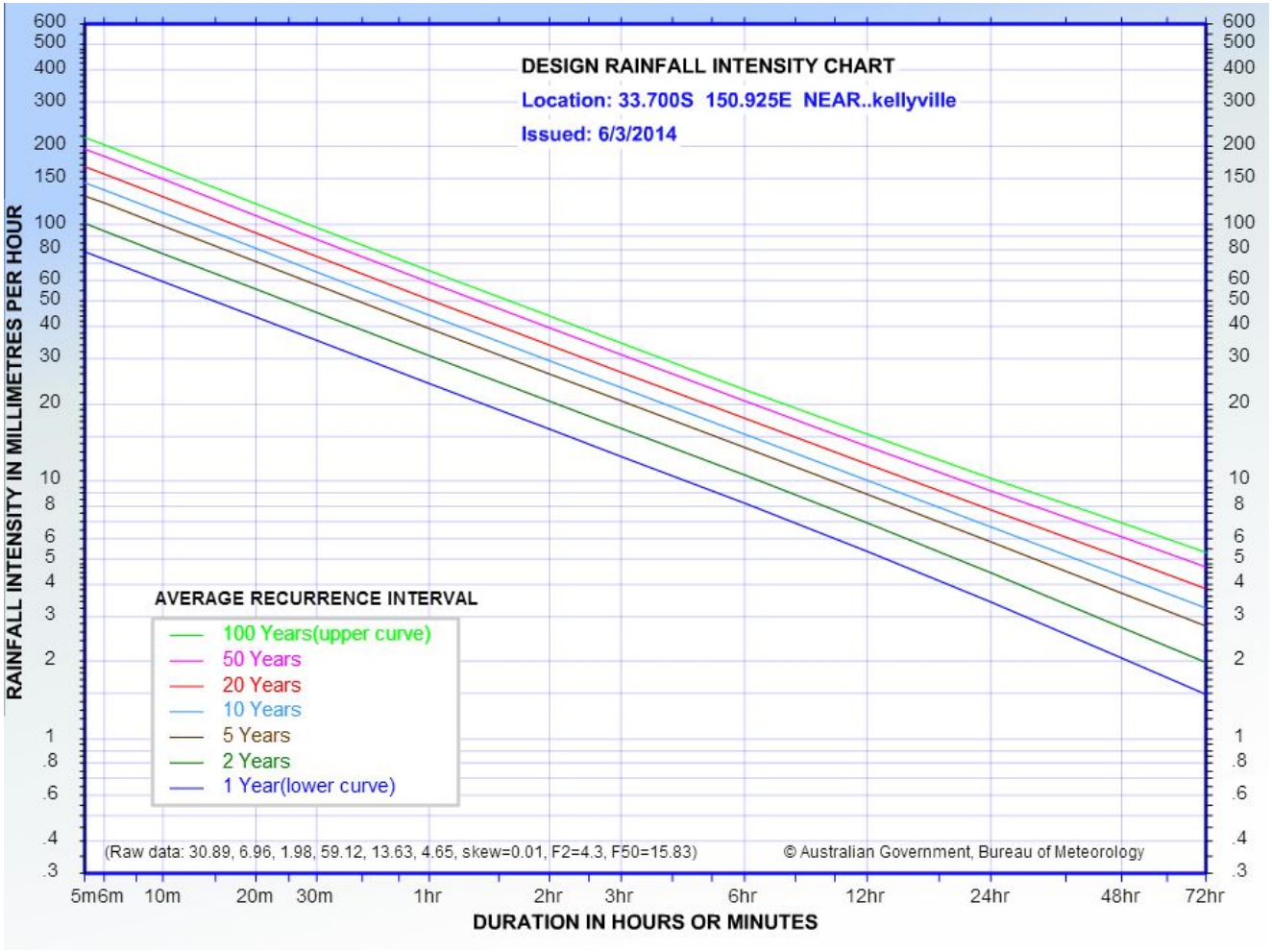
NOTE: The soil loss class for watercourse crossings is defaulted to Class 6 (very high). This means additional erosion control measures and/or timing of works is required in these areas during the period from 15th November to 31st May.

Background Information - Rainfall

- The rainfall erosivity (R-Factor) is 2,500.
- The site is in Rainfall Zone 1 (Landcom, 2004).
- Under the conditions in Landcom (2004) and DECC (2008), this project would be required to install sediment basins sized for the five-day 80th percentile rainfall depth (standard, non-sensitive receiving waters and 1-3 years construction time).
- However, given the scale and profile of the project, adopting the 5-day 85th percentile rainfall depth for sediment basin design is appropriately

conservative unless space does not permit construction of such basins. At nearby Blacktown, this equates to 32.2mm (note that the 80th percentile value is 24.6 mm so the adopted value represents a 30% increase over what might otherwise be required under standard Blue Book conditions.

- The IFD Chart is given below:



Potential Impacts	Potential impacts on surrounding water quality (as they relate to erosion and sediment control) include: • Erosion of exposed soils onsite • Increased runoff when compared to present levels • Increased sediment levels in runoff • Increased sediment loads and accumulations in receiving waters • Disturbance of acid sulfate soils (and subsequent acid drainage) • Dust impacts • Water quality issues from site dewatering (e.g. changed pH). Potential impacts will generally be mitigated, managed and/or minimised by implementing appropriate best-practice control measures and construction techniques.
Key Management Strategies – General Requirements	**General Requirements** 1. Progressive ESCPs will be prepared for each specific stage or parcel of work prior to commencing construction. 2. A specialist soil conservationist with relevant experience will be engaged to provide expert assistance with key aspects of design and review both before and during site works. 3. Wherever possible, the soil conservationist will provide specialist input into detailed design including: • design and location of sediment basins to maximise capture of runoff from construction areas • location and stabilisation of open drains (e.g. catch and berm drains) • batter treatments and rehabilitation • culvert design with consideration for a stable flow path during construction • dissipation of high-velocity flows. 4. Key personnel responsible for managing onsite erosion and sediment control measures will be trained in the effective installation and construction of controls, including sediment fences, batter drains on fill batters, and how to flocculate sediment basins etc. 5. Erosion and sediment controls will be installed at all sites associated with construction activities. 6. Relevant government authorities will be consulted in relation to control measures in watercourses and creeks. 7. All erosion and sediment controls will be installed in accordance with best-practice guidelines such as the NSW Blue Book Volumes 1 and 2D (Landcom, 2004 and DECC, 2008). Relevant standard drawings and details from these texts will be reproduced with Progressive ESCPs as required. 8. The Environment Manager will monitor weather conditions and forecasts (including rainfall prediction maps) daily and pass on relevant information to the site foremen to allow for adequate planning for significant rain events. 9. Relevant documentation and systems for recording erosion and sediment control activities will be implemented including:

	• Environmental Inspection Checklist • Progressive ESCPs • Site notes distributed internally between environmental and construction personnel (e.g. regarding weather forecasts) • Formal correspondence (e.g. EPA) • Water-quality monitoring results (e.g. sediment basins, receiving waters). 10. Relevant erosion and sediment control measures will be implemented for each particular section of works prior to the commencement of any clearing, stripping or earthworks. These will be installed as per the relevant Progressive ESCP. 11. Key management structures such as sediment basins, pipes and culverts will be installed as early works to assist in effective site management. (i.e. prior to clearing and stripping) wherever possible. 12. Additional erosion and sediment control measures will be implemented as required during the construction works. 13. Sufficient supplies of erosion and sediment control materials/products will be stored on site at all times. Storage locations will be provided in suitable location/s within the site compound. 14. An appropriate location for a site compound will be determined prior to construction works. As much as is feasible, erosion and sediment controls will be implemented for the site compound and all other construction facilities (i.e. offices, amenities and storage areas) prior to any clearing, stripping or earthworks commencing within these sites. 15. An appropriate equipment/vehicle wash down facility is to be located in a suitable area, away from all watercourses and flood prone lands and appropriate drainage and sediment controls will be established. 16. Designated impervious bunded concrete wash out facilities will to be provided at least 50m away from natural and built drainage lines. 17. Refer also to the requirements in the CSWMP.
Key Management Strategies – Access Limitations	1. Clearing limits and work boundaries will be established and well defined using barrier tape (or equivalent) prior to any construction, clearing or stripping works commencing. 2. The extent of clearing will be minimised as much as possible. 3. All vegetation that is to be maintained will be clearly delineated. 4. Land clearing will occur progressively and will be limited to the areas associated with the current section/stage of works only. 5. Areas will be initially cleared and grubbed to leave the soil surface in a reasonably rough condition with some surface vegetative cover. 6. Watercourses and adjacent areas will be left undisturbed until culvert/bridge constructions have commenced. 7. Grasses and understorey species will be left undisturbed during tree removal works wherever possible (especially in watercourses). 8. Disturbance and clearing in and around natural watercourses will be minimised as much as possible. Use the cut-stump method where possible instead of stump removal to further maintain stream bank stability. 9. Refer also to the requirements in the CSWMP.
Key Management	1. Separate ‘clean’ (offsite) run-on water from ‘dirty’ (onsite) construction area runoff.

Strategies – Drainage Management	2. Construct drainage structures early in the project including: • sediment basins and traps • catch drains • culverts/pipes and associated inlet and outlet protection (e.g. scour rock dissipaters). 3. Maximise the diversion of turbid construction runoff into sediment basins. 4. Control runoff during the construction of embankments (e.g. fill shaping and the construction of temporary windrows and batter drains). Use fill wind-rows and temporary batter chutes as required. 5. Divert formation runoff into pits and the stormwater drainage system as soon as practical to reduce surface flow lengths. 6. Diversion and catch drains are to be lined with geofabric, vegetation, concrete, TRM, organic fibre matting (e.g. jute) or similar to minimise the risk of scouring and erosion.
Key Management Strategies – Erosion Control (Source Control)	1. Separation of 'clean' (offsite) run-on water from 'dirty' (onsite) construction area runoff will be maximised as much as possible. 2. Divert offsite run-on water around the works site as much as possible. Permanent cut-off drains will be used to achieve this wherever possible. 3. Temporary diversions will be implemented during construction to divert 'clean' offsite run-on through/across the site so it doesn't come into contact with disturbed soils or sediment. 4. Slope lengths will be maintained at appropriate lengths to slow flows down and minimise erosion. 5. Geotextile linings, soil binders, tarps or similar will be used to provide temporary surface protection in areas where appropriate (e.g. batter drains, fills, culvert excavations). 6. Check dams will be used within drains to slow flows down and minimise erosion. 7. Stockpiles of soil material will be sited in low-hazard areas clear of watercourses and outside of flood prone lands. 8. Use geotextile linings, black plastic, organic fibre matting, rock or similar to provide temporary surface protection in areas of concentrated flows (e.g. batter drains, culvert construction). 9. Access/haul roads within areas containing potential acid sulfate soils, flood prone lands or any other high-erosion-hazard areas will be formed by providing a geotextile layer overlaid with 40-70mm rock (or similar). 10. Dust suppression will be carried out whenever necessary to minimise sediments becoming air borne due to wind erosion. 11. Stockpiles will be covered or stabilised to minimise erosion and dust generation. 12. The extent and time of soil exposure will be minimised. 13. C- Factors (a measure of ground cover) must be controlled to the requirements of Table A6-1. 14. Additional ground cover requirements are required in riparian zones (within 40 m of a watercourse) and in areas where it is not possible to construct a sediment basin. The progressive ESCPs drawing are to dictate the specific controls. Typical measures include: • Timing works for lower-risk periods of year. • Monitoring weather and flow forecasts.

- Stockpiling well away from watercourses.
- Use of temporary ground covers to minimise erosion of exposed soils during rainfall.
- Completing and stabilising new channels as quickly as possible.

Table A6-1 - Maximum C-Factors at Nominated Times

MAXIMUM ACCEPTABLE C-FACTORS AT NOMINATED TIMES DURING WORKS		
LANDS	MAXIMUM C-FACTOR	REMARKS
WATERWAYS AND OTHER AREAS SUBJECTED TO CONCENTRATED FLOWS POST CONSTRUCTION.	0.05	APPLIES AFTER TEN WORKING DAYS FROM COMPLETION OF FORMATION AND BEFORE THEY ARE ALLOWED TO CARRY ANY CONCENTRATED FLOWS. FLOW WILL BE LIMITED TO THOSE SHOWN IN TABLE 5.2 OF THE BLUE BOOK. FOOT AND VEHICULAR TRAFFIC WILL BE PROHIBITED IN THESE AREAS
STOCKPILES, POST CONSTRUCTION	0.1	APPLIES AFTER TEN WORKING DAYS FROM COMPLETION OF FORMATION. MAXIMUM C-FACTOR OF 0.1 EQUALS 60% GROUND COVER.
ALL LANDS, INCLUDING WATERWAYS AND STOCKPILES DURING CONSTRUCTION	0.15	APPLIES AFTER 20 WORKING DAYS OF INACTIVITY, EVEN THOUGH WORKS MIGHT CONTINUE LATER. MAXIMUM C-FACTOR OF 0.15 EQUALS 50% GROUND COVER.
ALL LANDS, POST CONSTRUCTION	0.1 - 0.05	0.1 C-FACTOR TO BE ACHIEVED IN 10 WORKING DAYS.(60% GROUND COVER) 0.05 C-FACTOR TO BE ACHIEVED WITHIN 60 DAYS OF COMPLETION, WHICH EQUATES TO 70% GROUND COVER.

Key Management Strategies – Sediment Control

1. Construct sediment control measures as close to the potential source of sediment as possible.
2. Maximise the diversion of turbid construction runoff into sediment basins.
3. Use smaller, filtration-style sediment traps in small catchments and where the erosion hazard is below 150 m3 per year. This includes in medians (although note that creation of a temporary low point might be required to minimise by-passing of flows).
4. Wherever possible, water in sediment basins will be re-used onsite for dust control. When necessary, sediment basins are to be treated using a flocculant such as gypsum to settle excess fine sediment. Refer to Appendix 7 of the Soil and Water Management Plan.
5. Water is not to be released from sediment basins prior to achieving acceptable water-quality standards. Refer to Appendix 7 of the Soil and Water Management Plan.
6. Control the tracking of mud and soil material onto local roads using shakers, rubble pads or wheel-wash areas.
7. Initiate a water-quality monitoring program (refer to Appendix 1 of the CSWMP for details).
8. Sediment fencing, mulch bunds or equivalent will be provided downslope of disturbed areas that can't be directed into a sediment basin unless completely impractical (e.g. works within watercourses). Alternative controls (e.g. silt curtains and/or enhanced erosion controls) will be implemented in these locations.
9. Mulch bunds or straw bales may be used as alternatives to sediment fencing where appropriate. Mulch will not be used in concentrated flow areas or if it has the potential to result in tannin leachate into waterways. Any bales (e.g. straw) used onsite are to be certified as weed-free by the supplier.

	10. Water accumulating within any sort of excavation, trap or low point on site that cannot be re-used in construction or dust suppression will be treated as per the requirements for sediment basins before discharge from site. 11. Sediment controls will be installed around stormwater inlet pits where appropriate and where they won't cause or exacerbate flooding. Traffic management and safety will need to be considered if installing such devices on live traffic roads. 12. Sediment controls will only be removed after 85% stabilisation of the upslope catchment is achieved. 13. Suitable access into sediment basin locations will be provided to allow for safe cleaning and maintenance operations. 14. Sediment basins will be tested and, if required, treated, prior to discharge within 5 days of the conclusion of any rain event.
Key Management Strategies – Stabilisation of Disturbed Areas	1. Undertake progressive stabilisation of ground surfaces as they are completed rather than at the end of the works program. 2. Progressively revegetate disturbed areas utilising appropriate species. 3. All areas (excluding lands taking concentrated flows) will be stabilised to achieve at least 60% cover within 20 working days of completion of formation and 70% cover) within a further 60 days. 4. Lands taking concentrated flows will be stabilised to achieve 70% cover within 10 working days of completion of formation. 5. Stabilisation of waterways including their beds and banks is to be commenced immediately after the completion of any works within these areas. 6. Separate mulch, topsoil and subsoil, and stockpile them separately. 7. Re-spread topsoil over completed areas prior to revegetating. Ensure topsoil is properly keyed with subsoil, especially on slopes, to avoid slippage/slumping. 8. Control dust through progressive revegetation techniques, water tankers etc. 9. Temporary ground covers such as hydraulic soil stabilisers (e.g. Vital Bon-Matt P47 or Gluon) or geotextile fabric will be used as much as possible to stabilise batters, stockpiles and large surface areas. 10. Sediment controls such as basins are to remain in place until their upslope catchment achieves 70% cover. 11. Revegetated areas will be slashed, watered and weeded as required.
Key Management Strategies – Soil and Stockpile Management	1. Topsoils will be stripped and stockpiled separately from subsoils. 2. As much as possible, soil structure will be preserved by not over-working soils, nor handling them when they are very wet or very dry. 3. Stockpiles will be located at least 50m away from any watercourse, drainage line or creek and at least 2m from any trees to be retained. 4. Stockpiles will not be located on flood prone lands below the 2-year flood level. 5. Stockpiles will be positioned within the project boundary and away from protected areas (e.g. native vegetation). 6. Long-term stockpiles will be secured with sediment fence downslope, diversion berm/drains upslope, and will be stabilised within 10 days of completion of formation to at least 60% cover. Long-term stockpiles with material continually coming or going will have a working face at one end and will be stabilised at the other. 7. Topsoil and mulch stockpiles will be constructed to no more than 2m in height where possible. 8. Stockpiles should ideally be battered down to a maximum slope of 2:1 (H:V) where space permits.

	9. Activities that might over compact topsoils will be avoided on topsoil stockpiles (i.e. avoid tracking excavators over the top of topsoil stockpiles). It is better to leave the surfaces of topsoil stockpiles loose. 10. Re-spread topsoil over completed areas prior to revegetating. 11. Dust suppression will be undertaken on stockpiles as required. 12. Weeds within natural soils will be managed (e.g. sprayed) prior to stockpiling and as they appear in stockpiles. All weed control to be undertaken by a qualified and licensed chemical applicator.

APPENDIX 7 - **Dewatering Work Instruction PWI22P-2**

1.0 Purpose & Scope

The purpose of this Work Instruction is to provide guidance on the preparation of WMS for dewatering activities that will involve the dewatering of ponded stormwater or infiltrated groundwater to ensure that all site dewatering activities are completed in a manner that does not cause harm to the environment.

2.0 References (Standards, Guidelines, Legislation)

- Project Environment Protection Licence (if applicable).
- Project Erosion & Sediment Control Plan.
- RMS Specification G36 & G38.
- RMS Technical Guideline Environmental Management of Construction Site Dewatering EMS-TG-011.
- Landcom - Soils & Construction, Managing Urban Stormwater (Blue Book); 2004

3.0 Definitions

Dewatering: is any activity that involves the removal of ponded stormwater or infiltrated groundwater from any location on site and the subsequent reuse or discharge of that water.

4.0 Process

During construction activities there may be a requirement to dewater numerous locations including:

- Sedimentation controls (e.g. sedimentation basins and sumps)
- Excavations
- Culvert and drainage constructions
- Low lying areas of road formations.

Captured stormwater and infiltrating groundwater will fill sedimentation controls and pool in low lying areas of construction formations and excavations. These areas must be dewatered to maintain the effectiveness of sedimentation controls and to ensure formations and excavations are not adversely affected by long periods of inundation.

4.1 Work Method Statement

A site-specific WMS must be developed for all construction and maintenance projects to ensure that dewatering actions are planned, approved and supervised to minimise impacts on the receiving environment.

Important: No construction site dewatering activity should be carried out unless it is in accordance with a WMS.

Every dewatering activity must be planned to achieve satisfactory environmental outcomes, the following points describe critical decisions that must be made in preparing dewatering WMS.

4.1.1 Identify areas of the site that will require dewatering

Dewatering locations will be identified though detailed design, in development of the CEMP and during construction as earthworks and construction phases result in changing site drainage conditions. These may include:

- Sedimentation controls (e.g. sedimentation basins and sumps)

- Excavations
- Culvert and drainage constructions
- Low lying areas of road formations.

Under no circumstances should first flush concrete batching water be pumped to sediment basins for treatment. These waters should be reused within the batching process or must be treated in-situ to ensure accidental discharges do not occur.

4.1.2 Consider dewatering methods to minimise potential environmental impacts

There are various methods available for dewatering sedimentation controls and inundated areas of construction excavations and formations. Assess different technologies with a view to providing the highest level of protection against environmental impacts.

Dewatering methods for sedimentation controls such as basins include pumping, low flow pipes and siphon discharges. Consideration should be given to alternatives to pumped discharges in all cases where practical.

Pumped dewatering presents specific risks relating to the pump inlet falling to the level of deposited sediment, resulting in direct discharge of polluted water to the environment. Any pumped discharge should be designed to prevent this scenario. Likewise, deposited sediment in controls such as basins must be maintained (removed) to ensure that inlets to dewatering systems are always above the level of deposited sediment.

There are two general methods for achieving water quality objectives for any site discharge, being:

a) Water quality treatment prior to discharge.

This is required for sedimentation basins and is the preferred method for any construction excavation or inundated area that has a sufficient volume and depth of water to provide flocculation of sediments prior to discharge. All area other than defined sedimentation basins that can be treated prior to discharge should have a designed dewatering method (e.g. a defined pumping point, low flow or siphon discharge).

b) Treatment with best practice controls prior to discharge.

Treatment with best practice erosion sedimentation controls during discharge is applicable for minor stormwater ponding and for activities such as individual culvert extensions where the volume of stormwater captured is minor and the dewatering activity is infrequent.

In these cases a suite of sedimentation controls, and appropriate erosion controls must be designed and implemented to provide on-site treatment of water prior to discharge to the environment. Controls may include sedimentation fences, mulch bunds, sedimentation sumps, geofabric wrapped gravel or mulch bunds, use of onsite grassed areas or a combination of techniques. The discharge from these activities must be managed to prevent erosion of the receiving environment.

4.1.3 Assess opportunities for reuse

Onsite reuse of stormwater or detained groundwater should be considered as a priority for all dewatering activities. Onsite reuse may include applications such as dust suppression, earthworks compaction, vegetation establishment/rehabilitation, and plant/vehicle wash-down.

Reuse of water on the construction site may reduce the need for imported or extracted water and provide a lower risk to the environment than direct discharge to the environment. Common minimum

requirements for any reuse activity are that the reuse should not cause the ponding or runoff of water, which may then cause concentrated runoff and unauthorised discharge.

Note: Where water is to be re-used for dust suppression, turbidity criteria do not need to be met.

4.1.4 Assess limitations for any proposed reuse methods

Any reuse activity may be limited by climatic or site conditions. During heavy rainfall periods when the need is greatest to remove treated stormwater from sedimentation basins, construction sites may be closed and un-trafficable due to the wet condition of the site. In these cases, onsite reuse for dust suppression or compaction is not feasible or possible. In these cases the water must be discharged to meet the sedimentation basin maintenance timeframes specified in either the environmental protection licence or the CEMP (for non-licensed sites).

Planning for any reuse activity and the WMS for dewatering must take these limitations into consideration, and a WMS developed for the management of discharge which may be required in high rainfall events.

Discharge water quality objectives will not apply only in the cases where the reuse activity is designed to be operational under all climatic and construction conditions and discharge to the environment will not be required.

4.1.5 Select discharge locations and provide adequate energy dissipation

It is important to ensure that dewatering activities do not cause subsequent erosion at the discharge location or in receiving environments. Consideration must be given to the potential for erosion at discharge locations when designing dewatering outlets. Preference should be given to locations with established stable drainage.

Energy dissipation must be provided at all dewatering discharge points. This may include the use of surface protection such as concrete aprons, geofabric, shade cloth, gabions or form ply depending on the condition of the receiving environment.

4.1.6 Determine and document water quality criteria for discharge and/or reuse

Sites with Environmental Protection Licenses will have defined water quality objectives for discharges from sedimentation basins. Best management practice still applies when discharging water from all other sites. This includes defining representative water quality criteria for the receiving environment and ensuring all discharges comply with these requirements. Standard project water quality objectives criteria are as follows:

- Total suspended solids 50mg/L
- pH 6.5 – 8.5
- oil an grease no visible trace

Specific water quality criteria may be required for activities that have the potential to impact water quality through a range of pollutants including:

- General earthworks in soils with contamination issues
- Earthworks in soils with naturally occurring issues such as acid sulphate soils, saline soils or high levels of other sulphide minerals (which may result in high concentrations of heavy metals in runoff).
- Hydrocarbon spills
- Concrete works (including batching operations)

- Stabilised pavements
- Precoat aggregates and spray sealing

Generally a review of environmental assessment and approval conditions and onsite conditions will provide further information on potential pollutants that may be present onsite or in site waters. Other methods to determine water pollutants may include the use of a testing probe, indicator strips, laboratory analysis, local knowledge and consultation with ESR's and regulatory agencies.

If reuse activities are properly designed and managed then ponded stormwater or groundwater may be able to be reused onsite without specific treatment.

4.1.7 Assess the treatment techniques required to meet the water quality criteria.

Treatments should be designed to achieve the water quality outcome specified for the project, as well as to cater for the time constraints that may be applicable to the activity (i.e. 5 day management period for sedimentation basins). Treatments should be applied to waters as soon as the requirement is determined, and should be applied only by experienced and competent personnel. Care needs to be taken to ensure treatment methods do not adversely affect water quality.

Examples of common treatment applicable may include:

- Flocculation of turbid waters is used to minimise the settling duration of suspended particles, as well as facilitate the clearing of waters exposed to dispersive soils. Flocculation enables water quality standards to be achieved within an accepted time period. A suitable flocculent should be chosen for sites based on an impact assessment of the receiving environment. In most cases gypsum will be utilised which is considered to be inert. There are other flocculants available however the use of these must be subject to consultation with relevant stakeholders, including regulatory authorities prior to use.
- pH adjustment using a base such as hydrated lime (for acidic waters) and inversely an acid such as hydrochloric acid (for alkaline waters). Low volume trials for each location will need to be carried out to determine dosage rates. Special care must be taken when adjusting pH to understand the buffer capacity of the waters, ensuring the neutral point is not over-shot. Any personnel involved in the adjustment of pH must be suitably trained and competent in the use of any additives.
- Absorption of oils and grease is used to remove traces of hydrocarbons that may have been mobilised by rainfall. Sources of oil and grease on a project may include spill and leaks from machinery, runoff from precoat aggregate stockpiles, and runoff from adjacent travel lanes. Generally oils and grease will be removed from the surface of water detention structure by the use of floating booms, pads and socks.

4.1.8 Assess water sampling and testing requirements

Water quality sampling and testing may be required to ensure that the water quality objectives are met prior to either reuse or discharge of the water. Techniques may include sample collection and laboratory testing or in-situ field assessment.

A list of approved testing methods for various analytes can be referenced from the various States/Territories environment regulatory authorities e.g. for NSW "Approved Methods for the Sampling and Analysis of Water Pollutant in New South Wales" (DEC 2004). Licensed premises require approved testing methods as per the conditions of the environmental protection licence (EPL) unless formal agreement has been reached with the relevant agencies. Any such agreement must be documented, and records kept onsite at all times

Non-licensed sites still require an approach to demonstrate due diligence for the testing of waters prior to discharge. This may include the use laboratory analysis and the approved testing methods, but alternatively can include calibrated comparison samples, turbidity tubes, portable probe analysis, or indicator strips. With the use of any of these alternative methods, their use should be discussed with environmental officers and personnel testing must be trained and competent. Regardless of the type testing utilised, comprehensive records must be kept onsite of all discharges.

4.1.9 WMS Format

The WMS should provide clear guidance for each dewatering activity on the following:

a) a map showing areas of the Site that will require dewatering
b) detailed description and justification of all selected dewatering methods
c) description of onsite water reuse requirements
d) a map showing proposed discharge locations for any offsite discharge
e) design requirements for each offsite discharge location to prevent erosion at the discharge location or in the receiving environment
f) water quality objectives relevant to the type of dewatering activity
g) description of the water quality treatment techniques to be used
h) water sampling and testing regime to validate water quality prior to and (if required) during dewatering
i) Proposed monitoring and supervision regime.

If changes are proposed to the dewatering method used at any location or new dewatering requirements are identified during construction then the WMS will need to be revised and submitted to the client (where required).

4.2 Record keeping for dewatering activities

You must keep the following records:

a) a copy of the dewatering WMS
b) date, time and estimated volume of water released for each discharge location using MSF22P-1 Dewatering
c) water quality test results for each discharge using MSF22P-2 Water Testing Chain of Custody Form and summary entered into MSR41-2 Environmental Monitoring Register
d) records indicating who provides approval for each dewatering activity, and
e) evidence of discharge monitoring or risk assessment i.e. using SWMS's and MSF43-2 Environmental Inspection Checklist.

Dewatering

Management System Form

Project: **NWRL**

ALL PARTS OF THE CHECKLIST MUST BE COMPLETED		
Date Inspected:	Basin No:	Location/ Zone:

#	CONTROL MEASURE	TICK	COMMENTS
1	Is oil and/or grease visible on the surface of the water? If visible, remove using suitable absorbent material.	☐ Yes ☐No	

DAY	DATE	pH	TURBIDITY (NTU) (TSS)		FLOCCULANT ADDED (kg)	pH ADJUSTED acid/base	SAMPLED BY	TESTED BY FIELD/ LAB	TIME
1									
2									
3									
4									
***5**									

***NB: Basins must be restored to <30% of design capacity within 5 days of cessation of rain event.**

2	TSS must be below 50mg/L otherwise flocculate basin before discharge until required standard is met.	Flocculant Used: Gypsum TSS acceptable (Tick)? ☐ Yes ☐No Meter Used: TN100 Calibrated:
3	Is base or acid required to meet required pH level?	Acid / Base (circle if applicable)
4	Acid: 10ml of 32% hydrochloric acid per m^3 water reduces pH approximately 0.1 pH unit. Base: Use lime in accordance with manufacturers specifications.	Chemical Used: pH acceptable (Tick)? ☐ Yes ☐No Meter Used: pHtestR Calibrated:

NOTES:

- All Dewatering must be performed in accordance with Dewatering Work Instructions PWI22P-1 Water Sampling & Testing, PWI22P-2 Dewatering, and PWI22P-3 Water Treatment
- Turbidity may ONLY be used to determine compliance with water quality criteria if a statistically valid correlation with TSS values has been established, approved by the Principal and submitted to EPA in accordance with the EPL.
- Consult Environment Coordinator for current correlated NTU value.
- All chemicals to be used in accordance with the relevant MSDS.
- If left overnight, water must be re-tested before re-commencing discharge.
- Form to be used for dewatering and dust suppression
- Records of all testing/inspections to be entered into MSR41-2 Environmental Monitoring Register

BASINS MUST BE RESTORED TO <30% OF DESIGN CAPACITY WITHIN 5 DAYS OF CESSATION OF RAIN EVENT

ALL PARTS OF THE CHECKLIST MUST BE COMPLETED		
Additional Comments:		
A correlation graph between TSS and NTU has been established for the site. Using a 25% safety factor, a NTU reading of		
71 has been adopted to ensure samples have a TSS below 50mg/L. Quality assurance measures and ongoing verification		
of the correlation will be used to ensure that this value continues to be an appropriate indicator of TSS.		
Discharge approved by: Position: Date:		
APPROVAL IS REQUIRED PRIOR TO DEWATERING		
Note: The approval to discharge from the sediment basin/sump must be given by the Environment Coordinator		
5	Water must be discharged within 24hours of sampling & testing.	Acceptable (Tick)? ☐ Yes ☐No
6	Is area where water will be discharged stable (e.g sealed, rocks, rip rap, concrete).	Acceptable (Tick)? ☐ Yes ☐No
7	If using pump ensure sediment /turbid water cannot enter line as water level is reduced.	Acceptable (Tick)? ☐ Yes ☐No
8	Date of discharge:	
9	Approximate volume left (%):	
		Discharged by: Position:

APPENDIX 8 - **Soil Salinity Report**

SEEC

Strategic Environmental & Engineering Consulting

Salinity Assessment and Management Report

for Northwest Rail Link (SSI-5100 & SSI-5414)

Prepared by: Mark Passfield and Andrew Macleod

SEEC Reference 14000038-SAL-04

15th October 2014

Strategic Environmental and Engineering Consulting

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.
Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the construction corridor at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

Mark Passfield
BSC (Hons) Engineering Geology and Geotechnics. CPESC.
Director, SEEC
15th October 2014

Document Version Table

Version	Author	Reviewer	Date
DRAFT	MP	AM	14th August 2014
DRAFT 2	MP	AM	28 August 2014
For agency review	MP	AM and NH (ISJV)	29 August 2014
Draft 3	MP/AM	ISJV and agencies	24 September 2014
Final	MP/AM	ISJV	15th October 2014

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1 Introduction

1.1 Background

Strategic Environmental Engineering & Consulting (SEEC) Pty Ltd has been commissioned by Impregilo-Salini Joint Venture (ISJV) to prepare this Salinity Assessment and Management Report for the Surface and Viaduct Civil (SVC) works section of the North-West Rail Link (NWRL). It forms Appendix 8 of the Soil and Water Management Plan and is required to address a number of Agency requirements (**Table 1**).

Table 1 - Agency Requirements

Condition Reference	Condition Text	Relevant Section of This Report
COA SSI-5100 C9 COA SSI-5414 C35	A Soil Salinity Report detailing the outcomes of geotechnical investigations and groundwater monitoring, to determine the presence, extent and severity of soil salinity within the SSI area and impacts to groundwater resources and hydrology, shall be prepared and submitted to the Director General prior to the commencement of bulk earth activities, or as otherwise agreed by the Director General. The report shall be prepared in consultation with OEH and NOW and detail, where relevant, that the SSI minimises, avoids and/or mitigates impacts on local/regional salinity processes, impacts on groundwater systems, and receiving environments. The recommendations of the Soil Salinity Report shall be incorporated into the Construction Soil and Water Quality Management Plan (condition E46(d)).	Section 3 Section 4 Section 1.2 Section 5
REMM SSI-5414: OpSG34	Appropriate soil salinity mitigation measures would be adopted in accordance with Draft Salinity Code of Practice (Western Sydney Regional Organisation of Councils, 2004) and Guidelines to Accompany Map of Salinity Potential in Western Sydney (DIPNR 2002). These mitigation measures would be included within Sub-Plans to the CEMP at all construction corridors within areas of known risk of soil salinity.	Section 5
REMM SSI-5414: OpSG35	A soil salinity assessment would be undertaken for each high risk construction corridor in accordance with the Construction corridor Investigations for Urban Salinity (DLWC 2002), including Phase 2 and Phase 3 investigation. This assessment would enable construction corridor specific mitigation measures to be developed to ensure saline soils are appropriately managed and damage to the environment and infrastructure is minimised. These investigations would be informed by the completed groundwater monitoring program.	Sections 3 and 4 Section 5
REMM SSI-5100 SG8	Appropriate soil salinity mitigation measures would be adopted in accordance with Western Sydney Regional Organisation of Council's Draft Salinity Code of Practice and the former Department of Infrastructure, Planning and Natural Resources' Guidelines to Accompany Map of Salinity Potential in Western Sydney (2002).	Section 5
REMM SSI-5100 SG9	Where appropriate, a soil salinity assessment would be undertaken in accordance with the DLWC Construction corridor Investigations for Urban Salinity (2002), including Phase 2 and Phase 3 investigation. This assessment would enable construction corridor specific mitigation measures to be developed to ensure saline soils are appropriately managed and damage to the environment and infrastructure is minimised. These investigations would be informed by the completed groundwater monitoring program.	Section 3 Sections 4 and 5

This assessment concentrates on the possible environmental effects caused by potential salinity at the Project Construction corridor. It does not address the aggressiveness of soil or rock to the proposed structures as that is being addressed by the design team.

Although this assessment covers the entire SVC project area, soil analyses have not been undertaken in a few areas where boreholes are yet to be drilled due to site access or environmental constraints (refer to **Table 5**). Bulk earthmoving activities will not commence in these areas unless:

- The outstanding soil analyses have been undertaken and this assessment report has been updated and submitted to the Director General; or
- An alternative plan for managing any potential salinity issues is prepared for those areas, a copy of which must be submitted to the Director General.

1.2 Agency Consultation

Both NSW Office of Water (NOW) and NSW Office of Environment and Heritage (OEH) have been contacted regarding this document. **Table 2** summarises the feedback received and relevant responses. Copies of Agency feedback are in Appendix 3.

Table 2 - Summary of Agency Consultation

Agency	Contact name and details	Feedback	Response
NOW	Rohan McDonald 4904 2642	Letter provided – no comments.	None required
OEH	Richard Bonner and Rob Muller 6932 9125	In Section 5.3, 1,000 µS/cm is used as the value to decide if specific saline groundwater management measures need to be taken or not. Generally, around 800 µS/cm is used as an environmental trigger. Pumping 1,000 µS/cm water onto vegetated lands could have detrimental impacts on plant health if pumping was to occur for an extended period of time.	Requirement amended to 800 µS/cm in Section 5.3
		Acid sulfate soils may be encountered in areas where Ashfield Shales are present. The report does not consider potential ASS impacts.	This is addressed in the Soil and Water Management Plan and is outside the scope of the Salinity Management Assessment.

		The Emerson Aggregate Test (EAT) is a useful general guide to sodicity. However, salinity and clay type also play a role in whether dispersion of the soil will occur. Sodium Adsorption Ratio (SAR) or Exchangeable Sodium Percentage (ESP) analysis of soil samples would be useful for more detailed evaluation of the dispersive nature of soils. These tests may need to be considered when investigating the 'Environmentally Sensitive Areas' if sodicity impacts are of particular concern.	Outside the scope of the Salinity Management Assessment to investigate soil dispersion potential. This is addressed in the Soil and Water Management Plan and is considered in the Erosion and Sediment Control Plan(s).
		Similarly, SAR and EC levels in groundwater and be used to assess potential sodium imbalance impacts on vegetation and soil structure. SAR analysis may need to be considered when investigating the 'Environmentally Sensitive Areas'	Outside the scope of the Salinity Management Assessment to investigate soil chemistry other than as it relates directly to salinity. This is addressed in the Soil and Water Management Plan and is considered in the Erosion and Sediment Control Plan(s).
		The figures describing the location of the proposed rail link are not consistent.	Inconsistency acknowledged. It does not impact on the findings nor the recommendations of this report. Figure 1 is the most accurate although for precise maps, refer to the NWRL website.

2 Brief Project Description

2.1 General

The project involves building a 4 km 'Skytrain' between Bella Vista and Rouse Hill, along with other surface works including bridges, embankments and railway cuttings. The Skytrain's alignment follows Winsor Road on its eastern side until the junction with Schofields Road. The alignment then turns west for about 1.3 km to meet Cudgegong Road just after crossing Second Ponds Creek, Rouse Hill. The width of the project Corridor is variable but averages approximately 50 m and the total footprint area of the Project Corridor is about 31 ha.

2.2 Piers

For most of its length the Skytrain will be supported on a combination of concrete pads and piers spaced at 40 m intervals. Each pad/pier will found on competent material, most likely shale bedrock. Each pier/pad location would require an excavation of approximate dimensions 6 m x 6 m.

2.3 Embankments

Bridges with abutments will be built at:

- Balmoral Road at Chainage (Ch.) 41060
- North-West Transitway at Ch. 41400
- Rouse Hill Drive/ Windsor Road at Ch. 45320
- Second Ponds Creek at Ch. 46520 m

Other smaller filled embankments are required along the length of the alignment.

2.4 Cuttings

Significant cut is required at:

- Ch. 40460 to 41260, north of Bella Vista Station.
- Ch. 45800 to 46000, east of Tallawong Station and associated with a small local knoll, the other side of which is an excavation (a quarry).

2.5 Construction Access

An unsealed access road will be built along the Skytrain's alignment and will be used for construction-access. Periodically this road will have access to Windsor Road or adjacent side roads. The road pavement will consist of approximately 150 to 300 mm of compacted road base placed directly on the subgrade after grubbing (removal of topsoil) and subgrade compaction. The road will be capable of supporting construction vehicles including large machinery, drilling rigs and cranes required to construct the elevated railway.

3 Construction Corridor Description

3.1 Topography and Drainage

The southern part of the construction corridor (Balmoral Road to Sanctuary Drive) follows a low, broad, north-south trending ridge that is bisected by Caddies Creek and one of its (un-named) tributaries. North of Sanctuary Drive the construction corridor occupies a gentle, east-facing side slope.

At Schofields Road the construction corridor turns west towards Cudegong Road, Rouse Hill for a distance of about 1.3 km. This section of the construction corridor drains to Second Ponds Creek.

Gradients across the whole construction corridor and in its immediate vicinity are typically between 0% and 5%. Total relief is less than 30 m. Significant cut will be required into the northern side of a small knoll at about Ch. 45700. However, most other areas of the construction corridor involve at-grade or above-ground construction.

The construction corridor is affected by a number of watercourses, the most notable being (south to north):

- Elizabeth Macarthur Creek, a third-order[1] stream at approximately Ch. 43000;
- Caddies Creek, a third-order stream also at approximately Ch. 43000 (Note that Elizabeth Macarthur Creek joins Caddies Creek at this location);
- Second Ponds Creek, a second-order stream at approximately Ch. 46540.

A first order stream is crossed at Ch. 44000, just north of Caddies Creek. All the watercourses drain generally north or northeast towards Cattai Creek and, ultimately, to the Hawkesbury River.

3.2 Soil Landscapes

3.2.1 Soil Landscape Mapping

DECC (2008) Soil Landscape Mapping shows the construction corridor lies predominantly on the Blacktown Soil Landscape, with small areas on the South Creek and Second Ponds Creek Soil Landscapes associated with major watercourse crossings (**Figure 1**). Descriptions of these soil landscapes are given below.

[1] Based on the Strahler System of stream classification.

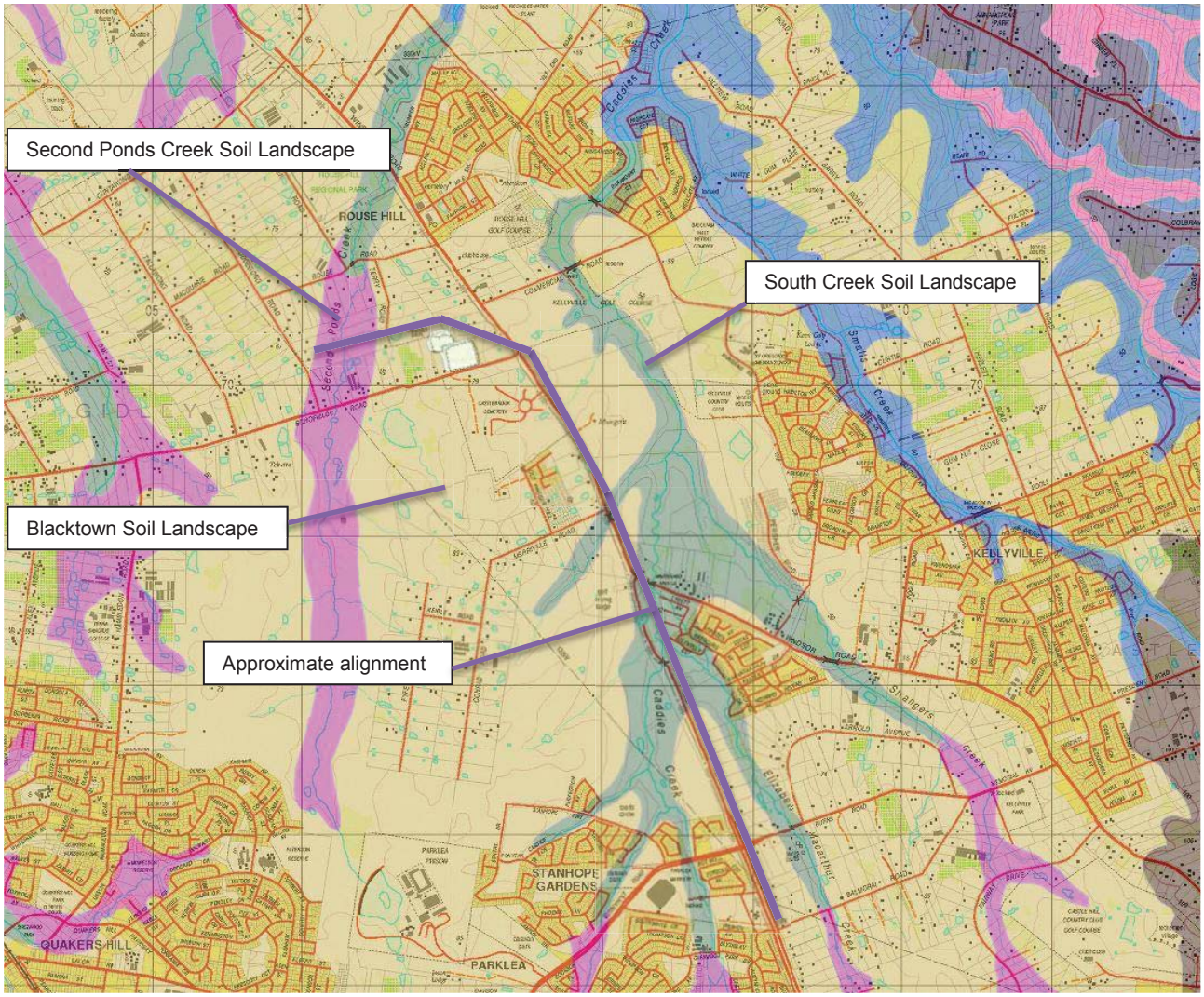

Figure 1 - Soil landscape mapping (DECC, 2008). Underlying mapping by LPI Australia, 2000.

3.2.2 The Blacktown Soil Landscape

This is a residual soil landscape formed mainly from *in situ* weathering of Wianamatta Shales (Ashfield Shale and Bringelly Shale). It generally consists of clay loam topsoil over medium to heavy silty clay subsoil. **Table 3** gives the common limitations to urban development on this soil landscape (DECC, 2008).

Table 3 – Limitations of the Blacktown Soil Landscape (DECC, 2008)

Soil Limitation	Extent
Strongly Acidic Conditions	Widespread, all layers
Hardsetting Surfaces	Topsoil only
Low fertility	Widespread, all layers
Reactivity	Widespread, subsoil only
Low Permeability	Widespread, subsoil only
Low available water-holding capacity	Widespread, subsoil only
Salinity	Localised, subsoil only
Sodicity	Localised, subsoil only
Dispersion	Localised, subsoil only
High aluminium toxicity	Widespread, all layers
High erodibility	Localised, subsoil only
Low CEC[2]	Widespread, all layers
Landscape Limitation	**Extent**
Surface Movement	Widespread
Seasonal Waterlogging	Widespread

3.2.3 The South Creek Soil Landscape

This is a fluvial soil landscape comprising the active flood plains associated with local watercourses. It occurs in the following approximate locations:

- Chainage 42660 to 43600; and
- Chainage 43920 to 44080

The soils are derived from the Wianamatta Shale and the Hawkesbury Sandstone. It is a dynamic landscape where stream bank and sheet erosion is common. Commonly, the soil profile consists of loam to clay loam topsoil over light to medium, sometimes sandy, clay subsoil. Sandier soils are found near active channels and on neighbouring terraces and levee banks. **Table 4** gives the limitations to urban development (DECC, 2008).

[2] Cation Exchange Capacity

Table 4 - Limitations of the South Creek and Second Ponds Creek Soil Landscapes (DECC, 2008)

Soil Limitation	Extent
High Erodibility	Widespread, all layers
Hardsetting Surfaces	Widespread, topsoil only
Strongly Acidic Conditions	Widespread, topsoil, A2 horizon
Low fertility	Widespread, all layers
Salinity	Localised, subsoil only
Dispersion	Widespread, all layers
Low CEC	Widespread, all layers
Landscape Limitation	**Extent**
Flood hazard	Widespread
Waterlogging	Localised
Permanently High Water tables	Localised
High erosion hazard	Widespread
Seasonal waterlogging	Widespread
Non-cohesive soils	Localised

3.2.4 The Second Ponds Creek Soil Landscape

The Second Ponds Creek Soil Landscape is a transferral soil landscape formed on foot-slopes and plains and comprises colluvium and alluvium. It occurs between (approximately) Chainage 46480 to 46610.

Local relief is 5 - 30 m and slopes are 0 - 3%. It has the same general urban limitations as the South Creek Soil Landscape (**Table 4**).

3.3 Geology

The entire corridor lies on the Wianamatta Group which is a thick sequence of Triassic-Period shale. The Wianamatta Group is made up of the following units (listed in stratigraphic order):

- Bringelly Shale
- Minchinbury Sandstone
- Ashfield Shale

All three units formed in coastal marine environments and they can have a naturally high salt content (DECC, 2008).

3.4 Climate

Western Sydney experiences a warm temperate climate with evaporation exceeding rainfall throughout the year. Mean annual rainfall is 801 mm and mean pan evaporation is about 1,523 mm (Bureau of Meteorology Station 67021; University of Western Sydney, Hawkesbury). The mean number of days with rainfall more than 1 mm is 77 per year.

3.5 Salinity Mapping

3.5.1 Hawkesbury Nepean Catchment Map

According to the *Hawkesbury Nepean Catchment Map - Salinity Hazard and Salt Outbreaks* (DECC, 2008) the majority of the works are in areas identified as having localised salinity hazard (i.e. salinity occurs only in specific parts of the landscape, but is not widespread).

However, a widespread salinity hazard has been identified along the major watercourses and west of Windsor Road (**Figure 2**).

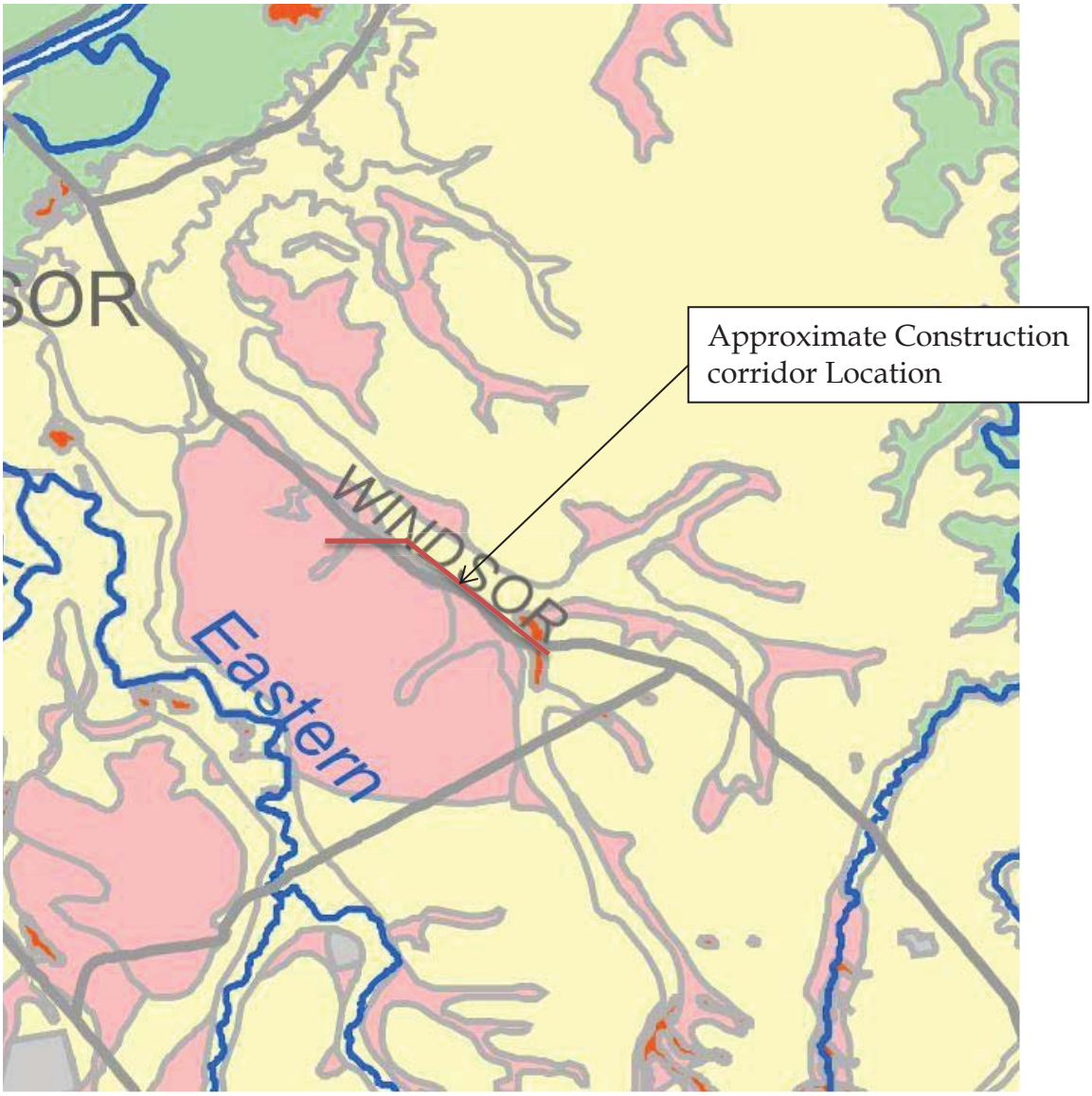

Figure 2 - Salinity Hazard and Salt Outbreaks (DECC, 2008).

Yellow = "localised" and red = "widespread" salinity occurrences

3.5.2 Department of Primary Industries

According to maps in DPI (2013) the locality is in Area VH2 – Sydney Shales. This category comprises Wianamatta Shale landscapes with low relief in the Central Cumberland Plains area of Western Sydney (**Figure 3**).

DPI (2013) states this area has a *"very high salinity hazard due to flat lying shales (Ashfield Shale and Bringelly Shale) and the relative dominance of Ashfield Shale which contains high levels of salt, stored in both derived soils and regolith. Low relief contributes to saline land development at all points in the landscape, but particularly at discharge points on lower slopes and floodplains"*

Potential impacts on the construction corridor include *"locally severe salt scalding and associated gully erosion along drainage depressions, damage to buildings and infrastructure as a result of salinity, fluvial and sheet erosion, high in-stream salinity, saline groundwater and localised water-logging and flood hazard. Off-construction corridor impacts include a decline in water quality".*

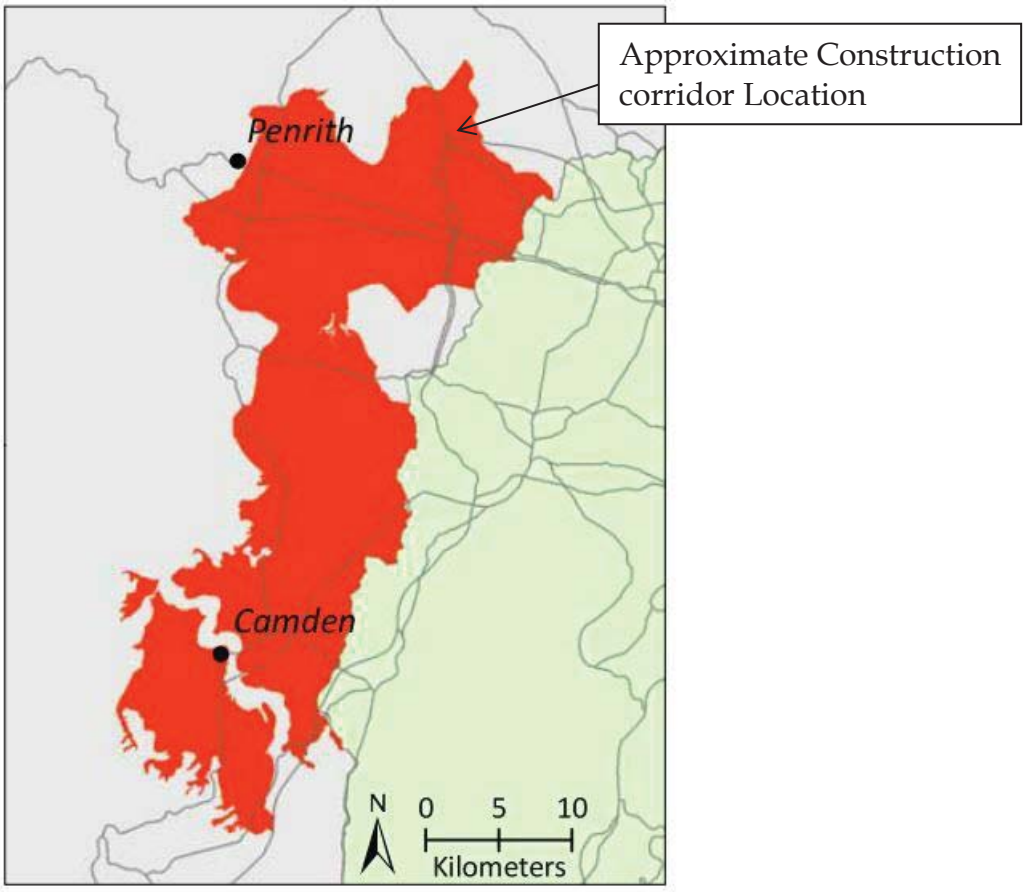

Figure 3 - Salinity Risk (DPI, 2013)

3.5.3 Department of Planning, Industry and Natural Resources (DIPNR)

DIPNR (2003c) is a map of Salinity Potential in Western Sydney (**Figure 4**). It shows high salinity potential along Elizabeth Macarthur Creek, Caddies Creek, the first order watercourse just north of Caddies Creek and Second Ponds Creek. Elsewhere along the proposed construction alignment there is a moderate salinity potential.

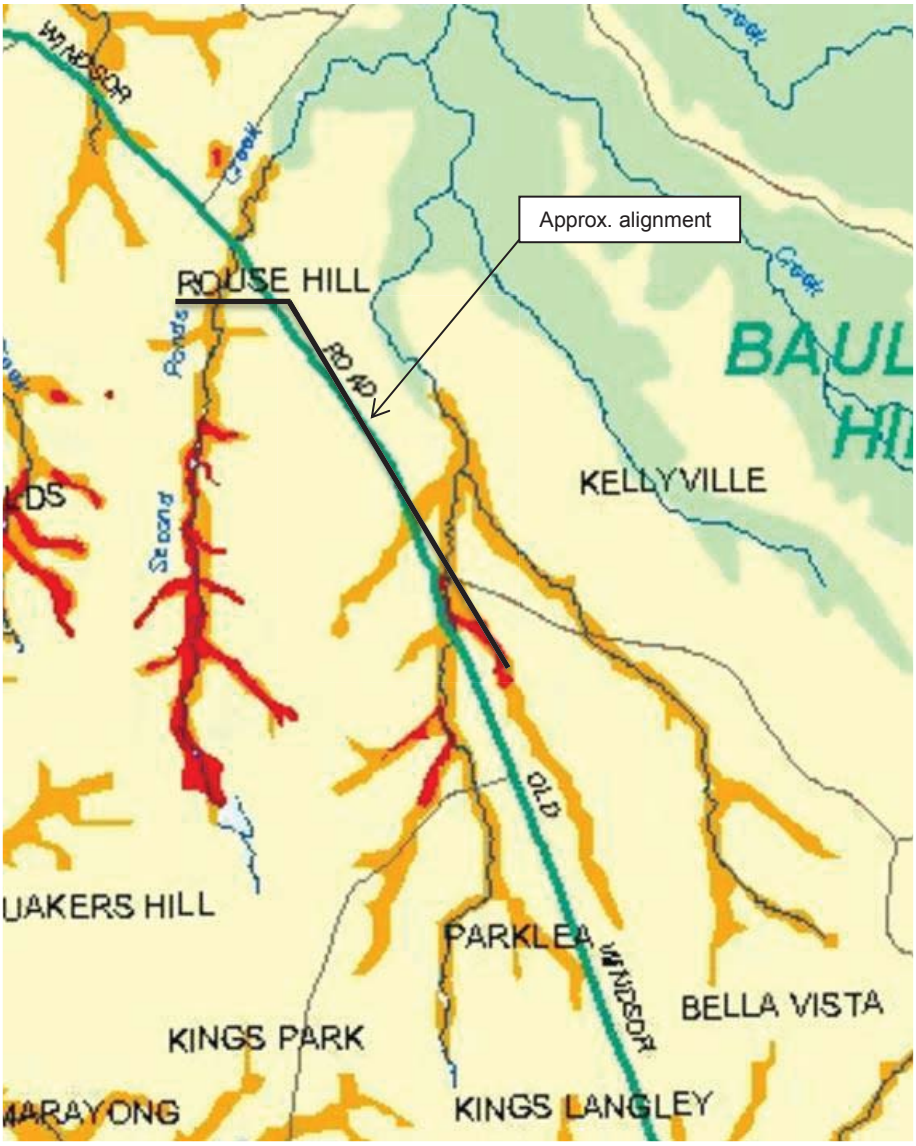

Figure 4 - Extract from Map of Salinity Potential in Western Sydney (DIPNR, 2003c)

Yellow = moderate salinity hazard. Orange = high salinity hazard. Red = extreme salinity hazard.

3.6 Subsurface Investigations

3.6.1 Introduction

Subsurface investigations have been undertaken by JK Geotechnics. These investigations included drilling a significant number of boreholes and test pits, mainly at each of the pier locations. Primarily, JK Geotechnics' investigations have concentrated on the engineering properties of the shale bedrock. However, at the request of SEEC, the investigations were expanded at a number of locations to include salinity–related soil testing. JK Geotechnics prepared a log for each borehole and test pit, copies of which are included in **Appendix 1**.

This project is classified as *Moderately Intensive Construction* under the Local Government Salinity Initiative (DLWC, 2002) due to the limited subsoil exposure and limited extent and depth of excavation. DLWC (2002) recommends a detailed profile description be made at the rate of 0.5 to 1 per hectare. However, given the construction corridor does not have complicated geology, 30 soil profiles was considered sufficient over the length of the proposed corridor. These are described (as bore hole or test pit logs) in **Appendix 1**[3].

DLWC (2002) recommends laboratory analysis is done at the rate of 0.2 to 1 profile per five hectares. Therefore, from the 30 locations described in **Appendix 1**, a suite of salinity-related soil tests were requested for soil layers at 17 locations.

Access to several proposed borehole investigation sites has been limited by the presence of Environmentally Sensitive Areas or other access constraints. Those areas will be subject to soil sampling and testing in future to determine the salinity hazard and ensure appropriate management regimes are implemented. No earthworks will occur in those areas until such testing has been completed.

At least three sampling and testing locations were conducted in the South Creek and Second Ponds Creek Soil Landscapes (as shown in **Figure 4**) as these were determined by the desktop assessment (**Section 3.5**) to be the areas with the highest risk of salinity.

3.6.2 Soil Profiles

The soil profiles conform to the typical soil profile descriptions contained in the Soil Landscape Mapping (DECC, 2008). All boreholes described in **Appendix 1** except BH649 and BH661A, BH807, BH808 and BH809 were drilled on the Blacktown Soil Landscape. They show a varying depth (commonly 0.5 m to 1.0 m but rarely above 2.0 m) of residual clay over weathered shale bedrock. Fill is present in some locations and topsoil can be thin or even absent, particularly where the land has been disrupted by past agricultural activities or urban development.

Boreholes BH807, BH808 and BH809 were drilled on the Second Ponds Creek Soil Landscape. BH649 and BH661A were drilled on the South Creek Soil Landscape. The fluvial soil profiles in these boreholes were significantly deeper (3 to 5.5 m) than the residual soil profiles found elsewhere along the construction corridor.

3.6.3 Soil Laboratory Testing

Representative samples from typical profile layers were collected and sent via chain-of-custody protocols to a reputable laboratory for a suite of soil tests. This included:

- Electrical conductivity (EC)
- Cation Exchange Capacity (CEC) and Sodicity (not all locations)

[3] Note only that part of the borehole log relating to the soil profile is included.

- pH
- Emerson Aggregate Test (EAT)

The results available at the time of writing are given in **Table 5** and an interpretation of them follows. As noted in **Section 3.6.1**, access to several proposed borehole investigation sites has been limited by the presence of Environmentally Sensitive Areas (in the case of BH677 and BH692), contamination (BH904) or access restrictions (TP503 and TP504). Those areas will be subject to soil sampling and testing in future to determine the salinity hazard and ensure appropriate management regimes are implemented.

Table 5 - Salinity-Related Soil Testing

Bore or Test Pit No.	Ch.	Depth (m)	Electrical Conductivity (EC) µS/cm (1:5 soil:water)	Salinity (ECe)[4] dS/m	Salinity Rating[5]	EAT	Sodicity Rating[5]	pH (1:5 soil:water)
BH507	41000	0 – 0.1	360	3.0	Slightly saline	8	Non-sodic	6.2
		0.5-0.95	64	1	Non-Saline		Non-sodic	6
TP507	41000	2-2.5	140	0.98	Non-Saline		Slightly sodic	6
TP516	40850	0.4-0.5	69	0.483	Non-Saline	2		4.8
BH509a	41060	0-0.4	62	0.53	Non-Saline	4	Non-sodic	5.7
		0.5-0.7	100	0.85	Non-Saline	4	Non-sodic	5
BH612	41810	0.4 – 0.5	860	7.7	Mod. Saline			7.8
		0.9 – 1.0	610	5.5	Mod. Saline			6.4
		1.8-2	270	1.89	Non Saline			
		4.2-4.5	430	3.01	Slightly Saline			
BH623A	42240	0 – 0.1	46	0.4	Non-Saline			5.6
		0.5 – 0.7	64	0.54	Non-Saline			4.9
BH639	42710	0 – 0.1	37	0.33	Non-Saline			5.5
		0.5 – 0.95	47	0.38	Non-Saline	4		5.8
		1.4 – 1.5	54	0.46	Non-Saline	2		5.9
BH649	43080	0-0.1	100	0.9	Non-Saline	2	Non-sodic	6.3
		0.5 – 0.95	62	0.53	Non-Saline	2	Non-sodic	6.2
BH661A	43510	3 - 3.5	68	0.5	Non-Saline	2	Slightly sodic	5.9
		4.5 – 4.95	110	0.66	Non-Saline	2	Slightly sodic	8.1
BH677	44140	TBA	TBA	TBA	TBA	TBA		TBA
BH692	44710	TBA	TBA	TBA	TBA	TBA		TBA
BH718A	45550	0 – 0.1	43	0.43	Non-Saline			6.1
		0.5 – 0.95	130	1	Non-Saline			5.1
		1.5 – 1.7	110	1.1	Non-Saline			5.6
BH904	45900	TBA	TBA	TBA	TBA	TBA		TBA
BH802	46310	1.5-1.95	1300	9.1	Highly Saline	2		
		4-4.06	340	2.3	Slightly Saline			
BH807	46510	0 – 0.1	360	2.88	Slightly Saline	2		5.8
		0.5 – 0.95	320	2.6	Slightly Saline	2		6.7
		1.5 – 1.95	620	5	Mod. Saline	2		7.0

Shaded cells show salinity (ECe) >4dS/m (moderately saline or greater).
Red identifiers = drilled on fluvial soil landscapes.
Blue = not yet tested due to access restrictions.

[4] A conversion factor is applied to EC to account for soil type. It is commonly 7-8 for clay. The result is then converted to dS/m to give ECe.
[5] Hazleton and Murphy (2007).

3.6.4 Groundwater Bores

JK Geotechnics have also installed numerous groundwater bores throughout the construction corridor. Groundwater samples have been taken from some and tested for electrical conductivity (EC). Where salinity results were available at the time of writing they are given in **Table 6**. A high salinity rating is given if the result is greater than 10,000 µS/cm.

Table 6 - Groundwater Well Salinity

Location	Chainage	Electrical Conductivity (µS/cm)	Salinity Rating[6]
BH506	41020	940	Low
BH517	41100	11000	High
BH714	45400	9600	Moderate
BH673A	44020	870	Low
BH720B	45600	2400	Moderate

Shaded cells show moderate salinity or greater.

3.7 Surface Investigations

3.7.1 Stream Water

Stream water quality is being monitored by ISJV at 12 locations within or in close proximity to the proposed construction corridor. The locations are given in **Table 7** and **Appendix 2**.

Note that stream water quality testing will be ongoing during construction. The results presented in **Table 7** (supplied by ISJV) are for the initial rounds of sampling and testing.

[6] Hazleton and Murphy (2007).

Table 7 – Initial Stream Water Quality Testing (Provided by ISJV)

Location			Laboratory Analysis						On-site Measurements							
Site name	Latitude	Longitude	Dissolved Oxygen (mg/L)	Turbidity (NTU)	pH	Conductivity @ 25 C (µS/cm)	Salinity (mg/L or ppm)	Total Suspended Solids Dried at 103-105°C (mg/L)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	pH	Conductivity (µS/cm)	Salinity (mg/L or ppm)	Total Dissolved Solids (mg/L)	Dissolved Oxygen % Saturation	Water Temperature (°C)
EMC1	-33.7242	150.9444	6.8	6.7	7.2	1200	770	19	5.2	17.25	7.47	1155	0.6	0.741	46.5	9.815
EMC3	-33.7186	150.9406	8.4	1.7	7.3	1200	760	<5	9.54	13.55	7.72	1120	0.55	0.715	85.5	9.18
EMCa1	-33.7147	150.9378	6.5	2.5	7.2	890	580	7	6.7	8.1	7.575	820	0.4	0.5245	59.55	9.42
EMCa3	-33.7099	150.936	6.7	6.5	7	480	310	9	4.855	43.65	7.51	437	0.2	0.2845	42.65	8.71
CC1	-33.7099	150.9315	6.7	4.5	7	680	440	7	5.735	19.1	7.57	633.5	0.3	0.405	51.65	9.495
CC3	-33.7017	150.9323	5.1	5.5	7	1000	660	23	6.165	75.75	7.885	810	0.35	518.5	57.95	11.5
CCa1	-33.7014	150.9287	10.6	1	7.6	1100	730	12	8.475	7.5	7.845	1007	0.5	0.644	79.9	11.4
CCa3	-33.6994	150.93	6.8	1.1	7.2	970	630	<5	6.9	8.45	7.75	878.5	0.4	0.563	62.85	10.27
SC1	-33.6941	150.925	6.7	3.3	7.2	580	380	<5	5.91	9.35	7.54	524.5	0.25	0.336	60	11.045
SC3	-33.6924	150.927	7.1	2.3	6.9	850	550	10	6.685	8.1	7.625	784	0.4	0.448	60.3	10.16
SPC1	-33.6951	150.9088	8.8	1.5	7.7	1200	800	<5	9.095	6.1	8.005	1135	0.55	0.726	82.85	10.205
SPC3	-33.685	150.9108	7.9	1.9	7.6	1500	980	<5	6.52	12.5	7.79	1455	0.4	0.929	58.5	9.67

3.8 Salinity Assessment

3.8.1 Soils

Salinity potential was identified in all of the soil landscapes along the project alignment and the shale bedrock is known to be saline (DECC, 2008, DIPNR, 2003c and DPI, 2013). The salt is ultimately derived from the parent bedrock but is mobilised by elevated groundwater tables and capillary rise, particularly as the land is almost entirely cleared.

Groundwater, which once would have been transpired by deep-rooted vegetation, now remains in the soil profile longer as a result of extensive land clearing. In doing so, it accumulates and elevates closer to the ground surface, collecting natural regolith salts. These salts can then be moved into the soil profile and might, in some situations, reach the root zone of sensitive vegetation or even reach the ground surface.

The subsoils have a low permeability which means groundwater movement is slow. The low permeability is often excerbated by sodicity which itself can be worsened by salinity. Groundwater generally drains to the lowest points in the landscape (e.g. the streams, or to deep excavations) and so surface expressions of salinity are usually confined to those areas.

In addition, areas where subsoils are intercepted, compacted or where groundwater movement is impeded can also result in groundwater rise. This is aided by the dry, warm climate, which exacerbates capillary rise, drawing groundwater up into the soils. All three soil landscapes are prone to perched watertables and seasonal waterlogging. Saline groundwater that reaches the surface is often evaporated, leading to localised surface scalding.

The residual soils of the Blacktown Soil Landscape have been tested at numerous locations (**Table 5**). The results show the soils are generally non-saline or only mildly-saline, although:

- Those at the surface of BH612 (Ch. 41810) were moderately saline;
- The deep (1.5 – 1.95 m below ground level) soils in BH807 (Ch. 46510) were moderately saline; and
- Soils at 1.5 -1.95 m below ground level in BH802 (Ch. 46310) were highly saline.

Fluvial soils of the South Creek and Second Ponds Creek Soil Landscapes were represented by testing from BH807 (Second Ponds Creek Soil Landscape) and BH649 and BH661A (South Creek Soil Landscape). The soils samples tested were either non-saline or only mildly saline (**Table 5**).

Approximately 25% of the locations where testing has been completed had moderately or highly saline soils.

3.8.2 Groundwater

Groundwater test results are given in **Table 6**. They show the groundwater salinity is highly variable and sometimes the groundwater tested was higher than the upper limit for the salinity trigger for a NSW lowland stream (2,000 µS/cm) (ANZECC, 2000). Approximately 60% of the groundwater bore locations tested have saline groundwater. Land disturbance activities that could raise groundwater should be avoided.

3.8.3 Stream Water

The stream water quality test results (**Table 7**) show that stream water is slightly saline but all results are below the upper salinity stress indicator trigger for NSW Lowland Rivers (2,000µS/cm) (ANZECC, 2000). The pH of stream water was consistently between 7 and 8.

3.8.4 Hydrological Interpretation

For the majority of the works area the topography is dominated by a broad, low, ridge line with low slope gradients and low total relief. The soils generally consist of low-permeability residual clay, so runoff will occur under most rainfall events. Infiltration (re-charge) would occur but would be slight. Construction activities are unlikely to increase the amount of groundwater recharge and, as such, are unlikely to lead to the creation or exacerbation of off-site salinity.

Common grey-mottling in the clay above the shale bedrock indicates that infiltrated water percolates through the soil slowly and is confined on the bedrock's surface, which is largely impermeable. However, where soils are duplex in nature (i.e. permeable topsoil over impermeable subsoil), perched watertables can occur on the subsoil layer. Here, localised seasonal waterlogging can occur that can lead to localised saline discharge and scalding (DIPNR, 2003a). Groundwater discharge would be predominantly limited to incised drainage lines and watercourses.

4 Project Salinity Risks

4.1.1 Identified Geographical Salinity Risk Areas

Based on the salinity mapping (**Section 3.5**), soil testing and the hydrological interpretation, those areas considered most at risk of salinity are:

- Lands on the fluvial soil landscapes (South Creek Soil Landscape and Second Ponds Creek Soil Landscape). This covers all areas between the following chainages (and also shown in **Figure 1**):
  - Chainage 42660 to 43600
  - Chainage 43920 to 44080
  - Chainage 46480 to 46610.
- Lands at the foot of significant slopes. The only occurrence of this is at Ch. 45800 to 46000 where the track alignment is at the foot of a small local knoll (i.e. within Zone 2 of **Figure 5** (Porter and Clifton, 2001)). **Figure 6** shows potential salinity problems arising from roads on footslopes. However, on the other side of the knoll is an excavation (an existing shale quarry), the base of which lies at or below the proposed cut level. Therefore, the local watertable has already been disrupted here and it is unlikely the proposed cut will intercept the groundwater table.

Elsewhere, the likelihood of salinity is moderate to low (about 20%) as shown by the soil test results. However, localised salinity could occur:

- Anywhere that residual soil has, or will be, removed or significantly thinned by erosion or human activities; or
- In areas where ground disturbance activities expose saline soils or encourage excessive infiltration; or
- In areas where the local geology or man-made structures cause groundwater to surface.

4.1.2 Potential to Trigger or Exacerbate Salinity

Construction activities that could cause or exacerbate surface expressions of salinity include:

(i) Excess infiltration of water; e.g. from excessive irrigation, infiltration of stormwater, leaking stormwater basins/ponds;

(ii) Interception of saline subsoil by earthworks (cuttings, trenches, piers);

(iii) Interception of saline groundwater by earthworks (cuttings, trenches, piers);

(iv) Saline-spoil (leachate and runoff);

(v) Interception of the subsoil layers by impervious structures (e.g. footings or piers).

(vi) Excessive compaction of soil which can reduce the *in situ* permeability /transmissivity[7] of groundwater (e.g. under compacted areas such as access roads or embankments). Refer to **Figure 6** for an example.

Management strategies for identified risk areas are discussed in **Section 5**.

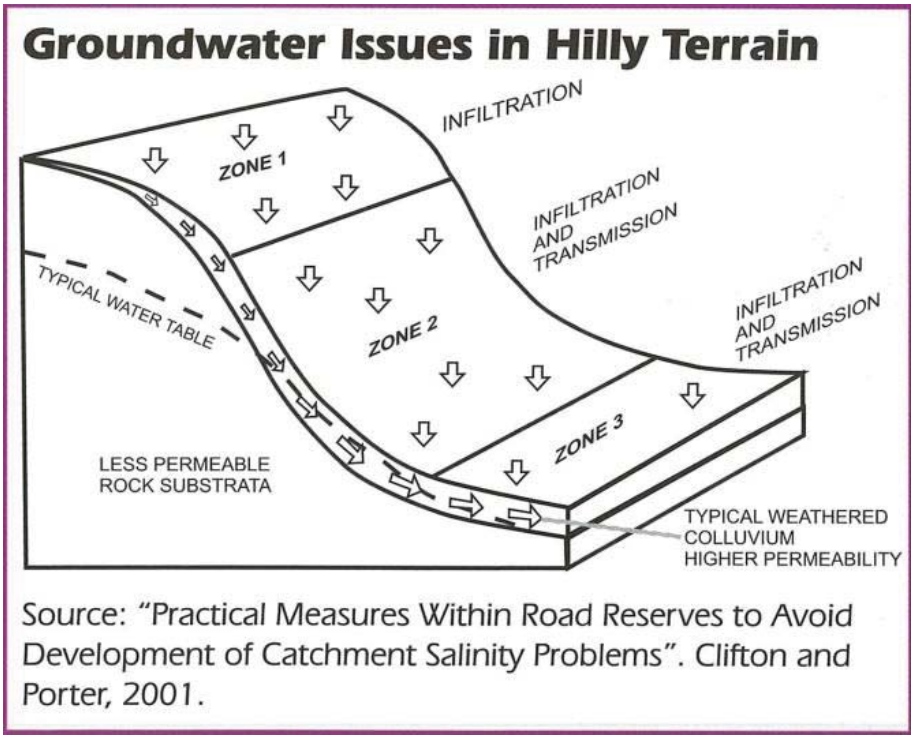

Figure 5 - Groundwater Issues on Hilly Terrain (Clifton and Porter, 2001)

[7] The ability for lateral groundwater movement.

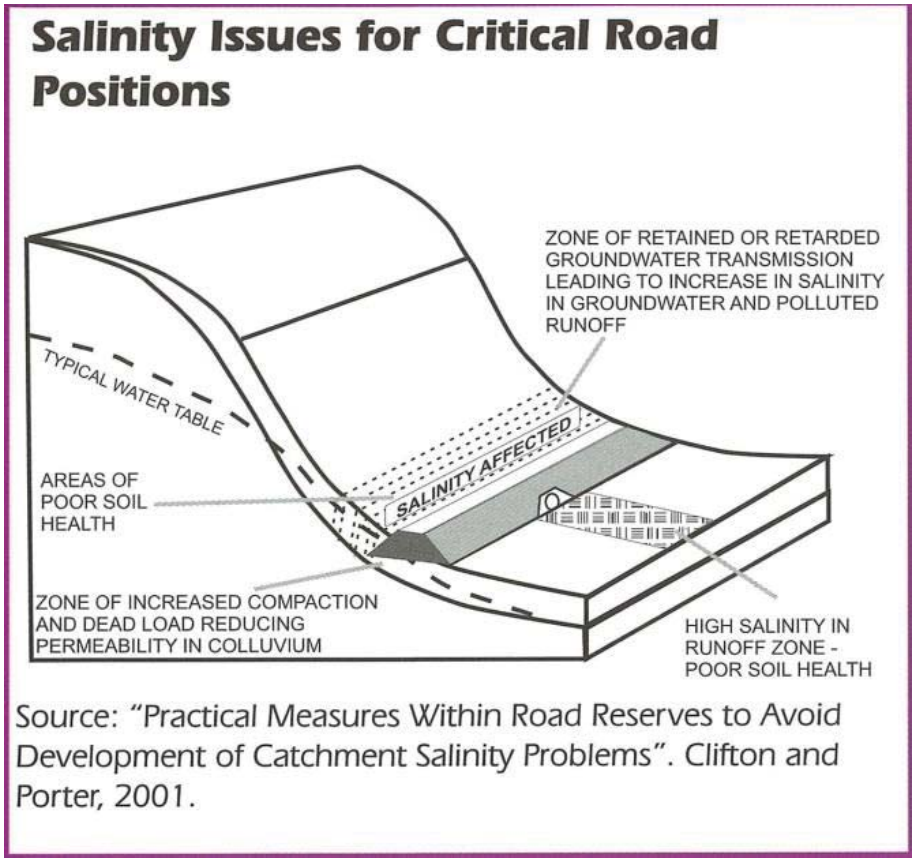

Figure 6 - Salinity Problems Caused by Road Positioning (Clifton and Porter, 2001)

5 Salinity Management Strategies

5.1 Management of Potential Infiltration

As identified in Section 4.1.2, activities that increase the amount of infiltration could cause or exacerbate offsite salinity impacts. As such, the following management measures will be applied to ISJV's works:

- Sediment basins will be de-watered within 5 dry (rain-free) days of a rainfall event that caused inflow.
- Sediment basins will be excavated into low permeability clay or shale. Considering the short duration that water would be stored (5 days) this will limit the potential for infiltration to groundwater.
- Dust suppression using water carts will avoid over-watering and only use sufficient water to manage dust rise. Surface ponding will be avoided during dust suppression.
- Irrigation of rehabilitated or landscaped areas will utilize low-water-use fixtures such as drippers, sub-surface irrigation or similar. Water will be applied sparingly and only in quantities sufficient to promote plant growth. Subsoil moisture will be physically checked (through visual observation) regularly during irrigation to ensure watering rates are not excessive.
- Wherever possible, effluent from ablutions onsite will be connected to existing sewer or will use portable systems that are regularly pumped-out or replaced. If this is not possible and an onsite wastewater treatment system is used, disposal of treated effluent must use a surface or near-surface system that relies mainly on evaporation. Infiltration systems (e.g. trenches) are not recommended.
- Water used for construction purposes (e.g. to achieve adequate compaction rates) will be applied sparingly and carefully to minimise the potential for infiltration.
- Any stockpiles of potentially-saline material (refer to **Section 5.2**) are to be covered with impermeable material (e.g. builders' plastic) to minimise the risk of saline water leaching from the stockpile. Alternatively, stockpiles are to be completely bunded to minimise runoff and collected water evaporated or treated prior to release.

5.2 Management During Excavations

As identified in Section 4.1.2, activities that involve excavating into potentially saline soils could cause or exacerbate local salinity problems and/or cause saline water to drain into local waterways.

In those areas, the management measures detailed in **Table 8** will be applied to ISJV's works.

Table 8 - Management Measures During Excavations

Location	Total estimated spoil quantity	Soil testing	Salinity Management Action
At each pier footing excavation between Chainage 42660 to 43600, Chainage 43920 to 44080 and Chainage 46480 to 46610	50,000 t	One sample per every two piers will be field-tested for electrical conductivity (EC). Refer to the methodology below.	If ECe < 3 dS/m, no salinity management action required. If ECe > 3 dS/m, refer to management options below.
At each pier footing excavation – all other chainages outside of those listed above.		One sample per every five piers will be field-tested for electrical conductivity (EC). Refer to the methodology below.	If ECe < 3 dS/m, no salinity management action required. If ECe > 3 dS/m, refer to management options below.
Cut at Ch. 40460 to 41260	200,000 t	One sample per 10,000 tonnes excavated will be field-tested for electrical conductivity (EC). Refer to the methodology below.	If ECe < 3 dS/m, no salinity management action required. If ECe > 3 dS/m, refer to management options below.
Cut at Ch. 45800 to 46000	50,000 t	One sample per 10,000 tonnes excavated will be field-tested for electrical conductivity (EC). Refer to the methodology below.	If ECe < 3 dS/m, no salinity management action required. If ECe > 3 dS/m, refer to management options below.

Methodology for Field Testing of Soils

- During excavations a sample of each subsoil layer (i.e. only those layers 300mm or more below ground level) will be field-tested as follows:
    - Collect a small sample of soil and mix it with distilled or de-mineralised water (not tap water) at the rate of one part soil to five parts water (e.g. 10 g soil to 50 mL water, or 200 g soil to 1L water).
    - Test the EC (electrical conductivity) of the mixed sample using a calibrated EC probe (dS/m).
    - Multiply the EC value by 8 to give the ECe (salinity) value (dS/m).

Management Options Where ECe > 3 dS/m

- If the ECe value is less than 3 dS/m the soil may be considered non-saline to slightly saline and may be managed without mitigation.

- If the ECe value is more than 3 dS/m, the soil must be considered saline and should be separated from non to slightly-saline material for the purpose of spoil management. Options for management include (but are not limited to):
    - Disposed at landfill; or
    - Re-buried onsite (e.g. in a fill); or
    - Shandied with non-saline material (note that expert advice from a soil scientist is recommended prior to undertaking this); or
    - Stockpiled and covered with non-permeable material such as builders' plastic for later re-use or while management options are determined. In that case a soil scientist can be engaged to determine other potential options for managing saline material.

5.3 Management of Saline Groundwater

Groundwater monitoring (**Section 3.6.4**) identified a risk of intercepting saline groundwater across the project. As such, the following management measures will be adopted during ISJV's works:

- If groundwater is encountered during excavations it will be tested for salinity using a calibrated, good-quality probe.
- If the salinity reading is below 800 µS/cm, no specific management measures are required. Water can be pumped out to the receiving environment or onto well-vegetated lands or used as required (subject to the Project's discharge procedure(s) and other water quality requirements being met such as turbidity or pH).
- If the salinity exceeds 800 µS/cm then it could exceed the salinity of the nearest receiving water (**Table 7**). In that case, options include (but are not limited to):
    - The receiving waters can be tested and, if they have higher salinity than was recorded onsite, site water can be pumped to the receiving waters; or
    - Saline water can be disposed of via a trade waste agreement with Sydney Water (i.e. drain to sewer). Note that a permit is required; or
    - Saline water can be pumped to shallow, ponds excavated into natural clay or shale or bunds for evaporation; or
    - Saline water can be shandied with fresh water elsewhere onsite (e.g. in sediment basins), providing this would not compromise the requirements to have basins emptied within 5 days of rainfall ceasing (note that expert advice from a water scientist is recommended prior to undertaking this); or
    - Saline water can be treated using a proprietary water treatment system (e.g. Enviss or Ultraclear) prior to discharge from site; or
    - Engage an environmental specialist with experience in the management of soil and water to advise on potential options.

5.4 Management of Footings Post Construction

Each pad footing will consist of a concrete pad excavated into the natural soil which will form a localised obstruction to lateral subsurface groundwater flow. However, their limited size and discontinuous nature means groundwater flow will not be significantly disrupted, and it would soon stabilise around these structures.

Therefore, the presence of the concrete piers is not expected to cause groundwater to rise to the surface or to the root zone of sensitive vegetation. As such, no specific action is required for salinity management associated with footings post construction.

5.5 Soil Compaction

As identified in **Section 4.1.1**, **Figure 5** and **Figure 6**, activities that cause compaction on mid- to foot-slope positions can reduce soil permeability and restrict lateral groundwater flow. If such activities have a significant longitudinal extent (e.g. roads or embankments) then groundwater flow can be impeded and saline groundwater can surface upslope of the feature (DIPNR, 2003b).

The only section of the project where this is triggered is Chainage 45800 to 46000, where there will be a significant cut into the north-facing side slope of a small localised knoll. Groundwater is not expected to be encountered during these excavations due to the presence of a nearby quarry that would have already intercepted the groundwater (assuming groundwater was present).

Salinity investigations have been limited by access restrictions at this location as discussed in Section 3.6. As such, earthworks will not proceed in the section from Chainage 45800 to 46000 until a Phase 2 and Phase 3 investigation (in accordance with DLWC, 2002) is undertaken.

6 Summary and Conclusion

This report presents the results of a desktop assessment of salinity along ISJV's construction corridor for the SVC works package of the NWRL project. It includes stream, groundwater and soil testing across the project to identify potential salinity risks and management options.

Significant salinity risk is identified at a number of locations along the project and these locations are identified in **Section 3** of this report.

Section 4 of this report discusses how the proposed construction activities might cause, exacerbate or be affected by, salinity.

Section 5 of this report contains a series of management measures to address the potential risks identified in **Section 4**. These have been prepared giving due consideration to salinity management guidelines produced by WSROC (2003), DIPNR (2003a, b and c), and DLWC (2002).

Providing the management measures in **Section 5** of this report are followed and due care is taken in managing soils, surface water and groundwater, construction activities are unlikely to cause, exacerbate or be adversely impacted by salinity. However, ongoing monitoring is recommended to verify the effectiveness of the adopted management measures. If required, the management plan contained in **Section 5** should be reviewed and updated as required.

7 References

ANZECC (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Clifton C. and Porter K. (2001). *Practical Measures Within Road Reserves to Avoid Development of Catchment Salinity Problems.* Salinity Summit, Moama, NSW

DECC (2008). *Soil and Land Resources of the Hawkesbury-Nepean Catchment.* NSW Department of Environment and Climate Change.

DIPNR (2003a). Local Government Salinity Initiative. *Groundwater Basics for Understanding Urban Salinity.* NSW Department of Infrastructure, Planning and Natural Resources, Sydney.

DIPNR (2003b). Local Government Salinity Initiative. *Roads and Salinity.* NSW Department of Infrastructure, Planning and Natural Resources, Sydney.

DIPNR (2003c). *Salinity Potential in Western Sydney.* NSW Department of Infrastructure, Planning and Natural Resources, Sydney.

DLWC (2002). Local Government Salinity Initiative. *Construction Corridor Investigations for Urban Salinity.* NSW Department of Land and Water Conservation, Sydney.

DPI (2013). *Salinity Hazard Report for Catchment Action Plan Upgrade - Hawkesbury-Nepean CMA.* NSW Department of Primary Industries, Sydney.

Hazleton and Murphy (2007). *Interpreting Soil Test Results: What Do All the Numbers Mean?* NSW Department of Natural Resources, CSIRO Puiblishing.

WSROC (2003). *Western Sydney Salinity Code of Practice.* Western Sydney Regional Organisation of Councils Ltd.

8 Appendices

8.1 Appendix 1 – Bore Holes Logs

30 representative borehole logs prepared by JK Geotechnics are presented. The first ones presented are those from which soil samples were obtained for salinity-related soil testing (**Table 5**).

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
SVC-BH507
1 / 1

EASTING: 309478.000
NORTHING: 6266508.000
CHAINAGE: N/A m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: SOIL NAIL WALL CW - DRAINAGE HEAD WALL

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 60.57 m
Date: 7/7/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./P.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL: Clayey silt, medium plasticity, brown and dark brown, trace of fine to medium grained ironstone gravel, roots and root fibres.	MC<PL			GRASS COVER
									CL		MC~PL	VSt - H		RESIDUAL
						60				SILTY CLAY: medium plasticity, dark brown and dark grey, trace of ash, roots and root fibres.			320 410 370	
							1							
						59							420 370 380	
							2		CL-CH	SILTY CLAY: medium to high plasticity, red brown and brown, trace of fine to medium grained ironstone gravel.		VSt		
						58				as above, but with fine to medium grained ironstone gravel.				
							3						300 210 260	
ON COMPLETION						57			-	SHALE: dark grey, with clay bands.	XW	EL - VL		VERY LOW 'TC' BIT RESISTANCE
							4				DW	L - M		LOW RESISTANCE
						56	5			END OF BOREHOLE AT 5.00 m				MONITORING WELL INSTALLED TO 4.3m, CLASS 18 50mm DIA. MACHINE SLOTTED PVC FROM 4.3m TO 1.3m, CASING FROM 1.3m TO SURFACE, 2mm SAND FILTER PACK FROM 4.3m TO 0.8m, BENTONITE SEAL FROM 0.8m TO 0.2m, COMPLETED WITH A STEEL GATIC COVER AND LOCKABLE CAP
						55								
							6							
						54								

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

TEST PIT LOG

Test Pit No.
TP516
1 / 1

EASTING: 309117.580
NORTHING: 6266354.520
CHAINAGE: 41020.00 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: BALMORAL ROAD RETAIINING WALL

Job No.: 26401LM **Method:** MACHINE EXCAVATED **R.L. Surface:** 72.12 m
Date: 30/4/14 **Datum:** AHD
Plant Type: 5t EXCAVATOR **Logged/Checked By:** I.S./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION					REFER TO DCP TEST RESULTS	72				FILL: Silty clay, low plasticity, grey brown, trace of root fibres.	MC<PL			APPEARS POORLY COMPACTED
									CH	SILTY CLAY: high plasticity, red brown becoming light grey.	MC<PL	H	500	RESIDUAL
									-	SHALE: light grey, with iron indurated bands.	DW	L - M		
						71	1					M		
												M - H		
										END OF TEST PIT AT 1.50 m				REFUSAL
						70	2							
						69	3							
						68	4							
						67	5							
						66	6							

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BOREHOLE LOG

Borehole No.
SVC-BH509A
1 / 5

EASTING: 309213.438
NORTHING: 6266424.089
CHAINAGE: 410620 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: BALMORAL ROAD OVERBRIDGE, WEST ABUTMENT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 76.53 m
Date: 7/7/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.W./P.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									CL	SILTY CLAY: medium plasticity, red brown, trace of root fibres.	MC<PL	(H)		GRASS COVER RESIDUAL
					N > 23 8,5,18/ 100mm REFUSAL	76				as above, but mottled grey and red brown, with fine to coarse grained ironstone gravel.	XW	EL		LOW 'TC' BIT RESISTANCE
							1			SHALE: light grey, orange brown and red brown, with M strength iron indurated bands. REFER TO CORED BOREHOLE LOG				
						75	2							
						74	3							
						73	4							
						72	5							
						71	6							
						70								

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BOREHOLE LOG

Borehole No.
SVC-BH612
1 / 4

EASTING: 308928.273
NORTHING: 6267117.153
CHAINAGE: 41811.27 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 12 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 61.68 m
Date: 6/5/14 TO 7/5/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										FILL: Silty clay, low to medium plasticity, brown, with fine to medium grained sand, trace of fine to medium grained igneous and ironstone gravel, fabric and steel fragments.	MC<PL			GRASS COVER
					N = 17 7,8,9	61	1		CL-CH	SILTY CLAY: medium to high plasticity, red brown and grey, with iron indurated bands.	MC<PL	H	>600 >600 >600	RESIDUAL
										as above, but trace of shale bands.				
					N > 22 12,22/ 100mm REFUSAL	60	2		-	SHALE: light grey and grey, with iron indurated bands and clay bands.	XW	EL		
						59	3			REFER TO CORED BOREHOLE LOG				
						58	4							
						57	5							
						56	6							
						55								

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BOREHOLE LOG

Borehole No. SVC-BH623A 1 / 5

EASTING: 308773.451
NORTHING: 308757.939
CHAINAGE: 42240.27 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 24 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 57.98 m
Date: 16/6/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** C.J.M./P.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING									CL	SILTY CLAY: low to medium plasticity, brown, trace of root fibres.	MC<PL	(VSt)		GRASS COVER RESIDUAL
										SILTY CLAY: medium plasticity, grey, with fine to medium grained ironstone gravel.		H	>600 >600 >600	
					N > 42 11,19,23/ 90mm REFUSAL					SHALE: grey.	XW	EL		
						57	1			as above, but with red brown M-H strength iron indurated bands, trace of roots.				BANDED LOW 'TC' BIT RESISTANCE
					N > 22 19,22/ 150mm REFUSAL						XW - DW	EL - VL		
						56	2							
						55	3			REFER TO CORED BOREHOLE LOG				
						54	4							
						53	5							
						52	6							

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BOREHOLE LOG

Borehole No.
SVC-BH639
1 / 4

EASTING: 308563.426
NORTHING: 6267937.528
CHAINAGE: 42709.27 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 39 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 47.64 m
Date: 8/5/14 TO 9/5/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										FILL: Sand clay, low to medium plasticity, brown, fine to medium grained sand, trace of fine to medium grained ironstone gravel.	MC<PL			
									CL-CH		MC<PL	H		RESIDUAL
					N = 17 6,8,9	47	1			SILTY CLAY: medium to high plasticity, red brown and grey, trace of fine to medium grained ironstone gravel.			>600 >600 >600	
					SPT 10/ 100mm REFUSAL	46			-	SHALE: light grey and grey, with iron indurated bands	XW	EL		VERY LOW 'TC' BIT RESISTANCE
						45	2 3			REFER TO CORED BOREHOLE LOG				
						44	4							
						43	5							
						42	6							
						41								

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BOREHOLE LOG

Borehole No.
SVC-BH649
1 / 4

EASTING: N/A
NORTHING: N/A
CHAINAGE: 43082.57 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 49 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM
Method: SPIRAL AUGER
R.L. Surface: N/A
Date: 8/7/14 TO 9/7/14
Datum: AHD
Plant Type: JK305
Logged/Checked By: O.F./P.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING								ML	CLAYEY SILT: low plasticity, brown.	MC<PL	VSt - H		GRASS COVER
					N = 13 4,6,7	1		CL	SILTY CLAY: medium plasticity, brown, red brown and orange brown, trace of fine to medium grained ironstone gravel and ash.			420 350 440	
					N = 14 5,6,8	2			as above, but trace of fine grained sand,	MC~PL	VSt	290 340 320	
					N > 37 9,17,20/ 50mm REFUSAL	3			SHALE: grey and light grey, trace of iron indurated bands.	XW	EL		VERY LOW 'TC' BIT RESISTANCE
						4			SHALE: dark grey and brown.	DW	L		VERY LOW RESISTANCE WITH LOW BANDS LOW RESISTANCE
						5			REFER TO CORED BOREHOLE LOG				
						6							

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BOREHOLE LOG

Borehole No.
SVC-BH661A
1 / 4

EASTING: 308253.880
NORTHING: 6268676.500
CHAINAGE: 43513.71 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 61 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 44.29 m
Date: 7/7/14 TO 8/7/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./P.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						44				FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained igneous and ironstone gravel, roots and root fibres.	D			GRASS COVER APPEARS WELL COMPACTED
					N = 20 10,11,9		1							
						43				FILL: Silty clay, medium plasticity, dark grey, grey brown and dark brown, trace of fine to medium grained ironstone and igneous gravel, fine to medium grained sand and ash.	MC<PL			
					N = 15 7,8,7		2							
									CL-CH	SILTY CLAY: medium to high plasticity, red brown, trace of fine to medium grained ironstone gravel.	MC~PL	H		RESIDUAL
						42								
							3						460 420 420	
					N = 13 5,6,7	41								
							4			as above, but grey and orange brown.	MC<PL			
						40								
					N = 23 6,9,14								520 540 540	
							5							
						39			-	SHALE: grey and light grey, trace of iron indurated bands.	XW	EL - VL		VERY LOW 'TC' BIT RESISTANCE
										SHALE: dark grey.	DW	M		LOW RESISTANCE
							6			REFER TO CORED BOREHOLE LOG				
						38								

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BOREHOLE LOG

Borehole No.
SVC-BH718A
1 / 7

EASTING: 307247.240
NORTHING: 6270383.340
CHAINAGE: 45534.54 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 113 MANDATORY OPTION OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 57.60 m
Date: 20/5/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.W./P.C.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING									CL	SILTY CLAY: low to medium plasticity, brown, trace of root fibres.	MC<PL	(H)		GRASS COVER
									CL-CH	SILTY CLAY: medium to high plasticity, red brown mottled light grey, trace of fine to medium grained ironstone gravel.		H	>600 >600 >600	
					N = 14 4,6,8	57	1			as above, but light grey, with orange brown stained and occasional dark grey M strength shale bands.		VSt - H		
					N = 32 8,8,24	56	2		-	SHALE: dark grey, with light grey clay bands and red brown M strength iron indurated bands.	DW	VL - L	340 450	LOW 'TC' BIT RESISTANCE
						55				REFER TO CORED BOREHOLE LOG				
						54	3							
						53	4							
						52	5							
						51	6							

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BOREHOLE LOG

Borehole No.
SVC-BH802
1 / 3

EASTING: 306505.554
NORTHING: 6270235.560
CHAINAGE: 46311.92 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 2 OF SECOND PONDS CREEK VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 48.36 m
Date: 24/4/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										FILL: Gravelly sandy clay, medium plasticity, brown, fine to medium grained igneous and ironstone gravel, fine to coarse grained sand.	MC<PL			
						48			CL-CH		MC<PL	H		
				■	N = 15 4,7,8					SILTY CLAY: medium to high plasticity, red brown and orange brown, trace of fine to medium grained ironstone gravel.			550 550 540	
							1							
										as above but light grey.	MC~PL			RESIDUAL
						47								
		■		■	N = 16 5,7,9								420 440 520	
							2							
						46								
										SHALE: dark grey, with iron indurated bands.	DW	VL - L		VERY LOW 'TC' BIT RESISTANCE
							3			REFER TO CORED BOREHOLE LOG				
						45								
							4							
						44								
							5							
						43								
							6							
						42								

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BOREHOLE LOG

Borehole No.
SVC-BH807
1 / 4

EASTING: 306311.692
NORTHING: 6270220.931
CHAINAGE: 46506.92 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 7, SECOND PONDS CREEK VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 47.04 m
Date: 18/7/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						47				TOPSOIL: Silty clay, medium plasticity, brown, trace of roots and root fibres.	MC<PL			GRASS COVER
									CL	SILTY CLAY: medium plasticity, brown and red brown, trace of fine grained ironstone gravel.	MC~PL	VSt		RESIDUAL
					N = 7 2,3,4								210 230 220	
						46	1							
					N = 18 4,7,11				CL-CH	SILTY CLAY: medium to high plasticity, orange brown, red brown and grey, with fine to medium grained ironstone gravel.			270 270 260	
						45	2							
					N = 19 8,9,10	44	3				MC<PL	H	>600 >600 >600	
										SHALE: grey and light grey.	XW	EL		
											XW - DW	EL - L		VERY LOW TO LOW 'TC' BIT RESISTANCE
						43	4			as above, but dark grey and brown.	DW	L		LOW RESISTANCE
										REFER TO CORED BOREHOLE LOG				50mm DIAMETER CLASS 18 PVC PIEZOMETER INSTALLED TO 4.4m DEPTH. MACHINE SLOTTED FROM 4.4m TO 1.4m DEPTH, CASING FROM 1.4m TO 0m, BACKFILLED WITH BENTONITE GROUT FROM 18.07m TO 4.4m, 2mm SAND BACKFILL FROM 4.4m TO 1.05m, BENTONITE FROM 1.05m TO 0.5m DEPTH, COMPLETE WITH CONCRETE COLLAR AND GATIC COVER
						42	5							
						41	6							

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BOREHOLE LOG

Borehole No.
SVC-BH600
1 / 3

EASTING: 309096.245
NORTHING: 6266692.233
CHAINAGE: 41354.36 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: ABUTMENT A OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 68.91 m
Date: 22/4/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.W./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					SPT 21/ 110mm REFUSAL	68	1		CL-CH	SILTY CLAY: medium to high plasticity, orange brown and light grey, with fine to medium grained ironstone gravel, with trace of root fibres.	MC<PL			GRASS COVER
									-	SHALE: light grey and orange brown, with medium strength iron indurated bands.	XW	EL		
						67	2			REFER TO CORED BOREHOLE LOG				
						66	3							
						65	4							
						64	5							
						63	6							
						62								

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BOREHOLE LOG

Borehole No.
SVC-BH609
1 / 4

EASTING: 308971.285
NORTHING: 6267008.347
CHAINAGE: 41694.27 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 9 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 64.45 m
Date: 5/5/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.W./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					N = 14 8,8,6	64	1			FILL: Silty clay, medium plasticity, dark brown mottled orange brown, light grey and dark grey, with fine to medium grained shale and sandstone gravel, fine to medium grained sand, trace of plastic fragments and root fibres.	MC>PL	-		GRASS COVER APPEARS WELL COMPACTED
					N = 7 4,3,4	63	2		CL	SILTY CLAY: medium plasticity, dark grey, trace of fine grained ironstone gravel, ash and roots.	MC>PL	VSt - H	540 300 270	RESIDUAL
									CL-CH	SILTY CLAY: medium to high plasticity, mo0ttled light grey and red brown, trace of fine grained ironstone gravel.				
						62	3		-	BANDED SHALE and SILTY CLAY: light grey, medium plasticity clay, with iron indurated bands.	MC>PL MC>PL / DW	(VSt) / VL - L		LOW 'TC' BIT RESISTANCE
						61	4			REFER TO CORED BOREHOLE LOG				
						60	5							
						59	6							
						58								

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BOREHOLE LOG

Borehole No.
SVC-BH613
1 / 4

EASTING: 308913.870
NORTHING: 6267153.396
CHAINAGE: 41850.27 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 13 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 59.16 m
Date: 6/5/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						59				FILL: Clayey silt, low to medium plasticity, brown, trace of fine to medium grained ironstone gravel, asphaltic concrete and concrete fragments.	MC<PL			GRASS COVER
									CL-CH		MC<PL	(H)		RESIDUAL
					N > 33 9,18,15/ 50mm REFUSAL					SILTY CLAY: medium to high plasticity, grey and red brown, with fine to medium grained ironstone gravel.	XW	EL - VL		VERY LOW 'TC' BIT RESISTANCE
						58	1			SHALE: light grey and grey, with iron indurated bands.				
										REFER TO CORED BOREHOLE LOG				
						57	2							
						56	3							
						55	4							
						54	5							
						53	6							

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BOREHOLE LOG

Borehole No.
SVC-BH631A
1 / 4

EASTING: 308661.529
NORTHING: 6267727.361
CHAINAGE: 42477.27 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 32 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 52.47 m
Date: 23/5/14 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** R.A.P./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						52			CH	FILL: Silty clay, low plasticity, dark brown.	MC<PL			GRASS COVER
										SILTY CLAY: high plasticity, brown mottled light grey, trace of fine to coarse grained ironstone gravel.	MC<PL	H		RESIDUAL
				■	N = 29 9,12,17								>600 >600 >600	
							1		-	SHALE: light grey, with iron indurated bands and clay bands.	XW - DW	EL - VL		
				■	N> 13 13,13/ 100mm REFUSAL	51								
										REFER TO CORED BOREHOLE LOG				
						50	2							
						49	3							
						48	4							
						47	5							
						46	6							

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BOREHOLE LOG

Borehole No.
SVC-BH642
1 / 4

EASTING: 308508.433
NORTHING: 6268040.798
CHAINAGE: 42826.27 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 42 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 45.59 m
Date: 13/5/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						45.59				FILL: Silty clay, medium plasticity, brown, trace of fine to medium grained igneous and ironstone and shale gravel, plastic and fabric fragments.	MC<PL			GRASS COVER APPEARS MODERATELY COMPACTED
			■		N = 11 5,5,6	45	1							
									CL-CH	SILTY CLAY: medium to high plasticity, red brown and grey brown, trace of fine to medium grained ironstone gravel.	MC~PL	VSt - H	320 420 400	
			■		N = 14 6,7,7	44	2			as above, but with fine to medium grained ironstone gravel.	MC<PL			
						43	3						600 450 300	
			■		N = 22 8,11,11	42	4			SILTY CLAY: medium to high plasticity, light grey and orange brown, trace of fine to medium grained ironstone gravel.		(H)		RESIDUAL
										SHALE: light grey.	XW	EL		VERY LOW 'TC' BIT RESISTANCE
						41	5			REFER TO CORED BOREHOLE LOG				
						40	6							
						39								

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BOREHOLE LOG

Borehole No.
SVC-BH666A
1 / 4

EASTING: 308191.250
NORTHING: 6268868.505
CHAINAGE: 43715.71 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 66 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 45.08 m
Date: 26/5/14 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** P.C./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						45				FILL: Silty clay, low to medium plasticity, dark grey, trace of fine to medium grained sub angular igneous gravel.	MC<PL			GRASS COVER
									CL-CH	SILTY CLAY: medium to high plasticity, red brown mottled dark brown, trace of ash.	MC<PL	H		RESIDUAL
				■	N = 12 7,6,6								550 600	
						44	1		CH	SILTY CLAY: high plasticity, mottled light grey and red brown.				
				■	N = 29 4,9,20								550 560 >600	
						43	2		-	SHALE: grey and dark grey.	XW - DW	EL - VL		BANDED VERY LOW 'TC' BIT RESISTANCE
										REFER TO CORED BOREHOLE LOG				
						42	3							
						41	4							
						40	5							
						39	6							

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BOREHOLE LOG

Borehole No.
SVC-BH670A
1 / 4

EASTING: 308138.013
NORTHING: 6269027.846
CHAINAGE: 43883.71 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 70 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 45.80 m
Date: 23/6/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** O.F./D.W.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										FILL: Silty sand, fine to medium grained, dark brown, trace of roots and root fibres.	M			GRASS COVER
									CL-CH		MC<PL	H		RESIDUAL
										SILTY CLAY: medium to high plasticity, red brown, trace of fine to medium grained ironstone gravel. and ash.			>600	
					N = 11 5,5,6	45	1						>600	
										as above, but grey.			>600	
									-	SHALE: grey and dark grey, trace of iron indurated bands.	XW	EL - VL		VERY LOW 'TC' BIT RESISTANCE
					N > 18 11,18/ 130mm REFUSAL	44	2				DW	L		LOW RESISTANCE
						43	3			REFER TO CORED BOREHOLE LOG				50mm DIAMETER CLASS 18 PVC PIEZOMETER INSTALLED TO 14.2m DEPTH. MACHINE SLOTTED FROM 2.2m TO 14.2m DEPTH, CASING FROM 2.2m TO 0.10m, BACKFILLED WITH BENTONITE GROUT FROM 20.77m TO 14.2m DEPTH, 2mm SAND 14.2m TO 1.5m, BENTONITE FROM 1.5m TO 0.10m, COMPLETED WITH CONCRETE COLLAR AND GATIC COVER
						42	4							
						41	5							
						40	6							
						39								

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BOREHOLE LOG

Borehole No.
SVC-BH681
1 / 4

EASTING: 308007.153
NORTHING: 6269418.996
CHAINAGE: 44296.17 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 80 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 47.41 m
Date: 8/5/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.W./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						47				TOPSOIL: Silty clay, low plasticity, brown, trace of fine grained sand and root fibres.	MC<PL	(VSt)		GRASS COVER
				■	N = 17 6,7,10		1		CL	SILTY CLAY: medium plasticity, orange brown and red brown, with fine to medium grained ironstone gravel.	MC<PL	H	>600 >600 >600	RESIDUAL
										SILTY CLAY: medium plasticity, light grey mottled orange brown, with M strength ironstone and shale bands.				
				■	SPT 20/ 140mm REFUSAL	46	2		-	SHALE: light grey, with red brown M strength iron indurated bands,	XW	EL	>600	BANDED LOW 'TC' BIT RESISTANCE
						45				as above, but light grey, red brown and dark grey.	XW - DW	EL - VL		
				■			3			SHALE: dark grey, with light grey laminae.	DW	VL - L		
						44	4			REFER TO CORED BOREHOLE LOG				
						43	5							
						42	6							
						41								

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BOREHOLE LOG

Borehole No.
SVC-BH686
1 / 4

EASTING: 307930.966
NORTHING: 6269597.840
CHAINAGE: 44491.17 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 86 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 53.39 m
Date: 14/5/14 TO 15/5/15 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						53				FILL: Clayey silt, low to medium plasticity, brown, trace of fine to medium grained ironstone gravel.	MC<PL			APPEARS WELL COMPACTED
					N = 15 6,7,8		1			FILL: Silty clay, medium plasticity, brown, red brown and grey brown, trace of ash and fine to medium grained ironstone gravel.				
					N = 16 9,9,7	52	2							
						51			CL-CH	SILTY CLAY: medium to high plasticity, red brown and grey, trace of fine to medium grained ironstone gravel.	MC~PL	(H)		RESIDUAL
					N > 10 13,10/ 30mm REFUSAL		3		-	SHALE: grey, with iron indurated bands.	XW - DW	EL - VL		VERY LOW 'TC' BIT RESISTANCE
						50				as above, but dark grey.	DW	L		
										REFER TO CORED BOREHOLE LOG				
						49	4							
							5							
						48								
							6							
						47								

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BOREHOLE LOG

Borehole No.
SVC-BH704
1 / 4

EASTING: 307600.094
NORTHING: 6270069.860
CHAINAGE: 45067.78 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 104 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 50.03 m
Date: 5/6/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										CONCRETE: 400mm.t				NO OBSERVED REINFORCEMENT
					N > 21 20,21/ 110mm REFUSAL					FILL: Sandy gravel, fine to medium grained igneous and quartz, grey brown, fine to coarse grained sand.	D	-		
									-	SHALE: grey, trace of iron indurated bands.	XW	EL		VERY LOW 'TC' BIT RESISTANCE
						49	1			as above, but dark grey, with iron indurated bands.	DW	VL		VERY LOW TO LOW RESISTANCE
										REFER TO CORED BOREHOLE LOG				
						48	2							
						47	3							
						46	4							
						45	5							
						44	6							

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BOREHOLE LOG

Borehole No. SVC-BH712A 1 / 4

EASTING: 307443.190
NORTHING: 6270275.378
CHAINAGE: 45326.62 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 111 OF BELLA VISTA TO ROUSE HILL VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 50.90 m
Date: 29/5/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** D.W./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					N = 17 12,9,8	50	1			FILL: Gravelly sandy clay, medium plasticity, mottled brown, red brown and grey, fine to coarse grained sand, fine to medium grained igneous, ironstone and shale gravel, with slag and ash.	MC<PL			GRASS COVER APPEARS MODERATELY COMPACTED
					N = 7 3,3,4	49	2				MC>PL			APPEARS POORLY COMPACTED
										FILL: Sandy silty clay, medium plasticity, grey, fine to coarse grained sand, with fine to medium grained igneous and ironstone gravel, trace of ash.				
					N = 13 3,5,8	48	3							
						47	4		CL-CH	SILTY CLAY: medium to high plasticity, red brown mottled orange brown and light grey, with fine grained ironstone gravel, trace of ash and root fibres.	MC>PL	VSt	240 300	RESIDUAL
											MC<PL			
					N > 30 11,18,12/ 90mm REFUSAL	46	5		CL	SILTY CLAY: medium plasticity, light grey, red brown and dark grey, with M strength shale bands.		H	>600 >600	
										SHALE: dark grey, with XW bands and M strength bands.	DW	VL - L		VERY LOW TO LOW 'TC' BIT RESISTANCE
												M		MODERATE RESISTANCE
						45	6			REFER TO CORED BOREHOLE LOG				
						44								

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BOREHOLE LOG

Borehole No.
SVC-BH801
1 / 3

EASTING: 306544.340
NORTHING: 6270237.310
CHAINAGE: 46272.92 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 1 OF SECONDS POND CREEK VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 50.90 m
Date: 23/4/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					N = 12 5,6,6	50	1			FILL: Silty clay, medium to high plasticity, orange brown, grey and brown, trace of fine to medium grained ironstone gravel, ash, roots and root fibres.	MC>PL			GRASS COVER BOREHOLE ON BERM BESIDE DAM APPEARS MODERATELY COMPACTED
					N = 15 6,8,7	49	2		CL-CH	SILTY CLAY: medium to high plasticity, orange brown and light grey.	MC~PL	H		RESIDUAL
					N = 40 7,18,22	48	3		-	SHALE: light grey, grey, dark grey and orange brown, trace of iron indurated bands.	XW	EL - VL	>600 >600	VERY LOW 'TC' BIT RESISTANCE
						47	4			REFER TO CORED BOREHOLE LOG				
						46	5							
						45	6							
						44								

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BOREHOLE LOG

Borehole No.
SVC-BH808
1 / 3

EASTING: 306275.282
NORTHING: 6270211.685
CHAINAGE: 46545.92 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 8 OF SECOND PONDS CREEK VIADUCT

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 44.69 m
Date: 29/4/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										TOPSOIL: Clayey silt, low to medium plasticity, brown.	MC<PL			GRASS COVER
									CL	SILTY CLAY: medium plasticity, red brown, orange brown and light brown, trace of fine to medium grained sand, ash, roots and root fibres.	MC<PL	H		
				■	N = 14 6,6,8	44	1						>600 >600 >600	
									CL-CH	SILTY CLAY: medium to high plasticity, red brown, orange brown and grey, trace of fine to medium grained ironstone gravel.	MC~PL		510 490 500	
				■	N = 12 5,6,6	43	2							
						42	3			as above, but trace of fine grained sand.	MC>PL	St - VSt	250 180 220	
				■	N = 16 4,6,10	41	4			SILTY CLAY: medium to high plasticity, orange brown, grey and light grey, trace of fine to medium grained ironstone gravel.	MC<PL	H		
				■	N = 27 10,14,13	40	5						>600 >600 >600	
						39	6			SHALE: dark grey, trace of iron indurated bands.	DW	L		LOW 'TC' BIT RESISTANCE
						38				REFER TO CORED BOREHOLE LOG				

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BOREHOLE LOG

Borehole No.
SVC-BH809
1 / 3

EASTING: 306236.200
NORTHING: 6270201.164
CHAINAGE: 46584.92 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: SAMPLE SITE

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 44.90 m
Date: 29/4/14 TO 30/4/14 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** O.F./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										TOPSOIL: Clayey silt, low to medium plasticity, brown, trace of roots and root fibres.	MC<PL			GRASS COVER
									CL	SILTY CLAY: medium plasticity, grey brown, brown and orange brown, trace of ash, roots and root fibres.	MC<PL	H	>600 >600 >600	
					N = 17 6,8,9	44	1		CL-CH	SILTY CLAY: medium to high plasticity, red brown, orange brown and grey, trace of fine to medium grained ironstone gravel.	MC~PL	VSt - H		
					N = 12 5,6,6	43	2						300 310 420	
										as above, but trace of fine grained sand.	MC<PL			RESIDUAL
					N = 22 6,10,12	42	3						510 340 450	
						41	4			SHALE: grey and dark grey, trace of iron indurated bands.	XW - DW	VL - L		VERY LOW 'TC' BIT RESISTANCE
										as above, but trace of XW seams and clay bands.	DW	L		VERY LOW TO LOW RESISTANCE
						40	5			REFER TO CORED BOREHOLE LOG				
						39	6							
						38								

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BOREHOLE LOG

Borehole No.
SVC-BH900
1 / 4

EASTING: 307023.900
NORTHING: 6270363.500
CHAINAGE: 45780.00 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: CUT CW-2U

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 66.73 m
Date: 24/6/14 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** P.C./P.C.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										TOPSOIL: Silty clay, low plasticity, grey brown, with root fibres.	MC<PL	(St)		GRASS COVER
									CL	SILTY CLAY: low to medium plasticity, red brown.	MC<PL	(H)		RESIDUAL
				■	N > 20 8,20/ 150mm REFUSAL	66	1		-	SHALE: grey, and orange brown, with dark grey L strength bands.	XW	EL		
											XW - DW	EL - VL		VERY LOW TO LOW 'TC' BIT RESISTANCE
						65	2			REFER TO CORED BOREHOLE LOG				
						64	3							
						63	4							
						62	5							
						61	6							
						60								

8.2 Appendix 2 - Locations of Stream Water Quality Monitoring (ISJV)

See overpage.

REV	DATE	BY	DESCRIPTION	CHK	APD
D	30/05/14	BH	Revised issue following site works	JM	
C	14/05/14	BH	Revised issue	SF	SF
B	12/05/14	BH	Revised issue	SF	SF
A	31/03/14	BH	Draft issue for comment	SF	SF

DRAWING STATUS: **DRAFT**

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring
- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link
Surface and Viaducts Civil Works
Site 9: Celebration to Balmoral

SCALE: 1:3,000 @ A3
0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 1

REV: A

Document Path: \\W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

REV	DATE	BY	DESCRIPTION		
D	30/7/14	BH	Revised issue following site visits	JM	-
C	24/7/14	BH	Revised issue	SF	SF
B	14/7/14	BH	Revised issue	SF	SF
A	3/7/14	BH	Draft issue for comment	SF	SF

DRAWING STATUS: DRAFT

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring
- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx

- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link Surface and Viaducts Civil Works Site 9/10: Balmoral to Memorial

SCALE: 1:3,000 @ A3

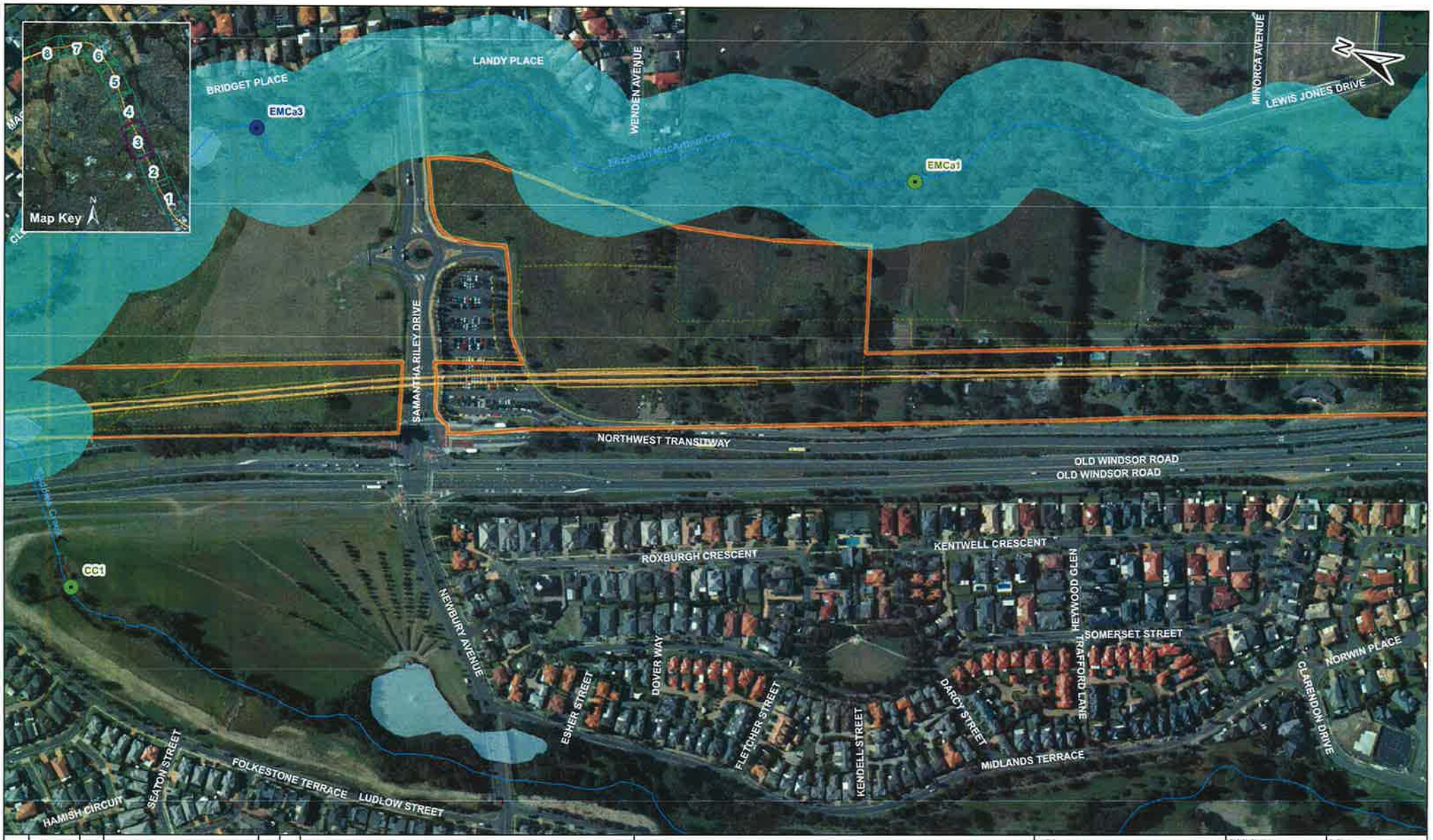
0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 2

REV: A

Document Path: W:\3_PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd



REV	DATE	BY	DESCRIPTION	SHE	APD
D	30/5/14	BH	Revised issue following site works	JM	-
C	24/5/14	BH	Revised issue	SF	SF
B	12/3/14	BH	Revised issue	SF	SF
A	31/2/14	BH	Draft issue for comment	SF	SF

DRAWING STATUS: DRAFT

northwestrail link

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN/DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link
Surface and Viaducts Civil Works
Site 11: Kellyville

SCALE: 1:3,000 @ A3
0 12.5 25 50 75 100 125
Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 3

REV: A

Document Path: W:\3 PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

REV	DATE	BY	DESCRIPTION	BRK	APD
D	30/07/14	BH	Revised issue following site works	JM	
C	24/06/14	BH	Revised issue	SF	SF
B	13/05/14	BH	Revised issue	SF	SF
A	31/03/14	BH	Draft issue for comment	SF	SF

DRAWING STATUS: **DRAFT**

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN-DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link Surface and Viaducts Civil Works Site 12: SR Drv to Windsor Rd

SCALE: 1:3,000 @ A3

0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 4

REV: A

Document Path: W:\3 PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

REV	DATE	BY	DESCRIPTION	CHK	APD
D	30/07/14	BH	Revised issue following site works	JM	
C	24/06/14	BH	Revised issue	SF	SF
B	13/05/14	BH	Revised issue	SF	SF
A	31/03/14	BH	Draft issue for comment	SF	SF

DRAWING STATUS: DRAFT

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN/DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link
Surface and Viaducts Civil Works
Site 13: Old Windsor Rd to WHD

SCALE: 1:3,000 @ A3

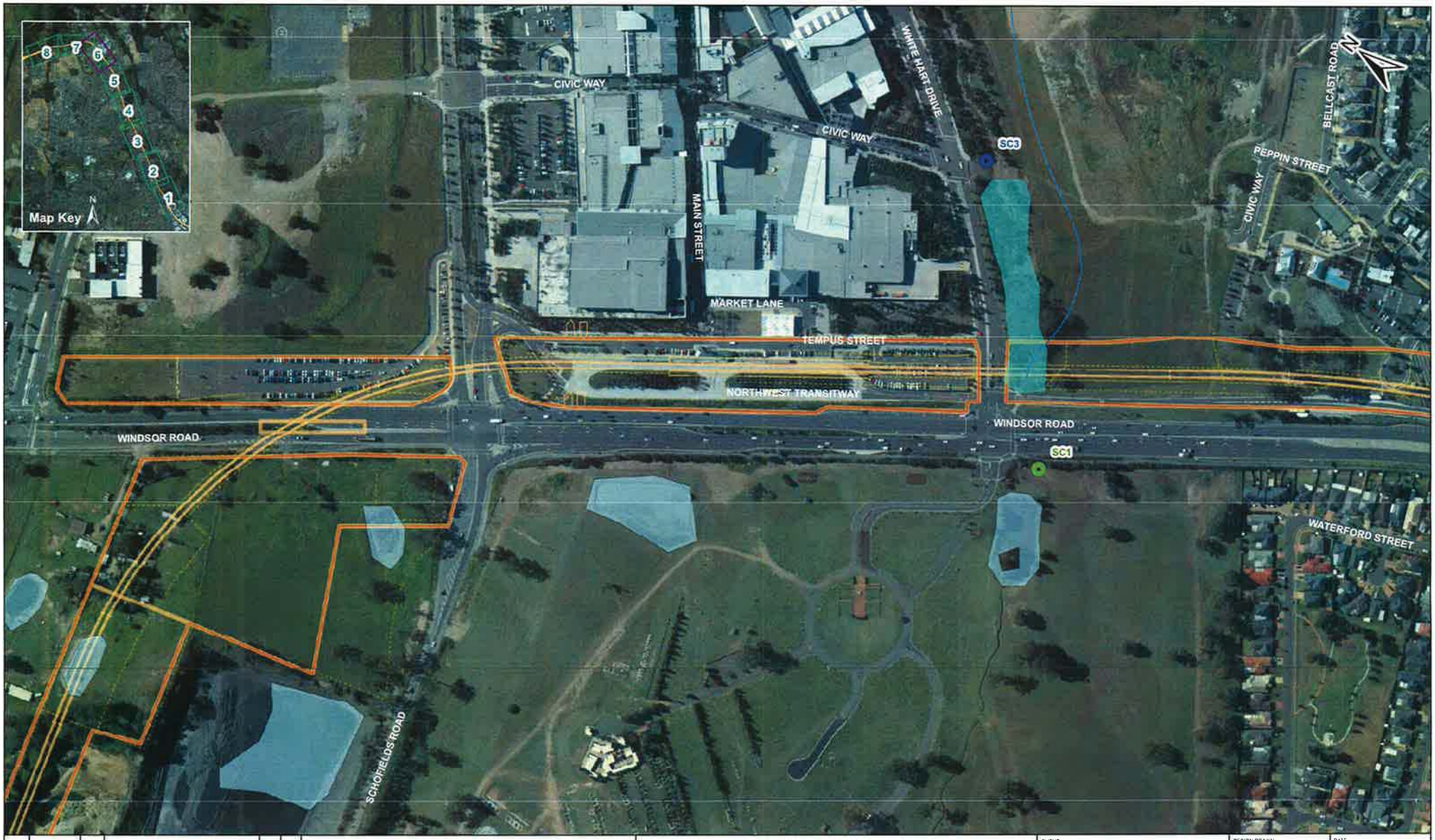
0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No.: FIGURE 5

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd



REV	DATE	BY	DESCRIPTION	CHK	APD
D	10/07/14	BH	Revised issue following site works	JM	
C	24/06/14	BH	Revised issue	SF	SF
B	13/03/14	BH	Revised issue	SF	SF
A	3/03/14	BH	Draft issue for comment	SF	SF

DRAWING STATUS: DRAFT

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

PROJECT: North West Rail Link Surface and Viaducts Civil Works Site 14: Rouse Hill

TITLE: Water Quality Monitoring Locations

DESIGN-DRAWN: BH

DATE: JULY 2014

SCALE: 1:3,000 @ A3

0 12.5 25 50 75 100 125 Meters

DRAWING No: FIGURE 6

REV: A

Document Path: W:\3. PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

REV	DATE	BY	DESCRIPTION	CHK	APD
D	[illegible]	BH	Revised issue following site works	JM	
C	[illegible]	BH	[illegible]	SF	SF
B	12/03/14	BH	[illegible]	SF	SF
A	31/03/14	BH	Draft issue for comment	SF	SF

DRAWING STATUS: DRAFT

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link
Surface and Viaducts Civil Works
Site 15: Windsor Rd Viaduct

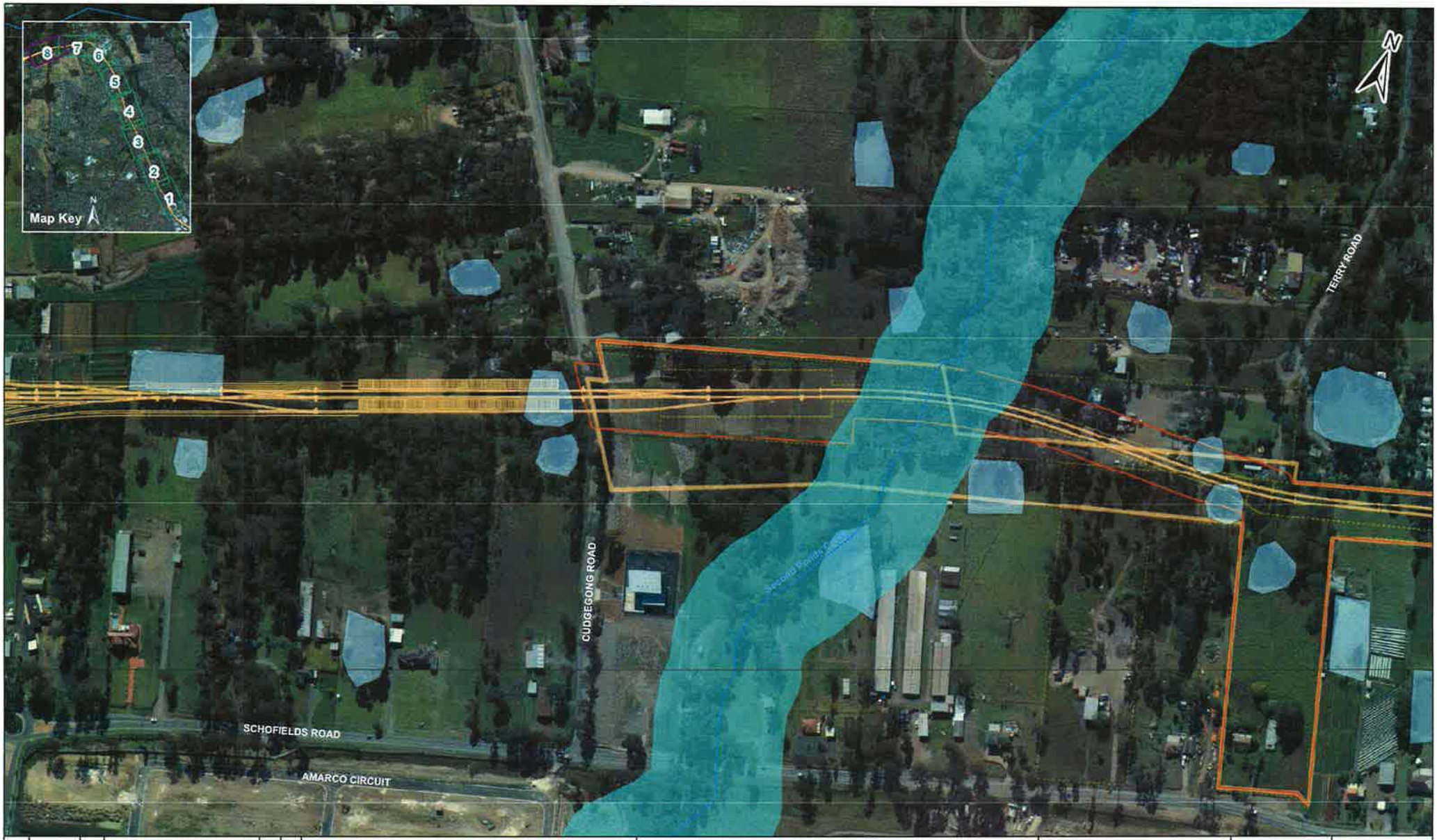
SCALE: 1:3,000 @ A3
0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 7

REV: A

Document Path: W:\3 PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd



REV	DATE	BY	DESCRIPTION	CHK	APD
D	30/07/14	BH	Revised issue following site works	JM	-
C	24/06/14	BH	Revised issue	SF	SF
B	19/05/14	BH	Revised issue	SF	SF
A	31/03/14	BH	Draft issue for comment	SF	SF

DRAWING STATUS: **DRAFT**

northwestraillink

salini impregilo

SVC WORKS

Legend

Surface Water Monitoring

- Downstream
- Upstream
- River / Creek
- Water body
- Riparian Buffer - Approx
- Concept Alignment: EIS2Sub
- Project Boundary
- Construction Boundary EIS1
- Construction Boundary EIS2

CLIENT: Impregilo Salini Joint Venture

DESIGN DRAWN: BH

DATE: JULY 2014

PROJECT: North West Rail Link
Surface and Viaducts Civil Works
Site 16: WR Via to Cudgegong Rd

SCALE: 1:3,000 @ A3

0 12.5 25 50 75 100 125 Meters

TITLE: Water Quality Monitoring Locations

DRAWING No: FIGURE 8

REV: A

Document Path: W:\3 PROJECT OUTPUT\NWRL Docs\GIS MXD Files\Water.mxd

8.3 Appendix 3: Agency Correspondence

Copies of Agency correspondence provided overpage.

NSW GOVERNMENT | Office of Environment & Heritage

Your reference: SSI_5414
Our reference: DOC14/194582

Infrastructure Projects
Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

Attention: Belinda Scott Senior Planning Officer

Dear Ms Scott

The Office of Environment and Heritage (OEH) has been contacted directly by Strategic Environmental and Engineering Consulting (SEEC), acting as consultants to Impregilo Salini Joint Venture (ISJV), the contractor building the Skytrain, and requested to review the *Northwest Rail Link Salinity Assessment and Management Report*.

OEH has reviewed the report and considers that overall it gives due consideration to most of the salinity issues that may occur in the area. There are, however, several items that OEH considers should be addressed as follows:

- In Section 5.3, 1000 uS/cm is used as the value to decide if specific saline groundwater management measures need to be taken or not. Generally, around 800 uS/cm is used as an environmental trigger. Pumping 1000 uS/cm water onto vegetated lands could have detrimental impacts on plant health if pumping was to occur for an extended period of time.
- Acid sulfate soils (ASS) may be encountered in areas where Ashfield Shales are present. The report does not consider potential ASS impacts. OEH questions whether this issue is being considered in a different study.
- The Emerson Aggregate Test (EAT) is a useful general guide to sodicity. However, salinity and clay type also play a role in whether dispersion of the soil will occur. Sodium Adsorption Ratio (SAR) or Exchangeable Sodium Percentage (ESP) analysis of soil samples would be useful for more detailed evaluation the dispersive nature of soils. These tests may need to be considered when investigating the 'Environmentally Sensitive Areas' if sodicity impacts are of particular concern.
- Similarly, SAR and EC levels in groundwater can be used to assess potential sodium imbalance impacts on vegetation and soil structure. SAR analysis may need to be considered when investigating the 'Environmentally Sensitive Areas'.
- The figures describing the location of the proposed rail link are not consistent. For example Figure 1 shows the rail aligning with Old Windsor Road but then having a short length at approximately 45 degrees and then a further length to the new Cudgegong Road station. Figures 2 and 3 show the Cudgeong Station as a straight line only. OEH considers that the location of the proposed rail link should be consistently described in each of these maps.

PO Box 644 Parramatta NSW 2124
Level 6, 10 Valentine Ave Parramatta NSW 2150
ABN 30 841 387 271
www.environment.nsw.gov.au

If you have any queries regarding this correspondence please contact Rob Muller, Senior Scientist – Hydrology & Geology Assessment on 6932 9125 or by email at rob.muller@environment.nsw.gov.au or Rachel Lonie, Senior Operations Officer on 9995 6837 or by email at rachel.lonie@environment.nsw.gov.au.

Yours sincerely

R Bonner 22/9/14

RICHARD BONNER
A/Senior Team Leader Planning
Greater Sydney
Regional Operations

cc Steve Fermio, Project Environment Manager

Department of Primary Industries
Office of Water

Contact Rohan Macdonald
Phone 02 4904 2642
Fax 02 4904 2503
Email rohan.macdonald@water.nsw.gov.au

Our ref ER21676
Your ref 14000038-SAL-02

Strategic Environmental and Engineering Consulting
PO Box 1098
BOWRAL NSW 2576

Attention: Andrew Macleod

Dear Mr Macleod

North West Rail Link (SSI-5100 & SSI-5414)

Surface and Viaduct Civil Works Salinity Assessment and Management Report

Thank you for providing the Office of Water an opportunity to provide comment on the Salinity Assessment and Management Report for the North West Rail Link Surface and Viaduct Civil Works.

The Office of Water is satisfied that the report adequately addresses potential salinity impacts to water resources as a result of the project.

If you require further information please contact Rohan Macdonald, Water Regulation Officer on (02) 4904 2642.

Yours sincerely

Mitchell Isaacs
Manager, Strategic Stakeholder Liaison
24 September 2014

Appendix 8 A

APPENDIX 8A: Addendum to the SEEC Salinity Assessment and Management Report (Reference:14000038-SAL-04, 15 October 2014)

for Northwest Rail Link (SSI-5100 & SSI-5414)

31 March 2015

The purpose of this Addendum is to update the SEEC Salinity Assessment and Management Report with additional Salinity investigation assessments to two of three locations that were inaccessible at the time of initial investigation. These Locations are BH904 and BH692.

Table 5 - Salinity-Related Soil Testing, (page 16) can now include results of salinity investigation for BH904 and BH692 as follows:

Bore or Test Pit No.	Ch.	Depth (m)	Electrical Conductivity (EC) µS/cm (1:5 soil:water)	Salinity (ECe)[4] dS/m	Salinity Rating[5]	EAT	Sodicity Rating[5]	pH (1:5 soil:water)
BH692	44710	1.5-1.6	49	0.4	Non-Saline	2	Non- sodic	5.9
BH904	45900	0.1-0.2	94	1.0	Non-Saline	4	Non- sodic	8.5
BH904	45900	0.5-0.95	2000	14	Highly Saline	4	Non- sodic	7.9
BH904	45900	3.0-3.45	1200	9.0	Highly Saline	4	Non- sodic	8.1

See following pages for Bore Hole Logs and relevant testing and analysis paperwork relating to BH692 and BH904

From these updated investigation results, the following pages of SEEC's Report can then be updated:

1) Page 20 under 3.8.1, paragraph 5 > insert additional dot point "Soils at 0.1 – full depth in BH904 (Ch. 45900)were highly saline."
2) Page 21 under 4.1.1, paragraph 1 > insert additional dot point "Lands within the Knights Quarry between Ch45800 to Ch45950."
3) Page 25 Table 8 – Management Measures During Excavations > insert following addition:

Cut at Ch. 45900 (BH904)	30,000 t	N/A as all material will be managed under site specific RAP	Refer to site specific RAP (Remediation Action Plan)

Note: There remains a location identified in the initial report referenced as BH BH677, which is still inaccessible and hence still requires salinity investigation.

APPENDIX 8A-1: Laboratory Results for Bore Hole No. 904

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 122475

Client:
JK Geotechnics
PO Box 976
North Ryde BC
NSW 1670

Attention: Vittal Boggaram

Sample log in details:

Your Reference:	**26401L, Various**
No. of samples:	3 Soils
Date samples received / completed instructions received	23/01/2015 / 23/01/2015

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	2/02/15 / 30/01/15
Date of Preliminary Report:	Not Issued

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

Misc Inorg - Soil				
Our Reference:	UNITS	122475-1	122475-2	122475-3
Your Reference	----------	SVC-BH904	SVC-BH904	SVC-BH904
Depth	----------	0.1-0.2	0.5-0.95	3.0-3.45
Date Sampled		12/01/2015	12/01/2015	12/01/2015
Type of sample		Clay	Clay	Clay
Date prepared	-	28/01/2015	28/01/2015	28/01/2015
Date analysed	-	28/01/2015	28/01/2015	28/01/2015
Electrical Conductivity 1:5 soil:water	µS/cm	94	2,000	1,200
pH 1:5 soil:water	pH Units	8.5	7.9	8.1

Texture and Salinity				
Our Reference:	UNITS	122475-1	122475-2	122475-3
Your Reference	----------	SVC-BH904	SVC-BH904	SVC-BH904
Depth	----------	0.1-0.2	0.5-0.95	3.0-3.45
Date Sampled		12/01/2015	12/01/2015	12/01/2015
Type of sample		Clay	Clay	Clay
Electrical Conductivity 1:5 soil:water	µS/cm	95	2,000	1,200
Texture Value		8.0	7.0	8.0
TEXTURE	-	Light Medium Clay	Medium Clay	Light Medium Clay
ECe	dS/m	1.0	14	9.0
Class	-	NON SALINE	VERY SALINE	VERY SALINE

CEC Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	122475-1 SVC-BH904 0.1-0.2 12/01/2015 Clay	122475-2 SVC-BH904 0.5-0.95 12/01/2015 Clay	122475-3 SVC-BH904 3.0-3.45 12/01/2015 Clay
Date extracted	-	29/01/2015	29/01/2015	29/01/2015
Date analysed	-	29/01/2015	29/01/2015	29/01/2015
Exchangeable Ca	meq/100g	9.7	54	19
Exchangeable K	meq/100g	0.6	0.3	0.4
Exchangeable Mg	meq/100g	2.0	0.73	1.9
Exchangeable Na	meq/100g	<0.1	<0.1	0.17
Cation Exchange Capacity	meq/100g	12	55	22

Method ID	Methodology Summary
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Metals-009	Determination of exchangeable cations and cation exchange capacity in soil based on Rayment and Lyons 2011.

QUALITY CONTROL Misc Inorg - Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD
Date prepared	-			28/1/2015	122475-1	28/01/2015 || 28/01/2015
Date analysed	-			28/01/2015	122475-1	28/01/2015 || 28/01/2015
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	122475-1	94 || 76 || RPD: 21
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	122475-1	8.5 || 8.3 || RPD: 2

QUALITY CONTROL Texture and Salinity	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	122475-1	95 || 76 || RPD: 22	LCS-1	106%
Texture Value			Inorg-002	[NT]	122475-1	8.0 || [N/T]	[NR]	[NR]
Class	-			[NT]	122475-1	NON SALINE || [N/T]	[NR]	[NR]

QUALITY CONTROL CEC	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			29/01/2015	122475-1	29/01/2015 || 29/01/2015	LCS-1	29/01/2015
Date analysed	-			29/01/2015	122475-1	29/01/2015 || 29/01/2015	LCS-1	29/01/2015
Exchangeable Ca	meq/100g	0.1	Metals-009	<0.1	122475-1	9.7 || 10 || RPD: 3	LCS-1	96%
Exchangeable K	meq/100g	0.1	Metals-009	<0.1	122475-1	0.6 || 0.7 || RPD: 15	LCS-1	103%
Exchangeable Mg	meq/100g	0.1	Metals-009	<0.1	122475-1	2.0 || 2.0 || RPD: 0	LCS-1	101%
Exchangeable Na	meq/100g	0.1	Metals-009	<0.1	122475-1	<0.1 || <0.1	LCS-1	95%
Cation Exchange Capacity	meq/100g	1	Metals-009	<1.0	122475-1	12 || 13 || RPD: 8	[NR]	[NR]

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client:

JK Geotechnics
PO Box 976
North Ryde BC NSW 1670

ph: 02 9888 5000
Fax: 02 9888 5001

Attention: Vittal Boggaram

Sample log in details:

Your reference:	**26401L, Various**
Envirolab Reference:	**122475**
Date received:	23/01/2015
Date results expected to be reported:	**2/02/15**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	3 Soils
Turnaround time requested:	Standard
Temperature on receipt (°C)	18.5
Cooling Method:	Ice Pack
Sampling Date Provided:	YES

Comments:

If there is sufficient sample after testing, samples will be held for the following time frames from date of receipt of samples:
Water samples - 1 month
Soil and other solid samples - 2 months
Samples collected in canisters - 1 week. Canisters will then be cleaned.
All other samples are not retained after analysis
If you require samples to be retained for longer periods then retention fees will apply as per our pricelist.

Contact details:

Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200 fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au

TO:
Envirolab Services Pty Ltd
12 Ashley Street, Chatswood 2067

Phone: (02) 9910 6200
Fax: (02) 9910 6201

Attention: Aileen / David

Date Results Required: STANDARD

SAMPLE AND CHAIN OF CUSTODY FORM

EIS Job Number: 26401L

Sheet 1 /1

FROM:
JK Geotechnics

Rear 115 Wicks Road
Macquarie Park NSW 2113

Phone: (02) 9888 5000
Fax: (02) 9888 5004

Contact: Vittal Boggaram

Project: Proposed Development
Location: Various
Sampler: OF/DW/PC

Tests Required

Sample Preservation:
In esky on ice

Date Sampled	Lab No.	Sample/ Borehole Number	Depth (m)	Sample Container	Sample Description	pH (AS1289.4.3.1)	CEC	EC (1:5 soil : water)	Texture										
12/1/15	1	SVC7 BH904	0.1/0.2	Plastic Bag	Fill-clay	X	X	X	X										
↓	2	↓	0.5/0.95	Plastic Bag	↓	X	X	X	X										
↓	3	↓	3.0/3.45	Plastic Bag	↓	X	X	X	X										
				Plastic Bag															
				Plastic Bag															
				Plastic Bag															

ENVIRO LAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 122475
Date Received: 23/1/15
Time Received: 16:30
Received by: PT
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished By: Vittal B-S
Date: 23/1/15
Time: 1:30pm.
Received By: PT EL

Remarks:

PLEASE CONTACT VITTAL OR ADRIAN AT JK/EIS IF YOU REQUIRE ANY CLARIFICATIONS

APPENDIX 8A-2: Laboratory Results for Bore Hole No. 692

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 118864

Client:
JK Geotechnics
PO Box 976
North Ryde BC
NSW 1670

Attention: Vittal Boggaram

Sample log in details:

Your Reference:	**26401LM, Various**		
No. of samples:	6 soils		
Date samples received / completed instructions received	05/11/14	/	05/11/14

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	12/11/14	/	12/11/14
Date of Preliminary Report:	Not Issued		

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

Miscellaneous Inorg - soil			
Our Reference:	UNITS	118864-4	118864-5
Your Reference	----------	SVC-BH692	SVC-BH692
Depth	----------	1.5-1.6	2.2-2.4
Date Sampled		03/11/2014	03/11/2014
Type of sample		Soil	Soil
Date prepared	-	07/11/2014	07/11/2014
Date analysed	-	11/11/2014	11/11/2014
pH 1:2.5 soil:water*	pH Units	5.9	6.0

CEC Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ---------- - -	118864-4 SVC-BH692 1.5-1.6 03/11/2014 Soil	118864-5 SVC-BH692 2.2-2.4 03/11/2014 Soil
Date extracted	-	11/11/2014	11/11/2014
Date analysed	-	11/11/2014	11/11/2014
Exchangeable Ca	meq/100g	0.8	0.2
Exchangeable K	meq/100g	0.3	0.3
Exchangeable Mg	meq/100g	2.0	1.7
Exchangeable Na	meq/100g	0.59	0.88
Cation Exchange Capacity	meq/100g	3.7	3.1

Texture and Salinity			
Our Reference:	UNITS	118864-4	118864-5
Your Reference	----------	SVC-BH692	SVC-BH692
Depth	----------	1.5-1.6	2.2-2.4
Date Sampled		03/11/2014	03/11/2014
Type of sample		Soil	Soil
Electrical Conductivity 1:5 soil:water	µS/cm	49	63
Texture Value		8.5	8.5
TEXTURE	-	Light Clay	Light Clay
ECe	dS/m	0	1.0
Class	-	NON SALINE	NON SALINE

Method ID	Methodology Summary
Inorg-001	pH in soil in accordance with AS1289.4.3.1, ratio 1:2.5 for soil:water, measurement using pH meter.*
Metals-009	Determination of exchangeable cations and cation exchange capacity in soil based on Rayment and Lyons 2011.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment & Lyons.

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			07/11/2014	[NT]	[NT]	LCS-1	07/11/2014
Date analysed	-			11/11/2014	[NT]	[NT]	LCS-1	11/11/2014
pH 1:2.5 soil:water*	pH Units		Inorg-001	[NT]	[NT]	[NT]	LCS-1	102%
QUALITY CONTROL CEC	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/11/2014	118864-4	11/11/2014 || 11/11/2014	LCS-1	06/11/2014
Date analysed	-			06/11/2014	118864-4	11/11/2014 || 11/11/2014	LCS-1	06/11/2014
Exchangeable Ca	meq/100g	0.1	Metals-009	<0.1	118864-4	0.8 || 0.7 || RPD: 13	LCS-1	113%
Exchangeable K	meq/100g	0.1	Metals-009	<0.1	118864-4	0.3 || 0.3 || RPD: 0	LCS-1	108%
Exchangeable Mg	meq/100g	0.1	Metals-009	<0.1	118864-4	2.0 || 1.9 || RPD: 5	LCS-1	111%
Exchangeable Na	meq/100g	0.1	Metals-009	<0.1	118864-4	0.59 || 0.55 || RPD: 7	LCS-1	108%
Cation Exchange Capacity	meq/100g	1	Metals-009	<1.0	118864-4	3.7 || 3.4 || RPD: 8	[NR]	[NR]
QUALITY CONTROL Texture and Salinity	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	LCS-1	101%
Texture Value			Inorg-002	[NT]	[NT]	[NT]	[NR]	[NR]
Class	-			[NT]	[NT]	[NT]	[NR]	[NR]

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

APPENDIX 8A-3: Bore Hole Log SVC-BH904

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
SVC-BH904
1 / 2

EASTING: 306869.624
NORTHING: 6270330.349
CHAINAGE: 45935.00 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: CUT FACE, CUT CW-2U

Job No.: 26401LM
Date: 12/1/15
Plant Type: JK305
Method: SPIRAL AUGER
Logged/Checked By: O.F./M.P.
R.L. Surface: 63.12 m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					N = 25 9,12,13	63	1			FILL: Silty clay, medium plasticity, dark brown, with fine to medium grained sandstone gravel, trace of timber and brick fragments, ash, root and root fibres.	MC<PL			APPEARS WELL COMPACTED
					N = 14 8,7,7	62	2			FILL: Silty clay, medium plasticity, dark brown, trace of fine to medium grained sand, shale gravel and brick and plastic fragments.				
					N = 9 4,4,5	61	3							FIBRO IN SPT SAMPLE
						60				SHALE: dark grey.	XW	EL		VERY LOW 'TC' BIT RESISTANCE
						59	4				DW	VL - L		
					SPT 14/ 30mm REFUSAL	58	5			REFER TO CORED BOREHOLE LOG				
						57	6							

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CORED BOREHOLE LOG

Borehole No.
SVC-BH904
2 / 2

EASTING: 306869.624
NORTHING: 6270330.349
CHAINAGE: 45935.00 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: CUT FACE, CUT CW-2U

Job No.: 26401LM | **Core Size:** HQ | **R.L. Surface:** 63.12 m
Date: 12/1/15 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK305 | **Bearing:** N/A | **Logged/Checked By:** O.F./M.P.

Water Loss/Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT SPACING (mm) (500, 300, 100, 50, 30, 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific	General
		59			START CORING AT 4.43m						
30% RETURN		58	5		SHALE: dark grey, with light grey and brown laminae, bedded at 0°.	DW	M			J, 85°, P, R, IS XWS, 0°, 8 mm t HEALED J, 0-10°, Un, IS J, 20°, P, R	$I_{S(50)}(A) = 0.7MPa$ $I_{S(50)}(D) = 0.4MPa$
					SHALE: dark grey, with light grey laminae, bedded at 0°.	FR				J, 40°, P, R	
		57	6							J, 10°, P, R, IS J, 60°, P, R	$I_{S(50)}(A) = 1MPa$ $I_{S(50)}(D) = 0.5MPa$
		56	7							J, 70°, Un, R, IS Be, 0°, P, R	$I_{S(50)}(A) = 0.7MPa$ $I_{S(50)}(D) = 0.5MPa$
		55	8							Be, 0°, P, R J, 90°, P, S, IS J, 80°, P, R, IS J, 45 - 80°, Un, R J, 70 - 90°, Un, R	$I_{S(50)}(A) = 0.7MPa$ $I_{S(50)}(D) = 0.4MPa$
		54	9							J, 60 - 80°, P, S HEALED J, 0-90°, Un 2x J, 45°, P, S J, 45°, P, R	$I_{S(50)}(A) = 1.1MPa$ $I_{S(50)}(D) = 0.3MPa$
		53	10							HEALED J, 20°, P	$I_{S(50)}(A) = 0.6MPa$ $I_{S(50)}(D) = 0.4MPa$
					END OF BOREHOLE AT 10.83 m						$I_{S(50)}(A) = 0.5MPa$ $I_{S(50)}(D) = 0.4MPa$

APPENDIX 8A-4: Bore Hole Log SVC-BH692

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BOREHOLE LOG

Borehole No.
SVC-BH692
1 / 3

EASTING: 307812.971
NORTHING: 6269781.765
CHAINAGE: 44709.38 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 92 OF BELLA VISTA TO ROUSE HILL VIADUCT, NSW

Job No.: 26401LM **Method:** SPIRAL AUGER **R.L. Surface:** 49.72 m
Date: 3/11/14 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** C.J.M./M.P.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					N = 5 4,3,2	49	1			FILL: Silty clay, low to medium plasticity, light brown, with root fibres and concrete fragments.	MC<PL			GRASS COVER APPEARS POORLY COMPACTED
					SPT 11/ 100mm REFUSAL	48	2		CL-CH	SILTY CLAY: medium to high plasticity, light grey and red brown, with occasional M strength shale fragments and H strength ironstone gravel.	MC~PL	(H)		
						47	3		-	INTERBEDDED SILTY CLAY and SHALE: low to medium plasticity, light grey and occasional H strength ironstone gravel.	MC<PL MC<PL / (DW)	VL - L		
						46	4			SHALE: dark grey, with occasional H strength iron indurated bands.	DW	L		LOW 'TC' BIT RESISTANCE
						45	5			REFER TO CORED BOREHOLE LOG				
						44	6							
						43								

JK_LIB_CURRENT - V7.3.GLB Log J & K AUGERHOLE - MASTER 26401LM NWRL.GPJ DWG88693.GDW 10/03/2015 16:54 Produced by gINT Professional, Developed by Datgel

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

CORED BOREHOLE LOG

Borehole No.
SVC-BH692
2 / 3

EASTING: 307812.971
NORTHING: 6269781.765
CHAINAGE: 44709.38 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 92 OF BELLA VISTA TO ROUSE HILL VIADUCT, NSW

Job No.: 26401LM
Core Size: NMLC
R.L. Surface: 49.72 m
Date: 3/11/14
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: C.J.M./M.P.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10 DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
					START CORING AT 4.20m				
100% RETURN		45	5		SHALE: dark grey, with occasional red brown iron indurated bands.	XW DW	EL L		XWS, 0°, 3 mm.t XWS, 0°, 3 mm.t $I_{S(50)}(A)$ = 0.4MPa $I_{S(50)}(D)$ = 0.5MPa
						SW	M		FROM 4.32m TO 5.05m DEPTH, NUMEROUS BEDDING PARTINGS AND JOINTS RANGING FROM 5° TO 30°, TYPICALLY P, R, AND IS SPACED 10-50mm, NOT INDIVIDUALLY DESCRIBED J, 20°, P, R, IS 2x Be, 0-5°, P, S, IS $I_{S(50)}(A)$ = 1.2MPa $I_{S(50)}(D)$ = 0.7MPa
		44	6		SHALE: dark grey.				J, 40 - 70°, Un, S, IS Be, 10°, P, S J, 60°, P, S J, 70°, P, S, IS XWS, 0°, 20 mm.t Be, 5°, S, IS HEALED J, 09-50°, P, IS XWS, 0°, 3 mm.t
		43	7			FR			$I_{S(50)}(A)$ = 1.3MPa $I_{S(50)}(D)$ = 0.7MPa J, 60 - 90°, Un, S $I_{S(50)}(A)$ = 0.9MPa $I_{S(50)}(D)$ = 0.7MPa
		42	8						
		41	9		SHALE: dark grey, with light grey laminae, bedded at 0°				$I_{S(50)}(A)$ = 0.7MPa $I_{S(50)}(D)$ = 0.2MPa
		40	10		SANDSTONE: fine to medium grained, light grey, with occasional dark grey shale lenses and bands, bedded at 0-5°.		H		Be, 0°, P, S UCS = 17.3MPa $I_{S(50)}(A)$ = 2MPa $I_{S(50)}(D)$ = 1.1MPa Be, 5°, P, S $I_{S(50)}(A)$ = 1.2MPa $I_{S(50)}(D)$ = 0.8MPa
		39							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

CORED BOREHOLE LOG

Borehole No.
SVC-BH692
3 / 3

EASTING: 307812.971
NORTHING: 6269781.765
CHAINAGE: 44709.38 m

Client: IS JOINT VENTURE
Project: NORTH WEST RAIL LINK - SVC
Location: PIER 92 OF BELLA VISTA TO ROUSE HILL VIADUCT, NSW

Job No.: 26401LM
Core Size: NMLC
R.L. Surface: 49.72 m
Date: 3/11/14
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: C.J.M./M.P.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
100% RETURN		38	12		SANDSTONE: fine to medium grained, light grey, with occasional dark grey shale lenses and bands, bedded at 0-5°.	FR	H			— Be, 0°, P, S $I_{S(50)}(A)$ = 2.8MPa $I_{S(50)}(D)$ = 0.9MPa
					as above, but medium grained.					
		37	13							$I_{S(50)}(A)$ = 1.7MPa $I_{S(50)}(D)$ = 0.8MPa
		36	14							$I_{S(50)}(A)$ = 1.9MPa $I_{S(50)}(D)$ = 0.9MPa
					SANDSTONE: medium grained, light grey, with occasional carbonaceous laminae, bedded at -0-5°.					$I_{S(50)}(A)$ = 2.6MPa $I_{S(50)}(D)$ = 1.2MPa
		35	15		SANDSTONE: fine to medium grained, light grey.					
		34	16							$I_{S(50)}(A)$ = 2MPa $I_{S(50)}(D)$ = 1.6MPa
		33	17							$I_{S(50)}(A)$ = 1.3MPa $I_{S(50)}(D)$ = 1.1MPa
					as above, but with dark grey shale laminae, bedded at 0°.					$I_{S(50)}(A)$ = 3.2MPa $I_{S(50)}(D)$ = 1.3MPa
		32			END OF BOREHOLE AT 17.77 m					

APPENDIX 9 - **Response to Agency Comments**

NOW: In its letter of 7 May 2014 the NOW advised that it was satisfied with the CSWMP and had no comments on the Plan.

The EPA in its letter of 13 May 2014 advised that it had no comments on the CSWMP.

Our reference: DOC14/67813

Salini Impregilo
Suite 1 Level 7
100 Walker Street
North Sydney NSW 2060

Attention: Sam Turnbull

Dear Mr Turnbull,

I refer to your letter of 7 April 2014 seeking input from the Environment Protection Authority (EPA) to the Environmental Management Plans for the Surface and Viaduct Civil Works section of the North West Rail Link.

Thank you for the opportunity to provide input to the management plans. The EPA does not generally comment on, approve or endorse environmental management plans. The EPA utilises a range of regulatory tools such as environment protection licences and pollution reduction programs to help achieve positive environmental outcomes.

Construction of the North West Rail Link project is licenced by the EPA under the *Protection of the Environment Operations Act 1997*. The environmental performance of the project's licence holders and sub-contractors is regulated through compliance with the relevant licences and legislation.

If you have any questions regarding this letter please contact Mark Jansons, Regional Operations Officer, EPA on (02) 9995 6829 or mark.jansons@epa.nsw.gov.au.

Yours sincerely

13.05.2014

MARK HANEMANN
Unit Head Infrastructure
Environment Protection Authority

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Tel: (02) 9995 6801 Fax: (02) 9995 6900
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Department of Primary Industries
Office of Water

Contact Rohan Macdonald
Phone 02 4904 2642
Email rohan.macdonald@water.nsw.gov.au

Our ref ER21676

BY EMAIL: steve.fermio@isjv.com.au

ISJV
Suite 701, Level 7
NORTH SYDNEY NSW 2060

Attention: Steve Fermio

Dear Steve

NWRL (Surface Viaduct) Environmental Plans

NSW Office of Water consultation

I refer to your request for comment regarding the Construction Soil and Water Management Plan, Construction Flora and Fauna Management Plan and Water Quality Monitoring Program for the North West Rail Link (NWRL) Surface Viaduct construction works. The Office of Water has reviewed the plans provided and is satisfied that they adequately address the conditions of approval and are sufficient to mitigate potential impacts to surface and groundwater resources.

It is noted that no groundwater is proposed to be used during the works, however dewatering of groundwater may be required from excavations to facilitate construction. Such dewatering may require authorisation under the *Water Act 1912*. ISJV should liaise with the Office of Water to determine any licensing requirements prior to dewatering activities commencing.

Yours sincerely

Mitchell Isaacs
Manager Strategic Stakeholder Liaison
7 May 2014

APPENDIX 10 - **Progressive ESCPs Examples**

BASIN AND CATCHMENTS		

KEY	
	CULVERT UNDER HAUL ROAD
	OUTLET FROM PROJECT AREAS
	CHANNELISED SURFACE FLOWS – OFF SITE WATER (BLUE) SITE WATER (BROWN)
	GENERAL FALL OF SURFACE – SITE WATER
	SEDIMENT FENCE PER SD 6-8
	SUB PORTION BOUNDARY – APPROXIMATE ONLY
	SURFACE WATER DIVERSION- SCRATCH DRAIN OR BERM (STABILISED WITH GEOTEXTILE WHERE INDICATED)
	CHECK DAM/SEDIMENT CONTROL STRUCTURE – STACKED GRAVEL BAGS- WRAPPED IN GEOTEXTILE WHERE INDICATED
	SEDIMENT CONTROL – GOETEXTILE OVER COMPACTED BERM
	REVEGATATED / VEGEATATED AREA INCLUDES PROTECTED VEGETATION
	SEDIMENT CONTROL – BASIN OR LARGE SUMP`
	STABLE SITE ACCESS – CATTLE GRID OR SHAKER

ErSed Environmental Pty Ltd
PO Box 1124 Leichhardt 2040

M. 0424 203 046
E.info@ersed.com.au

SHEETS IN THIS PLAN SET
1. GENERAL ARRANGEMENT – BALMORAL STOCKPILE/SEGMENT STORAGE

ERSED REF:	14007	**PROGRESSIVE EROSION AND SEDIMENT CONTROL PLAN**
DRAWN	CV	GENERAL ARRANGEMENT BALMORAL STOCKPILE/SEGMENT STORAGE
CREATED	MAY 2015	
DATE THIS AMDT	7 APRIL 2017	1 of 1 | 4
CLIENT	ISJV	PREFIX NUMBER SHEET | AMDT

AREA NORTH OF VIADUCT STABILISED WITH HYDRO-MULCH. DRAINS TO SECOND PONDS CREEK

SEDIMENT CONTROL – GRAVEL BAG CHECK – SET AT LOWER LIMIT OF HYDROMULCHED AREA – MAINTAIN CONTROLS UNTIL AREA IS STABILISED.

BERM SET AT TOP OF BATTER TO NEW SWALE DRAINS. BATTERS TO SWALE DRAINS STABILISED WITH TOPSOIL AND HYDROMULCH

HAUL ROAD DRAINED BACK AND TO DRAPS AS INDICATED

VIADUCT SURFACES DRAIN TO SIDE AND ALSO INTERNAL DRAINAGE – NOT SHOWN

EXCAVATION AT EASTERN ABUTMENT HOLDS WATER FROM SWALE DRAINS. DEWATERED TO LARGER CONTROLS AS REQUIRED FOR TREATMENT OR RE USE ON SITE

KEY	
	CULVERT UNDER HAUL ROAD
	OUTLET FROM PROJECT AREAS
	CHANNELISED SURFACE FLOWS – OFF SITE WATER (BLUE) SITE WATER (BROWN)
	GENERAL FALL OF SURFACE – SITE WATER
	SEDIMENT FENCE PER SD 6-8
	SUB PORTION BOUNDARY – APPROXIMATE ONLY
	SURFACE WATER DIVERSION- SCRATCH DRAIN OR BERM (STABILISED WITH GEOTEXTILE WHERE INDICATED)
	CHECK DAM/SEDIMENT CONTROL STRUCTURE – STACKED GRAVEL BAGS- WRAPPED IN GEOTEXTILE WHERE INDICATED
	SEDIMENT CONTROL – GOETEXTILE OVER MULCH/SHAPED EARTH OR GRAVEL BERM – CENTRAL SPILLWAY INCLUDED
	REVEGATATED / VEGEATATED AREA
	SEDIMENT CONTROL – BASIN OR LARGE SUMP`
	STABLE SITE ACCESS – CATTLE GRID OR SHAKER

NOTES TO ESC ARRANGEMENT SUB-PORTION Q (WEST)

- SURFACE WATER DIVERSION – RAISED BERM OR CUT SWALE – AT ISJV SIDE OF HAUL ROAD
- HAUL ROAD DRAINS TO SUB-PORTION H OR WESTERN SIDE
- DIVERSION DIRECTS WATER TO NORTH AND TO GEOTEXTILE LINED SEDIMENT CONTROL SUMP (SEE NOTES BELOW FOR RECOMMENDED CAPACITY.
- USE BAGS OR GRAVEL CHECKS TO CONTROL SCOUR AT DIVERSION
- SUMP OUTLETS OVER GEOTEXTILE SPILLWAY TO CLEAN WATER DRAIN AT EASTERN BOUNDARY, THEN VIA CULVERT TO EXISTING FARM POND.

SUMP REQUIREMENTS

- APPROXIMATE CATCHMENT TO SEDIMENT CONTROL SUMP 0.72HA
- 80^{TH}%ILE 5 DAY REQUIRED CAPACITY = 136M3
- 80^{TH}%ILE 2 DAY REQUIRED CAPACITY = 82M3
- SEDIMENT CONTROL SUMP – RECOMMENDED TARGET VOLUME =50M3 OR GREATER

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SHEETS IN THIS PLAN SET	ERSED REF:	14007	**EROSION AND SEDIMENT CONTROL PLAN**
GENERAL ARRANGMENT – ESC SUB PORTION H	DRAWN	CV	GENERAL ARRANGMENT – ESC SUB PORTION H (PART)
	CREATED	DEC 2016	
	DATE THIS AMDT	5 APRIL 2017	1 / 3
	CLIENT	ISJV	PREFIX NUMBER SHEET AMDT