EASTERN TUNNELLING PACKAGE
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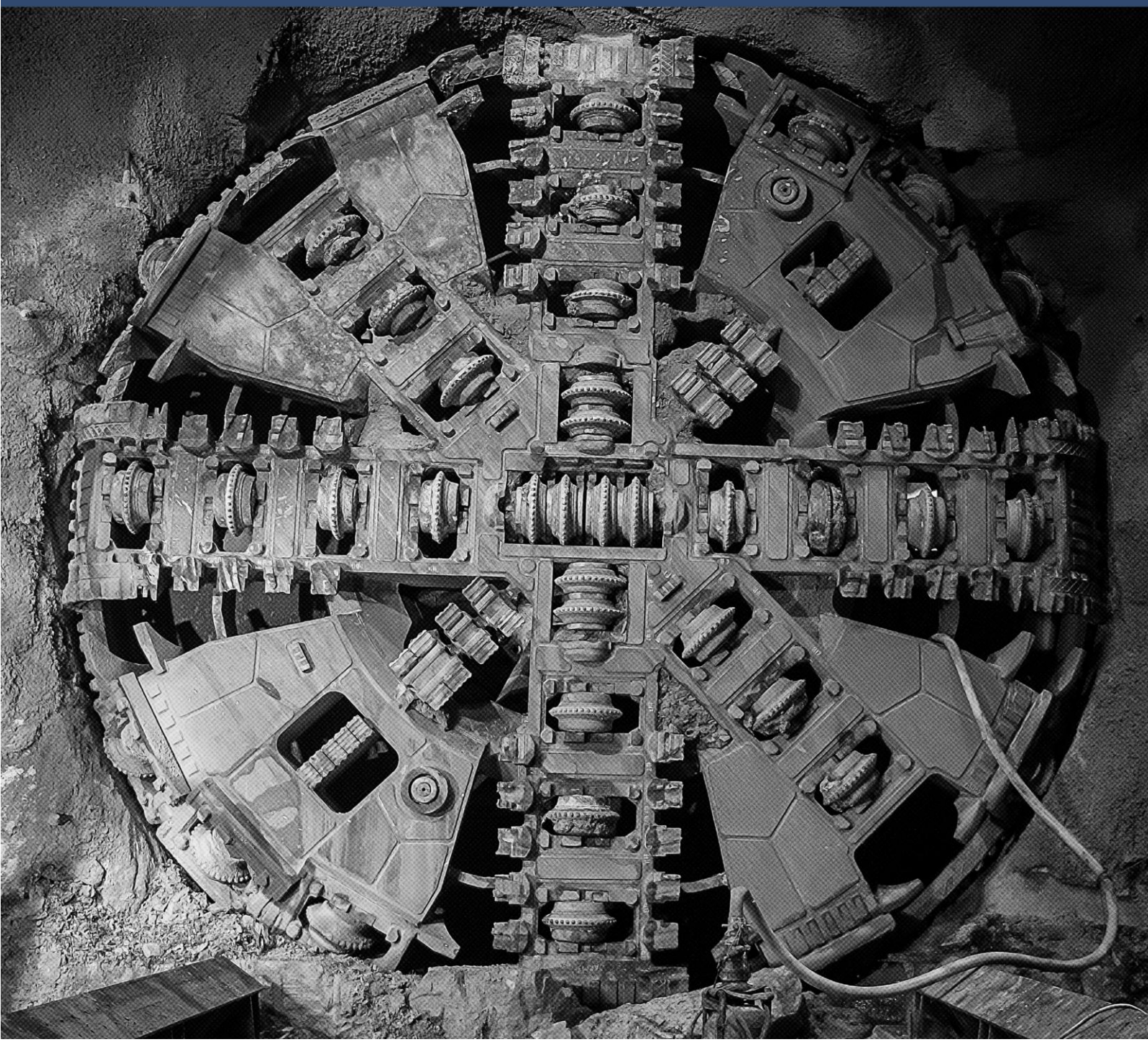
JOHN HOLLAND CPB CONTRACTORS Ghella

# GROUNDWATER MONITORING PROGRAM



# GROUNDWATER MONITORING PROGRAM

| | |
|---|---|
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| Document number | SMWSTETP-JCG-SWD-SW000-EN-PLN-002026 |

## Document approval

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|---|---|---|---|---|---|
| A | 5/12/2022 | B Rouvray (PSM)<br>T Wright (Douglas Partners) | S Anstee<br>D Corish<br>D Harris (EPIC) | Draft for consultation | S Reynolds |
| B | 15/02/2023 | T Wright (CEnvP(SC)) | S Anstee<br>D Corish<br>D Harris (EPIC) | Revised in response to Sydney Metro, ER and stakeholder comments. Submitted for Sydney Metro for review and ER endorsement. | S Reynolds |
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| 03 | 17/10/2023 | S. Anstee | S. Reynolds | Updates following PSM review | S. Reynolds |
| 04 | 25/09/24 | M. Whittaker<br>I. Mejia | S. Anstee | Updated derived trigger values, management responses to exceedances and testing parameters | S. Reynolds |
| 05 | 01/08/25 | M. Whittaker | S. Anstee | Removed inaccessible/destroyed wells | S. Reynolds |
| 06 | 09/09/2025 | M. Whittaker | S. Anstee | Removed BH04A, BH08 and BH05 | S. Reynolds |
| Signature: | | | | | |

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## Compliance

*Table 1: Compliance matrix*

| ID | Requirement | Reference |
|---|---|---|
| **SSI 19238057 Infrastructure Approval** | | |
| A6 | Where the conditions of this approval require a document or monitoring program to be prepared, or a review to be undertaken, in consultation with identified parties, evidence of the consultation undertaken must be submitted to the Planning Secretary with the document. The evidence must include:<br>(a) documentation of the engagement with the party identified in the condition of approval that has occurred before submitting the document for approval;<br>(b) a log of the dates of engagement or attempted engagement with the identified party and a summary of the issues raised by them;<br>(c) documentation of the follow-up with the identified party(s) where feedback has not been provided to confirm that the party(s) has none or has failed to provide feedback after repeated requests;<br>(d) outline of the issues raised by the identified party(s) and how they have been addressed; and<br>(e) a description of the outstanding issues raised by the identified party(s) and the reasons why they have not been addressed.<br>**Note:** *Consultation with the community and businesses will be undertaken in accordance with the Overarching Community Communication Strategy required under Condition B1. | Section 1.4 |
| C13 (c) | In addition to the relevant requirements of the CEMF, the Soil and Water CEMP Sub-plan must include, but not be limited to:<br>(c) a description of how the effectiveness of the actions and measures for managing contamination impacts would be monitored during the proposed works, clearly indicating how often this monitoring would be undertaken, the locations where monitoring would take place, and how the results of the monitoring would be recorded and reported. | Section 7.1<br>Section 5<br>Section 6<br>Section 7<br>Section 8<br>Section 9<br>Section 11.4 |
| C14 | The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each to compare actual performance of construction of the CSSI against the performance predicted in the documents listed in Condition A1 or in the CEMP:<br>• Noise and vibration: EPA, Place Management NSW (in respect of The Bays) and Relevant Council(s)<br>(a) Surface water quality: DPE Water, Relevant Council(s) and Sydney Water (if any Sydney Water assets are impacted)<br>• Groundwater: DPE Water | Section 1.4<br>Consultation Report (Appendix D of the Soil and Water Management Sub-plan) |
| C15 | Each Construction Monitoring Program must provide:<br>(a) details of baseline data available including the period of baseline monitoring; | Section 4.2 |
| | (a) details of baseline data to be obtained and when; | Section 4.2 |
| | (b) details of all monitoring of the project to be undertaken; | Section 6<br>Section 7<br>Section 8<br>Section 9 |
| | (c) the parameters of the project to be monitored; | Section 6.5<br>Section 7.1 |
| | (d) the frequency of monitoring to be undertaken; | Section 7.1 |

| ID | Requirement | Reference |
|---|---|---|
| | (e) the location of monitoring; | Section 5 |
| | (f) the reporting of monitoring results and analysis results against relevant criteria; | Section 11.4 (reporting)<br>Performance criteria are detailed in Sections 6.5, 7.5, 8.1.4, 8.2.4 and 9.3. |
| | (g) details of the methods that will be used to analyse the monitoring data; | Section 6.4<br>Section 7.4<br>Section 8.1.3<br>Section 8.2.3<br>Section 9.2 |
| | (h) procedures to identify and implement additional mitigation measures where the results of the monitoring indicated unacceptable project impacts; | Section 6.5<br>Section 7.5<br>Section 8.1.4<br>Section 8.2.4<br>Section 9.3 |
| | (i) a consideration of SMART principles; and | Section 1.2<br>Section 6.1 of the SWMP |
| | (j) any consultation to be undertaken in relation to the monitoring programs; and | Section 1.4 |
| | (k) any specific requirements as required by Conditions C16 and C17. | Condition C16 is not applicable to the GWMP. Condition C17 is addressed in this table. |
| C17 | Groundwater Construction Monitoring Program must include:<br>(a) groundwater monitoring networks at each construction excavation site; | Section 5 |
| | (b) detail of the location of all monitoring bores with nested sites to monitor both shallow and deep groundwater levels and quality; | Section 5 |
| | (c) define the location of saltwater interception monitoring where sentinel groundwater monitoring bores will be installed between the saline sources of the estuary or river and that of the stations or shafts; | Section 5 |
| | (d) results from existing monitoring bores; | Section 4.2.2<br>Appendix A |
| | (e) monitoring and gauging of groundwater inflow to the excavations, appropriate trigger action response plan for all predicted groundwater impacts upon each noted neighbouring groundwater system component for each excavation construction site; | Section 8.1<br>Section 8.2 |
| | (f) trigger levels for groundwater quality, salinity and groundwater drawdown in monitoring bores and / or other groundwater users; | Section 6.5<br>Section 7.5<br>Section 8.1.4<br>Section 8.2.4<br>Section 9.3 |
| | (g) daily measurement of the amount of water discharged from the water treatment plants; | SWQMP |

| ID | Requirement | Reference |
|---|---|---|
| | (h) water quality testing of the water discharged from treatment plants; | SWQMP |
| | (i) management and mitigation measures and criteria; | Section 10<br>Section 7 of the Soil and Water Management Sub-plan (SWMP)<br>Table 11 |
| | (j) groundwater inflow to the excavations to enable a full accounting of the groundwater take from the Sydney Basin Central Groundwater Source; and | Section 8 |
| | (k) reporting of groundwater gauging at excavations, groundwater monitoring, groundwater trigger events and action responses; and | Section 11.4 |
| | (l) methods for providing the data collected to Sydney Water where discharges are directed to their assets. | Section 11.4 |
| C18 | With the exception of any Construction Monitoring Programs expressly nominated by the Planning Secretary to be endorsed by the ER, all Construction Monitoring Programs must be submitted to the Planning Secretary for approval. | Section 1.4 |
| C19 | The Construction Monitoring Programs not requiring the Planning Secretary's approval must obtain the endorsement of the ER as being in accordance with the conditions of approval and all undertakings made in the documents listed in Condition A1. Any of these Construction Monitoring Programs must be submitted to the ER for endorsement at least one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase. | Section 1.4 |
| C20 | Any of the Construction Monitoring Programs which require Planning Secretary approval must be endorsed by the ER and then submitted to the Planning Secretary for approval at least one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase. | Section 1.4 |
| C21 | Unless otherwise agreed with the Planning Secretary, construction must not commence until the Planning Secretary has approved, or the ER has endorsed (whichever is applicable), all of the required Construction Monitoring Programs and all relevant baseline data for the specific construction activity has been collected. | Section 1.4 |
| C22 | The Construction Monitoring Programs, as approved by the Planning Secretary or the ER has endorsed (whichever is applicable), including any minor amendments approved by the ER, must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Planning Secretary or the ER (whichever is applicable), whichever is the greater. | Section 1.4 |
| C23 | The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, ER, AA (where relevant) and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.<br>Notes:<br>1. Where a relevant CEMP Sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP Sub-plan.<br>2. Data must be provided in an acceptable format for relevant regulatory agencies.<br>3. With regards to monitoring data to be provided to DPE Water, the format of the dataset must be both in a tabulated and electronic quality-controlled data (.csv, Excel) ready to use format. | Section 11.4 |

| ID | Requirement | Reference |
|---|---|---|
| **Revised Environmental Mitigation Measures (REMM)** | | |
| GW3 | Monitoring of groundwater levels and quality at the site area would occur before and during construction. This would also include monitoring of potential contaminants of concern. Groundwater level data would be regularly reviewed during and after construction by a qualified hydrogeologist. Groundwater monitoring data would be provided to the NSW EPA and Department of Planning and Environment and the Natural Resources Access Regulator for information. | Section 5<br>Section 6<br>Section 7<br>Section 11.4 |
| C6 | Where off-site sources of groundwater contamination have been identified, development and implementation of controls to manage the potential impacts of contamination due to drawdown and resulting migration of contaminated groundwater into the construction footprint would be implemented.<br>A review of available groundwater data would be completed to inform the relevant subplan in the Construction Environmental Management Framework (the Groundwater Management Plan). Where insufficient data is available to understand groundwater conditions and the potential for contamination to migrate as a result of the proposal, further investigation would be carried out if considered necessary and if not already undertaken under mitigation measure C2. | Section 7.1<br>Section 7.3 of the SWMP |
| **Construction Environmental Management Framework (CEMF)** | | |
| 7.2 (b) viii | Details of groundwater monitoring if required. | This GWMP |

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## Definitions

*Table 2: Definitions*

| Acronym | Definition |
|---|---|
| ANZG Guidelines | Australian and New Zealand Guidelines for Fresh and Marine Water Quality |
| AIP | NSW Aquifer Interference Policy |
| ASS | Acid Sulfate Soils |
| CEMP | Construction Environmental Management Plan |
| CLM Act | Contaminated Land Management Act 1997 (NSW) |
| CoPC | contaminants of potential concern |
| CoC | Chain of custody |
| DO | Dissolved Oxygen |
| DPE | Department of Planning and Environment |
| EC | Electrical Conductivity |
| ECM | Environmental Control Map |
| Eh | redox potential |
| EIS | Environmental Impact Statement |
| Environmental aspect | Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment. |
| Environmental impact | Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects. |
| Environmental objective | Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve. |
| Environmental target | Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives. |
| EP&A Act | Environmental Planning and Assessment Act 1979 |
| EPA | NSW Environment Protection Authority |
| EPL | Environment Protection Licence |
| ETP Works | Eastern Tunnelling Package Works |
| ER | Environmental Representative |
| E&SMS | Environment and Sustainability Management System |
| GWMP | Groundwater Monitoring Program |
| HIR | Hydrogeological Interpretive Report |
| IC | Independent Certifier |
| JCG | John Holland CPB Ghella Joint Venture |
| LOR | limit of reporting |
| LSI | Langelier Saturation Index |
| mAHD | metres Australian Height Datum |
| mBGL | Metres below ground level |
| mbTOC | metres below top of casing |

| Acronym | Definition |
|---|---|
| NAPL | non-aqueous phase liquid |
| NEPM | National Environment Protection Measure |
| PFAS | Perfluorinated alkyl substances |
| POEO Act | Protection of the Environment Operations Act 1997 |
| PPE | Personal Protective Equipment |
| PQL | practical quantification limits |
| Project, the | Eastern Tunnelling Package |
| REMM | Revised Environmental Mitigation Measure |
| RPD | relative percentage difference |
| SOP | Standard Operating Procedure |
| SSI | State Significant Infrastructure |
| SSTV | Site Specific Trigger Values |
| STP | Slurry Treatment Plant |
| SWMP | Soil and Water Management Sub-plan |
| TBM | Tunnel Boring Machine |
| VOC | Volatile Organic Compound |
| VWP | Vibrating Wire Piezometer |
| Waste Regulation, the | Protection of the Environment Operations (Waste) Regulation 2014 |
| WM Act | Water Management Act 2000 |
| WTP | Water Treatment Plant |

# Part A: Overview

## 1. Introduction

### 1.1. Purpose

This Groundwater Monitoring Program (GWMP) is applicable to the Sydney Metro West - Eastern Tunnelling Package (ETP Works or the Project). This GWMP describes how John Holland CPB Ghella Joint Venture (JCG) will monitor groundwater during the Tunnelling, Excavation and Associated Works phase of the Project.

This GWMP has been prepared to address the requirements of the:

- State Significant Infrastructure (SSI) 19238057 Infrastructure Approval (dated 24 August 2022) and relevant conditions of the Sydney Metro West Concept Schedule 2 of SSI 10038 Infrastructure Approval (dated 11 March 2021) (Infrastructure Approvals)
- Environment Protection Licence 21784 (EPL)
- Sydney Metro West – Stage 2 – Phasing Report (Phasing Report)
- AS/NZS ISO 14001:2016 Environmental Management Systems – Requirements with guidance for use
- Sydney Metro Construction Environmental Management Framework (CEMF), Version 4.3
- Environmental Impact Statement (EIS) and the Submissions Report, including the Revised Environmental Mitigation Measures (REMMs)
- Contractual requirements including the ETP Deed and General and Particular Specifications
- Applicable legislation.

### 1.2. Objectives, targets and key performance indicators

The objectives, targets and key performance indicators for the GWMP are detailed in Table 3. Targets will be reviewed regularly throughout the ETP Works and will consider the SMART principles: Specific, Measurable, Achievable, Relevant and Time-Bound.

*Table 3: Objectives, targets and key performance indicators*

| Objectives | Targets | Key Performance Indicators |
|---|---|---|
| Establish and implement adequate and appropriate processes to achieve compliance with the groundwater monitoring requirements of the Infrastructure Approval, REMMs, performance outcomes, EPL, and CEMF | ▪ No breaches or regulatory infringements (PINs or prosecutions)<br>▪ No incidents or non-compliances associated with groundwater | ▪ Number of breaches or regulatory infringements<br>▪ Number of groundwater incidents or non-compliances |

### 1.3. Context and interface with other plans

To achieve the intended environmental performance outcomes of the Project, JCG have established an Environment and Sustainability Management System (E&SMS) in accordance with the requirements of ISO 14001:2016. Guided by the Environment and Sustainability Policy, the E&SMS consists of a Construction Environmental Management Plan (CEMP), issue-specific procedures, Sub-plans and monitoring programs as illustrated in Figure 1. Implementation of the E&SMS is achieved through tools, checklists and forms as detailed in the CEMP.

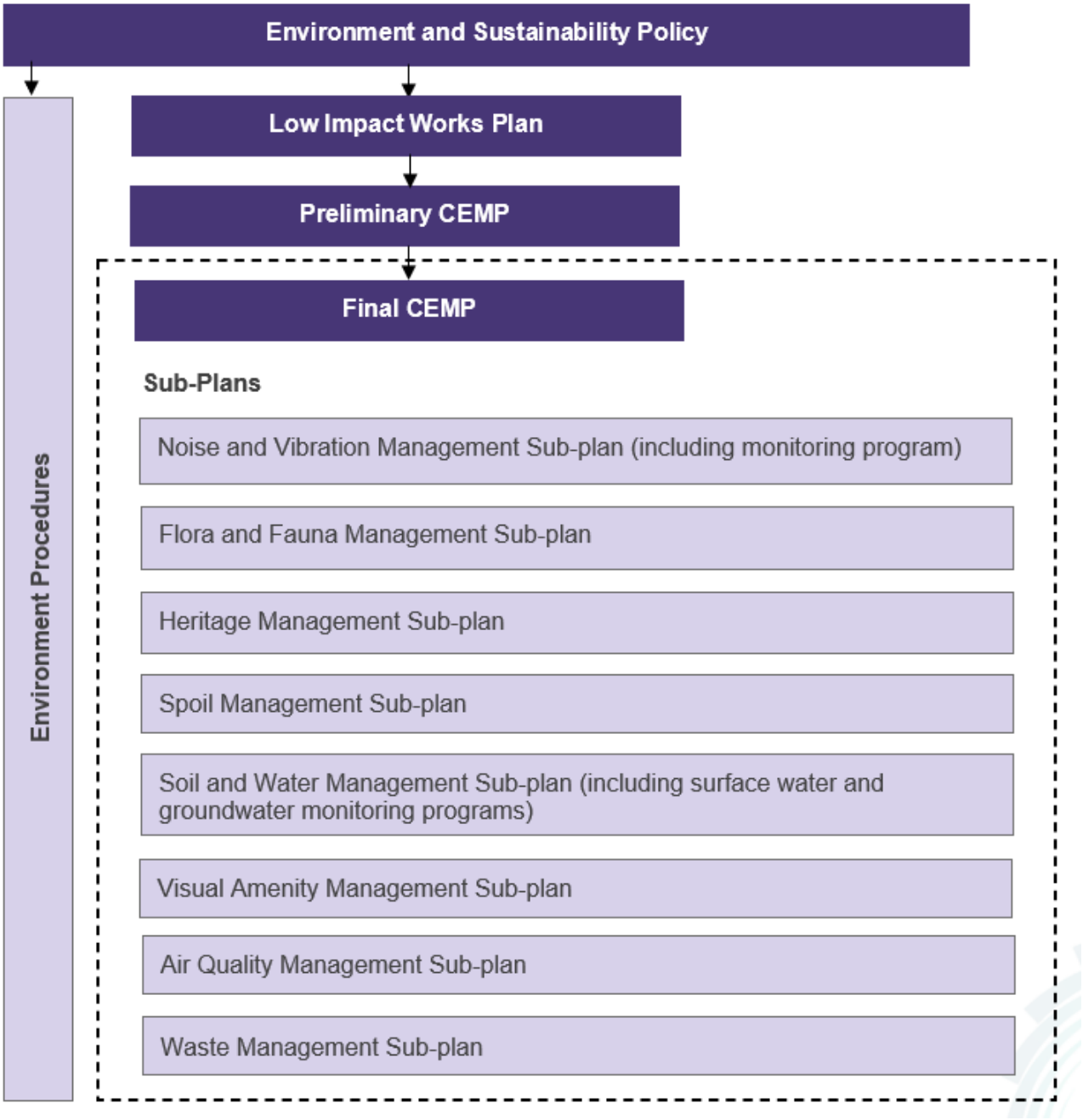


*Figure 1: CEMP Framework*

## 1.4. Consultation and approval

Reflecting the requirements of Conditions A6 and C14, this GWMP has been prepared in consultation with Department of Planning and Environment (DPE) Water. A detailed consultation report, including matters raised by stakeholders and JCG responses, is provided in Appendix D of the Soil and Water Management Sub-plan (SWMP).

As nominated in the Phasing Report, this monitoring program will be endorsed by the ER as being in accordance with the conditions of approval and all relevant undertakings made in the EIS and Submissions Report. This monitoring program was submitted to the ER no later than one month before the commencement of the Tunnelling, Excavation and Associated Works phase.

Construction did not commence until the CEMP, Sub-plans and monitoring programs had been approved by the Planning Secretary or endorsed by the ER (whichever is applicable). This GWMP, including any minor amendments approved by the ER, will be implemented for the duration of the Project. In accordance with the Sydney Metro Phasing Report, construction of a phase will not

commence until the CEMP and CEMP Sub-plans for that phase have been approved by the Planning Secretary or endorsed by the ER upon nomination by the Planning Secretary (whichever is applicable).

# 2. Project overview

## 2.1. Background

Sydney Metro West is a new 24-kilometre metro line that will connect Greater Parramatta with the Sydney CBD via stations at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Hunter Street (Sydney CBD).

The planning process for Sydney Metro West was assessed as a staged infrastructure application under section 5.20 of the *Environment Planning and Assessment Act 1979* (EP&A Act).

Stage 1 of the development, the Sydney Metro West Concept and major civil construction work for Sydney Metro West between Westmead and The Bays (SSI-10038 Schedule 2), was approved on 11 March 2021 and includes:

- Construction of new passenger rail infrastructure between Westmead and The Bays, including:
  - Tunnels, stations (including surrounding areas) and associated rail facilities
  - Stabling and maintenance facilities (including associated underground and overground connections to tunnels)
- Modification of existing rail infrastructure, including stations and surrounding areas
- Ancillary development.

The Eastern Tunnelling Package (ETP or this Project) is addressed under the Stage 2 Infrastructure Approval (SSI 19238057). This Project includes all major civil construction work including station excavation (at the Pyrmont Station and Hunter Street Station (Sydney CBD) construction sites) and tunnelling between The Bays and Sydney CBD (Figure 2).

It is noted that the existing Sydney Metro West precast facility at Eastern Creek will be utilised in the delivery of the ETP Works. The facility, which was assessed by Sydney Metro in a Review of Environmental Factors (REF) and approved on 11 March 2021, is outside of the scope of the GWMP.

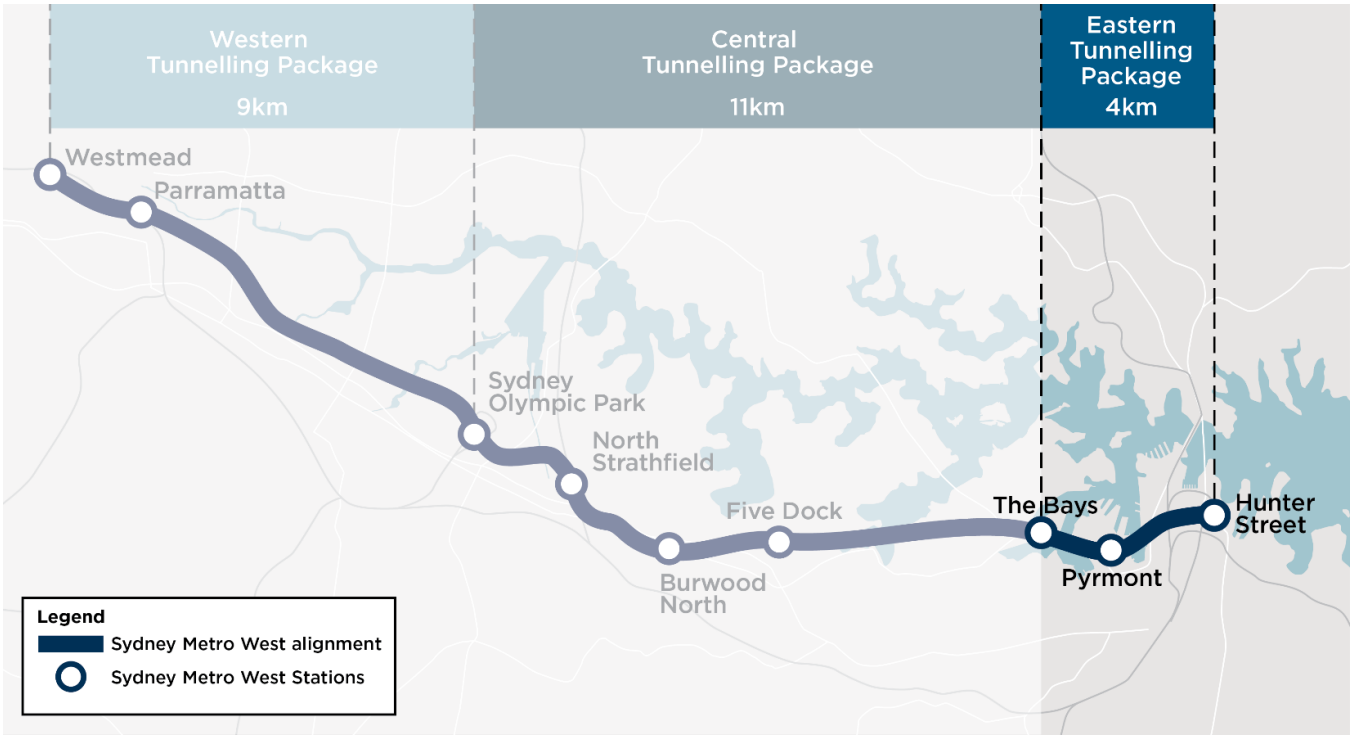


*Figure 2: Overview of the Sydney Metro West alignment*

## 2.2. Project scope

The ETP Works include design and construction of:

- Demolition of existing buildings at Pyrmont East and West shaft sites and at Hunter Street East and West shaft sites

- Tunnel Boring Machine (TBM) assembly, launch, tunnelling support from an existing shaft at The Bays
- Approximately 2.5 km twin underground eastbound and westbound bored railway tunnels between The Bays and Hunter Street and ten cross passages spaced up to 236 metres apart
- Pyrmont Station excavation, including two shaft excavations, associated access adits and nozzle enlargements, including temporary ground support and cast in situ cavern linings
- Excavation and lining of a mined crossover cavern to allow trains to cross from one track to the other
- Hunter Street station mined cavern excavation, including:
  - Two shaft excavations, associated access adits
  - Nozzle enlargements
  - Conversion of an existing temporary connection adit at Bligh Street linking Hunter Street Station to Martin Place Station into a permanent pedestrian connection linking the stations (including temporary ground support and cast in situ linings)
- A turnback extension tunnel, of approximately 675 metres, east of the Hunter Street Station works to enable Sydney Metro train storage and to change tracks and travel direction (eastbound to westbound)
- TBM disassembly and retrieval from Hunter Street East.

An overview of works at each ETP worksite is summarised in Table 4.

*Table 4: Overview of ETP Works at each worksite*

| Worksite | Overview of ETP Works |
|---|---|
| Hunter Street East | ▪ Use of existing offices and amenities where practicable and establishment of additional offices and amenities<br>▪ Tree trimming and removal<br>▪ Use of existing acoustic shed and access driveways<br>▪ Use of existing temporary Water Treatment Plant (WTP)<br>▪ Protection, adjustment and decommissioning of utility services<br>▪ Excavation of temporary decline, station cavern, nozzle enlargements, adits and turnbacks from within an existing acoustic shed<br>▪ Establish site including new construction access driveways, site hoardings, instrumentation and monitoring<br>▪ Demolition of existing high-rise buildings and excavation of stage 1 of station access shaft<br>▪ Archaeological monitoring and salvage (if triggered)<br>▪ Backfill of temporary decline prior to decommissioning<br>▪ Demolition of existing acoustic shed and amenities and excavation of stage 2 of station access shaft<br>▪ Permanent concrete lining of station cavern and turnbacks<br>▪ TBM disassembly and retrieval |
| Hunter Street West | ▪ Protection, adjustment and decommissioning of utility services<br>▪ Establish site including new construction access driveways, site hoardings, instrumentation and monitoring<br>▪ Demolition of existing buildings<br>▪ Archaeological testing and salvage (if triggered)<br>▪ Establishment and use of temporary offices and amenities<br>▪ Excavation of station access shaft |
| Pyrmont East | ▪ Protection, adjustment and decommissioning of utility services<br>▪ Establish site including new construction access driveways, site hoardings, instrumentation and monitoring<br>▪ Street tree removal<br>▪ Demolition of existing buildings<br>▪ Detailed site investigation and contamination management<br>▪ Establishment of high voltage construction power supply<br>▪ Establishment and use of temporary offices and amenities<br>▪ Excavation of temporary shaft within the station shaft footprint<br>▪ Installation of acoustic shed with gantry crane and steel bridging deck for excavation of station shaft and cavern |

| Worksite | Overview of ETP Works |
|---|---|
| | ▪ Permanent concrete lining of station cavern and nozzle enlargements<br>▪ Installation of acoustic shed will support material handling outside standard hours of work |
| Pyrmont West | ▪ Protection, adjustment and decommissioning of utility services<br>▪ Establish site including new construction access driveways, site hoardings, instrumentation and monitoring<br>▪ Archaeological testing and salvage (if triggered)<br>▪ Demolition of existing buildings<br>▪ Establishment and use of temporary offices and amenities<br>▪ Excavation of temporary shaft within the station shaft footprint<br>▪ Installation of acoustic shed with gantry crane and steel bridging deck for excavation of station shaft, pedestrian and service adits and spoil handling for cross over cavern<br>▪ Permanent concrete lining of cross over cavern and adit connections<br>▪ Installation of acoustic shed will support material handling outside standard hours of work |
| The Bays | ▪ Protection, adjustment and decommissioning of utility services<br>▪ Use of existing infrastructure for start-up<br>▪ Establishment of instrumentation and monitoring<br>▪ Establishment of additional temporary offices amenities and car parking<br>▪ Establish high voltage construction power supply<br>▪ Nozzle enlargements and TBM launch stub tunnels<br>▪ TBM assembly, launch and tunnelling support works from an existing shaft<br>▪ Cross passage construction<br>▪ Segment storage, temporary WTP and Slurry Treatment Plant (STP)<br>▪ Principal spoil handling facility for ETP Works |

## 2.3. Project phasing

A staged approach to commencement of investigations and works which considers potential environmental risks and the construction program has been developed for the ETP Works. This approach includes Low Impact Works as defined under SSI 19238057 and phased commencement of Construction. Construction for the ETP Works package has been divided into the following activity-based phases, with construction environmental management documentation also reflecting this activity-based staging:

- **Preliminary Works –** Including works within the existing Hunter Street East acoustic shed (temporary decline, ventilation-duct bores and ventilation adits), and critical works which are required to be conducted outside of standard hours (remaining design investigations, establishment of in-ground monitoring, and relocation of overhead power at Pyrmont west).
- **Tunnelling, Excavation and Associated Works** (addressed in this GWMP) – Including the Preliminary Works (not completed prior to approval of the final CEMP), demolition of existing industrial premises, establishment of offices, amenities and access roads, piling and station box excavation, and tunnelling.

# 3. Legal and other requirements

## 3.1. Legislation

This GWMP has been prepared in accordance with the:

- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Protection of the Environment Operations Act 1997* (POEO Act)
- *Protection of the Environment Operations (Waste) Regulation 2014* (the Waste Regulation)
- *Contaminated Land Management Act 1997* (CLM Act)
- *Water Management Act 2000* (WM Act)
- *Sydney Water Act 1994*.

Additional details on legislative requirements, including exemptions, are provided in Section 3.3 of the CEMP. Specifically, it is noted that the primary purpose of the tunnel excavation is the provision of public transport and not groundwater extraction. Section 5.23(1)(g) of the EP&A Act provides for the exemption of SSI projects from requiring a water use approval, a water management approval or an activity approval (other than an aquifer interference approval). Part 5 of the Water Act 1912 is specific to artesian wells and licencing under this part can only confer authority to change an existing bore or take water from a groundwater well/bore. A licence under this Act is not required for the construction or operation of a tunnel, including for water entering the tunnel or excavations, as this part of the Act does not apply to the Project.

## 3.2. Guidelines

The main guidelines, specifications and policy documents of relevance to this GWMP include:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (known as 'ANZG Guidelines') (ANZG 2018)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000)
- Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (NSW EPA, 2004)
- Guidelines for the Assessment and Management of Groundwater Contamination (DEC 2007)
- National Environment Protection Council (NEPC) 1999 (amended 2013), National Environment Protection (Assessment of Site Contamination) Measure (NEPM)
- NSW Environment Protection Authority Contaminated Land Guidelines Consultants reporting on contaminated land (EPA 2020)
- PFAS National Environmental Management Plan 2.0 (HEPA 2020).

## 3.3. Other environmental requirements

Other environmental requirements relevant to groundwater monitoring are the conditions of the EPL in relation to the discharge of treated groundwater. These requirements are addressed in the Surface water Quality Management Plan.

# 4. Existing environment and baseline monitoring

## 4.1. Existing environment

A summary of the existing groundwater environment is provided in Section 5.6 of the SWMP. Reflecting the outcomes of baseline monitoring, the contaminants of potential concern are detailed in Table 9 .

## 4.2. Baseline monitoring

### 4.2.1. Groundwater reports

In addition to the EIS chapters and supporting technical papers, the documents identified in Table 5 provide information on baseline groundwater monitoring and conditions, contamination, and considerations for WTPs.

*Table 5. Previous groundwater monitoring reports relevant to the ETP Works*

| Report Title | Summary |
|---|---|
| JCG JV (2024) Biannual Water Monitoring Report – October 2023 to March 2024, SMWSTETP-JCG-SWD-SW000-EN-RPT-095047 Rev01 | ▪ Contains the factual results of groundwater, surface water and water treatment plant monitoring undertaken between October 2023 and March 2024 including:<br>– Results from surface water sampling were used to develop site-specific trigger values for several monitoring points<br>– Groundwater hydrographs showed slight declines in water level associated with excavations at some sites<br>– Groundwater monitoring data was compared to Derived Groundwater Trigger Values at Hunter St, and considered baseline data at all other sites<br>▪ Some exceedances for nutrients were noted |
| Epic (2023c) Factual Groundwater Monitoring Report –October 2023, SCL230002.02, dated 6 December 2023 | ▪ Contains the factual results of groundwater investigations and undertaken in October 2023 including:<br>– Manual groundwater level management at 27 GWMWs along the project alignment<br>– Sampling of 27 GWMWs along the project alignment<br>– Level logger data collection from 28 GWMWs along the project alignment<br>– Analysis of collected groundwater samples<br>▪ Preparation of groundwater level hydrographs and Scholler Plots<br>▪ Groundwater quality monitoring identified multiple exceedances of ANZECC 95% default guideline values (marine) |
| JCG JV (2023) Biannual Water Monitoring Report – April 2023 to September 2023, SMWSTETP-JCG-SWD-SW000-EN-RPT-095028 Rev01 | ▪ Contains the factual results of groundwater, surface water and water treatment plant monitoring undertaken between April and September 2023 including:<br>– Results from surface water sampling were used to develop site-specific trigger values for several monitoring points<br>– Groundwater hydrographs showed slight declines in water level associated with excavations at some sites<br>– Groundwater monitoring data was compared to Derived Groundwater Trigger Values at Hunter St, and considered baseline data at all other sites<br>▪ Some exceedances for nutrients were noted |
| Epic (2023b) Factual Groundwater Monitoring Report – July 2023, SCL230002.02, dated 8 September 2023 | ▪ Contains the factual results of groundwater investigations and undertaken in July 2023 including:<br>– Manual groundwater level management at 29 GWMWs along the project alignment<br>– Sampling of 26 GWMWs along the project alignment<br>– Level logger data collection from 26 GWMWs along the project alignment<br>– Analysis of collected groundwater samples |

| Report Title | Summary |
|---|---|
| | ▪ Preparation of groundwater level hydrographs and Scholler Plots<br>▪ Groundwater quality monitoring identified multiple exceedances of ANZECC 95% default guideline values (marine) |
| Epic (2023a) Factual Groundwater Monitoring Report – Baseline (April 2023), SCL230002.02, dated 8 August 2023 | ▪ Contains the factual results of groundwater investigations and undertaken in April/May 2023 including:<br>– Inspection of 37 GWMWs along the project alignment<br>– Manual groundwater level management at 32 GWMWs along the project alignment<br>– Sampling of 32 GWMWs along the project alignment<br>– Level logger data collection from 15 GWMWs along the project alignment<br>– Analysis of collected groundwater samples<br>▪ Preparation of groundwater level hydrographs and Scholler Plots<br>▪ Groundwater quality monitoring identified multiple exceedances of ANZECC 95% default guideline values (marine) |
| Golder Douglas Partners (2023), Sydney Metro West Groundwater Monitoring Report – Eastern Tunnelling Package Locations, 20446669-018-R-GWMR-Rev M, 4 April 2023 | ▪ Contains the factual results of groundwater investigations and monitoring of boreholes undertaken from August 2021 to March 2023, including details from:<br>– Installation of 37 groundwater monitoring wells<br>– Installation and monitoring of 1 Vibrating Wire Piezometer (VWP)<br>– Laboratory testing of selected groundwater samples<br>– Installation of 32 groundwater level loggers to monitor groundwater levels<br>▪ As detailed in the hydrographs in Appendix A, groundwater levels in the majority of wells remained relatively constant over the monitoring period. Variations in groundwater levels at the remaining wells were attributed to rainfall events, tidal fluctuations and well development.<br>▪ Groundwater quality monitoring identified multiple exceedances of ANZECC 95% default guideline values, (marine and freshwater), including heavy metals (chromium, cadmium, cobalt, copper, lead, nickel, manganese and zinc), perfluorooctane sulfonic acid (PFOS), nitrate and ammonia (Appendix A). |
| Golder Douglas Partners (2022), Sydney Metro West Geotechnical Investigation ETP – Factual Contamination Assessment Report, 20446669-018-R-CAR, 10 Nov 2022 | ▪ Provides an overview of the scope of work and methodologies used to investigate contamination across the project alignment. The report presents the analytical results for soil and water, along with summary tables of the results and comparisons with relevant health, ecological and waste classification criteria. The report presents results from soil sampling at 31 locations and groundwater sampling from 37 locations between the Bays and Hunter St Station.<br>▪ Groundwater quality monitoring identified multiple exceedances of ANZECC 95% default guideline values, (marine and freshwater), including heavy metals (chromium, cadmium, cobalt, copper, lead, nickel, manganese and zinc), perfluorooctane sulfonic acid (PFOS), nitrate and ammonia (Appendix A). The potential impact of the exceedances are subject to further investigation during the ETP Works. |

### 4.2.2. Baseline groundwater monitoring data

A network of groundwater monitoring bores has been installed across the Project area and regularly monitored over the period from August 2021 to October 2024. Results from these existing monitoring bores, collected as part of the EIS stage investigations and subsequent investigations by Sydney Metro, Epic Environmental and JCG JV, have been documented in the reports detailed in Table 5.

The Baseline monitoring period for each of the project areas (The Bays, Pyrmont and Hunter St) is defined in Table 6.

*Table 6. Baseline Monitoring Period*

| Zone | Baseline period | Construction works | Relevant data |
|---|---|---|---|
| The Bays | November 2021 - July 2024 | No dewatering as of July 2024 | Golder \| Douglas Partners (2022)<br>Epic (2023a)<br>Epic (2023b)<br>Epic (2023c)<br>JCG JV (2024) |
| Pyrmont | January 2022 - July 2024 | No dewatering as of July 2024 | Golder \| Douglas Partners (2022)<br>Epic (2023a)<br>Epic (2023b)<br>Epic (2023c)<br>JCG JV (2024) |
| Hunter Street and Turnback tunnels | March 2022 - May 2023 | Dewatering at Hunter St for station cavern from May 2023 | Golder \| Douglas Partners (2022)<br>Epic (2023a) |

A list of boreholes that have been converted to groundwater monitoring bores as either standpipe piezometers or vibrating wire piezometers is presented in Table 8.

The Project baseline was developed from a reasonable level of monitoring data for groundwater levels and groundwater quality with analysis covering a broad analytical suite (Appendix A).

All vibrating wire piezometers are fitted with continuous dataloggers. A number of standpipe piezometers have also been fitted with transducers and dataloggers for continuous measurement of water pressure.

The viability of existing monitoring bores for ongoing monitoring has been assessed as part of the initial monitoring events undertaken for the Project and the list of monitoring wells updated in Table 8.

For wells in the Hunter Street area potentially affected by tunnelling works which commenced in early 2023, the baseline monitoring data applicable to the area is considered to be March 2022 – April/May 2023. Groundwater drawdown is observed in groundwater level monitoring data in the Hunter St area from June/July 2023 onwards and represents the commencement of construction dewatering.

For wells in the Pyrmont and Rozelle area, the results of the July 2023 – May 2024 monitoring events have been used to further add to the existing baseline dataset. Water level or water quality monitoring data collected over this period is not indicative of surface activities impacting on groundwater quality and levels and as such the data is considered suitable for adoption as baseline data.

### 4.2.3. Salinity monitoring

Groundwater salinity in the Project area is primarily derived from three sources:

- Aeolian deposition of wind-blown salts and subsequent infiltration following rainfall
- Groundwater flowing through or draining from saline rocks, e.g., Ashfield Shale
- Intrusion of saline water from the coastline due to density and buoyancy effects and variations in the rate of groundwater discharge towards the coastline.

Baseline groundwater quality within the Hawkesbury Sandstone varies but is generally of low salinity. The low salinity typically observed in Hawkesbury Sandstone is mainly a result of rainfall recharge and short residence times. However, some boreholes do observe elevated salinity, particularly near tidal water bodies and in some deeper boreholes near the coast, and in locations where older groundwater has been in contact with shale rock types and/or dykes.

The Project's baseline electrical conductivity measurements within the Hawkesbury Sandstone aquifer have an average Electrical Conductivity (EC) of 1.55mS/cm, with a standard deviation of 1.656 mS/cm. The inferred EC values, from laboratory resistivity measurements, have an average of 1.8 mS/cm and a standard deviation of 1.343mS/cm.

For Hawkesbury sandstone at depth (0 m AHD to -40m AHD):

- 80 per cent of measured samples had salinity less than 2.29mS/cm
- 90 per cent of samples had salinity less than 3.4mS/cm
- 95 per cent of samples had salinity less than 5.89mS/cm.

Considering the commentary on salinity within the EIS and the salinity data provided the general baseline consideration of salinity is summarised in Table 7.

Based on the interpreted groundwater flow directions, the elevated salinity of 5mS/cm at Pyrmont East Shaft is inferred to be associated with migration of saline water from Cockle Bay in the direction of the basement carpark of the Star City Casino.

*Table 7 Summary of baseline groundwater salinity (EC) measurements from HIR*

| Domain | Structure | Approximate Baseline Groundwater Salinity |
|---|---|---|
| CBD/Hunter | Turnback Tunnels | 1.4 mS/cm near the cavern informed by limited data<br>Probably similar to Hunter Street Station |
| | Turnback Cavern | 1.5 mS/cm near the cavern informed by limited data<br>Probably similar to Hunter Street Station |
| | Hunter St East Shaft | Up to 3.6 mS/cm near the shaft<br>Up to 6.0 mS/cm in the bores at Barangaroo, 800m away |
| | Hunter St West Shaft | Up to 1.4 mS/cm near the shaft a<br>Up to 6.0 mS/cm at Barangaroo bores, 800m away |
| Pyrmont | Pyrmont East Shaft | Up to 1.05 mS/cm at shallow depth and<br>Up to 5.0 mS/cm at deeper depth near the shafts |
| | Pyrmont West Shaft | Up to 1.55 mS/cm near the shafts |
| | Pyrmont Crossover cavern | Up to 2.1 mS/cm near the crossover cavern |
| The Bays | Running Tunnels | Up to 44 mS/cm based on readings at EDS-ETP-BH036 |

## 5. Groundwater monitoring network

Groundwater level and quality monitoring will be carried out throughout the Tunnelling, Excavation and Associated Works phase to assess impacts to groundwater conditions, including groundwater levels, drawdown, contamination status, and salinity.

The nominated groundwater monitoring network (based on the existing groundwater monitoring network installed by Sydney Metro 12 months prior to Project award) is summarised in Table 8 for standpipe piezometers and VWPs. This monitoring network is based on existing monitoring points located at each of the construction sites (in accordance with Condition C17(a)). Within Table 7, the nested sites Bore ID are annotated with an “s” suffix denoting a shallow piezometer was installed at that location.

All standpipe piezometers identified in Table 8 will be manually dipped to record groundwater levels, where possible. A sub-set of the nominated monitoring bores will be installed with digital transducers (dataloggers) to record continuous data on groundwater level, and a separate sub-set have been nominated for groundwater quality sampling.

The location of ongoing groundwater monitoring points and the frequency of groundwater sampling events has been reviewed following the initial monitoring event undertaken prior to commencement of the Tunnelling, Excavation and Associated Works phase. The initial monitoring events were used to:

- Undertake an on-site audit on the condition of monitoring bores and identify any boreholes that have been damaged, destroyed or decommissioned
- Collect samples to assess baseline water quality and identify where risks associated with groundwater contamination may be present
- Retrieve existing dataloggers, download available data and reprogram loggers where necessary
- Review the proposed monitoring network and assess whether additional or alternative monitoring points are required.

As a result of the review some modifications to the proposed monitoring network and monitoring frequency have been updated as detailed in Table 8.

*Table 8 Groundwater Monitoring Network*

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| The Bays | ~~EDS-ETP-BH017~~ | ~~41.0~~ | ~~Rozelle – James Craig Road~~ | ~~332063.0~~ | ~~6250983.2~~ | ~~2.18~~ | ~~Logger~~ | ~~Quarterly~~ | Damaged | August 2021 – October 2023 | August 2024 | July 2024 |
| | EDS-ETP-BH018 | 30.2 | Rozelle – Port Access Road | 331728.0 | 6251088.4 | 3.25 | Logger | Quarterly | | August 2021 – October 2023 | June 2024 | April 2024 |

[1] Commencement of construction in the zone of influence of the groundwater monitoring well
* Well was decommissioned due to close proximity to the mainline tunnels and the risk of slurry loss

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EDS-ETP-BH023 | 34.8 | Rozelle – Sommerville Road | 331843.0 | 6251031.9 | 13.19 | Logger | Quarterly | | August 2021 – October 2023 | September 2024 | July 2024 |
| | ~~EDS-ETP-BH036~~ | ~~10.5~~ | ~~Rozelle – James Craig Road~~ | ~~331993.8~~ | ~~6250976.6~~ | ~~2.18~~ | ~~Logger~~ | ~~Monthly~~ | Damaged | | | |
| | EDS-ETP-BH051 | 13.1 | Rozelle – James Craig | 331913.2 | 6250986.8 | 2.89 | Logger | Quarterly | | August 2021 – October 2023 | August 2024 | October 2024 |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Road | | | | | | | | | |
| Pyrmont | ~~EDS-ETP-BH008~~ | ~~17.00~~ | ~~Sydney – Murray Street~~ | ~~333356.8~~ | ~~6250833.6~~ | ~~4.06~~ | ~~Logger~~ | ~~Quarterly~~ | Decommisioned* | August 2021 – April 2023 | January 2024 | July 2024 |
| | EDS-ETP-BH009* | 40.00 | Pyrmont – Pyrmont Bridge Road | 333211.0 | 6250778.4 | 12.9 | Logger | Quarterly | | August 2021 – October 2023 | January 2024 | July 2024 |
| | EDS-ETP-BH009s | 21.00 | Pyrmont – Pyrmont | 333210.9 | 6250778.6 | 12.88 | Logger | Quarterly | | August 2021 – October 2023 | January 2024 | July 2024 |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Bridge Road | | | | | | | | | |
| | EDS-ETP-BH010A | 38.3 | Pyrmont – Pyrmont Street | 333089.0 | 6250749.8 | 14.36 | Logger | Quarterly | | August 2021 – October 2023 | January 2024 | January 2024 |
| | EDS-ETP-BH011 | 39.00 | Pyrmont – Harris Street | 333005.4 | 6250724.1 | 16.14 | Logger | Quarterly | | August 2021 – October 2023 | April 2024 | January 2024 |
| | EDS-ETP-BH012 | 34.5 | Pyrmont – Jones | 332765.7 | 6250777.2 | 9.92 | Logger | Quarterly | | August 2021 – October 2023 | October 2024 | July 2024 |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Street | | | | | | | | | |
| | EDS-ETP-BH013 | 39.0 | Pyrmont – Bank Street | 332413.8 | 6250846.5 | 3.70 | Logger | Quarterly | | August 2021 – October 2023 | September 2024 | July 2024 |
| | EDS-ETP-BH033* | 29.6 | Pyrmont – Union Street | 333212.6 | 6250807.2 | 9.10 | Logger | Quarterly | | August 2021 – October 2023 | January 2024 | July 2024 |
| | EDS-ETP-BH033s* | 14.00 | Pyrmont – Union Street | 333211.8 | 6250807.3 | 9.02 | Logger | Quarterly | | August 2021 – October 2023 | January 2024 | July 2024 |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EDS-ETP-BH034 | 22.00 | Pyrmont – Paternoster Row | 333013.6 | 6250793.8 | 15.30 | Logger | Quarterly | | August 2021 – October 2023 | April 2024 | July 2024 |
| | EDS-ETP-BH035 | 20.9 | Pyrmont – Paternoster Row | 333057.5 | 6250707.0 | 14.46 | Logger | Quarterly | | August 2021 – October 2023 | January 2024 | July 2024 |
| | ~~EDS-ETP-BH052~~ | ~~32.0~~ | ~~Pyrmont- Saunders Street~~ | ~~332669.2~~ | ~~6250804.5~~ | ~~11.22~~ | ~~Logger~~ | ~~Monthly~~ | Destroyed | | | |
| | ~~EDS-ETP~~ | ~~29.0~~ | ~~Pyrmont-~~ | ~~333176.4~~ | ~~6250778.0~~ | ~~9.39~~ | ~~Logger~~ | ~~Monthly~~ | Decommissioned | | | |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ~~-BH054*~~ | | ~~Edward Street~~ | | | | | | | | | |
| | ~~EDS-ETP-BH054s*~~ | ~~14.00~~ | ~~Pyrmont-Edward Street~~ | ~~333177.4~~ | ~~6250778.1~~ | ~~9.39~~ | ~~Logger~~ | ~~Monthly~~ | Decommissioned | | | |
| | ~~SMW_ENV312*~~ | ~~30.50~~ | ~~Pyrmont – Pyrmont Bridge Road~~ | ~~333128.5~~ | ~~6250727.8~~ | ~~15.13~~ | ~~Logger~~ | ~~Monthly~~ | Destroyed | | | |
| Hunter Street | EDS-ETP- | 28.40 | Sydney – Sha | 334751.3 | 6251253.8 | 32.47 | Logger | Quarterly | | August 2021 – April 2023 | February | July 2023 |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| and Turnback tunnels | BH002 | | kespeare Place | | | | | | | | 2024 | |
| | ~~EDS-ETP-BH003*~~ | ~~23.70~~ | ~~Sydney-De Mestre Place~~ | ~~334127.5~~ | ~~6251245.9~~ | ~~10.44~~ | ~~Logger~~ | ~~Monthly~~ | Decommissioned | | | |
| | ~~EDS-ETP-BH003s*~~ | ~~11.90~~ | ~~Sydney – De Mestre Place~~ | ~~334217.5~~ | ~~6251245.9~~ | ~~10.44~~ | ~~Logger~~ | ~~Monthly~~ | Decommissioned | | | |
| | ~~EDS-ETP-~~ | ~~19.70~~ | ~~Sydney – Sus~~ | ~~333798.3~~ | ~~6251217.0~~ | ~~5.69~~ | ~~Logger~~ | ~~Quarterly~~ | Decommisioned* | August 2021 – July 2023 | February 2025 | April 2025 |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ~~BH004A~~ | | ~~sex St~~ | | | | | | | | | |
| | ~~EDS-ETP-BH005~~ | ~~32~~ | ~~Sydney – Lime Street~~ | ~~333668.3~~ | ~~6251147~~ | ~~5.14~~ | ~~Logger~~ | ~~Quarterly~~ | Decommisioned* | August 2021 – July 2023 | February 2025 | April 2025 |
| | EDS-ETP-BH019 | 6.3 | Sydney – Phillip Street | 334549.1 | 6251290.4 | 25.98 | Logger | Quarterly | | August 2021 – April 2023 | October 2023 | July 2023 |
| | EDS-ETP-BH030 | 32.7 | Sydney-Domain Parkland | 334798.5 | 6251131.8 | 27.67 | Logger | Quarterly | | August 2021 – April 2023 | March 2024 | July 2023 |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EDS-ETP-BH001 | 31.0 | City – The Domain | 334810.4 | 6250971.4 | 25.91 | Logger | Quarterly | | August 2021 – April 2023 | March 2024 | July 2023 |
| | ~~EDS-ETP-BH032~~ | ~~24.2~~ | ~~Sydney – Pitt Street~~ | ~~334258.7~~ | ~~6251269.0~~ | ~~7.92~~ | ~~Logger~~ | ~~Quarterly~~ | Destroyed | August 2021 – April 2023 | March 2023 | July 2023 |
| | EDS-ETP-BH038 | 34.0 | Sydney – Hunter Street | 334399.8 | 6251254.0 | 16.23 | Logger | Quarterly | | August 2021 – April 2023 | March 2023 | July 2023 |
| | ~~EDS-ETP-BH056~~ | ~~17.1~~ | ~~Sydney-Hunter Street~~ | ~~334355.6~~ | ~~6251291.4~~ | ~~1.33~~ | ~~Logger~~ | ~~Monthly~~ | Destroyed | August 2021 – April 2023 | | |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EDS-ETP-BH058 | 32.0 | Sydney – Domain Parkland | 334811.6 | 6251072.5 | 26.07 | Logger | Quarterly | | August 2021 – April 2023 | March 2024 | July 2023 |
| | SMW_ENV309* | 30.40 | Sydney – Hunter Street | 334357.5 | 6251273.7 | 12.68 | Logger | Quarterly | | August 2021 – April 2023 | March 2023 | July 2023 |
| | SMW_ENV309s* | 7.0 | Sydney – Hunter Street | 334356.5 | 6251274.2 | 12.68 | Logger | Quarterly | | August 2021 – April 2023 | March 2023 | July 2023 |

| Excavation Site | Bore ID | Depth | Location | Easting | Northing | Elevation (mAHD) | GWL Method | Frequency | Reason for removal | Baseline Monitoring | Construction Commencement[1] | Construction Monitoring Commencement Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SMW_ENV310* | 22.00 | Sydney – O'Connell Street | 334403.8 | 6251358.3 | 13.58 | Logger | Quarterly | | August 2021 – April 2023 | March 2023 | July 2023 |
| | SMW_ENV310s* | 12.30 | Sydney – O'Connell Street | 334403.1 | 6251357.6 | 13.58 | Logger | Quarterly | | August 2021 – April 2023 | March 2023 | July 2023 |

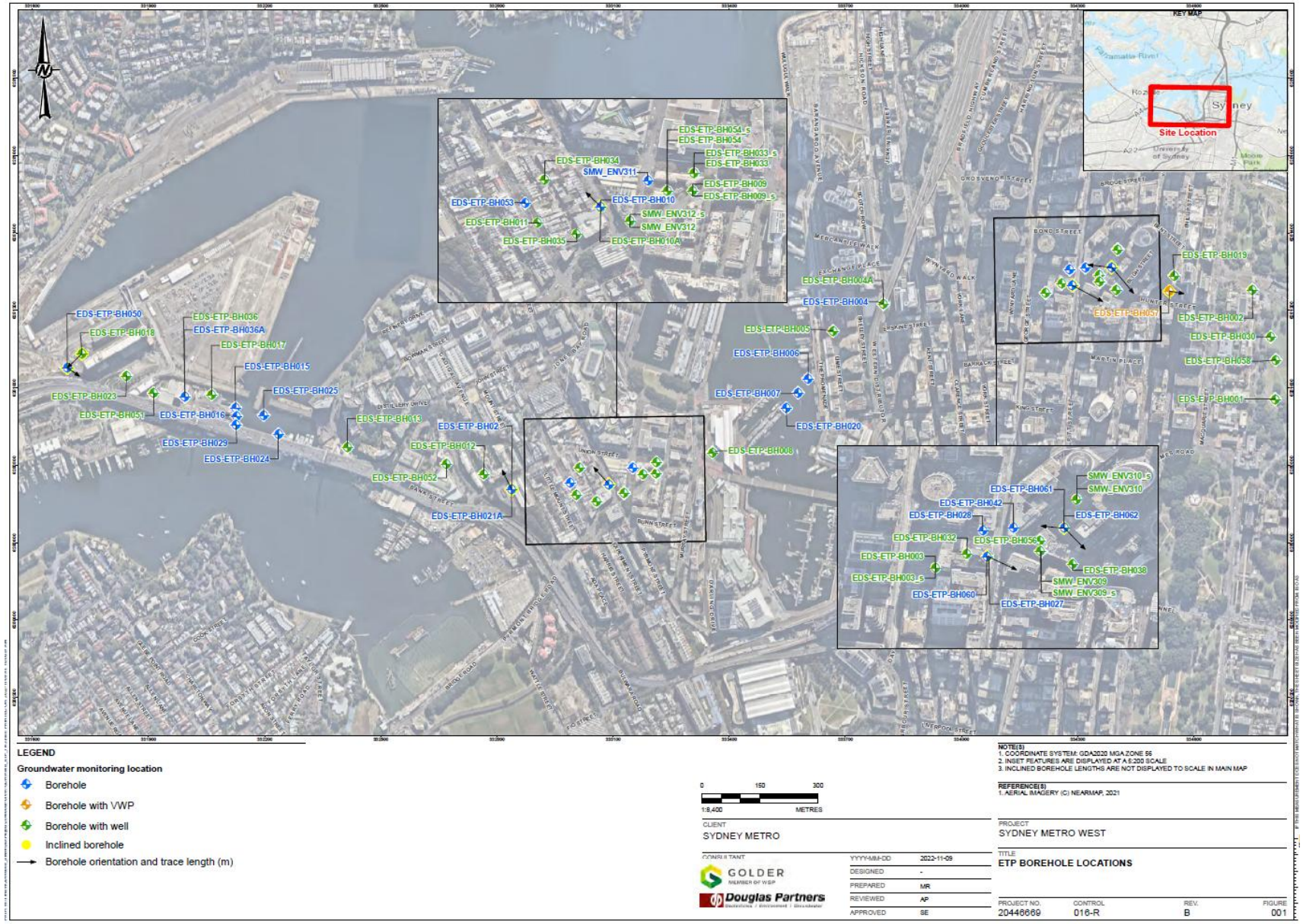


*Figure 3 Location of existing groundwater monitoring wells*

# 6. Groundwater level and drawdown monitoring

## 6.1. Monitoring program

The standpipe piezometers and vibrating wire piezometers that have been nominated as part of the Project groundwater level and drawdown monitoring program (including initial baseline monitoring) have been specified in Table 8 . The monitoring methodology is discussed in the Sections that follow, including data collection methods.

## 6.2. Monitoring methodology

### 6.2.1. Standpipe Piezometers

Pressure transducers with digital dataloggers will be installed (or maintained from the baseline monitoring phase) in selected standpipe piezometers within and around the predicted radius of drawdown for the Project to provide continuous data collection. The dataloggers will be programmed to record at hourly intervals.

Data loggers will be checked and maintained as necessary before being re-calibrated, decontaminated and then returned to the monitoring bore at a known depth below the top of casing.

The data loggers will be either telemetered or downloaded quarterly. The readings from dataloggers will be calibrated with manual depth to water measurements as part of the monitoring program.

The static groundwater level will be measured and recorded at each standpipe piezometer quarterly using an oil/water interface probe to verify the continuous data recorded by dataloggers and identify any non-aqueous phase liquid (NAPL) contamination. Recorded data will be compensated for barometric pressure and converted to a groundwater level measurement.

Measurements will be recorded in metres below top of casing (mbTOC) and converted to metres below ground level (mBGL) and metres Australian Height Datum (mAHD).

Groundwater monitoring will be overseen by personnel with appropriate qualifications and experience. Trained field personnel will complete monitoring rounds using appropriate personal protective equipment (PPE) and calibrated monitoring equipment.

All groundwater level data will be compared to local rainfall records to assess recharge response.

## 6.3. Vibrating Wire Piezometers

VWPs are used to monitor porewater pressure (which can be converted to an equivalent groundwater level) at the depth where the VWP is installed. The VWP converts water pressure to a frequency signal via a diaphragm, a tensioned steel wire, and an electromagnetic coil.

The piezometer is designed so that a change in pressure on the diaphragm causes a change in tension of the wire. An electro-magnetic coil is used to excite the wire, which then vibrates at its natural frequency. The vibration of the wire in the proximity of the coil generates a frequency signal that is transmitted to the readout device.

The readout or data logger stores the reading in Hz. Modern data logger readouts may also automatically convert the reading in Hz to a pressure or level reading when a suitable precalibration is used. For non-vented piezometers, barometric pressure corrections are required because the space inside the piezometer isolated and disconnected from the atmosphere. Vented piezometers designed to eliminate barometric effects, and as such barometric pressure corrections are not required.

Details on VWPs used on the Project to monitor water pressure (level) will be provided in future updates to this GWMP after hand over of existing instrumentation from Sydney Metro.

VWPs will be set to record data at a maximum interval of once every six hours. VWP monitoring data will be downloaded and reviewed on a quarterly basis to assess changes in groundwater levels during the Tunnelling, Excavation and Associated Works. Monitoring events and data downloads will be downloaded directly from the readouts by manual collection.

Results from repeat monitoring rounds will be collated into continuous data graphs to show trends in groundwater levels over time and infer any trends that may be attributable to ETP Works.

## 6.4. Data analysis

All groundwater level data from standpipe piezometers and vibrating wire piezometers will be uploaded to a central database that will be continuously updated over the course of the Tunnelling, Excavation and Associated Works monitoring program.

Groundwater level data will be converted into digital graphs for each standpipe piezometer and vibrating wire piezometer.

Manual dip measurements will be routinely included for all continuous logging data in standpipe piezometers to check on potential for drift or errors that may have occurred in digital records.

Barometric data loggers will be installed in select monitoring bores to allow for post-correction of water level data from continuous loggers to atmospheric fluctuations.

Atmospheric correction of water level data should be conducted as per the following example:

$$WLcorr = WLabs - Patm$$

Where:

- $WL_{corr}$ = corrected SWL
- $WL_{abs}$ = absolute water level as recorded by the data logger) barometric pressure plus water pressure)
- $P_{atm}$ = atmospheric pressure as recorded by the barometric logger.

Note that due to the variable salinity (density) of groundwater measured across the Project, measured water level will require correction to account for this difference in fluid density as per the following:

$$hf \times \rho f = hm \times \rho m$$

Where:

- hm = measured water column in bore
- ρm = density of groundwater in bore based on measured TDS
- hf = equivalent freshwater column in the bore ρf is freshwater density.

VWPs are equipped with data loggers, which are to be programmed to record pore pressures at six-hourly intervals. Data will be collected quarterly and converted to equivalent metres of head.

## 6.5. Performance criteria

Where the drawdown is identified as affecting a groundwater resource under the AIP, specific triggers may be defined for that sensitive groundwater receptor and or monitoring installations in proximity of that receptor.

Management actions will be initiated as soon as reasonably practicable (within 48 hours) if there is evidence of an unacceptable impact to or potential for unacceptable impact to a specific groundwater resource identified as being potentially affected by the works under the NSW Aquifer Interference Policy (AIP).

Management actions may include further investigation including (but not limited to) a review of groundwater levels in surrounding monitoring bores and comparison of results against model predictions, and assessment of potential impacts as a result of the observed drawdown.

If the observed groundwater levels indicate potential for unacceptable impacts to the environment, human health, or built infrastructure, then appropriate management measures to remedy the effect will be implemented. Appropriate remedial actions may include measures such as additional grouting or alternative inflow management measures to limit inflows to excavations and reduce dewatering effects. In the event of potential risks to Sydney Water assets, consultation will be undertaken with Sydney Water.

If registered groundwater users are impacted by a material decline in groundwater supply levels (i.e., >2m), quality or quantity, make good provisions will be provided to those groundwater users in accordance with the SWMP.

# 7. Groundwater quality monitoring

## 7.1. Monitoring program

Groundwater quality monitoring will be undertaken as an initial event prior to the Tunnelling, Excavation and Associated Works at the monitoring bores identified in Table 8 and on a quarterly (3 month) or six-monthly basis as specified in Table 7, thereafter at selected bores based on well viability, previous results and proximity to the site.

The initial event and quarterly sampling program for the first four events will retain all parameters listed in Table 9 (contaminants of potential concern identified in baseline data) to provide ongoing monitoring of groundwater conditions and assess any potential changes in groundwater quality which may have occurred as a result of the construction activities or other local events. Thereafter the results will be reviewed and the parameters of concern reassessed based on the results to date.

Sampling frequencies will be increased to monthly sampling at the affected and adjacent wells in the event that laboratory testing results identify any exceedances of the trigger values and construction related impacts to humans or the environment. The groundwater quality triggers are outlined in Section 7.5.

Water quality monitoring at the nominated groundwater bores is intended to identify where contaminants or saline water are potentially migrating to the work areas as a result of drawdown and to inform whether contamination has occurred as a result of site activities or local events. Both factors will inform potential risks to compliance with construction water treatment plants and risks to sensitive environmental or human health receivers. Water treatment plant discharge is detailed within the SWQMP Section 7.

Following an exceedance of a trigger, monthly sampling for all parameters exceeding the adopted triggers will continue at the applicable sampling location unless parameters are measured at concentrations consistently below the trigger values for a period of at least 2 months.

All samples will be submitted for testing at the appropriate limit of reporting (LoR) for comparison against the relevant trigger values.

*Table 9 Groundwater sampling parameters and frequency*

| Parameter Suite | Parameter * | Testing Frequency |
|---|---|---|
| General water quality | Electrical conductivity, pH, carbonate alkalinity, bicarbonate alkalinity, hydroxide alkalinity, TDS, total organic carbon. | Quarterly |
| Major ions | Calcium, magnesium, sodium, potassium, chloride, sulfate | |
| Dissolved metals (ultra-trace) | Aluminium, arsenic, cadmium, chromium III, chromium VI, cobalt, copper, lead, iron, manganese, mercury, nickel, zinc | |
| Petroleum hydrocarbons | Total Petroleum/Recoverable Hydrocarbons (TPH/TRH) fractions >C6 - C40 | |
| Select nutrients (ultra-trace) | Total nitrogen, nitrate, nitrite, total ammonia, total phosphorous, reactive phosphorous | |
| Aromatic hydrocarbons | Benzene, toluene, ethylbenzene, xylene, naphthalene | |
| Monitored Natural Attenuation (MNA) Indicators | Ferric ($Fe^{3+}$) and ferrous ($Fe^{2+}$) iron | |
| Polycyclic aromatic hydrocarbons | All relevant ANZG (2018) polycyclic aromatic hydrocarbons | Six monthly (select locations) |
| Volatile organic compounds | All relevant ANZG (2018) volatile organic compounds | |
| ~~Semi-volatile organic compounds~~ | ~~All relevant ANZG (2018) semi-volatile organic compounds~~[1] | |
| Organochlorine pesticides | All relevant ANZG (2018) organochlorine pesticides | |

| Parameter Suite | Parameter * | Testing Frequency |
|---|---|---|
| Organophosphorus pesticides | All relevant ANZG (2018) organophosphorus pesticides | |
| Perfluorinated alkyl substances (PFAS) | All relevant NEMP PFAS compounds | |

*[1] Parameters reassessed after seven monitoring rounds. Semi-volatile organic compounds (SVOC's) were detected above laboratory Limit of Reporting (LOR) in just 0.1% of all samples, therefore SVOC's were removed from potential contaminants of concern.*

## 7.2. Monitoring methodology

Groundwater quality sampling will be carried out by suitably qualified personnel, in accordance with standard operating procedures, and will follow these general principles:

- Sampling equipment should not change the water quality in any way; particular effort should be made to avoid cross contamination between bores and sampling equipment
- Sufficient water should be removed to ensure the sample is representative of the aquifer being sampled rather than from water that is potentially stagnant in the bore
- Methods of collection, storage bottles and transportation to the laboratory should suit the type of analysis required.

Groundwater sampling may produce a potentially large volume of purged water. Sampling methods will be used to minimise the volume of purged water being produced including hydrasleeves and low-flow sampling techniques.

The groundwater monitoring program will adopt a low-flow sampling methodology for the collection of all groundwater samples at all sites identified in Table 8. The low-flow sampling methodology employs specifically designed sample pumps. ASTM D6771-21 provides the standard practice for low-flow purging and sampling used for groundwater monitoring.

A Standard Operating Procedure (SOP) that is compliant with AS/NZS 5667.11:1998 will be developed and adhered to for all low-flow sampling operations. The SOP will include a requirement for positioning the intake of the low-flow tubing at the depth of the aquifer that is contributing formation water to the standpipe piezometer.

### 7.2.1. Sample Collection

In general, groundwater sampling will align with the following procedure:

- All monitoring bores will be gauged to obtain SWL and total depth of each well (prior to purging) using a cleaned / decontaminated electric water level probe. This will provide information regarding purge volumes required for ensuring the collection of representative groundwater samples when using the low-flow method
- A low-flow SOP will be developed for the Project to ensure that samples are taken consistently and at the same depth
- Field measurements for physical groundwater parameters will be taken using a calibrated water quality meter fitted with a multi-sensor probe to collect field quality parameters (pH, EC, dissolved oxygen (DO), temperature, and redox potential (Eh)) during purging
- Groundwater samples will be collected after confirmation of aquifer parameter stabilisation (refer Table 10).
- A physical description of the sample, including colour, turbidity (visual), odour, and presence of film, sheen or foam will be recorded on standardised field sheets
- Groundwater samples will be stored in clean laboratory prepared bottles containing the appropriate preservatives
- Samples for dissolved metal analysis will be filtered through a 0.45 µm in-line filter and stored in laboratory prepared bottles containing nitric acid preservative
- All groundwater samples will be labelled accordingly and placed immediately into an esky containing ice.
- Chain of custody (CoC) documentation will be completed at the time of sampling and will accompany the samples to the laboratory

- One rinsate blank will be collected from the water level probe and the pump (or other sampling equipment) during each day of sampling
- Rinsate samples will be analysed for the same analytes as primary samples to ensure cross-contamination has not occurred
- Samples will be submitted to a National Association of Testing Authorities (NATA) accredited laboratory for analysis.

Some physicochemical parameters cannot be reliably measured in the laboratory as their characteristics change over a very short time scale. Parameters that should thus be measured in the field include pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), redox potential (Eh) and alkalinity.

Field parameters should be measured in a flow cell using a multiparameter probe (water quality meter) to avoid contact between the groundwater and the atmosphere. Readings of field parameters should be recorded until parameters have stabilised.

Once the SWL stabilises, wait for three successive stable parameter readings before sampling. Criteria for the acceptance of stable water quality parameters are summarised in Table 10

*Table 10: Example Criteria Defining Stabilisation of Water Quality Parameters*

| Field parameter | Control limit |
|---|---|
| Dissolved Oxygen | ±10% of reading or ±0.2mg/L |
| Temperature | ±0.2°C |
| pH | ±0.2 pH units |
| Electrical Conductivity | ±3% of reading |
| Redox Potential | ±20 mV |

The pump tubing should be disconnected from the flow-through-cell, following stabilisation and prior to sample collection, so that the samples are collected from the pump's discharge tubing without contact with the flow-through-cell. Air pressure on the gas cylinder can be turned down so samples can be filled with minimal turbulence (if applicable).

A SOP will be developed and adhered to for all low flow sampling operations, including the collection of field parameters.

### 7.2.2. Sample Filtration and Preservation

The proposed sample filtration and preservative requirements for the laboratory testing parameters are presented in Table 11. Filtration should be carried out in the field for all samples unless otherwise specified so that results are representative of dissolved concentrations. All samples should be maintained at approximately 4 degrees C as part of the preservation protocols before being transferred to the laboratory.

*Table 11: Sample Filtration and Preservative Requirements*

| Analyte suite | Field Filtration | Chemical preservative |
|---|---|---|
| General Water Quality | Not required | Not Required |
| Nutrients | 0.45µm | Sulphuric acid |
| Dissolved Metals | 0.45µm | Not Required |
| Dissolved Iron Species | 0.45µm | Hydrochloric acid |
| Dissolved Arsenic Species | 0.45µm | Hydrochloric acid |
| Dissolved Hexavalent Chromium | 0.45µm | Sodium hydroxide |
| Petroleum Hydrocarbons | Not Required | Not Required |
| Aromatic Hydrocarbons (BTEXN) | Not Required | Not Required |
| Polycyclic aromatic hydrocarbons | Not Required | Not Required |
| Volatile organic compounds | Not Required | Sulphuric acid |
| Semi-volatile organic compounds | Not Required | Not Required |

| Analyte suite | Field Filtration | Chemical preservative |
|---|---|---|
| Organochlorine pesticides | Not Required | Not Required |
| Organophosphorus pesticides | Not Required | Not Required |
| PFAS | Not Required | Not Required |

### 7.2.3. Salinity Measurement

As described in Section 7.1, dedicated water level data loggers, which can measure both depth-to water and EC, will be installed in select standpipe piezometers between the Project and the closest saline water bodies.

EC results will be assessed to detect changes in water quality that may indicate the intrusion of saline water towards the Project. Where groundwater quality monitoring is also proposed, the field EC data will be assessed in conjunction with the laboratory data. Performance criteria for assessment of saline intrusion is included in Section 7.5.

## 7.3. Quality Assurance and Control Samples

The following quality assurance and control samples are proposed for the monitoring program. It is noted that per the PFAS NEMP (HEPA, 2020), where PFAS samples are collected, the frequency of analysis for QA/QC samples should be increased from what is defined in ASC NEPM (NEPC,2013). This has been considered below.

### 7.3.1. Rinsate Blanks

Rinsate blanks are used to estimate the amount of contamination introduced during the re-use of sampling equipment. Rinsate blank samples are obtained by pouring laboratory supplied deionised water over decontaminated sampling equipment (e.g., groundwater interface probe) and collecting the water in laboratory supplied bottles. Rinsate blank sample should be included at a rate of one per day of sampling or wherever uncertainty may arise regarding the potential for contamination.

Where PFAS is proposed for analysis, rinsate blanks should be collected at a rate of at least for every ten primary samples (10%).

### 7.3.2. Intra-Laboratory Duplicates

Intra-laboratory (blind) duplicate samples are used to identify variation in the analyte concentration between samples from the same sampling point. Intra-laboratory duplicates should be analysed at a rate of one per ten primary samples (10%).

### 7.3.3. Inter-Laboratory Duplicates (Triplicates)

Inter-laboratory (split) duplicate samples provide an indication of the repeatability of the results between laboratories. Inter-laboratory duplicates should be analysed at a rate of one per ten primary samples (10%).

### 7.3.4. Trip Blanks/Trip Spikes

A sample of laboratory supplied deionised water should accompany the primary samples over the course of the fieldworks and should be submitted to the laboratory for analysis. Trip blanks provide an indication of contamination introduced during sample transport and handling, and also ensure that the testing laboratory is not reporting “false positives”. Trip blanks should not indicate concentrations of the contaminants of potential concern (CoPC) above the laboratory detection limits. A trip blank sample should be included at a rate of one per batch.

Similarly, a laboratory provided trip spike should be submitted at a rate of one per batch. The trip spike will provide an indication of whether contaminant loss was possible during sample transport and handling. The results be used to identify the potential for false negatives.

### 7.3.5. Sampling Records

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

Details of all quality samples will be recorded on an internal database.

### 7.3.6. Decontamination

Equipment will need to be cleaned periodically and between sampling locations to prevent a build- up of dirt and cross-contamination. The following methodology will be followed:

- Rinse the equipment in tap water
- Clean with Decon 90 (a phosphate free detergent), or Liquinox (or similar) where PFAS is analysed for
- Rinse with tap water
- Thorough rinse with laboratory supplied de-ionised water
- Allow to dry away from dust and direct sunlight.

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

### 7.3.7. Laboratory Analysis

Laboratory analysis procedures for groundwater samples are discussed in Section 9.

## 7.4. Data Analysis

The groundwater monitoring program will be used to assess any changes in groundwater quality over the course of the Tunnelling, Excavation and Associated Works. The key performance criteria for groundwater quality are discussed in Section 7.5. Monitoring frequency will be increased from quarterly to monthly for any parameter identified as having a reportable change based on the performance criteria attributable to the Project.

Data analysis procedures for groundwater quality will involve collating and assessing results from the following sources:

- Stabilised readings from field parameter measurements
- Laboratory testing results
- Transducers fitted with salinity sensors.

Field and laboratory data will be collated into a master database that will be updated with new information on completion of each monitoring event to include raw data and statistical summaries. Raw data results and statistical summary data collated in spreadsheets will be compared against the performance criteria for groundwater quality and salinity to assess whether further investigations or management responses are required.

## 7.5. Performance Criteria

Trigger levels derived from the baseline monitoring data have been adopted as the indicator values of the performance criteria for groundwater quality. Any changes in groundwater quality will be measured relative to these performance criteria. A summary of the Trigger Action Response Plan (TARP) is provided in **Error! Reference source not found.**.

*Table 12 Trigger Action Response Plans for Groundwater*

| Category | Performance Criteria | Action | Response |
|---|---|---|---|
| Groundwater Inflows | I1. Water quality at inlet to Water Treatment Plant exceeds ANZECC 95% default guideline values for marine ecosystems. | Treatment to EPL discharge criteria | Refer to SWQMP. |
| | I2. Material decline in groundwater supply (quality or quantity) at a registered groundwater work | Hydrogeological investigation to assess if associated with Project dewatering activities. | Make good provisions to be implemented |
| Groundwater Quality | Q1. A parameter exceeding the ANZG/ANZECC marine 95% species protection | Investigate | Immediate management response (if required) |

| Category | Performance Criteria | Action | Response |
|---|---|---|---|
| | trigger values for two consecutive monitoring events, which has been recorded during baseline monitoring as below the limit of reporting | | |
| | Q2. A parameter increasing in concentration over a sustained period (i.e., for at least 3 months) to more than 2x the 99$^{th}$ percentile of its baseline value in any monitoring bore, where the 99$^{th}$ percentile of the baseline value exceeds the ANZG/ANZECC marine 95% species protection trigger value | Repeat sampling to confirm measurement. | Immediate management response (if required) |
| Saline Water Migration | S1. EC more than two times larger than the baseline 99th percentile for two consecutive samples. | Repeat sampling to confirm measurement. | Trigger S2. |
| | S2. EC more than two times larger than the baseline 99th percentile for three consecutive samples and exhibits a rising trend, or exceeds three times the baseline 99th percentile | Investigate, including review of historical and surrounding monitoring bore data, and modelling predictions | To be confirmed following investigation |
| | S3. Exceedance of infrastructure target salinity value | To be advised. | To be advised. |

A reportable change in groundwater quality will be defined as:

- A parameter exceeding default guideline values (DGVs) over a sustained period (i.e., for at least two, 2, consecutive monitoring rounds), which has been recorded during baseline monitoring as non-detect or below trigger value criteria, or
- A parameter increasing in concentration over a sustained period (i.e., for at least two, 2, consecutive monitoring rounds) to more than two (2) times the baseline trigger value, where the baseline trigger value exceeds the DGV trigger value
- An increase of salinity (measured as total dissolved solids (TDS) over a sustained period (i.e., for at least two, 2, consecutive monitoring rounds) to more than two (2) times the recorded 95th percentile baseline trigger value

If significant / reportable changes in groundwater quality and salinity are identified, then further investigation may result in the requirement for additional monitoring and management responses to be implemented as necessary.

### 7.5.1. Application of Trigger Values

An update to the trigger values was undertaken by Epic Environmental in 2024. The most significant change was the use of aquifer-specific, rather than well-specific data to determine trigger values. This update was undertaken to decrease the potential for identifying false positives in groundwater trends by significantly increasing the size of the datasets used to calculate the trigger values. The Epic Trigger Value Technical Memo attached in Appendix B further details the updates made. Where the statistically

significant trend (via Mann Kendall trend analysis on all available data, or other appropriate means) in groundwater quality is identified and the two (2) time baseline trigger value multiplier is exceeded, this will trigger further desktop investigation and a management response. The objectives of the desktop investigation are to determine if:

- The contaminant concentrations are likely to present a potential immediate risk to human health or the environment which have previously not been identified (e.g. concentration significantly exceeds site concentration maximums), or
- The contaminants have potentially been introduced to groundwater directly as a result of construction activities (e.g. TRH introduced from site leaks and spills), or
- Contaminant migration is potentially occurring resulting in degradation of groundwater quality.

Desktop investigation may include but not be limited to:

- Assessment of potential sources of contamination
- Comparison to existing site data
- Comparison against nearby well data for similar/same aquifers
- Investigation of recent site activities (eg. unexpected finds, incidents)
- Assessment of contaminant migration pathways

Additional monitoring and management responses are to be undertaken in circumstances where any of the below mentioned scenarios are demonstrated as likely to have occurred/been occurring. Monitoring frequency is to be to increased to monthly to further assess the potential requirements for management responses.

If required, an immediate management response will be initiated as soon as reasonably practicable (within 48 hours). An immediate management response will be initiated for groundwater quality if any of the following occurs:

- The contaminant concentrations present a significant immediate risk to human health or the environment requiring immediate response, or
- The contaminants have been introduced to groundwater directly as a result of Tunnelling, Excavation and Associated Works (e.g., on site leaks and spills), or
- Contaminant migration is occurring and resulting in degradation of groundwater quality within and around sensitive receptors (including groundwater supply bores).

An immediate management response will be initiated for groundwater salinity if any of the following occurs:

- The EC or water quality data continuously exceeds the trigger value over a period of two monitoring periods and depicts a rising trend, or
- The EC or water quality data exceeds the trigger value at any time by more than two (2) times the recorded 95$^{th}$ percentile value prior to Tunnelling, Excavation and Associated Works.

The process of further assessment and investigation in response to significant/reportable changes is represented in the flow chart presented in Figure 4.

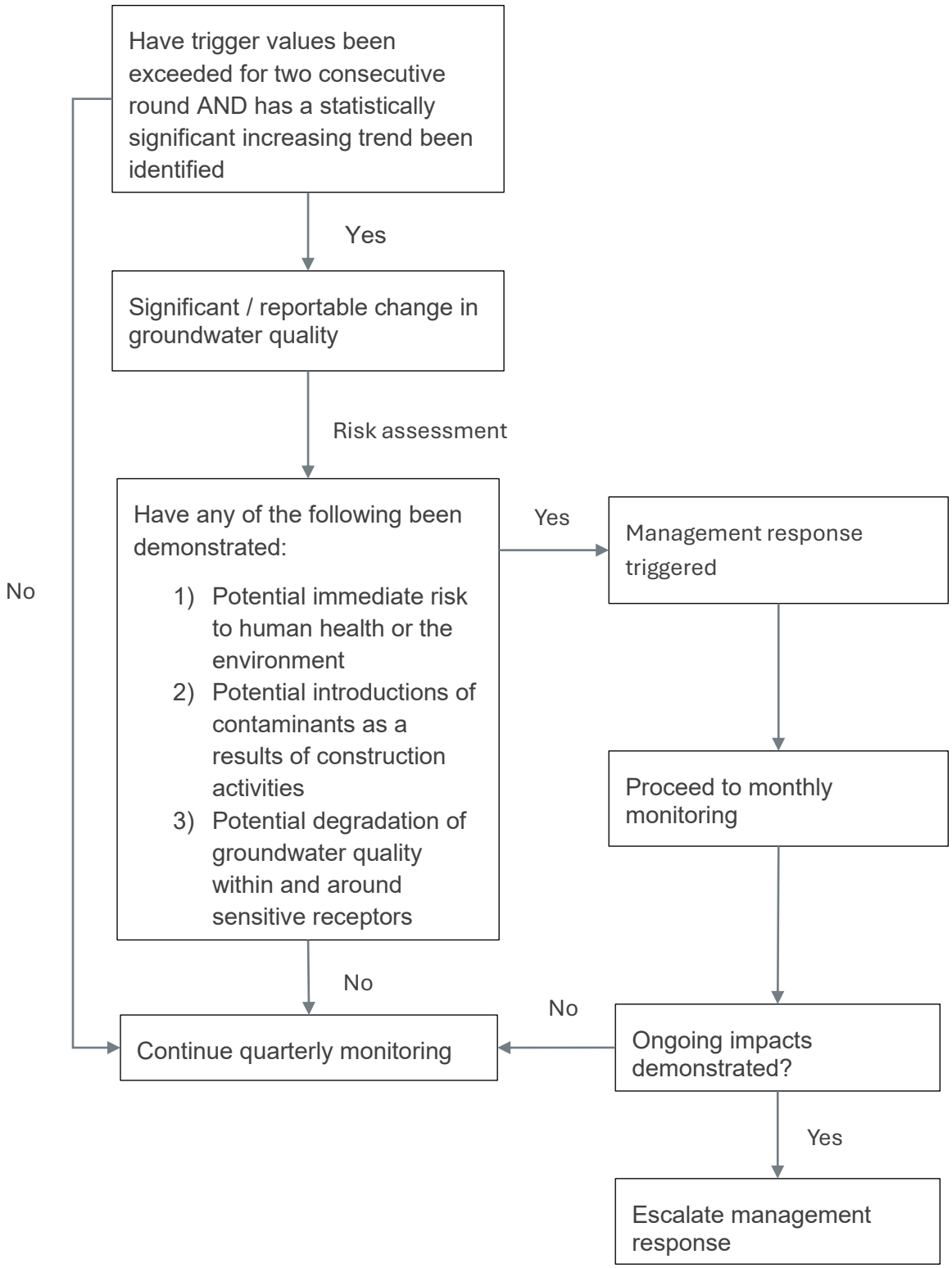


*Figure 4: Trigger value exceedance response process*

It should be noted that saline intrusion has not been identified as a significant risk factor in the context of the Project activities given the absence of GDE's and private groundwater wells at risk. Despite this, performance criteria to assess potential for saline intrusion have been adopted as part of a best management practice approach.

Assessment of the activation of Acid Sulfate Soils (ASS) will involve plotting major anion and cation compositions and pH on a Schoeller diagram to identify deviations in the concentration of base cations before (i.e., baseline conditions) and during dewatering. Total alkalinity decreasing below 30mg/L is considered to represent a reduction in the acid buffering capacity of the soil. If pH reduces by a unit as compared to the baseline pH range prior to excavation, this indicates that ASS have been activated.

The estimated groundwater aggressivity (tendency for corrosion) pre- and during Tunnelling, Excavation and Associated Works will be assessed following the Langelier Saturation Index (LSI). The following definitions for interpretation of LSI will be used to determine groundwater aggressivity and implementation of mitigation measures:

- LSI <0.5 (potential for scaling)
- Log Cl/CO3 >2 (potentially corrosive)
- pH (for bedrock) = 4.5 – 5.5 (moderately aggressive)
- pH (for bedrock) = 5.5 – 6.0 (mildly aggressive)
- SO4 (for bedrock) = 0 – 1,000 mg/l (mildly aggressive)
- SO4 (for bedrock) = 1,000 – 3,000 mg/l (moderately aggressive)
- Cl (for bedrock) = 0 – 3,000 mg/l (non-aggressive)
- Cl (for bedrock) = 3,000 – 6,000 mg/l (mildly aggressive).

No existing potential vapour intrusion risks have been identified based on baseline data previously collected, and therefore no SSTVs for VOC have been developed. Additional analysis for VOC along the alignment in existing monitoring bores is proposed to provide the baseline conditions.

If VOC are detected and assessed as a potential risk based on the additional baseline data collected, a risk monitoring framework for vapour intrusion will be adopted and Site Specific Trigger Values (SSTVs) will be developed to identify where existing conditions have been changed by Project activities, and an adverse change in risk may have occurred.

Any SSTVs developed will include three response levels:

- Alert – increase in monitoring frequency
- Action – adverse trend due to Tunnelling, Excavation and Associated Works, with action and/or additional assessment of risk required
- Not to exceed level.

Should unexpected groundwater conditions be encountered (beyond the potential exceedances of ANZECC 95% default guideline values (marine) identified during baseline monitoring), or groundwater monitoring indicates groundwater quality alteration due to contaminant migration, then the following corrective actions / measures will be evaluated and implemented as appropriate:

- Pump and treat from the vertical groundwater bores, to allow for the capture of possible contaminants migrating in groundwater prior to entering Project work areas
- Groundwater will then be treated, to meet discharge criteria, before disposal
- Preparation of a Remedial Management Plan
- If activation of ASS occurs, the immediate response should be to investigate further to confirm change in conditions and assess the need to dose with lime or to determine if action needs to be taken (e.g., commence groundwater recharge, alter dewatering practice etc / continue monitoring).

Make good provisions for groundwater users will be provided in the event of a material decline in water supply levels, quality or quantity from registered existing bores associated with groundwater changes from either Tunnelling, Excavation and Associated Works and/or ongoing operational dewatering caused by the Project.

# 8. Excavations and tunnel inflows

## 8.1. Excavations

Shafts and mined caverns are expected to be open for extended periods of time with variable inflow rates dependent on hydrogeological conditions and inflow control measures.

During the Tunnelling, Excavation and Associated Works, groundwater inflows to excavations will be collected in sumps / collection points and transferred via pumping to the WTPs located at:

- The Bays
- Pyrmont East
- Hunter St East.

Volume 4B (Particular Specification) Sydney Metro West Eastern Tunnelling Package Schedule C1 (Version 4.1 Sydney Metro, 2022) provides the design criteria for the assessment on inflow and drawdown; the inflow criteria are discussed further in Section 4.1.8. Section 4.2.2 (n) of the specification requires the provision of one sump for groundwater and stormwater collection at the base of each station shaft excavation.

### 8.1.1. Monitoring program

Groundwater inflow monitoring will be undertaken at all excavations for shafts and caverns.

Observations of inflows during the Tunnelling, Excavation and Associated Works will be undertaken to characterise contributions from surface water and groundwater into the excavations and to meet Condition C17 (e) and (j). This information will be assessed in combination with WTP discharge to develop an overall water balance.

The level of risk resulting from groundwater contamination and vapour will be determined as part of Detailed Site Investigations and Remediation Action Plans (refer to Section 7.9 of the SWMP). Where necessary, this GWMP will be revised in accordance with Section 9.2 of the SWMP to include additional monitoring. Monitoring of groundwater inflows into excavations (collected in sumps) will also be undertaken in response to unexpected contamination i.e. odour, visual indicators that are identified during regular inspections of the dewatering system.

### 8.1.2. Monitoring methodology

The inflow volume will be determined through the use of flow meters on each of the WTPs when they are established. Flow meters can also be installed on individual pumps within excavations where more focused inflow data is required.

Assessment of relative inputs from surface water and groundwater would be supported by the installation of a site-specific rain gauge.

### 8.1.3. Data analysis

The groundwater inflow monitoring register will be compiled quarterly to account for groundwater take from the Sydney Basin Central Groundwater Source in accordance with Condition C17(j). Results of this accounting will be included in the six-monthly groundwater monitoring reports.

### 8.1.4. Performance criteria

JCG must comply with the following for the drainage of caverns, shafts, and non-tunnel structures / assets:

- Crossover Caverns – undrained
- Turnback Caverns – undrained
- Station Caverns, Station Adits and Bligh Street Adit – undrained
- Station Shaft Excavations – drained.

The groundwater seepage within each station shaft excavation must not exceed:

- 15,000 Litres in any 24-hour period, measured over any square with an area of 10 $m^2$, at any and all locations within the sides and bases of the excavations; and
- The volumes identified below in any 24-hour period:

- Maximum volume calculated at 0.75 litres/second per 10,000m$^2$ of excavated surface such as the sides and base of the shaft excavations.

The above drainage criteria relate to the condition of the infrastructure at 'handover' to Sydney Metro for subsequent construction on internal station features. Handover is expected to approximate a period of two years after commencement of the Tunnelling, Excavation and Associated Works as indicated in the final tender program.

Where inflows are found to exceed the above inflow criteria, targeted grouting and/or alternative management measures may be undertaken to reduce inflow rates to excavations and achieve the required inflow criteria. Where a management response is required, this will be initiated as soon as reasonably practicable (within 48 hours). It is noted that a reduction in inflow rates over time is expected due to the gradual loss of storage in connected surface aquifers over the course of the Tunnelling, Excavation and Associated Works.

In the event of adverse inflows being encountered, management measures may be required to minimise long term groundwater inflows. The station shaft structures are to be constructed with perimeter walls socketed into the sandstone. As such, there will be limited groundwater ingress through the structure. One sump will be provided for each station shaft excavation, with long term discharge flows expected to be monitored with flow meters.

## 8.2. Tunnel inflows

TBM tunnelling direction is from the Bays to Hunter Street. As a result of the tunnelling methodology (slurry TBM), generally the internal tunnel wall will only be exposed for a very short time period (i.e., less than one hour) before being enclosed (i.e., sealed to groundwater inflow) behind pre-cast concrete units.

During tunnel construction, groundwater inflows will be collected in sumps / collection points at regular intervals within the tunnel. Collected water will be transferred via pumping or gravity drains to the WTP located at The Bays.

The inflows rely on bulk formation hydraulic conductivities. Localised high hydraulic conductivity rock features may be encountered that result in higher incidental inflow.

### 8.2.1. Monitoring program

Groundwater inflow monitoring is required in tunnels during progression of the tunnelling sections. The inflow monitoring program will continue throughout the tunnelling, excavation and associated Works with cumulative flow records from the main tunnel sump being used to provide information on groundwater inflow conditions for overall tunnel progression.

### 8.2.2. Monitoring methodology

The inflow volume will be determined through the use of flow meters on the intake into each of the WTP when they are established. Flow meters can also be installed on individual pumps throughout the tunnel where more focused inflow data is required.

### 8.2.3. Data analysis

The groundwater inflow monitoring register will be compiled quarterly to account for groundwater take from the Sydney Basin Central Groundwater Source in accordance with Condition C17(j). Results of this accounting will be included in the six-monthly groundwater monitoring reports.

### 8.2.4. Performance criteria

Volume 4B (Particular Specification) Sydney Metro West Eastern Tunnelling Package Schedule C1 (Version 4.1 Sydney Metro, 2022b) provides the design criteria for the assessment on inflow and drawdown.

The potential for groundwater drawdown impacts is relatively low compared to other tunnelling methodologies (i.e., primary use of roadheaders), noting that roadheaders are being used for caverns and turn back tunnels. Due to the short timeframe between the tunnel excavation and sealing, the inflow rates and resulting drawdown is not anticipated to be a significant issue for the Tunnelling, Excavation and Associated Works.

There are criteria specified for watertightness, which relate to the seepage of groundwater through finished internal walls of infrastructure that is undrained at handover. The tunnelling contractor must comply with the following for the drainage of tunnel assets:

- Running Tunnels – undrained
- Cross Passages – undrained
- Cross Passages with Sump – undrained
- Nozzle Enlargements – undrained.

# 9. Laboratory testing – water quality

## 9.1. Quality Assurance / Quality Control

The primary and secondary laboratories used for this project will be NATA-accredited for the analyses being undertaken and be chosen following a formal tender evaluation process. Laboratory methods are to be suitable for environmental contaminant analysis and are based on established internationally recognised procedures.

The ASC NEPM (NEPC 2013) and PFAS NEPM (HEPA, 2020) outline the approaches to be adopted for QC verification of field procedures.

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.

## 9.2. Laboratory Data Quality Indicators

### 9.2.1. Laboratory duplicate samples

Laboratory duplicate sample analysis is the analysis of a laboratory derived duplicate sample from the process batch, at a rate equivalent to one in 10 samples per analytical batch, or one sample per batch if less than 10 samples are analysed in a batch. A laboratory duplicate provides data on the analytical precision and reproducibility of the analytical results.

The permitted ranges for the relative percentage difference (RPD) of laboratory duplicates are dependent on the magnitude of the results in comparison to the level of reporting as summarised below:

- Result is < 10 x LOR: No limits
- Result is 10 - 20 x LOR: 0% - 50%
- Result is > 20 x LOR: 0% - 20%.

### 9.2.2. Method blank samples

Method or blank sample analysis are the analyses of a sample that is as free as possible of the analyte(s) of interest but has been prepared the same as the samples under investigation. The analysis is to ascertain if laboratory reagents, glassware and other laboratory consumables contribute to the observed concentration of analytes in the process batch. If below the maximum acceptable method blank (below practical quantification limit), the contribution is subtracted from the gross analytical signal for each analysis before calculating the sample analyte concentration. The method blank should return analyte concentrations as ‘not detected’.

### 9.2.3. Laboratory control samples

Laboratory control spike analysis is the analysis of either a reference material or a control matrix fortified with analytes representative of the analyte class. The purpose of laboratory control spike samples is to monitor method precision and accuracy independent of the sample matrix. Typically, the percentage recovery of the laboratory control spike sample is compared to the dynamic recovery limits based on the statistical analysis of the processed laboratory control spike sample analysis. Recoveries should lie between 70% and 130%.

### 9.2.4. Matrix spike samples

Matrix spike sample analysis is the analysis of one or more replicate portions of samples from the batch, after fortifying the additional portion(s) with known quantities of the analyte(s) of interest. The percentage recovery of target analyte(s) from matrix spike samples is used to determine the bias of the method in the specific sample matrix. Recoveries should lie between 70% and 130%.

### 9.2.5. Surrogate spike samples

Surrogate spike samples are samples with known additions of known amounts of compounds, which are similar to the analytes of interests in terms of extractability, recovery through clean-up procedures and response to chromatographic or other measurement. Surrogate compounds may be alkylated or halogenated analogues or structural isomers of analytes of interest. The purpose of surrogate spikes, which are added immediately before the sample extraction step, is to provide a

check for every analysis that no gross processing errors have occurred, which could have led to significant analyte loss or faulty calculation. Recoveries should lie between 50% and 150%.

#### 9.2.6. Internal standards

Internal standards are known additions of known amounts of compounds which are not found in real samples, will not interfere with quantification of analytes of interest and may be separately and independently quantified. The purpose of internal standards in instrumental techniques is to provide independent signals, which serve to check the consistency of the analytical step.

### 9.3. Water Quality Testing Parameters

All water quality samples will be scheduled for analysis of the parameters at the nominated NATA accredited testing laboratory, at the specified testing frequency. Sampling frequencies for quarterly parameters will be increased to monthly sampling in the event that laboratory testing results identify any exceedances of the adopted trigger values. Increased sampling frequencies will only apply to boreholes where the criteria exceedances are recorded.

Quality assurance / quality control samples will be scheduled for testing of all parameters except for the general water quality suite and major ions.

### 9.4. Suitability of Sampling Results

#### 9.4.1. Duplicate relative percentage difference

Blind and split duplicate samples will be assessed by calculating the RPD between the primary, blind and split samples.

RPD values are calculated using the following equation.

Where $C_0$ = reported concentration from primary sample
$C_S$ = reported concentration from duplicate sample

According to AS 4482.1 – 2005 (Standards Australia, 2005), typical RPDs are expected to range between 30% and 50%; however, this may be higher for concentrations which are close to the laboratory LOR. Considering this, the following RPD limits are acceptable, based on standard industry practice:

- 200% for concentrations within one to ten times the analyte LOR
- 50% for concentrations within ten to 30 times the analyte LOR
- 30% for concentrations greater than 30 times the analyte LOR.

#### 9.4.2. Calibration Records

All instruments will be calibrated in accordance with manufacturers specifications or relevant Australian Standards. Records of monitoring equipment calibration will be maintained by JCG throughout delivery of the Project.

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

#### 9.4.3. Calibration and Quality Assurance

All instruments will be calibrated in accordance with manufacturers specifications or relevant Australian Standards. Records of monitoring equipment calibration will be maintained by JCG throughout delivery of the Project.

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.

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 (2000) to ensure the integrity of each 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)
- 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.

## 10. Groundwater management strategies

The groundwater management strategies will be developed during the design and construction planning and will be confirmed in future updates to this GWMP. Generic groundwater management strategies may include the effects of the Project works on groundwater levels being subjected to detailed assessment as part of the HIR. This will assist in informing the design and construction controls for groundwater.

The majority of groundwater on the Project will be collected and treated at WTPs and discharged into local waterways. This will be undertaken in consultation with relevant stakeholders where there is potential for interaction with existing groundwater management programs.

Where this is not possible, groundwater will also be reused on site or disposed of as liquid waste in line with the waste classification guidelines.

If groundwater is proposed to be reused on site, the water will be tested to ensure the water is suitable for reuse and does not result in a human health or environmental risk from any contaminants of concern.

A full discussion on groundwater management strategies is provided in the SWMP. The performance criteria for beneficial reuse of groundwater are also discussed in the SWMP.

Groundwater reinjection is not currently being considered as a groundwater disposal option or management strategy.

# 11. Compliance management

## 11.1. Roles, responsibility and training

The JCG organisational structure and overall roles and responsibilities are outlined in the Section 4 of the SWMP. Specific responsibilities for the implementation of environmental controls are detailed in Section 7 of the SWMP.

All groundwater monitoring will be carried out by an appropriately trained and competent persons who are familiar with the requirements of the relevant standards and procedures detailed in this GWMP. Specific targeted training will be developed by the Environment, Approvals and Sustainability Director to ensure that officers involved in water quality monitoring are appropriately trained in sample collection, decontamination procedures, quality assurance sampling, and the correct use of equipment.

Further details regarding staff induction and training are outlined in Section 3.8 of the CEMP.

## 11.2. Monitoring and inspection

This GWMP details the monitoring requirements for groundwater. In accordance with Section 3.11 of the CEMP, the Environment, Approvals and Sustainability Director will be responsible for ensuring monitoring activities are undertaken with this GWMP. Additional requirements and responsibilities in relation to inspections are documented in the SWMP and Section 3.11of the CEMP.

## 11.3. Compliance and Auditing

Compliance monitoring and auditing (both internal and external) will be undertaken to assess the effectiveness of environmental controls, and verify compliance with this GWMP, the SSI 19238057 Infrastructure Approval, and other relevant approvals, licenses and guidelines. Compliance and auditing requirements are detailed in Section 3.12 of the CEMP.

## 11.4. Reporting

During the Tunnelling, Excavation and Associated Works, groundwater quality monitoring data will be collected, tabulated and assessed against baseline conditions and performance criteria. Reporting requirements associated with the GWMP are presented in Table 13.

*Table 13: Groundwater Monitoring Reporting Requirements*

| Report | Content | Frequency | Recipient |
|---|---|---|---|
| Groundwater Monitoring Report | Data summary reports presenting tabulated groundwater monitoring data collected during the reporting period including:<br>▪ Water quality data<br>▪ Groundwater levels, inflow and any actions and responses<br>▪ All monitoring results (including groundwater levels, quality, inflow, WTP monitoring and discharge volumes) and the results will be analysed against relevant performance criteria<br>▪ Groundwater gauging at excavations, groundwater trigger events and action responses. | 6 monthly within 40 business days of the reporting period | DPE (Planning Secretary)<br>DPE Water<br>NRAR<br>EPA (if requested)<br>Sydney Water (where discharges are directed to their assets)<br>Sydney Water<br>ER |

Notes:

1. With regards to monitoring data to be provided to DPE Water, the format of the dataset will be both in a tabulated and electronic quality-controlled data (.csv, Excel) ready to use format.

# 12. Review and improvement

## 12.1. Continual improvement

Monitoring data will be reviewed throughout the Tunnelling, Excavation and Associated Works to identify opportunities for continual improvement. The continual improvement process will be undertaken in accordance with the CEMP with a view to:

- Identify opportunities 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
- Make comparisons with objectives and targets.

## 12.2. Monitoring Network

The groundwater monitoring network outlined in Table 7 will be implemented throughout the construction phase of the Project. Monitoring at each well will commence prior to the commencement of activities in each location that will have a potential impact on groundwater level or groundwater quality. The expected date for commencement of monitoring at each location is detailed in Table 8.

Monitoring of groundwater levels through the download of dataloggers and manual level readings will continue on a quarterly basis following the commencement of monitoring at each well. Quarterly download of groundwater level data loggers and data review will continue until the levels have remained stable or shown recovery over three successive months. Following the completion of groundwater level monitoring, dataloggers will remain in place for the duration of the Project and will be downloaded at the completion of the works. This will provide a continuous dataset for future reference if required.

Monitoring of groundwater quality will continue on a quarterly basis following the commencement of monitoring at each well. Monitoring of groundwater quality will continue until groundwater levels have remained stable or shown recovery over three successive months.

Any decision to cease monitoring at a particular location will be done in consultation with a qualified Hydrogeologist, the Environmental Representative and Sydney Metro, and will be documented in the 6-monthly monitoring report. This document (Groundwater Monitoring Plan) will be updated as part of the annual review.

## 12.3. Document review

This revision of the GWMP relies upon the tender stage evaluation of the project and groundwater requirements. This GWMP will be further developed in parallel with the design documentation and construction planning, including supplementary investigations and the development of the ETP Hydrogeological Interpretive Report (HIR). The HIR will present the detailed evaluation of groundwater conditions including the influence of the Tunnelling, Excavation and Associated Works on those conditions.

Revisions of this GWMP will occur in accordance with Section 3.14.2 of the CEMP.

A copy of the updated GWMP and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure.

# Part B Annexures

## Appendix A Existing groundwater level and water quality monitoring results

See Biannual Water Monitoring Report

# Appendix B Trigger Value Update Technical Memo

HBI Healthy Buildings International Pty Ltd
A.C.N. 003 270 693 A.B.N. 39 003 270 693

Suite 2.06, Level 2
29-31 Solent Circuit
Norwest, NSW 2153

Tel: 61 (02) 9659 5433
e-mail: hbi@hbi.com.au
Web:

www.hbi.com.au

Mr Ryan Butler
A/Director Sustainability, Environment and Planning
Metro West
Sydney Metro
Transport for NSW
PO Box K659
HAYMARKET NSW 1240

10 September 2025

REF: 201208 (G) GWMONPROG_Rev 6

Dear Ryan

**RE: Sydney Metro West Stage 2 – Eastern Tunnelling Package: Groundwater Monitoring Program (Rev 6) (Appendix B of the Soil and Water Management Sub-Plan)**

I refer to Sydney Metro's (SM) submission of the following document required by Condition C15 and C18 of the Sydney Metro West – The Bays to Sydney CBD Approval (SSI 19238057) which was approved by the Department of Planning and Environment (DPE) on 24 August 2022:

- Sydney Metro West, Eastern Tunnelling Package Groundwater Monitoring Program Rev 6 dated 9 September 2025 (SMWSTETP-JCG-SWD-SW000-EN-PLN-002026)

The document forms Appendix B of Sydney Metro West, Eastern Tunnelling Package Soil and Water Management Sub-Plan Rev 5 dated 25 July 2025 (SMWSTETP-JCG-SWD-SW000-EN-PLN-002014). This document was not updated and is not part of this approval.

It is noted that:

- Previous versions of the GWMonProgram have been assessed as part of the SWMP approvals and various revisions.
- This Rev 6 of the GWMonProgram was updated to reflect the removal of 3 boreholes that will be decommissioned due to their proximity to the alignment of the TBM and the stated risk by JCG that TBM tunnelling works could interact with the boreholes.
- Sydney Metro has completed a review of the changes and does not have any open comments on Rev 6 of the document.

Following the above, the amendments made in Rev 6 of the document are considered to remain consistent with the Conditions of Approval (SSI 19238057) in relation to the Groundwater Monitoring Program.

As the approved Environmental Representative for the Sydney Metro West and as required by Condition A32(j), on the basis of the above, the Groundwater Monitoring Program (Revision 6) is approved.

Yours sincerely

*Michael Woolley*
Michael Woolley

Environmental Representative – Sydney Metro West – Eastern Tunnelling Package
CC: Ari Stypel and Sara Yasi.