JHCPB Joint Venture

Surface Water Quality Monitoring Program

RIC-JHC-MPL-00-PL-270-002

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Glossary/ Abbreviations

Abbreviations	Expanded text
CEMP	Construction Environmental Management Plan
CoA	Conditions of Approval
DoI Water	Department of Industry – Water (formerly DPI Water)
EC	Electrical Conductivity
EIS	WestConnex M4-M5 Link Environmental Impact Statement
EPL	Environment Protection Licence
GMP	Groundwater Management Sub-plan
JHCPB	John Holland CPB Contractors Joint Venture
REMM	Revised Environmental Management Measures
Roads and Maritime	Roads and Maritime Services
SPIR	WestConnex M4-M5 Link Submissions and Preferred Infrastructure Report
SSTV	Site Specific Trigger Values
SSWMP	Soil and Water Management Plan
SWQMP	Surface Water Quality Monitoring Program
TDS	Total Dissolved Solids
WTP	Water Treatment Plant

1. Introduction

1.1. Context

This Surface Water Quality Monitoring Program (the Program) has been prepared for the Design and Construction of Rozelle Interchange Project (the Project). The Program forms Appendix B of the Soil and Surface Water Management Sub-plan (SSWMP).

This Program has been prepared to address the requirements of the Ministers Conditions of Approval (CoA), Project Approvals and all applicable guidance and legislation.

1.2. Scope of the SWQMP

The scope of this Program is to describe how John Holland CPB Contractors Joint Venture (JHCPB) proposes to monitor potential impacts to surface water during construction of the Project. Operational monitoring and operation measures do not fall within the scope of the construction phase and therefore are not included within the processes contained within this Program.

2. Purpose and objectives

2.1. Purpose

The purpose of the Program is to describe how JHCPB will monitor surface water quality during construction of the Project.

The Program will be implemented to monitor the effectiveness of mitigation measures applied during the construction phase of the Project. Monitoring of surface water will be undertaken to identify potential impacts and ensure an appropriate management regime can be implemented to address those impacts and manage local surface water quality.

This Program provides details of the surface water monitoring network, frequency of monitoring, and test parameters. This this Program supplements the SWMP, which itself is an appendix of the Construction Environmental Management Plan (CEMP).

This Program is based on baseline studies developed for the project EIS (AECOM, 2017).

2.2. Objectives

The key objectives of this Program are to ensure all CoAs, REMMs, and licence/permit requirements relating to surface water monitoring are described, scheduled, and assigned responsibility as outlined in:

- The EIS prepared for WestConnex M4-M5 Link,
- The SPIR prepared for WestConnex M4-M5 Link,
- The Modification Report and Response to Submissions Report prepared for the Mainline Tunnel Modification,
- Conditions of Approval granted to the project on 17 April 2018 and as subsequently modified,
- RMS specifications G36, G38 and G40,
- The Project's Environment Protection Licence (EPL) issued on 18 June 2019 with a Section 58 Licence Variation issued on 18 August 2020, and
- All relevant legislation and other requirements described in Section 3 of the SSWMP.

2.3. Consultation

This program was provided to DoI Water, Sydney Water and Inner West Council in accordance with CoA C9(a). Refer to Section 3.7.2 of the CEMP for the consultation requirements relating to the CEMP and all sub-plans.

Ongoing consultation with relevant councils and other stakeholders, including any unique local receivers, will be undertaken for particular issues pertaining to the Project's impact on soil and surface water as required by CoA C4(e) and C9(a). Community feedback and complaints relating to surface water quality will be managed in accordance with the Communication Strategy and Complaints Management System.

3. Surface water monitoring

3.1. Baseline monitoring

3.1.1. Overview

In July 2016 a baseline surface water monitoring program was implemented as part of the project EIS (AECOM, 2017). The program was based on a desktop assessment involving a review of the existing surface water environment across the project area, including:

- Information obtained from geotechnical investigations and assessments carried out as part of the project,
- Information and water quality monitoring data from the M4 East EIS and the New M5 EIS relevant to surface water within the project area, and
- Data relevant to the existing surface water conditions in the study area from sources including the Inner West Council and the City of Sydney Council, WestConnex (formerly Sydney Motorway Corporation, and NSW Government agencies including Sydney Water and the RMS.

The baseline surface water monitoring program was implemented to:

- Evaluate the existing surface water quality at key locations in the project area,
- Identify potential pathways of pollutants to surface water receivers, and
- Monitor and assess the surface water quality in the project area to form a baseline of environmental conditions, to measure the environmental performance of the project during the construction and operation of the project.

3.1.2. Monitoring network

Baseline water quality monitoring locations were located upstream and downstream of the Project alignment and ancillary facilities as shown in Figure 1, Figure 2 and listed in Table 1. Monitoring locations SW03 and SW04 shown on Figure 1 are associated with the M4-M5 Link Mainline Tunnels Project and are not included in the monitoring program established by this Program. The monitoring locations were chosen to provide general characterisation of the waterways in the vicinity of the Project and include water quality monitoring locations established for the Project.

Table 1 Baseline surface water monitoring locations

Sample ID	Sample Location	Waterway
SW01	Whites Creek outlet at City West Link/ The Crescent, Rozelle	Rozelle Bay (downstream of construction)
SW02	Whites Creek Valley Park, Railway Parade, Annandale	Whites Creek (downstream of construction)*
SW07	Adjacent to 88-90 Lilyfield Road, Lilyfield	Easton Park drain (upstream of construction)
SW11	Under Iron Cove Bridge, Rozelle	Iron Cove (downstream of construction)
SW12	King George Park, Rozelle	Iron Cove (downstream of construction)

* SW02 is listed as downstream of the M4-M5 link construction compounds in the EIS (AECOM, 2017). However, SW02 is upstream of the Rozelle Interchange construction compound.

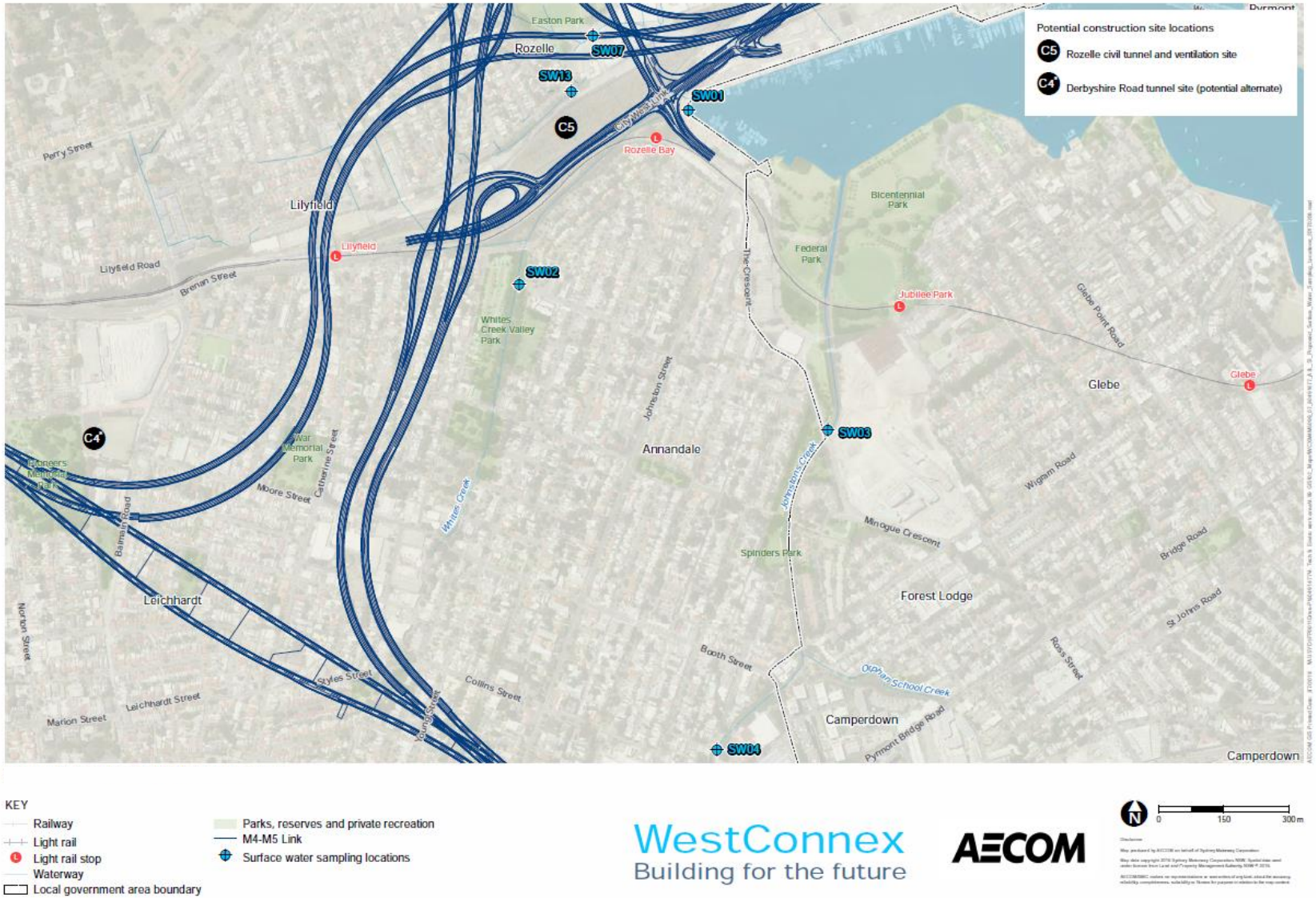

Figure 1 Rozelle Interchange showing sampling locations (SW03 and SW04 will not be monitored for this project and are associated with the Mainline Tunnels Project)

Figure 2 Iron Cove Link showing sampling locations

3.1.3. Surface water quality

The baseline surface water quality sampling program (Table 2) included the following analytes:

- Physio-chemical (field) parameters (pH, temperature, electrical conductivity (EC), oxidation / reduction potential, dissolved oxygen, and turbidity),
- Benzene, toluene, ethylbenzene, xylene, and naphthalene (BTEXN),
- Dissolved metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel and zinc),
- Nutrients (nitrite as N, nitrate as N, reactive phosphorus and ammonia),
- Total recoverable hydrocarbons (TRHs), and
- Total petroleum hydrocarbons (TPHs).

Summary tables of the baseline water quality data are included in Annexure A. Interpretation of the baseline surface water monitoring data is included in the EIS (AECOM, 2017) and summarised in Table 3. The results are compared against the ANZECC (2000a) water quality guidelines. It should be noted that these guidelines are not to be used as a mandatory standard; rather they provide a guideline for the environmental values of water resources.

Table 2 Baseline surface water quality sampling program

Sample ID	Number of samples	Start of baseline monitoring	Minimum frequency
SW01	37	July 2016	Monthly
SW02	37	July 2016	Monthly
SW07	37	July 2016	Monthly
SW11	31	November 2016	Monthly
SW12	31	November 2016	Monthly

Table 3 Baseline water quality conditions in the Project area

Waterway	Baseline data obtained	Description of water quality
Rozelle Bay	Samples collected at SW01. Samples collected by The University of Sydney on behalf of UrbanGrowth NSW at BW1 as part of The Bays Precinct transformation project between July 2016 and June 2018.	Elevated concentrations of heavy metals (copper, chromium, lead and zinc), nitrogen, phosphorous, nitrate, oxides of nitrogen, ammonia and chlorophyll have been recorded. On some occasions the pH is outside guideline levels and the turbidity exceeds guideline levels.
Whites Creek	Samples collected at SW02. Samples collected by The University of Sydney on behalf of UrbanGrowth NSW within a tidally influenced location (at SW02) as part of The Bays Precinct transformation project between June and September 2016.	Elevated concentrations of heavy metals (chromium, copper, lead and zinc), phosphorus, nitrogen, nitrate and oxides of nitrogen were recorded. On some occasions the pH was outside guideline levels and the turbidity exceeds guideline levels.
Easton Park drain	Samples collected at SW07.	Elevated concentrations of heavy metals (copper, lead, and zinc) and nutrients (nitrogen phosphorus and nitrate) were recorded. On some occasions, the pH was outside guideline levels and the turbidity exceeded guideline levels.
Iron Cove	Samples collected at SW11 and SW12.	Elevated concentrations of metals (copper, chromium, lead, mercury and zinc), nitrogen, nitrate and phosphorous have been recorded.

Waterway	Baseline data obtained	Description of water quality
		Turbidity exceeds guideline values. The pH was outside guideline levels on occasions.
Open stormwater drain - Rozelle Rail Yards	Samples collected at SW13.	Elevated concentrations of metals (copper, chromium, lead, mercury and zinc), nitrogen, nitrate and phosphorous have been recorded. Turbidity exceeds guideline levels.

3.2. Surface water quality construction monitoring

3.2.1. Overview

The mobilisation of sediments and pollutants during the above-ground surface construction works and tunnelling is identified as a potential impact on surface water within the highly urbanised and disturbed catchments and waterways. A soil conservation specialist will be engaged to provide design input.

Table 5 contains the parameters to be tested as part of this Program. Site specific trigger values (SSTVs) are identified in Table 6 and will be used to assess potential impacts on sensitive receiving environments (Section 4.2.3 of SSWMP).

Variation in physio-chemical parameters (Table 6) provides an indication of a change to overall water quality triggering the assigned performance criteria and further impact assessment.

Groundwater inflows intercepted during tunnelling will be discharged via the Project WTP. The Project EPL may authorise discharge of water from specific locations or premises and establish criteria that differ from those given in this Program. In such circumstances the EPL, and any conditions and criteria of that EPL, take precedence over this Program. Discharged water quality will be monitored as detailed in the Project GWMP (in Section 4.3).

3.2.2. Rainfall monitoring

To provide data to assess water quality trends, rainfall will be monitored during the construction phase via a rain gauge at Rozelle Railyards, which will be checked on each workday or automated using an electronic weather station.

3.2.3. Monitoring locations

Surface water quality monitoring will be carried out during construction at six sites, listed in Table 4 and shown in Figure 1 and Figure 2. The monitoring program will commence prior to any ground disturbance in accordance with REMM SW02 (SSWMP Annexure A). Background monitoring commenced in July 2016 comprises the background monitoring of this program. Construction phase monitoring will commence following approval by DPE of this Program. The monitoring allows for the assessment trends in water quality, including natural variations, and will allow sufficient data to enable assessment of any potential impacts measured during construction. The surface water quality monitoring locations were also monitored during the baseline monitoring period that informed the EIS (as discussed in Section 3.1). Monitoring of discharge from the WTPs is discussed in the GWMP (Section 4.3).

Table 4 Construction phase surface water monitoring program

Sample ID[1]	Sample location	Ancillary Facility	Receiving environment	Analysis suite	Sampling frequency
SW01	Rozelle Bay (down-gradient)	Rozelle civil and tunnel site	Sydney Harbour/ Parramatta River	Physio-chemical parameters[2]	Monthly/ Wet weather[3]

Sample ID[1]	Sample location	Ancillary Facility	Receiving environment	Analysis suite	Sampling frequency
SW02	Whites Creek (up-gradient of Rozelle Interchange)	Rozelle civil and tunnel site	Sydney Harbour/ Parramatta River	Physio-chemical parameters[2]	Monthly/ Wet weather[3]
SW07	Easton Park drain (Up-gradient and down-gradient of construction)	Rozelle civil and tunnel site	Sydney Harbour/ Parramatta River	Physio-chemical parameters[2]	Monthly/ Wet weather[3]
SW11	Iron Cove (downstream)	Iron Cove civil and tunnel site	Sydney Harbour/ Parramatta River	Physio-chemical parameters[2]	Monthly/ Wet weather[3]
SW12	Iron Cove (downstream)	Iron Cove civil and tunnel site	Sydney Harbour/ Parramatta River	Physio-chemical parameters[2]	Monthly/ Wet weather[3]

Note:
1 Sample location ID's retained from EIS for consistency
2 Physico-chemical (field) parameter analysis as detailed in Table 5
3 Quarterly wet weather monitoring (at least once every 3 months following 25 mm of continuous rainfall – see Sampling frequency)

3.2.4. Sampling frequency

During the construction phase water quality sampling will be undertaken monthly.

Wet weather monitoring will be carried out (a minimum of once per 3 months where rainfall does not exceed 25mm) when a continuous rainfall event of >25 mm is received in the local catchment during a 24-hour period (as recorded at the Project's rain gauge(s) or nearby weather station) and has generated runoff from site.

For safety reasons sampling will not be undertaken during peak storm-flows. Sampling will be completed when flows are reasonably constant and monitoring points can be safely accessed, monitoring locations will be selected where possible to enable a safe monitoring location during all weather conditions.

The monitoring program will continue for the duration of construction and until the affected waterways are rehabilitated to an acceptable condition as certified by a suitably qualified and experienced independent expert.

3.2.5. Surface water quality parameters

Table 5 details the analytes that will be monitored during the construction phase surface water monitoring, at the locations listed in Table 4 and shown in Figure 1 and Figure 2.

Table 5 Surface water quality monitoring parameters

Category	Parameters[1]
Physico-chemical parameters	▪ Temperature (˚C) ▪ Dissolved Oxygen (mg/L) ▪ Electrical Conductivity (µS/cm) ▪ Reduction-Oxidation Potential (Redox)(mV) ▪ pH ▪ Total dissolved solids (TDS) ▪ Turbidity (NTU) ▪ Visible oil and grease

Note:
[1] Measured in the field using calibrated multi-probe water quality meter(s)

Surface water quality analysis results will be assessed and compared to baseline conditions, rainfall records, upstream monitoring results, and the performance criteria described below.

3.2.6. Performance criteria

Baseline monitoring shows that some surface water quality parameters exceed the default ANZECC (2000a) water quality trigger values for slightly to moderately disturbed ecosystems.

This is not unexpected given the highly urbanised and disturbed area and receiving waterways surrounding the project.

Location specific performance criteria (site-specific trigger values (SSTV)) have been developed for downstream (impact) surface water monitoring locations (see Table 6).

SSTV were developed for appropriate parameters using baseline monitoring data and ANZECC (2000a) guideline criteria for slightly to moderately disturbed ecosystems (generally protecting 90% of species) (Table 6).

- The 80th percentile of baseline data is used as the SSTV for those parameters/locations that exceeded the relevant ANZECC (2000a) guideline criteria. It is noted that exceedances of the ANZECC (2000a) guideline criteria are not unexpected due to the highly disturbed nature of the urban catchment area,
- The relevant ANZECC (2000a) guideline criteria is used as the SSTV for parameters where the 80th percentile of baseline data was below the relevant ANZECC (2000a) guideline criteria.

Table 6 Site specific trigger values

Parameter	Units	ANZECC guidelines	SW01	SW02	SW07	SW11	SW12	SW13
pH	pH	7.0-8.5	7.0-8.5	7.0-8.5	7.0-8.5	7.0-8.5	7.0-8.5	7.0-8.5
Electrical Conductivity	µS /cm	125 - 2,200	49,812	23,348	18,190	51,914	51,947	575
Turbidity	NTU	0.5 - 10	8.66	12.98	12.14	28.44	7.44	65.2

The SSTV's provide an easily identifiable indication of a potential change in water quality. A management response would be initiated if any of the following occurs:

- A parameter exceeds the SSTV for any single monitoring event by more than 30%,
- A parameter downstream exceeds the corresponding parameter upstream for any single monitoring event by more than 20%,
- A parameter exceeds the SSTV for two consecutive monthly monitoring events,
- A parameter exceeds the SSTV for half of the sampling events in a twelve-month period.

In the event that any of the above triggers are observed, a review will be initiated immediately to determine the significance of the exceedance(s) and possible causes. The review will assess the baseline data for the relevant waterway, recent rainfall records, other activities within the catchment and recent activities or recorded erosion/sediment control incidents occurring in the catchment.

If the exceedance is determined to be attributable to Project works, the event will be treated as an environmental incident and managed in accordance with the requirements of Section 3.10 of the CEMP. Corrective and preventative actions will be identified and implemented as part of that process.

4. Monitoring methodology / Sampling protocol

4.1. Sampling collection

Grab samples will be collected manually from the sampling locations identified in Table 4, Figure 1 and Figure 2. The volume of sample collected will be sufficient for the required physio-chemical (field) parameter analysis using a multi-probe water quality meter(s).

4.2. Field measures

Field physico-chemical parameters including EC, pH, DO, TDS, ORP, temperature, and turbidity will be measured at each sampling location using a fully calibrated multi-probe water quality meter(s) or provided for laboratory analysis. Other observations including odour and colour may also be recorded.

The multi-probe field water quality meter(s) will be calibrated against known standards, as supplied by the manufacturer, at the start and completion of each day of water quality sampling.

4.3. Recording of field results

Results for each monitoring location will be recorded on appropriate field sheets (hard copy or digital) using unique sampling identification nomenclature consisting of the sample date, location, and sampler details.

4.4. Decontamination

Sampling equipment will be cleaned (decontaminated) between each sample. Where a sample site shows evidence of contamination (i.e. there is an algal bloom, or the site smells strongly of hydrocarbons, sewage or something else) equipment will need to be cleaned thoroughly. In addition, equipment will need to be cleaned periodically to prevent a build-up of dirt.

The following method will be followed:

- Rinse the equipment in tap water,
- Clean with De-Con 90 (a phosphate free detergent), or equivalent,
- Rinse again with tap water,
- Rinse three times with de-ionised water; and
- Allow to dry.

De-ionised and tap water will be available for washing equipment in the field, if required.

4.5. Quality Assurance and documentation

Any sample to be sent to a laboratory will be subject to quality assurance protocols.

Quality assurance and control protocols during sampling and recording of physio-chemical (field) parameters will be undertaken monthly (each sampling event) in accordance with ANZECC/ARMCANZ (2000b) to ensure the integrity of the dataset.

As part of sampling the following will be undertaken:

- Rinsate blanks (one per sampling event only),
- Blind duplicates (at a rate not less than 20% of total samples), and
- Split duplicates (at a rate not less than 20% of total samples).

Samples are to be transported to a NATA-accredited laboratory under documented chain-of custody protocols.

Field results will be checked for accuracy before leaving the site and errors or discrepancies will be cross-checked, and further investigation initiated if required.

Monitoring and calibration records will be maintained in accordance with the appropriate standard.

5. Compliance management

5.1. Roles, responsibility, and training

The JHCPB Project Team's organisational structure and overall roles and responsibilities are outlined in Section 3.3 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in the SWMP.

All employees, contractors and utility staff working on site will undergo site induction and targeted training relating to surface water management issues, detailed in the SWMP.

Further details regarding staff induction and training are outlined in Section 3.5 of the CEMP.

5.2. Monitoring and inspection

This Program details the monitoring requirements for surface water. Additional soil and surface water inspection requirements (including weekly site inspections) are detailed in the SSWMP Section 7.3.

In accordance with Section 3.3.1 of the CEMP, JHCPB Environmental and Sustainability Manager will be responsible for ensuring monitoring activities are undertaken.

Additional requirements and responsibilities in relation to inspections are documented in Section 3.9.2 of the CEMP.

5.3. Data analysis and management response

Results from the construction monitoring program will be compared with the SSTVs and with previous results.

Monthly monitoring results for surface water quality will be compared against SSTVs (Table 6), and reported in the construction compliance monitoring reports (Section 5.5). If a trigger is observed (see Section 3.2.6), a review will be initiated to determine the significance of the exceedance(s) and possible causes. The review will assess available surface water data, baseline data for the relevant waterway, recent rainfall records, and recent activities or recorded erosion/sediment control incidents occurring in the catchment. If the exceedance is determined to be attributable to Project works, the event will be treated as an environmental incident and managed in accordance with the requirements of the CEMP. Corrective and preventative actions will be identified and implemented as part of that process.

5.4. Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this Program, CoA, and other relevant approvals, licenses and guidelines.

Audit requirements are detailed in Section 3.9.3 of the CEMP.

5.5. Reporting

During construction, surface water quality data will be collected, tabulated and assessed against baseline conditions and performance criteria. Monitoring reports will be submitted to DPIE, EPA, DoI Water and Sydney Water within 30 days of the reporting period unless otherwise agreed with DPIE.

Reporting requirements associated with the Program for the construction phase of the Project are presented in Table 7.

Table 7 Reporting requirements

Schedule (during construction)	Requirements	Recipient (relevant authority)
Water Monitoring Reports (every six months)	Data summary reports presenting tabulated surface water monitoring data collected during the reporting period. Surface water quality results will be presented and performance criteria exceedances will be highlighted. Applicable management responses will be documented.	EPA, DPE, DoI Water, Sydney Water
EPL Monitoring Reports and Annual Returns	EPL monitoring reports will be prepared in accordance with the requirements of the EPL. An EPL Annual Return will be prepared in respect of each EPL reporting period (typically 12 months).	EPA
Construction Compliance Reports (every six months)	A results summary an analysis of environmental monitoring.	DPE, RMS, ER
Monthly Environmental Report (every month)	Monitoring program performance will be documented in the Monthly Environmental Report. Any incidents and key environmental issues will be documented.	RMS

6. Review and improvement

6.1. Continuous improvement

Monitoring data will be reviewed throughout the construction period to provide potential requirements to increase, or decrease, the number of sampling locations and/or the analytical suites. SSTV will be reviewed for appropriateness following 12 months of construction monitoring. Alterations to SSTV, monitoring locations, analytical suites, or frequencies will be reported in the Water Monitoring Reports (Section 5.5).

Continuous improvement of this Program will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets (detailed in Section 2.2), and the Project performance outcomes of the EIS for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance,
- Determine the cause or causes of non-conformances and deficiencies,
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies,
- Verify the effectiveness of the corrective and preventative actions,
- Document any changes in procedures resulting from process improvement, and
- Make comparisons with objectives and targets.

6.2. SWQMP update and amendment

The processes described in Section 3.13.1 and Section 3.13.2 of the CEMP may result in the need to update or revise this Program.

Revisions of this Program will be in accordance with the process outlined in Section 3.13.1 of the CEMP.

A copy of the updated Program and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 3.11.2 of the CEMP.

7. References

Acid Sulfate Soil Management Advisory Committee (ASSMAC),1998. Acid Sulfate Soil Manual

AECOM, 2017. WestConnex M4-M5 EIS Technical Working Paper: Surface Water and Flooding, August 2017.

ANZECC/ARMCANZ, 2000a. Australian and New Zealand Guidelines for Fresh and Marine Water Quality

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EPA, 2004. Approved Methods for the Sampling and Analysis of Water Pollutants in NSW.

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NSW Department of Conservation and Land Management, 1989. Soil Landscapes of the Sydney 1:100,000 Sheet 9130

NSW Department of Infrastructure, Planning and Natural Resources, 2002. Salinity Potential in Western Sydney Map

RTA, 1999. Guideline for Construction Water Quality Monitoring. NSW Road and Traffic Authority

Annexure A Baseline surface water monitoring results

Baseline Surface Water Monitoring SW01						
Parameter	Units	Count	mean	min	max	80th percentile
Physiochemical Parameters						
Turbidity	NTU	33	5.89	0	52	8.66
pH	-	37	7.49	5.65	8.04	7.904
EC	µS/cm	37	40433.89	403	541180	49812.4
Temp	0C	37	20.74	15.7	28	24.68
DO	Mg/L	37	23.63	-0.16	558	6.656
Redox	mV	37	393.84	209.7	3980	387.04
Chemical analytes						
Ammonia as N	µg/L	3	245	70	240	-
Kjeldahl Nitrogen Total	mg/L	31	3.8	0.2	41.4	1.44
Nitrite (as N)	mg/L	31	0.03	0.01	0.04	0.04
Nitrogen (Total Oxidised)	mg/L	29	0.27	0.01	1.82	0.46
Nitrogen (Total)	mg/L	31	4315	300	41500	2240
Reactive Phosphorus as P	mg/L	31	0.027	0.01	0.08	0.04
Phosphorus (Total)	mg/L	31	0.30	0.02	3.76	0.17
Arsenic	mg/L	34	0.04	0.0013	0.42	0.0892
Cadmium	mg/L	34	0.0018	0.0001	0.006	0.00284
Chromium	mg/L	34	0.00167	0.0004	0.0064	0.00202
Chromium (III+VI)	mg/L	-	-	-	-	-
Copper	mg/L	28	0.010627	0.002	0.0586	0.0134
Ferrous Iron	mg/L	31	0.35	0.05	2.94	0.388
Iron	mg/L	33	0.3965	0.005	4.01	0.353
Lead	mg/L	34	0.0369054	0.0009	6.64	0.11208
Manganese	mg/L	33	0.021821429	0.0012	0.121	0.02484
Mercury	mg/L	34	0.021309	0.00006	0.0422	0.03674
Nickel	mg/L	34	0.44395	0.000008	1	0.00176
Zinc	mg/L	34	0.089169	0.0008	0.053	0.094

Baseline Surface Water Monitoring SW01						
Benzene	µg/L	34	0.5	0.5	0.5	0.5
Ethylbenzene	µg/L	34	1	1	1	1
Toluene	µg/L	34	1	1	1	1
Xylene (m & p)	µg/L	34	1	1	1	1
Xylene (o)	µg/L	34	1	1	1	1
Xylene Total	µg/L	34	1	1	1	1
Naphthalene	µg/L	34	2.5	2.5	2.5	2.5
C6-C10	mg/L	34	0.01	0.01	0.01	0.01
C6-C10 less BTEX (F1)	mg/L	34	0.01	0.01	0.01	0.01
F2-NAPHTHALENE	mg/L	34	0.05	0.05	0.05	0.05
C10-C16	mg/L	34	0.05	0.05	0.05	0.05
C16-C34	mg/L	34	0.05	0.05	0.05	0.05
C34-C40	mg/L	34	0.05	0.05	0.05	0.05
C10-C40 (Sum of total)	mg/L	34	0.05	0.05	0.05	0.05
C6-C9	mg/L	34	0.01	0.01	0.01	0.01
C10-C14	mg/L	34	0.025	0.025	0.025	0.025
C15-C28	mg/L	34	0.05	0.05	0.05	0.05
C29-C36	mg/L	34	0.025	0.025	0.025	0.025
+C10-C36 (Sum of Total)	mg/L	34	0.025	0.025	0.025	0.025

Baseline Surface Water Monitoring SW02						
Parameter	Units	Count	mean	min	max	80th percentile
Physiochemical Parameters						
Turbidity	NTU	33	20.8	0	430.7	12.98
pH	-	37	7.92	5.38	9.49	8.592
EC	µS/cm	37	8955.027	268	51935	23348
Temp	0C	37	20.11	13	32.5	23.27
DO	Mg/L	37	13.06	2.67	74.5	13.948
Redox	mV	36	335.61	211	584	373.24
Chemical analytes						
Ammonia as N	µg/L	3	190	30	480	-
Kjeldahl Nitrogen Total	mg/L	32	0.13	0.2	1.3	0.8
Nitrite (as N)	mg/L	32	0.8109375	<0.01	0.18	0.13
Nitrogen (Total Oxidised)	mg/L	32	0.88	0.02	2.76	1.11
Nitrogen (Total)	mg/L	32	1543	300	3600	2000
Reactive Phosphorus as P	mg/L	32	0.04	0.01	0.012	0.056
Phosphorus (Total)	mg/L	32	0.09	0.02	0.48	0.134
Arsenic	mg/L	36	0.001172414	0.0005	0.003	0.0016
Cadmium	mg/L	36	0.000162	0.0001	0.00033	0.0002
Chromium	mg/L	36	0.002133	0.0004	0.0056	0.00364
Chromium (III+VI)	mg/L	-	-	-	-	-
Copper	mg/L	36	0.011	0.003	0.119	0.0098
Ferrous Iron	mg/L	32	0.13	0.05	0.62	0.178
Iron	mg/L	35	0.42	0.134	1.15	0.058
Lead	mg/L	36	0.0071	0.0008	0.055	0.0116
Manganese	mg/L	35	0.019	0.006	0.06	0.027
Mercury	mg/L	36	2.93333E-05	0.0000019	0.000049	0.000049
Nickel	mg/L	36	0.00144	0.0006	0.003	0.00196
Zinc	mg/L	36	0.08275	0.017	0.361	0.1362
Benzene	µg/L	36	0.5	0.5	0.5	0.5
Ethylbenzene	µg/L	36	1	1	1	1
Toluene	µg/L	36	1	1	1	1

Baseline Surface Water Monitoring SW02						
Xylene (m & p)	µg/L	36	1	1	1	1
Xylene (o)	µg/L	36	1	1	1	1
Xylene Total	µg/L	36	1	1	1	1
Naphthalene	µg/L	36	2.5	2.5	2.5	2.5
C6-C10	mg/L	36	0.01	0.01	0.01	0.01
C6-C10 less BTEX (F1)	mg/L	36	0.01	0.01	0.01	0.01
F2-NAPHTHALENE	mg/L	36	0.05	0.05	0.05	0.05
C10-C16	mg/L	36	0.05	0.05	0.05	0.05
C16-C34	mg/L	36	0.05	0.05	0.05	0.05
C34-C40	mg/L	36	0.05	0.05	0.05	0.05
C10-C40 (Sum of total)	mg/L	36	0.05	0.05	0.05	0.05
C6-C9	mg/L	36	0.01	0.01	0.01	0.01
C10-C14	mg/L	36	0.025	0.025	0.025	0.025
C15-C28	mg/L	36	0.05	0.05	0.05	0.05
C29-C36	mg/L	36	0.025	0.025	0.025	0.025
+C10-C36 (Sum of Total)	mg/L	36	0.025	0.025	0.025	0.025

Baseline Surface Water Monitoring SW07						
Parameter	Units	Count	mean	min	max	80th percentile
Physiochemical Parameters						
Turbidity	NTU	33	24.19	0	390.7	12.14
pH	-	37	7.89	5.87	10.06	8.584
EC	µS/cm	37	8124.39	200	50618	18190
Temp	0C	37	19.23	13.9	25.3	22.54
DO	Mg/L	37	8.32	1.94	12.58	10.314
Redox	mV	37	333.34	126	625	378.36
Chemical analytes						
Ammonia as N	µg/L	7	372.86	50	1640	890
Kjeldahl Nitrogen Total	mg/L	36	1.34	<0.1	5.9	1.88
Nitrite (as N)	mg/L	36	<0.041	<0.01	0.13	0.06
Nitrogen (Total Oxidised)	mg/L	30	1.809333333	0.02	4.17	2.54
Nitrogen (Total)	mg/L	36	3080	800	6300	4160
Reactive Phosphorus as P	mg/L	36	0.07	0.01	0.23	0.11
Phosphorus (Total)	mg/L	36	0.21	<0.1	1.28	0.294
Arsenic	mg/L	37	0.0026	0.0006	0.006	0.004
Cadmium	mg/L	37	0.000162	0.0001	0.00033	0.0002
Chromium	mg/L	37	0.002133	0.0004	0.0056	0.00364
Chromium (III+VI)	mg/L	-	-	-	-	-
Copper	mg/L	37	0.016008	<0.01	0.054	0.0186
Ferrous Iron	mg/L	36	0.238	<0.05	1.28	0.326
Iron	mg/L	35	0.91	0.11	4.16	1.8
Lead	mg/L	37	0.027	0.001	0.164	0.0446
Manganese	mg/L	36	0.024	0.0041	0.072	0.038
Mercury	mg/L	37	0.00000725	0.000005	0.00001	0.00001
Nickel	mg/L	37	0.005380556	0.0009	0.014	0.00792
Zinc	mg/L	37	0.17	0.038	0.4	0.25
Benzene	µg/L	37	0.5	0.5	0.5	0.5
Ethylbenzene	µg/L	37	1	1	1	1
Toluene	µg/L	37	1	1	1	1

Baseline Surface Water Monitoring SW07						
Xylene (m & p)	µg/L	37	1	1	1	1
Xylene (o)	µg/L	37	1	1	1	1
Xylene Total	µg/L	37	1	1	1	1
Naphthalene	µg/L	37	2.5	2.5	2.5	2.5
C6-C10	mg/L	37	0.01	0.01	0.01	0.01
C6-C10 less BTEX (F1)	mg/L	37	0.01	0.01	0.01	0.01
F2-NAPHTHALENE	mg/L	37	0.05	0.05	0.05	0.05
C10-C16	mg/L	37	0.05	0.05	0.05	0.05
C16-C34	mg/L	37	0.05	0.05	0.05	0.05
C34-C40	mg/L	37	0.05	0.05	0.05	0.05
C10-C40 (Sum of total)	mg/L	37	0.05	0.05	0.05	0.05
C6-C9	mg/L	37	0.01	0.01	0.01	0.01
C10-C14	mg/L	37	0.025	0.025	0.025	0.025
C15-C28	mg/L	37	0.05	0.05	0.05	0.05
C29-C36	mg/L	37	0.025	0.025	0.025	0.025
+C10-C36 (Sum of Total)	mg/L	37	0.025	0.025	0.025	0.025

Baseline Surface Water Monitoring SW11						
Parameter	Units	Count	mean	min	max	80th percentile
Physiochemical Parameters						
Turbidity	NTU	27	39.37778	0	647	28.44
pH	-	31	7.865161	6.56	8.29	8.066
EC	µS/cm	31	45142.81	3565	54337	51914
Temp	0C	31	20.62258	13.6	27.2	24.04
DO	Mg/L	31	6.577742	-0.76	9.71	7.692
Redox	mV	31	313.029	62.5	456.1	376.8
Chemical analytes						
Ammonia as N	µg/L	7	60	40	110	86
Kjeldahl Nitrogen Total	mg/L	31	0.05	0.05	0.05	0.05
Nitrite (as N)	mg/L	31	0.01	0.01	0.02	0.01
Nitrogen (Total Oxidised)	mg/L	25	0.11	0.01	0.48	0.17
Nitrogen (Total)	mg/L	31	1500	700	3900	3360
Reactive Phosphorus as P	mg/L	31	0.023	0.01	0.08	0.03
Phosphorus (Total)	mg/L	31	0.311	0.06	1.3	0.682
Arsenic	mg/L	32	0.00258	0.0014	0.006	0.00344
Cadmium	mg/L	32	0.0002	0.001	0.00021	0.0002
Chromium	mg/L	32	0.002772	0.0006	0.0117	0.00512
Chromium (III+VI)	mg/L	-	-	-	-	-
Copper	mg/L	32	0.006815	0.002	0.029	0.0104
Ferrous Iron	mg/L	32	0.15	0.06	0.046	0.198
Iron	mg/L	31	0.7815	0.015	3.97	1.398
Lead	mg/L	32	0.01033	0.0002	0.0622	0.01692
Manganese	mg/L	31	0.021	0.0054	0.0829	0.0344
Mercury	mg/L	32	0.000103	0.000007	0.00035	0.00016
Nickel	mg/L	32	0.001088889	0.0006	0.0028	0.00148
Zinc	mg/L	32	0.025692	0.007	0.106	0.0376
Benzene	µg/L	32	0.5	0.5	0.5	0.5
Ethylbenzene	µg/L	32	1	1	1	1
Toluene	µg/L	32	1	1	1	1

Baseline Surface Water Monitoring SW11						
Xylene (m & p)	µg/L	32	1	1	1	1
Xylene (o)	µg/L	32	1	1	1	1
Xylene Total	µg/L	32	1	1	1	1
Naphthalene	µg/L	32	2.5	2.5	2.5	2.5
C6-C10	mg/L	32	0.01	0.01	0.01	0.01
C6-C10 less BTEX (F1)	mg/L	32	0.01	0.01	0.01	0.01
F2-NAPHTHALENE	mg/L	32	0.05	0.05	0.05	0.05
C10-C16	mg/L	32	0.05	0.05	0.05	0.05
C16-C34	mg/L	32	0.05	0.05	0.05	0.05
C34-C40	mg/L	32	0.05	0.05	0.05	0.05
C10-C40 (Sum of total)	mg/L	32	0.05	0.05	0.05	0.05
C6-C9	mg/L	32	0.01	0.01	0.01	0.01
C10-C14	mg/L	32	0.025	0.025	0.025	0.025
C15-C28	mg/L	32	0.05	0.05	0.05	0.05
C29-C36	mg/L	32	0.025	0.025	0.025	0.025
+C10-C36 (Sum of Total)	mg/L	32	0.025	0.025	0.025	0.025

Baseline Surface Water Monitoring SW12						
Parameter	Units	Count	mean	min	max	80th percentile
Physiochemical Parameters						
Turbidity	NTU	28	4.017857	-0.2	15	7.44
pH	-	31	7.826452	7.32	8.26	8.024
EC	µS/cm	31	44428.03	465	54271	51947
Temp	0C	31	20.85806	14.4	26.5	24.44
DO	Mg/L	31	5.714194	-1.22	8.52	7.144
Redox	mV	31	268.5484	101.3	479.5	352.44
Chemical analytes						
Ammonia as N	µg/L	8	<5	<0.001	160	<5
Kjeldahl Nitrogen Total	mg/L	32	17.11	0.5	200	1
Nitrite (as N)	mg/L	32	0.21	0.01	0.87	0.01
Nitrogen (Total Oxidised)	mg/L	32	0.0264	0.01	1.1	
Nitrogen (Total)	mg/L	32	664	0.04	1900	1260
Reactive Phosphorus as P	mg/L	32	0.041	0.01	0.25	0.04
Phosphorus (Total)	mg/L	32	133.61	0.03	1200	1.09
Arsenic	mg/L	31	0.00222	0.0014	0.005	0.00238
Cadmium	mg/L	31	0.000331	0.0001	0.0006	0.00054
Chromium	mg/L	31	0.001771	0.0005	0.013	0.0012
Chromium (III+VI)	mg/L	-	-	-	-	
Copper	mg/L	31	0.005092	0.001	0.016	0.00628
Ferrous Iron	mg/L	31	25.12	0.05	160	66
Iron	mg/L	30	0.45	0.036	5.43	0.4126
Lead	mg/L	31	0.005723	0.0003	0.-63	0.00456
Manganese	mg/L	30	0.01947	0.0049	0.068	0.03012
Mercury	mg/L	31	0.0001356	0.000007	0.0006	0.00049
Nickel	mg/L	31	0.005377	0.0005	0.0502	0.0062
Zinc	mg/L	31	0.055815	0.01	0.306	0.0986
Benzene	µg/L	31	0.5	0.5	0.5	0.5
Ethylbenzene	µg/L	31	1	1	1	1
Toluene	µg/L	31	1	1	1	1

Baseline Surface Water Monitoring SW12						
Xylene (m & p)	µg/L	31	1	1	1	1
Xylene (o)	µg/L	31	1	1	1	1
Xylene Total	µg/L	31	1	1	1	1
Naphthalene	µg/L	31	2.5	2.5	2.5	2.5
C6-C10	mg/L	31	0.01	0.01	0.01	0.01
C6-C10 less BTEX (F1)	mg/L	31	0.01	0.01	0.01	0.01
F2-NAPHTHALENE	mg/L	31	0.05	0.05	0.05	0.05
C10-C16	mg/L	31	0.05	0.05	0.05	0.05
C16-C34	mg/L	31	0.05	0.05	0.05	0.05
C34-C40	mg/L	31	0.05	0.05	0.05	0.05
C10-C40 (Sum of total)	mg/L	31	0.05	0.05	0.05	0.05
C6-C9	mg/L	31	0.01	0.01	0.01	0.01
C10-C14	mg/L	31	0.025	0.025	0.025	0.025
C15-C28	mg/L	31	0.05	0.05	0.05	0.05
C29-C36	mg/L	31	0.025	0.025	0.025	0.025
+C10-C36 (Sum of Total)	mg/L	31	0.025	0.025	0.025	0.025

Baseline Surface Water Monitoring SW13						
Parameter	Units	Count	mean	min	max	80th percentile
Physiochemical Parameters						
Turbidity	NTU	23	63.53913	0	726.5	65.2
pH	-	27	7.733333	6.8	9.9	8.294
EC	µS/cm	27	530.0741	86	3879	575.2
Temp	0C	27	17.72222	9.3	23.4	20.96
DO	Mg/L	27	5.22	0.13	46.68	5.464
Redox	mV	28	254.2143	0	405	358.7
Chemical analytes						
Ammonia as N	µg/L	3	290	70	510	-
Kjeldahl Nitrogen Total	mg/L	27	3.988461538	0.3	37	4.48
Nitrite (as N)	mg/L	27	0.023	0.01	0.04	0.03
Nitrogen (Total Oxidised)	mg/L	22	0.267	0.01	1.07	0.462
Nitrogen (Total)	mg/L	27	4285	300	37,000	4700
Reactive Phosphorus as P	mg/L	27	0.083846154	0.01	0.46	0.116
Phosphorus (Total)	mg/L	27	1.1164	0.08	6.93	1.852
Arsenic	mg/L	27	0.013985	0.0015	0.103	0.017
Cadmium	mg/L	27	0.002784	0.00019	0.0123	0.00564
Chromium	mg/L	27	0.005687	0.0004	0.048	0.00564
Chromium (III+VI)	mg/L	-	-	-	-	-
Copper	mg/L	27	0.033737	0.0013	0.288	0.0408
Ferrous Iron	mg/L	27	3.01	0.09	22.1	3.4
Iron	mg/L	22	9.3607	0.219	50.6	16.46
Lead	mg/L	27	0.078067	0.0022	0.6	0.1314
Manganese	mg/L	23	1.042326	0.037	8.3	1.056
Mercury	mg/L	27	7.05556E-05	0.000005	0.0002	0.0001
Nickel	mg/L	27	0.005619	0.001	0.021	0.0096
Zinc	mg/L	27	1.263	0.083	5.62	2.628
Benzene	µg/L	27	0.5	0.5	0.5	0.5
Ethylbenzene	µg/L	27	1	1	1	1
Toluene	µg/L	27	1	1	1	1

Baseline Surface Water Monitoring SW13						
Xylene (m & p)	µg/L	27	1	1	1	1
Xylene (o)	µg/L	27	1	1	1	1
Xylene Total	µg/L	27	1	1	1	1
Naphthalene	µg/L	27	2.5	2.5	2.5	2.5
C6-C10	mg/L	27	0.01	0.01	0.01	0.01
C6-C10 less BTEX (F1)	mg/L	27	0.01	0.01	0.01	0.01
F2-NAPHTHALENE	mg/L	27	0.05	0.05	0.05	0.05
C10-C16	mg/L	27	0.05	0.05	0.05	0.05
C16-C34	mg/L	27	0.05	0.05	0.05	0.05
C34-C40	mg/L	27	0.05	0.05	0.05	0.05
C10-C40 (Sum of total)	mg/L	27	0.05	0.05	0.05	0.05
C6-C9	mg/L	27	0.01	0.01	0.01	0.01
C10-C14	mg/L	27	0.025	0.025	0.025	0.025
C15-C28	mg/L	27	0.05	0.05	0.05	0.05
C29-C36	mg/L	27	0.025	0.025	0.025	0.025
+C10-C36 (Sum of Total)	mg/L	27	0.025	0.025	0.025	0.025

ANZECC (2000a) water quality guidelines

Parameter	Units	South-east Australia default triggers			Freshwater		Marine	
		NSW Lowland Rivers	Estuarine	Recreation	99% Protection	95% Protection	99% Protection	95% Protection
Turbidity	NTU	6-50	0.5-10					
pH	-	6.5-8.5	7.0-8.5	6.5-8.5				
EC	µS/cm	125-2,200						
Temp	0C							
DO	Mg/L							
Redox	mV							
Chemical analytes								
Ammonia as N	µg/L	20	15	10	320	900	500	910
Kjeldahl Nitrogen Total	mg/L							
Nitrite (as N)	mg/L							
Nitrogen (Total Oxidised)	mg/L	0.04	0.015	10/1				
Nitrogen (Total)	mg/L	0.35	0.3					
Reactive Phosphorus as P	mg/L	0.02	0.005					
Phosphorus (Total)	mg/L	0.025	0.03					
Arsenic	mg/L			0.05	0.001/0.0008	0.024/0.013	ID	ID
Cadmium	mg/L			0.005	0.00006	0.0002	0.0007	0.0055
Chromium	mg/L			0.05	ID/o.oooo1	ID/0.001	0.008/0.00014	0.027/0.0044
Chromium (III+VI)	mg/L							
Copper	mg/L			1	0.0010	0.0014	0.0003	0.0013
Ferrous Iron	mg/L			0.3	ID	ID	ID	ID
Iron	mg/L			0.3	ID	ID	ID	ID
Lead	mg/L			0.05	0.001	0.0034	0.0022	0.0044
Manganese	mg/L			0.1	1.2	1.9	ID	ID
Mercury	mg/L			0.001	0.00006	0.0006	0.0001	0.0004

Parameter	Units	South-east Australia default triggers			Freshwater		Marine	
		NSW Lowland Rivers	Estuarine	Recreation	99% Protection	95% Protection	99% Protection	95% Protection
Nickel	mg/L			0.1	0.008	0.011	0.007	0.015
Zinc	mg/L			5	0.0024	0.008	0.007	0.015
Benzene	µg/L			10	600	950	500	700
Ethylbenzene	µg/L				ID	ID	ID	ID
Toluene	µg/L				ID	ID	ID	ID
Xylene (m & p)	µg/L				ID	ID	ID	ID
Xylene (o)	µg/L				200	350	ID	ID
Xylene Total	µg/L							
Naphthalene	µg/L				2.5	16	50	70
C6-C10	mg/L							
C6-C10 less BTEX (F1)	mg/L							
F2-NAPHTHALENE	mg/L							
C10-C16	mg/L							
C16-C34	mg/L							
C34-C40	mg/L							
C10-C40 (Sum of total)	mg/L							
C6-C9	mg/L							
C10-C14	mg/L							
C15-C28	mg/L							
C29-C36	mg/L							
+C10-C36 (Sum of Total)	mg/L							