ENVIRONMENT
& HEALTH

RESPONSE TO EPA PREVENTION NOTICE 3503607 MANAGEMENT OF TARAGO RAIL YARD CONTAMINATION

Project name	**Management of Tarago Rail Yard Contamination**
Project no.	**318001376**
Recipient	**Joanne McLoughlin, Transport for New South Wales** **E: Joanne.Mcloughlin@transport.nsw.gov.au**
Document type	**Report**
Description	**Response to EPA Prevention Notice 3503607 addressing all directions to take preventative action.**

Revision	Date	Prepared by	Checked by	Approved by
Draft	6/10/2022	Jordyn Kirsch and Greer Laing	Stephen Maxwell CEnvP (SC) 41184	Fiona Robinson
Final	7/10/2022	Jordyn Kirsch and Greer Laing	Stephen Maxwell CEnvP (SC) 41184	Fiona Robinson

Ramboll
Level 2, Suite 18 Eastpoint
50 Glebe Road
PO Box 435
The Junction
NSW 2291
Australia

T +61 2 4962 5444
https://ramboll.com
https://ramboll.com

CONTENTS

1. Background 3
1.1 NSW EPA Prevention Notice 3503607 3

2. Preventive Action 6: Review of the Monitoring/Inspection Program 4
2.1 Compliance summary – routine inspections 4
2.2 Compliance summary – other matters 5
2.3 Surface water monitoring 6
2.4 Air quality monitoring program 7
2.4.1 Overview 7
2.4.2 Summary of the 2020/2021 air quality monitoring program 7
2.4.3 Basis of the discontinuation of the air quality monitoring program 11
2.4.4 Meteorological conditions since discontinuation of the air quality monitoring program 12

3. Preventive Actions 1, 4 and 5: Ramboll Site inspection 16
3.1 Recommendations for Corrective Actions 16

4. Preventive Action 2: Corrective Actions 17

5. Action Plan Revision 17

6. Summary Response 18

Limitations 19

References 19

1. Appendix 1: Figures 20

2. Appendix 2: Inspection Record Compliance Assessment 21

3. Appendix 3: September 2022 Surface water Monitoring Report 22

4. Appendix 4: Ramboll Photographs 23

5. Appendix 5: UGL RL Photographs 24

6. Appendix 6: Tarago Lead Management Action Plan 25

1. Background

Ramboll Australia Pty Ltd (Ramboll) has provided assessment and management advice to John Holland Rail (JHR) and Transport for New South Wales (TfNSW) for contamination at or originating from the Tarago Rail Siding (the Site) which was historically used to load-out ore concentrates. Previous investigation identified contamination from this activity to be present within an area of approximately three hectares within the corridor as shown on the **Figures 2a – 2e**, **Appendix 1**[1].

The Tarago Lead Management Action Plan here-in referred to as the Action Plan (Ramboll 2020a) was developed to address risks related to exposure to lead from the Site and has been in effect since July 2020.

1.1 NSW EPA Prevention Notice 3503607

On 8 September 2022 the NSW EPA issued a Prevention Notice (Notice Number 3503607) with directions to take preventative action related to the interim containment of stockpiled soils, previous application of polymer sealant to surface soils at the Site and the capacity of monitoring / inspection programs to identify emerging issues with the integrity of Site pollution controls. Specific directions to take preventive action were:

1. Undertake a detailed inspection of the integrity of the encapsulation layers of the interim containment cell (i.e., capped stockpile).
2. Where deficiencies are identified, undertake all necessary works to reinstate the encapsulation layer to prevent surface or air pollution
3. Undertake an assessment of the adequacy and efficiency of surface water controls at the Site and implement any required works or measures to ensure contamination is not remobilised to waters
4. Undertake an inspection of the polymer application area on the historic rail siding to identify any defects or deficiencies with the polymer layer
5. Identify any other areas that require controls implemented to prevent the movement of soil by surface water or dust.
6. Undertake a review the monitoring/inspection programs capacity to identify emerging issues with the integrity of the Site pollution controls and ensure that rectification works are undertaken to resolve any identified issues in a timely manner.
7. Submit a report to the EPA detailing the findings of above inspections, associated works completed, and findings/outcomes of the inspection program review.

This report is presented to address Preventive Action 7.

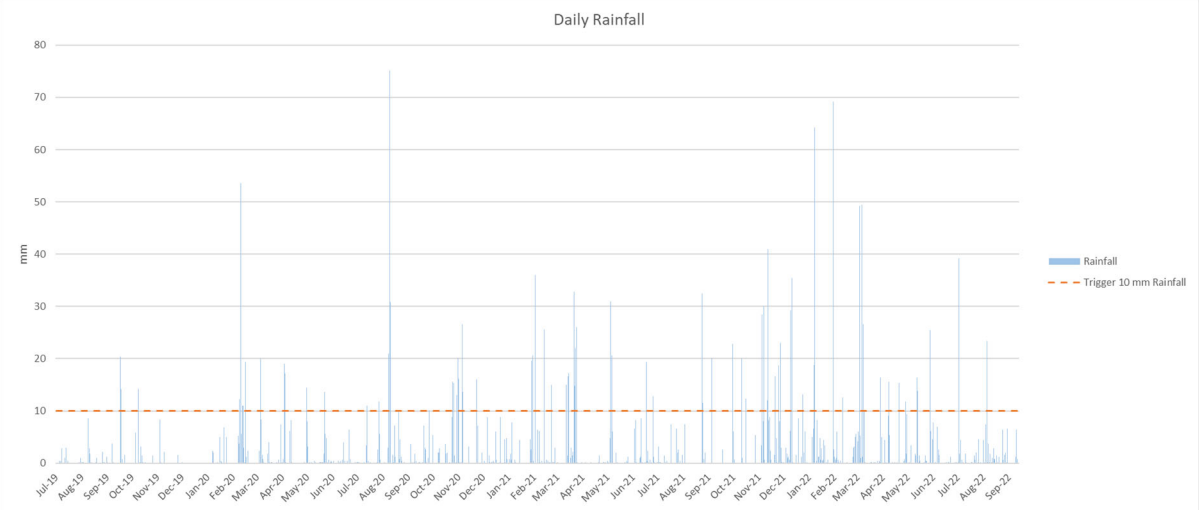
[1] Further assessment of the Tarago Station including the carpark and area between the carpark and 106 Goulburn Street was completed and concluded that risks associated with lead in this area were low and acceptable (Ramboll 2020b).

2. Preventive Action 6: Review of the Monitoring/Inspection Program[2]

2.1 Compliance summary – routine inspections

The objective of the Action Plan (Ramboll 2020a) was to address risks from exposure to lead from the Site due to the presence of lead containing ore. Specific actions included measures to prevent further offsite migration of contamination via airborne dust or surface water and monitoring to assess the effectiveness of these measures. Monitoring was to occur on a monthly basis or following >10 mm of rainfall in a 24-hour period through completion of a checklist appended to the Action Plan. Instances of > 10mm of rainfall in a 24-hour period since the Action Plan was initiated (July 2020) are presented in **Figure 2-1.**

Figure 2-1: Daily Rainfall (BoM)



Ramboll completed an audit of monitoring checklists provided for the period of July 2020 to September 2022, a detailed summary sheet is provided in **Table 1**, **Appendix 2**.

Evidence of inspections provided for review indicates compliance with requirements described in the Action Plan with the following exceptions:

- Records were not provided for the period April 2021 - March 2022
- The Bureau of Meteorology reported 29 events where >10 mm rainfall occurred in non-consecutive 24 hour periods since July 2020 (refer to **Figure 2-1**). Records were not provided for five of these events outside the April 2021 – March 2022 period.
- Records were not provided for monthly monitoring during September 2020 or December 2020.

Generally, corrective actions were not proposed where inspections identified non-compliant controls.

In June 2021 it was identified that records for inspection of the polymer sealant didn't adequately describe the condition of the sealant and so Ramboll inspected sealed areas (from the Station platform). **Photograph 1** below presents the Woodlawn Siding opposite the train station platform as observed by Ramboll in June 2021.

[2] This report is structured based on chronology of events related to management of contamination at the Site and differs from the order that the EPA presented directions for preventive action in the Prevention Notice.

Photograph 1: Polymer Sealant on the Woodlawn Siding in January 2021

Darker and lighter patches of surface soil visible in **Photograph 1** were evident adjacent the Woodlawn Siding close to the former loadout area in June 2021. The observed colour differential was considered indicative of polymer sealant degradation or movement of unsealed sediments over the top of sealed soils. While this indicated potential for increase offsite contaminant migration recent monitoring of surface water and air quality indicated that risks associated with potential offsite contaminant migration remain low. Within this context Ramboll recommended to the site auditor (Ramboll email 2021a) that reinstatement of the polymer sealant was not required.

2.2 Compliance summary – other matters

Several additional controls are presented in the Action Plan that are not captured on the inspection checklist. These are:

- All excavation works undertaken within the lead impacted areas identified onsite are deemed lead risk works and specific work methods developed for these works should include notification to SafeWork NSW of lead risk work evidence of excavation to improve sediment controls upstream of each of the three rail culverts at the Site was observed however documentation describing this corrective action was not provided for review. Evidence of specific work methods and notification to SafeWork NSW of lead risk work was not provided for review and so compliance with these provisions remains unclear.
- Verification of the adequacy of controls was to occur through monitoring of surface water and air quality within the receiving environment. Further detail of these monitoring programs is presented in **Sections 2.3** and **2.4.**
- Periodic review of the Action Plan is prescribed at least annually. The Action Plan has been in place 27 months and so two annual reviews should have occurred however no evidence of this review was provided.

The following opportunities for improvement were identified based on review of the inspection records provided:

- Action Plan inspections should be completed by a UGL Representative suitably trained and experienced in application and management of erosion and sediment controls including stockpile management.
- Evidence of non-conformances identified during inspections should be adopted as a trigger for corrective action.
- Inspections should be completed in accordance with the identified triggers.
- Corrective actions should be recorded for any non-conformance and implemented immediately following identification.
- Periodic review of the Action Plan should be completed at least annually and include assessment of whether the Action Plan an assessment of the compliance of the inspection program.

2.3 Surface water monitoring

Surface water monitoring relevant to contamination at or from the Site was completed on quarterly intervals from August 2019 to July 2021 and was progressively expanded to increase monitoring within the downstream environment.

The monitoring data was considered representative of the effects of rainfall variation on contaminant transport from the Site. Within this context the surface water monitoring data was considered adequately representative of the effects of reasonably foreseeable potential climatic influences to inform assessment of associated risks to human health and the environment.

Monitoring results indicated no evidence of offsite migration of contaminants in surface water that would represent an unacceptable human health risk, with no reported exceedances in the adopted human health criteria for the contaminants of concern in the April 2021 monitoring event and minor exceedances indicative of regional impacts not related to the Site in previous monitoring data.

Similarly, monitoring results indicated no evidence of offsite migration of contaminants in surface water that would represent an unacceptable ecological risk. Concentrations of lead, copper and zinc observed in the Mulwaree River were consistent with background concentrations and did not indicate impacts from the Site.

Surface water monitoring was discontinued in April 2021 as the monitoring data was considered representative of the effects of potential meteorology and indicate risks to human health and/or ecology in the receiving environment were low.

In August 2022, the EPA accredited site auditor provided an opinion that in the absence of activities in the rail corridor Site disturbing the surface, ongoing surface water monitoring prior to remedial activities was not required (JBSG 2022). Notwithstanding this advice, surface water monitoring recommenced with fieldwork completed between 12 and 13 September 2022.

Ramboll has prepared a report presenting the findings of September 2022 surface water monitoring (Ramboll 2022a) which is presented as **Appendix 3**. Monitoring results indicated no evidence of offsite migration of contaminants in surface water that would represent an unacceptable human health risk, with no reported exceedances in the adopted human health criteria for the contaminants of concern.

Similarly, monitoring results indicated no evidence of offsite migration of contaminants in surface water that would represent an unacceptable risk to ecology. Concentrations of lead, copper and zinc observed in the Mulwaree River were consistent with background concentrations and did not indicate impacts from the Site.

It is noted that controls relevant to mitigating contaminant impacts such as the polymer sealant and recently improved sediment controls upstream of rail culverts have changed since the Action Plan (Ramboll 2020a) commenced. Despite changes to surface water and sediment controls, monitoring indicates that contaminant exposure risks within the receiving environment have remained low. Within this context current controls (noting recent implementation of additional controls as described under **Sections 3** - **5**) are considered adequate.

2.4 Air quality monitoring program

2.4.1 Overview

Ramboll was commissioned by John Holland Rail Pty Ltd (JHR) to implement and maintain an air quality monitoring program to inform air quality impacts resulting from retained lead containing ore within the Goulburn – Bombala rail corridor in the Tarago Area. The focus of this air quality monitoring program was lead in particulate form, both for ambient airborne fractions and deposited dust. The program was commissioned in Tarago on 7 April 2020 and decommissioned on 31 July 2021. The program did not capture the period prior to dust mitigation measures commencing by JHR.

The results of the air quality monitoring program have been summarised in this report, with detailed methodology available in the set of reports prepared for the air quality program (Ramboll 2021b and preceding versions). The results from the final version of this report (August 2021) are reproduced here.

2.4.2 Summary of the 2020/2021 air quality monitoring program

Lead is emitted to air from both natural and anthropogenic sources. Ambient lead levels in NSW have decreased significantly since the phase-out of lead-based fuels but risk remains in areas where local point sources exist, such as metal smelting facilities, mining operations and waste incineration.

The air quality monitoring program in Targo was designed to measure airborne particulate matter in total suspended particulates (TSP), lead in deposited dust and a supplementary continuous near-reference continuous measure of particles of known health concern (e.g. PM_{10}, $PM_{2.5)}$. The relevant Australian Standards and guidance standards applied to the program are provided in the air quality monitoring reports (Ramboll 2021).

The relevant NSW ambient air quality criteria applied to understand measured concentrations during the monitoring program are provided in **Table 2-1**.

Table 2-1: Air quality criteria relevant to JHR Tarago air quality monitoring program

Pollutant	Averaging period	Criteria	Source
Lead	Annual	0.5 μg/m³	NEPC (1998)
TSP	Annual	90 μg/m³	NHMRC (1996)
$PM_{2.5}$	24 hours	25 μg/m³	DoE (2016)
	Annual	8 μg/m³	DoE (2016)
PM_{10}	24 hours	50 μg/m³	DoE (2016)
	Annual	25 μg/m³	DoE (2016)
Deposited dust	Annual	4 g/m²/month	NERDDC (1988)

All 24-hour average lead concentrations from TSP measured every 1 day in 6 during the program were below the annual average lead criterion (refer to **Figure 2-2**). All TSP measurements were below the annual average criterion (refer to **Figure 2-3**).

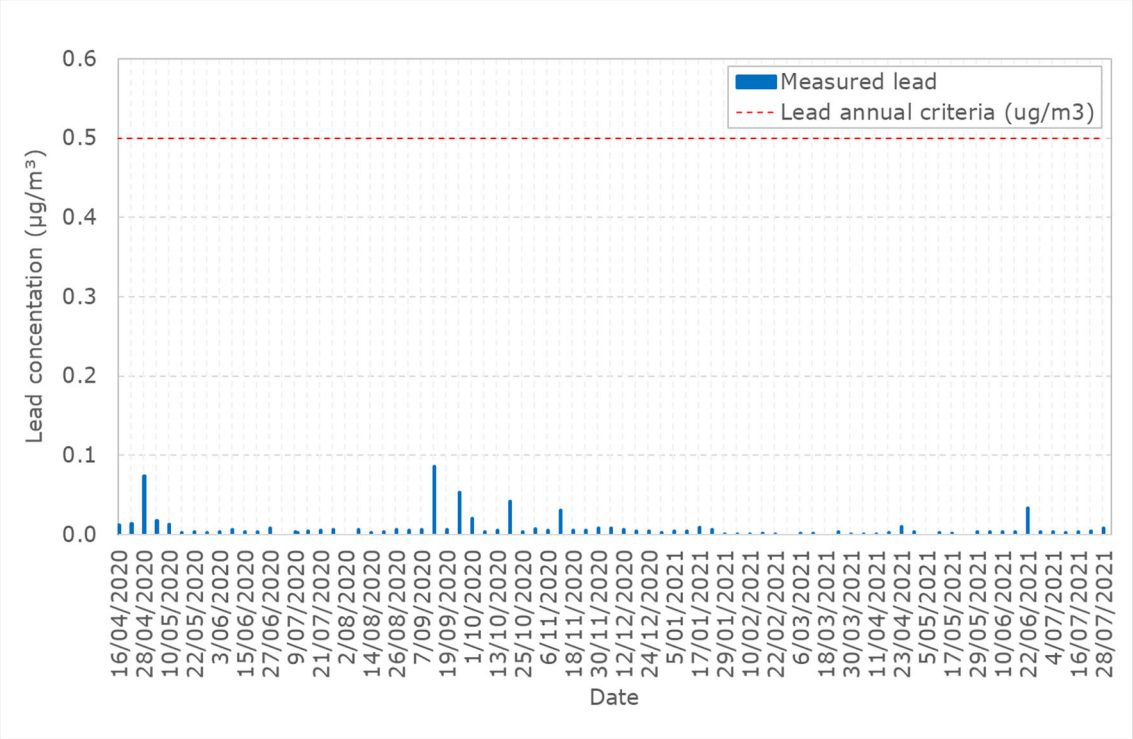


Figure 2-2: Measured 24-hour average lead concentration in TSP, one day in six since program commissioning

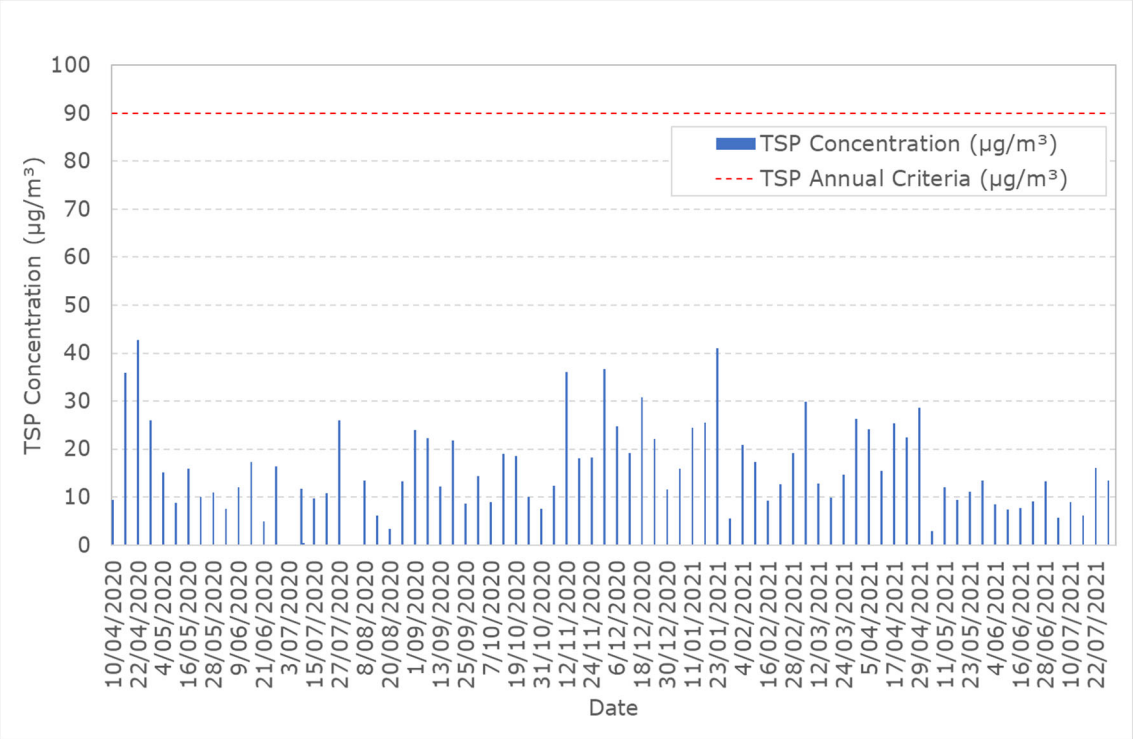


Figure 2-3: Measured 24-hour average TSP concentration, one day in six since program commissioning

For all valid deposition samples during the program (i.e., not contaminated or damaged), no lead was measured above the limit of reporting (refer to **Table 2-2**). The rolling average for dust deposition was below the annual average air quality criterion for this parameter for the duration of the monitoring program in all locations, when considering all valid samples.

Correlation between lead and TSP concentrations from the same 24-hour sample was analysed for the program (refer to **Figure 2-4**). A number of outliers for higher lead concentrations were identified in April and May 2020, October and November 2020 and June 2021. This may suggest that local lead sources were disturbed during these periods. Decreasing lead concentrations with no corresponding decrease in TSP concentrations later data in the program may suggest a lower fraction of lead in TSP over time.

Table 2-2: Measured lead content in deposited dust and deposited dust at four properties around Tarago, NSW

Month	DDG1, Stewart St		DDG2, Station Masters Cottage		DDG3, Boyd St		DDG4, Mulwaree St	
	Lead (µg)	Insoluble solids (g/m2 /month)	Lead (µg)	Insoluble solids (g/m2 /month)	Lead (µg)	Insoluble solids (g/m2 /month)	Lead (µg)	Insoluble solids (g/m2 /month)
April (1-4-2020 to 30-4-2020)	<0.01	1.0	<0.01	0.7	<0.01	0.6	<0.01	0.4
May (30-4-2020 to 1-6-2020)	<1	0.9	<1	0.4	<1	0.4	<1	0.3
June (1-6-2020 to 1-7-2020)	<1	0.9	<1	0.5	<1	1.3	<1	0.3
July (1-7-2020 to 13-08-2020)	<1	1.9	<1	0.8	<1	0.2	<1	0.7
August (13-08-2020 to 1-09-2020)	<1	0.5	<1	0.2	<1	0.2	<1	0.2
September (1-09-2020 to 30-09-2020)	<1	2.1	<1	1.2	<1	7.2[a]	<1	0.8
October (30-09-2020 to 30-10-2020)	<1	3.0	<1	3.9	<1	1.4	<1	1.2
November (30-10-2020 to 1-12-2020)	<1	0.9	<1	1.4	<1	1.2	<1	0.6
December (1-12-2020 to 29-12-2020)	<1	2.3	<1	1.0	<1	4.0	<1	1.0
January (29-12-2020 to 28-01-2021)	<1	1.8	<1	**4.3**	<1	4.2[b]	<1	1.5
February (28-01-2021 to 26-02-2021)	<1	1	<1	1.8	<1	**8.8**	<1	0.7
March (26-02-2021 to 29-03-2021)	<1	1.2	<1	1.2	<1	1.5	<1	0.2
April (29-03-2021 to 30-04-2021)	<1	1.6	<1	0.7	<1	3.4	<1	2
May (30-04-2021 to 1-06-2021)	<1	1.0	<1	0.4	<1	0.2	<1	0.4
June (1-06-2021 to 2-07-2021)	<1	0.3	<1	0.5	<1	1.9	<1	0.4
July (2-07-2021 to 3-08-2021)	<1	0.7	-[c]	-[c]	<1	3.3	-[c]	-[c]
Rolling annual average	**<1**	**1.4**	**<1**	**1.5**	**<1**	**2.6**	**<1**	**0.8**

Limit of reporting = 0.01 µg during April and 1 µg from May forward following change in laboratory facility completing analysis
[a] Sample invalidated – DDG3 September 2020 sample contaminated with animal faeces
[b] Sample invalidated – DDG3 January 2021 sample contaminated with spiders and insects
[c] Sample invalidated – DDG2 and DDG4 July 2021 sample funnel damaged by high winds

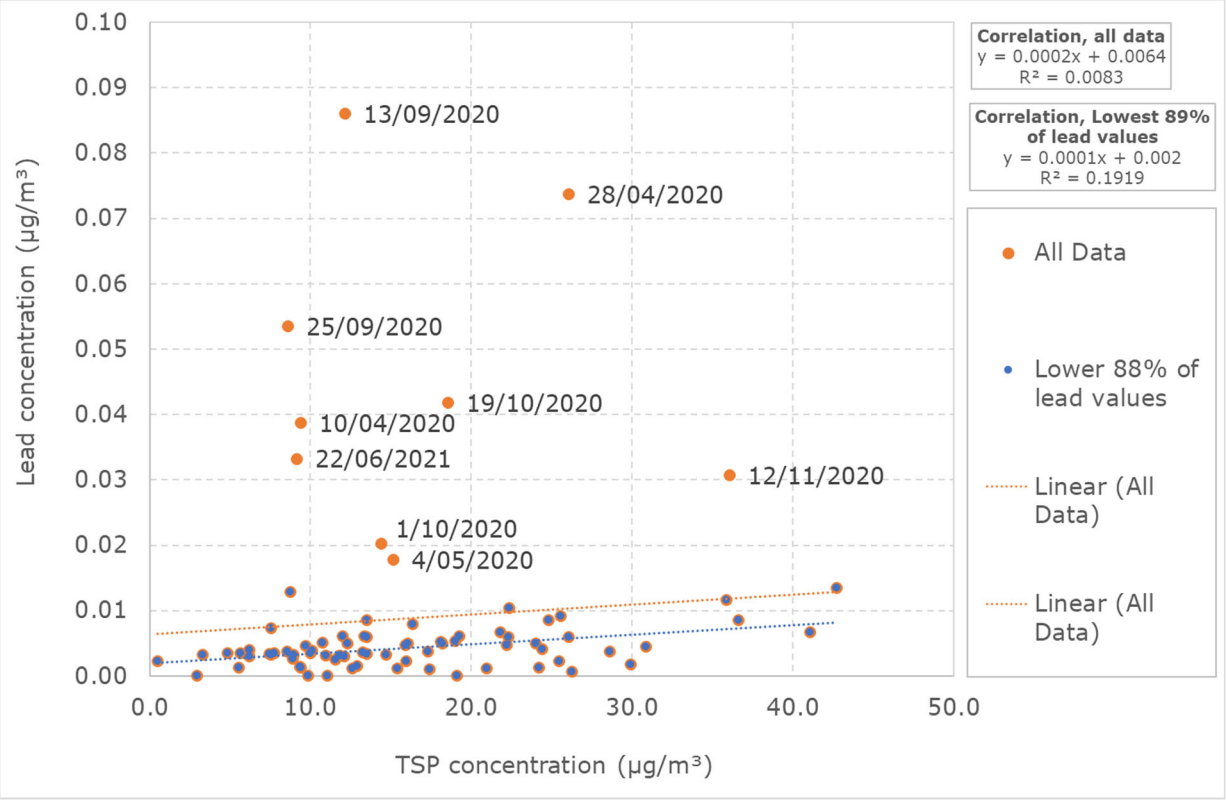


Figure 2-4: Correlation between TSP concentration and lead concentration from the same sample

Ramboll completed prognostic meteorological modelling for Tarago compared to Goulburn applying CSIRO's The Air Pollution Model (TAPM) to allow presentation of pollution roses. This analysis can provide an illustration of the likely direction of lead source contribution against the monitoring location at the Station Masters Cottage. Using the measured and predicted meteorological data, bivariate polar plots suggested lead impacts originated most frequently from north-west quadrant and north, the direction of the rail corridor relative to the monitoring location. When applying this methodology for TSP, TSP was more likely to originate from all directions suggesting other regional influences for TSP but not for lead.

Of relevance to meteorological conditions, the modelled meteorological predictions centred on Tarago were consistent with those measured in Goulburn. It is noted that the terrain influences between each location are likely to be different (further described in Ramboll 2021b) representing a limitation in applying Goulburn meteorological data to understand conditions in Tarago.

2.4.3 Basis of the discontinuation of the air quality monitoring program

Current air quality criteria in NSW are designed to protect against chronic, long-term influence of air pollutants on human health. Air quality criteria for lead, TSP and dust deposition are set as annual average values, with other particle sizes compared against 24-hour air quality criteria and annual criteria. On that basis, to understand the impacts of lead and particulate matter at least an annual period of monitoring was recommended by Ramboll. An annual period also allowed for an understanding of seasonal influences on potential emissions and dispersion such as, for example, changes in wind patterns, temperature and humidity across a longer period.

Given the relatively low correlation between TSP and finer particulate matter fractions found during the program, Ramboll agreed with the NSW EPA accredited site auditor (Ramboll 2021c) that it would be

reasonable to end the continuous real-time PM_{10} and $PM_{2.5}$ monitoring with potential to recommence during remediation activities.

2.4.4 Meteorological conditions since discontinuation of the air quality monitoring program

Meteorological conditions are primary drivers of generation, dispersion, transformation and eventual removal of air pollution in the atmosphere. High temporal resolution data was purchased from the Goulburn Airport AWS (station ID: 070330) Bureau of Meteorology (BoM) station to inform this analysis. The period reviewed included January 2019 to September 2022 (present), incorporating periods prior to monitoring, during and after disestablishment. The meteorological station at Goulburn is located approximately 29 km to the north-north-east from Tarago and as described above does have some limitations when considering differences in terrain and conditions. Goulburn Airport AWS is the closest BoM site to Tarago with available data and considered to be most representative.

Broadly the primary meteorology drivers for air pollution include:

- Wind direction, determining the direction of transport of pollutants and potential lift-off from source.
- Wind speed, determining the initial dilution of the plume where higher wind speeds are generally more effective at pollutant dispersion from increased mechanical mixing energy. Calm conditions will lower plume spread and generally produce higher concentrations at and near source.
- Ambient temperature, influencing the vertical mixing of pollutants through convection and drying of material contributing to dust generation.
- Relative humidity, influencing secondary reactions with gaseous pollutants in the atmosphere and wetting of particles and pollutants in the atmosphere.
- Atmospheric stability, influencing the degree of turbulence or mixing that occurs in the atmosphere. Neutral to unstable conditions are more effective for pollutant dispersion than stable conditions.
- Rainfall, having a scavenging effect of washing out particulate matter and dissolving gaseous pollutants.

Wind roses, illustrating the relative frequency of wind speeds and directions across each season for the period analysis, are presented in **Figure 2-5**. It is noted that spring (i.e., October 2022) and summer (i.e. November and December 2022) was in the future at time of writing, but available data for these periods is presented. Patterns for the time since monitoring (i.e., spring 2021, summer 2021/2022, autumn 2022) are relatively consistent with previous years suggesting that pollutant transport conditions, dilution and mechanical mixing would have likely been reasonably consistent with past conditions since monitoring was disestablished.

Temperature and relative humidity data from Goulburn Airport AWS is presented in **Figure 2-6** and **Figure 2-7**. Temperature data, from 24-hour averages, shows a slightly lower range in temperature since monitoring was disestablished, particularly for the hotter periods in the year. Lower temperature maximums are likely to reduce dust generating conditions. Relative humidity since monitoring was disestablished shows higher moisture in the air which is also likely to reduce dust generating conditions through washing out of particles in the air and dampening of potential sources.

Total monthly rainfall from Goulburn Airport AWS is shown in **Figure 2-8**. The highest rainfall was measured in the second half of 2021 and early part of 2022, that is, the period since monitoring was disestablished. High rainfall conditions assist in suppressing dust potential, and therefore higher rainfall is likely to have a beneficial influence on reducing air pollutants.

In summary, meteorological parameters from the Goulburn Airport AWS BoM station were reviewed to understand the relative influence of prevailing conditions when comparing conditions during the

monitoring campaign in 2020/2021 to the period since disestablishment (i.e., August 2021) to end of September 2022. When considering broadly the influence of each parameter, the prevailing conditions since air quality monitoring disestablishment were considered to have a beneficial influence on the levels of concentrations of particulate matter through influences on generation, dispersion, transformation and eventual removal of particles from the atmosphere.

Ramboll has been contracted to re-establish the monitoring program in Tarago from October 2022 for lead, dust deposition and TSP. Continuous high temporal-scale measurement of PM_{10} and $PM_{2.5}$ is not currently planned for the monitoring program, but this technique could be reconsidered during remediation activities to allow real-time access to concentration data and trigger alerts during works.

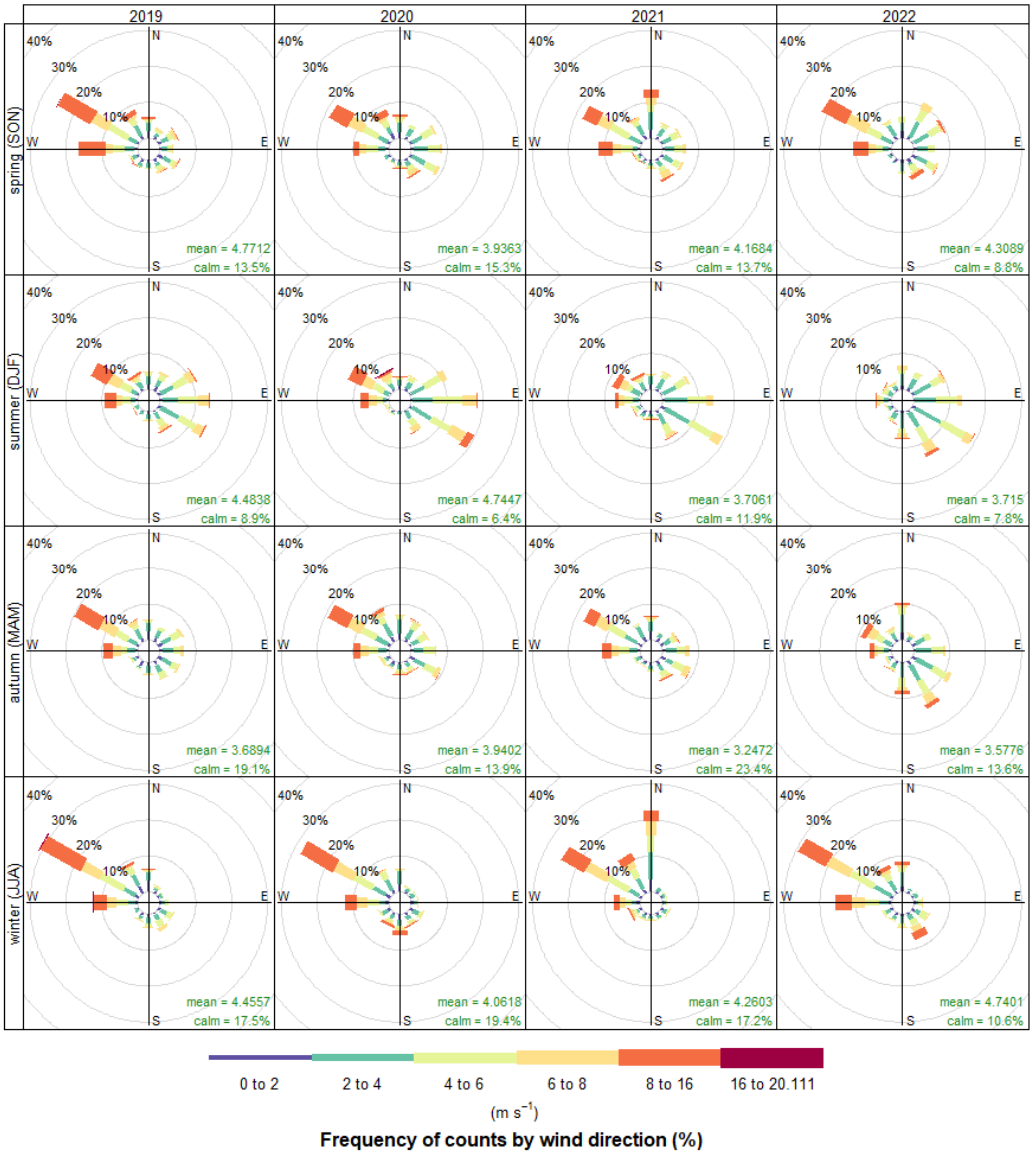


Figure 2-5: Seasonal wind roses from Goulburn Airport AWS BoM station, 2019 – 2022

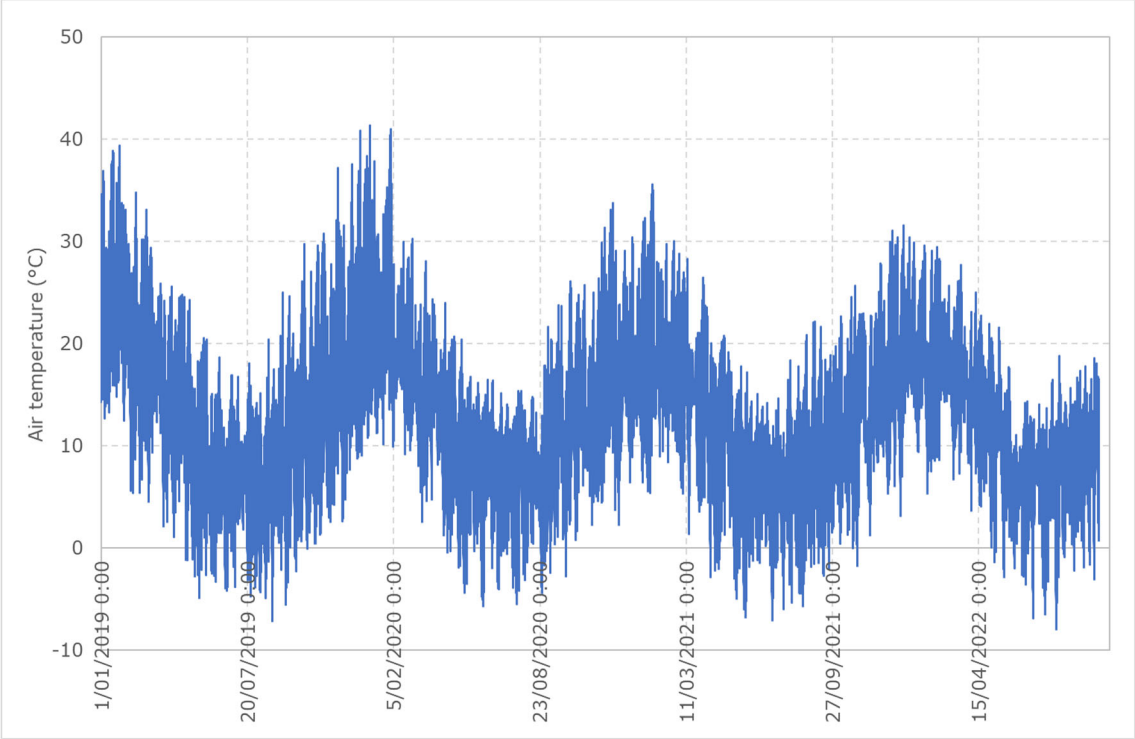


Figure 2-6: Hourly average air temperature (°C) measured at Goulburn Airport AWS (BoM) from January 2019 to September 2022

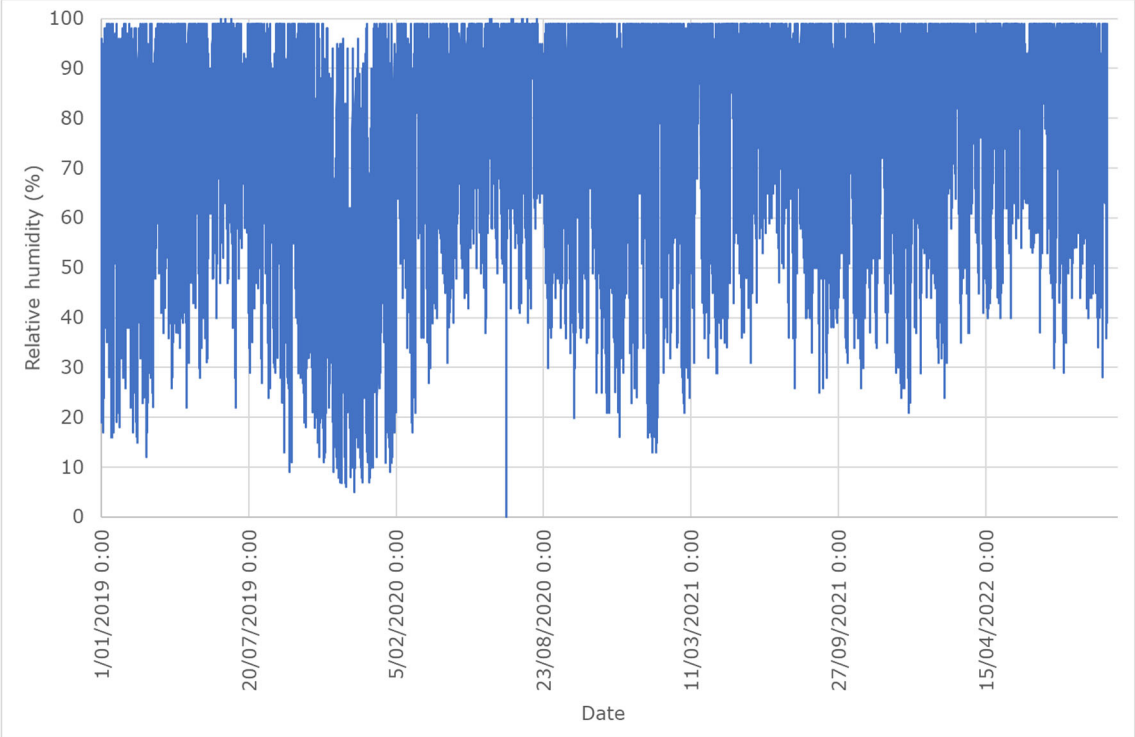


Figure 2-7: Hourly average relative humidity (%) measured at Goulburn Airport AWS (BoM) from January 2019 to September 2022

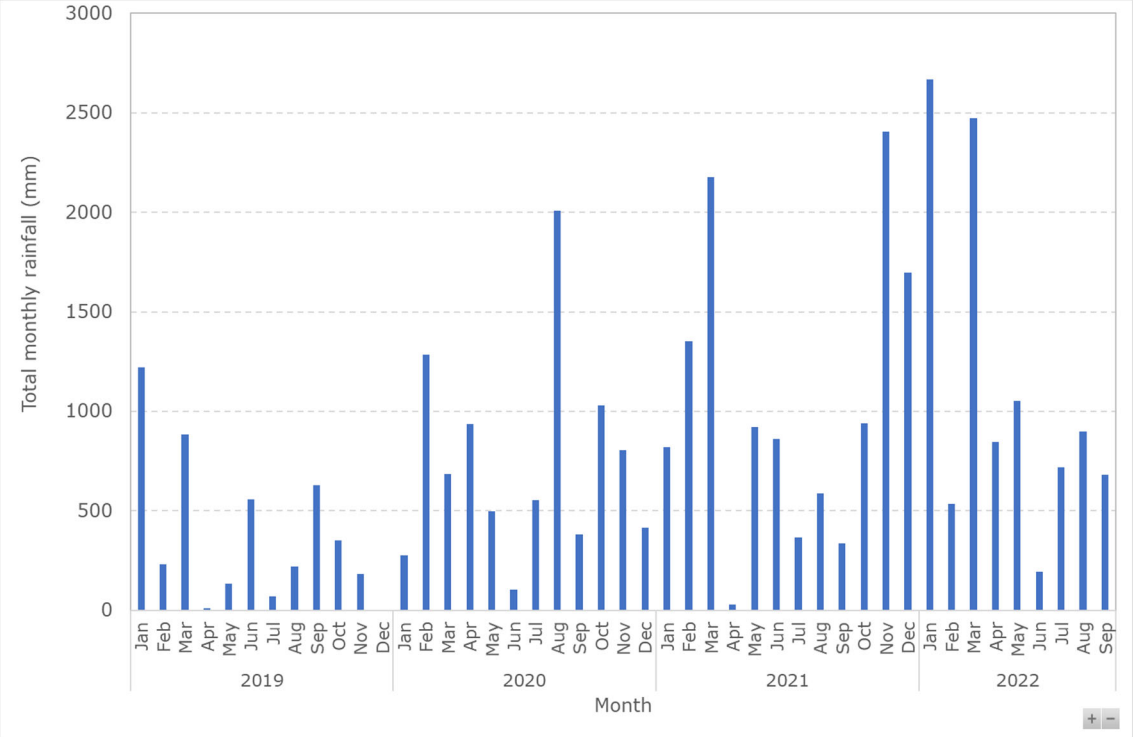


Figure 2-8: Total monthly rainfall (mm) measured at Goulburn Airport AWS (BoM) from January 2019 to September 2022

3. Preventive Actions 1, 4 and 5: Ramboll Site inspection

Ramboll was engaged on 7 September 2022 to:

- Recommence surface water and air quality monitoring previously completed to assess the adequacy of Action Plan controls and
- Inspect the current condition of action plan controls and any evidence of contaminant migration within the Site and / or from the Site to the surrounding environment.

Key observations from Ramboll inspection were:

- Geofabric marker layer and contaminated spoil was observed indicating that stockpile capping is compromised at several locations however the sand cement capping was otherwise competent and erosion from the stockpile was not evident.
- Surface water was observed to be discharging from the rail corridor downstream of each of the three rail culverts within the Tarago Yard. Visibly, discharge appeared to be clear. Surface water sampling was completed and included field measurement of Total Dissolved Solids. Similarly no evidence of sediment discharge offsite was observed. We note that inspection of the discharge downstream of the southern and northern culverts was limited by the presence of established vegetation however this vegetation provides additional removal mechanisms for entrained sediment.
- Inspection of the Woodlawn Siding and surrounds indicates polymer sealant is past end of life and visible evidence of vehicular access over contaminated soil was observed. Surface soils were moist at time of inspections and no evidence of airborne dust was observed.

3.1 Recommendations for Corrective Actions

Ramboll recommendations following the Site inspection were:

- Damage / degradation of the stockpile cap should be repaired through application of additional stabilised sand to ensure the geofabric and any visible excavation spoil is completely covered to achieve a minimum capping thickness of 0.1 m and a free draining final surface.
- The results of surface water sampling should be reviewed to assess the adequacy of existing erosion and sediment controls.
- Controls should be implemented to prevent future vehicular access over contaminated soils. Results of air monitoring should be reviewed to assess the adequacy of dust mitigation measures. If elevated dust levels are observed, reapplication of polymer sealant may be warranted. Specific controls to be implemented comprised additional signage and fencing as described on Figures presented as **Appendix 1.**
- Ongoing routine inspections should be completed as prescribed under the Action Plan (Ramboll 2020a). These inspections should be completed by environmental representatives who understand the requirements of the Action Plan and are suitably qualified and experienced in the application of controls to mitigate contaminant exposure risks.
- To ensure erosion and sediment controls are consistently implemented, preparation of a Site specific erosion and sediment control (ERSED) plan by a suitably qualified and experienced environmental professional should be co-ordinated. Once completed this ERSED Plan should be referenced in the Action Plan.

4. Preventive Action 2: Corrective Actions

UGL RL completed corrective actions 28 – 29 September 2022. UGL RL actions comprised:

- Repair of stockpile capping to achieve minimum capping thickness of 0.1 m and a free draining final surface.
- Installation of additional signage and fencing as presented on **Figures 2a – 2e**, **Appendix 1.**

Ramboll inspected the Site on 28 and 29 September 2022. Key observations were that fencing and signage had been implemented and that, while the stockpile cap had been significantly improved, additional capping was required to ensure consistent coverage across the sides of the stockpile. UGL RL returned to Site on 30 September 2022 and applied additional stabilised sand capping. Photographic logs are presented as **Appendix 4** and **Appendix 5**.

5. Action Plan Revision

Ramboll has prepared an update to the Action Plan (Ramboll 2022b) to reflect the following amendments:

- Change from John Holland Rail to UGL RL as the manager of the CRN with responsibility for implementing the Action Plan.
- Specification that Action Plan inspections are to be undertaken by a UGL Representative suitably trained and experienced in application and management of erosion and sediment controls including stockpile management.
- Removal of requirement to maintain polymer sealant over contaminated soils as migration of contaminants from the site have not been detected through monitoring since polymer sealant was observed to be degraded.
- Increased fencing and signage to prevent vehicular access over contaminated soils.

The updated Action Plan (Ramboll 2022b) is presented as **Appendix 6**.

6. Summary Response

A summary of the response to Directions to take preventative action that were provided in NSW EPA Prevention Notice 3503607 is presented in **Table 3**.

Table 3: Summary Response to EPA Prevention Notice 3503607

Direction for preventive action	Response
Undertake a detailed inspection of the integrity of the encapsulation layers of the interim containment cell (i.e., capped stockpile).	Detailed Site inspection completed as described in **Section 3**.
Where deficiencies are identified, undertake all necessary works to reinstate the encapsulation layer to prevent surface or air pollution	Recommendations for corrective actions described under **Section 3.1**. Surveillance of corrective actions presented under **Section 4.**
Undertake an assessment of the adequacy and efficiency of surface water controls at the Site and implement any required works or measures to ensure contamination is not remobilised to waters	Assessment of the adequacy of surface water controls is presented in **Section 2.3**. Further detail presented in the September 2022 surface water monitoring report (Ramboll 2022a). Recommendation to develop an ERSED Plan to ensure consistent implementation presented in **Section 3.1**.
Undertake an inspection of the polymer application area on the historic rail siding to identify any defects or deficiencies with the polymer layer	Assessment presented in **Section 3**.
Identify any other areas that require controls implemented to prevent the movement of soil by surface water or dust.	Recommendations presented in **Section 3.1** including additional controls to prevent vehicular access across contaminated soils.
Undertake a review the monitoring/inspection programs capacity to identify emerging issues with the integrity of the Site pollution controls and ensure that rectification works are undertaken to resolve any identified issues in a timely manner.	Presented in **Section 2**. Corrective actions presented in **Section 4.**
Submit a report to the EPA detailing the findings of above inspections, associated works completed, and findings/outcomes of the inspection program review.	This report is presented to address EPA direction to detail the findings of inspection, associated works completed and findings/outcomes of the inspection program review.

Limitations

This document is issued in confidence to Transport for New South Wales for the purposes of informing management of risks associated with identified lead contamination on or originating from the rail corridor at Tarago NSW. It is understood that Transport for New South Wales will use this document to respond to NSW EPA Prevention Notice 3503607 and to communicate with UGL RL controls for management of contamination at the Tarago Rail Yard. Ramboll extends reliance to the NSW EPA and UGL RL for these purposes. It should not be used for any other purpose.

The report must not be reproduced in whole or in part except with the prior consent of Ramboll Australia Pty Ltd and subject to inclusion of an acknowledgement of the source. No information as to the contents or subject matter of this document or any part thereof may be communicated in any manner to any third party without the prior consent of Ramboll Australia Pty Ltd.

Whilst reasonable attempts have been made to ensure that the contents of this report are accurate and complete at the time of writing, Ramboll Australia Pty Ltd disclaims any responsibility for loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this report (except by the NSW EPA or UGL RL).

References

Ramboll (2020a) *Tarago Lead Management Action Plan Rev 2*

Ramboll (2020b) *Tarago Railway Station, Goulburn Street, Tarago NSW Lead Investigation Report*

Ramboll (2021a) *RE: JHR Tarago AQM – January 2021.* Email dated 23 September 2021

Ramboll (2021b). *Tarago Air Quality Monitoring Report – July 2021*. Prepared for John Holland Rail Pty Ltd, 20 August 2021, reference 318000780.140.

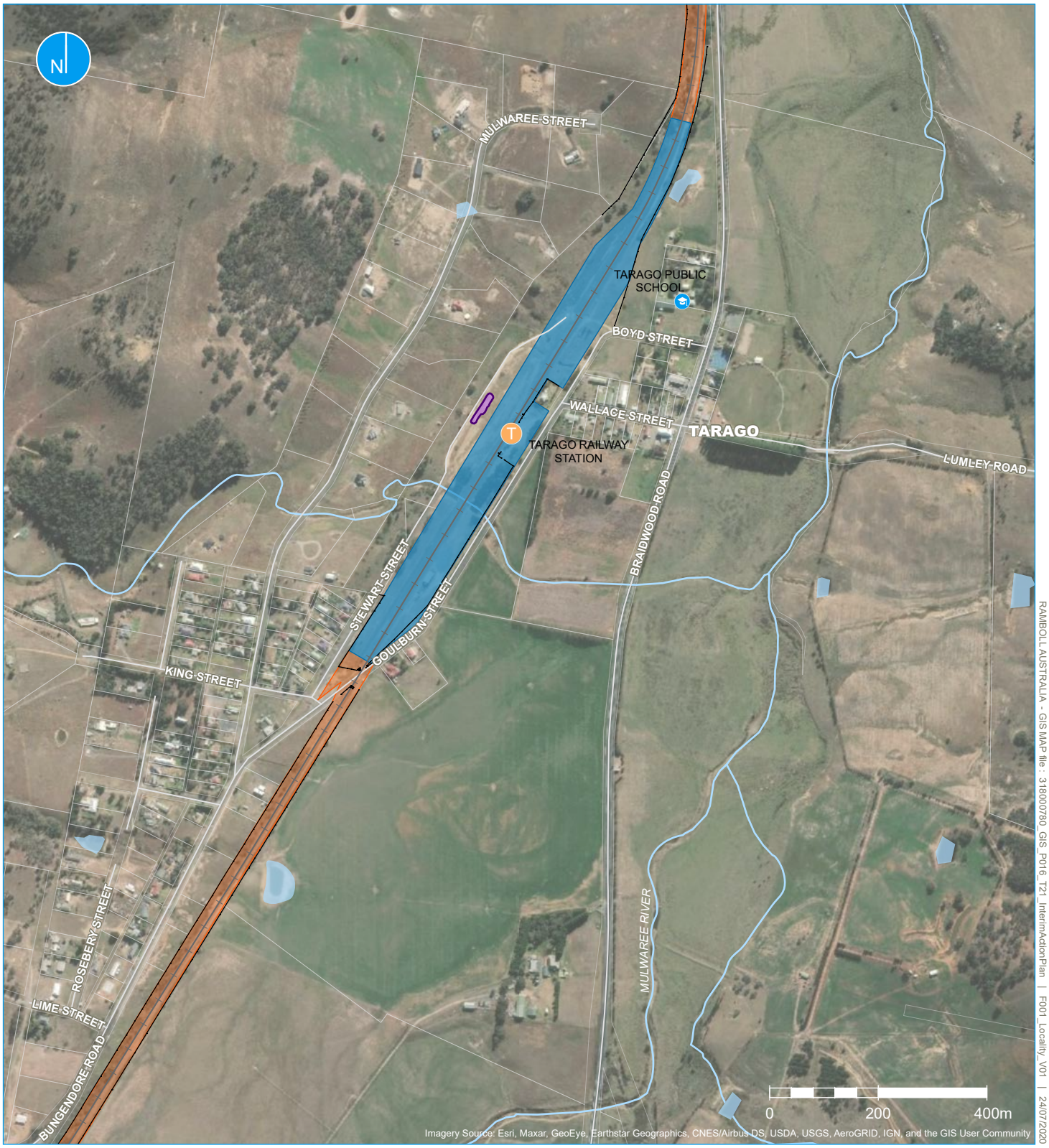
Ramboll (2021c) *RE: Modification of the Tarago AQM program.* Email dated 21 July 2021.

Ramboll (2022a) *Tarago NSW September 2022 Surface Water Monitoring Report*

Ramboll (2022b) *Tarago Lead Management Action Plan Rev 3*

JBSG (2022) *DRAFT - L02 Interim Audit Advice (0503-2303-02) – Tarago Rail Corridor – Interim (Pre Remediation) Monitoring Requirements*

1. Appendix 1: Figures



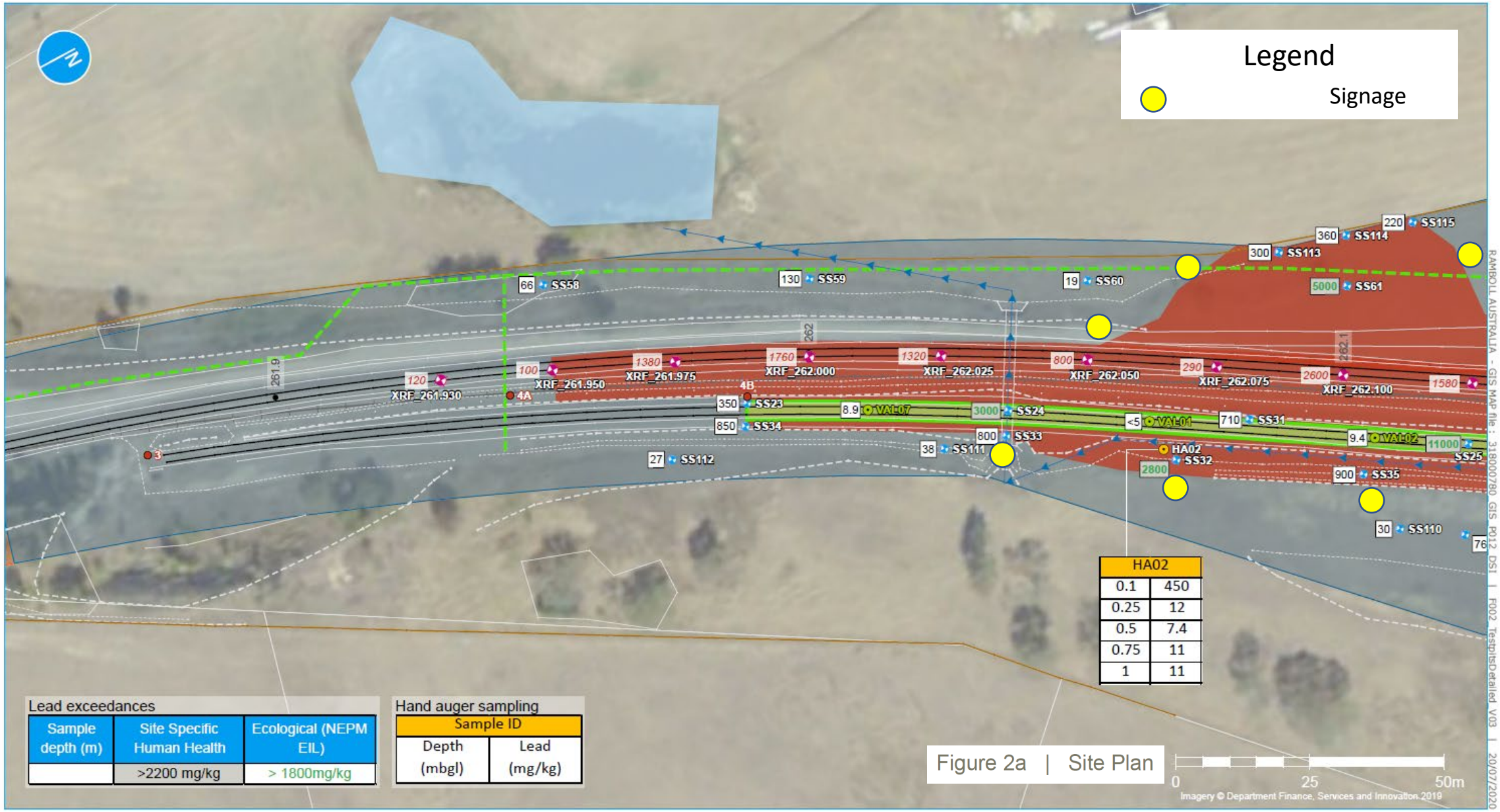
RAMBOLL AUSTRALIA - GIS MAP file : 318000780_GIS_P016_T21_InterimActionPlan | F001_Locality_V01 | 24/07/2020

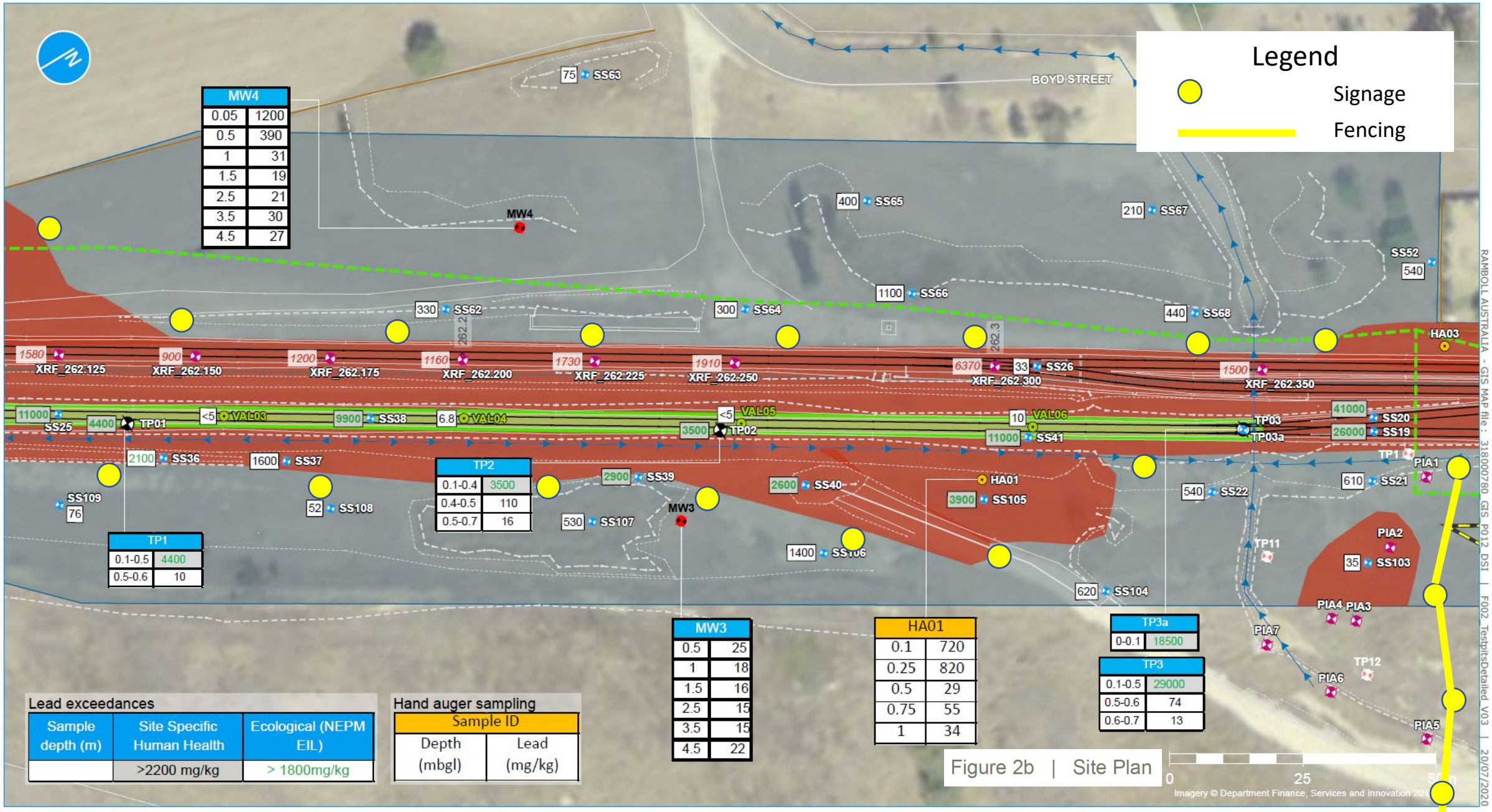
Legend

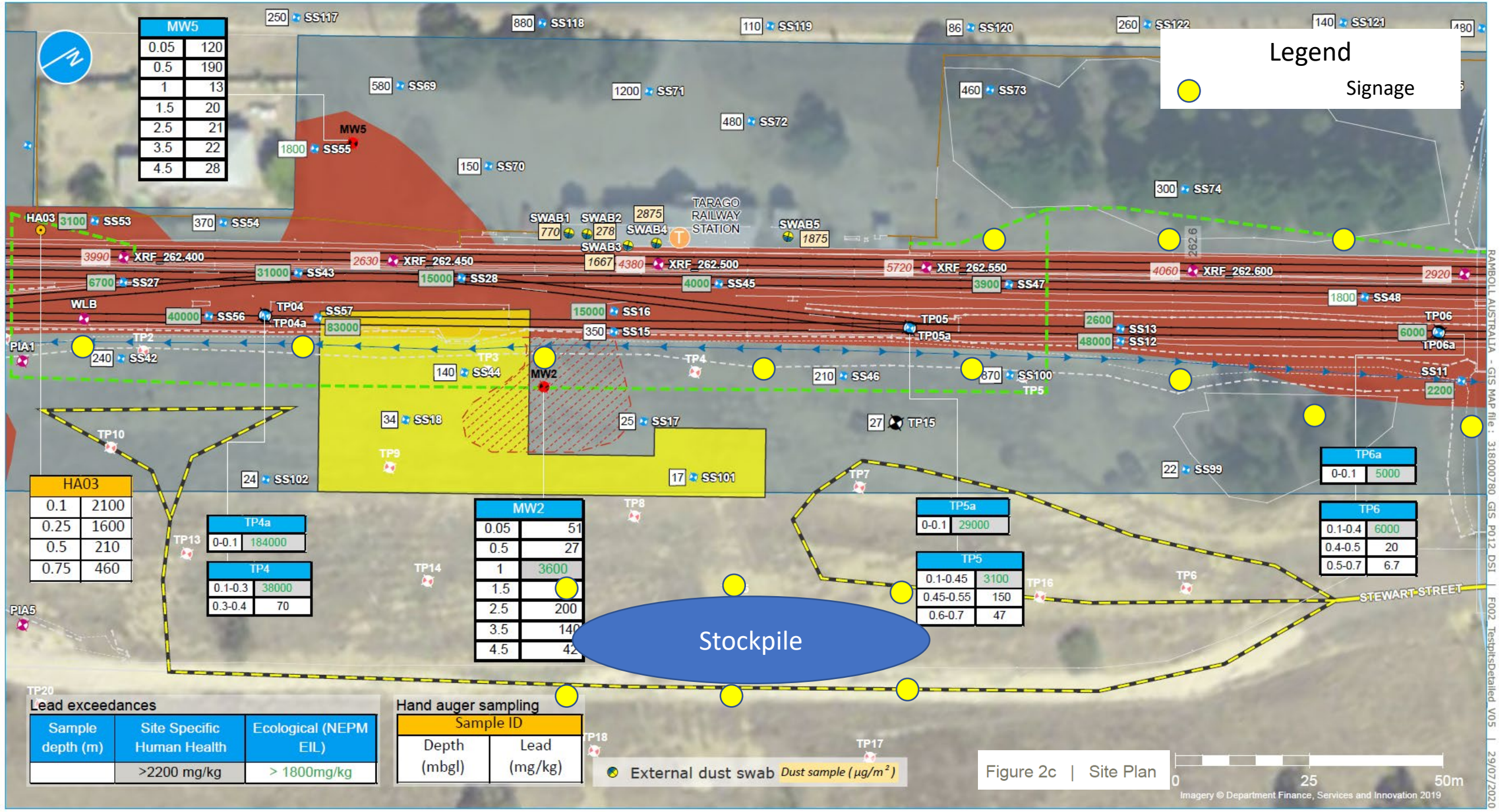
- Site boundary
- Approximate location of contaminated stockpile
- Rail corridor
- Rail corridor fence

A4
1:10,000

Figure 1 | Locality Plan


Legend
Signage
66 SS58
130 SS59
19 SS60
220 SS115
360 SS114
300 SS113
5000 SS61
120 XRF_261.930
100 XRF_261.950
1380 XRF_261.975
1760 XRF_262.000
1320 XRF_262.025
800 XRF_262.050
290 XRF_262.075
2600 XRF_262.100
1580
4A
4B
350 SS23
8.9 VAL07
3000 SS24
<5 VAL01
710 SS31
9.4 VAL02
11000 SS25
850 SS34
800 SS33
38 SS111
HA02
SS32
2800
900 SS35
27 SS112
30 SS110
76
261.9
262
262.1
HA02
0.1 450
0.25 12
0.5 7.4
0.75 11
1 11
Lead exceedances
Sample depth (m)
Site Specific Human Health
Ecological (NEPM EIL)
>2200 mg/kg
> 1800mg/kg
Hand auger sampling
Sample ID
Depth (mbgl)
Lead (mg/kg)
Figure 2a | Site Plan
0
25
50m
Imagery © Department Finance, Services and Innovation 2019
RAMBOLL AUSTRALIA - GIS MAP file : 318000780 GIS P012 DSI | F002 TestpitsDetailed V03 | 20/07/2020


Legend
Signage
Fencing
BOYD STREET
MW4
0.05 1200
0.5 390
1 31
1.5 19
2.5 21
3.5 30
4.5 27
TP1
0.1-0.5 4400
0.5-0.6 10
TP2
0.1-0.4 3500
0.4-0.5 110
0.5-0.7 16
MW3
0.5 25
1 18
1.5 16
2.5 15
3.5 15
4.5 22
HA01
0.1 720
0.25 820
0.5 29
0.75 55
1 34
TP3a
0-0.1 18500
TP3
0.1-0.5 29000
0.5-0.6 74
0.6-0.7 13
Lead exceedances
Sample depth (m)
Site Specific Human Health
Ecological (NEPM EIL)
>2200 mg/kg
> 1800mg/kg
Hand auger sampling
Sample ID
Depth (mbgl)
Lead (mg/kg)
Figure 2b | Site Plan
0
25
Imagery © Department Finance, Services and Innovation 20
RAMBOLL AUSTRALIA - GIS MAP file : 318000780 GIS P012 DSI | F002 TestpitsDetailed V03 | 20/07/2020


Legend
Signage
MW5
0.05 120
0.5 190
1 13
1.5 20
2.5 21
3.5 22
4.5 28
HA03
0.1 2100
0.25 1600
0.5 210
0.75 460
TP4a
0-0.1 184000
TP4
0.1-0.3 38000
0.3-0.4 70
MW2
0.05 51
0.5 27
1 3600
1.5
2.5 200
3.5 140
4.5 42
TP5a
0-0.1 29000
TP5
0.1-0.45 3100
0.45-0.55 150
0.6-0.7 47
TP6a
0-0.1 5000
TP6
0.1-0.4 6000
0.4-0.5 20
0.5-0.7 6.7
Stockpile
STEWART STREET
TARAGO RAILWAY STATION
Lead exceedances
Sample depth (m) | Site Specific Human Health | Ecological (NEPM EIL)
>2200 mg/kg | > 1800mg/kg
Hand auger sampling
Sample ID
Depth (mbgl) | Lead (mg/kg)
External dust swab Dust sample (µg/m²)
Figure 2c | Site Plan
0 25 50m
Imagery © Department Finance, Services and Innovation 2019
RAMBOLL AUSTRALIA - GIS MAP file : 318000780_GIS_P012_DSI | F002_TestpitsDetailed_V05 | 29/07/2020

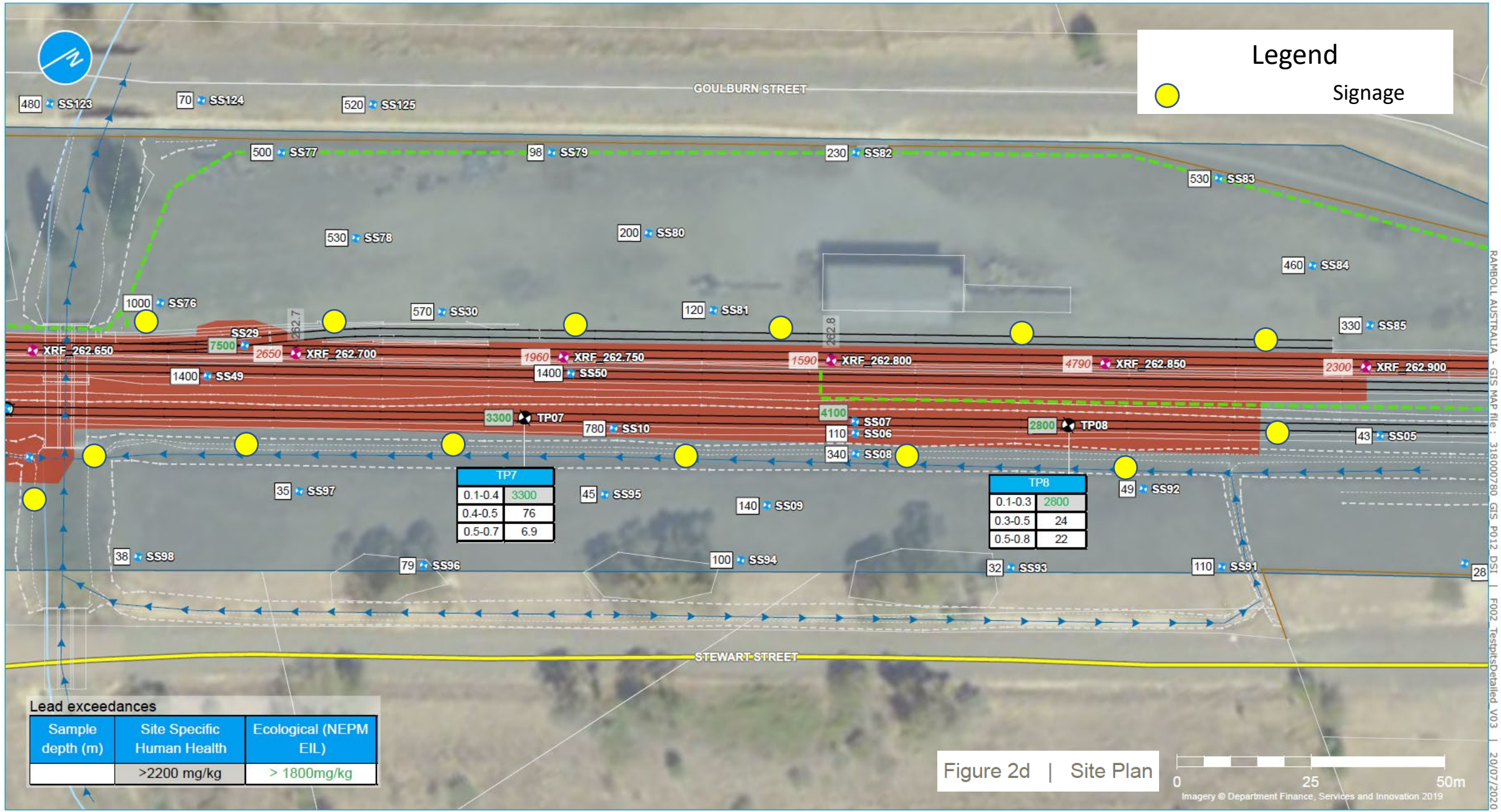
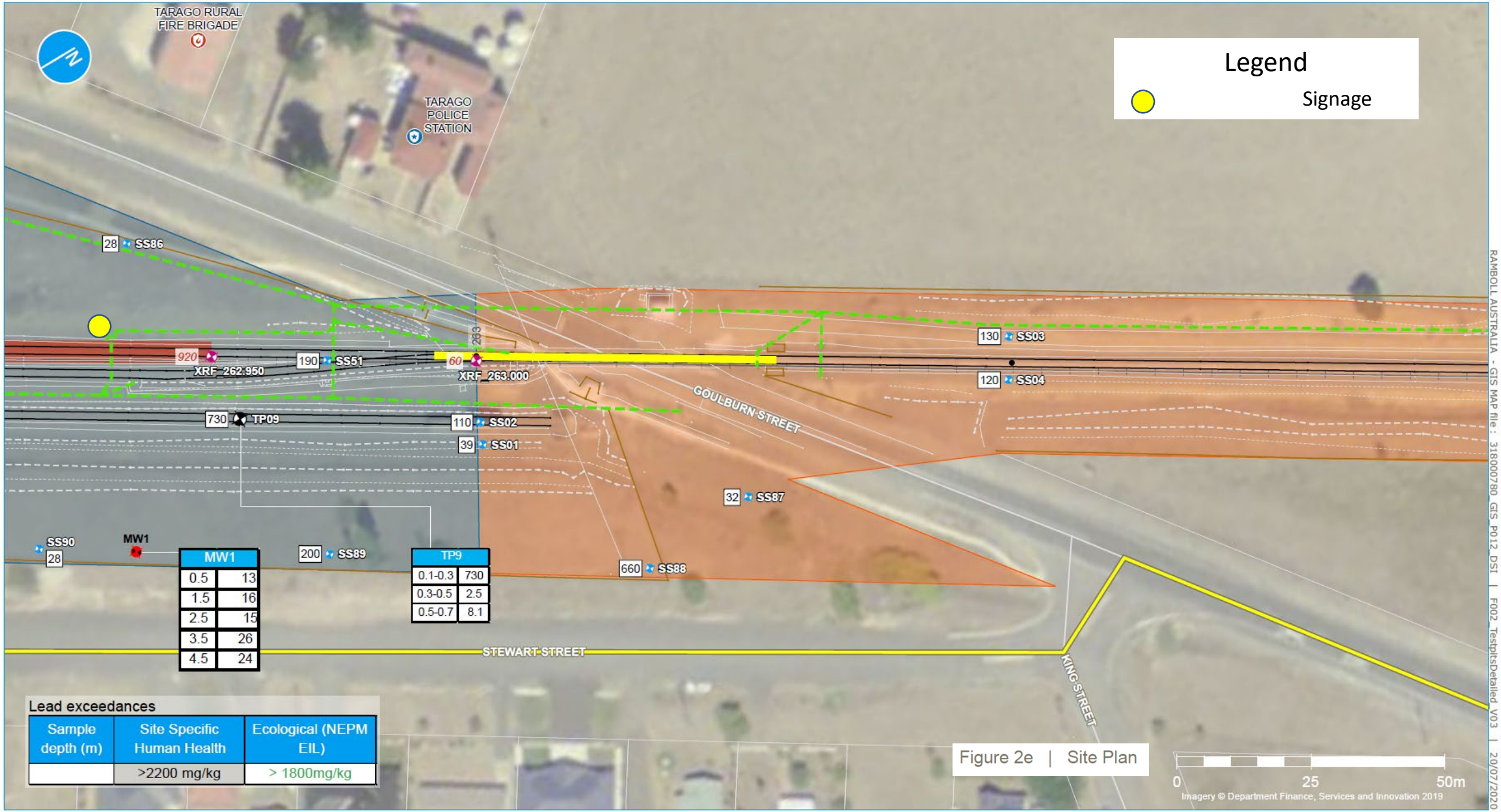


Figure 2d | Site Plan


TARAGO RURAL FIRE BRIGADE
TARAGO POLICE STATION
Legend
Signage
28 SS86
920 XRF_262.950
190 SS51
60 XRF_263.000
262
730 TP09
110 SS02
39 SS01
130 SS03
120 SS04
GOULBURN STREET
32 SS87
660 SS88
200 SS89
SS90 28
MW1
MW1
0.5 13
1.5 16
2.5 15
3.5 26
4.5 24
TP9
0.1-0.3 730
0.3-0.5 2.5
0.5-0.7 8.1
STEWART STREET
KING STREET
Lead exceedances
Sample depth (m)
Site Specific Human Health
Ecological (NEPM EIL)
>2200 mg/kg
> 1800mg/kg
Figure 2e | Site Plan
0
25
50m
Imagery © Department Finance, Services and Innovation 2019
RAMBOLL AUSTRALIA - GIS MAP file : 318000780_GIS_P012_DSI | F002_TestpitsDetailed_V03 | 20/07/2020

2. Appendix 2: Inspection Record Compliance Assessment

Client: Transport for New South Wales
Job No: 318001376
Project Name: Turrago Rail Corridor Lead Management
5/10/2022

Appendix 2
Table 1: Inspection Record Compliance Assessment

RAMBOLL

			General Observations					Reference 5.1							Reference 7.3							
Date	Weather	Volume of Rainfall in preceding 24 hours	Is airborne dust from site evident?	Is sediment run-off evident that is not captured by sediment controls?	Is surface water discharging from site?	Is there evidence of excavation or other works non-compliant with the Action Plan?	Other Observations	Exclusion Zone signage present on 100 lineal meter increments adjacent both sides of the rail formation and on similar spacing to demarcate contamination in adjacent soils?	Exclusion Zone signage undamaged?	Condition of polymer sealant visually inspected by walking 5m lineal transects parallel to the rail formation across all contaminated areas?	Areas of disturbance marked on the site-grid inspection sheet?	Are sediment controls present in/adjacent each rail culvert?	If sediment is present what is the estimated depth of sediment?	Are sediment controls still functional?	Is the existing stockpile covered securely to prevent surface water infiltration?	Are there signs of cracking, erosion, sediment run-off or vegetation on or relating to the existing stockpile?	Have any additional stockpiles of contaminated material been created?	Are additional stockpiles placed away from drainage lines, gutters, stormwater pits or inlets?	Are stockpiles covered securely to prevent surface water infiltration?	Are stockpiles positioned on level surfaces with construction of bunds to control water ingress / egress.	Corrective Actions	Ramboll Comment
30/Jul/2020	Windy, cloudy, rain	10 mm+	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	-	No	None	None	Yes	NA	Yes	Yes	No	No	-	Yes	Yes	None provided	● No specific observations made. ● Exclusion Zone signage not present or damaged. ● Polymer sealant not inspected or not evident.
8/Aug/2020	Rain	10 mm+	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	NA	Yes	No	No	Yes	-	Yes	Yes	No	No	No	Yes	Yes	None provided	● No specific observations made. ● Exclusion Zone signage not present or damaged. ● Polymer sealant not inspected or not evident. ● Areas of distrubance not marked on site grid inspection sheet. ● Presence of sediment not indicated/depth not specified
24/Oct/2020	Raining	10 mm+	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	-	No damage	OK	No	Yes	-	Yes	Yes	No	No	-	Yes	Yes	None provided	● No specific observations made. ● Areas of distrubance not marked on site grid inspection sheet. ● Presence of sediment not indicated/depth not specified
25/Oct/2020 26/Oct/2020	Raining	15 mm+ each day	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	-	No	-	No	Yes	-	Yes	Yes	No	No	No	Yes	Yes	None provided	● No specific observations made. ● Exclusion Zone signage not present or damaged. ● Polymer sealant not inspected or not evident. ● Areas of distrubance not marked on site grid inspection sheet. ● Presence of sediment not indicated/depth not specified
31/Oct/2020 1/Nov/2020	Rain	10 mm +	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	-	No damage	-	No	Yes	-	Yes	Yes	No	No	No	Yes	Yes	None provided	● No specific observations made. ● Polymer sealant not inspected or not evident. ● Areas of distrubance not marked on site grid inspection sheet. ● Presence of sediment not indicated/depth not specified
5/Jan/2021	Raining	10 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	None provided	● No specific observations made. ● Presence of sediment indicated but depth not recorded. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
29/Jan/2021	Raining	Not recorded	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	-	Yes	Yes	No	No	No	Yes	Yes	None provided	● No specific observations made. ● Presence of sediment not indicated/depth not specified
2/Feb/2021	Raining	40 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	None provided	● No specific observations made. ● Presence of sediment indicated but depth not recorded. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
13/Feb/2021	Rain	22 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	None provided	● No specific observations made. ● Presence of sediment indicated but depth not recorded. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
12/Mar/2021	Rain	15 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	None provided	● No specific observations made. ● Presence of sediment indicated but depth not recorded. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
15/Mar/2021	Rain	16 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	None provided	● No specific observations made. ● Presence of sediment indicated but depth not recorded. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
21/Mar/2021	Rain	20 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	None provided	● No specific observations made. ● Presence of sediment indicated but depth not recorded. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
22/Mar/2021	Rain	16 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	No	No	Yes	Yes	None provided	● No specific observations made. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
23/Mar/2021	Rain	25 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	No	No	Yes	Yes	None provided	● No specific observations made. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
24/Mar/2021	Rain	33 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	None provided	● No specific observations made. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
19/Apr/2022	Overcast	15 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	NA	Yes	Yes	None provided	● No specific observations made. ● Signs of cracking, erosion, sediment run-off etc. but no corrective actions indicated.
27/Apr/2022	Overcast with light showers	Preceding 24 hour rainfall not recorded	No	Yes	There is evidence that it probably is given the condition of sediment fencing.	No	Condition of sediment control is poor with the silt fencing material torn and shredded, gaps underneath, sediment at top or over the top of silt fencing (photographs included). There is no silt fencing in place on the country side of the culvert at 262.650 km. Could not clearly see polymer coating through the yard.	Yes	Yes	Polymer sealant not evident	Not provided	Yes	Not provided	No - not functioning at 100%	Yes	No	No	NA	NA	NA	Sediment controls in poor condition and needs renewal. Sediment controls need replacement.	● Polymer sealant not evident. ● Information reagarding areas of distrubance not provided. ● Presence of sediment not indicated/depth not specified
30/Apr/2022	Overcast, rain and drizzle	11 mm	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	Yes	Yes	Yes	NA	Yes	20 cm	Some	Yes	No	No	NA	NA	NA	None provided	● No specific observations made. ● Sediment controls not functioning at 100% but no corrective actions indicated
30/May/2022	Rain/windy	Nil	No	No	No	No	No. Done as a part of red alert track patrol	Yes	Yes	Yes	NA	Yes	Unsure	Yes	Yes	No	No	NA	NA	NA	Nil	● No specific observations made. ● Depth of sediment not recorded.
24/Jun/2022	Cloudy	-	No	No	No	No	No	Yes	Yes	Yes	NA	Yes	Unsure	Yes	Yes	No	No	NA	NA	NA	Nil	● No specific observations made. ● Depth of sediment not recorded.
23/Jul/2022	Cloudy	Nil	No	No	No	No	No	Yes	Yes	Yes	NA	Yes	Unsure	Yes	Yes	No	No	NA	NA	NA	Nil	● No specific observations made. ● Depth of sediment not recorded.
4/Aug/2022	Raining (Showers)	10 mm +	No	No	No	No	Silt fencing recently refurbished, all in good condition	Yes	Yes	Yes	Yes	Yes	-	Yes	Yes	No	No	-	-	-	None provided	
19/Aug/2022	Overcast	-	No	No	No	No	Nil	Yes	Yes	Yes	NA	Yes	Unsure	Yes	Yes	No	No	-	-	-	-	● No specific observations made. ● Depth of sediment not recorded.
Date no clear	Cloudy, wind, light rain	10 mm +	No	No	Yes	No	We attend site to inspect after 10 mm or more rain has fallen. We also do a visual inspection twice a week during our track patrols.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	● No specific observations made. ● Exclusion Zone signage not present or damaged. ● Polymer sealant not inspected or not evident. ● Areas of distrubance not marked on site grid inspection sheet. ● Second page of inspection no provided

3. Appendix 3: September 2022 Surface water Monitoring Report

Intended for
Transport for NSW

Document type
Report

Date
October 2022

TARAGO, NSW
SEPTEMBER 2022 SURFACE WATER MONITORING REPORT

RAMBOLL Bright ideas. Sustainable change.

TARAGO, NSW
SEPTEMBER 2022 SURFACE WATER MONITORING REPORT

Ramboll
Level 2, Suite 18 Eastpoint
50 Glebe Road
PO Box 435
The Junction
NSW 2291
Australia

T +61 2 4962 5444
https://ramboll.com

Project name	**Tarago Surface Water Monitroing**
Project no.	**318001376-T3**
Recipient	**TfNSW**
Description	**This report describes the methodology and factual results for quarterly surface water monitoring undertaken as part of the Tarago Lead Management Project at Tarago, NSW.**

evision Number	Revision	Date	Prepared by	Checked by	Approved by
0	Draft	30/09/2022	J Kirsch	S Maxwell CEnvP (SC) 41184	F Robinson
1	Final	07/10/2022	J Kirsch	S Maxwell CEnvP (SC) 41184	F Robinson

Ramboll Australia Pty Ltd.
ACN 095 437 442
ABN 49 095 437 442

CONTENTS

Abbreviations **3**

1. INTRODUCTION **4**

1.1 Background 4

1.2 Objectives 4

2. Scope of Work **5**

2.1 Monitoring Scope 5

3. SAMPLING and ANALYSIS QUALITY PLAN **7**

4. QUALITY ASSURANCE / QUALITY CONTROL PROGRAM **8**

4.1 QA/QC Data Evaluation 8

5. ASSESSMENT CRITERIA **11**

5.1 Rationale for Application of Guidelines 11

6. RESULTS **14**

6.1.1 Monitoring Events 14

6.1.2 Physico-Chemical Results 16

6.1.3 Analytical Results 17

6.1.4 Analytical Results Trends 20

7. Summary **38**

8. Conclusions **40**

9. LIMITATIONS **41**

9.1 User Reliance 41

10. References **42**

LIST OF TABLES

Table 2-1: Surface Water Sampling Locations 5

Table 4-1: QA/QC –Assessment of DQIs 8

Table 5-1: Hardness Corrections for Tier 1 Freshwater Ecology Guidelines 12

Table 5-2: Guidelines Applied to Sampling Points 12

Table 5-3: Guideline Criteria (mg/L) 13

Table 6-1: Indicative Summary of Rainfall Preceding Sampling Events 15

Table 6-2: Summary of Surface Water Physico-Chemical Parameters 16

Table 6-3: Summary of Onsite and Near Site Surface Water Analytical Results (SW1_UP, SW1, SW2, SW3, SW4, SW5, SW6, SW7) 18

Table 6-4: Summary of Mulwaree River Surface Water Analytical Results (SW8, SW9, SW10) 19

Table 7-1: CoPC Results Summary (Lead, Copper, Zinc) 38

LIST OF FIGURES

Figure 2-1: Surface Water Monitoring Locations 6

Figure 6-1: Upgradient and Onsite Total Lead Concentration Trend - Logarithmic Scale 21

Figure 6-2: Upgradient and Onsite Dissolved Lead Concentration Trend 22

Figure 6-3: Mulwaree River (Offsite) Total Lead Concentration Trend 24

Figure 6-4: Mulwaree River Offsite Dissolved Lead Concentration Trend 25

Figure 6-5: Upgradient and Onsite Total Copper Concentration Trend 27

Figure 6-6: Upgradient and Onsite Dissolved Copper Concentration Trend 28
Figure 6-7: Mulwaree River (Offsite) Total Copper Concentration Trend – Logarithmic Scale 30
Figure 6-8: Mulwaree River (Offsite) Dissolved Copper Concentration Trend 31
Figure 6-9: Upgradient and Onsite Total Zinc Concentration Trend – Logarithmic Scale 33
Figure 6-10: Upgradient and (Onsite) Dissolved Zinc Concentration Trend 34
Figure 6-11: Mulwaree River (Offsite) Total Zinc Concentration Trend 36
Figure 6-12: Mulwaree River (Offsite) Dissolved Zinc Concentration Trend 37

APPENDICES

Appendix 1
SAQP

Appendix 2
Calibration Certificate

Appendix 3
Results Tables

Appendix 4
Laboratory Reports

Appendix 5
Site Photographs

ABBREVIATIONS

Measures	Description
ADWG	Australian Drinking Water Guidelines
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines (for Fresh and Marine Water Quality)
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
COC	Chain of Custody
CoPC	Contaminants of Potential Concern
DEC	Department of Environment and Conservation
DO	Dissolved Oxygen
DQI	Data Quality Indicator
EC	Electrical Conductivity
EPA	Environment Protection Authority (NSW)
EnRiskS	Environmental Risk Sciences Pty Ltd
Mercury	Inorganic mercury unless noted otherwise
mg/L	Milligrams per Litre
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NSW	New South Wales
ORP	Oxidation/Reduction Potential
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
SAQP	Sampling and Analysis Quality Plan
TDS	Total Dissolved Solids
TfNSW	Transport for New South Wales
VMP	Voluntary Management Proposal
-	On tables is "not calculated", "no criteria" or "not applicable"

1. INTRODUCTION

Ramboll Australia Pty Ltd (Ramboll) was engaged by Transport for New South Wales (TfNSW) to complete periodic surface water monitoring upstream and downstream of contamination identified with the Goulburn – Bombala rail corridor at Tarago, New South Wales (NSW).

Contamination has been identified along approximately 900 lineal meters of the rail corridor (Ramboll, 2019). This area is herein referred to as "the Site" and is presented with surface water monitoring locations on **Figure 2-1**.

1.1 Background

The Woodlawn Mines Ore Concentrate Load-Out Complex operated within the Goulburn – Bombala rail corridor at Tarago from the 1970s to the 1990s. Concentrates were produced at the Woodlawn Mine approximately 6.5 km west and included a zinc concentrate consisting mainly of sphalerite (zinc oxide), lead concentrate of galena (lead sulphide) and copper concentrate of chalcopyrite (copper iron sulphide).

On 25 March 2020, the NSW Environment Protection Authority (NSW EPA) declared the Site as significantly contaminated under Section 11 of the *Contaminated Land Management Act 1997* (Declaration Number 20201103). TfNSW is currently managing the contamination under a Voluntary Management Proposal (VMP) which includes further assessment of site contamination and remediation to address the potential risks to human health and the environment.

An extensive body of work has been completed to characterise contaminant impacts associated with historical operation of the Site. This work has included assessment of soil, groundwater and surface water across the Site and assessment of soil, groundwater, surface water and airborne dust within the surrounding area. A previous assessment completed by Ramboll (2020) identified contaminants of potential concern (CoPC) relevant to receiving surface waters were limited to metals which exceed relevant human health and ecological assessment criteria.

In 2020, Environmental Risk Sciences Pty Ltd (EnRiskS) were commissioned to undertake a review of the existing data and provide further advice in relation to the risk to human health and the environment due to lead and other metals in areas adjacent to the Site (EnRiskS, 2020). As part of the assessment EnRiskS (2020) developed site specific criteria for metals in soil, sediment, and surface water for the drainage features accessed during surface water monitoring. These site-specific criteria have been adopted for assessment of the surface water results presented in this report.

Periodic monitoring of onsite and offsite surface water commenced in 2019 and ceased in April 2021 following consistent observation that risks to the receiving environment from Site contamination were low. On 6 September 2022 the NSW EPA issued a Prevention Notice to TfNSW relating to deficiencies in the implementation the Tarago Lead Management Plan (Ramboll, 2019). In response, surface water monitoring was reinstated to further assess temporal and geographic trends in contaminant distribution from the Site.

1.2 Objectives

The objectives of the surface water monitoring program are to:

- Collect reliable water quality data, to provide a data continuum which forms the basis for assessment of impacts from the Site on surrounding surface water receptors.
- Present data to date on a quarterly basis.

2. SCOPE OF WORK

2.1 Monitoring Scope

The scope of work for each surface water monitoring event includes:

- Collection of surface water samples at 11 predefined locations, as presented in **Table 2-1** and **Figure 2-1** (plus collection of quality assurance samples).
- Measurement of surface water physico-chemical properties including pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), redox potential (ORP) and total dissolved solids (TDS).
- Submission of samples to a National Association of Testing Authorities (NATA) accredited laboratory for analysis of total and dissolved metals (aluminium, arsenic, barium, beryllium, cadmium, chromium, cobalt, iron, lead, manganese, mercury, nickel and zinc).
- Assessment of laboratory results against adopted assessment criteria, as presented in **Section 5**.
- Assessment of data quality and reliability.

Table 2-1: Surface Water Sampling Locations

Sample ID	Location
On and Near Site	
SW1	Adjacent to a culvert on the western side of the rail line at CH 262.600 on tributary of Mulwaree River.
SW1 – UP	Intended as an up-gradient sample, located on a western tributary of the Mulwaree River, approximately 100 m west of the rail corridor at CH. 262.600.
SW2	Adjacent to a culvert on the eastern side of the rail line at CH 262.600 on tributary of Mulwaree River.
SW3	Adjacent to a culvert on the western side of the rail line at CH 262.300.
SW4	Adjacent to a culvert on the eastern side of the rail line at CH 262.300.
SW5	Adjacent to a culvert on the western side of the rail line at CH 262.000.
SW6	Adjacent to a culvert on the eastern side of the rail line at CH 262.000.
SW7	A dam located downgradient from the Site northern rail culvert forming part Lot A DP 440822.
Offsite – Mulwaree River	
SW8	Mulwaree River adjacent Lumley Road.
SW9	Mulwaree River off Braidwood Road.
SW10	Mulwaree River off Braidwood Road.

RAMBOLL AUSTRALIA - GIS MAP file - 318000780_GIS_P018_T22_RAPs_02_RAP_RailCorridor | F003_SurfaceWaterSamples_V01 | 13/04/2021

A4
1:10,000

Legend

- Surface water sampling location
- Rail corridor
- Rail corridor fence
- Area of lead exceedance (within rail corridor)
- Indicative surface water flow path (ie: not ephemeral)
- Indicative ephemeral surface water flow path

Figure 2-1: Surface Water Monitoring Locations

3. SAMPLING AND ANALYSIS QUALITY PLAN

Prior to the commencement of routine surface water monitoring, which commenced in February 2020, Ramboll prepared a Sampling and Analysis Quality Plan titled '*Sampling Analysis and Quality Plan (SAQP) – Surface Water Monitoring, Tarago Lead Management*' (Ramboll, 2020).

The SAQP is attached as **Appendix 1**.

4. QUALITY ASSURANCE / QUALITY CONTROL PROGRAM

4.1 QA/QC Data Evaluation

An assessment was made of data completeness, comparability, representativeness, precision and accuracy based on field and laboratory considerations, as outlined in NEPM 1999 Amendment (2013) guidelines. The DQI assessment for the September 2022 surface water monitoring event is provided in **Table 4-1**.

Table 4-1: QA/QC –Assessment of DQIs

Assessment of DQIs (as per NSW EPA, 2020)	Ramboll's Assessment	Completeness	Comparability	Representativeness	Precision	Accuracy
Field QA/QC						
Sampling team	Sampling was completed by Ramboll experienced environmental scientists/engineers between 12 and 13 September 2022.	x	x			
Reference to sampling plan/method, including any deviations from SAQP	Sampling was undertaken in general accordance with the SAQP. SW5 could not be sampled as the location was dry.	x				
Any information that could be required to evaluate measurement uncertainty for subsequent testing (analysis)	Samples were collected from 11 pre-determined locations (unless dry) for consistency between the sampling rounds. Samples were collected from 100 mm below surface, where practical.				x	x
Decontamination procedures carried out between sampling events	Samples were collected directly into laboratory supplied sampling containers using dedicated disposable sampling equipment. Disposable nitrile gloves were worn during sample collection and were changed between sample locations. Field parameters were recorded after analytical samples had been collected. Non disposable sampling equipment (i.e., water quality meter probe) were rinsed between sampling locations with a solution of Decon®90 and potable water.			x	x	x
Logs for each sample collected, including date, time, location (with GPS coordinates if possible), sampler, duplicate samples, chemical analyses to be performed, site observations and weather/environmental (i.e., surroundings) conditions. Include any diagrams, maps, photos.	Each sample was labelled with a unique sample ID, as presented in **Table 2-1**. Surface water parameters including pH, temperature, EC, DO and ORP were measured and recorded for each of the sampling locations using a calibrated multi-parameter water quality meter. Measurements of field parameters were recorded once parameters had stabilised.		x	x		
Chain of custody fully identifying – for each sample – the sampler, nature of the sample, collection date, analyses to be performed, sample preservation method, departure time from the site and dispatch courier(s) (where applicable)	Samples were transported to the laboratory under chain of custody conditions. The chain of custody forms were signed by the laboratory on receipt of the samples. All surface water samples were placed into laboratory-supplied bottles that were prepared with the required preservatives. Surface water samples were stored in an ice filled cooler in the field and during transportation to the laboratory.	x	x			
Field quality assurance/quality control results (e.g., field blank, rinsate blank, trip blank, laboratory prepared trip spike)	Intra-laboratory and inter-laboratory duplicate results, are presented in **Table 13**, **Appendix 3**. No trip spike/blanks were collected due to the targeted contaminants of the investigation not being volatile. Relative Percent Differences (RPDs) were all below the RPD criteria (<=30%).				x	x

Assessment of DQIs (as per NSW EPA, 2020)	Ramboll's Assessment	Completeness	Comparability	Representativeness	Precision	Accuracy
Sample splitting techniques – subsampling, containers/preservation (ensure unique ID for subsequent samples provided)	The external duplicate samples were obtained by first gathering a larger volume of water and then decanting to create three identical sub samples. Field duplicate samples were labelled with a unique identification that does not reveal the association between the primary and duplicate samples e.g., D01.			x		
Statement of duplicate frequency	Intra- and inter- laboratory duplicate samples were analysed at a rate of 9%.			x	x	
Field instrument calibrations (when used)	The water quality meter was hired from a rental company who calibrated the equipment prior to hire. The calibration certificate is included in **Appendix 2**.				x	x
Sampling devices and equipment	A water quality meter was used to collect field data, including pH, temperature, EC, DO, ORP and TDS. These parameters were recorded once stabilised.	x	x			
Laboratory QA/QC						
A copy of signed chain-of-custody forms acknowledging receipt date, time and temperature and identity of samples included in shipments	Copy of the signed COC forms are provided in **Appendix 4.**	x	x			
Record of holding times and a comparison with method specifications	Review of the Chain of Custody (COC) forms and laboratory certificates indicated that holding times were met.	x	x			
Analytical methods used, including any deviations	Summary analytical methods were included in the laboratory test certificates presented in **Appendix 4**.	x	x			
Laboratory accreditation for analytical methods used, also noting any methods used which are not covered by accreditation	Eurofins MGT was used as the primary laboratory and ALS was used as the secondary laboratory. The laboratory certificates are NATA stamped.	x			x	
Laboratory performance for the analytical method using inter-laboratory duplicates	Analytical methods were comparable between laboratories.		x			x
Surrogates and spikes used throughout the full method process, or only in parts. Results are corrected for the recovery	A matrix spike recovery less than the lower data quality objective was reported by the secondary laboratory (ALS) for mercury. All remaining laboratory control samples and surrogates were acceptable.	x	x			
A list of what spikes and surrogates were run with their recoveries and acceptance criteria (tabulate)	Laboratory spike and surrogate recoveries are detailed in the laboratory certificates provided in **Appendix 4.**		x			x
Practical quantification limits (PQL)	The PQL for dissolved mercury (<0.0001 mg/L) exceeds the adopted ecological screening criteria for 95% species protection (0.00006 mg/L). Mercury was not detected above the PQL in any of the samples collected indicating that any exceedances of the criteria are anticipated to be minor (within 0.00004 mg/L). All remaining PQLs were below the adopted assessment criteria.	x	x			

Assessment of DQIs (as per NSW EPA, 2020)	Ramboll's Assessment	Completeness	Comparability	Representativeness	Precision	Accuracy
Reference laboratory control sample (LCS) and check results	The results for laboratory control samples were acceptable and no detections were made in blank samples.	x				
Laboratory frequencies (tabulate)	Laboratory quality control samples including duplicates, surrogate spikes and blanks were undertaken by the laboratories at appropriate frequencies.	x				x
Laboratory results (tabulate)	The results for laboratory duplicates were acceptable and no detections were made in blank samples.	x				x

Overall, it is considered that the completed investigation works and the data obtained adequately complied with the requirements of NEPM 1999 Amendment (2013) guidelines. Some uncertainty surrounds the mercury results due to the low matrix spike recoveries and PQLs above criteria. However, it is considered that the data is of suitable quality to meet the project objectives.

5. ASSESSMENT CRITERIA

The criteria adopted for the assessment of surface water contamination are sourced from the following references:

- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999, as amended 2013* (NEPC, 2013).
- National Health and Medical Research Council (NHMRC) (2001) *National Resource Management Ministerial Council (NRMMC) Australian Drinking Water Guidelines 6, Version 3.6 updated March 2021*, (ADWG, 2011).
- National Health and Medical Research Council (NHMRC), *National Resource Management Ministerial Council (NRMMC) Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008).
- Department of Environment and Conservation (DEC) *Guidelines for the Assessment and Management of Groundwater Contamination* (DEC, 2007).
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018) (available at www.waterquality.gov.au/anz-guidelines).
- Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000).
- *Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW, Site specific criteria – Protection of human health and terrestrial and/or aquatic ecosystems* (EnRiskS, 2020).

5.1 Rationale for Application of Guidelines

The relevance of guidelines was determined based on iterative screening from the broadest and most sensitive water usage scenario which occurs in the Mulwaree River back through agricultural land and public roads to the least sensitive scenario which occurs at the Site.

All results from Mulwaree River samples (SW8 to SW10) have been screened against Tier 1 / screening guidelines relevant to human health (incidental ingestion), freshwater ecology, irrigation and stock watering as each of these receptors occur within the receiving waters (the Mulwaree River). Should results exceed screening guidelines and indicate site contamination as the source, it would be appropriate to apply the guidelines that were exceeded to sampling locations upstream as this would inform further assessment of the Site as the potential source. Previous monitoring results do not indicate site contamination is adversely affecting the Mulwaree River. Site-specific guidelines were developed for Arsenic, Cadmium, Lead, Manganese and Nickel (EnRiskS, 2020) that integrate the ephemeral nature of surface water features between the Mulwaree River and the Site. Additionally, several technical refinements were identified and are relevant to guideline application. These were:

- ADWG (2011) Section 6.3.1 states that guideline values refer to the total amount of the substance present, regardless of its form (e.g., in solution or attached to suspended matter) and so analytical results from unfiltered samples should be assessed against human health criteria. The primary human health risk from contaminants in surface water from the Site is via recreational use. NHMRC (2008) suggests that 10-times the ADWG values may provide a conservative estimate of acceptable recreational exposure guidelines values. This approach was applied to derive recreational exposure criteria.
- ANZG (2018) guidelines for metals in freshwater are adopted from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) which states the major toxic effect of metals comes from the dissolved fraction, so it is valid to filter

samples (e.g., to 0.45 µm) and compare the filtered concentration against the trigger values.

- Water hardness is identified as a physical parameter with quantifiable effects. Correction factors are defined in the guidelines to address the effect of water hardness on the bioavailability of cadmium, chromium, lead, nickel and zinc.

To define appropriate hardness correction factors, water was conservatively presumed to be moderately hard based on the Goulburn Mulwaree Regional State of the Environment Report 2004-2009 (Goulburn Mulwaree Council, 2009). Hardness correction factors were adopted from Table 3.4.4 of the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000) to refine Tier 1 criteria as described in **Table 5-1** below.

Table 5-1: Hardness Corrections for Tier 1 Freshwater Ecology Guidelines

	Original guideline value (mg/L)	Hardness Correction Factor	Corrected guideline value (mg/L)
Cadmium	0.0002	2.7	0.00054
Chromium	0.001	2.5	0.0025
Lead	0.0034	4	0.0136
Nickel	0.011	2.5	0.0275
Zinc	0.008	2.5	0.02

Application of guidelines at each sampling point is summarised in **Table 5-2**.

Table 5-2: Guidelines Applied to Sampling Points

Sampling Point	Location	Human Health - Site Specific[1]	Ecology - Site Specific[1]	Human Health - Recreational Sceening[2]	Ecology – Screening[3]	Irrigation – Screening[3]	Stock Water – Screening[3]
SW1-UP	Upstream of Southern Culvert (offsite)	✓	✓	✓	✓	-	-
SW1	Upstream of Southern Culvert	✓	✓	✓	✓	-	-
SW2	Downstream of Southern Culvert	✓	✓	✓	✓	-	-
SW3	Upstream of Middle Culvert	✓	✓	✓	✓	-	-
SW4	Downstream of Middle Culvert	✓	✓	✓	✓	-	-
SW5	Upstream of Northern Culvert	✓	✓	✓	✓	-	-
SW6	Downstream of Northern Culvert	✓	✓	✓	✓	-	-
SW7	Dam on farm downstream of Northern Culvert (offsite)	-	-	✓	✓	✓	✓
SW8	Mulwaree River upstream of Middle and Northern Culvert Discharge	-	-	✓	✓	✓	✓
SW9	Mulwaree River upstream of Southern Culvert Discharge	-	-	✓	✓	✓	✓
SW10	Mulwaree River downstream of Middle and Northern Culvert Discharge	-	-	✓	✓	✓	✓

[1] *EnRiskS (2021)*

[2] *ANZG (2018)*

[3] *ANZECC (2000)*

Assessment criteria adopted under each guideline are presented in **Table 5-3**.

Table 5-3: Guideline Criteria (mg/L)

Contaminant	Human Health - Site Specific Criteria	Human Health - Recreation Screening	Ecology - Site Specific Criteria	95% Fresh water (ANZG 2018)	Irrigation - Screening	Stock Water - Screening
Total Metals						
Aluminium	-	2	NA	NA	NA	NA
Arsenic	7	0.1	NA	NA	NA	NA
Barium	-	2	NA	NA	NA	NA
Beryllium	-	0.6	NA	NA	NA	NA
Cadmium	1.4	0.002	NA	NA	NA	NA
Chromium	-	0.5	NA	NA	NA	NA
Cobalt	-	-	NA	NA	NA	NA
Copper	-	20	NA	NA	NA	NA
Iron	-	3	NA	NA	NA	NA
Lead	7	0.1	NA	NA	NA	NA
Manganese	350	5	NA	NA	NA	NA
Mercury	-	0.01	NA	NA	NA	NA
Nickel	14	0.2	NA	NA	NA	NA
Zinc	-	30[h]	NA	NA	NA	NA
Dissolved Metals						
Aluminium	NA	NA	5	0.055[a]	20	5
Arsenic	NA	NA	0.5	0.024[b]	2	0.5-5
Barium	NA	NA	-	-	-	-
Beryllium	NA	NA	-	-	0.5	-
Cadmium	NA	NA	10	0.00054[g]	0.05	0.01
Chromium	NA	NA	-	0.002.5[g]	1	1
Cobalt	NA	NA	-	0.0014	0.1	1
Copper	NA	NA	0.5	0.0014	5	0.4-5
Iron	NA	NA	-	-	10	not sufficiently toxic
Lead	NA	NA	0.1	0.0034	5	0.1
Manganese	NA	NA	-	1.9	10	not sufficiently toxic
Mercury	NA	NA	-	0.00006[d, e]	0.002	0.002
Nickel	NA	NA	1	0.0275[g]	2	1
Zinc	NA	NA	20	0.02[g]	5	20

NA – not applicable

blank cell denoted with – indicates no criterion available.

[a] Aluminium guidelines for pH > 6.5, based on the pH of groundwater measured at the Site and surrounding area. This is an aesthetic criteria only based on post flocculation problems

[b] Guideline value for arsenic (III).

[c] Guideline value for chromium (VI).

[d] Guideline value for inorganic mercury.

[e] 99% species protection level DGV has been adopted to account for the bioaccumulating nature of this contaminant.

[f] Guideline value for m-xylene. Guideline values also exist for both o-xylene and p-xylene as per ANZG (2018). The default guideline value for m-xylene guideline has been adopted as it is the most conservative

[g] Hardness correction factor applied to the threshold value as detailed in ANZG 2018

[h] Calculated using the ADWG (2011) aesthetic guideline. Insufficient data to set a guideline value based on health considerations

6. RESULTS

6.1.1 Monitoring Events

A total of 10 monitoring events have been completed between August 2019 and September 2022. Surface water monitoring events were completed after a period of rainfall (where possible) as this is the only occasion where surface water is present in the drainage channels.

Table 6-1 includes information on rainfall conditions preceding each monitoring event. The table includes comparison of the rainfall over the 48-hour period preceding the sampling event to the design rainfall events for the Mulwaree catchment (Wollondilly and Mulwaree Rivers Flood Study WMA Water 2016) in order to provide an indication of the significance of the rainfall event. Average monthly rainfall data compared to actual monthly rainfall data is also included to indicate the general climate conditions in the month of sampling.

Table 6-1: Indicative Summary of Rainfall Preceding Sampling Events

Event	Max Rainfall over 48hr Critical Duration (mm)	Rainfall in 48 hrs preceding monitoring events (mm)									
		13-Aug-19	24-Sep-19	29-Jan-20	1-Apr-20	11-Aug-20	13-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	12-Sep-22
>10% AEP	< 126	0	0	0	0	-	0	0	0	0	7.2
10% AEP	126	-	-	-	-	-	-	-	-	-	-
5% AEP	147	-	-	-	-	-	-	-	-	-	-
2% AEP	175	-	-	-	-	163	-	-	-	-	-
1% AEP	197	-	-	-	-	-	-	-	-	-	-
Monthly Rainfall Observed (mm)		19	41.2	22	79.2*	157.8	94.4	64	2.4	26	66.6
Average Monthly Rainfall (mm)		42.9	44	49	40.4*	42.9	44	63.9	25.9	32.6	44.1
Comment		Dry month, dry conditions precedent	Average rainfall month, dry conditions precedent	Dry month, dry conditions precedent	Wet month, dry conditions precedent	Wet month, high rainfall event precedent	Wet month, dry conditions precedent	Average rainfall month, dry conditions precedent	Dry month, dry conditions precedent	Average rainfall moth, dry conditions precedent	Wet month, low rainfall event precedent

Notes: All rainfall data was sourced from the Australian Bureau of Meteorology. Daily rainfall was sourced from the closest weather station with rainfall records preceding each monitoring event (Lake Bathurst, Windellama and Goulburn Airport). Monthly averages and records were sourced from the closest weather station with a complete record (Goulburn Airport).

**Monthly observations and averages are for rainfall in the calendar month in which each monitoring event occurred except for the 1 April 2020 event for which March data is presented. Based on this the monthly data is not a direct representation of rainfall preceding monitoring though is considered as an indicator of general conditions around each monitoring event.*

AEP – Annual Exceedance Probability

6.1.2 Physico-Chemical Results

Surface water physico-chemical parameters were measured in the field during the majority of sampling rounds and are summarised in **Table 6-2**. The full physico-chemical parameter dataset is provided as **Table 1** of **Appendix 3**.

Table 6-2: Summary of Surface Water Physico-Chemical Parameters

Sample ID	Records		Temp.	SPC	pH	DO	ORP	TDS	Comments
			°C	µS/cm	pH units	mg/L	mV	mg/L	
On and Near Site									
SW1	7	Minimum	7.8	206.1	6.35	0.04	23.6	133.9	Dry January 2020.
		Maximum	17.4	733	7.77	11	175.8	434	
		Average	11.6	575.3	7.4	5.6	120.3	335.7	
SW1-UP	7	Minimum	8	205.6	7.05	0.1	-41.4	133.3	Dry January 2020. Parameters not recorded September 2019.
		Maximum	19.94	704	7.8	10.86	186.9	431	
		Average	12.8	569.4	7.4	5.7	119.0	337.0	
SW2	8	Minimum	7.3	213.3	6.54	0.12	48.3	137.8	Dry January 2020. Parameters not recorded September 2019.
		Maximum	17.54	677	8.27	10.59	185.9	416	
		Average	11.5	541.5	7.7	5.5	140.7	320.9	
SW3	6	Minimum	8.54	142.5	6.23	4.7	64.8	92.3	Dry January 2020 and January 2021. Parameters not recorded September 2019.
		Maximum	21.75	245	7.96	9.43	186	159	
		Average	11.9	204.0	7.0	6.6	150.0	130.1	
SW4	9	Minimum	7.4	128.2	5.75	1.12	70	99.45	Dry January 2020. Parameters not recorded September 2019.
		Maximum	20.33	388.3	8.8	10.42	263.1	251.8	
		Average	12.0	233.2	7.3	6.2	174.5	167.1	
SW5	4	Minimum	8.71	117.9	6.45	4.06	-3	76.7	Dry January, April 2020, and January 2021 and September 2022.
		Maximum	11.95	251.2	8.35	9.33	191	121	
		Average	10.9	187.0	7.2	7.5	106.5	98.9	
SW6	3	Minimum	8.3	168.3	7.32	4.5	111	109.2	Dry January, April, October 2020, and January, April 2021.
		Maximum	11.8	180.6	9.07	9.73	187	117	
		Average	9.7	174.0	8.0	7.9	158.0	113.1	
Offsite									
SW7	8	Minimum	7.38	94.7	6.57	1.8	56	61.8	---
		Maximum	23.1	2342	8.92	8.76	168	396.6	
		Average	15.3	483.4	7.4	5.9	107.6	155.4	
SW8	8	Minimum	8.4	170.5	7.2	3.1	84.0	107.9	---
		Maximum	23.6	1007.0	8.5	9.3	136.1	656.5	
		Average	15.1	696.2	7.6	6.4	115.8	415.8	
SW9	8	Minimum	7.7	125.3	7.3	0.3	83.0	115.7	---
		Maximum	25.0	1030.0	8.4	16.8	227.7	812.5	
		Average	15.2	593.8	7.8	8.9	134.3	452.6	
SW10	5	Minimum	7.9	682.0	7.2	3.6	3.8	454.4	---
		Maximum	18.2	978.0	7.6	8.2	125.2	564.0	
		Average	12.9	790.6	7.4	5.5	83.9	491.5	

6.1.3 Analytical Results

A summary of the surface water analytical results for monitoring events from August 2019 to September 2022 is presented in **Table 6-3** and **Table 6-4** for on and near site and the Mulwaree River sampling locations, respectively. The corresponding results tables are presented in **Tables 2** through **12** of **Appendix 3**.

SW7 is sampled from a dam receiving water from the Northern Culvert and is located at 2135 Braidwood Road. Based on repeated discussion with the owner of 2135 Braidwood Road Ramboll understands the dam is to be decommissioned and backfilled in the near future. Within this context elevated contaminant concentrations in surface water identified at this location are not considered to present a risk to human health or ecology.

Table 6-3: Summary of Onsite and Near Site Surface Water Analytical Results (SW1_UP, SW1, SW2, SW3, SW4, SW5, SW6, SW7)

Analyte	No. of Samples	No. of Detects	Minimum	Maximum	Average	No. above site-specific criteria		No above Tier 1 criteria			
								ANZECC (2000) Fresh Water Guidelines		Health-based Screening Criteria (Recreational Waters)	Eco Screening Criteria (ANZG 95% Protection) Fresh Water
						Human Health	Ecology	Irrigation	Stock Water		
Total Metals											
Aluminium	50	36	0.06	11	0.895	-	-	-	-	**2**	-
Arsenic	51	28	0.001	0.016	0.003	0	-	-	-	0	-
Barium	50	50	0.03	0.36	0.076	-	-	-	-	0	-
Beryllium	51	0	0	0	-	-	-	-	-	0	-
Cadmium	51	32	0.0003	0.04	0.005	0	-	-	-	**2**	-
Chromium	50	27	0.001	0.011	0.002	-	-	-	-	0	-
Cobalt	51	20	0.001	0.014	0.004	-	-	-	-	-	-
Copper	51	43	0.001	0.31	0.047	-	-	-	-	0	-
Iron	50	49	0.06	8.9	1.457	-	-	-	-	**7**	-
Lead	56	45	0.001	0.17	0.024	0	-	-	-	**2**	-
Manganese	51	51	0.009	1.1	0.180	0	-	-	-	0	-
Mercury	51	4	0.0001	0.0001	0.000	-	-	-	-	0	-
Nickel	51	36	0.001	0.451	0.024	0	-	-	-	**1**	-
Zinc	51	48	0.005	7	0.573	-	-	-	-	0	-
Dissolved Metals											
Aluminium	48	30	0.05	3.6	0.737	-	-	0	0	-	**29**
Arsenic	49	27	0.001	0.011	0.002	-	0	0	0	-	0
Barium	48	48	0.03	0.12	0.061	-		-	-	-	-
Beryllium	49	0	0	0	-	-		-	0	-	0
Cadmium	49	28	0.0002	0.018	0.003	-	**2**	**2**	0	-	**26**
Chromium	48	16	0.001	0.003	0.002	-		0	0	-	**6**
Cobalt	49	12	0.001	0.005	0.002	-		0	0	-	**7**
Copper	49	38	0.001	0.2	0.038	-	0	0	4	-	**37**
Iron	48	34	0.08	2.6	0.890	-		-	0	-	**27**
Lead	49	32	0.001	0.033	0.010	-	0	0	0	-	**25**
Manganese	49	48	0.005	1	0.091	-		0	0	-	0
Mercury	49	0	0	0	-	-		0	0	-	0
Nickel	49	31	0.001	0.421	0.021	-	0	0	0	-	**8**
Zinc	49	43	0.005	2.6	0.352	-	0	0	0	-	**35**

Table 6-4: Summary of Mulwaree River Surface Water Analytical Results (SW8, SW9, SW10)

Analyte	No. of Samples	No. of Detects	Minimum	Maximum	Average	Health-based Screening Criteria (Recreational Waters)	Ecological Screening Criteria (ANZG 95% Protection) Fresh Water	ANZECC (2000) Fresh Water Guidelines	
								Irrigation	Stock Water
Total Metals									
Aluminium	20	5	0.05	0.72	0.296	0	NA	-	-
Arsenic	21	6	0.001	0.001	0.001	0	NA	-	-
Barium	20	19	0.02	0.12	0.074	0	NA	-	-
Beryllium	21	0	0	0	-	0	NA	-	-
Cadmium	21	2	0.0003	0.0004	0.000	0	NA	-	-
Chromium	20	4	0.001	0.002	0.002	0	NA	-	-
Cobalt	21	1	0.003	0.003	0.003	-	NA	-	-
Copper	21	12	0.001	0.01	0.003	0	NA	-	-
Iron	20	19	0.15	3.2	0.556	**1**	NA	-	-
Lead	21	5	0.001	0.002	0.002	0	NA	-	-
Manganese	21	21	0.03	1.9	0.207	0	NA	-	-
Mercury	21	0	0	0	-	0	NA	-	-
Nickel	21	19	0.001	0.002	0.002	0	NA	-	-
Zinc	21	18	0.008	0.16	0.033	0	NA	-	-
Dissolved Metals									
Aluminium	18	2	0.35	0.41	0.380	-	**2**	0	0
Arsenic	19	3	0.002	0.003	0.003	-	0	0	0
Barium	18	17	0.02	0.12	0.072	-	-	-	-
Beryllium	19	0	0	0	-	-	0	-	0
Cadmium	19	2	0.0002	0.0004	0.000	-	**1**	0	0
Chromium	18	1	0.001	0.001	0.001	-	0	0	0
Cobalt	19	0	0	0	-	-	0	0	0
Copper	19	11	0.002	0.008	0.004	-	**11**	0	0
Iron	18	15	0.07	0.8	0.220	-	**2**	-	0
Lead	19	0	0	0	-	-	0	0	0
Manganese	19	19	0.012	0.33	0.092	-	0	0	0
Mercury	19	0	0	0	-	-	0	0	0
Nickel	19	14	0.001	0.002	0.001	-	0	0	0
Zinc	19	14	0.006	0.14	0.032	-	**7**	0	0

NA = not applicable

6.1.4 Analytical Results Trends

The following time series charts present total and dissolved concentrations of lead, copper and zinc for the 10 monitoring events completed between August 2019 and September 2022. Dailly rainfall is presented for the same period.

6.1.4.1 Lead

Concentration Trends On and Near Site

Figure 6-1 presents total lead concentrations reported in surface water samples (SW1-UP, SW1 through to SW7) collected upstream and downstream of three onsite rail culverts. The data are shown relative to the adopted site-specific criterion for human health (7 mg/L), derived by EnRiskS (2020). The y-axis is presented on a logarithmic scale to allow for presentation of the relative variation in concentrations.

All surface water samples collected on and near the site to date have reported total lead concentrations below the site-specific human health criterion. Slight increases in concentrations were reported at SW1, SW3 and SW4 (maximum increase of 0.019 mg/L at SW4) when compared to the previous monitoring event (July 2021).

Figure 6-2 presents dissolved lead concentrations reported for the samples mentioned above. Data is presented relative to the EnRiskS (2020) site-specific ecological criterion for lead (0.1 mg/L). All samples to date have reported dissolved lead concentrations below the site-specific ecological criterion. Similar to total lead, slight increases in concentrations were reported at SW3 and SW4 (maximum increase of 0.009 mg/L at SW3 and SW4, respectively) when compared to the previous monitoring event (July 2021).

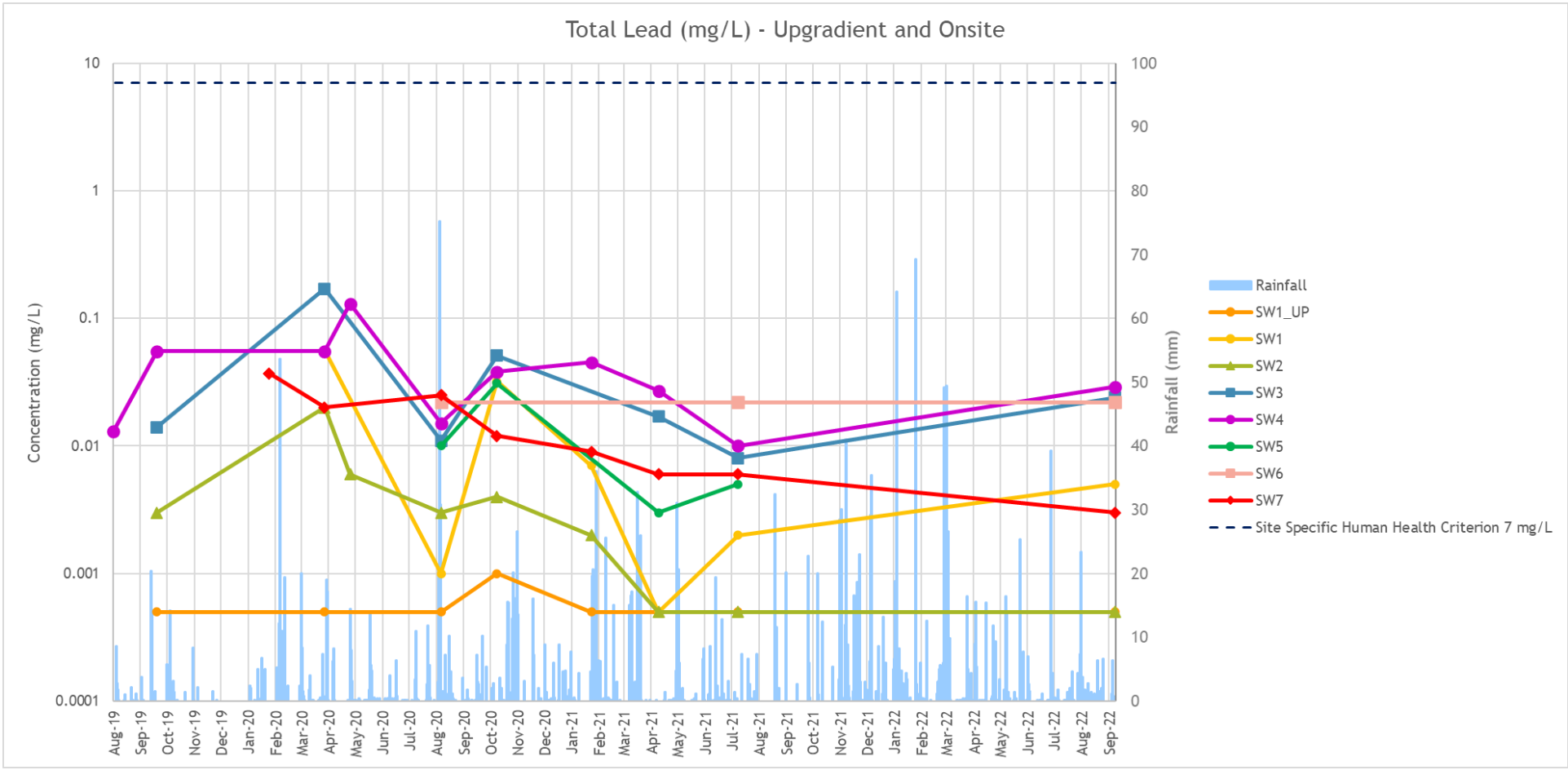


Figure 6-1: Upgradient and Onsite Total Lead Concentration Trend - Logarithmic Scale

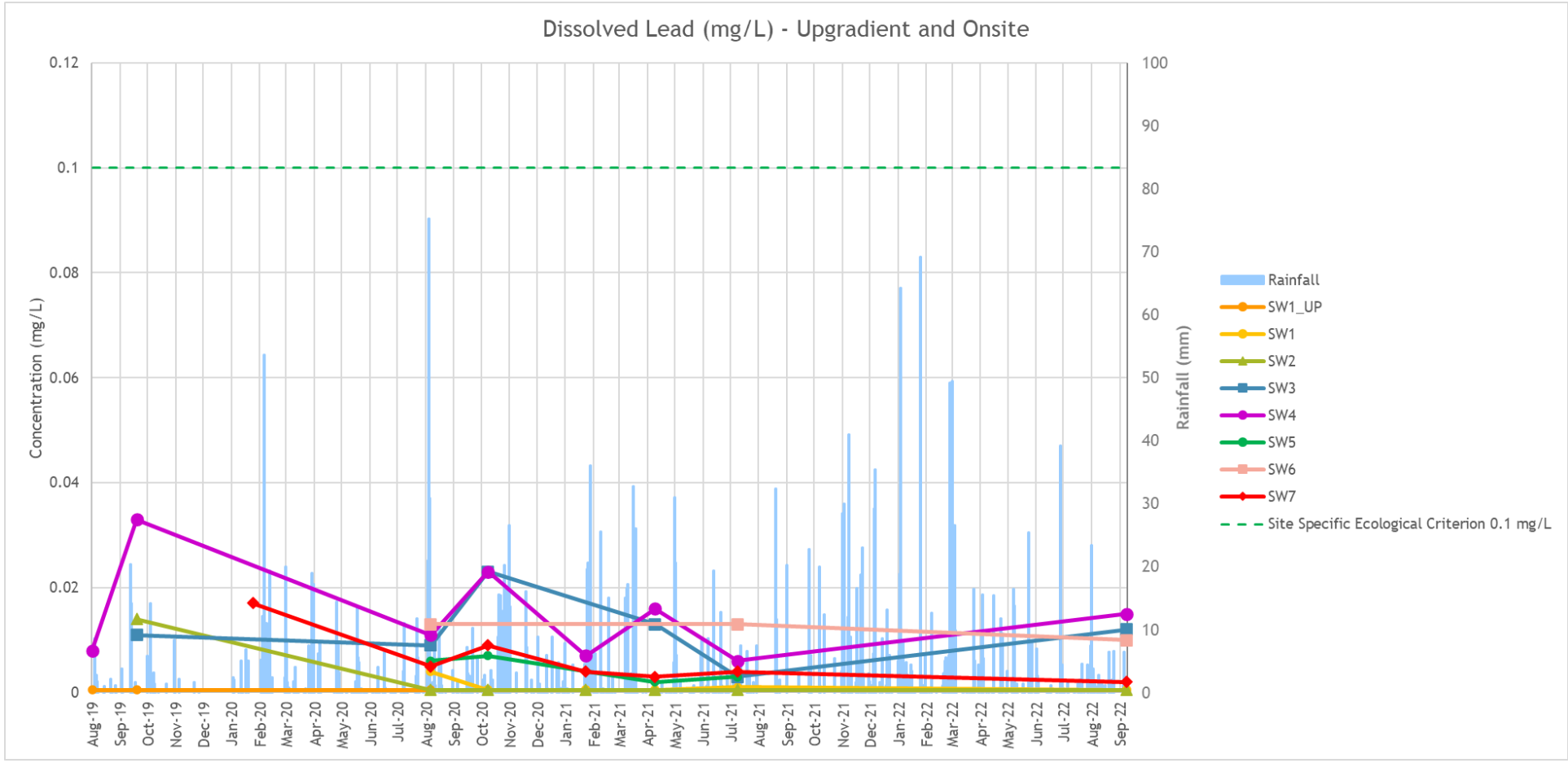


Figure 6-2: Upgradient and Onsite Dissolved Lead Concentration Trend

Concentration Trends Mulwaree River (Offsite)

Figure 6-3 presents total lead concentrations reported in surface water samples (SW8, SW9, SW10) collected from the Mulwaree River located offsite. Total lead concentrations in surface water samples are approximately 50-times lower than the adopted human health criterion for recreational water (0.1 mg/L). Therefore, the criterion has not been plotted on the y-axis of the graph in order to allow visual assessment of the low concentration trends. Total lead has not been detected above the laboratory PQL (0.001 mg/L) in surface water samples collected from the Mulwaree River since January 2021.

For the assessment of ecological risk, dissolved lead concentrations in samples collected from the Mulwaree River have been plotted relative to the adopted criterion for 95% protection of species protection in freshwater aquatic ecosystems (0.0034 mg/L), presented in **Figure 6-4**. All samples collected from the Mulwaree River to date have reported dissolved lead concentrations below the laboratory PQL and below adopted ecological criterion. Samples do not exceed the less sensitive guidelines for irrigation (0.1 mg/L) and stock water (5 mg/L).

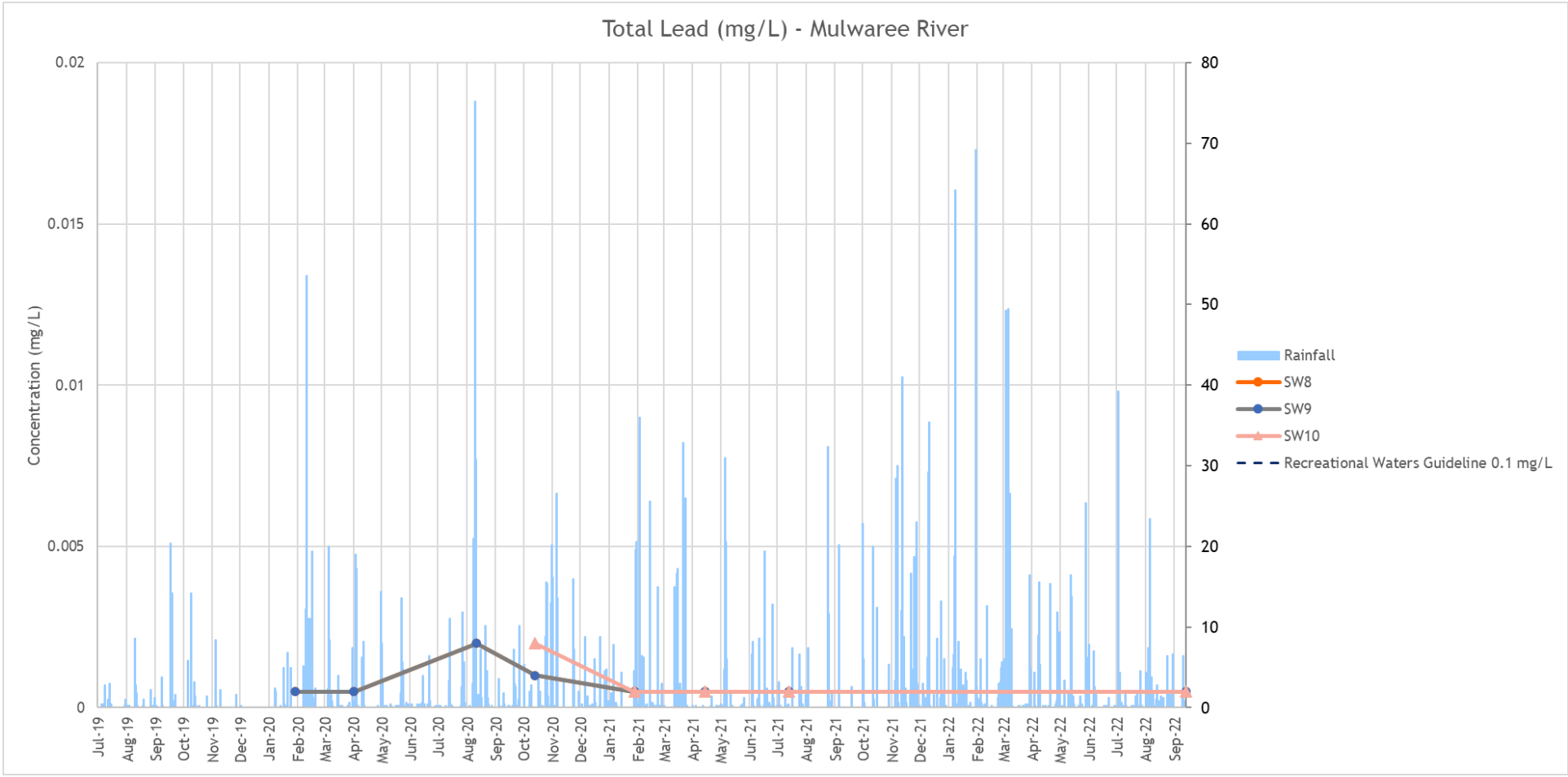


Figure 6-3: Mulwaree River (Offsite) Total Lead Concentration Trend

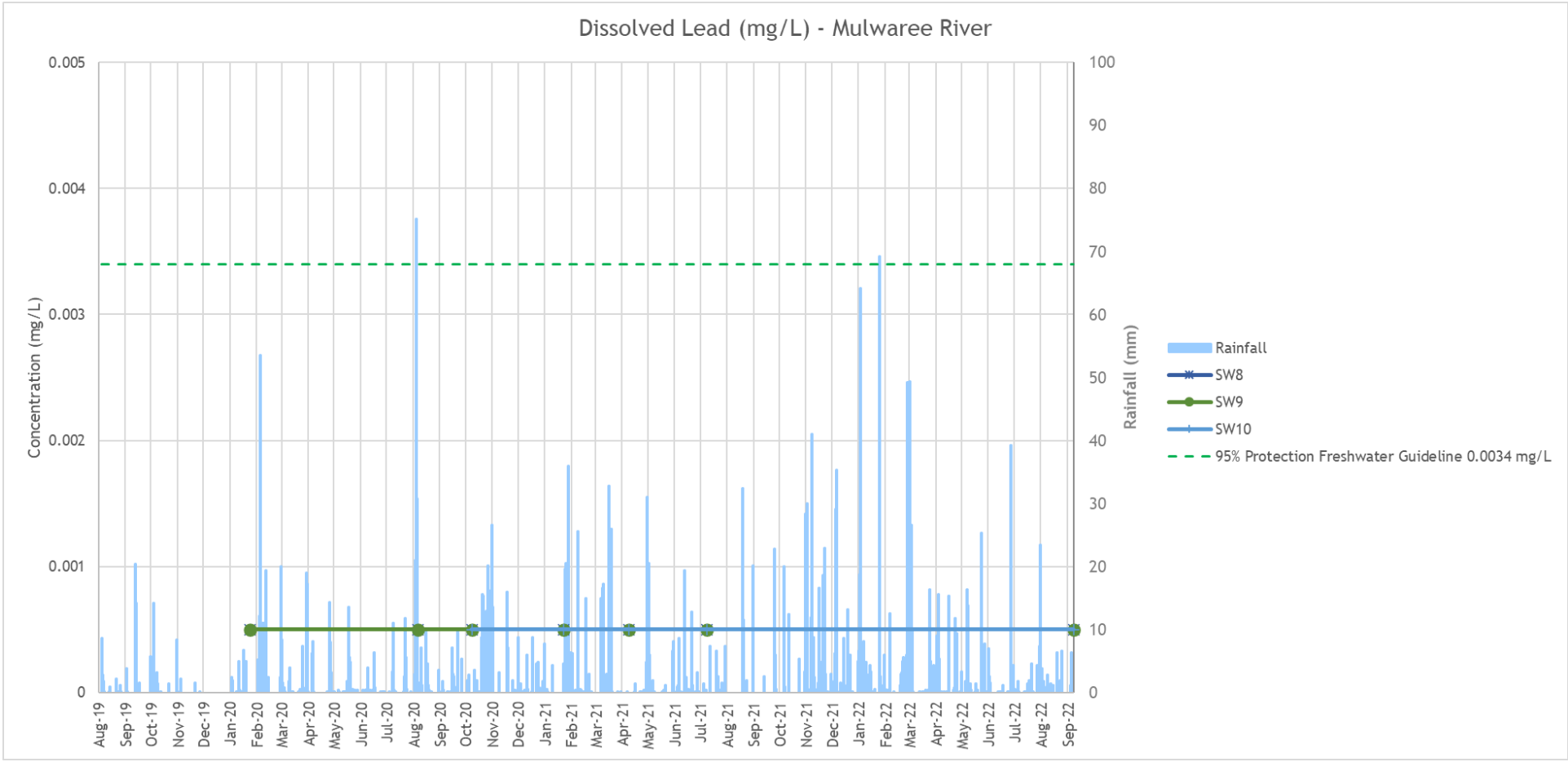


Figure 6-4: Mulwaree River Offsite Dissolved Lead Concentration Trend

6.1.4.2 Copper

Concentration Trends On and Near Site

Figure 6-5 presents the total copper concentration in surface water samples (SW1-UP, SW1 through to SW7) collected upstream and downstream of three onsite rail culverts. Total copper concentrations in surface water are approximately 66-times lower than the adopted human health criterion for recreational water (20 mg/L). Therefore, the criterion has not been plotted on the y-axis of the graph in order to allow visual assessment of the low concentration trends. All surface water samples collected on and near the Site to date have reported total copper concentrations below the human health criterion. Concentrations reported during September 2022 were largely consistent with the previous monitoring event (July 2021). Samples SW1-UP, SW1 and SW2, located upgradient to and at the southern culverts, have consistently reported total copper concentrations below or close to the laboratory PQL.

Figure 6-6 presents dissolved copper concentrations reported for the samples mentioned above, relative to the adopted site-specific ecological criterion (0.5 mg/L). All samples collected on and near the site to date reported dissolved copper concentrations below the site-specific ecological criterion.

Total and dissolved copper concentrations have historically been highest at SW4, located at the middle rail culvert. Recent monitoring events conducted in July 2021 and September 2022 have reported the highest concentrations at SW6, located at the northern rail culvert. SW7, located downgradient from the northern rail culvert, has consistently reported low copper concentrations (total and dissolved) when compared with remaining locations on or near the site.

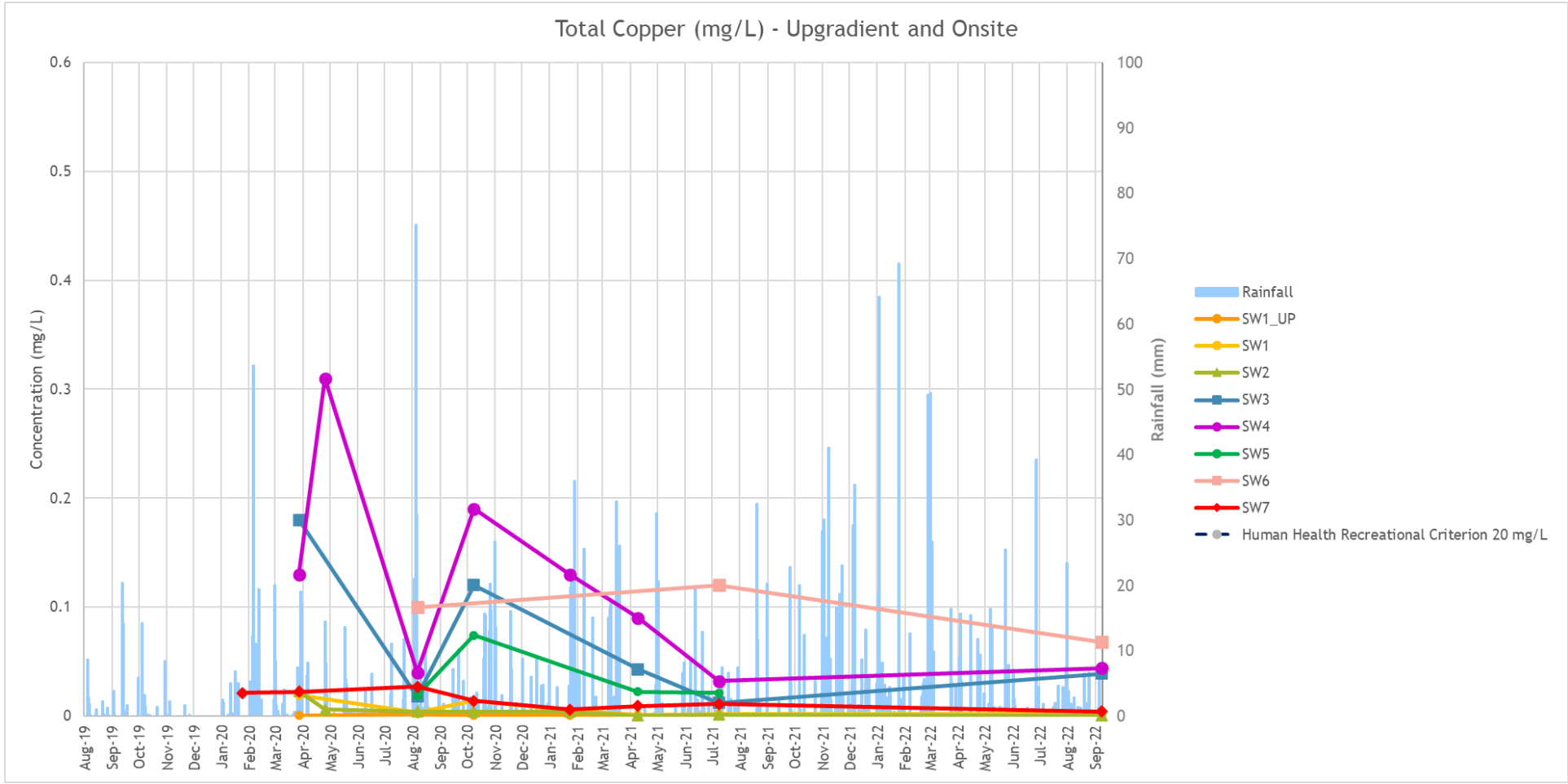


Figure 6-5: Upgradient and Onsite Total Copper Concentration Trend

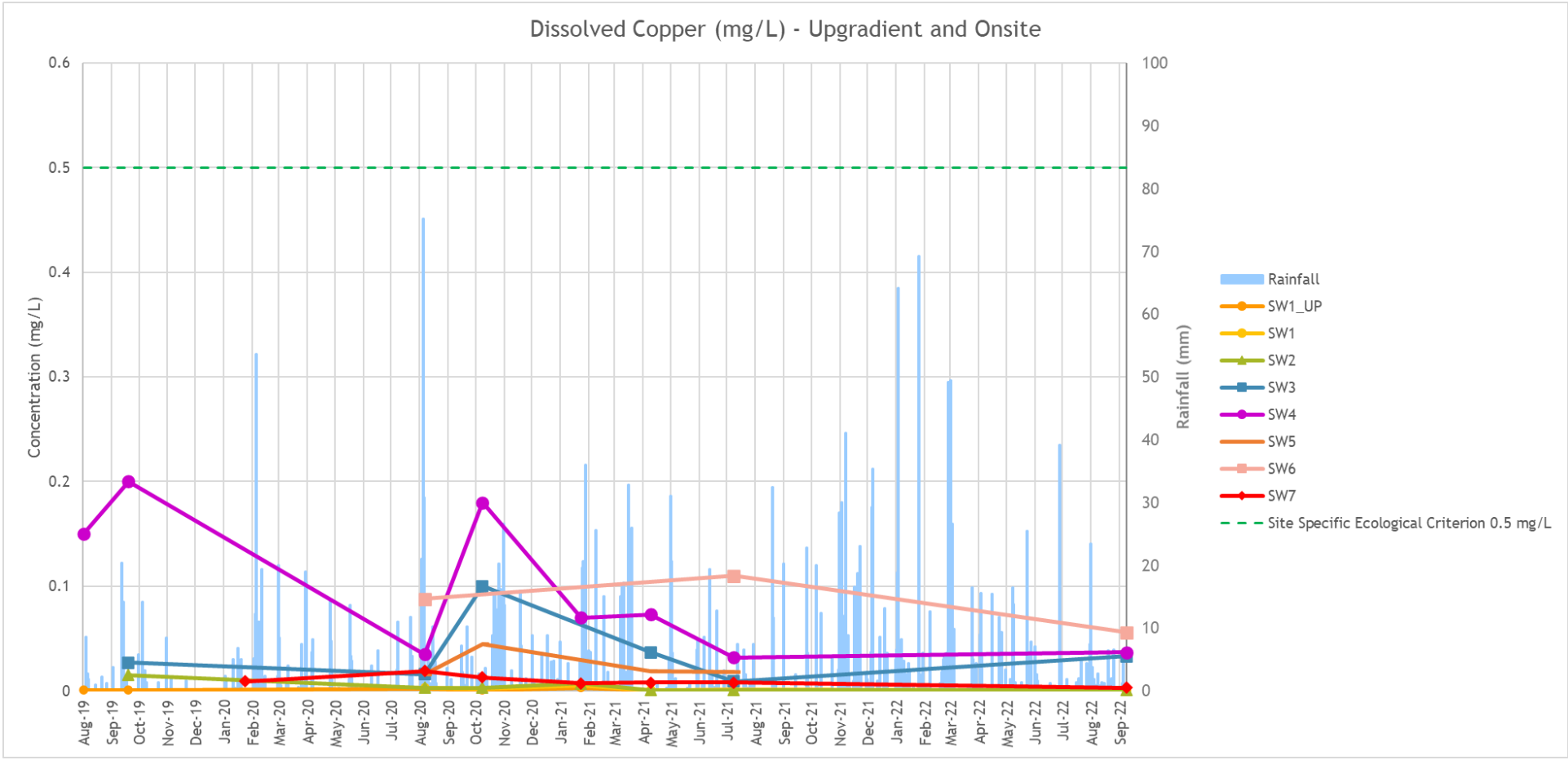


Figure 6-6: Upgradient and Onsite Dissolved Copper Concentration Trend

Concentration Trends Offsite

Figure 6-7 presents total copper concentrations reported in surface water samples (SW8, SW9, SW10) collected from the Mulwaree River located offsite. The data are shown relative to the human health criterion for recreational use (20 mg/L). The y-axis is presented on a logarithmic scale to allow for presentation of the relative variation in concentrations. All samples collected from the Mulwaree River to date have reported total copper concentrations below the human health assessment criterion. Similar concentrations have been reported in SW9 and SW8, located upstream and downstream of the Site, respectively with all locations reporting identical concentrations between October 2020 and September 2022. This indicates that total copper concentrations in the Mulwaree River are likely to be influenced by sources other than the Site and represent background conditions in the receiving waters.

Concentrations of dissolved copper in samples collected from the Mulwaree River relative to the adopted ecological assessment criterion (0.0014 mg/L) for 95% protection of freshwater species (ANZG, 2018) is presented in **Figure 6-8**. Dissolved copper concentrations exceeded the ecological assessment criterion for samples collected from the Mulwaree River in August 2020, January 2021, July 2021 and September 2022. Concentrations in all samples correlated closely, noting that sampling of the downstream location SW10 commenced in October 2020. Prior to April 2021, the highest dissolved copper concentrations were generally reported in SW9, located upstream. Dissolved copper concentrations in the Mulwaree River appear representative of background and not representative of impacts from the Site. Samples do not exceed the less sensitive guidelines for irrigation (0.5 mg/L) and stock water (0.1 mg/L).

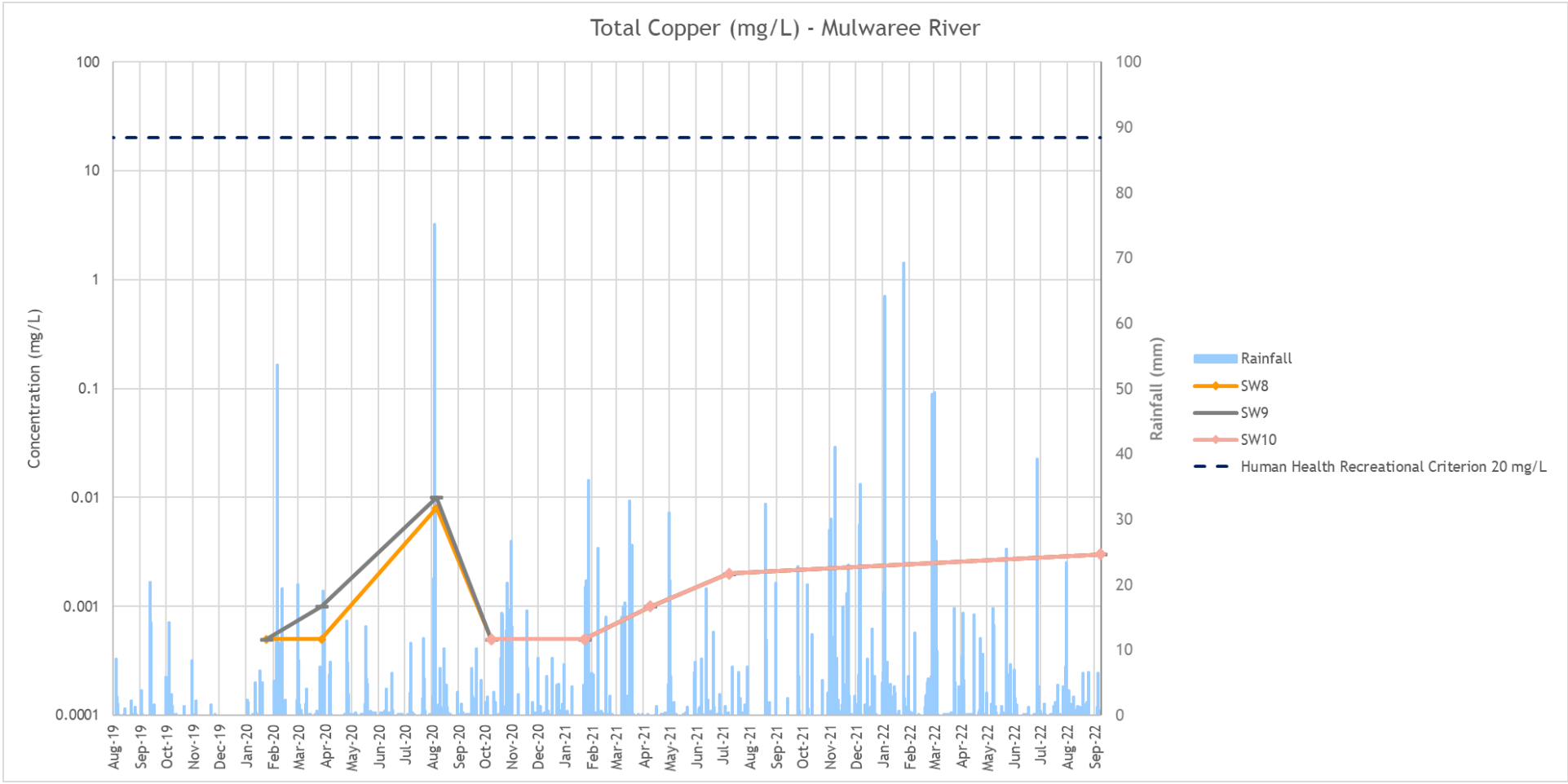


Figure 6-7: Mulwaree River (Offsite) Total Copper Concentration Trend – Logarithmic Scale

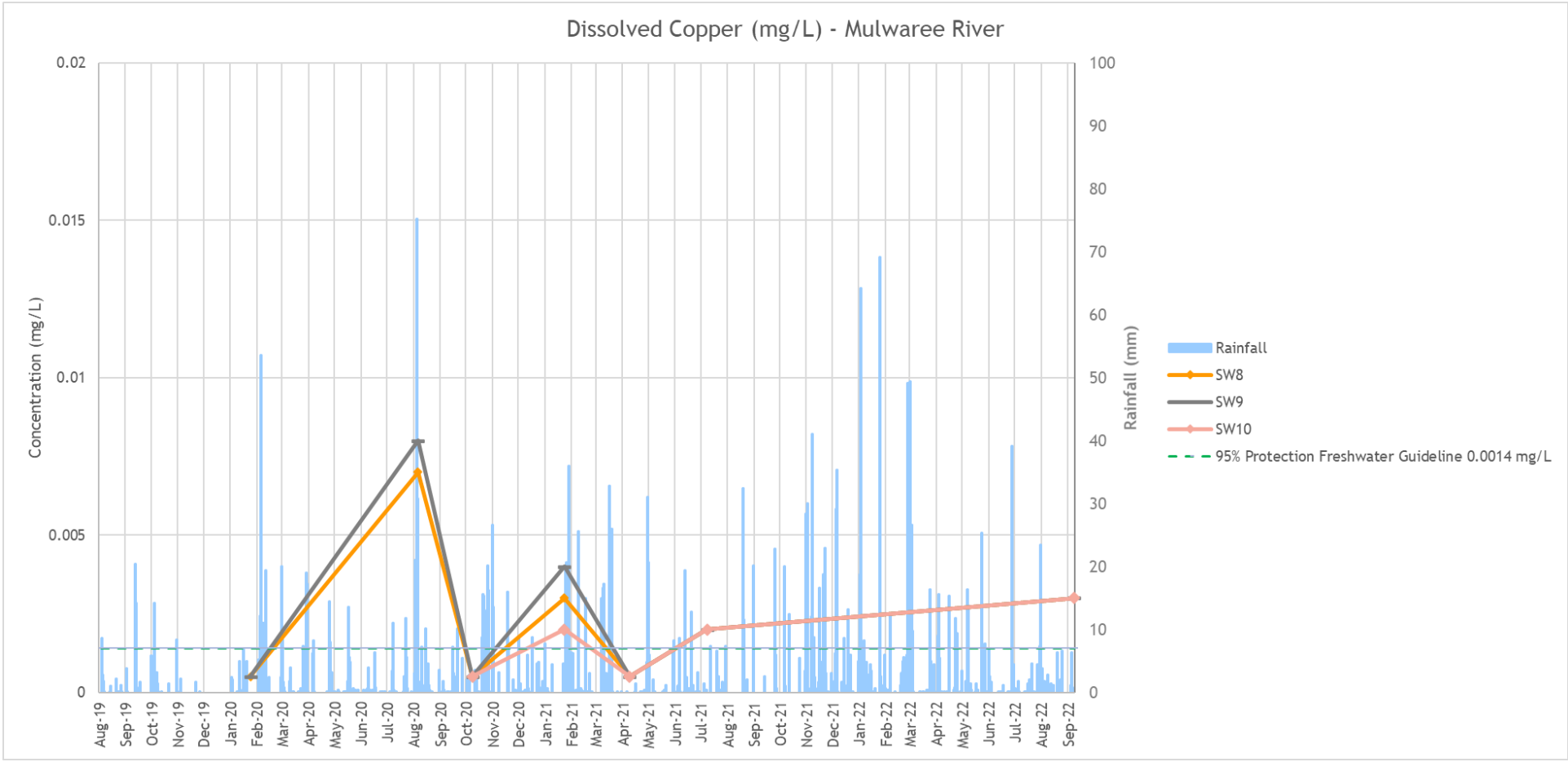


Figure 6-8: Mulwaree River (Offsite) Dissolved Copper Concentration Trend

6.1.4.3 Zinc

Concentration Trends On and Near the Site

Figure 6-9 presents total zinc concentrations reported in surface water samples (SW1-UP, SW1 through to SW7) collected upstream and downstream of three onsite rail culverts. The data are shown relative to the adopted site-specific criterion for human health (30 mg/L). The y-axis is presented as a logarithmic scale to allow for presentation of the relative variation in concentrations.

All surface water samples collected on and near the site to date have reported total zinc concentrations below the adopted human health criterion.

Figure 6-10 presents dissolved zinc concentrations reported for the samples described above, relative to the site-specific ecological criterion of 20 mg/L. All samples collected on and near the site to date have reported dissolved zinc concentrations below the adopted criteria. Concentrations have been reported at or below 2.6 mg/L and have remained largely stable since January 2021.

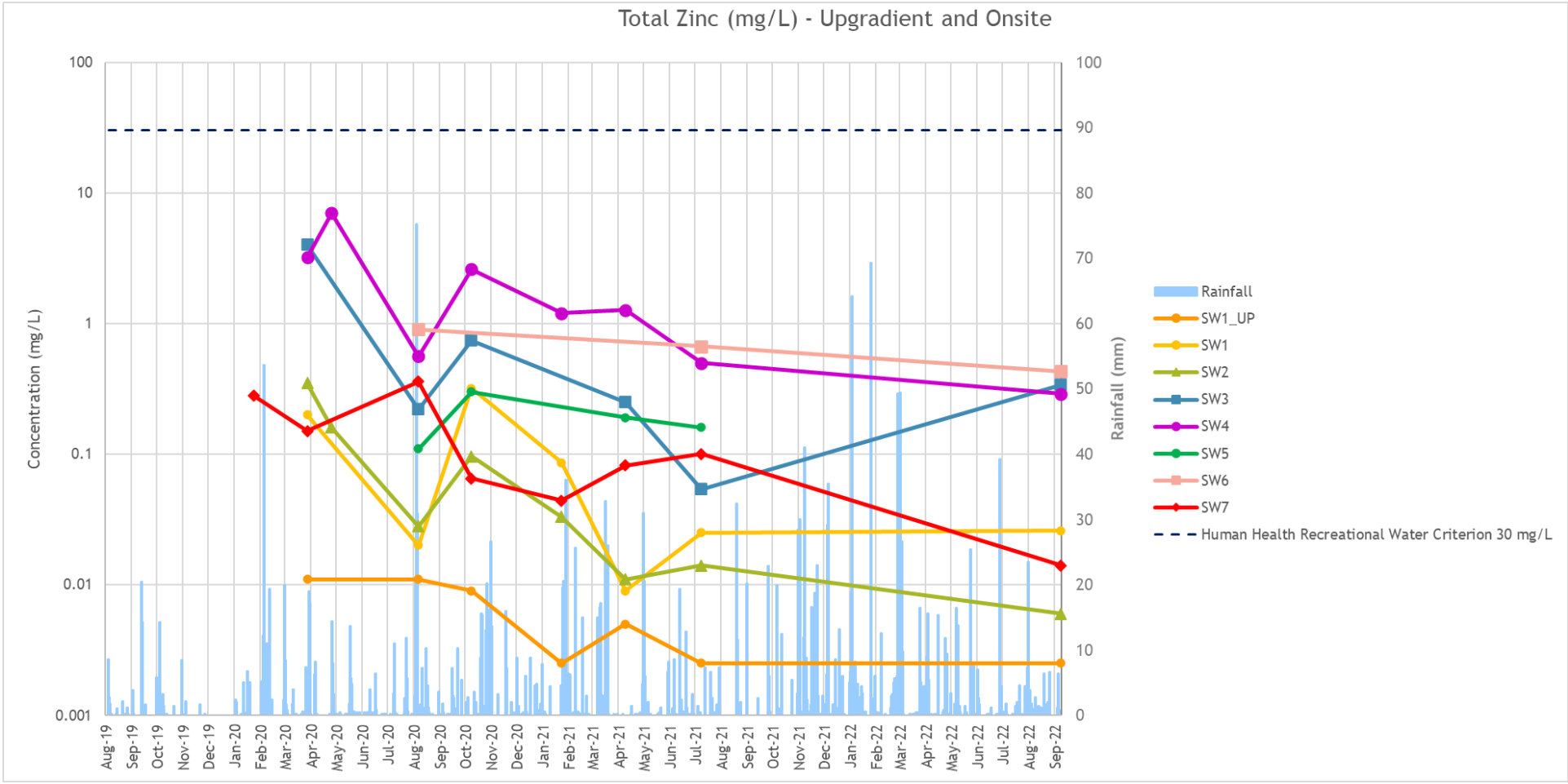


Figure 6-9: Upgradient and Onsite Total Zinc Concentration Trend – Logarithmic Scale

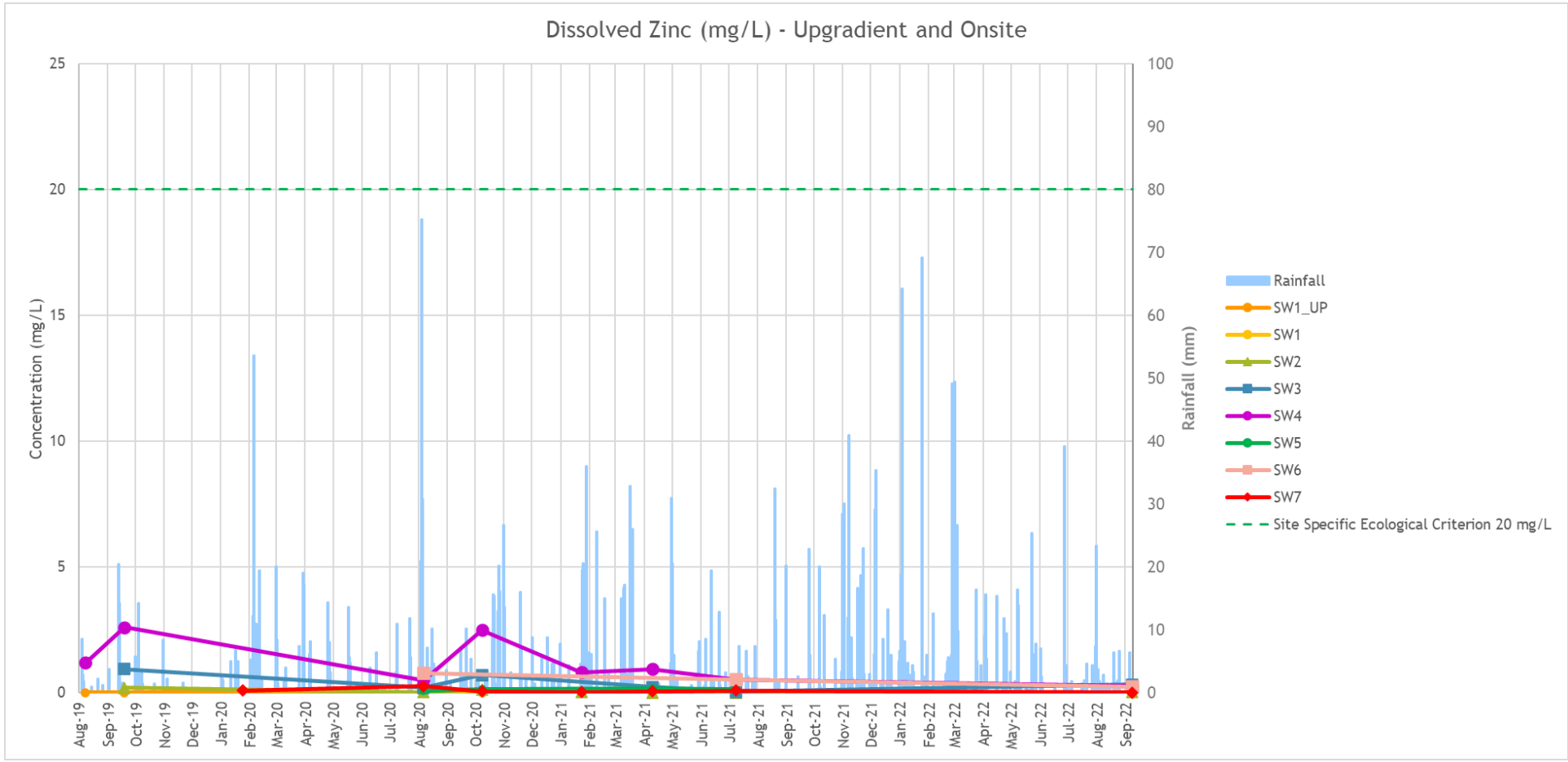


Figure 6-10: Upgradient and (Onsite) Dissolved Zinc Concentration Trend

Concentration Trends Offsite

Figure 6-11 presents total zinc concentrations in surface water samples (SW8, SW9, SW10) collected from the Mulwaree River located offsite. Total zinc concentrations in surface water are approximately 188-times lower than the adopted human health criterion for recreational water (30 mg/L). Therefore, the criterion has not been plotted on the y-axis of the graph in order to allow visual assessment of the low concentration trends. All samples collected from the Mulwaree River to date have reported concentrations below the adopted criteria. A minor increase (maximum 0.145 mg/L) at SW9 was identified following high rainfall in August 2020. Similar to copper, this increase in concentration was reported at both the upgradient (SW9) and downgradient (SW8) locations indicating a potential upstream contaminant source. A relationship between zinc in surface water from the Site and in the Mulwaree River was not identified.

Figure 6-12 presents dissolved zinc concentrations in samples collected form the Mulwaree River relative to the adopted ecological criterion (0.02 mg/L). Concentrations of dissolved zinc exceeded the adopted ecological criterion at SW8 and SW9 in August 2020 and at SW9 and SW10 in July 2021. All samples exceeded the adopted ecological criteria during the most recent monitoring event (September 2022). The upgradient location (SW9) has generally reported the highest concentrations of dissolved zinc in the Mulwaree River (with the exception of October 2020). Similar to copper, concentrations in the Mulwaree River appear representative of background and not representative of impacts from the Site. Samples do not exceed the less sensitive guidelines for irrigation (20 mg/L) and stock water (5 mg/L).

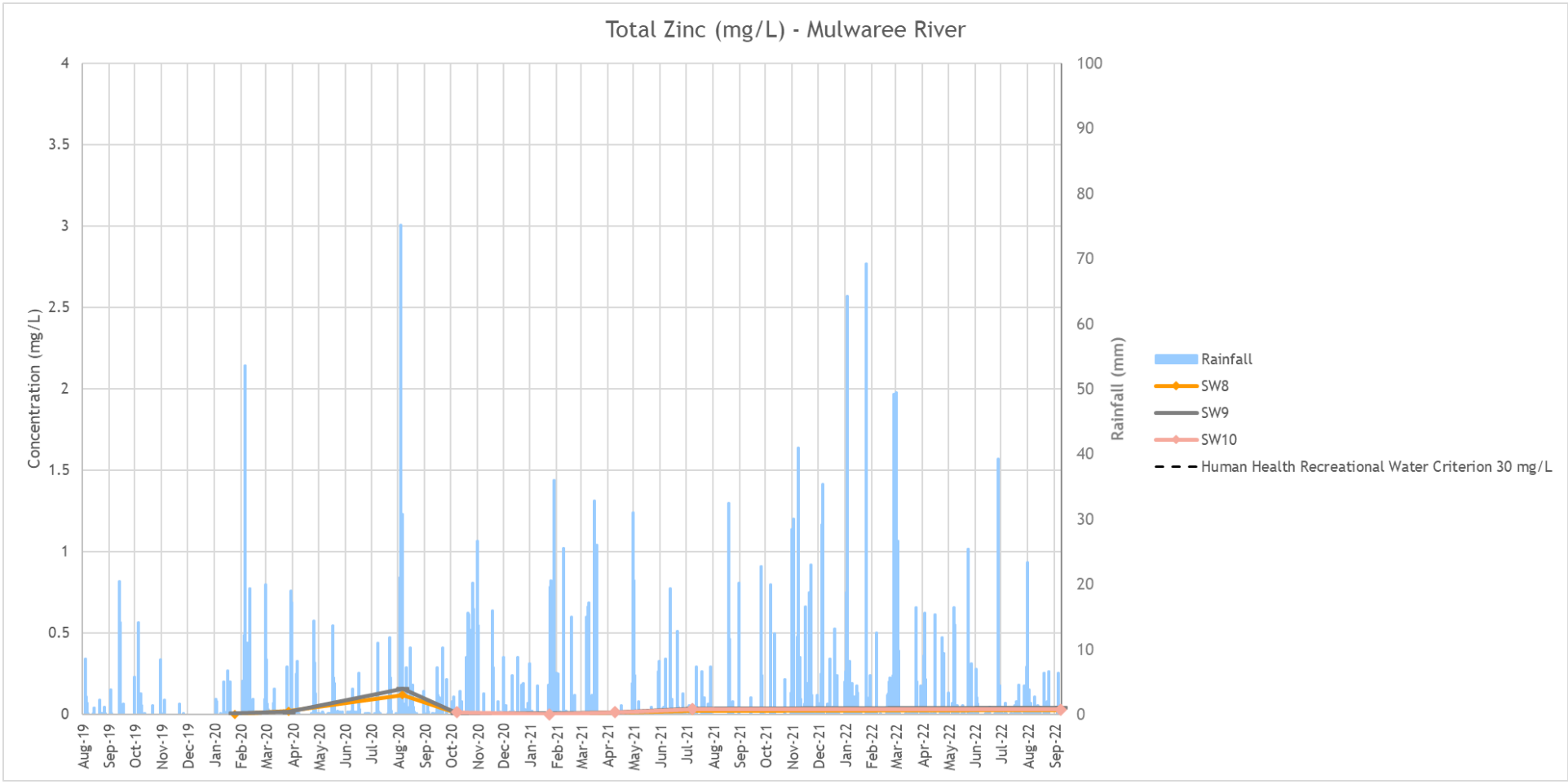


Figure 6-11: Mulwaree River (Offsite) Total Zinc Concentration Trend

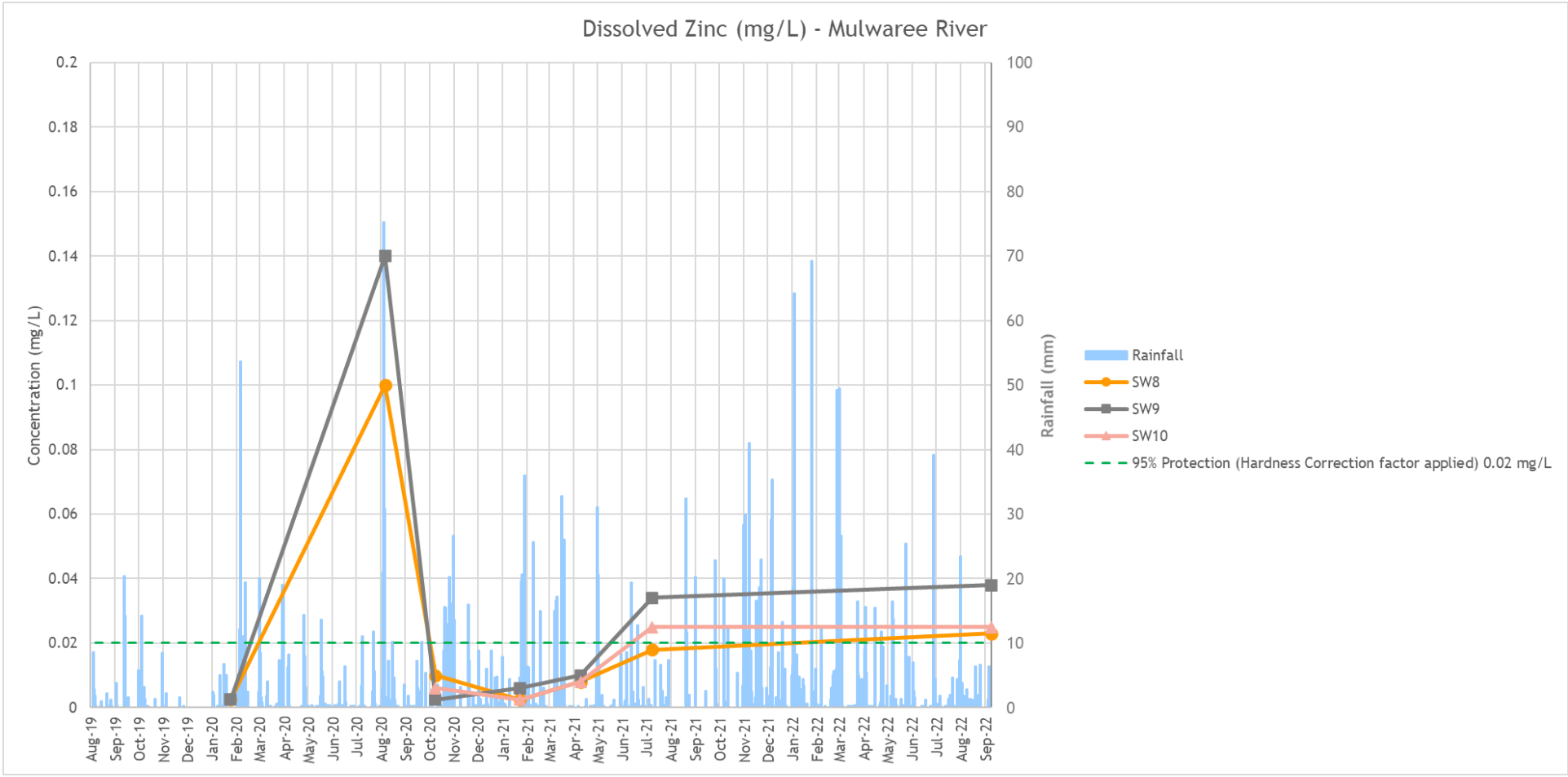


Figure 6-12: Mulwaree River (Offsite) Dissolved Zinc Concentration Trend

7. SUMMARY

A summary of CoPC results with regard for human health and ecological risk is presented in **Table 7-1**.

Table 7-1: CoPC Results Summary (Lead, Copper, Zinc)

Metal	Total/ Dissolved	Sample Location	Criteria	Summary	Assessment
Lead	Total	On and Near Site (SW1-UP, SW1, SW2, SW3, SW4, SW5, SW6, SW7)	Site-specific human health criterion of 7 mg/L (EnRiskS, 2021).	Concentrations of total lead were below the adopted human health criteria in all samples collected to date.	Based on the monitoring data assessed, which accounts for some seasonal variation, the risk to human health from lead in surface water is considered to be low and acceptable.
		Mulwaree River/Offsite (SW8, SW9, SW10)	Recreational water criterion (0.1 mg/L).		
	Dissolved	On and Near Site (SW1-UP, SW1, SW2, SW3, SW4, SW5, SW6, SW7)	Site-specific ecological criterion of 0.1 mg/L (EnRiskS, 2021).	Concentrations of dissolved lead were below the adopted ecological assessment criterion in all sampled collected to date.	Risk to ecological receptors from lead in surface water was found to be low and acceptable.
		Mulwaree River/Offsite (SW8, SW9, SW10)	95% species protection for freshwater ecosystems (0.0034 mg/L) (ANZG, 2018). ANZECC (2000) Freshwater guidelines for irrigation and stock water.		
Copper	Total	On and Near Site (SW1-UP, SW1, SW2, SW3, SW4, SW5, SW6, SW7)	Recreational water criterion (20 mg/L). Recreational water criterion (20 mg/L).	Concentrations of total copper were below the adopted human health criteria in all samples collected to date.	The risk to human health from copper in surface water is considered low and acceptable.
		Mulwaree River/Offsite (SW8, SW9, SW10)			
	Dissolved	On and Near Site (SW1-UP, SW1, SW2, SW3, SW4, SW5, SW6, SW7)	Site-specific ecological criterion of 0.5 mg/L (EnRiskS, 2021).	Concentrations of dissolved copper were below the adopted ecological criteria in all samples collected to date.	Risk to ecological receptors from the drainage system is low and acceptable.
		Mulwaree River/Offsite (SW8, SW9, SW10)	95% species protection for freshwater ecosystems (0.0014 mg/L) (ANZG, 2018). ANZECC (2000) Freshwater guidelines for	Concentrations of dissolved copper exceeded the adopted ecological criteria in August 2020, January 2021, July 2021 and September 2022. The highest concentrations were generally reported in the upstream sample (SW9).	Exceedances of the ecological criteria at the upstream location does not indicate the Site as a source of contamination impacting the river.

Metal	Total/ Dissolved	Sample Location	Criteria	Summary	Assessment
			irrigation and stock water.		
Zinc	Total	On and Near Site (SW1-UP, SW1, SW2, SW3, SW4, SW5, SW6, SW7)	Recreational water criterion (30 mg/L). Recreational water guideline of 30 mg/L.	Concentrations of total zinc were below the adopted human health criteria in all samples collected to date.	Risk to human health associated with zinc in the drainage system is considered to be low and acceptable.
		Mulwaree River/Offsite (SW8, SW9, SW10)			Risks to human health associated with zinc in offsite surface water are considered to be low and acceptable.
	Dissolved	On and Near Site (SW1-UP, SW1, SW2, SW3, SW4, SW5, SW6, SW7)	Site-specific ecological criterion of 20 mg/L (EnRiskS, 2021).	Concentrations of dissolved zinc were below the adopted ecological criteria in all samples collected to date.	Risks to ecology associated with zinc in the drainage system is considered to be low and acceptable.
		Mulwaree River/Offsite (SW8, SW9, SW10)	95% species protection for freshwater ecosystems (ANZG, 2018) corrected for hardness (0.02 mg/L). ANZECC (2000) Freshwater guidelines for irrigation and stock water.	Concentrations of dissolved zinc exceeded the adopted ecological criterion at SW8 and SW9 in August 2020 and at SW9 and SW10 in July 2021. All samples exceeded the adopted ecological criteria during the most recent monitoring event (September 2022). The highest concentrations were generally reported in the upstream sample (SW9).	Exceedances of the ecological criteria at the upstream location does not indicate the Site as a source of contamination impacting the river.

8. CONCLUSIONS

Routine surface water monitoring was reinstated at Tarago NSW in September 2022 in response to a Prevention Notice issued by the NSW EPA to TfNSW. Surface water monitoring was completed between 12 and 13 September 2022. Results were compared against historical observations and relevant assessment criteria.

Monitoring results indicate no evidence of offsite migration of contaminants in surface water that would represent an unacceptable human health risk, with no reported exceedances in the adopted human health criteria for the contaminants of concern.

Similarly, monitoring results indicate no evidence of offsite migration of contaminants in surface water that would represent an unacceptable risk to ecology. Concentrations of lead, copper and zinc observed in the Mulwaree River are consistent with background concentrations and do not indicate impacts from the Site.

9. LIMITATIONS

Ramboll Australia Pty Ltd (Ramboll) prepared this report in accordance with the scope of work as outlined in our proposal (ref: P210) to TfNSW dated 2 September 2022 and in accordance with our understanding and interpretation of current regulatory standards.

A representative program of sampling and laboratory analyses was undertaken as part of this investigation, based on past and present known uses of the site. While every care has been taken, concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. We cannot therefore preclude the presence of materials that may be hazardous. Site conditions may change over time. This report is based on conditions encountered at the Site at the time of the report and Ramboll disclaims responsibility for any changes that may have occurred after this time.

The conclusions presented in this report represent Ramboll's professional judgment based on information made available during the course of this assignment and are true and correct to the best of Ramboll's knowledge as at the date of the assessment.

Ramboll did not independently verify all of the written or oral information provided to Ramboll during the course of this investigation. While Ramboll has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Ramboll was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

9.1 User Reliance

This report has been prepared exclusively for TfNSW and may not be relied upon by any other person or entity without Ramboll's express written permission.

10. REFERENCES

ADWG (2011). National Health and Medical Research Council (NHMRC) (2001) National Resource Management Ministerial Council (NRMMC) Australian Drinking Water Guidelines 6, Version 3.5 updated August 2018.

ANZECC (2000). Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

EnRiskS (2021). *Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW*.

NEPM (2013). National Environment Protection Council (NEPC), National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013

NHMRC (2008). National Health and Medical Research Council (NHMRC), National Resource Management Ministerial Council (NRMMC) Guidelines for Managing Risks in Recreational Water

NSW DEC (2007). Contaminated Sites – Guidelines for the Assessment and Management of Groundwater Contamination, Department of Environment and Conservation NSW, Sydney, March 2007.

NSW EPA (2017). *Contaminated Land Management - Guidelines for the NSW Site Auditor Scheme (3rd Edition),* New South Wales Environment Protection Authority, Sydney, NSW, October 2017.

Ramboll (2019). *Tarago Loop Extension: Further Intrusive Assessment and Lead Management Plan*, document reference 318000780-01-Rev3, Ramboll Australia Pty Ltd, September 2019.

Ramboll (2020). *Sampling Analysis and Quality Plan (SAQP) – Surface Water Monitoring, Tarago Lead Management*, document reference 318000780-T24-01-Rev0, Ramboll Australia Pty Ltd, August 2020.

APPENDIX 1
SAQP

Intended for
Transport for New South Wales

Document type
Plan

Date
October 2022

Project Number
Sampling Analysis and Quality Plan (SAQP) – Surface Water Monitoring

SAMPLING ANALYSIS AND QUALITY PLAN (SAQP) – SURFACE WATER MONITORING

TARAGO LEAD MANAGEMENT

RAMBOLL Bright ideas. Sustainable change.

TARAGO LEAD MANAGEMENT
SAMPLING ANALYSIS AND QUALITY PLAN (SAQP) – SURFACE WATER MONITORING

Project name	**Tarago Lead Management**
Project no.	**318001376-T6-A1**
Recipient	**Joanne McLoughlin - Transport for New South Wales** **E: Joanne.Mcloughlin@transport.nsw.gov.au**
Document type	**Plan**
Version	**1**
Date	**7/10/2022**
Prepared by	**Stephen Cadman/Jordyn Kirsch**
Checked by	**Stephen Maxwell**
Approved by	**Fiona Robinson**
Description	**This document comprises the Sampling Analysis and Quality Plan (SAQP) for surface water monitoring associated with management of lead contamination from the Tarago rail corridor.**

Ramboll
Level 2, Suite 18 Eastpoint
50 Glebe Road
PO Box 435
The Junction
NSW 2291
Australia

T +61 2 4962 5444
https://ramboll.com

Revision	Date	Prepared by	Checked by	Approved by
0	Draft	6/08/2020	S Maxwell	F Robinson
1	Revised draft	7/10/2022	S Maxwell CEnvP (SC) 41184	F Robinson

Ramboll Australia Pty Ltd.
ACN 095 437 442
ABN 49 095 437 442

CONTENTS

1.	**INTRODUCTION**	**1**
1.1	Preamble	1
1.2	Background	1
1.3	Regulation	1
1.4	Objective	1
2.	**SITE IDENTIFICATION**	**2**
3.	**REGULATORY REQUIREMENTS**	**3**
4.	**SUMMARY OF CONCEPTUAL SITE MODEL**	**4**
5.	**ASSESSMENT CRITERIA**	**5**
5.1	Rationale for Application of Guidelines	5
6.	**DATA QUALITY OBJECTIVES**	**8**
6.1	Step 1: State the problem	8
6.1.1	Contaminants of Concern	8
6.2	Step 2: Identify the decisions / goal of the study	8
6.3	Step 3: Identify the information inputs	8
6.4	Step 4: Definition of the Study Boundary	9
6.5	Step 5: Develop the decision rules or analytical approach	9
6.6	Step 6: Specify the performance or acceptance criteria	9
6.6.1	The tolerable limits on decision errors are as follows:	9
6.6.2	Evaluation of Analytical Data	10
6.7	Step 7: Develop a plan for obtaining data	12
7.	**SAMPLING PLAN**	**13**
7.1.1	Water Quality Monitoring Performance Criteria	13
8.	**REPORTING**	**15**
9.	**REFERENCES**	**16**

LIST OF TABLES

Table 2-1: Site Identification 2

Table 4-1 Conceptual Site Model Summary 4

Table 5-1: Hardness Corrections for Tier 1 Freshwater Ecology Guidelines 6

Table 5-2: Guidelines Applied to Sampling Points 6

Table 5-3: Guideline Criteria (mg/L) 7

Table 7-1 Performance Criteria 13

APPENDICES

Appendix 1

Figures

1. INTRODUCTION

1.1 Preamble

Ramboll Australia Pty Ltd (Ramboll) was engaged by Transport for NSW (TfNSW) to complete periodic surface water monitoring upstream and downstream of contamination within the Goulburn – Bombala rail corridor at Tarago, New South Wales, Australia.

1.2 Background

The site is identified as part Lot 22 Deposited Plan (DP) 1202608 and is located in Tarago, NSW. The site occupies an area of approximately three hectares and is located approximately 32 km south of Goulburn.

The Woodlawn Mines Ore Concentrate Load-Out Complex operated within the Goulburn – Bombala rail corridor at Tarago from the 1970s – 1990s. Concentrates were produced at the Woodlawn Mine approximately 6.5 km west and included a zinc concentrate consisting mainly of sphalerite (zinc sulphide), a lead concentrate of galena (lead sulphide) and copper concentrates of chalcopyrite (copper iron sulphide).

An extensive body of work has been completed to characterise contaminant impacts associated with historic operation of the site. This work has included assessment of soil, groundwater and surface water across the site and assessment of soil, groundwater, surface water and airborne dust within the surrounding area. Recent assessments identified contaminants within approximately 900 lineal meters of the rail formation at Tarago. This area is herein referred to as the 'site' and is presented on **Figure 1**, **Appendix 1**.

Offsite discharge of surface water appears to be generally related to three culverts which pass beneath the rail formation onsite. Contaminants of potential concern (CoPC) relevant to receiving surface waters appear limited to metals (aluminium, cadmium, copper, lead, nickel, zinc) which exceed the adopted relevant health and/or ecological assessment criteria.

1.3 Regulation

On 25 March 2020 the NSW Environment Protection Authority (NSW EPA) declared the site as significantly contaminated under Section 11 of the Contaminated Land Management Act 1997 (Declaration Number 20201103). Transport for NSW is currently managing the contamination under a Voluntary Management Proposal (VMP) which includes further assessment of site contamination and remediation to address the potential risks to human health and the environment posed by the contamination.

1.4 Objective

The objective of the surface water monitoring is to collect reliable water quality data, providing a data continuum which forms a basis for assessment of impacts from the site on surrounding surface water receptors.

2. SITE IDENTIFICATION

The site locality is shown in **Figure 1, Appendix 1**.

The site details are presented in **Table 2-1.**

Table 2-1: Site Identification

Information	Description
Street Address:	Accessed from Stewart Street and Goulburn Street Tarago NSW
Identifier:	Part Lot 1 DP 595856
Site Area:	Approximately 7.5 ha
Local Government:	Goulburn Mulwaree Shire
Owner:	Transport for NSW
Current Site Use:	Forms part of the Goulburn to Bombala rail line and the Country Regional rail Network (CRN)

3. REGULATORY REQUIREMENTS

This SAQP has been prepared in general accordance with the following guidance documents:

1. Australia and New Zealand Environment and Conservation Council, *Guidelines for Fresh and Marine Water Quality* (ANZECC, 2018)
2. National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013* (NEPM, 2013)
3. NSW EPA, Contaminated Sites: *Guidelines for Consultants Reporting on Contaminated Lands* (NSW EPA 2020)
4. NSW EPA, *Guidelines for the Site Auditor Scheme (3rd Edition)* (NSW EPA, 2017)

4. SUMMARY OF CONCEPTUAL SITE MODEL

A Conceptual Site Model (CSM) was prepared as part of a Detailed Site Investigation prepared by Ramboll (2020). The CSM provides a summary of the source-pathway-receptor linkages for surface water and is summarised in **Table 4-1**.

Table 4-1 Conceptual Site Model Summary

Exposure Pathway	Onsite Workers	Onsite Ecology	Residents	Community Activities	Offsite Workers	Offsite Ecology	Irrigation and Livestock
Surface Water							
Direct contact	N	**P**	N	N	N	**P**	**P**
Incidental ingestion	N	**P**	N	N	N	**P**	**P**
Root uptake	N/A	**P**	N/A	N/A	N/A	**P**	N/A
Migration to groundwater	N	**P**	N	N	N	**P**	**P**

5. ASSESSMENT CRITERIA

The criteria adopted for the assessment of surface water contamination are sourced from the following references:

- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999, as amended 2013* (NEPC, 2013).
- National Health and Medical Research Council (NHMRC) (2001) *National Resource Management Ministerial Council (NRMMC) Australian Drinking Water Guidelines 6, Version 3.6 updated March 2021*, (ADWG, 2011).
- National Health and Medical Research Council (NHMRC), *National Resource Management Ministerial Council (NRMMC) Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008).
- Department of Environment and Conservation (DEC) *Guidelines for the Assessment and Management of Groundwater Contamination* (DEC, 2007).
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018) (available at www.waterquality.gov.au/anz-guidelines).
- Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000).
- *Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW, Site specific criteria – Protection of human health and terrestrial and/or aquatic ecosystems* (EnRiskS, 2020).

5.1 Rationale for Application of Guidelines

The relevance of guidelines was determined based on iterative screening from the broadest and most sensitive water usage scenario which occurs in the Mulwaree River back through agricultural land and public roads to the least sensitive scenario which occurs at the Site.

All results from Mulwaree River samples (SW8 to SW10) have been screened against Tier 1 / screening guidelines relevant to human health (incidental ingestion), freshwater ecology, irrigation and stock watering as each of these receptors occur within the receiving waters (the Mulwaree River). Should results exceed screening guidelines and indicate site contamination as the source, it would be appropriate to apply the guidelines that were exceeded to sampling locations upstream as this would inform further assessment of the Site as the potential source. Previous monitoring results do not indicate site contamination is adversely affecting the Mulwaree River. Site-specific guidelines were developed for Arsenic, Cadmium, Lead, Manganese and Nickel (EnRiskS, 2020) that integrate the ephemeral nature of surface water features between the Mulwaree River and the Site. Additionally, several technical refinements were identified and are relevant to guideline application. These were:

- ADWG (2011) Section 6.3.1 states that guideline values refer to the total amount of the substance present, regardless of its form (e.g., in solution or attached to suspended matter) and so analytical results from unfiltered samples should be assessed against human health criteria. The primary human health risk from contaminants in surface water from the Site is via recreational use. NHMRC (2008) suggests that 10-times the ADWG values may provide a conservative estimate of acceptable recreational exposure guidelines values. This approach was applied to derive recreational exposure criteria.
- ANZG (2018) guidelines for metals in freshwater are adopted from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) which states the major toxic effect of metals comes from the dissolved fraction, so it is valid to filter samples (e.g., to 0.45 µm) and compare the filtered concentration against the trigger values.
- Water hardness is identified as a physical parameter with quantifiable effects. Correction factors are defined in the guidelines to address the effect of water hardness on the bioavailability of cadmium, chromium, lead, nickel and zinc.

To define appropriate hardness correction factors, water was conservatively presumed to be moderately hard based on the Goulburn Mulwaree Regional State of the Environment Report 2004-2009 (Goulburn Mulwaree Council, 2009). Hardness correction factors were adopted from Table 3.4.4 of the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000) to refine Tier 1 criteria as described in **Table 5-1** below.

Table 5-1: Hardness Corrections for Tier 1 Freshwater Ecology Guidelines

	Original guideline value (mg/L)	Hardness Correction Factor	Corrected guideline value (mg/L)
Cadmium	0.0002	2.7	0.00054
Chromium	0.001	2.5	0.0025
Lead	0.0034	4	0.0136
Nickel	0.011	2.5	0.0275
Zinc	0.008	2.5	0.02

Application of guidelines at each sampling point is summarised in **Table 5-2**.

Table 5-2: Guidelines Applied to Sampling Points

Sampling Point	Location	Human Health - Site Specific[1]	Ecology - Site Specific[1]	Human Health - Recreational Sceening[2]	Ecology – Screening[3]	Irrigation – Screening[3]	Stock Water – Screening[3]
SW1-UP	Upstream of Southern Culvert (offsite)	✓	✓	✓	✓	-	-
SW1	Upstream of Southern Culvert	✓	✓	✓	✓	-	-
SW2	Downstream of Southern Culvert	✓	✓	✓	✓	-	-
SW3	Upstream of Middle Culvert	✓	✓	✓	✓	-	-
SW4	Downstream of Middle Culvert	✓	✓	✓	✓	-	-
SW5	Upstream of Northern Culvert	✓	✓	✓	✓	-	-
SW6	Downstream of Northern Culvert	✓	✓	✓	✓	-	-
SW7	Dam on farm downstream of Northern Culvert (offsite)	-	-	✓	✓	✓	✓
SW8	Mulwaree River upstream of Middle and Northern Culvert Discharge	-	-	✓	✓	✓	✓
SW9	Mulwaree River upstream of Southern Culvert Discharge	-	-	✓	✓	✓	✓
SW10	Mulwaree River downstream of Middle and Northern Culvert Discharge	-	-	✓	✓	✓	✓

[1] *EnRiskS (2021)*

[2] *ANZG (2018)*

[3] *ANZECC (2000)*

Assessment criteria adopted under each guideline are presented in **Table 5-3**.

Table 5-3: Guideline Criteria (mg/L)

Contaminant	Human Health - Site Specific Criteria	Human Health - Recreation Screening	Ecology - Site Specific Criteria	95% Fresh water (ANZG 2018)	Irrigation - Screening	Stock Water - Screening
Total Metals						
Aluminium	-	2	NA	NA	NA	NA
Arsenic	7	0.1	NA	NA	NA	NA
Barium	-	2	NA	NA	NA	NA
Beryllium	-	0.6	NA	NA	NA	NA
Cadmium	1.4	0.002	NA	NA	NA	NA
Chromium	-	0.5	NA	NA	NA	NA
Cobalt	-	-	NA	NA	NA	NA
Copper	-	20	NA	NA	NA	NA
Iron	-	3	NA	NA	NA	NA
Lead	7	0.1	NA	NA	NA	NA
Manganese	350	5	NA	NA	NA	NA
Mercury	-	0.01	NA	NA	NA	NA
Nickel	14	0.2	NA	NA	NA	NA
Zinc	-	30[h]	NA	NA	NA	NA
Dissolved Metals						
Aluminium	NA	NA	5	0.055[a]	20	5
Arsenic	NA	NA	0.5	0.024[b]	2	0.5-5
Barium	NA	NA	-	-	-	-
Beryllium	NA	NA	-	-	0.5	-
Cadmium	NA	NA	10	0.00054[g]	0.05	0.01
Chromium	NA	NA	-	0.002.5[g]	1	1
Cobalt	NA	NA	-	0.0014	0.1	1
Copper	NA	NA	0.5	0.0014	5	0.4-5
Iron	NA	NA	-	-	10	not sufficiently toxic
Lead	NA	NA	0.1	0.0034	5	0.1
Manganese	NA	NA	-	1.9	10	not sufficiently toxic
Mercury	NA	NA	-	0.00006[d, e]	0.002	0.002
Nickel	NA	NA	1	0.0275[g]	2	1
Zinc	NA	NA	20	0.02[g]	5	20

NA – not applicable

blank cell denoted with – indicates no criterion available.

[a] *Aluminium guidelines for pH > 6.5, based on the pH of groundwater measured at the Site and surrounding area. This is an aesthetic criteria only based on post flocculation problems*

[b] *Guideline value for arsenic (III).*

[c] *Guideline value for chromium (VI).*

[d] *Guideline value for inorganic mercury.*

[e] *99% species protection level DGV has been adopted to account for the bioaccumulating nature of this contaminant.*

[f] *Guideline value for m-xylene. Guideline values also exist for both o-xylene and p-xylene as per ANZG (2018). The default guideline value for m-xylene guideline has been adopted as it is the most conservative*

[g] *Hardness correction factor applied to the threshold value as detailed in ANZG 2018*

[h] *Calculated using the ADWG (2011) aesthetic guideline. Insufficient data to set a guideline value based on health considerations*

6. DATA QUALITY OBJECTIVES

To achieve the objectives and purpose of the surface water monitoring program, both the field and laboratory programs must result in data that is representative of the conditions at the site. As such, specific Data Quality Objectives (DQOs) have been developed for the tasks to be completed to validate the remediation of the site. The DQO process is a systematic, seven step process that defines the criteria that the validation sampling should satisfy in accordance with the *Guidelines for the NSW Site Auditor Scheme (3rd Edition)* (NSW EPA 2017).

The seven step DQOs process comprises:

1. Step 1: State the problem;
2. Step 2: Identify the decisions/ goal of the study;
3. Step 3: Identify the information inputs;
4. Step 4: Define the boundaries of the study;
5. Step 5: Develop the decision rules or analytical approach;
6. Step 6: Specify the performance or acceptance criteria;
7. Step 7: Develop the plan for obtaining data.

The seven step DQO process has been completed for surface water monitoring to be completed before, during and after site remediation.

6.1 Step 1: State the problem

Due to historic loadout of ore concentrate surface water flow over ore impacted soils has been identified to result in migration of total and dissolved metal concentrations from the site. The site has been declared significantly contaminated land by the NSW EPA and a VMP has been prepared to describe how associated risks to human health and the environment will be managed.

6.1.1 Contaminants of Concern

Contaminant of Concern relevant to receiving surface waters appear limited to metals (aluminium, cadmium, copper, lead, nickel, zinc) which exceed the adopted relevant health and/or ecological assessment criteria.

6.2 Step 2: Identify the decisions / goal of the study

The goal of the study is to assess the migration of metal(loid) contamination from the site in surface waters and the impact of migration to surface waters off site.

Based on the decision-making process for assessing urban redevelopment sites, detailed in the *NSW Site Auditor Guidelines, 3rd Edition 2017*, the following decisions must be made with respect to the targeted validation goals:

1. Is the data collected of sufficient quality to meet the project objectives?
2. Is the data reliable?
3. What is the fate and transport of contaminant offsite?
4. What are the potential risks to human health and the environment?

6.3 Step 3: Identify the information inputs

Inputs to the decisions will be sourced from:

1. Review of historical surface water monitoring results
2. Physico-chemical properties collected for each of the 10 surface water sampling locations
3. Sampling of surface water and analysis for contaminants of concern

4. Analytical results for metal(loid)s in surface water samples from each of the 10 sampling locations
5. Quality Assurance / Quality Control data review
6. Comparison of the above samples to the assessment criteria outlined in **Section 5**.
7. All sample analyses conducted using National Association of Testing Authorities (NATA) registered methods in accordance with ANZECC (1996) and NEPC (1999) guidelines
8. All samples appropriately preserved and handled in accordance with the sampling methodology
9. PQLs less that the adopted assessment criteria

6.4 Step 4: Definition of the Study Boundary

The spatial boundaries are shown on **Figure 1** and include:

1. Three tributaries of the Mulwaree River, one located approximately 100 m west of the rail corridor at CH. 262.600, one adjacent to a culvert on the western side of the rail line at CH 262.600 and one adjacent a culvert on the eastern side of the rail line at CH 262.600.
2. Four locations adjacent to culverts, one western side of the rail line at CH 262.300, one on the eastern side of the rail line at CH 262.300, one on the western side of the rail line at CH 262.000 and one on the eastern side of the rail line at CH 262.000.
3. The dam located downgradient from the site northern rail culvert forming part Lot A DP 440822, and three locations along the Mulwaree River

The vertical boundaries are limited to the depth of surface waters encountered and accessible.

The temporal boundary includes historical surface water results as well as data collected under this SAQP comprising quarterly monitoring events over pre-remediation, remediation and post-remediation periods. Two post remediation surface water monitoring events will be included in the validation report.

6.5 Step 5: Develop the decision rules or analytical approach

The decisions rules for this investigation are as follows:

1. Has contaminant migration via surface water been adequately assessed?
2. Have contaminant impacts to surface water off site been adequately assessed?
3. Is the data reliable?
4. Does the data define clear presence / absence of unacceptable risk when assessed against Tier 1 criteria?
5. If Tier 1 assessment of risk is not clear, then does Tier 2 / Tier 3 risk assessment define absence of unacceptable risk?
6. Are there any remaining data gaps?

6.6 Step 6: Specify the performance or acceptance criteria

6.6.1 The tolerable limits on decision errors are as follows:

1. Probability that 95% of data will satisfy the DQIs, therefore a limit on decision error will be 5% that a conclusive statement may be incorrect:

a. A 5% probability of a false negative (i.e. assessing that the average concentration of contaminants of concern are less than the assessment criteria when they are not); and
b. A 5% probability of a false positive (i.e. assessing that the average concentration of contaminants of concern are more than the assessment criteria when they are not).

The potential for significant errors will be minimised by:

1. Completion of QA/QC measures of the investigation data to assess if the data satisfies the DQIs.
2. Assessment of whether appropriate sampling and analytical densities were completed for the purposes of the investigation.
3. Ensuring that the criteria set for the investigation were appropriate for the land use.

DQIs have been established to set acceptance limits on field and laboratory data collected as part of the investigation and are discussed further below.

6.6.2 Evaluation of Analytical Data

Acceptable limits and the manner of addressing possible decision errors for laboratory analysis associated with water quality monitoring and verification of imported materials are outlined below.

Accuracy: Accuracy is defined as the nearness of a result to the true value, where all random errors have been statistically removed. Internal accuracy is measured using percent recovery '%R' and external accuracy is measured using the Relative Percent Difference '%RPD'.

Internal accuracy will be tested utilising:

Surrogates	Surrogates are QC monitoring spikes, which are added to all field and QA/QC samples at the beginning of the sample extraction process in the laboratory, where applicable. Surrogates are closely related to the organic target analytes being measured, are to be spiked at similar concentrations, and are not normally found in the natural environment;
Laboratory control samples	An externally prepared and supplied reference material containing representative analytes under investigation. These will be undertaken at a frequency of one per analytical batch.
Matrix spikes	Field samples which are injected with a known concentration of contaminant and then tested to determine the potential for adsorption onto the matrix. These will be undertaken at a frequency of 5%.

Recovery data shall be categorised into one of the following control limits:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

External accuracy will be determined by the submission of inter-laboratory duplicates at a frequency of 5%. Data will be analysed in accordance with the following control limits:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

Precision: The degree to which data generated from replicate or repetitive measurements differ from one another due to random errors. Precision is measured using the standard deviation 'SD' or Relative Percent Difference '%RPD'.

Internal precision will be determined by the undertaking of laboratory duplicates, where two sub samples from a submitted sample are analysed. These will be undertaken at a frequency of 10%. A RPD analysis is calculated and results compared to:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

External precision will be determined by the submission of intra-laboratory duplicates at a frequency of 5%. The external duplicate samples are to be obtained by mixing and then splitting the primary sample to create two identical sub samples. Field duplicate samples are to be labelled with a unique identification that does not reveal the association between the primary and duplicate samples e.g., QA1.

It must be noted that significant variation in duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity or concentrations reported near the Practical Quantification Limit (PQL).

A RPD analysis is calculated and results compared to:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

Blank samples will be submitted with the analytical samples and analysed for the contaminants of concern One field blank will be collected and analysed per matrix type for each batch samples/each day.

The laboratory will additionally undertake a method blank with each analytical batch of samples. Laboratory method blank analyses are to be below the PQLs. Results shall be examined, and any positive results shall be examined. Positive blank results may not be subtracted from sample results.

Positive results may be acceptable if sample analyte concentrations are significantly greater than the amount reported in the blank (ten times for laboratory reagents such as methylene chloride, chloroform, and acetone etc., and five times for all other analytes). Alternatively, the laboratory PQL may be raised to accommodate blank anomalies provided that regulatory guidelines are not compromised by any adjustment made to the PQL.

Completeness: The completeness of the data set shall be judged as:

1. The percentage of data retrieved from the field compared to the proposed scope of works. The acceptance criterion is 95%.
2. The percentage of data regarded as acceptable based on the above data quality objectives. 95% of the retrieved data must be reliable.
3. The reliability of data based on cumulative sub-standard performance of data quality objectives.
4. All PQLs are below adopted assessment criteria.

Where two or more data quality objectives indicate less reliability than what the acceptance criteria dictates, the data will be considered with uncertainty.

Representativeness: Sufficient samples must have been collected.

Samples must be collected and preserved in accordance with the sampling methodology proposed in Step 7 to ensure that the sample is representative of the assessed stratum.

Comparability: The data must show little to no inconsistencies with results and field observations and include likely associates e.g. TPH C6-C9 and BTEX.

Decision Error Protocol

If the data received is not in accordance with the defined acceptable limits outlined in Step 6, it may be considered to be an estimate or be rejected. Determination of whether this data may be used or if re-sampling is required will be based on the following considerations:

1. Closeness of the result to the guideline concentrations.
2. Specific contaminant of concern (e.g. response to carcinogens may be more conservative).
3. The area of site and the potential lateral and vertical extent of questionable information.
5. Whether the uncertainty can be effectively incorporated into site management controls.

6.7 Step 7: Develop a plan for obtaining data

The overall design of the sampling plan considers migration of surface water from the site. Further detail is provided in **Section 7**.

7. SAMPLING PLAN

The sampling plan for surface water quality will be based on quarterly monitoring events over pre-remediation, remediation and post-remediation periods. Two post remediation surface water monitoring events will be included in the validation report.

Surface water sampling will target conditions upstream and downstream of three culverts which direct surface water beneath the rail formation onsite. Surface water at the site only occurs after rainfall and is received to the surrounding environment as follows:

1. Water passing through the northern culvert discharges to an adjacent agricultural property and during high rainfall events to a dam on the agricultural property.
2. Water passing through the middle culvert discharges across a causeway on Boyd Street to an adjacent vacant block.
3. Water passing through the southern culvert discharges beneath Goulburn Street to agricultural land in a tributary to the Mulwaree River (approximately 550m east of site)

Surface water samples will be collected upstream and downstream of each culvert and in receiving water bodies as shown on **Figure 1**, **Appendix 1**.

7.1.1 Water Quality Monitoring Performance Criteria

Surface water sampling will be completed in accordance with performance criteria defined in **Table 7-1**.

Table 7-1 Performance Criteria

Category	Validation Criteria
Accuracy: Accuracy in the collection of field data will be controlled by:	1. Calibrated measurement equipment used. The water quality meter will be calibrated by the technical rental company prior to use. 2. Appropriate sampling methodologies utilised and complied with. Works to be completed with regard for AS NZS 5667.6-1998 Water quality - Sampling - Guidance on sampling of rivers and streams. 3. Collection of one intra-laboratory duplicate for surface water. 4. Rinsate samples are not proposed to be collected due to surface water samples being collected directly into dedicated sampling containers (or field filtered using single use syringes and filters) using disposable nitrile gloves.
Precision: The degree to which data generated from replicate or repetitive measurements differ from one another due to random errors. Precision of field data will be maintained by:	1. A new pair of disposable nitrile gloves to handle each sample. 2. Samples will be placed immediately into laboratory supplied and appropriately preserved sampling vessels. 3. Samples will be stored in chilled, insulated containers with ice for transportation to the laboratory. 4. Sample numbers, preservation and analytical requirements will be recorded on chain of custody documents. 5. Samples will be transported to the laboratory under chain of custody conditions.
Completeness: The completeness of the data set shall be judged by:	1. All locations sampled as outlined in **Sections 7.1.1** and **Figure 1, Appendix 1.** 2. Sampling completed by experienced personnel. 3. Field documentation completed correctly.
Representativeness: The representativeness of the field data will be judged by:	1. Non-disposable sampling equipment, such as the grab sampler and water quality meter, will be thoroughly decontaminated between locations using Decon 90 solution and deionised rinsate water. 2. At each location, a pair of disposable nitrile gloves will be worn while sampling and handling the sample; gloves will be replaced between each successive sample. 3. Surface water analytical samples will be collected directly into the sampling vessels using an extendable pole sampler where appropriate.
Comparability: Comparability to existing field data will be maintained by:	1. Use of the same appropriate sampling methodologies. 2. Same sampling depths for surface water (where practical). 3. Field water quality parameters will be obtained using a calibrated water quality meter and recorded on a field sheet, comprising pH, temperature, total dissolved solids (TDS), dissolved oxygen (DO), redox potential and electrical conductivity (EC).

Category	Validation Criteria
	4. Samples for dissolved metal analysis will collected in dedicated disposable 50 mL plastic syringes and field filtered through 0.45 µm filters directly into a sample bottle containing acid preservative. 5. Visual and olfactory observations will also be recorded on the field sheet. 6. Photographs will be taken of sampling location conditions at the time of sampling.

8. REPORTING

On completion of each monitoring event, a report will be prepared documenting the completed sampling, trend analysis, quality assurance / quality control and laboratory reports.

The report shall include the following:

1. Executive summary
2. Introduction
3. Objectives and scope of work
4. Summary of completed field sampling and laboratory analysis
5. QA/QC review
6. Temporal trend analysis
7. Conclusions

9. REFERENCES

ADWG (2011). National Health and Medical Research Council (NHMRC) (2001) National Resource Management Ministerial Council (NRMMC) Australian Drinking Water Guidelines 6, Version 3.5 updated August 2018.

ANZECC (2000). Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

EnRiskS (2021). *Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW*.

NEPM (2013). National Environment Protection Council (NEPC), National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013

NHMRC (2008). National Health and Medical Research Council (NHMRC), National Resource Management Ministerial Council (NRMMC) Guidelines for Managing Risks in Recreational Water

NSW DEC (2007). Contaminated Sites – Guidelines for the Assessment and Management of Groundwater Contamination, Department of Environment and Conservation NSW, Sydney, March 2007.

NSW EPA (2017). *Contaminated Land Management - Guidelines for the NSW Site Auditor Scheme (3rd Edition),* New South Wales Environment Protection Authority, Sydney, NSW, October 2017.

APPENDIX 1
FIGURES

RAMBOLL AUSTRALIA - GIS MAP file - 318000780_GIS_P018_T22_RAPs_02_RAP_RailCorridor | F003_SurfaceWaterSamples_V01 | 13/04/2021

A4
1:10,000

Legend

- Surface water sampling location
- Rail corridor
- Rail corridor fence
- Area of lead exceedance (within rail corridor)
- Indicative surface water flow path (ie: not ephemeral)
- Indicative ephemeral surface water flow path

Figure 1 | Surface Water Monitoring

APPENDIX 2
CALIBRATION CERTIFICATE

Multi Parameter Water Meter

Instrument **YSI Pro DSS**
Serial No. **15J100067**

Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
	Recharge OK?	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	1. pH/ORP	✓	
	2. Turbidity	✓	
	3. Conductivity	✓	
	4. D.O	✓	
	5. Temp	✓	
	6. Depth	✓	
Alarms	Beeper		
	Settings		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. EC		2.76mS		385041	2.76mS
2. Temp		20.6°C		Testo	19.9°C
3. pH 4		pH 4.00		389384	pH 3.89
4. pH 7		pH 7.00		381241	pH 6.95
6. DO		0ppm		379624	0ppm
7.Turbidity		50NTU		386950	48.22 NTU
8. mV		238.7mV		385070/387771	238.7 mV

Calibrated by: **Alex Buist**

Calibration date: **9/09/2022**

Next calibration due: **9/10/2022**

APPENDIX 3
RESULTS TABLES

Table 1:
Surface Water Parameters

Sample Location	Sample Date	Time	Sample Depth (mm below surface)	Temperature (°C)	Spec Conductivity (µScm-1)	pH	Dissolved Oxygen (mg/L)	Redox (mV)	TDS (ppm)	Turbidity (NTU)	Comments
SW1_UP											
SW1_UP	13-Aug-19	7:45	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	Not recorded
SW1_UP	24-Sep-19	*Not recorded*	100	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	Clear/slightly brown. Frogs audible.
SW1_UP	29-Jan-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW1_UP	1-Apr-20	13:25	200	19.94	584	7.05	4.72	154	374	*Not recorded*	Clear. No turbidity. No odour. No flow.
SW1_UP	11-Aug-20	*Not recorded*	100	8	205.6	7.43	10.55	170.7	133.3	*Not recorded*	Clear to slightly brown. Flowing.
SW1_UP	13-Oct-20	7:37	400	11.89	673	7.39	2.6	94	431	*Not recorded*	Water clear/brown. Flowing.
SW1_UP	28-Jan-21	8:15	100	16.9	587	7.3	0.1	186.9	375.7	*Not recorded*	Clear, low-no odour, no observable contamination.
SW1_UP	14-Apr-21	8:01	100	13.6	704	7.42	10.86	-41.4	*Not recorded*	*Not recorded*	Clear, no odour. Fence panel stack at downstream end. Flowing.
SW1_UP	13-Jul-21	13:47	300	8.18	662	7.65	6.12	162	*Not recorded*	*Not recorded*	Clear, colourless, no odour. Reeds growing adjacent to pond. Flowing.
SW1_UP	12-Sep-22	14:20	100	11.10	570	7.8	4.9	107	371.00	-0.96	Clear, not murky, not turbid, very minor suspended solids, no obvious smells or odours, natural running stream.
SW1											
SW1	29-Jan-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW1	1-Apr-20	12:45	100	17.4	575	6.35	5.88	115	368	*Not recorded*	Clear to brown, low/no turbidity, minor suspendid solids. No odour. No flow.
SW1	11-Aug-20	Not recorded	100	7.8	206.1	7.44	11.00	169.5	133.9	*Not recorded*	Brown, slightly turbid, continuous flow.
SW1	13-Oct-20	7:35	50	10.38	678	7.7	2.71	125	434	*Not recorded*	Water flowing, turbid, yellow/borwn, water level shallow.
SW1	28-Jan-21	8:35	*Not recorded*	16.5	618	7.35	0.04	175.8	395.5	*Not recorded*	Clear, no observable contamination, amongst reeds.
SW1	14-Apr-21	8:28	50	12.2	684	7.65	9.81	23.6	*Not recorded*	*Not recorded*	Clear, no odour, some suspended solids. Shallow sampled at upstream end of culvert.
SW1	13-Jul-21	13:56	100	7.93	733	7.77	5.29	76	*Not recorded*	*Not recorded*	Clear, colourless, no odour. Reeds up stream. Sampled at culvert entrance.
SW1	12-Sep-22	14:45	10	9.2	533	7.67	4.7	156.9	347	0.61	Couldn't get completely 10cm underneath waterbody due to shallow depth, clear, not murky, not turbid, very minor suspended solids, no obvious smells or odours, small natural stream flowing into a culvert adjacent to the rail corridor, some vegetation and moss on the surface and within the waterbody.
SW2											
SW2	24-Sep-19	*Not recorded*	Surface. Shallow water.	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	Clear.
SW2	29-Jan-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW2	1-Apr-20	13:50	100	17.5	358	7.25	3.84	163	233	*Not recorded*	Brown, low-medium turbidity, some suspended solids. No odour. No flow.
SW2	30-Apr-20	17:40	50	9.8	605	6.54	3.32	185.9	391.9	*Not recorded*	Collected at Goulburn Street footbridge. Clear, not flowing.
SW2	11-Aug-20	*Not recorded*	100	7.3	213.3	8.13	10.59	185.2	137.8	*Not recorded*	Clear to slightly turbid. Flowing.
SW2	13-Oct-20	8:15	200	11.8	650	8.27	5.92	96	416	*Not recorded*	Water clear, flowing, water level low.
SW2	28-Jan-21	8:45	*Not recorded*	17	614	8.07	0.12	166.7	393	*Not recorded*	Light brown, low turbidity, no observable contamination.
SW2	14-Apr-21	8:47	100	12	677	7.82	9.83	48.3	*Not recorded*	*Not recorded*	Clear, no odour.
SW2	13-Jul-21	14:05	100	7.56	670	7.98	5.66	108	*Not recorded*	*Not recorded*	Clear, colourless, no odour. Sampled at culvert.
SW2	12-Sep-22	15:05	100	9.40	545	7.81	4.7	172	354	17.10	Clear, not murky, not turbid, very minor suspended solids, no obvious smells or odours, small waterbody flowing from a culvert adjacent to the rail corridor, some vegetation and moss on the surface and within the waterbody.
SW3											
SW3	24-Sep-19	*Not recorded*	50	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	Moderate turbidity. Frogs audible.
SW3	29-Jan-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW3	1-Apr-20	14:20	100	21.8	245	6.23	5.24	178	159	*Not recorded*	Brown to yellow, medium turbidity, some brown matter at surface.
SW3	11-Aug-20	*Not recorded*	100	8.9	142.5	7.43	9.43	174.7	92.3	*Not recorded*	Brown to clear.
SW3	13-Oct-20	8:36	100	11.63	229	7.96	4.84	137	149	*Not recorded*	Water clear/brown to slightly trubid, flowing.
SW3	28-Jan-21	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW3	14-Apr-21	9:10	100	10.7	242.4	7	8.06	64.8	*Not recorded*	*Not recorded*	Pale yellow, no odour
SW3	13-Jul-21	13:17	300	8.54	181	6.79	7.2	186	*Not recorded*	*Not recorded*	Clear, colourless to pale green/brown, no odour. Algae and reeds growing in drainage line. Not flowing.
SW3	12-Sep-22	15:32	10	9.80	184	6.8	4.7	159	*120.0*	11.51	Couldn't get completely 10cm underneath the waterbody due to shallow depth, brown to light brown, slightly murky, slightly turbid, some suspended solids, no obvious smells or odours, small stream from drain leading into a culvert adjacent to the rail corridor.
SW4											
SW4	6-Aug-19	11:35	100	12.4	128.2	8.8	9.74	200	*Not recorded*	*Not recorded*	Stagnant pond, clear to slightly yellow.
SW4	24-Sep-19	*Not recorded*	100	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	*Not recorded*	Turbid. Frogs audible.
SW4	29-Jan-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW4	1-Apr-20	15:00	200	20.33	297	6.73	5.24	168	193	*Not recorded*	Light brown, low turbidity. No odour. No flow.
SW4	30-Apr-20	17:30	50	9	388.3	5.75	3.53	263.1	251.8	*Not recorded*	Collected at Boyd Street culvert. Flowing.
SW4	11-Aug-20	*Not recorded*	100	7.4	153.4	7.69	10.42	210.9	99.5	*Not recorded*	Brown, slightly trubid, full but flow not evident.
SW4	13-Oct-20	8:50	300	13.1	307	8.19	5.73	107	200	*Not recorded*	Water flowing, turbid, brown, no odour.
SW4	28-Jan-21	9:10	100	17.4	227.3	7.93	1.12	180.8	145.5	*Not recorded*	Brown-orange, stagnant, low-moderate turbidity, no observable contamination.
SW4	14-Apr-21	9:38	100	11.5	231.1	7.35	9.77	70	*Not recorded*	*Not recorded*	Pale yellow, no odour.
SW4	13-Jul-21	13:28	300	7.95	192	6.87	5.41	173	*Not recorded*	*Not recorded*	Clear, colourless, no odour. Not flowing.
SW4	12-Sep-22	15:45	100	9	174.3	6.79	4.9	197.5	113	13.89	Brown, murky, turbid, suspended solids, no obvious smells or odours, small stream and water body coming from a culvert adjacent to rail corridor, vegetation and moss on the surface and within the water body.
SW5											
SW5	29-Jan-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW5	1-Apr-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW5	11-Aug-20	*Not recorded*	100	11.2	117.9	7.33	7.94	163.2	76.7	*Not recorded*	Brown, turbid, flow at culvert evident beneath crushed rock.
SW5	13-Oct-20	9:06	50	11.95	187	8.35	4.06	-3	121	*Not recorded*	Water not flowing, very shallow, turbid, light brown, no odour.
SW5	28-Jan-21	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW5	14-Apr-21	10:20	100	11.6	251.2	6.85	8.75	74.9	*Not recorded*	*Not recorded*	Pale yellow, no odour. Small pool of water north of culvert, rest of area dry.
SW5	13-Jul-21	12:50	100	8.71	192	6.45	9.33	191	*Not recorded*	*Not recorded*	Turbid, pale brown, no odour. Sample taken from puddle adjacent to culvert. Not flowing.
SW5	12-Sep-22	---	---	---	---	---	---	---	---	---	DRY
SW6											
SW6	29-Jan-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW6	1-Apr-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW6	11-Aug-20	*Not recorded*	50	8.3	168.3	7.47	9.61	187	109.2	*Not recorded*	Brown, slightly turbid. Not flowing.
SW6	13-Oct-20	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW6	28-Jan-21	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW6	14-Apr-21	---	---	---	---	---	---	---	---	*Not recorded*	DRY
SW6	13-Jul-21	12:58	50	9.08	173	7.32	9.73	176	*Not recorded*	*Not recorded*	Clear to slightly turbid, pale yellow/brown, no odour. Flowing slightly.
SW6	12-Sep-22	15:58	10	11.8	180.6	9.07	4.5	111	117	83.53	Couldn't get completely 10cm underneath the waterbody due to shallow depth, brown, slightly murky, slightly turbid, some suspended solids, no obvious smells or odours, small stream coming from a culvert. Minor vegetation on the banks and surface of the water body.
SW7											
SW7	29-Jan-20	10:00	50	23.1	609	8.92	8.46	83	396.6	*Not recorded*	Silty, from dam, low level water.
SW7	2-Apr-20	*Not recorded*	10	18.1	2342	7.23	4.45	114.2	152.1	*Not recorded*	Highly turbid.
SW7	11-Aug-20	*Not recorded*	100	12.5	94.7	7.26	7.80	109.8	61.8	*Not recorded*	Brown, trubid.
SW7	12-Oct-20	17:46	200	21.34	172	7.69	5.35	56	112	*Not recorded*	Water slightly trubid, brown, not flowing.
SW7	28-Jan-21	11:30	100	18.4	148.6	7.4	1.80	168	95.1	*Not recorded*	Light brown, low-moderate turbidity, no observable contamination.
SW7	14-Apr-21	10:51	100	11.5	140.7	6.57	8.76	86.7	*Not recorded*	*Not recorded*	Pale brown, dark colour to dam, earthy odour.
SW7	13-Jul-21	14:25	200	7.38	183	7.41	5.62	120	*Not recorded*	*Not recorded*	Slightly turbid, palye yellow/brown, no odour. Reeds growing in pond. Not flowing.
SW7	12-Sep-22	9:04	100	9.9	177	6.91	5.1	122.8	115	8.6	Light brown to brown, murky, turbid, suspended solids, no obvious smells or odours, waterbody within private property coming from a drain adjacent to the rail corridor and fenceline. Minor vegetation and moss on the surface and within the water body. Evidence of property owner pushing material into the water body to fill to the surface.
SW8											
SW8	29-Jan-20	11:01	100	23.6	1007	7.77	5.22	121.6	656.5	*Not recorded*	Upstream Lumley Road bridge. Clear, vegetation. Not flowing.
SW8	2-Apr-20	9:30am	10	18	425.7	7.23	4.39	124	276.9	*Not recorded*	Grease at surface, lots of algae growing on plants.
SW8	10-Aug-20	*Not recorded*	100	9.1	170.5	8.53	9.34	123.6	107.9	*Not recorded*	Water flowing, level high, turbid, sediment sample collected higher up embankment than previous round due to water level.
SW8	12-Oct-20	17:26	200	20.12	847	7.76	7.58	84	542	*Not recorded*	Water flowing, clear/brown.
SW8	28-Jan-21	10:30	100	18.9	730	7.48	3.09	97.8	467.2	*Not recorded*	Clear, low turbidity, no observable contamination.
SW8	14-Apr-21	11:19	100	13.4	712	7.15	8.61	116.2	*Not recorded*	*Not recorded*	Clear, no odour, leaf litter on surface
SW8	13-Jul-21	14:50	300	8.43	994	7.62	7.82	123	*Not recorded*	*Not recorded*	Clear, colourless, no odour. Reeds growing in river. Flowing.
SW8	12-Sep-22	9:17	100	9.5	683	7.24	5.1	136	444	2.84	Clear, not murky, not turbid, very minor suspended solids, no obvious smells or odours, natural running stream, minor vegetation and moss on the banks of the stream and within the water body.
SW9											
SW9	29-Jan-20	12:22	300	25.0	125.3	8.35	16.8	99.4	812.5	*Not recorded*	Stagnant pond. Algae and fish present. Slightly turbid.
SW9	02-Apr-20	*Not recorded*	10	18.2	381.7	7.62	6.29	124.5	247.7	*Not recorded*	Non-turbid, slightly brown, not flowing but full.
SW9	10-Aug-20	*Not recorded*	100	8.9	178.2	7.84	10.73	173.6	115.7	*Not recorded*	High level, brown, slightly turbid, bubbles at surface.
SW9	12-Oct-20	16:47	200	21.39	852	8.17	10.04	83	545	*Not recorded*	Water flowing, clear/brown, slightly turbid.
SW9	28-Jan-21	10:00	100	18.7	820	7.5	0.32	227.7	524.8	*Not recorded*	Clear, low turbidity, no observable contamination.
SW9	14-Apr-21	12:05	100	12.7	639.4	7.57	10.32	115.1	*Not recorded*	*Not recorded*	Very pale yellow, no odour.
SW9	13-Jul-21	15:32	200	7.66	1030	7.77	11.53	130	*Not recorded*	*Not recorded*	Clear, colourless, no odour. Flowing.
SW9	12-Sep-22	8:32	100	9.1	724	7.27	5.1	121	*470.0*	0.94	Light brown to brown, slightly murky, slightly turbid, some suspended solids, no obvious smells or odours, natural running stream, minor vegetation and moss on the banks of the stream and within the water body.
SW10											
SW10	13-Oct-20	12:26	400	16.02	881	7.19	3.58	79	564	*Not recorded*	Water flowing, clear/brown, slightly turbid, no odour.
SW10	28-Jan-21	10:30	100	18.2	710	7.27	4.1	3.8	454.4	*Not recorded*	Clear, low turbidity, no observable contamination.
SW10	14-Apr-21	11:33	100	12.9	682	7.35	8.18	103.5	*Not recorded*	*Not recorded*	Clear, no odour.
SW10	13-Jul-21	15:00	100	7.87	978	7.64	6.71	108	*Not recorded*	*Not recorded*	Clear to slighty turbid, colourless, no odour. Flowing.
SW10	12-Sep-22	9:28	100	9.3	702	7.45	5.1	125	*456.0*	3.08	No discharge downstream of drainage line (north), clear, not murky, not turbid, very minor suspended solids, no obvious smells or odours, natural running stream, minor vegetation and moss on the banks of the stream and within the water body.

Notes
L = Litre

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 2: SW1 Analytical Results

	Site Specific Human Health Criteria[a]	Site Specific Ecology Criteria (Southern Culvert)[a]	Health-based Screening Criteria (Recreational Waters)[b]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[c]										
Sample Type:							Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Lab ID							-	S20-Ap12286	S20-Au23115	S20-Oc25141	S21-Ja34960	S21-Ap22332	N21-Jl30451	S22-Se00368
Sample date:							29-Jan-20	1-Apr-20	11-Aug-20	13-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	12-Sep-22
Sample ID:							SW1	SW1	SW1	SW1	SW1	SW1	SW1	SW1
Project Name:							Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
Project No:							318000780	318000780	318000780	318000780	318000780	318000780	318000780	318001376
Sample Location							Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
Sampling Method:							-	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					**Sample Description:**		DRY	Clear to brown, low/no turbidity, minor suspendid solids. No odour.	Brown, slightly turbid, continuous flow.	Water flowing, turbid, yellow/brown, water level shallow.	Clear, no observable contamination, amongst reeds	Clear, no odour, some suspended solids. Shallow sampled at upstream end of culvert	Clear, colourless, no odour. Reeds up stream. Sampled at culvert entrance.	Clear, colourless, very minor suspended solids, no odour. Reeds up stream, minor vegetation on the surface and within the waterbody. Sampled at culvert entrance, unable to completely submerge sample container 10cm below water surface.
Analyte grouping/Analyte					**Units**	**LOR**								
Total Metals														
Aluminium	-	NA	2[d]	NA	mg/L	0.05	-	0.13	0.88	0.61	< 0.05	< 0.05	< 0.05	0.17
Arsenic	7	NA	NA	NA	mg/L	0.001	-	0.004	< 0.001	0.004	< 0.001	< 0.001	< 0.001	<0.001
Barium	-	NA	20	NA	mg/L	0.001	-	0.15	0.04	0.36	0.12	0.08	0.07	0.06
Beryllium	-	NA	0.6	NA	mg/L	0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium	1.4	NA	NA	NA	mg/L	0.0002	-	0.0013	< 0.0002	0.0021	0.0005	< 0.0002	< 0.0002	<0.0002
Chromium	-	NA	0.5	NA	mg/L	0.001	-	< 0.001	0.002	0.001	< 0.001	< 0.001	< 0.001	<0.001
Cobalt	-	NA	-	NA	mg/L	0.001	-	0.014	< 0.001	0.007	0.002	< 0.001	< 0.001	<0.001
Copper	-	NA	20	NA	mg/L	0.001	-	0.019	0.003	0.014	0.005	0.001	0.002	0.002
Iron	-	NA	3	NA	mg/L	0.05	-	4.5	0.91	1.41	1.1	0.07	0.18	0.94
Lead	7	NA	NA	NA	mg/L	0.001	-	0.056	0.001	0.032	0.007	< 0.001	0.002	0.005
Manganese	350	NA	NA	NA	mg/L	0.005	-	0.76	0.024	0.706	0.28	0.032	0.036	0.093
Mercury	-	NA	0.01	NA	mg/L	0.0001	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0001
Nickel	14	NA	NA	NA	mg/L	0.001	-	0.003	0.002	0.002	< 0.001	< 0.001	< 0.001	<0.001
Zinc	-	NA	30	NA	mg/L	0.005	-	0.2	0.02	0.32	0.086	0.009	0.025	0.026
Dissolved Metals														
Dissolved Aluminium	NA	5	NA	NA	mg/L	0.05	-	-	0.54	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Dissolved Arsenic	NA	0.5	NA	NA	mg/L	0.001	-	-	< 0.001	< 0.001	0.003	< 0.001	< 0.001	<0.001
Dissolved Barium	NA	-	NA	-	mg/L	0.001	-	-	0.04	0.11	0.12	0.08	0.06	0.05
Dissolved Beryllium	NA	-	NA	-	mg/L	0.001	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Cadmium	NA	0.01	NA	NA	mg/L	0.0002	-	-	0.0003	0.0005	0.0002	< 0.0002	< 0.0002	<0.0002
Dissolved Chromium	NA	NA	NA	0.0025	mg/L	0.001	-	-	0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Cobalt	NA	NA	NA	0.0014	mg/L	0.001	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Copper	NA	0.5	NA	NA	mg/L	0.001	-	-	0.003	0.002	0.005	< 0.001	0.001	<0.001
Dissolved Iron	NA	-	NA	-	mg/L	0.05	-	-	0.34	< 0.05	0.13	< 0.05	0.14	0.16
Dissolved Lead	NA	0.1	NA	NA	mg/L	0.001	-	-	0.004	< 0.001	< 0.001	< 0.001	0.001	<0.001
Dissolved Manganese	NA	NA	NA	1.9	mg/L	0.005	-	-	0.018	0.044	0.12	0.029	0.035	0.048
Dissolved Mercury	NA	NA	NA	0.00006	mg/L	0.0001	-	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Dissolved Nickel	NA	1	NA	-	mg/L	0.001	-	-	0.002	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Zinc	NA	20	NA	-	mg/L	0.005	-	-	0.045	0.073	0.058	0.005	0.025	0.02

- indicates no criterion available
NA indicates non-applicable
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.

[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.
Concentrations in blue bold font exceed human health recreational screening or site specific criteria
Concentrations in grey box exceed ecological screening or site specific criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 3: SW1_UP Analytical Results

	Site Specific Human Health Criteria[a]	Site Specific Ecology Criteria (Southern Culvert)[a]	Health-based Screening Criteria (Recreational Waters)[b]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[c]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		S19-Au17273	S19-Se37061	-	S20-Ap12287	S20-Au23116	S20-Oc25321	S21-Ja34959	S21-Ap22331	N21-Jl30450	S22-Se00368
					Sample date:		13-Aug-19	24-Sep-19	29-Jan-20	1-Apr-20	11-Aug-20	13-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	12-Sep-22
					Sample ID:		SW1-UP	SW1-UP	SW1_UP	SW1-UP	SW1_UP	SW1_UP	SW1_UP	SW1_UP	SW1_UP	SW1_UP
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000780	318000780	318000780	318000780	318000780	318000780	318000780	318000781	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		Grab Sample	Grab Sample	-	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		Not recorded.	Clear/slightly brown.	DRY	Clear. No turbidity. No odour.	Clear to slightly brown. Flowing.	Water clear/brown, flowing.	Clear, low-no odour, no observable contamination	Clear, no odour. Fence panel stack at downstream end. Flowing	Clear, colourless, no odour. Reeds growing adjacent to pond. Flowing.	Clear, colourless, very minor suspended solids no odour. Reeds growing adjacent to pond. Flowing.
Analyte grouping/Analyte					**Units**	**LOR**										
Inorganics																
Ammonia (as N)	-	-	0.5	0.9	mg/L	0.01	0.01	<0.01	-	-	-	-	-	-	-	-
Conductivity (at 25@°C)	-	-	-	-	µS/cm	100	820	730	-	-	-	-	-	-	-	-
Nitrate & Nitrite (as N)	-	-	-	-	mg/L	0.05	< 0.05	< 0.05	-	-	-	-	-	-	-	-
Nitrate (as N)	-	-	50	3.5	mg/L	0.02	< 0.02	< 0.02	-	-	-	-	-	-	-	-
Nitrite (as N)	-	-	30	-	mg/L	0.02	< 0.02	< 0.02	-	-	-	-	-	-	-	-
pH (at 25@°C)	-	-	-	-	pH units	0.1	7.9	7.6	-	-	-	-	-	-	-	-
Phosphate total (as P)	-	-	-	-	mg/L	0.05	< 0.05	< 0.05	-	-	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	-	-	-	-	mg/L	0.005	0.42	0.37	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	-	-	0.8	-	mg/L	0.2	<0.2	<0.2	-	-	-	-	-	-	-	-
Total Nitrogen (as N)	-	-	-	-	mg/L	0.2	<0.2	<0.2	-	-	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	-	-	-	0.7	mg/L	0.005	<0.005	5.6	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	NTU	1	1	1.3	-	-	-	-	-	-	-	-
Total Metals																
Aluminium	-	NA	2[d]	NA	mg/L	0.05	-	-	-	< 0.05	0.85	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Arsenic	7	NA	NA	NA	mg/L	0.001	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Barium	-	NA	20	NA	mg/L	0.001	-	-	-	0.1	0.05	0.1	0.11	0.08	0.07	0.05
Beryllium	-	NA	0.6	NA	mg/L	0.001	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium	1.4	NA	NA	NA	mg/L	0.0002	-	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	<0.0002
Chromium	-	NA	0.5	NA	mg/L	0.001	-	-	-	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cobalt	-	NA	-	NA	mg/L	0.001	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Copper	-	NA	20	NA	mg/L	0.001	-	-	-	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Iron	-	NA	3	NA	mg/L	0.05	-	-	-	0.26	0.93	0.12	0.19	0.07	0.06	0.07
Lead	7	NA	NA	NA	mg/L	0.001	-	< 0.001	-	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	<0.001
Manganese	350	NA	NA	NA	mg/L	0.005	-	-	-	0.044	0.026	0.022	0.054	0.037	0.009	0.01
Mercury	-	NA	0.01	NA	mg/L	0.0001	-	-	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0001
Nickel	14	NA	NA	NA	mg/L	0.001	-	-	-	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Zinc	-	NA	30	NA	mg/L	0.005	-	-	-	0.011	0.011	0.009	< 0.005	0.005	< 0.005	<0.005
Dissolved Metals																
Dissolved Aluminium	NA	5	NA	NA	mg/L	0.05	< 0.05	< 0.05	-	-	0.45	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Dissolved Arsenic	NA	0.5	NA	NA	mg/L	0.001	< 0.001	0.001	-	-	< 0.001	< 0.001	0.003	< 0.001	< 0.001	<0.001
Dissolved Barium	NA	-	NA	-	mg/L	0.001	0.1	0.1	-	-	0.04	0.1	0.12	0.08	0.05	0.05
Dissolved Beryllium	NA	-	NA	-	mg/L	0.001	< 0.001	<0.001	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Cadmium	NA	0.01	NA	NA	mg/L	0.0002	< 0.0002	<0.0002	-	-	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	<0.0002
Dissolved Chromium	NA	NA	NA	0.0025	mg/L	0.001	< 0.001	0.001	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Cobalt	NA	NA	NA	0.0014	mg/L	0.001	< 0.001	<0.001	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Copper	NA	0.5	NA	NA	mg/L	0.001	< 0.001	<0.001	-	-	0.002	< 0.001	0.003	< 0.001	< 0.001	<0.001
Dissolved Iron	NA	-	NA	-	mg/L	0.05	< 0.05	< 0.05	-	-	0.3	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Dissolved Lead	NA	0.1	NA	NA	mg/L	0.001	< 0.001	0.001	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Manganese	NA	NA	NA	1.9	mg/L	0.005	< 0.005	0.005	-	-	0.02	0.022	0.056	0.034	0.007	0.009
Dissolved Mercury	NA	NA	NA	0.00006	mg/L	0.0001	< 0.0001	< 0.0001	-	-	<0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Dissolved Nickel	NA	1	NA	-	mg/L	0.001	< 0.001	<0.001	-	-	0.002	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Zinc	NA	20	NA	-	mg/L	0.005	< 0.005	0.005	-	-	0.008	< 0.005	< 0.005	< 0.005	< 0.005	<0.005
Total Recoverable Hydrocarbons - 2013 NEPM Fractions																
Naphthalene	-	-	17	16	µg/L	10	<10	<10	-	-	-	-	-	-	-	-
TRH >C10-C16	-	-	-	-	µg/L	50	<50	<50	-	-	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	-	-	-	-	µg/L	50	<50	<50	-	-	-	-	-	-	-	-
TRH >C10-C40 (total)*	-	-	-	-	µg/L	100	<100	<100	-	-	-	-	-	-	-	-
TRH >C16-C34	-	-	-	-	µg/L	100	<100	<100	-	-	-	-	-	-	-	-
TRH >C34-C40	-	-	-	-	µg/L	100	<100	<100	-	-	-	-	-	-	-	-
TRH C6-C10	-	-	-	-	µg/L	20	<20	<20	-	-	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	-	-	-	-	µg/L	20	<20	<20	-	-	-	-	-	-	-	-
BTEX																
Benzene	-	-	10	950	µg/L	1	<1	<1	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	3000	80	µg/L	1	<1	<2	-	-	-	-	-	-	-	-
m&p-Xylenes	-	-	-	-	µg/L	2	<2	<2	-	-	-	-	-	-	-	-
o-Xylene	-	-	-	-	µg/L	1	<1	<2	-	-	-	-	-	-	-	-
Toluene	-	-	8000	180	µg/L	1	<1	<2	-	-	-	-	-	-	-	-
Xylenes - Total	-	-	6000	200	µg/L	3	<3	<3	-	-	-	-	-	-	-	-

- indicates no criterion available
NA indicates non-applicable
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.

[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.
Concentrations in blue bold font exceed human health recreational screening or site specific criteria
Concentrations in grey box exceed ecological screening or site specific criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 4: SW2 Analytical Results

	Site Specific Human Health Criteria[A]	Site Specific Ecology Criteria (Southern Culvert)[A]	Health-based Screening Criteria (Recreational Waters)[B]	Ecological Screening Criteria (ANZG 95% Protection) Fresh Water[C]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		S19-Se37062	-	S20-Ap12288	S20-My01341	S20-Au23117	S20-Oc25143	S21-Ja34961	S21-Ap22333	N21-Jl30452	S22-Se00368
					Sample date:		24-Sep-19	29-Jan-20	1-Apr-20	30-Apr-20	11-Aug-20	13-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	12-Sep-22
					Sample ID:		SW2	SW2	SW2	SW2	SW2	SW2	SW2	SW2	SW2	SW2
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000780	318000780	318000780	318000780	318000780	318000780	318000780	318000781	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		Grab Sample	-	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		Clear.	DRY	Brown, low-medium turbidity, some suspended solids. No odour.	Collected at Goulburn Street footbridge. Not flowing.	Clear to slightly turbid. Flowing.	Water clear, flowing, water level low.	Light brown, low turbidity, no observable contamination	Clear, no odour	Clear, colourless, no odour. Sampled at culvert.	Clear, colourless, no odour. Sampled at culvert, minor vegeatation and moss on the surface and within the waterbody.
Analyte grouping/Analyte					**Units**	**LOR**										
Inorganics																
Ammonia (as N)	-	-	0.5	0.9	mg/L	0.01	0.15	-	-	-	-	-	-	-	-	-
Conductivity (at 25@°C)	-	-	-	-	µS/cm	100	520	-	-	-	-	-	-	-	-	-
Nitrate & Nitrite (as N)	-	-	-	-	mg/L	0.05	0.22	-	-	-	-	-	-	-	-	-
Nitrate (as N)	-	-	50	3.5	mg/L	0.02	0.22	-	-	-	-	-	-	-	-	-
Nitrite (as N)	-	-	30	-	mg/L	0.02	<0.02	-	-	-	-	-	-	-	-	-
pH (at 25@°C)	-	-	-	-	pH units	0.1	8	-	-	-	-	-	-	-	-	-
Phosphate total (as P)	-	-	-	-	mg/L	0.05	<0.05	-	-	-	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	-	-	-	-	mg/L	0.005	0.29	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	-	-	0.8	-	mg/L	0.2	<0.2	-	-	-	-	-	-	-	-	-
Total Nitrogen (as N)	-	-	-	-	mg/L	0.2	0.22	-	-	-	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	-	-	-	0.7	mg/L	0.005	<0.005	-	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	NTU	1	3	-	-	-	-	-	-	-	-	-
Total Metals																
Aluminium	-	NA	2[d]	NA	mg/L	0.05	-	-	0.08	0.06	0.95	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Arsenic	7	NA	NA	NA	mg/L	0.001	-	-	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Barium	-	NA	20	NA	mg/L	0.001	-	-	0.1	0.08	0.05	0.11	0.1	0.08	0.07	0.05
Beryllium	-	NA	0.6	NA	mg/L	0.001	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium	1.4	NA	NA	NA	mg/L	0.0002	-	-	0.0019	0.0004	< 0.0002	0.0007	< 0.0002	< 0.0002	< 0.0002	<0.0002
Chromium	-	NA	0.5	NA	mg/L	0.001		-	0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	0.005	<0.001
Cobalt	-	NA	-	NA	mg/L	0.001	-	-	0.004	0.002	< 0.001	< 0.001	0.001	< 0.001	< 0.001	<0.001
Copper	-	NA	20	NA	mg/L	0.001	-	-	0.023	0.006	0.004	0.004	0.004	< 0.001	0.001	<0.001
Iron	-	NA	3	NA	mg/L	0.05	-	-	0.94	0.75	1	< 0.05	0.41	0.14	0.14	0.19
Lead	7	NA	NA	NA	mg/L	0.001	0.003	-	0.02	0.006	0.003	0.004	0.002	< 0.001	< 0.001	<0.001
Manganese	350	NA	NA	NA	mg/L	0.005	-	-	0.41	0.26	0.043	0.017	0.21	0.062	0.015	0.024
Mercury	-	NA	0.01	NA	mg/L	0.0001		-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Nickel	14	NA	NA	NA	mg/L	0.001		-	0.002	< 0.001	0.002	< 0.001	< 0.001	< 0.001	0.001	<0.001
Zinc	-	NA	30	NA	mg/L	0.005		-	0.35	0.16	0.028	0.096	0.033	0.011	0.014	0.006
Dissolved Metals																
Aluminium (filtered)	NA	5	NA	NA	mg/L	0.05	< 0.05	-	-	-	0.47	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Arsenic (filtered)	NA	0.5	NA	NA	mg/L	0.001	< 0.001	-	-	-	< 0.001	< 0.001	0.004	< 0.001	< 0.001	<0.001
Barium (filtered)	NA	-	NA	-	mg/L	0.001	0.07	-	-	-	0.04	0.11	0.11	0.08	0.06	0.05
Beryllium (filtered)	NA	-	NA	-	mg/L	0.001	< 0.001	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium (filtered)	NA	0.01	NA	NA	mg/L	0.0002	0.0014	-	-	-	< 0.0002	0.0007	< 0.0002	< 0.0002	< 0.0002	<0.0002
Chromium (filtered)	NA	NA	NA	0.0025	mg/L	0.001	< 0.001	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cobalt (filtered)	NA	NA	NA	0.0014	mg/L	0.001	< 0.001	-	-	-	< 0.001	< 0.001	0.001	< 0.001	< 0.001	<0.001
Copper (filtered)	NA	0.5	NA	NA	mg/L	0.001	0.015	-	-	-	0.003	0.003	0.007	< 0.001	< 0.001	<0.001
Iron (filtered)	NA	-	NA	-	mg/L	0.05	< 0.05	-	-	-	0.31	< 0.05	< 0.05	< 0.05	< 0.05	0.08
Lead (filtered)	NA	0.1	NA	NA	mg/L	0.001	0.014	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Manganese (filtered)	NA	NA	NA	1.9	mg/L	0.005	0.014	-	-	-	0.015	0.017	0.22	0.06	0.011	0.028
Mercury (filtered)	NA	NA	NA	0.00006	mg/L	0.0001	< 0.0001	-	-	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Nickel (filtered)	NA	1	NA	-	mg/L	0.001	< 0.001	-	-	-	0.002	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Zinc (filtered)	NA	20	NA	-	mg/L	0.005	0.2	-	-	-	0.02	0.13	0.028	0.009	0.006	0.021
Total Recoverable Hydrocarbons - 2013 NEPM Fractions																
Naphthalene	-	-	17	16	µg/L	10	<10	-	-	-	-	-	-	-	-	-
TRH >C10-C16	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-	-	-
TRH >C10-C40 (total)*	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-	-	-
TRH >C16-C34	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-	-	-
TRH >C34-C40	-	-	-		µg/L	100	<100	-	-	-	-	-	-	-	-	-
TRH C6-C10	-	-	-		µg/L	20	<20	-	-	-	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	-	-	-	-	µg/L	20	<20	-	-	-	-	-	-	-	-	-
BTEX																
Benzene	-	-	10	950	µg/L	1	<1	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	3000	80	µg/L	1	<2	-	-	-	-	-	-	-	-	-
m&p-Xylenes	-	-	-	-	µg/L	2	<2	-	-	-	-	-	-	-	-	-
o-Xylene	-	-	-	-	µg/L	1	<2	-	-	-	-	-	-	-	-	-
Toluene	-	-	8000	180	µg/L	1	<2	-	-	-	-	-	-	-	-	-
Xylenes - Total	-	-	6000	200	µg/L	3	<3	-	-	-	-	-	-	-	-	-

- indicates no criterion available
NA indicates non-applicable
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.

[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.
Concentrations in blue bold font exceed human health recreational screening or site specific criteria
Concentrations in grey box exceed ecological screening or site specific criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 5: SW3 Analytical Results

	Site Specific Human Health Criteria[a]	Site Specific Ecology Criteria (Middle and Northern Culverts)[a]	Health-based Screening Criteria (Recreational Waters)[b]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[c]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		S19-Se37063	-	S20-Ap12289	S20-Au23118	S20-Oc25145	-	S21-Ap22334	N21-Jl30453	S22-Se00368
					Sample date:		24-Sep-19	29-Jan-20	1-Apr-20	11-Aug-20	13-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	12-Sep-22
					Sample ID:		SW3	SW3	SW3	SW3	SW3	SW3	SW3	SW3	SW3
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000780	318000780	318000780	318000780	318000780	318000780	318000780	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		Grab Sample	-	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		Moderate turbidity.	DRY	Brown to yellow, medium turbidity, some brown matter at surface.	Brown to clear.	Water clear/brown to slightly trubid, flowing.	DRY	Pale yellow, no odour	Clear, colourless to pale green/brown, no odour. Algae and reeds growing in drainage line. Not flowing.	Slightly murky, slightly turbid, light brown to brown, some suspended solids, no odour. Algae and reeds growing in drainage line, unable to completely submerge sample container 10cm below water surface. Not flowing.
Analyte grouping/Analyte					**Units**	**LOR**									
Inorganics															
Ammonia (as N)	-	-	0.5	0.9	mg/L	0.01	0.001	-	-	-	-	-	-	-	-
Conductivity (at 25@°C)	-	-	-	-	µS/cm	100	170	-	-	-	-	-	-	-	-
Nitrate & Nitrite (as N)	-	-	-	-	mg/L	0.05	3.8	-	-	-	-	-	-	-	-
Nitrate (as N)	-	-	50	3.5	mg/L	0.02	3.7	-	-	-	-	-	-	-	-
Nitrite (as N)	-	-	30	-	mg/L	0.02	<0.02	-	-	-	-	-	-	-	-
pH (at 25@°C)	-	-	-	-	pH units	0.1	6	-	-	-	-	-	-	-	-
Phosphate total (as P)	-	-	-	-	mg/L	0.05	0.06	-	-	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	-	-	-	-	mg/L	0.005	0.13	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	-	-	0.8	-	mg/L	0.2	0.6	-	-	-	-	-	-	-	-
Total Nitrogen (as N)	-	-	-	-	mg/L	0.2	4.4	-	-	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	-	-	-	0.7	mg/L	0.005	0.0072	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	NTU	1	37	-	-	-	-	-	-	-	-
Total Metals															
Aluminium	-	NA	2[d]	NA	mg/L	0.05	-	-	0.92	0.61	0.46	-	0.16	0.3	0.26
Arsenic	7	NA	NA	NA	mg/L	0.001	-	-	0.004	< 0.001	0.003	-	0.002	< 0.001	0.002
Barium	-	NA	20	NA	mg/L	0.001	-	-	0.1	0.05	0.07	-	0.06	0.04	0.05
Beryllium	-	NA	0.6	NA	mg/L	0.001	-	-	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	<0.001
Cadmium	1.4	NA	NA	NA	mg/L	0.0002	-	-	0.021	0.0011	0.0036	-	0.0011	0.0003	0.0016
Chromium	-	NA	0.5	NA	mg/L	0.001	-	-	0.002	0.001	0.001	-	0.001	< 0.001	<0.001
Cobalt	-	NA	-	NA	mg/L	0.001	-	-	0.006	< 0.001	< 0.001	-	0.001	< 0.001	0.004
Copper	-	NA	20	NA	mg/L	0.001	-	-	0.18	0.018	0.12	-	0.043	0.012	0.039
Iron	-	NA	3	NA	mg/L	0.05	-	-	1.8	0.6	1.4	-	1.4	0.82	1.4
Lead	7	NA	NA	NA	mg/L	0.001	0.014	-	0.17	0.011	0.051	-	0.017	0.008	0.024
Manganese	350	NA	NA	NA	mg/L	0.005	-	-	0.52	0.017	0.042	-	0.071	0.011	0.24
Mercury	-	NA	0.01	NA	mg/L	0.0001	-	-	< 0.0001	< 0.0001	< 0.0001	-	< 0.0001	< 0.0001	0.0001
Nickel	14	NA	NA	NA	mg/L	0.001	-	-	0.036	0.002	0.011	-	0.004	0.001	0.004
Zinc	-	NA	30	NA	mg/L	0.005	-	-	4	0.22	0.74	-	0.25	0.054	0.34
Dissolved Metals															
Aluminium (filtered)	NA	5	NA	NA	mg/L	0.05	0.3	-	-	0.69	0.4	-	0.08	0.28	0.26
Arsenic (filtered)	NA	0.5	NA	NA	mg/L	0.001	0.001	-	-	< 0.001	0.002	-	0.002	< 0.001	0.001
Barium (filtered)	NA	-	NA	-	mg/L	0.001	0.08	-	-	0.05	0.07	-	0.05	0.04	0.05
Beryllium (filtered)	NA	-	NA	-	mg/L	0.001	<0.001	-	-	< 0.001	< 0.001	-	< 0.001	< 0.001	<0.001
Cadmium (filtered)	NA	0.01	NA	NA	mg/L	0.0002	0.0053	-	-	0.001	0.0033	-	0.001	0.0002	0.0015
Chromium (filtered)	NA	NA	NA	0.0025	mg/L	0.001	0.001	-	-	0.001	0.001	-	< 0.001	< 0.001	<0.001
Cobalt (filtered)	NA	NA	NA	0.0014	mg/L	0.001	0.005	-	-	< 0.001	< 0.001	-	0.001	< 0.001	0.004
Copper (filtered)	NA	0.5	NA	NA	mg/L	0.001	0.027	-	-	0.016	0.1	-	0.037	0.009	0.033
Iron (filtered)	NA	-	NA	-	mg/L	0.05	0.33	-	-	0.46	1.1	-	1.1	0.54	0.98
Lead (filtered)	NA	0.1	NA	NA	mg/L	0.001	0.011	-	-	0.009	0.023	-	0.013	0.003	0.012
Manganese (filtered)	NA	NA	NA	1.9	mg/L	0.005	0.015	-	-	0.014	0.029	-	0.065	0.008	0.23
Mercury (filtered)	NA	NA	NA	0.00006	mg/L	0.0001	< 0.0001	-	-	< 0.0001	< 0.0001	-	< 0.0001	< 0.0001	<0.0001
Nickel (filtered)	NA	1	NA	-	mg/L	0.001	0.002	-	-	0.002	0.011	-	0.003	0.001	0.004
Zinc (filtered)	NA	20	NA	-	mg/L	0.005	0.95	-	-	0.2	0.7	-	0.23	0.048	0.32
Total Recoverable Hydrocarbons - 2013 NEPM Fractions															
Naphthalene	-	-	17	16	µg/L	10	<10	-	-	-	-	-	-	-	-
TRH >C10-C16	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-	-
TRH >C10-C40 (total)*	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-	-
TRH >C16-C34	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-	-
TRH >C34-C40	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-	-
TRH C6-C10	-	-	-	-	µg/L	20	<20	-	-	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	-	-	-	-	µg/L	20	<20	-	-	-	-	-	-	-	-
BTEX															
Benzene	-	-	10	950	µg/L	1	<1	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	3000	80	µg/L	1	<2	-	-	-	-	-	-	-	-
m&p-Xylenes	-	-	-	-	µg/L	2	<2	-	-	-	-	-	-	-	-
o-Xylene	-	-	-	-	µg/L	1	<2	-	-	-	-	-	-	-	-
Toluene	-	-	8000	180	µg/L	1	<2	-	-	-	-	-	-	-	-
Xylenes - Total	-	-	6000	200	µg/L	3	<3	-	-	-	-	-	-	-	-

- indicates no criterion available
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.

[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.
Concentrations in blue bold font exceed human health recreational screening or site specific criteria
Concentrations in grey box exceed ecological screening or site specific criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 6: SW4 Analytical Results

	Site Specific Human Health Criteria[a]	Site Specific Ecology Criteria (Middle and Northern Culverts)[a]	Health-based Screening Criteria (Recreational Waters)[b]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[c]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		S19-Au07234	S19-Se37064	-	S20-Ap12290	S20-My01342	S20-Au23119	S20-Oc25147	S21-Ja34962	S21-Ap22335	N21-Jl30453	S22-Se00368
					Sample date:		06-Aug-19	24-Sep-19	29-Jan-20	1-Apr-20	30-Apr-20	11-Aug-20	13-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	12-Sep-22
					Sample ID:		SW4	SW4	SW4	SW4	SW4	SW4	SW4	SW4	SW4	SW4	SW4
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000780	318000780	318000780	318000780	318000780	318000780	318000780	318000780	318000780	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		Grab Sample	Grab Sample	-	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		Stagnant pond, clear to slightly yellow.	Turbid.	DRY	Light brown, low turbidity. No odour.	Collected at Boyd Street culvert. Flowing.	Brown, slightly trubid, full but flow not evident.	Water flowing, turbid, brown, no odour.	Brown-orange, stagnant, low-moderate turbidity, no observable contamination	Pale yellow, no odour	Clear, colourless, no odour. Not flowing.	Brown, murky, turbid, some suspended solids, no odour. Not flowing, minor vegetation on the surface and within the water body
Analyte grouping/Analyte					**Units**	**LOR**											
Inorganics																	
Ammonia (as N)	-	-	0.5	0.9	mg/L	0.01	<0.01	0.09	-	-	-	-	-	-	-	-	-
Conductivity (at 25@°C)	-	-	-	-	µS/cm	100	170	180	-	-	-	-	-	-	-	-	-
Nitrate & Nitrite (as N)	-	-	-	-	mg/L	0.05	<0.05	2.1	-	-	-	-	-	-	-	-	-
Nitrate (as N)	-	-	50	3.5	mg/L	0.02	<0.02	2.1	-	-	-	-	-	-	-	-	-
Nitrite (as N)	-	-	30	-	mg/L	0.02	<0.02	<0.02	-	-	-	-	-	-	-	-	-
pH (at 25@°C)	-	-	-	-	pH units	0.1	6.9	6.5	-	-	-	-	6.9	-	-	-	-
Phosphate total (as P)	-	-	-	-	mg/L	0.01	0.03	<0.01	-	-	-	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	-	-	-	-	mg/L	0.01	<0.01	0.014	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	-	-	0.8	-	mg/L	0.2	1.2	1.6	-	-	-	-	-	-	-	-	-
Total Nitrogen (as N)	-	-	-	-	mg/L	0.2	1.2	3.7	-	-	-	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	-	-	-	0.7	mg/L	0.005	0.007	0.012	-	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	NTU	1	6	39	-	-	-	-	-	-	-	-	-
Total Metals																	
Aluminium	-	NA	2[d]	NA	mg/L	0.05	-	-	-	0.18	0.49	0.59	0.36	0.23	0.18	0.25	0.28
Arsenic	7	NA	NA	NA	mg/L	0.001	-	-	-	0.002	0.002	< 0.001	0.003	0.003	0.003	< 0.001	0.002
Barium	-	NA	20	NA	mg/L	0.001	-	-	-	0.07	0.07	0.05	0.08	0.07	0.06	0.04	0.05
Beryllium	-	NA	0.6	NA	mg/L	0.001	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium	1.4	NA	NA	NA	mg/L	0.0002	-	-	-	0.019	0.04	0.003	0.019	0.0066	0.0025	0.0025	0.0015
Chromium	-	NA	0.5	NA	mg/L	0.001	-	-	-	< 0.001	0.001	0.001	0.001	< 0.001	0.001	0.001	0.002
Cobalt	-	NA	-	NA	mg/L	0.001	-	-	-	0.005	0.009	0.001	0.004	0.002	< 0.001	< 0.001	0.002
Copper	-	NA	20	NA	mg/L	0.001	-	-	-	0.13	0.31	0.04	0.19	0.13	0.09	0.032	0.044
Iron	-	NA	3	NA	mg/L	0.05	-	-	-	0.68	0.83	0.57	1.3	1.8	1.4	0.64	1.3
Lead	7	NA	NA	NA	mg/L	0.001	0.013	0.055	-	0.055	0.13	0.015	0.038	0.045	0.027	0.01	0.029
Manganese	350	NA	NA	NA	mg/L	0.005	-	-	-	0.42	0.63	0.045	0.37	0.3	0.024	0.016	0.13
Mercury	-	NA	0.01	NA	mg/L	0.0001	-	-	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Nickel	14	NA	NA	NA	mg/L	0.001	-	-	-	0.037	0.12	0.006	0.038	0.027	0.451	0.004	0.004
Zinc	-	NA	30	NA	mg/L	0.005	-	-	-	3.2	7	0.56	2.6	1.2	1.27	0.5	0.29
Dissolved Metals																	
Aluminium (filtered)	NA	5	NA	NA	mg/L	0.05	0.17	0.38	-	-	-	0.63	0.28	0.05	0.19	0.34	0.32
Arsenic (filtered)	NA	0.5	NA	NA	mg/L	0.001	0.001	0.001	-	-	-	< 0.001	0.002	0.005	0.002	< 0.001	0.001
Barium (filtered)	NA	-	NA	-	mg/L	0.001	0.04	0.05	-	-	-	0.04	0.08	0.07	0.05	0.04	0.04
Beryllium (filtered)	NA	-	NA	-	mg/L	0.001	<0.001	<0.001	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium (filtered)	NA	0.01	NA	NA	mg/L	0.0002	0.0056	0.013	-	-	-	0.0029	0.018	0.0051	0.0021	0.0025	0.0013
Chromium (filtered)	NA	NA	NA	0.0025	mg/L	0.001	0.001	0.001	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	0.001	<0.001
Cobalt (filtered)	NA	NA	NA	0.0014	mg/L	0.001	<0.001	0.003	-	-	-	< 0.001	0.004	0.001	< 0.001	< 0.001	0.002
Copper (filtered)	NA	0.5	NA	NA	mg/L	0.001	0.15	0.2	-	-	-	0.035	0.18	0.07	0.073	0.032	0.037
Iron (filtered)	NA	-	NA	-	mg/L	0.05	0.22	0.37	-	-	-	0.47	0.89	0.28	0.89	0.52	0.91
Lead (filtered)	NA	0.1	NA	NA	mg/L	0.001	0.008	0.033	-	-	-	0.011	0.023	0.007	0.016	0.006	0.015
Manganese (filtered)	NA	NA	NA	1.9	mg/L	0.005	0.015	0.2	-	-	-	0.041	0.38	0.26	0.014	0.015	0.12
Mercury (filtered)	NA	NA	NA	0.00006	mg/L	0.0001	< 0.0001	< 0.0001	-	-	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Nickel (filtered)	NA	1	NA	-	mg/L	0.001	0.014	0.019	-	-	-	0.006	0.038	0.022	0.421	0.004	0.004
Zinc (filtered)	NA	20	NA	-	mg/L	0.005	1.2	2.6	-	-	-	0.5	2.5	0.82	0.95	0.52	0.26
Total Recoverable Hydrocarbons - 2013 NEPM Fractions																	
Naphthalene	-	-	17	16	mg/L	10	<10	<10	-	-	-	-	-	-	-	-	-
TRH >C10-C16	-	-	-	-	mg/L	50	<50	<50	-	-	-	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	-	-	-	-	mg/L	50	<50	<50	-	-	-	-	-	-	-	-	-
TRH >C10-C40 (total)*	-	-	-	-	mg/L	100	<100	<100	-	-	-	-	-	-	-	-	-
TRH >C16-C34	-	-	-	-	mg/L	100	<100	<100	-	-	-	-	-	-	-	-	-
TRH >C34-C40	-	-	-	-	mg/L	100	<100	<100	-	-	-	-	-	-	-	-	-
TRH C6-C10	-	-	-	-	mg/L	20	<20	<20	-	-	-	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	-	-	-	-	mg/L	20	<20	<20	-	-	-	-	-	-	-	-	-
BTEX																	
Benzene	-	-	10	950	mg/L	1	<1	<1	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	3000	80	mg/L	1	<1	<2	-	-	-	-	-	-	-	-	-
m&p-Xylenes	-	-	-	-	mg/L	2	<2	<2	-	-	-	-	-	-	-	-	-
o-Xylene	-	-	-	-	mg/L	1	<1	<2	-	-	-	-	-	-	-	-	-
Toluene	-	-	8000	180	mg/L	1	<1	<2	-	-	-	-	-	-	-	-	-
Xylenes - Total	-	-	6000	200	mg/L	3	<3	<3	-	-	-	-	-	-	-	-	-

- indicates no criterion available
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.

[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 7: SW5 Analytical Results

	Site Specific Human Health Criteria[a]	Site Specific Ecology Criteria (Middle and Northern Culverts)[a]	Health-based Screening Criteria (Recreational Waters)[b]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[c]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		-	-	S20-Au23120	S20-Oc25149	-	S21-Ap22336	N21-Jl30455	S22-Se00368
					Sample date:		29-Jan-20	1-Apr-20	11-Aug-20	13-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	12-Sep-22
					Sample ID:		SW5	SW5	SW5	SW5	SW5	SW5	SW5	SW5
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000785	318000785	318000785	318000780	318000780	318000780	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		-	-	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		DRY	DRY	Brown, turbid, flow at culvert evident beneath crushed rock.	Water not flowing, very shallow, turbid, light brown, no odour.	DRY	Pale yellow, no odour. Small pool of water north of culvert, rest of area dry	Turbid, pale brown, no odour. Sample taken from puddle adjacent to culvert. Not flowing.	DRY
Analyte grouping/Analyte					**Units**	**LOR**								
Inorganics														
Ammonia (as N)	-	-	0.5	0.9	mg/L	0.01	-	-	-	-	-	-	-	-
Conductivity (at 25@°C)	-	-	-	-	µS/cm	100	-	-	-	-	-	-	-	-
Nitrate & Nitrite (as N)	-	-	-	-	mg/L	0.05	-	-	-	-	-	-	-	-
Nitrate (as N)	-	-	50	3.5	mg/L	0.02	-	-	-	-	-	-	-	-
Nitrite (as N)	-	-	30	-	mg/L	0.02	-	-	-	-	-	-	-	-
pH (at 25@°C)	-	-	-	-	pH units	0.1	-	-	-	-	-	-	-	-
Phosphate total (as P)	-	-	-	-	mg/L	0.05	-	-	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	-	-	-	-	mg/L	0.005	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	-	-	0.8	-	mg/L	0.2	-	-	-	-	-	-	-	-
Total Nitrogen (as N)	-	-	-	-	mg/L	0.2	-	-	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	-	-	-	0.7	mg/L	0.005	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	NTU	1	-	-	-	-	-	-	-	-
Total Metals														
Aluminium	-	NA	2[d]	NA	mg/L	0.05	-	-	1.8	11	-	0.29	1.3	-
Arsenic	7	NA	NA	NA	mg/L	0.001	-	-	0.001	0.005	-	0.002	0.001	-
Barium	-	NA	20	NA	mg/L	0.001	-	-	0.03	0.17	-	0.08	0.04	-
Beryllium	-	NA	0.6	NA	mg/L	0.001	-	-	< 0.001	< 0.001	-	< 0.001	< 0.001	-
Cadmium	1.4	NA	NA	NA	mg/L	0.0002	-	-	0.0009	0.0021	-	0.0009	0.0008	-
Chromium	-	NA	0.5	NA	mg/L	0.001	-	-	0.003	0.011	-	0.001	0.002	-
Cobalt	-	NA	-	NA	mg/L	0.001	-	-	< 0.001	0.003	-	< 0.001	< 0.001	-
Copper	-	NA	20	NA	mg/L	0.001	-	-	0.019	0.074	-	0.022	0.021	-
Iron	-	NA	3	NA	mg/L	0.05	-	-	1.5	8.9	-	0.97	1.1	-
Lead	7	NA	NA	NA	mg/L	0.001	-	-	0.01	0.031	-	0.003	0.005	-
Manganese	350	NA	NA	NA	mg/L	0.005	-	-	0.012	0.15	-	0.061	0.017	-
Mercury	-	NA	0.01	NA	mg/L	0.0001	-	-	< 0.0001	< 0.0001	-	< 0.0001	< 0.0001	-
Nickel	14	NA	NA	NA	mg/L	0.001	-	-	0.002	0.007	-	0.004	0.003	-
Zinc	-	NA	30	NA	mg/L	0.005	-	-	0.11	0.3	-	0.19	0.16	-
Dissolved Metals														
Aluminium (filtered)	NA	5	NA	NA	mg/L	0.05	-	-	3.2	0.28	-	0.25	1.1	-
Arsenic (filtered)	NA	0.5	NA	NA	mg/L	0.001	-	-	0.001	0.002	-	0.001	< 0.001	-
Barium (filtered)	NA	-	NA	-	mg/L	0.001	-	-	0.03	0.08	-	0.07	0.04	-
Beryllium (filtered)	NA	-	NA	-	mg/L	0.001	-	-	< 0.001	< 0.001	-	< 0.001	< 0.001	-
Cadmium (filtered)	NA	0.01	NA	NA	mg/L	0.0002	-	-	0.0009	0.001	-	0.0006	0.0006	-
Chromium (filtered)	NA	NA	NA	0.0025	mg/L	0.001	-	-	0.003	< 0.001	-	< 0.001	0.002	-
Cobalt (filtered)	NA	NA	NA	0.0014	mg/L	0.001	-	-	< 0.001	0.001	-	< 0.001	< 0.001	-
Copper (filtered)	NA	0.5	NA	NA	mg/L	0.001	-	-	0.016	0.045	-	0.019	0.018	-
Iron (filtered)	NA	-	NA	-	mg/L	0.05	-	-	1.4	0.54	-	0.74	0.78	-
Lead (filtered)	NA	0.1	NA	NA	mg/L	0.001	-	-	0.006	0.007	-	0.002	0.003	-
Manganese (filtered)	NA	NA	NA	1.9	mg/L	0.005	-	-	0.008	0.09	-	0.044	0.013	-
Mercury (filtered)	NA	NA	NA	0.00006	mg/L	0.0001	-	-	< 0.0001	< 0.0001	-	< 0.0001	< 0.0001	-
Nickel (filtered)	NA	1	NA	-	mg/L	0.001	-	-	0.002	0.003	-	0.004	0.003	-
Zinc (filtered)	NA	20	NA	-	mg/L	0.005	-	-	0.094	0.14	-	0.17	0.13	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions														
Naphthalene	-	-	17	16	µg/L	10	-	-	-	-	-	-	-	-
TRH >C10-C16	-	-	-	-	µg/L	50	-	-	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	-	-	-	-	µg/L	50	-	-	-	-	-	-	-	-
TRH >C10-C40 (total)*	-	-	-	-	µg/L	100	-	-	-	-	-	-	-	-
TRH >C16-C34	-	-	-	-	µg/L	100	-	-	-	-	-	-	-	-
TRH >C34-C40	-	-	-	-	µg/L	100	-	-	-	-	-	-	-	-
TRH C6-C10	-	-	-	-	µg/L	20	-	-	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	-	-	-	-	µg/L	20	-	-	-	-	-	-	-	-
BTEX														
Benzene	-	-	10	950	µg/L	1	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	3000	80	µg/L	1	-	-	-	-	-	-	-	-
m&p-Xylenes	-	-	-	-	µg/L	2	-	-	-	-	-	-	-	-
o-Xylene	-	-	-	-	µg/L	1	-	-	-	-	-	-	-	-
Toluene	-	-	8000	180	µg/L	1	-	-	-	-	-	-	-	-
Xylenes - Total	-	-	6000	200	µg/L	3	-	-	-	-	-	-	-	-

- indicates no criterion available
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.
[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.
Concentrations in blue bold font exceed human health recreational screening or site specific criteria
Concentrations in grey box exceed ecological screening or site specific criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 8: SW6 Analytical Results

	Site Specific Human Health Criteria[a]	Site Specific Ecology Criteria (Middle and Northern Culverts)[a]	Health-based Screening Criteria (Recreational Waters)[b]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[c]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		-	-	S20-Au23121	-	-	-	N21-Jl30451	S22-Se00368
					Sample date:		29-Jan-20	1-Apr-20	11-Aug-20	13-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	12-Sep-22
					Sample ID:		SW6	SW6	SW6	SW6	SW6	SW6	SW6	SW6
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000785	318000785	318000785	318000785	318000785	318000785	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		-	-	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		DRY	DRY	Brown, slightly turbid. Not flowing.	DRY	DRY	DRY	Clear to slightly turbid, pale yellow/brown, no odour. Flowing slightly.	Brown, slightly murky, slightly turbid, some suspended solids, no odour. Flowing slightly, minor vegetation on the surface and banks of the water body. Unable to completely submerge sample container 10cm below water surface.
Analyte grouping/Analyte					**Units**	**LOR**								
Inorganics														
Ammonia (as N)	-	-	0.5	0.9	mg/L	0.01	-	-	-	-	-	-	-	-
Conductivity (at 25@°C)	-	-	-	-	µS/cm	100	-	-	-	-	-	-	-	-
Nitrate & Nitrite (as N)	-	-	-	-	mg/L	0.05	-	-	-	-	-	-	-	-
Nitrate (as N)	-	-	50	3.5	mg/L	0.02	-	-	-	-	-	-	-	-
Nitrite (as N)	-	-	30	-	mg/L	0.02	-	-	-	-	-	-	-	-
pH (at 25@°C)	-	-	-	-	pH units	0.1	-	-	-	-	-	-	-	-
Phosphate total (as P)	-	-	-	-	mg/L	0.05	-	-	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	-	-	-	-	mg/L	0.005	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	-	-	0.8	-	mg/L	0.2	-	-	-	-	-	-	-	-
Total Nitrogen (as N)	-	-	-	-	mg/L	0.2	-	-	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	-	-	-	0.7	mg/L	0.005	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	NTU	1	-	-	-	-	-	-	-	-
Total Metals														
Aluminium	-	NA	2[d]	NA	mg/L	0.05	-	-	1.8	-	-	-	**2.4**	1.1
Arsenic	7	NA	NA	NA	mg/L	0.001	-	-	0.002	-	-	-	0.002	0.002
Barium	-	NA	20	NA	mg/L	0.001	-	-	0.06	-	-	-	0.05	0.07
Beryllium	-	NA	0.6	NA	mg/L	0.001	-	-	< 0.001	-	-	-	< 0.001	<0.001
Cadmium	1.4	NA	NA	NA	mg/L	0.0002	-	-	0.0072	-	-	-	0.004	0.002
Chromium	-	NA	0.5	NA	mg/L	0.001	-	-	0.003	-	-	-	0.003	0.002
Cobalt	-	NA	-	NA	mg/L	0.001	-	-	< 0.001	-	-	-	< 0.001	0.002
Copper	-	NA	20	NA	mg/L	0.001	-	-	0.1	-	-	-	0.12	0.068
Iron	-	NA	3	NA	mg/L	0.05	-	-	1.4	-	-	-	1.9	1.9
Lead	7	NA	NA	NA	mg/L	0.001	-	-	0.022	-	-	-	0.022	0.022
Manganese	350	NA	NA	NA	mg/L	0.005	-	-	0.018	-	-	-	0.021	0.1
Mercury	-	NA	0.01	NA	mg/L	0.0001	-	-	< 0.0001	-	-	-	< 0.0001	0.0001
Nickel	14	NA	NA	NA	mg/L	0.001	-	-	0.029	-	-	-	0.022	0.012
Zinc	-	NA	30	NA	mg/L	0.005	-	-	0.9	-	-	-	0.67	0.43
Dissolved Metals														
Aluminium (filtered)	NA	5	NA	NA	mg/L	0.05	-	-	2.4	-	-	-	3.2	3.6
Arsenic (filtered)	NA	0.5	NA	NA	mg/L	0.001	-	-	0.001	-	-	-	0.002	0.002
Barium (filtered)	NA	-	NA	-	mg/L	0.001	-	-	0.05	-	-	-	0.04	0.04
Beryllium (filtered)	NA	-	NA	-	mg/L	0.001	-	-	< 0.001	-	-	-	< 0.001	<0.001
Cadmium (filtered)	NA	0.01	NA	NA	mg/L	0.0002	-	-	0.0063	-	-	-	0.0034	0.0013
Chromium (filtered)	NA	NA	NA	0.0025	mg/L	0.001	-	-	0.003	-	-	-	0.003	0.003
Cobalt (filtered)	NA	NA	NA	0.0014	mg/L	0.001	-	-	< 0.001	-	-	-	< 0.001	0.001
Copper (filtered)	NA	0.5	NA	NA	mg/L	0.001	-	-	0.088	-	-	-	0.11	0.056
Iron (filtered)	NA	-	NA	-	mg/L	0.05	-	-	1.1	-	-	-	1.7	2
Lead (filtered)	NA	0.1	NA	NA	mg/L	0.001	-	-	0.013	-	-	-	0.013	0.01
Manganese (filtered)	NA	NA	NA	1.9	mg/L	0.005	-	-	0.013	-	-	-	0.012	0.04
Mercury (filtered)	NA	NA	NA	0.00006	mg/L	0.0001	-	-	< 0.0001	-	-	-	< 0.0001	<0.0001
Nickel (filtered)	NA	1	NA	-	mg/L	0.001	-	-	0.026	-	-	-	0.019	0.012
Zinc (filtered)	NA	20	NA	-	mg/L	0.005	-	-	0.79	-	-	-	0.53	0.25
Total Recoverable Hydrocarbons - 2013 NEPM Fractions														
Naphthalene	-	-	17	16	µg/L	10	-	-	-	-	-	-	-	-
TRH >C10-C16	-	-	-	-	µg/L	50	-	-	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	-	-	-	-	µg/L	50	-	-	-	-	-	-	-	-
TRH >C10-C40 (total)*	-	-	-	-	µg/L	100	-	-	-	-	-	-	-	-
TRH >C16-C34	-	-	-	-	µg/L	100	-	-	-	-	-	-	-	-
TRH >C34-C40	-	-	-	-	µg/L	100	-	-	-	-	-	-	-	-
TRH C6-C10	-	-	-	-	µg/L	20	-	-	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	-	-	-	-	µg/L	20	-	-	-	-	-	-	-	-
BTEX														
Benzene	-	-	10	950	µg/L	1	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	3000	80	µg/L	1	-	-	-	-	-	-	-	-
m&p-Xylenes	-	-	-	-	µg/L	2	-	-	-	-	-	-	-	-
o-Xylene	-	-	-	-	µg/L	1	-	-	-	-	-	-	-	-
Toluene	-	-	8000	180	µg/L	1	-	-	-	-	-	-	-	-
Xylenes - Total	-	-	6000	200	µg/L	3	-	-	-	-	-	-	-	-

- indicates no criterion available
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.
[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.
Concentrations in **blue bold** font exceed human health recreational screening or site specific criteria
Concentrations in grey box exceed ecological screening or site specific criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 9: SW7 Analytical Results

	Health-based Screening Criteria (Recreational Waters)[b]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[c]	ANZECC Fresh Water Guidelines - Irrigation[c]	ANZECC Fresh Water Guidelines - Stock Water[c]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		S20-Ja29060	S20-Ap12291	S20-Au23122	S20-Oc25163	S21-Ja34963	S21-Ap22337	N21-Jl30457	S22-Se00368
					Sample date:		29-Jan-20	2-Apr-20	11-Aug-20	12-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	13-Sep-22
					Sample ID:		SW7	SW7	SW7	SW7	SW7	SW7	SW7	SW7
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000780	318000780	318000780	318000780	318000780	318000780	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		Silty, from dam, low level water.	Highly turbid.	Brown, turbid.	Water slightly trubid, brown, not flowing.	Light brown, low-moderate turbidity, no observable contamination	Pale brown, dark colour to dam, earthy odour	Slightly turbid, palye yellow/brown, no odour. Reeds growing in pond. Not flowing.	Light brown to brown, slightly murky, slightly turbid, suspended solids, no odour. Reeds growing in pond. Not flowing, minor vegetation on the surface and within the waterbody.
Analyte grouping/Analyte					**Units**	**LOR**								
Inorganics														
Ammonia (as N)	0.5	0.9	-	-	mg/L	0.01	0.02	-	-	-	-	-	-	-
Conductivity (at 25@°C)	-	-	-	-	µS/cm	100	580	-	-	-	-	-	-	-
Nitrate & Nitrite (as N)	-	-	**400**	100	mg/L	0.05	<0.05	-	-	-	-	-	-	-
Nitrate (as N)	50	3.5	**30**	10	mg/L	0.02	<0.02	-	-	-	-	-	-	-
Nitrite (as N)	30	-	-	-	mg/L	0.02	<0.02	-	-	-	-	-	-	-
pH (at 25@°C)	-	-	-	800-1200	pH units	0.1	7.4	-	-	-	-	-	-	-
Phosphate total (as P)	-	-	-	-	mg/L	0.05	0.69	-	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	-	-	-	-	mg/L	0.005	0.56	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	0.8	-	-	25-125	mg/L	0.2	15	-	-	-	-	-	-	-
Total Nitrogen (as N)	-	-	-	-	mg/L	0.2	15	-	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	-	0.7	-	-	mg/L	0.005	0.25	-	-	-	-	-	-	-
Turbidity	-	-			NTU	1	160	-	-	-	-	-	-	-
Total Metals														
Aluminium	2[d]	NA	NA	NA	mg/L	0.05	-	0.29	1.7	0.33	0.41	0.15	0.46	0.2
Arsenic	NA	NA	NA	NA	mg/L	0.001	0.016	0.004	0.003	0.005	0.003	0.002	0.002	0.002
Barium	20	NA	NA	NA	mg/L	0.001	-	0.08	0.04	0.05	0.09	0.04	0.04	0.03
Beryllium	0.6	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium	NA	NA	NA	NA	mg/L	0.0002	0.0016	0.0009	0.0014	0.0003	< 0.0002	0.0004	< 0.0002	<0.0002
Chromium	0.5	NA	NA	NA	mg/L	0.001	-	0.001	0.002	0.001	< 0.001	< 0.001	0.001	<0.001
Cobalt	-	NA	NA	NA	mg/L	0.001	0.002	0.002	< 0.001	< 0.001	0.002	< 0.001	< 0.001	<0.001
Copper	20	NA	NA	NA	mg/L	0.001	0.021	0.022	0.027	0.014	0.006	0.009	0.011	0.004
Iron	3	NA	NA	NA	mg/L	0.05	-	4.22	1.8	3	4	3.3	3.8	3.3
Lead	NA	NA	NA	NA	mg/L	0.001	0.037	0.02	0.025	0.012	0.009	0.006	0.006	0.003
Manganese	NA	NA	NA	NA	mg/L	0.005	1.1	0.41	0.032	0.063	1	0.072	0.083	0.04
Mercury	0.01	NA	NA	NA	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Nickel	NA	NA	NA	NA	mg/L	0.001	0.012	0.006	0.003	0.003	0.003	0.002	0.002	0.002
Zinc	30	NA	NA	NA	mg/L	0.005	0.28	0.15	0.36	0.065	0.044	0.082	0.1	0.014
Dissolved Metals														
Dissolved Aluminium	NA	0.055	**5**	20	mg/L	0.05	-	-	0.95	0.18	0.52	0.14	0.37	0.08
Dissolved Arsenic	NA	NA	**0.5**	2	mg/L	0.001	0.011	-	0.001	0.004	0.005	0.001	0.001	0.002
Dissolved Barium	NA	-	-	-	mg/L	0.001	-	-	0.03	0.05	0.05	0.03	0.04	0.03
Dissolved Beryllium	NA	-	-	0.5	mg/L	0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Cadmium	NA	0.00054	**0.01**	0.05	mg/L	0.0002	0.0005	-	0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0002	<0.0002
Dissolved Chromium	NA	0.0025	**1**	1	mg/L	0.001	-	-	0.002	< 0.001	0.001	< 0.001	< 0.001	0.001
Dissolved Cobalt	NA	0.0014	**1**	0.1	mg/L	0.001	0.002	-	< 0.001	< 0.001	0.002	< 0.001	< 0.001	<0.001
Dissolved Copper	NA	0.0014	**0.5**	0.1	mg/L	0.001	0.009	-	0.019	0.013	0.007	0.008	0.008	0.003
Dissolved Iron	NA	-	-	10	mg/L	0.05	-	-	0.57	2.4	1.8	1.6	2.5	2.6
Dissolved Lead	NA	0.0034	**0.1**	5	mg/L	0.001	0.017	-	0.005	0.009	0.004	0.003	0.004	0.002
Dissolved Manganese	NA	1.9	**10**	2.5	mg/L	0.005	0.68	-	0.028	0.056	1	0.063	0.07	0.035
Dissolved Mercury	NA	0.00006	**0.002**	0.002	mg/L	0.0001	< 0.0001	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Dissolved Nickel	NA	-	**1**	2	mg/L	0.001	0.009	-	0.003	0.003	0.002	0.002	0.002	0.001
Dissolved Zinc	NA	0.02	**20**	5	mg/L	0.005	0.087	-	0.26	0.051	0.031	0.057	0.082	0.01
Total Recoverable Hydrocarbons - 2013 NEPM Fractions														
Naphthalene	17	16	-	-	µg/L	10	<10	-	-	-	-	-	-	-
TRH >C10-C16	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-
TRH >C10-C40 (total)*	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-
TRH >C16-C34	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-
TRH >C34-C40	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-
TRH C6-C10	-	-	-	-	µg/L	20	<20	-	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	-	-	-	-	µg/L	20	<20	-	-	-	-	-	-	-
BTEX														
Benzene	10	950	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
Ethylbenzene	3000	80	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
m&p-Xylenes	-	-	-	-	µg/L	2	< 2	-	-	-	-	-	-	-
o-Xylene	-	-	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
Toluene	8000	180	-	-	µg/L	1	2	-	-	-	-	-	-	-
Xylenes - Total	6000	200	-	-	µg/L	3	< 3	-	-	-	-	-	-	-

- indicates no criterion available
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.

[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.

Concentrations in blue font exceed human health recreational screening criteria
Concentrations in grey box exceed ecological screening criteria
Concentrations in **bold** exceed irrigation screening criteria
Concentrations in *italics* exceed stockwatering screening criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 10: SW8 Analytical Results

	Health-based Screening Criteria (Recreational Waters)[b]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[c]	ANZECC Fresh Water Guidelines - Irrigation[c]	ANZECC Fresh Water Guidelines - Stock Water[c]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		S20-Ja29061	S20-Ap12292	S20-Au23123	S20-Oc25165	S21-Ja34964	S21-Ap22338	N21-Jl30457	S22-Se00368
					Sample date:		29-Jan-20	2-Apr-20	10-Aug-20	12-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	13-Sep-22
					Sample ID:		SW8	SW8	SW8	SW8	SW8	SW8	SW8	SW8
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000780	318000780	318000780	318000780	318000780	318000780	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		Clear, vegetation. Not flowing.	Grease at surface, lots of algae growing on plants.	Water flowing, level high, turbid.	Water flowing, clear/brown.	Clear, low turbidity, no observable contamination	Clear, no odour, leaf litter on surface	Clear, colourless, no odour. Reeds growing in river. Flowing.	Clear, colourless, very minor suspended solids, no odour. Reeds growing in river. Flowing, minor vegetation on the banks of the stream and within the water body
Analyte grouping/Analyte					**Units**	**LOR**								
Inorganics														
Ammonia (as N)	0.5	0.9	-	-	mg/L	0.01	<0.01	-	-	-	-	-	-	-
Conductivity (at 25@°C)	-	-	-	-	µS/cm	100	1000	-	-	-	-	-	-	-
Nitrate & Nitrite (as N)	-	-	400	100	mg/L	0.05	<0.05	-	-	-	-	-	-	-
Nitrate (as N)	50	3.5	30	10	mg/L	0.02	<0.02	-	-	-	-	-	-	-
Nitrite (as N)	30	-	-	-	mg/L	0.02	<0.02	-	-	-	-	-	-	-
pH (at 25@°C)	-	-	-	800-1200	pH units	0.1	7.7	-	-	-	-	-	-	-
Phosphate total (as P)	-	-	-	-	mg/L	0.05	0.04	-	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	-	-	-	-	mg/L	0.005	0.55	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	0.8	-	-	25-125	mg/L	0.2	0.5	-	-	-	-	-	-	-
Total Nitrogen (as N)	-	-	-	-	mg/L	0.2	0.5	-	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	-	0.7	-	-	mg/L	0.005	0.0064	-	-	-	-	-	-	-
Turbidity	-	-			NTU	1	2.7	-	-	-	-	-	-	-
Total Metals														
Aluminium	2[d]	NA	NA	NA	mg/L	0.05	-	< 0.05	0.72	< 0.05	< 0.05	< 0.05	< 0.05	0.09
Arsenic	0.1	NA	NA	NA	mg/L	0.001	< 0.001	0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	<0.001
Barium	2	NA	NA	NA	mg/L	0.001	-	0.12	0.02	0.08	0.1	0.06	0.06	0.07
Beryllium	0.6	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium	0.002	NA	NA	NA	mg/L	0.0002	< 0.0002	< 0.0002	0.0003	< 0.0002	< 0.0002	< 0.0002	< 0.0002	<0.0002
Chromium	0.5	NA	NA	NA	mg/L	0.001	-	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002
Cobalt	-	NA	NA	NA	mg/L	0.001	< 0.001	0.003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Copper	20	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	0.008	< 0.001	< 0.001	0.001	0.002	0.003
Iron	3	NA	NA	NA	mg/L	0.05	-	3.2	0.76	0.51	0.27	0.17	0.3	0.51
Lead	0.1	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	0.002	0.001	< 0.001	< 0.001	< 0.001	<0.001
Manganese	5	NA	NA	NA	mg/L	0.005	0.37	1.9	0.035	0.066	0.12	0.033	0.07	0.13
Mercury	0.01	NA	NA	NA	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Nickel	0.2	NA	NA	NA	mg/L	0.001	0.001	0.002	0.002	0.001	< 0.001	0.002	0.001	0.002
Zinc	30	NA	NA	NA	mg/L	0.005	< 0.005	0.022	0.12	0.009	< 0.005	0.011	0.024	0.029
Dissolved Metals														
Dissolved Aluminium	NA	0.055	**5**	20	mg/L	0.05	-	-	0.41	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Dissolved Arsenic	NA	0.024	**0.5**	2	mg/L	0.001	< 0.001	-	< 0.001	< 0.001	0.003	< 0.001	< 0.001	<0.001
Dissolved Barium	NA	-	**-**	-	mg/L	0.001	-	-	0.02	0.09	0.11	0.06	0.06	0.07
Dissolved Beryllium	NA	-	**-**	0.5	mg/L	0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Cadmium	NA	0.00054	**0.01**	0.05	mg/L	0.0002	< 0.0002	-	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	<0.0002
Dissolved Chromium	NA	0.0025	**1**	1	mg/L	0.001	-	-	0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Cobalt	NA	0.0014	**1**	0.1	mg/L	0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Copper	NA	0.0014	**0.5**	0.1	mg/L	0.001	< 0.001	-	0.007	< 0.001	0.003	< 0.001	0.002	0.003
Dissolved Iron	NA	-	**-**	10	mg/L	0.05	-	-	0.31	0.15	0.09	0.07	0.18	0.23
Dissolved Lead	NA	0.0034	**0.1**	5	mg/L	0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Manganese	NA	1.9	**10**	2.5	mg/L	0.005	0.33	-	0.028	0.064	0.11	0.03	0.061	0.12
Dissolved Mercury	NA	0.00006	**0.002**	0.002	mg/L	0.0001	< 0.0001	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Dissolved Nickel	NA	0.0275	**1**	2	mg/L	0.001	< 0.001	-	0.002	0.001	< 0.001	0.002	0.001	0.001
Dissolved Zinc	NA	0.02	**20**	5	mg/L	0.005	< 0.005	-	0.1	0.01	< 0.005	0.008	0.018	0.023
Total Recoverable Hydrocarbons - 2013 NEPM Fractions														
Naphthalene	17	16	-	-	µg/L	10	<10	-	-	-	-	-	-	-
TRH >C10-C16	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-
TRH >C10-C40 (total)*	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-
TRH >C16-C34	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-
TRH >C34-C40	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-
TRH C6-C10	-	-	-	-	µg/L	20	<20	-	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	-	-	-	-	µg/L	20	<20	-	-	-	-	-	-	-
BTEX														
Benzene	10	950	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
Ethylbenzene	3000	80	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
m&p-Xylenes	-	-	-	-	µg/L	2	< 2	-	-	-	-	-	-	-
o-Xylene	-	-	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
Toluene	8000	180	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
Xylenes - Total	6000	200	-	-	µg/L	3	< 3	-	-	-	-	-	-	-

- indicates no criterion available
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.
[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.
Concentrations in blue font exceed human health recreational screening criteria
Concentrations in grey box exceed ecological screening criteria
Concentrations in **bold** exceed irrigation screening criteria
Concentrations in *italics* exceed stockwatering screening criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 11: SW9 Analytical Results

	Health-based Screening Criteria (Recreational Waters)[B]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[C]	ANZECC Fresh Water Guidelines - Irrigation[D]	ANZECC Fresh Water Guidelines - Stock Water[E]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		S20-Ja29062	S20-Ap12293	S20-Au23124	S20-Oc25167	S21-Ja34965	S21-Ap22339	N21-Jl30459	S22-Se00368
					Sample date:		29-Jan-20	2-Apr-20	20-Aug-20	12-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	13-Sep-22
					Sample ID:		SW9	SW9	SW9	SW9	SW9	SW9	SW9	SW9
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000780	318000780	318000780	318000780	318000780	318000780	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		Stagnant pond. Algae and fish present. Slightly turbid.	Non-turbid, slightly brown, not flowing but full.	High level, brown, slightly turbid, bubbles at surface.	Water flowing, clear/brown, slightly turbid.	Clear, low turbidity, no observable contamination	Very pale yellow, no odour	Clear, colourless, no odour. Flowing.	Light brown to brown, slightly murky, slightly turbid, no odour. Flowing, minor vegetation and moss on the banks of the stream and within the waterbody.
Analyte grouping/Analyte					**Units**	**LOR**								
Inorganics														
Ammonia (as N)	0.5	0.9	-	-	mg/L	0.01	-	-	-	-	-	-	-	-
Conductivity (at 25@°C)	-	-	-	-	µS/cm	100	-	-	-	-	-	-	-	-
Nitrate & Nitrite (as N)	-	-	400	100	mg/L	0.05	-	-	-	-	-	-	-	-
Nitrate (as N)	50	3.5	30	10	mg/L	0.02	-	-	-	-	-	-	-	-
Nitrite (as N)	30	-	-	-	mg/L	0.02	-	-	-	-	-	-	-	-
pH (at 25@°C)	-	-	-	800-1200	pH units	0.1	-	-	-	-	-	-	-	-
Phosphate total (as P)	-	-	-	-	mg/L	0.05	-	-	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	-	-	-	-	mg/L	0.005	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	0.8	-	-	25-125	mg/L	0.2	-	-	-	-	-	-	-	-
Total Nitrogen (as N)	-	-	-	-	mg/L	0.2	-	-	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	-	0.7	-	-	mg/L	0.005	-	-	-	-	-	-	-	-
Turbidity	-	-			NTU	1	-	-	-	-	-	-	-	-
Total Metals														
Aluminium	2[d]	NA	NA	NA	mg/L	0.05	-	0.05	0.53	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Arsenic	0.1	NA	NA	NA	mg/L	0.001	0.001	0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	<0.001
Barium	2	NA	NA	NA	mg/L	0.001	-	0.08	0.02	0.09	0.11	0.06	0.07	0.07
Beryllium	0.6	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium	0.002	NA	NA	NA	mg/L	0.0002	< 0.0002	< 0.0002	0.0004	< 0.0002	< 0.0002	< 0.0002	< 0.0002	<0.0002
Chromium	0.5	NA	NA	NA	mg/L	0.001	-	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cobalt	-	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Copper	20	NA	NA	NA	mg/L	0.001	< 0.001	0.001	0.01	< 0.001	< 0.001	0.001	0.002	0.003
Iron	3	NA	NA	NA	mg/L	0.05	-	0.54	0.6	0.15	0.15	0.25	0.29	0.46
Lead	0.1	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	0.002	0.001	< 0.001	< 0.001	< 0.001	<0.001
Manganese	5	NA	NA	NA	mg/L	0.005	0.19	0.33	0.041	0.03	0.24	0.044	0.033	0.084
Mercury	0.01	NA	NA	NA	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Nickel	0.2	NA	NA	NA	mg/L	0.001	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.001
Zinc	30	NA	NA	NA	mg/L	0.005	0.009	0.015	0.16	0.008	0.008	0.014	0.038	0.042
Dissolved Metals														
Dissolved Aluminium	NA	0.055	**5**	20	mg/L	0.05	-	-	0.35	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Dissolved Arsenic	NA	0.024	**0.5**	2	mg/L	0.001	< 0.001	-	< 0.001	< 0.001	0.003	< 0.001	< 0.001	<0.001
Dissolved Barium	NA	-	**-**	-	mg/L	0.001	-	-	0.02	0.09	0.12	0.06	0.06	0.06
Dissolved Beryllium	NA	-	**-**	0.5	mg/L	0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Cadmium	NA	0.00054	**0.01**	0.05	mg/L	0.0002	< 0.0002	-	0.0004	< 0.0002	< 0.0002	< 0.0002	< 0.0002	<0.0002
Dissolved Chromium	NA	0.0025	**1**	1	mg/L	0.001	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Cobalt	NA	0.0014	**1**	0.1	mg/L	0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Copper	NA	0.0014	**0.5**	0.1	mg/L	0.001	< 0.001	-	0.008	< 0.001	0.004	< 0.001	0.002	0.003
Dissolved Iron	NA	-	**-**	10	mg/L	0.05	-	-	0.29	< 0.05	< 0.05	0.12	0.19	0.26
Dissolved Lead	NA	0.0034	**0.1**	5	mg/L	0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Dissolved Manganese	NA	1.9	**10**	2.5	mg/L	0.005	0.012	-	0.036	0.023	0.17	0.04	0.03	0.078
Dissolved Mercury	NA	0.00006	**0.002**	0.002	mg/L	0.0001	< 0.0001	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Dissolved Nickel	NA	0.0275	**1**	2	mg/L	0.001	< 0.001	-	0.002	0.001	0.001	0.002	0.001	0.001
Dissolved Zinc	NA	0.02	**20**	5	mg/L	0.005	< 0.005	-	0.14	< 0.005	0.006	0.01	0.034	0.038
Total Recoverable Hydrocarbons - 2013 NEPM Fractions														
Naphthalene	17	16	-	-	µg/L	10	<10	-	-	-	-	-	-	-
TRH >C10-C16	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	-	-	-	-	µg/L	50	<50	-	-	-	-	-	-	-
TRH >C10-C40 (total)*	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-
TRH >C16-C34	-	-	-	-	µg/L	100	<100	-	-	-	-	-	-	-
TRH >C34-C40	-		-	-	µg/L	100	<100	-	-	-	-	-	-	-
TRH C6-C10	-		-	-	µg/L	20	<20	-	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	-	-	-	-	µg/L	20	<20	-	-	-	-	-	-	-
BTEX														
Benzene	10	950	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
Ethylbenzene	3000	80	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
m&p-Xylenes	-	-	-	-	µg/L	2	< 2	-	-	-	-	-	-	-
o-Xylene	-	-	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
Toluene	8000	180	-	-	µg/L	1	< 1	-	-	-	-	-	-	-
Xylenes - Total	6000	200	-	-	µg/L	3	< 3	-	-	-	-	-	-	-

- indicates no criterion available
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.
[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.
Concentrations in blue font exceed human health recreational screening criteria
Concentrations in grey box exceed ecological screening criteria
Concentrations in **bold** exceed irrigation screening criteria
Concentrations in *italics* exceed stockwatering screening criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 12: SW10 Analytical Results

	Health-based Screening Criteria (Recreational Waters)[B]	Ecological Sceening Criteria (ANZG 95% Protection) Fresh Water[C]	ANZECC Fresh Water Guidelines - Irrigation[D]	ANZECC Fresh Water Guidelines - Stock Water[E]	Sample Type:		Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
					Lab ID		S20-Oc25153	S21-Ja34966	S21-Ap22340	N21-Jl30460	S22-Se00368
					Sample date:		13-Oct-20	28-Jan-21	14-Apr-21	13-Jul-21	13-Sep-22
					Sample ID:		SW10	SW10	SW10	SW10	SW10
					Project Name:		Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring	Tarago SW Monitoring
					Project No:		318000780	318000780	318000780	318000780	318001376
					Sample Location		Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Loop	Tarago Rail Corridor
					Sampling Method:		Grab Sample	Grab Sample	Grab Sample	Grab Sample	Grab Sample
Guidelines					Sample Description:		Water flowing, clear/brown, slightly turbid, no odour.	Clear, low turbidity, no observable contamination	Clear, no odour	Clear to slighty turbid, colourless, no odour. Flowing.	Clear, colourless, very minor suspended solids, no odour. Flowing, minor vegetation and moss on the banks of the stream and within the waterbody.
Analyte grouping/Analyte					**Units**	**LOR**					
Total Metals											
Aluminium	2[d]	NA	NA	NA	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.09
Arsenic	0.1	NA	NA	NA	mg/L	0.001	0.001	< 0.001	< 0.001	< 0.001	<0.001
Barium	2	NA	NA	NA	mg/L	0.001	0.1	0.1	0.06	0.07	0.07
Beryllium	0.6	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium	0.002	NA	NA	NA	mg/L	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	<0.0002
Chromium	0.5	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002
Cobalt	-	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Copper	20	NA	NA	NA	mg/L	0.001	< 0.001	< 0.001	0.001	0.002	0.003
Iron	3	NA	NA	NA	mg/L	0.05	0.55	0.79	0.24	0.29	0.53
Lead	0.1	NA	NA	NA	mg/L	0.001	0.002	< 0.001	< 0.001	< 0.001	<0.001
Manganese	5	NA	NA	NA	mg/L	0.005	0.089	0.31	0.036	0.066	0.13
Mercury	0.01	NA	NA	NA	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Nickel	0.2	NA	NA	NA	mg/L	0.001	0.001	< 0.001	0.002	0.002	0.002
Zinc	30	NA	NA	NA	mg/L	0.005	0.013	< 0.005	0.013	0.032	0.031
Dissolved Metals											
Aluminium (filtered)	NA	0.055	**5**	20	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Arsenic (filtered)	NA	0.024	**0.5**	2	mg/L	0.001	< 0.001	0.002	< 0.001	< 0.001	<0.001
Barium (filtered)	NA	-	**-**	-	mg/L	0.001	0.11	0.11	0.06	0.06	0.07
Beryllium (filtered)	NA	-	**-**	0.5	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cadmium (filtered)	NA	0.00054	**0.01**	0.05	mg/L	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	<0.0002
Chromium (filtered)	NA	0.0025	**1**	1	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Cobalt (filtered)	NA	0.0014	**1**	0.1	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Copper (filtered)	NA	0.0014	**0.5**	0.1	mg/L	0.001	< 0.001	0.003	< 0.001	0.002	0.003
Iron (filtered)	NA	-	**-**	10	mg/L	0.05	0.11	0.8	0.08	0.18	0.24
Lead (filtered)	NA	0.0034	**0.1**	5	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Manganese (filtered)	NA	1.9	**10**	2.5	mg/L	0.005	0.089	0.33	0.023	0.057	0.12
Mercury (filtered)	NA	0.00006	**0.002**	0.002	mg/L	0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.0001
Nickel (filtered)	NA	0.0275	**1**	2	mg/L	0.001	< 0.001	< 0.001	0.001	0.001	0.001
Zinc (filtered)	NA	0.02	**20**	5	mg/L	0.005	0.006	< 0.005	0.008	0.025	0.025

- indicates no criterion available
LOR = Limit of Reporting
Concentrations below the LOR noted as <value
NOC = No observed contamination
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Australia and New Zealand Environment and Conservation Council (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
ANZECC, NEPM and NHMRC guidelines for mercury are based on total mercury.
[a]EnRiskS (2020) Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW
[b]Recreational criteria adopted are 10 x Australian Drinking Water Gudielines ADWG (2011)
[c]ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
[d]The recreational criteria for aluminium is based on aesthtic issues post flocculation and is not indicative of risks to human health.
Concentrations in blue font exceed human health recreational screening criteria
Concentrations in grey box exceed ecological screening criteria
Concentrations in **bold** exceed irrigation screening criteria
Concentrations in *italics* exceed stockwatering screening criteria

Client: TfNSW
Job No: 3180001376
Project Name: September 2022 Surface Water Monitoring Report
30-09-22

Table 13: QA/QC Assessment

	Sample Type:		Surface Water	Surface Water		Surface Water	Surface Water		Surface Water	Surface Water		Surface Water	Surface Water	
	Duplicate Type:		Intra-Laboratory Duplicate			Intra-Laboratory Duplicate			Intra-Laboratory Duplicate			Intra-Laboratory Duplicate		
	Lab ID		N21-JI30460	N21-JI30461		N21-JI30460	ES2126481001		S22-Se0036866	S22-Se0036876		S22-Se0036866	ES2126481001	
	Sample date:		13-Jul-21	13-Jul-21		13-Jul-21	13-Jul-21		12-Sep-22	12-Sep-22		12-Sep-22	12-Sep-22	
	Sample ID:		SW10	D01_130721		SW10	T01_130721		SW1-UP	D01		SW1-UP	T01	
	Project Name:		Tarago SW Monitoring	Tarago SW Monitoring		Tarago SW Monitoring	Tarago SW Monitoring		Tarago SW Monitoring	Tarago SW Monitoring		Tarago SW Monitoring	Tarago SW Monitoring	
	Project No:		318000780	318000780	**RPD %**	318000780	318000780	**RPD %**	318001376	318001376	**RPD %**	318001376	318001376	**RPD %**
	Sample Location		Tarago Rail Loop	Tarago Rail Loop		Tarago Rail Loop	Tarago Rail Loop		Tarago Rail Corridor	Tarago Rail Corridor		Tarago Rail Corridor	Tarago Rail Corridor	
	Sampling Method:		Grab Sample	Grab Sample		Grab Sample	Grab Sample		Grab Sample	Grab Sample		Grab Sample	Grab Sample	
Analyte grouping/Analyte	**Units**	**LOR**												
Inorganics														
Ammonia (as N)	µg/L	10	-	-	NC	-	-	NC	-	-	-	-	-	-
Ammonium Ion (as N)	µg/L	10	-	-	NC	-	-	NC	-	-	-	-	-	-
Conductivity (at 25@°C)	µS/cm	1	-	-	NC	-	-	NC	-	-	-	-	-	-
Nitrate & Nitrite (as N)	µg/L	50	-	-	NC	-	-	NC	-	-	-	-	-	-
Nitrate (as N)	µg/L	20	-	-	NC	-	-	NC	-	-	-	-	-	-
Nitrite (as N)	µg/L	20	-	-	NC	-	-	NC	-	-	-	-	-	-
pH (at 25@°C)	pH units	0.1	-	-	NC	-	-	NC	-	-	-	-	-	-
Phosphate total (as P)	µg/L	50	-	-	NC	-	-	NC	-	-	-	-	-	-
Total Dissolved Solids Dried at 180°C ± 2°C	mg/L	10	-	-	NC	-	-	NC	-	-	-	-	-	-
Total Kjeldahl Nitrogen (as N)	µg/L	200	-	-	NC	-	-	NC	-	-	-	-	-	-
Total Nitrogen (as N)	µg/L	200	-	-	NC	-	-	NC	-	-	-	-	-	-
Total Suspended Solids Dried at 105°C	mg/L	5	-	-	NC	-	-	NC	-	-	-	-	-	-
Turbidity	NTU	1	-	-	NC	-	-	NC	-	-	-	-	-	-
Total Metals														
Aluminium	mg/L	0.05	< 0.05	< 0.05	NC	< 0.05	0.03	NC	<0.05	<0.05	NC	<0.05	0.04	NC
Arsenic	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Barium	mg/L	0.001	0.07	0.07	0.0	0.07	0.062	12.1	0.05	0.05	0.0	0.05	0.05	0.0
Beryllium	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Cadmium	mg/L	0.0002	< 0.0002	< 0.0002	NC	< 0.0002	0.0001	NC	<0.0002	<0.0002	NC	<0.0002	<0.0001	NC
Chromium	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Cobalt	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Copper	mg/L	0.001	0.002	0.002	0.0	0.002	0.001	**66.7**	<0.001	<0.001	NC	<0.001	<0.001	NC
Iron	mg/L	0.05	0.29	0.3	3.4	0.29	0.27	7.1	0.07	0.07	0.0	0.07	0.07	0.0
Lead	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Manganese	mg/L	0.005	0.066	0.065	1.5	0.066	0.058	12.9	0.01	0.01	0.0	0.01	0.01	0.0
Mercury	mg/L	0.0001	< 0.0001	< 0.0001	NC	< 0.0001	<0.0001	NC	0.0001	<0.0001	NC	0.0001	<0.0001	NC
Nickel	mg/L	0.001	0.002	0.001	**66.7**	0.002	0.002	0.0	<0.001	<0.001	NC	<0.001	<0.001	NC
Zinc	mg/L	0.005	0.032	0.035	9.0	0.032	0.033	3.1	<0.005	<0.005	NC	<0.005	<0.005	NC
Dissolved Metals														
Aluminium (filtered)	mg/L	0.05	< 0.05	< 0.05	NC	< 0.05	<0.01	NC	<0.05	<0.05	NC	<0.05	<0.01	NC
Arsenic (filtered)	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Barium (filtered)	mg/L	0.001	0.06	0.06	0.0	0.06	0.058	3.4	0.05	0.05	0.0	0.05	0.047	6.2
Beryllium (filtered)	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Cadmium (filtered)	mg/L	0.0002	< 0.0002	< 0.0002	NC	< 0.0002	<0.0001	NC	<0.0002	<0.0002	NC	<0.0002	<0.0001	NC
Chromium (filtered)	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Cobalt (filtered)	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Copper (filtered)	mg/L	0.001	0.002	0.002	0.0	0.002	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Iron (filtered)	mg/L	0.05	0.18	0.17	5.7	0.18	0.14	25.0	<0.05	<0.05	NC	<0.05	<0.05	NC
Lead (filtered)	mg/L	0.001	< 0.001	< 0.001	NC	< 0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Manganese (filtered)	mg/L	0.005	0.057	0.056	1.8	0.057	0.055	3.6	0.009	0.009	0.0	0.009	0.008	11.8
Mercury (filtered)	mg/L	0.0001	< 0.0001	< 0.0001	NC	< 0.0001	<0.0001	NC	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Nickel (filtered)	mg/L	0.001	0.001	0.001	0.0	0.001	0.001	0.0	<0.001	<0.001	NC	<0.001	<0.001	NC
Zinc (filtered)	mg/L	0.005	0.025	0.024	4.1	0.025	0.024	4.1	<0.005	<0.005	NC	<0.005	<0.005	NC
Total Recoverable Hydrocarbons - 1999 NEPM Fractions														
TRH C10-C14	µg/L	50	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH C10-C36 (Total)	µg/L	100	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH C15-C28	µg/L	100	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH C29-C36	µg/L	100	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH C6-C9	µg/L	20	-	-	NC	-	-	NC	-	-	-	-	-	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions														
Naphthalene	µg/L	10	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH >C10-C16	µg/L	50	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH >C10-C16 less Naphthalene (F2)	µg/L	50	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH >C10-C40 (total)*	µg/L	100	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH >C16-C34	µg/L	100	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH >C34-C40	µg/L	100	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH C6-C10	µg/L	20	-	-	NC	-	-	NC	-	-	-	-	-	-
TRH C6-C10 less BTEX (F1)	µg/L	20	-	-	NC	-	-	NC	-	-	-	-	-	-
BTEX														
Benzene	µg/L	1	-	-	NC	-	-	NC	-	-	-	-	-	-
Ethylbenzene	µg/L	1	-	-	NC	-	-	NC	-	-	-	-	-	-
m&p-Xylenes	µg/L	2	-	-	NC	-	-	NC	-	-	-	-	-	-
o-Xylene	µg/L	1	-	-	NC	-	-	NC	-	-	-	-	-	-
Toluene	µg/L	1	-	-	NC	-	-	NC	-	-	-	-	-	-
Xylenes - Total	µg/L	3	-	-	NC	-	-	NC	-	-	-	-	-	-

LOR = Limit of Reporting
ND = not calculated as one or more results are below the LOR.
Bold and Shaded cells exceed RPD >30%
Bold indicates when above the acceptance criteria for Trip Spikes/Blanks and Rinsates
Blank Cell indicates not analysed

APPENDIX 4
LABORATORY REPORTS

CHAIN OF CUSTODY RECORD

ABN 50 005 085 521

☑ **Sydney Laboratory** Unit F3 Bld.F, 16 Mars Rd, Lane Cove West, NSW 2066 02 9900 8400 EnviroSampleNSW@eurofins.com

☐ **Brisbane Laboratory** Unit 1, 21 Smallwood Pl., Murarrie, QLD 4172 07 3902 4600 EnviroSampleQLD@eurofins.com

☐ **Perth Laboratory** Unit 2, 91 Leach Highway, Kewdale, WA 6105 08 9251 9600 EnviroSampleWA@eurofins.com

☐ **Melbourne Laboratory** 2 Kingston Town Close, Oakleigh, VIC 3166 03 8564 5000 EnviroSampleVIC@eurofins.com

Company	Ramboll Australia	Project №	318001376	Project Manager	Stephen Maxwell
Address	Level 3, 100 Pacific Highway, North Sydney NSW 2060	Project Name	Tarago Rail Corridor Quarterly Surface Water Investigation	Report Format	EQuIS, excel, PDF
Contact Name	Mitchell MacDonald				
Phone №	0406 123 173				
Special Direction	Hold all non-analysis samples				
Purchase Order	318001376				
Quote ID №					

Sampler(s)	Mitchell MacDonald
Relinquished by	
Email for Invoice	asiapac-accounts@ramboll.com
Email for Results	smaxwell@ramboll.com, mmacdonald@ramboll.com, ngilbert@ramboll.com

Analyses (Where metals are requested, please specify 'Total' or 'Filtered'. SUITE code must be used to attract SUITE pricing.)

№	Client Sample ID	Date	Matrix	Total Metals (Al, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Zn)	Dissolved Metals (Al, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Zn)	Containers: 1L Plastic	250mL Plastic	125mL Plastic	200mL Amber Glass	40mL vial	250mL Glass Jar	200mL white polypropylene jar	Other (60mL Plastic Bottles (Total))	Other (60mL Plastic Bottles (Dissolved))	Sample Comments / DG Hazard Warning
	SW1 - UP	12/09/2022	WG	X	X								X	X	Hold all non analysis samples
	SW1	12/09/2022	WG	X	X								X	X	
	SW2	12/09/2022	WG	X	X								X	X	
	SW3	12/09/2022	WG	X	X								X	X	
	SW4	12/09/2022	WG	X	X								X	X	
	SW6	12/09/2022	WG	X	X								X	X	
	SW7	13/06/2022	WG	X	X								X	X	
	SW8	13/06/2022	WG	X	X								X	X	
	SW9	13/06/2022	WG	X	X								X	X	
	SW10	13/06/2022	WG	X	X								X	X	
	Total Counts			10	10								10	10	

Turn Around Requirements: ☐ Overnight (9am)* ☐ 1 Day* ☐ 2 Day* ☐ 3 Day* ☑ 5 Day ☐ Other ( ) * Surcharges apply

Method of Shipment	☑ Courier (#)	☐ Hand Delivered	☐ Postal	Name		Signature		Date	/ /	Time	:	Time	:
Laboratory Use Only	Received By		SYD | BNE | MEL | PER | ADL | NEW | DAR	Signature		Date	12/9/22	Time	1:28	Temperature	6.0
	Received By		SYD | BNE | MEL | PER | ADL | NEW | DAR	Signature		Date	/ /	Time	:	Report №	924219

CHAIN OF CUSTODY RECORD

ABN 50 005 085 521

☑ **Sydney Laboratory** Unit F3 Bld.F, 16 Mars Rd, Lane Cove West, NSW 2066 02 9900 8400 EnviroSampleNSW@eurofins.com

☐ **Brisbane Laboratory** Unit 1, 21 Smallwood Pl., Murarrie, QLD 4172 07 3902 4600 EnviroSampleQLD@eurofins.com

☐ **Perth Laboratory** Unit 2, 91 Leach Highway, Kewdale, WA 6105 08 9251 9600 EnviroSampleWA@eurofins.com

☐ **Melbourne Laboratory** 2 Kingston Town Close, Oakleigh, VIC 3166 03 8564 5000 EnviroSampleVIC@eurofins.com

Company	Ramboll Australia	Project №	318001376	Project Manager	Stephen Maxwell
Address	Level 3, 100 Pacific Highway, North Sydney NSW 2060	Project Name	Tarago Rail Corridor Quarterly Surface Water Investigation	Report Format	EQuIS, excel, PDF
Contact Name	Mitchell MacDonald				
Phone №	0406 123 173				
Special Direction	Hold all non-analysis samples				
Purchase Order	318001376				
Quote ID №					

Sampler(s): Mitchell MacDonald

Relinquished by: _____

Email for Invoice: asiapac-accounts@ramboll.com

Email for Results: smaxwell@ramboll.com, mmacdonald@ramboll.com, ngilbert@ramboll.com

Analyses (Where metals are requested, please specify "Total" or "Filtered". SUITE code must be used to attract SUITE pricing.)

№	Client Sample ID	Date	Matrix	Total Metals (Al, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Zn)	Dissolved Metals (Al, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Zn)	Containers: 1L Plastic	250mL Plastic	125mL Plastic	200mL Amber Glass	40mL Vial	250mL Glass Jar	200mL white polypropylene jar	Other (60mL Plastic Bottles (Total))	Other (60mL Plastic Bottles (Dissolved))	Sample Comments / DG Hazard Warning
	D01	12/09/2022	WG	X	X								X	X	Hold all non analysis samples
	T01	12/09/2022	WG	X	X								X	X	**Please send to ALS for same analysis**
	Total Counts			2	2								2	2	

Turn Around Requirements

- ☐ Overnight (9am)*
- ☐ 1 Day*
- ☐ 2 Day*
- ☐ 3 Day*
- ☑ 5 Day
- ☐ Other ( )

* Surcharges apply

Method of Shipment	☑ Courier (#)	☐ Hand Delivered	☐ Postal	Name		Signature		Date	___/___/___	Time	___:___
Laboratory Use Only	Received By		SYD | BNE | MEL | PER | ADL | NEW | DAR	Signature		Date	___/___/___	Time	___:___	Temperature	
	Received By		SYD | BNE | MEL | PER | ADL | NEW | DAR	Signature		Date	___/___/___	Time	___:___	Report №	

eurofins | Environment Testing

www.eurofins.com.au EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd

ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South
VIC 3175
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Geelong
19/8 Lewalan Street
Grovedale
VIC 3216
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Sydney
179 Magowar Road
Girraween
NSW 2145
Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

Canberra
Unit 1,2 Dacre Street
Mitchell
ACT 2911
Tel: +61 2 6113 8091

Brisbane
1/21 Smallwood Place
Murarrie
QLD 4172
Tel: +61 7 3902 4600
NATA# 1261 Site# 20794

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Tel: +61 2 4968 8448
NATA# 1261 Site# 25079

Eurofins ARL Pty Ltd

ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool
WA 6106
Tel: +61 8 6253 4444
NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd

NZBN: 9429046024954

Auckland
35 O'Rorke Road
Penrose,
Auckland 1061
Tel: +64 9 526 45 51
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Sample Receipt Advice

Company name:	Ramboll Australia Pty Ltd
Contact name:	Stephen Maxwell
Project name:	TARAGO RAIL CORRIDOR QUARTERLY SURFACE WATER INVESTIGATION
Project ID:	318001376
Turnaround time:	5 Day
Date/Time received	Sep 16, 2022 1:28 PM
Eurofins reference	924219

Sample Information

✓	A detailed list of analytes logged into our LIMS, is included in the attached summary table.
✓	All samples have been received as described on the above COC.
✓	COC has been completed correctly.
✓	Attempt to chill was evident.
✓	Appropriately preserved sample containers have been used.
✓	All samples were received in good condition.
✓	Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
✓	Appropriate sample containers have been used.
✓	Sample containers for volatile analysis received with zero headspace.
✗	Split sample sent to requested external lab.
✗	Some samples have been subcontracted.
N/A	Custody Seals intact (if used).

Notes

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Andrew Black on phone : (+61) 2 9900 8490 or by email: AndrewBlack@eurofins.com

Results will be delivered electronically via email to Stephen Maxwell - smaxwell@ramboll.com.

Note: A copy of these results will also be delivered to the general Ramboll Australia Pty Ltd email address.

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South
VIC 3175
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Geelong
19/8 Lewalan Street
Grovedale
VIC 3216
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Sydney
179 Magowar Road
Girraween
NSW 2145
Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

Canberra
Unit 1,2 Dacre Street
Mitchell
ACT 2911
Tel: +61 2 6113 8091

Brisbane
1/21 Smallwood Place
Murarrie
QLD 4172
Tel: +61 7 3902 4600
NATA# 1261 Site# 20794

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Tel: +61 2 4968 8448
NATA# 1261 Site# 25079

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool
WA 6106
Tel: +61 8 6253 4444
NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland
35 O'Rorke Road
Penrose,
Auckland 1061
Tel: +64 9 526 45 51
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: Ramboll Australia Pty Ltd
Address: Level 3/100 Pacific Highway
North Sydney
NSW 2060

Order No.: 318001376
Report #: 924219
Phone: 02 9954 8118
Fax: 02 9954 8150

Received: Sep 16, 2022 1:28 PM
Due: Sep 20, 2022
Priority: 3 Day
Contact Name: Stephen Maxwell

Project Name: TARAGO RAIL CORRIDOR QUARTERLY SURFACE WATER INVESTIGATION
Project ID: 318001376

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Barium	Barium (filtered)	Beryllium	Beryllium (filtered)	Cadmium	Cadmium (filtered)	Chromium	Chromium (filtered)	Cobalt	Cobalt (filtered)	Copper	Copper (filtered)	Iron	Iron (filtered)	Lead	Lead (filtered)	Manganese	Manganese (filtered)	Mercury	Mercury (filtered)	Nickel	Nickel (filtered)	Zinc	Zinc (filtered)
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																																	
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																												
1	SW1-UP	Sep 12, 2022		Groundwater	S22-Se0036866	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	SW1	Sep 12, 2022		Groundwater	S22-Se0036867	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	SW2	Sep 12, 2022		Groundwater	S22-Se0036868	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	SW3	Sep 12, 2022		Groundwater	S22-Se0036869	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	SW4	Sep 12, 2022		Groundwater	S22-Se0036870	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	SW6	Sep 12, 2022		Groundwater	S22-Se0036871	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	SW7	Jun 13, 2022		Groundwater	S22-Se0036872	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8	SW8	Jun 13, 2022		Groundwater	S22-Se0036873	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
9	SW9	Jun 13, 2022		Groundwater	S22-Se0036874	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	SW10	Jun 13, 2022		Groundwater	S22-Se0036875	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
11	D01	Sep 12, 2022		Groundwater	S22-Se0036876	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test Counts						11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11

Ramboll Environ Australia Pty Ltd
Level 3/100 Pacific Highway
North Sydney
NSW 2060

Attention: **Stephen Maxwell**

Report **924219-W**
Project name TARAGO RAIL CORRIDOR QUARTERLY SURFACE WATER INVESTIGATION
Project ID 318001376
Received Date Sep 16, 2022

Client Sample ID			**SW1-UP**	**SW1**	**SW2**	**SW3**
Sample Matrix			**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**
Eurofins Sample No.			**S22-Se0036866**	**S22-Se0036867**	**S22-Se0036868**	**S22-Se0036869**
Date Sampled			**Sep 12, 2022**	**Sep 12, 2022**	**Sep 12, 2022**	**Sep 12, 2022**
Test/Reference	LOR	Unit				
Heavy Metals						
Aluminium	0.05	mg/L	< 0.05	0.17	< 0.05	0.26
Aluminium (filtered)	0.05	mg/L	< 0.05	< 0.05	< 0.05	0.26
Arsenic	0.001	mg/L	< 0.001	< 0.001	< 0.001	0.002
Arsenic (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	0.001
Barium	0.02	mg/L	0.05	0.06	0.05	0.05
Barium (filtered)	0.02	mg/L	0.05	0.05	0.05	0.05
Beryllium	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Beryllium (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Cadmium	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	0.0016
Cadmium (filtered)	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	0.0015
Chromium	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chromium (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt	0.001	mg/L	< 0.001	< 0.001	< 0.001	0.004
Cobalt (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	0.004
Copper	0.001	mg/L	< 0.001	0.002	< 0.001	0.039
Copper (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	0.033
Iron	0.05	mg/L	0.07	0.94	0.19	1.4
Iron (filtered)	0.05	mg/L	< 0.05	0.16	0.08	0.98
Lead	0.001	mg/L	< 0.001	0.005	< 0.001	0.024
Lead (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	0.012
Manganese	0.005	mg/L	0.010	0.093	0.024	0.24
Manganese (filtered)	0.005	mg/L	0.009	0.048	0.028	0.23
Mercury	0.0001	mg/L	0.0001	0.0001	< 0.0001	0.0001
Mercury (filtered)	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel	0.001	mg/L	< 0.001	< 0.001	< 0.001	0.004
Nickel (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	0.004
Zinc	0.005	mg/L	< 0.005	0.026	0.006	0.34
Zinc (filtered)	0.005	mg/L	< 0.005	0.020	0.021	0.32

Client Sample ID			SW4	SW6	SW7	SW8
Sample Matrix			Groundwater	Groundwater	Groundwater	Groundwater
Eurofins Sample No.			S22-Se0036870	S22-Se0036871	S22-Se0036872	S22-Se0036873
Date Sampled			Sep 12, 2022	Sep 12, 2022	Jun 13, 2022	Jun 13, 2022
Test/Reference	LOR	Unit				
Heavy Metals						
Aluminium	0.05	mg/L	0.28	1.1	0.20	0.09
Aluminium (filtered)	0.05	mg/L	0.32	3.6	0.08	< 0.05
Arsenic	0.001	mg/L	0.002	0.002	0.002	< 0.001
Arsenic (filtered)	0.001	mg/L	0.001	0.002	0.002	< 0.001
Barium	0.02	mg/L	0.05	0.07	0.03	0.07
Barium (filtered)	0.02	mg/L	0.04	0.04	0.03	0.07
Beryllium	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Beryllium (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Cadmium	0.0002	mg/L	0.0015	0.0020	< 0.0002	< 0.0002
Cadmium (filtered)	0.0002	mg/L	0.0013	0.0013	< 0.0002	< 0.0002
Chromium	0.001	mg/L	0.002	0.002	< 0.001	0.002
Chromium (filtered)	0.001	mg/L	< 0.001	0.003	0.001	< 0.001
Cobalt	0.001	mg/L	0.002	0.002	< 0.001	< 0.001
Cobalt (filtered)	0.001	mg/L	0.002	0.001	< 0.001	< 0.001
Copper	0.001	mg/L	0.044	0.068	0.004	0.003
Copper (filtered)	0.001	mg/L	0.037	0.056	0.003	0.003
Iron	0.05	mg/L	1.3	1.9	3.3	0.51
Iron (filtered)	0.05	mg/L	0.91	2.0	2.6	0.23
Lead	0.001	mg/L	0.029	0.022	0.003	< 0.001
Lead (filtered)	0.001	mg/L	0.015	0.010	0.002	< 0.001
Manganese	0.005	mg/L	0.13	0.10	0.040	0.13
Manganese (filtered)	0.005	mg/L	0.12	0.040	0.035	0.12
Mercury	0.0001	mg/L	< 0.0001	0.0001	< 0.0001	< 0.0001
Mercury (filtered)	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel	0.001	mg/L	0.004	0.012	0.002	0.002
Nickel (filtered)	0.001	mg/L	0.004	0.012	0.001	0.001
Zinc	0.005	mg/L	0.29	0.43	0.014	0.029
Zinc (filtered)	0.005	mg/L	0.26	0.25	0.010	0.023

Client Sample ID			SW9	SW10	D01
Sample Matrix			Groundwater	Groundwater	Groundwater
Eurofins Sample No.			S22-Se0036874	S22-Se0036875	S22-Se0036876
Date Sampled			Jun 13, 2022	Jun 13, 2022	Sep 12, 2022
Test/Reference	LOR	Unit			
Heavy Metals					
Aluminium	0.05	mg/L	< 0.05	0.09	< 0.05
Aluminium (filtered)	0.05	mg/L	< 0.05	< 0.05	< 0.05
Arsenic	0.001	mg/L	< 0.001	< 0.001	< 0.001
Arsenic (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001
Barium	0.02	mg/L	0.07	0.07	0.05
Barium (filtered)	0.02	mg/L	0.06	0.07	0.05
Beryllium	0.001	mg/L	< 0.001	< 0.001	< 0.001
Beryllium (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001
Cadmium	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Cadmium (filtered)	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002
Chromium	0.001	mg/L	< 0.001	0.002	< 0.001
Chromium (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001
Cobalt	0.001	mg/L	< 0.001	< 0.001	< 0.001

Client Sample ID			SW9	SW10	D01
Sample Matrix			Groundwater	Groundwater	Groundwater
Eurofins Sample No.			S22-Se0036874	S22-Se0036875	S22-Se0036876
Date Sampled			Jun 13, 2022	Jun 13, 2022	Sep 12, 2022
Test/Reference	LOR	Unit			
Heavy Metals					
Cobalt (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001
Copper	0.001	mg/L	0.003	0.003	< 0.001
Copper (filtered)	0.001	mg/L	0.003	0.003	< 0.001
Iron	0.05	mg/L	0.46	0.53	0.07
Iron (filtered)	0.05	mg/L	0.26	0.24	< 0.05
Lead	0.001	mg/L	< 0.001	< 0.001	< 0.001
Lead (filtered)	0.001	mg/L	< 0.001	< 0.001	< 0.001
Manganese	0.005	mg/L	0.084	0.13	0.010
Manganese (filtered)	0.005	mg/L	0.078	0.12	0.009
Mercury	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001
Mercury (filtered)	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001
Nickel	0.001	mg/L	0.001	0.002	< 0.001
Nickel (filtered)	0.001	mg/L	0.001	0.001	< 0.001
Zinc	0.005	mg/L	0.042	0.031	< 0.005
Zinc (filtered)	0.005	mg/L	0.038	0.025	< 0.005

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Heavy Metals	Sydney	Sep 20, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Heavy Metals (filtered)	Sydney	Sep 20, 2022	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Mercury (filtered)	Sydney	Sep 20, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South
VIC 3175
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Geelong
19/8 Lewalan Street
Grovedale
VIC 3216
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Sydney
179 Magowar Road
Girraween
NSW 2145
Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

Canberra
Unit 1,2 Dacre Street
Mitchell
ACT 2911
Tel: +61 2 6113 8091

Brisbane
1/21 Smallwood Place
Murarrie
QLD 4172
Tel: +61 7 3902 4600
NATA# 1261 Site# 20794

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Tel: +61 2 4968 8448
NATA# 1261 Site# 25079

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool
WA 6106
Tel: +61 8 6253 4444
NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland
35 O'Rorke Road
Penrose,
Auckland 1061
Tel: +64 9 526 45 51
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: Ramboll Australia Pty Ltd
Address: Level 3/100 Pacific Highway
North Sydney
NSW 2060

Order No.: 318001376
Report #: 924219
Phone: 02 9954 8118
Fax: 02 9954 8150

Received: Sep 16, 2022 1:28 PM
Due: Sep 20, 2022
Priority: 3 Day
Contact Name: Stephen Maxwell

Project Name: TARAGO RAIL CORRIDOR QUARTERLY SURFACE WATER INVESTIGATION
Project ID: 318001376

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Barium	Barium (filtered)	Beryllium	Beryllium (filtered)	Cadmium	Cadmium (filtered)	Chromium	Chromium (filtered)	Cobalt	Cobalt (filtered)	Copper	Copper (filtered)	Iron	Iron (filtered)	Lead	Lead (filtered)	Manganese	Manganese (filtered)	Mercury	Mercury (filtered)	Nickel	Nickel (filtered)	Zinc	Zinc (filtered)
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																																	
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																												
1	SW1-UP	Sep 12, 2022		Groundwater	S22-Se0036866	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	SW1	Sep 12, 2022		Groundwater	S22-Se0036867	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	SW2	Sep 12, 2022		Groundwater	S22-Se0036868	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	SW3	Sep 12, 2022		Groundwater	S22-Se0036869	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	SW4	Sep 12, 2022		Groundwater	S22-Se0036870	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	SW6	Sep 12, 2022		Groundwater	S22-Se0036871	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	SW7	Jun 13, 2022		Groundwater	S22-Se0036872	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8	SW8	Jun 13, 2022		Groundwater	S22-Se0036873	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
9	SW9	Jun 13, 2022		Groundwater	S22-Se0036874	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	SW10	Jun 13, 2022		Groundwater	S22-Se0036875	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
11	D01	Sep 12, 2022		Groundwater	S22-Se0036876	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test Counts						11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Heavy Metals							
Aluminium	mg/L	< 0.05			0.05	Pass	
Aluminium (filtered)	mg/L	< 0.05			0.05	Pass	
Arsenic	mg/L	< 0.001			0.001	Pass	
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Barium	mg/L	< 0.02			0.02	Pass	
Barium (filtered)	mg/L	< 0.02			0.02	Pass	
Beryllium	mg/L	< 0.001			0.001	Pass	
Beryllium (filtered)	mg/L	< 0.001			0.001	Pass	
Cadmium	mg/L	< 0.0002			0.0002	Pass	
Cadmium (filtered)	mg/L	< 0.0002			0.0002	Pass	
Chromium	mg/L	< 0.001			0.001	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Cobalt	mg/L	< 0.001			0.001	Pass	
Cobalt (filtered)	mg/L	< 0.001			0.001	Pass	
Copper	mg/L	0.001			0.001	Pass	
Copper (filtered)	mg/L	< 0.001			0.001	Pass	
Iron	mg/L	< 0.05			0.05	Pass	
Iron (filtered)	mg/L	< 0.05			0.05	Pass	
Lead	mg/L	< 0.001			0.001	Pass	
Lead (filtered)	mg/L	< 0.001			0.001	Pass	
Manganese	mg/L	< 0.005			0.005	Pass	
Manganese (filtered)	mg/L	< 0.005			0.005	Pass	
Mercury	mg/L	0.0001			0.0001	Pass	
Mercury (filtered)	mg/L	< 0.0001			0.0001	Pass	
Nickel	mg/L	< 0.001			0.001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Zinc	mg/L	< 0.005			0.005	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
LCS - % Recovery							
Heavy Metals							
Aluminium	%	93			80-120	Pass	
Aluminium (filtered)	%	95			80-120	Pass	
Arsenic	%	103			80-120	Pass	
Arsenic (filtered)	%	102			80-120	Pass	
Barium	%	96			80-120	Pass	
Barium (filtered)	%	95			80-120	Pass	
Beryllium	%	93			80-120	Pass	
Beryllium (filtered)	%	98			80-120	Pass	
Cadmium	%	99			80-120	Pass	
Cadmium (filtered)	%	97			80-120	Pass	
Chromium	%	98			80-120	Pass	
Chromium (filtered)	%	96			80-120	Pass	
Cobalt	%	102			80-120	Pass	
Cobalt (filtered)	%	100			80-120	Pass	
Copper	%	101			80-120	Pass	
Copper (filtered)	%	97			80-120	Pass	
Iron	%	101			80-120	Pass	
Iron (filtered)	%	97			80-120	Pass	
Lead	%	100			80-120	Pass	
Lead (filtered)	%	98			80-120	Pass	

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Manganese			%	97			80-120	Pass	
Manganese (filtered)			%	96			80-120	Pass	
Mercury			%	109			80-120	Pass	
Mercury (filtered)			%	104			80-120	Pass	
Nickel			%	100			80-120	Pass	
Nickel (filtered)			%	97			80-120	Pass	
Zinc			%	99			80-120	Pass	
Zinc (filtered)			%	99			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Heavy Metals				Result 1					
Aluminium (filtered)	N22-Se0026630	NCP	%	88			75-125	Pass	
Arsenic (filtered)	N22-Se0026630	NCP	%	102			75-125	Pass	
Barium (filtered)	N22-Se0026630	NCP	%	91			75-125	Pass	
Beryllium (filtered)	N22-Se0026630	NCP	%	93			75-125	Pass	
Cadmium (filtered)	N22-Se0026630	NCP	%	99			75-125	Pass	
Chromium (filtered)	N22-Se0026630	NCP	%	93			75-125	Pass	
Cobalt (filtered)	N22-Se0026630	NCP	%	97			75-125	Pass	
Copper (filtered)	N22-Se0026630	NCP	%	83			75-125	Pass	
Iron (filtered)	N22-Se0026630	NCP	%	91			75-125	Pass	
Lead (filtered)	N22-Se0026630	NCP	%	93			75-125	Pass	
Manganese (filtered)	N22-Se0026630	NCP	%	93			75-125	Pass	
Mercury (filtered)	N22-Se0026630	NCP	%	84			75-125	Pass	
Nickel (filtered)	N22-Se0026630	NCP	%	92			75-125	Pass	
Zinc (filtered)	N22-Se0026630	NCP	%	100			75-125	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	S22-Se0026704	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Aluminium (filtered)	S22-Se0036866	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Arsenic	S22-Se0026704	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Arsenic (filtered)	S22-Se0036866	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Barium	S22-Se0026704	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Barium (filtered)	S22-Se0036866	CP	mg/L	0.05	0.05	1.0	30%	Pass	
Beryllium	S22-Se0026704	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Beryllium (filtered)	S22-Se0036866	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cadmium	S22-Se0026704	NCP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Cadmium (filtered)	S22-Se0036866	CP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium	S22-Se0026704	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Chromium (filtered)	S22-Se0036866	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt	S22-Se0026704	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt (filtered)	S22-Se0036866	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper	S22-Se0026704	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper (filtered)	S22-Se0036866	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Iron	S22-Se0026704	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Iron (filtered)	S22-Se0036866	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Lead	S22-Se0026704	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Lead (filtered)	S22-Se0036866	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Manganese	S22-Se0026704	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Manganese (filtered)	S22-Se0036866	CP	mg/L	0.009	0.009	<1	30%	Pass	
Mercury	S22-Se0026704	NCP	mg/L	0.0002	0.0002	2.5	30%	Pass	
Mercury (filtered)	S22-Se0036866	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel	S22-Se0026704	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Nickel (filtered)	S22-Se0036866	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc	S22-Se0026704	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Zinc (filtered)	S22-Se0036866	CP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium (filtered)	S22-Se0036867	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Arsenic (filtered)	S22-Se0036867	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Barium (filtered)	S22-Se0036867	CP	mg/L	0.05	0.05	1.1	30%	Pass	
Beryllium (filtered)	S22-Se0036867	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cadmium (filtered)	S22-Se0036867	CP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium (filtered)	S22-Se0036867	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt (filtered)	S22-Se0036867	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper (filtered)	S22-Se0036867	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Iron (filtered)	S22-Se0036867	CP	mg/L	0.16	0.16	<1	30%	Pass	
Lead (filtered)	S22-Se0036867	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Manganese (filtered)	S22-Se0036867	CP	mg/L	0.048	0.050	2.5	30%	Pass	
Mercury (filtered)	S22-Se0036867	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel (filtered)	S22-Se0036867	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc (filtered)	S22-Se0036867	CP	mg/L	0.020	0.018	13	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Andrew Black	Analytical Services Manager
Gabriele Cordero	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

CHAIN OF CUSTODY RECORD

ABN 50 005 085 521

☑ **Sydney Laboratory**
Unit F3 Bld.F, 16 Mars Rd, Lane Cove West, NSW 2066
02 9900 8400 EnviroSampleNSW@eurofins.com

☐ **Brisbane Laboratory**
Unit 1, 21 Smallwood Pl., Murarrie, QLD 4172
07 3902 4600 EnviroSampleQLD@eurofins.com

☐ **Perth Laboratory**
Unit 2, 91 Leach Highway, Kewdale, WA 6105
08 9251 9600 EnviroSampleWA@eurofins.com

☐ **Melbourne Laboratory**
2 Kingston Town Close, Oakleigh, VIC 3166
03 8564 5000 EnviroSampleVIC@eurofins.com

Company	Ramboll Australia	Project №	318001376
Address	Level 3, 100 Pacific Highway, North Sydney NSW 2060	Project Name	Tarago Rail Corridor Quarterly Surface Water Investigation
Contact Name	Mitchell MacDonald	Project Manager	Stephen Maxwell
Phone №	0406 123 173	Report Format	EQuIS, excel, PDF
Special Direction	Hold all non-analysis samples	Sampler(s)	Mitchell MacDonald
Purchase Order	318001376	Relinquished by	
Quote ID №		Email for Invoice	asiapac-accounts@ramboll.com
		Email for Results	smaxwell@ramboll.com; mmacdonald@ramboll.com; ngilbert@ramboll.com

Environmental Division Sydney
Work Order Reference
ES2233470

Telephone : +61-2-8784 8555

№	Client Sample ID	Date	Matrix	Analyses: Total Metals (Al, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Zn)	Analyses: Dissolved Metals (Al, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Ni, Zn)	Containers: 1L Plastic	250mL Plastic	125mL Plastic	200mL Amber Glass	40mL vial	250mL Glass Jar	200mL white polypropylene jar	Other (60mL Plastic Bottles (Total))	Other (60mL Plastic Bottles (Dissolved))
	D01	12/09/2022	WG	X	X								X	X
	I01	12/09/2022	WG	X	X								X	X
	Total Counts			2	2								2	2

Turn Around Requirements

☐ Overnight (9am)*
☐ 1 Day* ☐ 2 Day*
☐ 3 Day* ☑ 5 Day
☐ Other ( )
* Surcharges apply

Sample Comments / DG Hazard Warning

Hold all non analysis samples

Please send to ALS for same analysis

Method of Shipment: ☑ Courier (#) ☐ Hand Delivered ☐ Postal Name Signature

Laboratory Use Only

Received By		SYD | BNE | MEL | PER | ADL | NEW | DAR	Signature	Date ___/___/___	Time ___:___
Received By		SYD | BNE | MEL | PER | ADL | NEW | DAR	Signature	Date ___/___/___	Time ___:___
				Date ___/___/___	Time ___:___

Temperature

Report №

Submission of samples to the laboratory will be deemed as acceptance of Eurofins Terms & Conditions

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **ES2233470**

Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MITCHELL MACDONALD	Contact	: Cez Bautista
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: mmacdonald@ramboll.com	E-mail	: cez.bautista@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: 318001376 Tarago Rail Corridor Quarterly Surface Water Investigation	Page	: 1 of 2
Order number	: 318001376	Quote number	: EB2017ENVIAUS0001 (EN/222)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: Mitchell MacDonald		

Dates

Date Samples Received	: 19-Sep-2022 10:30	Issue Date	: 19-Sep-2022
Client Requested Due Date	: 27-Sep-2022	Scheduled Reporting Date	: **27-Sep-2022**

Delivery Details

Mode of Delivery	: Undefined	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 6.2'C - Ice present
Receipt Detail	: ESKY	No. of samples received / analysed	: 1 / 1

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Sampling date / time	Sample ID	WATER - EG020F Dissolved Metals by ICP/MS	WATER - EG020T Total Metals by ICP/MS (including digestion)	WATER - W-02 8 Metals	WATER - W-02T 8 metals (Total)
ES2233470-001	12-Sep-2022 00:00	T01	✓	✓	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ACCOUNTS PAYABLE		
- A4 - AU Tax Invoice (INV)	Email	AsiaPac-Accounts@Ramboll.com
MITCHELL MACDONALD		
- *AU Certificate of Analysis - NATA (COA)	Email	mmacdonald@ramboll.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	mmacdonald@ramboll.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	mmacdonald@ramboll.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	mmacdonald@ramboll.com
- Chain of Custody (CoC) (COC)	Email	mmacdonald@ramboll.com
- EDI Format - EQUIS_ENVIRON (EQUIS_ENVIRON)	Email	mmacdonald@ramboll.com
- EDI Format - XTab (XTAB)	Email	mmacdonald@ramboll.com
NATALIE GILBERT		
- *AU Certificate of Analysis - NATA (COA)	Email	ngilbert@ramboll.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	ngilbert@ramboll.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	ngilbert@ramboll.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	ngilbert@ramboll.com
- Chain of Custody (CoC) (COC)	Email	ngilbert@ramboll.com
- EDI Format - EQUIS_ENVIRON (EQUIS_ENVIRON)	Email	ngilbert@ramboll.com
- EDI Format - XTab (XTAB)	Email	ngilbert@ramboll.com
STEPHEN MAXWELL		
- A4 - AU Tax Invoice (INV)	Email	smaxwell@ramboll.com

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2233470**	Page	: 1 of 3
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MITCHELL MACDONALD	Contact	: Cez Bautista
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 318001376 Tarago Rail Corridor Quarterly Surface Water Investigation	Date Samples Received	: 19-Sep-2022 10:30
Order number	: 318001376	Date Analysis Commenced	: 23-Sep-2022
C-O-C number	: ----	Issue Date	: 27-Sep-2022 19:46
Sampler	: Mitchell MacDonald		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

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

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

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

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

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

- EG035: Poor matrix spike recovery was obtained for Mercury on sample ES2233276 #2. Confirmed by reanalysis.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	T01	----	----	----	----
				Sampling date / time	12-Sep-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2233470-001	--------	--------	--------	--------
					Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		<0.01	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		<0.001	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L		**0.047**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.008**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.04**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		<0.001	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L		**0.050**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.010**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**0.07**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----

QUALITY CONTROL REPORT

Work Order	: **ES2233470**	Page	: 1 of 5
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MITCHELL MACDONALD	Contact	: Cez Bautista
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 318001376 Tarago Rail Corridor Quarterly Surface Water Investigation	Date Samples Received	: 19-Sep-2022
Order number	: 318001376	Date Analysis Commenced	: 23-Sep-2022
C-O-C number	: ----	Issue Date	: 27-Sep-2022
Sampler	: Mitchell MacDonald		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

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

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 4595949)									
ES2233666-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.040	0.040	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.02	0.02	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
ES2233506-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.080	0.079	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.031	0.030	0.0	0% - 20%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.006	0.006	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.012	0.012	0.0	0% - 50%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.027	0.027	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 4595949) - continued									
ES2233506-001	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 4596041)									
ES2233352-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
ES2233751-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.013	0.012	0.0	0% - 50%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.008	0.008	0.0	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.004	0.004	0.0	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.052	0.052	0.0	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.01	0.01	0.0	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.58	0.58	0.0	0% - 50%
EG035F: Dissolved Mercury by FIMS (QC Lot: 4595950)									
ES2233506-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
ES2233705-003	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 4595979)									
ES2233276-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
ES2233276-011	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 4595949)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	91.6	80.0	116
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	91.5	85.0	114
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	88.5	85.0	115
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	94.2	82.0	110
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	94.6	84.0	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	92.7	85.0	111
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	91.1	82.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	89.9	81.0	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	92.1	83.0	111
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	94.6	82.0	110
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	91.1	82.0	112
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	90.8	81.0	117
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	91.8	82.0	112
EG020T: Total Metals by ICP-MS (QCLot: 4596041)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	97.1	82.0	120
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.8	82.0	114
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	93.9	79.0	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	101	84.0	116
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	99.3	84.0	112
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	98.2	86.0	116
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	97.2	84.0	116
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	98.7	83.0	118
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	97.3	85.0	115
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	98.6	85.0	113
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	97.1	84.0	116
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	97.0	79.0	117
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	97.9	85.0	117
EG035F: Dissolved Mercury by FIMS (QCLot: 4595950)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	90.9	83.0	105
EG035T: Total Recoverable Mercury by FIMS (QCLot: 4595979)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	91.5	77.0	111

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 4595949)							
ES2233506-003	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	92.9	70.0	130
		EG020A-F: Beryllium	7440-41-7	1 mg/L	92.2	70.0	130
		EG020A-F: Barium	7440-39-3	1 mg/L	95.4	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	94.0	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	92.2	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	92.8	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	95.6	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	96.8	70.0	130
		EG020A-F: Manganese	7439-96-5	1 mg/L	94.9	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	92.8	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	93.5	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 4596041)							
ES2233367-001	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	99.2	70.0	130
		EG020A-T: Beryllium	7440-41-7	1 mg/L	93.3	70.0	130
		EG020A-T: Barium	7440-39-3	1 mg/L	100	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	100.0	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	97.4	70.0	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	97.5	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	98.8	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	97.4	70.0	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	99.3	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	97.7	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	97.8	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 4595950)							
ES2233506-002	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	92.7	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 4595979)							
ES2233276-002	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	# 14.3	70.0	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES2233470**	Page	: 1 of 4
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MITCHELL MACDONALD	Telephone	: +61-2-8784 8555
Project	: 318001376 Tarago Rail Corridor Quarterly Surface Water Investigation	Date Samples Received	: 19-Sep-2022
Site	: ----	Issue Date	: 27-Sep-2022
Sampler	: Mitchell MacDonald	No. of samples received	: 1
Order number	: 318001376	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG035T: Total Recoverable Mercury by FIMS	ES2233276--002	Anonymous	**Mercury**	7439-97-6	14.3 %	70.0-130%	**Recovery less than lower data quality objective**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
T01	**12-Sep-2022**	**----**	----	----	**23-Sep-2022**	11-Mar-2023	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
T01	**12-Sep-2022**	**23-Sep-2022**	11-Mar-2023	✓	**23-Sep-2022**	11-Mar-2023	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
T01	**12-Sep-2022**	**----**	----	----	**23-Sep-2022**	10-Oct-2022	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
T01	**12-Sep-2022**	**----**	----	----	**23-Sep-2022**	10-Oct-2022	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

APPENDIX 5
SITE PHOTOGRAPHS

Photo 1: Sample location SW3 on unnamed drainage line adjacent to the rail corridor, facing south-east (12 September 2022)

Photo 2: Close up of sample location SW3 taking field water quality parameters, facing south-east (12 September 2022)

Photo 3: Sample location SW4 on unnamed creek adjacent to the rail corridor, facing south-west towards Tarago Station (12 September 2022)

Photo 4: Undertaking surface water sampling and water quality parameters at sample location SW4 (12 September 2022)

Photo 5: Sample location SW5 adjacent to the rail corridor, facing south-east. Unable to take sample due to the location being dry with very little water (12 September 2022)

Photo 6: Sample location SW7 within a private property adjacent to the rail corridor, facing north-east towards Braidwood Road (13 September 2022)

Photo 7: Undertaking surface water sampling and water quality parameters at sample location SW7 (13 September 2022)

Photo 8: Sample location SW9 within Mulwaree River adjacent to Braidwood Road, facing west (13 September 2022)

Title:	**Tarago Rail Corridor Surface Water Monitoring**	**Approved: SM**	**Project-Nr.: 318001376**	**Date: September 2022**
Site:	**Tarago, NSW**			
Client:	**Transport for New South Wales (TfNSW)**			

Photo 9: Undertaking surface water sampling and water quality parameters at sample location SW9 (13 September 2022)

Photo 10: Sample location SW10 within Mulwaree River, facing east (13 September 2022)

Photo 11: Sample location SW10 within Mulwaree River, facing south-east along the river (13 September 2022)

4. Appendix 4: Ramboll Photographs

Photo 1: Fencing to limit vehicular access to the northern portion of the Tarago Rail Yard including upstream of the middle and northern culverts. 106 Goulburn Street visible in the background provides a reference point.

Photo 2: Signage installed at locations per figures in Appendix 1.

Photo 3: Stabilised sand applied as stockpile capping (top of stockpile)

Photo 4: Stabilised sand applied as stockpile capping (top and eastern side of stockpile)

Photo 5: Stabilised sand applied as stockpile capping (western side of stockpile). Metal sleepers used as weights during initial placement of geofabric marker layer remain partially visible.

Photo 6: Surface water discharging across Boyd Street downstream of the middle culvert was visibly clear.

5. Appendix 5: UGL RL Photographs

FINAL TARAGO CONTAMINATED STOCKPILE CAPPING PHOTOS – FRI 30TH SEP 2022

The following photos were all taken on Friday 29th September following the instruction to provide additional capping/cover where steel sleepers were exposed. They include a before and after photo.

South Eastern Corner – Prior to final application of capping

South Eastern Corner – Post final application of capping

South Eastern Face – Prior to final application of capping

South Eastern Face – Post final application of capping

Central Eastern Face – Prior to final application of capping

Central Eastern Face – Post final application of capping

North Eastern Face – Prior to final application of capping

North Eastern Face – Post final application of capping

North End – Prior to final application of capping

North End – Post final application of capping

North Western Corner – Prior to final application of capping

North Western Corner – Post final application of capping

Central Western Face – Prior to final application of capping

Central Western Face – Post final application of capping

North Western Face – Prior to final application of capping

North Western Face – Post final application of capping

6. Appendix 6: Tarago Lead Management Action Plan

Intended for
Transport for New South Wales

Document type
Management Plan

Date
September 2022

TARAGO LEAD MANAGEMENT ACTION PLAN

RAMBOLL Bright ideas. Sustainable change.

TARAGO LEAD MANAGEMENT ACTION PLAN

Project name	**Tarago Lead Management: Action Plan**
Project no.	**318000780**
Recipient	**Joanne McLoughlin**
Document type	**Management Plan**
Report ref.	**318001376-06**
Description	**The report describes an action plan for interim management of risks from lead ore originating from the rail corridor at Tarago**

Ramboll
Level 18
50 Glebe Road
PO Box 435The Junction
NSW 2291
Australia

T +61 2 4962 5444

https://ramboll.com

Revision Number	Revision	Date	Prepared by	Checked by	Approved by
0	Draft	2/07/2020	S Maxwell	F Robinson	F Robinson
1	Revised draft	24/07/2020	S Maxwell	F Robinson	F Robinson
2	Final	31/07/2020	S Maxwell	F Robinson	F Robinson
3	Draft Update	30/09/2022	S Maxwell	F Robinson	F Robinson
4	Update	7/10/2022	S Maxwell CEnvP (SC) 41184	F Robinson	F Robinson

Ramboll Australia Pty Ltd.
ACN 095 437 442
ABN 49 095 437 442

CONTENTS

1.	**Introduction**	**2**
1.1	Background	2
1.2	Operation of the Action Plan	4
1.3	Objective	4
2.	**Hazard Identification**	**5**
2.1	Contamination within the Corridor	5
2.2	Contamination from the Corridor	5
3.	**Lead Management Strategy**	**6**
4.	**Lead Management Structure**	**8**
4.1	Roles and Responsibilities	8
4.2	Legislative and Regulatory Framework	9
4.3	Periodic Review	9
4.4	Corrective Actions	9
4.5	Record Keeping	9
5.	**Interim Management Measures and Verification Monitoring**	**10**
5.1	Mitigation of offsite contaminant migration	10
5.2	Verification Monitoring	10
5.2.1	Surface Water Monitoring	10
5.2.2	Air Monitoring	12
6.	**Offsite Lead Management**	**13**
6.1	Rainwater Tank Sediment	13
6.2	Dust Inside Buildings	13
6.3	Soil, Sediment and Surface Water	14
7.	**Site Lead Management**	**15**
7.1	Mitigating Onsite Risks	15
7.2	Material Tracking	18
7.3	Stockpile Management	18
7.4	Summary of Interim Monitoring Requirements	19
8.	**Limitations**	**20**
9.	**References**	**21**

APPENDICES

Appendix 1
SafeWork NSW Lead NotifIcation Requirements

Appendix 2
Figures

Appendix 3
Material Tracking Summary Template

GLOSSARY

Term	Description
mg/L	milligrams per Litre
ADWG	Australian Drinking Water Guidelines
ANZECC	Australian and New Zealand Environment and Conservation Council
CRN	Country Regional Network
Metals	As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Fe: Iron, Ni: Nickel, Pb: Lead, Zn:Zinc, Hg: Mercury
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
pH	A measure of acidity, hydrogen ion activity
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
SAQP	Sampling Analysis and Quality Plan
TDS	Total Dissolved Solids
VMP	Voluntary Management Proposal / Plan
-	On tables is "not calculated", "no criteria" or "not applicable"

1. INTRODUCTION

1.1 Background

Ramboll Australia Pty Ltd (Ramboll) was commissioned by Transport for NSW (TfNSW) to revise an Action Plan previously prepared under engagement to John Holland Rail Pty Ltd (Ramboll 2020) for the interim management of lead contamination existing within the rail corridor at Tarago. Lead contaminated ballast within the rail formation and surrounding soils occur within an area of approximately three hectares within the corridor and this area is here-in referred to as "the site" (see **Figure 1**, **Appendix 2**).

1.2 Site Identification

The site locality is shown in **Figure 1, Appendix 2** a site features plan is presented as **Figures 2a – 2e**, **Appendix 2**.

The site details are presented in **Table 1-1.**

Table 1-1: Site Identification

Information	Description
Street Address:	Accessed from Stewart Street and Goulburn Street Tarago NSW
Identifier:	Part Lot 22 DP1202608
Site Area:	Approximately 7.5 ha
Local Government:	Goulburn Mulwaree Shire
Owner:	Transport for NSW
Current Site Use:	Forms part of the Goulburn to Bombala rail line and the Country Regional rail Network (CRN)

1.3 Land Use

The site forms part of the Goulburn – Bombala rail corridor. Review of satellite imagery and site inspection identified land use within the surrounding environment including:

1. Tarago Station (onsite).
1. A residence adjacent (east of) the site and adjacent (north of) Tarago Station. This residence is defined as 106 Goulburn Street Tarago (Lot 1 DP816626 - the Station Masters Cottage) and is known to be impacted by the contamination from the site
2. A residence with a dam that receives waters from the site (during surface water flow), located adjacent (east of) the northern end of site.
3. Tarago Public School approximately 120 m east of the northern end of site.
4. Residences approximately 70 m west of the south end of site and east of Goulburn Street.
5. Tarago Recreation Area approximately 300 m east of site.

1.4 Site History Related to Contamination

Lead and to a lesser extent zinc and copper have been identified in soils within the Goulburn – Bombala rail corridor at Tarago in the vicinity of the former Woodlawn Mines Ore Concentrate Loadout Complex (the Loadout Complex). The load out complex was identified as having been historically located within the rail corridor at this location and investigations have identified lead and to a lesser extent zinc and copper in soils within the corridor.

Ramboll has completed a DSI of the rail corridor to characterise the extent of contamination present. Additional investigation comprising assessment of contamination to surrounding private

and public properties has been completed. Information relating to the site and offsite public land has been presented in the DSI. Private property reports have been presented under separate covers.

In November 2019, based on the investigations completed, the site was notified to the NSW Environment Protection Authority (EPA) under Section 60 of the *Contaminated Land Management Act 1997* (CLM Act) and on 25 March 2020 the NSW EPA declared the site to be significantly contaminated under Section 11 of the CLM Act (Declaration Number: 20201102; Area Number 3455). The site was published on the EPA's list of notified sites as "contamination is regulated by the EPA under the CLM Act". The declaration defines the substance of concern ("the Contaminant") in soil as lead described as follows:

- lead concentrations in soil within the rail corridor (Lot 22 DP1202608) exceed national guideline values for the protection of human health and the environment
- lead contamination has impacted adjacent land at 106 Goulburn Street, Tarago (Lot 1 DP816626), with soil found to contain lead at concentrations exceeding national guideline values for the protection of human health and the environment
- there are complete exposure pathways to lead for occupants of 106 Goulburn Street, as well as potentially complete exposure pathways for persons working within the rail corridor
- there are potentially complete exposure pathways for onsite and offsite ecological receptors.

A voluntary management proposal (VMP) was prepared to define how the Contaminant and associated risks would be managed and this was approved by the NSW EPA on 28 May 2020. Principal Feature 7 of the VMP relates to interim management and defines requirement to develop an Action Plan to define responses to mitigate risks from the Contaminant originating from the Site to offsite receptors.

This Action Plan has been prepared as an interim management measure to minimise exposure pathways to human health and ecology to contamination at or originating from the site until such time as permanent remediation works are completed.

This Action Plan has been prepared in accordance with the relevant legislation and industry standards, with reference to the *Guideline for the Preparation of Environmental Management Plans* (DIPNR 2004), *Preparing environmental management plans for contaminated land practice note* (NSW EPA 2022) and SafeWork NSW guidance.

This Action Plan shall be integrated within UGL management systems as the current manager of the CRN. UGL will be responsible for its implementation.

Development and implementation of this Action Plan is an element of a Voluntary Management Plan agreed to with the NSW EPA and is a legal requirement.

1.5 Topography, Hydrology, Geology and Hydrogeology

The site slopes gently east toward the Mulwaree River consistent with surrounding topography which is characterised by a drainage to the Mulwaree River which flows to the north.

Review of the Australian Geoscience Information Network (AUSGIN) portal (http://portal.geoscience.gov.au/ accessed 8/1/2020) identified regional geology including channel and flood plain alluvium (gravel, sand and clay) locally formed as calcrete overlying quaternary sedimentary rock.

Review of the NSW Department of Planning Industry Environment MinView portal (https://minview.geoscience.nsw.gov.au/) identified 12 wells within a 500 m radius from the site. Review of drilling and construction details for registered wells indicates the shallowest regional aquifer is present in gravel layers from 5.5 – 18.6 mbgl with deeper aquifers present in fractures of underlying shale, siltstone and limestone from 50 – 74 mbgl.

1.6 Operation of the Action Plan

The requirements of this Action Plan apply to lead contamination identified on and from the site and to the maintenance and management of the lead impacted soil stockpile.

This Action Plan will remain in place until a longer-term plan is developed and implemented or until the Site has been remediated and validated.

1.7 Objective

The objective of this Action Plan is to address risks from exposure to lead from the site due to the presence of lead containing ore. Specific actions include:

1. Measures to prevent further offsite migration of contamination via airborne dust or surface water and monitoring to assess the effectiveness of these measures
2. Removal of contaminated sediment from affected rainwater tanks surrounding the site
3. Removal of internal dust from affected buildings surrounding the site
4. Measures to prevent members of the public accessing the site
5. Controls for rail workers accessing the site

The plan does not address other lead sources that may be present on site or in the community, such as lead paint.

2. HAZARD IDENTIFICATION

Lead is known to cause health effects in humans, especially children and developing foetuses. SafeWork NSW recognises that females with childbearing capacity is the most sensitive receptor at work sites. Migration of lead into the environment, soils, groundwater and surface water, may cause environmental harm.

Future disturbance of lead impacted materials present a hazard, which can cause a risk if exposures occur. The main route of human exposure is via inhalation and ingestion of lead dust. Therefore, measures should be aimed at minimising dust generation and exposure at the site. As children and pregnant women are particularly prone to lead related health effects, care should be taken to avoid the spread of lead dust and stop its spread within the surrounding environment.

2.1 Contamination within the Corridor

Ballast within a rail siding, the loop line, mainline and adjacent soils are contaminated with lead and lead impacted spoil was generated during loop extension works. A site specific risk assessment was completed to consider risks associated with lead exposure to rail workers (Ramboll 2019b). A site specific criteria (maximum lead concentrations in soil) of 2,200 mg/kg was recommended to guide protection rail workers following loop extension. Areas remaining after construction works within the rail corridor at Tarago with lead concentrations above 2,200 mg/kg are presented on **Figure 2a – 2e**, **Appendix 2**.

Loop extension works included disturbance of contaminated materials at the site. An estimated total of 750 m^3 of fouled ballast and 50 m^3 of contaminated railway sleepers were excavated during construction. Contaminated railway sleepers have been disposed of at an appropriately licensed waste facility. Stockpiled ballast was observed to be covered with geofabric and stabilised sand (approximately 0.1m thick).

2.2 Contamination from the Corridor

Potential for offsite migration of contamination (lead) from the site has been considered through assessment of lands adjacent the site and (where requested) more broadly within the surrounding area. High lead concentrations arising from the site appear limited to adjacent land and have migrated through surface water and airborne dust. Specific impacts have been identified in soil, surface water, internal dust and sediment within rainwater tanks. Affected property owners have been notified and rectification works are underway.

The main routes of ecological exposure appear to be via dust deposition and overland flow.

3. LEAD MANAGEMENT STRATEGY

Section 17 of the WHS Act requires risks to health and safety be eliminated so far as is reasonably practicable. The SafeWork Australia code of practice for managing risks of hazardous chemicals in workplace provides a hierarchy of control measures. The hierarchy of controls is a framework integrated widely through health and safety planning and has been applied within this Action Plan to define controls for risks associated with lead within both the corridor and the surrounding area. Whilst management of impacts within the corridor are not governed by SafeWork NSW, the same approach to management is appropriate. **Figure 1** below depicts the hierarchy of controls as sourced from SafeWork NSW.

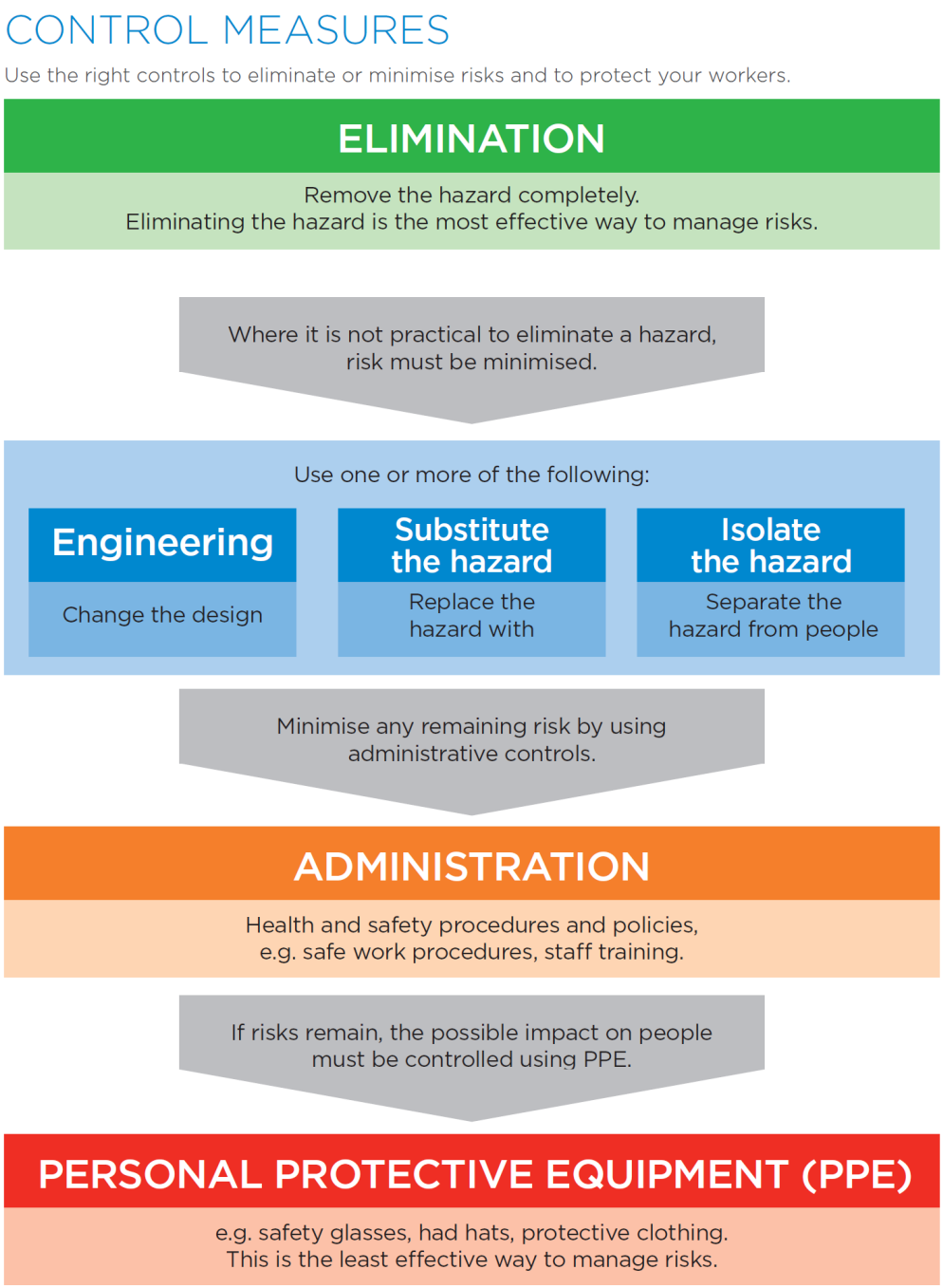


Figure 1: The Hierarchy of Controls (SafeWork NSW 2019)

4. LEAD MANAGEMENT STRUCTURE

4.1 Roles and Responsibilities

TfNSW (and its contractors) have a responsibility for protecting human health and the environment. The key roles and responsibilities for this Action Plan are presented in **Table 4-1**. UGL RL is ultimately responsible for developing a process to ensure this Action Plan is identified and implemented for management of retained contamination within the site.

Table 4-1: Roles and Responsibilities

Role	Responsibility
TfNSW	• To maintain ultimate responsibility for the Action Plan and enable UGL RL to implement it • Undertake all stakeholder management including public display of this Action Plan in accordance with the VMP Principal Feature 7, liaison with regulatory bodies and follow-up of all external complaints • Provision of a copy of this Action Plan to any future purchasers or occupiers of the site and attach a copy of the document to the contract of sale / lease
UGL Regional Linx (UGL RL) (Country Regional Network Contract Holder) Environment Manager –	• To implement this Action Plan including engagement of sub-contractors and consultants as required. This includes responsibility for: o Implementation of measures to prevent further offsite migration of contamination via airborne dust or surface water and monitoring to assess the effectiveness of these measures. These measures are defined further under **Sections 5.1** and **5.2** o Removal of contaminated sediment from affected rainwater tanks surrounding the site. This work is described in further detail under **Section 6.1** o Removal of internal dust from affected buildings surrounding the site. This work is described in further detail under **Section 6.2** o Measures to prevent members of the public accessing the site o Controls for rail workers accessing the site • To ensure that all employees, contractors and consultants that commission or carry out work on the site are aware of the contents of this Action Plan • To ensure compliance to the requirements of this Action Plan through surveillance and monitoring of consultants and contractors • Review effectiveness of this Action Plan following any incident or any other event that suggests this Action Plan is ineffective • Responsible for coordinating revisions and amendments to this Action Plan if site conditions change. Track all management of the revisions and amendments, and ensure amendments are communicated to all stakeholders • Ensure any site workers and contractors engaged at the Site are inducted on the requirements of this Action Plan
All site personnel	• To take reasonable care for their own health and safety and for the health and safety of their co-workers. With specific regard for this Action Plan all workers have a responsibility to implement controls as relevant to their site duties and to report any non-conformances with this plan to the UGL RL Environment Manager.
UGL RL health and safety representative	• Monitor and report (where relevant) on environmental and safety hazards, impacts or improvements to work activities. • Immediate reporting of all non-conformances or complaints or concerns to TfNSW regarding the implementation of this Action Plan • Undertake corrective actions to rectify non-conformances or complaints

Role	Responsibility
Environmental Representative	• Provide advice on environmental issues and incidents as necessary • Undertake monitoring and reporting requirements outlined in this Action Plan[1] • Update this Action Plan as necessary

[1]Action Plan inspections must be completed by a UGL Representative suitably trained and experienced in application and management of erosion and sediment controls including stockpile management.

4.2 Legislative and Regulatory Framework

This Action Plan has been prepared to address the requirements of relevant legislation and codes. The key pieces of legislation applicable to this Action Plan are:

1. NSW Work Health and Safety Act 2011
2. NSW Work Health and Safety Regulation 2017
3. Protection of the Environment Operations Act 1997
4. Protection of the Environment Operations (Waste) Regulation 2014
5. Contaminated Land Management Act 1997

The key codes of practice are:

1. SafeWork NSW Lead Guidance
2. SafeWork Australia Code of Practice Managing Risks of Hazardous Chemicals in the Workplace
3. NSW EPA LeadSmart – Work Smart: Tradespeople and Mining Industry Workers
4. NHMRC Managing Individual Exposure to Lead in Australia – A Guide for Health Practitioners 2016
5. Workplace Exposure Standards for Airborne Contaminants (SafeWork NSW 2018)

4.3 Periodic Review

This Action Plan must be reviewed routinely from date of issue or when:

1. Requested by a health and safety representative from UGL RL
2. Lead containing material is removed, disturbed, sealed or enclosed
3. If monitoring described in **Section 5.2** indicates offsite migration of contaminants is continuing to occur
4. Changes to land use occur
5. When a longer-term lead management plan is in place
6. Where a monitoring detects an exceedance of an exposure scenario
7. At least annually by the UGL RL Environment Manager

4.4 Corrective Actions

Where corrective actions are identified as required to be undertaken by any onsite personnel, these must be communicated to UGL RL. Corrective actions should be administered by the UGL RL Environment Manager. Where the actions relate to breaches in environmental controls, use of PPE and WHS requirements, corrective action must be implemented immediately.

4.5 Record Keeping

UGL RL (or appropriate contractor representative) shall keep records of the inductions, inspections, corrective actions and reports prepared for the Site. These records should be evaluated and used for completing the review of this Action Plan. Records shall be kept for a minimum of 30 years.

5. INTERIM MANAGEMENT MEASURES AND VERIFICATION MONITORING

5.1 Mitigation of offsite contaminant migration

The following interim management measures have been defined to prevent offsite contaminant migration via air borne dust or surface water. These measures shall be implemented until a long term remedial strategy is implemented and validated to have effectively mitigated risks associated with site contamination:

- Areas of contamination identified onsite (as described on the **Figure 2a** – **2e**, **Appendix 2** including the area of indicative contamination and the footprint of the former loadout complex buildings). Specific measures to implement the exclusion zone will include durable signage (similar in construction to public street signage) on 100 lineal meter increments adjacent both sides of the rail formation and on similar spacing to demarcate contamination in adjacent soils. Signage will include:

  DANGER DO NOT ENTER Induction to Tarago Lead Management Action Plan required. Contact the CRN – South Superintendent or Facilities Manager for further information via the CRN UGLRL Hotline: 1300 661 390

  Works within the exclusion zone will largely be limited to temporary stabling of trains on the Loop Line. Train operators must be provided with the Action Plan and advised that if exiting is required within the exclusion zone, controls described in **Section 7.1** must be implemented.

  Works will also include routine inspection of controls described within the Action Plan and could foreseeably include maintenance, emergency or construction works. Such works are centrally controlled though a work scheduling system and induction to the Action Plan has been added as a hold-point for works at Tarago.

  Exclusion zone controls shall be inspected monthly and repaired as required.
- Sediment controls will be installed and maintained in/or adjacent to each rail formation culvert onsite. Sediment controls shall be inspected monthly and after rainfall events (>10mm) in a 24 hour period. A telemetry enabled rain gauge is to be maintained at the site by UGL RL and rainfall data reviewed to identify triggers for inspections.
- Excavation within contaminated areas of the site shall only occur if completed in accordance with provisions defined in **Section 7**.
- Controls for the existing stockpile shall be implemented in accordance with **Section 7.3**.

5.2 Environmental Monitoring

The effectiveness of this Action Plan in preventing for further offsite contaminant migration shall be verified through monitoring of surface water and airborne dust as described in **Section 5.2.1** and **5.2.2** below. Monitoring is to be completed by contaminated land management and air quality specialists suitably qualified and experienced to complete the prescribed monitoring program. Monitoring reports are to be authored reviewed or approved by a site contamination specialist certified as an environmental practitioner under the Environment Institute of Australia and New Zealand CEnvP Scheme. Where verification monitoring indicates offsite contaminant migration continues, corrective actions shall be implemented by UGL RL.

5.2.1 Surface Water Monitoring

Surface water monitoring should occur on a quarterly basis and preferably after rainfall >10mm. Locations to be monitored are presented on **Figure 3**, **Appendix 2**. Field parameters and analyses are described in **Table 5-1**.

.

Table 5-1: Surface Water Analytes

Field Parameters	Metals (filtered and total)
Electrical Conductivity	Aluminium
pH	Arsenic
Total Dissolved Solids	Barium
	Cadmium
	Chromium
	Cobalt
	Copper
	Iron
	Lead
	Manganese
	Mercury
	Nickel
	Zinc

Additional detail for the surface water monitoring program is presented in the Sampling and Analyses Quality Plan (SAQP) presented as **Appendix 5**.

Surface water monitoring will occur until a long term remedial strategy is implemented and validated to have effectively mitigated risks associated with site contamination.

5.2.2 Air Monitoring

Air monitoring will occur including:

- Dust deposition and lead deposition measured continuously throughout each month
- Total suspended particulates (TSP) and lead measured for a 24-hour period completed every one day in six days
- Particulates less than 10 microns in aerodynamic diameter (PM10) and less than 2.5 microns measured continuously throughout each month

An air quality monitoring network was previously established at the locations presented on **Figure 4**, **Appendix 2**. This network is to be re-established at the same locations (or suitable substitutes). Monitoring will assess the performance of dust migration measures by collecting data to inform lead and dust migration rates from the site. Monitoring at these locations is proposed to continue until a long term remedial strategy is implemented and validated to have effectively mitigated risks associated with site contamination. Upward trends of lead in airborne dust will be a trigger to reapplication of polymer and/or other corrective actions to be implemented by UGL RL.

If excavation in lead impacted areas (defined on **Figures 2a –e**, **Appendix 1**) is proposed an onsite air quality monitoring program will be developed specific to the proposed scope of excavation and will include daily monitoring through the use of appropriate instruments.
An SAQP for air quality monitoring is to be prepared before the AQM network is re-established.

6. OFFSITE LEAD MANAGEMENT

Management measures for lead that has migrated from the site within the surrounding area are considered according to potential exposure pathways of:

- Surface water and deposition of sediment entrained in surface water
- Airborne dust deposition in surficial soils, rainwater tank catchments and in buildings.

The source/s of lead offsite remains unclear in some circumstances and the following measures have been designed conservatively to address risks from lead that may reasonably originate from the lead contamination present in the rail corridor.

Management measures described in the following will be undertaken in accordance with specific work methods developed for each activity. Methods will be developed in accordance with relevant environmental legislation, guidelines and regulations.

6.1 Rainwater Tank Sediment

Requirement for TfNSW to remove sediment from rainwater tanks is considered to exist where:

1. Lead concentrations in tank water exceed criteria adopted to assess risks from drinking

   AND/OR

2. Lead concentrations in tank sediment exceed criteria adopted to assess risks from reuse of sediment in a low density residential land use scenario (300 mg/kg) or open space (600 mg/kg – applicable to the Townhall, RFS station, CWA, show ground etc)

   AND

3. Rainwater tanks located within the immediate vicinity of the rail corridor site (notionally 500m)

Interim management will include:

Removal of water and sediment from tanks and refilling with clean water. Provision of a validation letter that documents the rainwater tank is free of significant sediment and water is suitable for use.

6.2 Dust Inside Buildings

Requirement for TfNSW to remove lead containing dust from inside properties is considered to exist where:

1. Dust lead loadings exceed criteria for residential land use (applicable to the houses, the preschool and public school) or open space (applicable to the Townhall, RFS station, CWA, show ground)

   AND

2. The building is located within the immediate vicinity of the rail corridor site (notionally 500m)

Exceptions to this occur where observed lead loadings are considered to likely originate from other sources or where integrated assessment of lead in internal dust and soil indicates risks from exposure to lead are low.

Dust removal measures will be determined based on whether high lead loadings were observed on hard surface floors, carpeted floors and or window sills / shelves on the type of carpet and on the extent of affected areas.

Validation will include sampling of cleaned areas in accordance with the Lead Dust Sampling – Technician Field Guide (US EPA 2009) and assessment of lead loadings against criteria sourced from Protect Your Family from Lead in Your Home (US EPA 2020).

6.3 Soil, Sediment and Surface Water

Further investigation of soil, sediment and surface water will occur where concentrations of lead are above applicable guidelines and/or a risk assessment concludes an unacceptable risk to be present to human health or ecology. Where remediation is required to be carried out remediation will be the subject of separate Remedial Action Plans. Interim actions have been co-ordinated with affected stakeholders.

7. SITE LEAD MANAGEMENT

7.1 Mitigating Onsite Risks

Remediation was recommended to remove lead impacted soils from the Woodlawn Siding and adjacent soils to temporary stockpile as an interim measure before remediation. The loop extension is now complete including all associated requirements for excavation of lead impacted materials.

Future disturbance of lead impacted materials (if/when required) presents a hazard, which can cause a risk if exposures occur. The main route of human exposure is via inhalation and ingestion of lead dust. Therefore, measures should be aimed at minimising dust generation and exposure at the site. As children and pregnant women are particularly prone to lead related health effects, care should be taken to avoid the spread of lead dust and stop its spread to workers homes and premises. SafeWork NSW definitions of lead risk work and associated notification requirements are provided in **Appendix 1**.

All excavation works undertaken within the lead impacted areas identified onsite (as described on the **Figure 2a – 2e, Appendix 2**) are deemed lead risk works and specific work methods developed for these works should include notification to SafeWork NSW of lead risk work unless a Certified Occupational Hygienist is engaged to assess the specific scope of works to be completed and advises that the scope is not lead risk work. Additional hazard mitigation measures are provided in **Table 7-1.**

Table 7-1: General Hazard Mitigation Measures

Category		General Requirements
Exposure abatement	Exclusion zones	Areas of contamination identified onsite (as described on the **Figure 2a – 2e**, **Appendix 2)** will be demarcated as exclusion zones. These areas shall not be utilised as thoroughfares and shall only be accessed by persons inducted to this Action Plan.
	Personal protective equipment (PPE)	Standard rail corridor PPE – full length clothing (sleeves and trousers / overalls), orange high visibility upper clothing or vest, safety (steel capped) boots, protective eyewear, hard hat or hat and gloves at all times. A P2 dust mask must be worn whenever entering lead impacted areas.
	Onsite practices	Use the required PPE whenever inside lead impact areas, prevent vehicular access over contaminated soils (unless a specific work method statement is developed), decontaminate after leaving lead impact areas by removing/washing/cleaning dusty work clothes, boots, shoes, tools, phones, hands/face/any other exposed body area, always wash hands before eating or drinking, eating or drinking to be conducted in a clean dust free location, any dust cleaning to be performed with damp cloth/mop, refrain from smoking or chewing gum when exposure to lead dust is likely, keep finger nails short.
	Offsite practices	Leave shoes, work clothes, work boots outside unless free of site-related dust, if possible shower prior to coming home, keep work gear separate from other clothing and wash separately. Keep baby

Category		General Requirements
		equipment like child car seats etc. out of work vehicle. Discourage family visits to the work place during hazard elimination.
Hazard elimination activity	Excavation (if required) – lead risk activity	If further excavation of lead impacted soils is required excavation shall be completed so that visible airborne dust is not generated. Control measures will include: • Avoidance of dust generating activities during adverse weather conditions (e.g. stop work or modify activities during winds above 30km/hr). A log of wind speeds at the site should be maintained during excavation works. • Application of water on disturbed surfaces and materials such as vehicle routes, stockpiles and excavation areas if dust is visible e.g. through use of a water cart. • Minimise travel speed and distance in the excavation area (e.g. limit light vehicles to 30 km/h and heavy machinery to 8 km/h). • Minimise drop height of material to reduce emissions from loading and unloading activities (e.g. limit drop height to less than 1.5m). • Avoid disturbance of areas stabilised with dust suppressant. • Air monitoring described in **Section 5.2.2** will be undertaken during all works that disturb soils within the Areas of contamination (as described on the **Figure 2a** – **2e**, **Appendix 2)**. The details of this Action Plan shall be communicated to all onsite workers including external contractors, any workers involved shall adhere to requirements set out below.
	Stockpiling	Refer to stockpiling requirements set out in **Section 7.3**
	Facilities	The following facilities are to be provided during lead risk works: • Clean and dust free workers area for eating and drinking • Toilet facilities and wash up areas for decontamination • Disposal of any work-related contaminated material such as dust masks, disposable gloves and overalls, etc.
Workers undertaking excavation within lead impacted areas	Machinery Operators	Whilst inside the cabin of the excavator, wearing of a dust mask is optional if: • Cabin is air conditioned and all windows are up and • Cabin air circulation system (air conditioning) is equipped with high efficiency filter and • Has good seals to eliminate cabin dust intrusion
	Workers outside – assisting excavation	Workers outside the excavator shall be used minimally and on as need basis. These workers shall remain outside a 20m exclusion zone from the excavator, ideally upwind. In addition to a P2 mask, if there is a need to be closer to the excavator (i.e. within 20m exclusion zone), workers shall also wear a Type 5 single use disposable Tyvek suit.

Category		General Requirements
		Workers outside assisting excavation are to be monitored for blood lead levels before and after excavation works as required by SafeWork NSW.
Others	Onsite workers / contractors / train drivers	Any onsite workers shall remain outside lead impacted areas and preferably upwind.
	Public	It is likely that public may be present at certain times at the Tarago train station during further excavation (e.g.: remediation), though noting public time at the station is likely to be less than 30 minutes. UGL RL shall assure no dust is generated within 50m of Tarago Station during excavation of contaminated materials. UGL RL may also wish to consider: • Limiting access to station platform until 10 mins prior to arrival/departure of any passenger trains • Stopping excavation works 10 mins prior to arrival/departure of any passenger trains Implementation of air quality monitoring program

7.2 Material Tracking

All material handled during excavation of lead impacted materials is to be tracked to verify appropriate movement and handling. The system will track materials from cradle-to-grave, and will provide detailed information on the origin, quantity and fate of all materials excavated during remediation. Records will be maintained by construction contractor site personnel defining chainage of origin, material types loaded, and material fate (temporary stockpile ID). These records shall be consolidated digitally according to the tracking spreadsheet attached as **Appendix 3**.

7.3 Stockpile Management

Lead contaminated material excavated during the extension works has been consolidated in a stockpile near to the rail alignment and in a manner to minimise human and environmental exposure. The stockpiles comprise in total approximately 750 m^3 of fouled ballast.

All workers undertaking future stockpiling or remedial activities outside of the excavator are to adhere to specific requirements set out in **Table 7-1**. The following stockpiling requirements are nominated to manage any human exposure or environmental migration of lead contaminated material that is excavated to stockpile:

- All stockpiles of lead contaminated materials are to be placed away from drainage lines, gutters or storm water pits or inlets
- All stockpiles of lead contaminated materials are to be covered securely ensuring that surface water infiltration cannot occur and that the cover is not disturbed or blown away under windy conditions
- All stockpiles of lead contaminated materials are to be stored in secure areas and sign posted to ensure the stockpile is not inadvertently moved or uncovered, e.g., 'Contaminated Stockpile – DO NOT MOVE OR UNCOVER. Contact [name and phone number of contact].' The objective of this is to ensure tracking of contaminated material is maintained and to prevent increased exposure risks from stockpiled contaminants
- Stockpiles are to be positioned on level surfaces to the extent practicable. If stockpiles cannot be positioned on level surfaces construction of bunds to control ingress/egress of surface water at the base of stockpiles shall occur
- Stockpiles are to be constructed in low elongated mounds to the extent practicable; and
- Stockpile management is to continue as described above until a long-term management plan is put in place.

Once stockpiles are complete, inspection of the stockpile is to be undertaken to ensure the above controls remain in place. Monitoring of stockpile management measures shall occur monthly and after rainfall events (>10mm in 24 hour period) and shall include inspection of the integrity of stockpile cover.

In the event that inspections identify rectification works are required to reinstate stockpile controls these rectification works are to be undertaken in a timely manner to avoid risk to the community or the environment occurring.

7.4 Summary of Interim Monitoring and Verification Requirements

As outlined in this plan, monitoring is required until a permanent remediation solution is identified. A summary of the monitoring requirements is outlined in **Table 7-2.**

Table 7-2: Summary of interim monitoring requirements

Element	Frequency	Reference
Dust suppression	Monthly and after >10 mm of rainfall in a 24 hour period	Section 5.1
Surface water	Quarterly	Section 5.2.1
Air Quality	Various	Section 5.2.2
Stockpile	Monthly and after >10 mm of rainfall in a 24 hour period	Section 7.3

Monitoring to ensure that the controls described within this plan are maintained will occur according on a monthly basis or after >10mm rainfall in a 24 hour period and will include completion of the checklist presented as **Appendix 4**.

8. LIMITATIONS

This document is issued in confidence to Transport for New South Wales for the purposes of informing management of risks associated with identified lead contamination on or originating from the rail corridor at Tarago NSW. It is understood that Transport for New South Wales will use this document to communicate with UGL RL controls for management of contamination at the Tarago Rail Yard. Ramboll extends reliance to the NSW EPA and UGL RL for these purposes. It should not be used for any other purpose.

Whilst reasonable attempts have been made to ensure that the contents of this report are accurate and complete at the time of writing, Ramboll Australia Pty Ltd disclaims any responsibility for loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this report.

9. REFERENCES

Department of Environment Climate Change and Water (2009) *NSW Waste Classification Guidelines*

Department of Infrastructure, Planning and Natural Resources (2004) *Guideline for the Preparation of Environmental Management Plans*

NHMRC *Managing Individual Exposure to Lead in Australia – A Guide for Health Practitioners 2016*

NSW EPA *LeadSmart – Work Smart: Tradespeople and Mining Industry Workers* *http://leadsmart.nsw.gov.au/wp-content/uploads/2016/09/LeadSmart-Brochure-Working.pdf*

NSW EPA (2022) Preparing environmental management plans for contaminated land practice note *www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/22p3473-emps-for-contaminated-land-practice-note.pdf?la=en&hash=CBC7F6F0E1997C8B5229A83A2407AEC7F7E5E31B* accessed 11/04/2022.

Ramboll (2019a) *Tarago Loop Extension, Further Intrusive Assessment and Lead Management Plan', prepared for John Holland Rail Rev 3 11/09/2019*

Ramboll (2019b) *Tarago Loop Extension Preliminary HHRA Rev 1 17/10/2019*

Ramboll (2019c) *Tarago Loop Extension, Short Term Lead Management Plan Rev 3 11/09/2019*

Ramboll (2020) *Tarago Lead Management Action Plan Rev 2*

SafeWork NSW *https://www.safework.nsw.gov.au/notify-safework/lead-notifications*

SafeWork NSW (2016*) NSW Code of Practice Managing Risks of Hazardous Chemicals in the Workplace*

SafeWork Australia (2018) *Workplace Exposure Standards for Airborne Contaminants*

APPENDIX 1
SAFEWORK NSW LEAD NOTIFICATION REQUIREMENTS

SafeWork NSW Lead Risk Definition

Lead risk work involves work that may cause lead levels in a worker's blood to exceed health limits.
'Lead risk work' means:

- 5 µg/dL (0.24 µmol/L) for a female of reproductive capacity
- 20 µg/dL (0.97 µmol/L) in other cases.

SafeWork NSW Notifications

Notification must be provided if the work is likely to cause lead levels in a worker's blood to exceed healthy levels. Notification is also needed if a worker needs to be removed from working with lead.

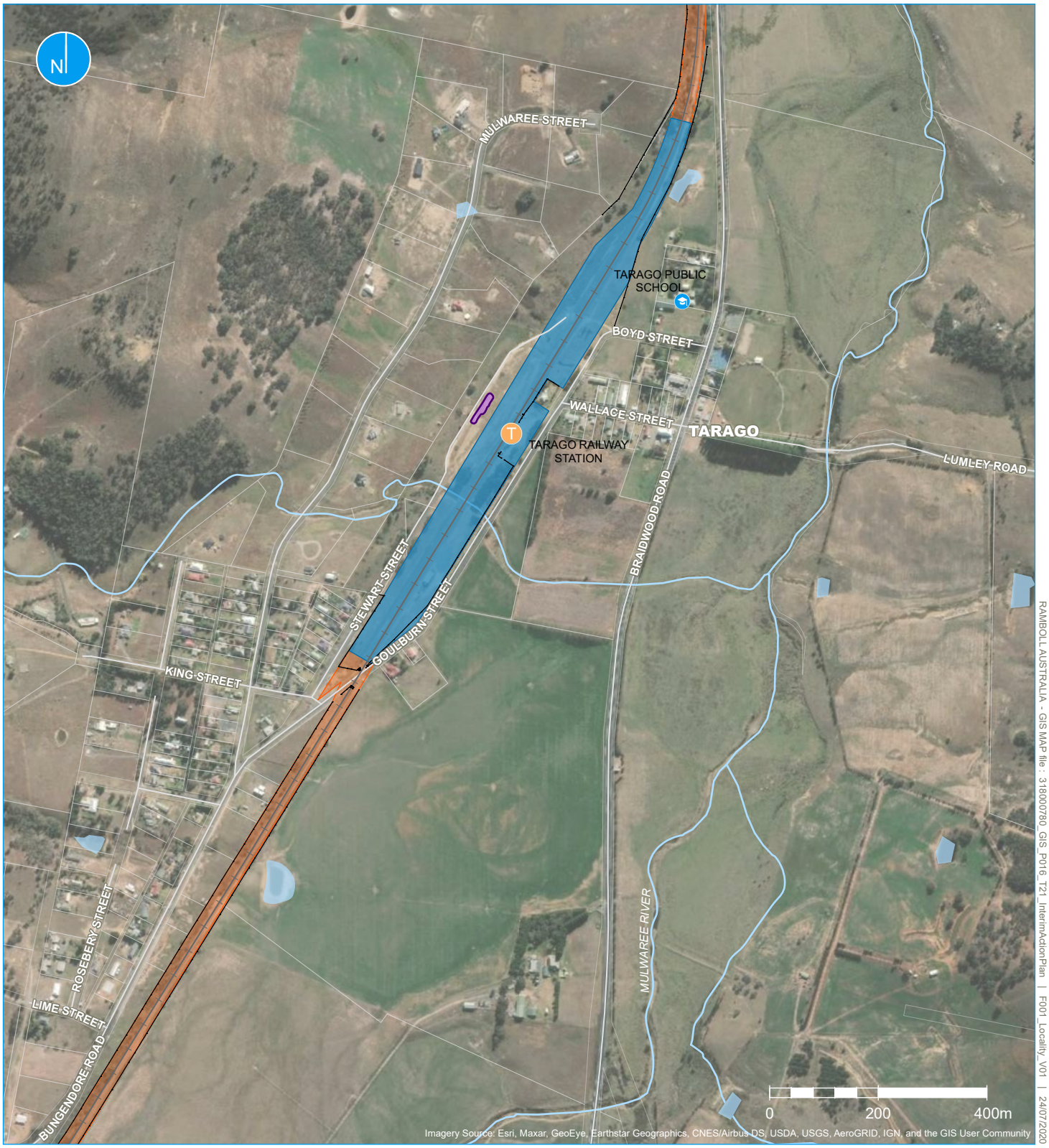
Notification for lead risk work

SafeWork NSW states the following:
You must assess each process that involves lead to determine whether lead risk work is being carried out.
If you cannot determine whether lead risk work is being carried out, then assume it is and notify us.
Submit the Notification of lead risk work form at least seven days before lead work begins. Each form is valid for the duration of the lead risk work.
You need to notify us if a worker needs to be removed from working with lead.
More information on this can be found in the legislation as well as in our Guide on lead notifications. https://www.safework.nsw.gov.au/resource-library/licence-and-registrations/guide-for-applicants-for-lead-notifications
All lead notifications are free.

Health Monitoring

SafeWork NSW states that:
Health monitoring must be provided to workers before lead risk work starts and one month after starting.
For workers who perform ongoing lead work, biological monitoring must be arranged in accordance with the frequencies published in the WHS Regulation.
Additional guidance can be found at https://www.safework.nsw.gov.au/notify-safework/lead-notifications

APPENDIX 2
FIGURES



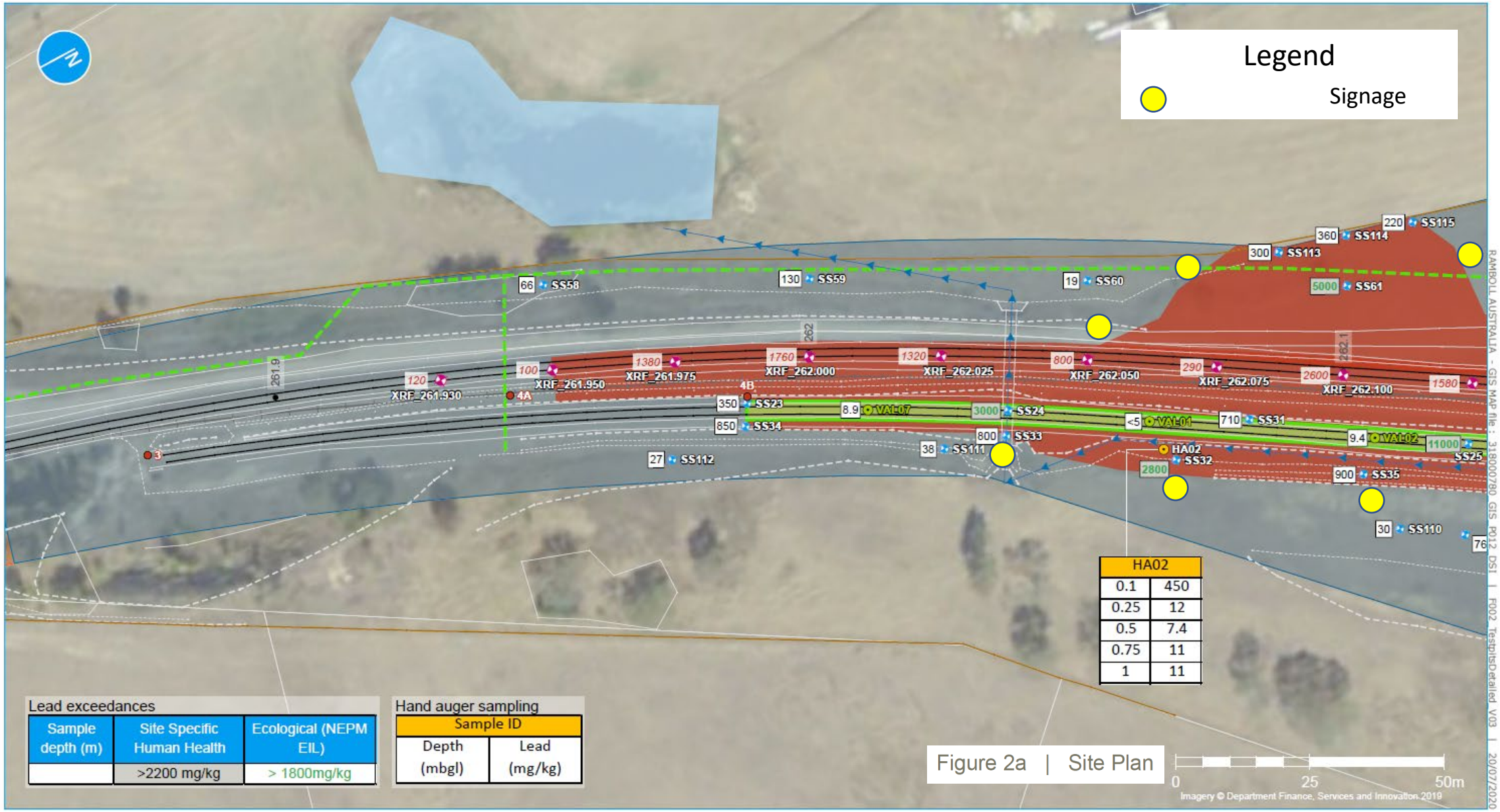
RAMBOLL AUSTRALIA - GIS MAP file : 318000780_GIS_P016_T21_InterimActionPlan | F001_Locality_V01 | 24/07/2020

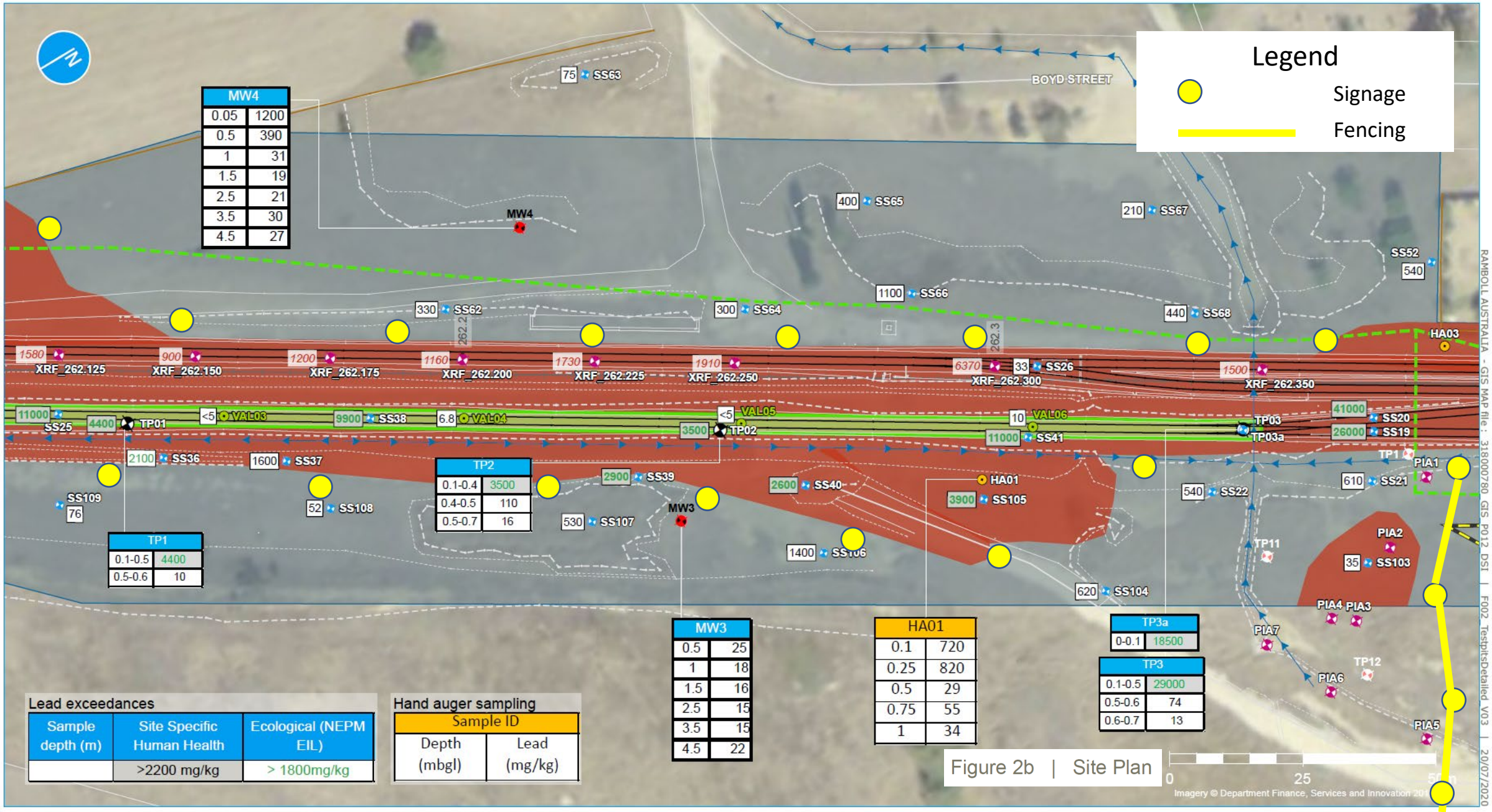
Legend

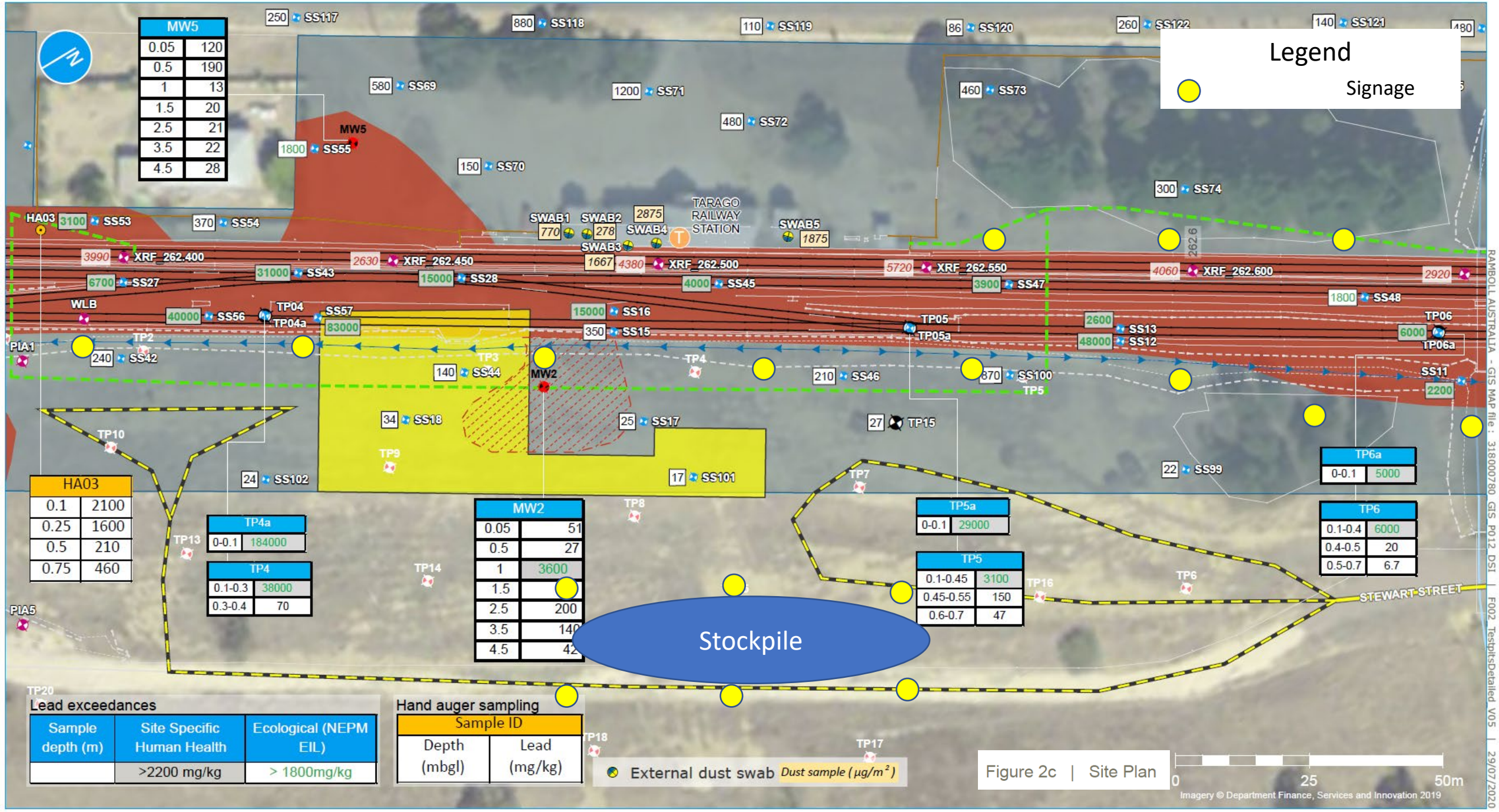
- Site boundary
- Approximate location of contaminated stockpile
- Rail corridor
- Rail corridor fence

A4
1:10,000

Figure 1 | Locality Plan


Legend
Signage
66 SS58
130 SS59
19 SS60
220 SS115
360 SS114
300 SS113
5000 SS61
120 XRF_261.930
100 XRF_261.950
1380 XRF_261.975
1760 XRF_262.000
1320 XRF_262.025
800 XRF_262.050
290 XRF_262.075
2600 XRF_262.100
1580
4A
4B
350 SS23
8.9 VAL07
3000 SS24
<5 VAL01
710 SS31
9.4 VAL02
11000 SS25
850 SS34
800 SS33
38 SS111
HA02
SS32
2800
900 SS35
27 SS112
30 SS110
76
261.9
262
262.1
HA02
0.1 450
0.25 12
0.5 7.4
0.75 11
1 11
Lead exceedances
Sample depth (m)
Site Specific Human Health
Ecological (NEPM EIL)
>2200 mg/kg
> 1800mg/kg
Hand auger sampling
Sample ID
Depth (mbgl)
Lead (mg/kg)
Figure 2a | Site Plan
0
25
50m
Imagery © Department Finance, Services and Innovation 2019
RAMBOLL AUSTRALIA - GIS MAP file : 318000780 GIS P012 DSI | F002 TestpitsDetailed V03 | 20/07/2020


Legend
Signage
Fencing
BOYD STREET
MW4
0.05 1200
0.5 390
1 31
1.5 19
2.5 21
3.5 30
4.5 27
TP1
0.1-0.5 4400
0.5-0.6 10
TP2
0.1-0.4 3500
0.4-0.5 110
0.5-0.7 16
MW3
0.5 25
1 18
1.5 16
2.5 15
3.5 15
4.5 22
HA01
0.1 720
0.25 820
0.5 29
0.75 55
1 34
TP3a
0-0.1 18500
TP3
0.1-0.5 29000
0.5-0.6 74
0.6-0.7 13
Lead exceedances
Sample depth (m)
Site Specific Human Health
Ecological (NEPM EIL)
>2200 mg/kg
> 1800mg/kg
Hand auger sampling
Sample ID
Depth (mbgl)
Lead (mg/kg)
Figure 2b | Site Plan
0
25
Imagery © Department Finance, Services and Innovation 20
RAMBOLL AUSTRALIA - GIS MAP file : 318000780 GIS P012 DSI | F002 TestpitsDetailed V03 | 20/07/2020


Legend
Signage
MW5
0.05 120
0.5 190
1 13
1.5 20
2.5 21
3.5 22
4.5 28
HA03
0.1 2100
0.25 1600
0.5 210
0.75 460
TP4a
0-0.1 184000
TP4
0.1-0.3 38000
0.3-0.4 70
MW2
0.05 51
0.5 27
1 3600
1.5
2.5 200
3.5 140
4.5 42
TP5a
0-0.1 29000
TP5
0.1-0.45 3100
0.45-0.55 150
0.6-0.7 47
TP6a
0-0.1 5000
TP6
0.1-0.4 6000
0.4-0.5 20
0.5-0.7 6.7
Stockpile
STEWART STREET
TARAGO RAILWAY STATION
Lead exceedances
Sample depth (m) | Site Specific Human Health | Ecological (NEPM EIL)
>2200 mg/kg | > 1800mg/kg
Hand auger sampling
Sample ID
Depth (mbgl) | Lead (mg/kg)
External dust swab Dust sample (µg/m²)
Figure 2c | Site Plan
0 25 50m
Imagery © Department Finance, Services and Innovation 2019
RAMBOLL AUSTRALIA - GIS MAP file : 318000780_GIS_P012_DSI | F002_TestpitsDetailed_V05 | 29/07/2020

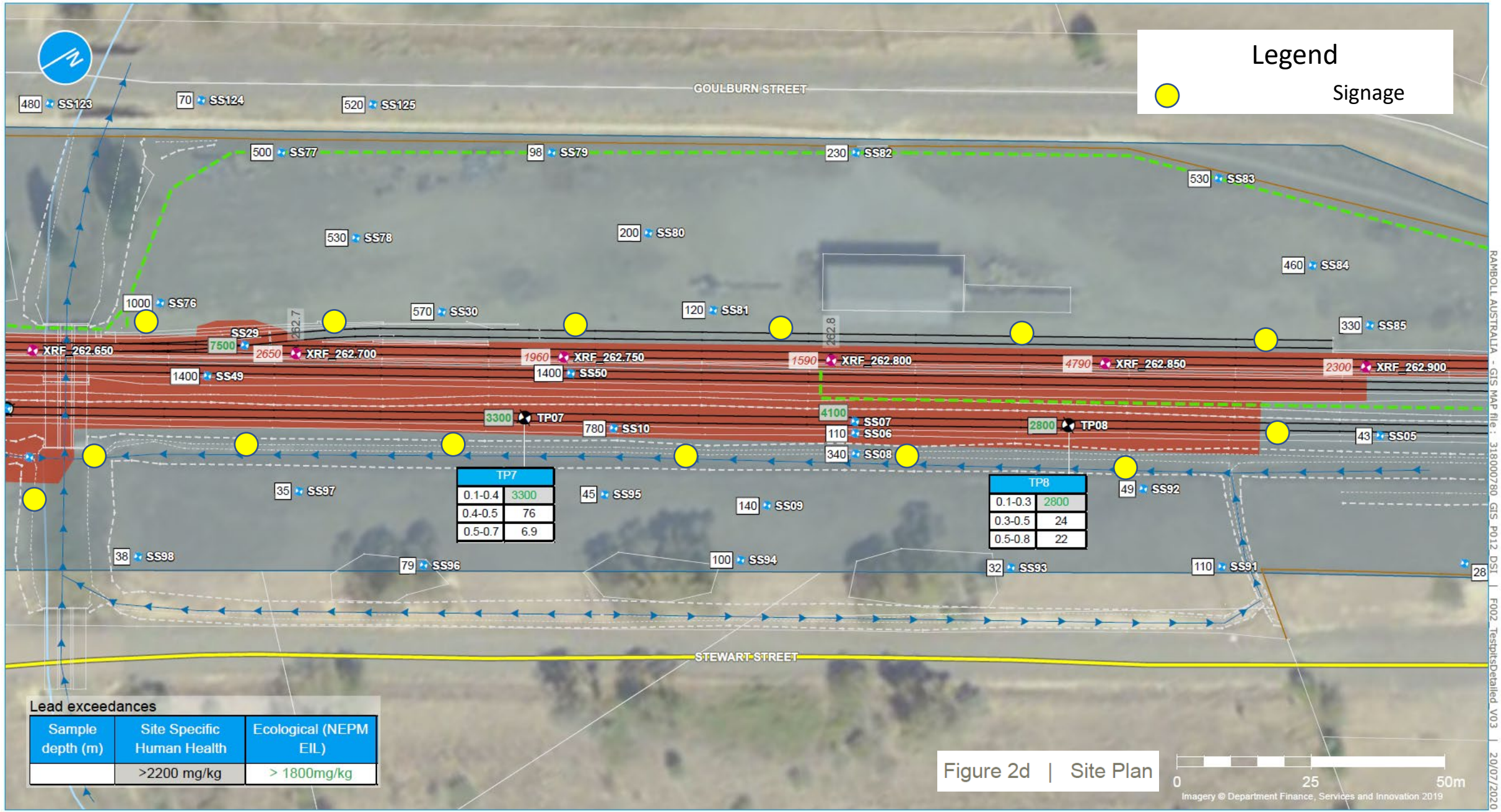
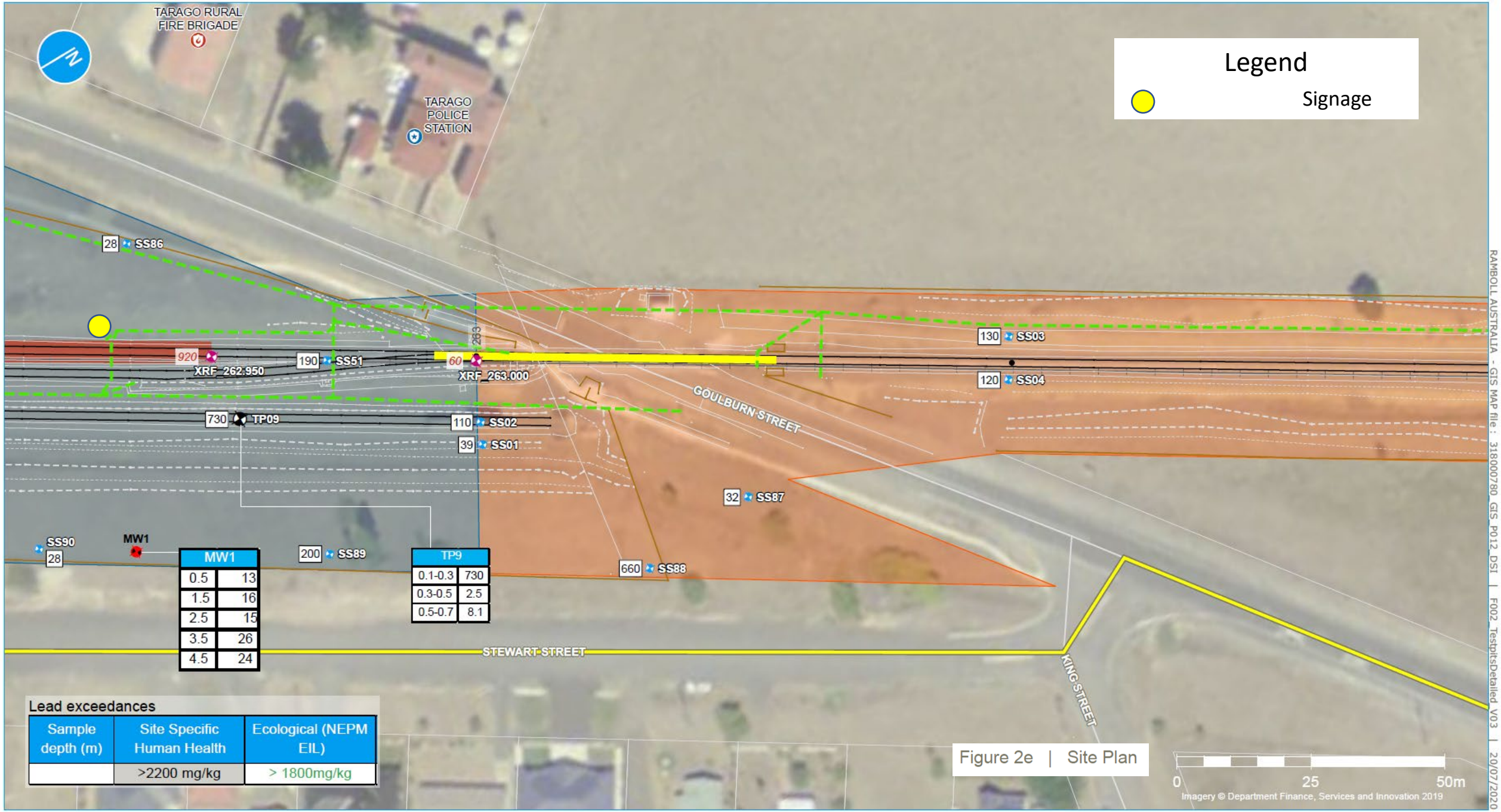


Figure 2d | Site Plan


TARAGO RURAL FIRE BRIGADE
TARAGO POLICE STATION
Legend
Signage
28 SS86
920 XRF_262.950
190 SS51
60 XRF_263.000
262
730 TP09
110 SS02
39 SS01
130 SS03
120 SS04
GOULBURN STREET
32 SS87
660 SS88
200 SS89
SS90 28
MW1
MW1
0.5 13
1.5 16
2.5 15
3.5 26
4.5 24
TP9
0.1-0.3 730
0.3-0.5 2.5
0.5-0.7 8.1
STEWART STREET
KING STREET
Lead exceedances
Sample depth (m)
Site Specific Human Health
Ecological (NEPM EIL)
>2200 mg/kg
> 1800mg/kg
Figure 2e | Site Plan
0
25
50m
Imagery © Department Finance, Services and Innovation 2019
RAMBOLL AUSTRALIA - GIS MAP file : 318000780_GIS_P012_DSI | F002_TestpitsDetailed_V03 | 20/07/2020

RAMBOLL AUSTRALIA - GIS MAP file - 318000780_GIS_P018_T22_RAPs_02_RAP_RailCorridor | F003_SurfaceWaterSamples_V01 | 13/04/2021

A4
1:10,000

Legend

- Surface water sampling location
- Rail corridor
- Rail corridor fence
- Area of lead exceedance (within rail corridor)
- Indicative surface water flow path (ie: not ephemeral)
- Indicative ephemeral surface water flow path

Figure 2-1: Surface Water Monitoring Locations

RAMBOLL AUSTRALIA - GIS MAP file : 318000780_GIS_P012_DSI | F004_AQMLocality_V03 | 29/06/2020

A4
1:5,000

Legend

- Site boundary
- Rail corridor
- Rail corridor fence
- Area of lead contamination within the rail corridor

Sampling locations

- Deposited dust and lead (from dust deposition guage)
- TSP and lead (from high volume air samper)
- Continuous PM10 and PM2.5 (from particle counter)
- Regional meteorological monitoring from DPIE Air quality monitoring station (see location inset)

Figure 4 | Air quality monitoring locations

APPENDIX 3
MATERIAL TRACKING SUMMARY TEMPLATE

Client: John Holland Rail

Project Name: Tarago Rail Corridor Lead Management

31-07-20

Material Tracking Summary

Material Source	Vehicle Registration	Tranpsort Company	Waste Type	Waste Classification	Time Excavated	Date Excavated	Destination	Weighbridge Time	Weighbridge Date	Docket #	Net Weight (t)

Notes

Material source and destination (if onsite) should be defined with reference to a 10 x 10m site grid refernce such that the insitu contaminant characterisation can inform waste management.

This material tracking summary will be miantained digitally.

APPENDIX 4
ROUTINE MONITORING CHECKLIST

Tarago Action Plan Routine Inspection Checklist

Date:	UGL RL Environmental Representative completing inspection[1]:
Start time:	
Finish time:	
Weather:	
BoM	
Date and volume of maximum rainfall in a 24hr period since last inspection?	
Date:	
Max volume (mm) in 24hr period:	
General Site Observations	
Is airborne dust from site evident?	
Is sediment run-off evident that is not captured by sediment controls?	
Is surface water discharging from site?	
Is there evidence of excavation or other works non-compliant with the Action Plan?	
Other observations?	

[1]Action Plan inspections must be completed by a UGL Representative suitably trained and experienced in application and management of erosion and sediment controls including stockpile management.

Plan Ref	Control	Inspection		Corrective Action
		Yes	No	
5.1	Is Exclusion Zone signage present as recommended on Figures 2a - 2e Appendix 1 to demarcate contamination in the rail formation and adjacent soils?			
	Is Exclusion Zone signage undamaged?			
	Are sediment controls present in/adjacent each rail culvert?			
	If sediment is present what is the estimated depth of sediment?			
	Are sediment controls still functional?			
	Is the existing stockpile covered securely to prevent surface water infiltration?			
	Are there signs of cracking, erosion, sediment run-off or vegetation on or relating to the existing stockpile?			
7.3	Have any additional stockpiles of contaminated material been created?			
	Are additional stockpiles placed away from drainage lines, gutters, stormwater pits or inlets?			
	Are stockpiles covered securely to prevent surface water infiltration?			
	Are stockpiles positioned on level surfaces with construction of bunds to control water ingress / egress.			

[1]Action Plan inspections must be completed by a UGL Representative suitably trained and experienced in application and management of erosion and sediment controls including stockpile management.

APPENDIX 5
SURFACE WATER MONITORIUNG SAQP

Intended for
Transport for New South Wales

Document type
Plan

Date
October 2022

Project Number
Sampling Analysis and Quality Plan (SAQP) – Surface Water Monitoring

SAMPLING ANALYSIS AND QUALITY PLAN (SAQP) – SURFACE WATER MONITORING

TARAGO LEAD MANAGEMENT

RAMBOLL Bright ideas. Sustainable change.

TARAGO LEAD MANAGEMENT
SAMPLING ANALYSIS AND QUALITY PLAN (SAQP) – SURFACE WATER MONITORING

Project name	**Tarago Lead Management**
Project no.	**318001376-T6-A1**
Recipient	**Joanne McLoughlin - Transport for New South Wales** **E: Joanne.Mcloughlin@transport.nsw.gov.au**
Document type	**Plan**
Version	**1**
Date	**7/10/2022**
Prepared by	**Stephen Cadman/Jordyn Kirsch**
Checked by	**Stephen Maxwell**
Approved by	**Fiona Robinson**
Description	**This document comprises the Sampling Analysis and Quality Plan (SAQP) for surface water monitoring associated with management of lead contamination from the Tarago rail corridor.**

Ramboll
Level 2, Suite 18 Eastpoint
50 Glebe Road
PO Box 435
The Junction
NSW 2291
Australia

T +61 2 4962 5444
https://ramboll.com

Revision	Date	Prepared by	Checked by	Approved by
0	Draft	6/08/2020	S Maxwell	F Robinson
1	Revised draft	7/10/2022	S Maxwell CEnvP (SC) 41184	F Robinson

Ramboll Australia Pty Ltd.
ACN 095 437 442
ABN 49 095 437 442

CONTENTS

1.	**INTRODUCTION**	**1**
1.1	Preamble	1
1.2	Background	1
1.3	Regulation	1
1.4	Objective	1
2.	**SITE IDENTIFICATION**	**2**
3.	**REGULATORY REQUIREMENTS**	**3**
4.	**SUMMARY OF CONCEPTUAL SITE MODEL**	**4**
5.	**ASSESSMENT CRITERIA**	**5**
5.1	Rationale for Application of Guidelines	5
6.	**DATA QUALITY OBJECTIVES**	**8**
6.1	Step 1: State the problem	8
6.1.1	Contaminants of Concern	8
6.2	Step 2: Identify the decisions / goal of the study	8
6.3	Step 3: Identify the information inputs	8
6.4	Step 4: Definition of the Study Boundary	9
6.5	Step 5: Develop the decision rules or analytical approach	9
6.6	Step 6: Specify the performance or acceptance criteria	9
6.6.1	The tolerable limits on decision errors are as follows:	9
6.6.2	Evaluation of Analytical Data	10
6.7	Step 7: Develop a plan for obtaining data	12
7.	**SAMPLING PLAN**	**13**
7.1.1	Water Quality Monitoring Performance Criteria	13
8.	**REPORTING**	**15**
9.	**REFERENCES**	**16**

LIST OF TABLES

Table 2-1: Site Identification 2

Table 4-1 Conceptual Site Model Summary 4

Table 5-1: Hardness Corrections for Tier 1 Freshwater Ecology Guidelines 6

Table 5-2: Guidelines Applied to Sampling Points 6

Table 5-3: Guideline Criteria (mg/L) 7

Table 7-1 Performance Criteria 13

APPENDICES

Appendix 1

Figures

1. INTRODUCTION

1.1 Preamble

Ramboll Australia Pty Ltd (Ramboll) was engaged by Transport for NSW (TfNSW) to complete periodic surface water monitoring upstream and downstream of contamination within the Goulburn – Bombala rail corridor at Tarago, New South Wales, Australia.

1.2 Background

The site is identified as part Lot 22 Deposited Plan (DP) 1202608 and is located in Tarago, NSW. The site occupies an area of approximately three hectares and is located approximately 32 km south of Goulburn.

The Woodlawn Mines Ore Concentrate Load-Out Complex operated within the Goulburn – Bombala rail corridor at Tarago from the 1970s – 1990s. Concentrates were produced at the Woodlawn Mine approximately 6.5 km west and included a zinc concentrate consisting mainly of sphalerite (zinc sulphide), a lead concentrate of galena (lead sulphide) and copper concentrates of chalcopyrite (copper iron sulphide).

An extensive body of work has been completed to characterise contaminant impacts associated with historic operation of the site. This work has included assessment of soil, groundwater and surface water across the site and assessment of soil, groundwater, surface water and airborne dust within the surrounding area. Recent assessments identified contaminants within approximately 900 lineal meters of the rail formation at Tarago. This area is herein referred to as the 'site' and is presented on **Figure 1**, **Appendix 1**.

Offsite discharge of surface water appears to be generally related to three culverts which pass beneath the rail formation onsite. Contaminants of potential concern (CoPC) relevant to receiving surface waters appear limited to metals (aluminium, cadmium, copper, lead, nickel, zinc) which exceed the adopted relevant health and/or ecological assessment criteria.

1.3 Regulation

On 25 March 2020 the NSW Environment Protection Authority (NSW EPA) declared the site as significantly contaminated under Section 11 of the Contaminated Land Management Act 1997 (Declaration Number 20201103). Transport for NSW is currently managing the contamination under a Voluntary Management Proposal (VMP) which includes further assessment of site contamination and remediation to address the potential risks to human health and the environment posed by the contamination.

1.4 Objective

The objective of the surface water monitoring is to collect reliable water quality data, providing a data continuum which forms a basis for assessment of impacts from the site on surrounding surface water receptors.

2. SITE IDENTIFICATION

The site locality is shown in **Figure 1, Appendix 1**.

The site details are presented in **Table 2-1.**

Table 2-1: Site Identification

Information	Description
Street Address:	Accessed from Stewart Street and Goulburn Street Tarago NSW
Identifier:	Part Lot 1 DP 595856
Site Area:	Approximately 7.5 ha
Local Government:	Goulburn Mulwaree Shire
Owner:	Transport for NSW
Current Site Use:	Forms part of the Goulburn to Bombala rail line and the Country Regional rail Network (CRN)

3. REGULATORY REQUIREMENTS

This SAQP has been prepared in general accordance with the following guidance documents:

1. Australia and New Zealand Environment and Conservation Council, *Guidelines for Fresh and Marine Water Quality* (ANZECC, 2018)
2. National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013* (NEPM, 2013)
3. NSW EPA, Contaminated Sites: *Guidelines for Consultants Reporting on Contaminated Lands* (NSW EPA 2020)
4. NSW EPA, *Guidelines for the Site Auditor Scheme (3rd Edition)* (NSW EPA, 2017)

4. SUMMARY OF CONCEPTUAL SITE MODEL

A Conceptual Site Model (CSM) was prepared as part of a Detailed Site Investigation prepared by Ramboll (2020). The CSM provides a summary of the source-pathway-receptor linkages for surface water and is summarised in **Table 4-1**.

Table 4-1 Conceptual Site Model Summary

Exposure Pathway	Onsite Workers	Onsite Ecology	Residents	Community Activities	Offsite Workers	Offsite Ecology	Irrigation and Livestock
Surface Water							
Direct contact	N	**P**	N	N	N	**P**	**P**
Incidental ingestion	N	**P**	N	N	N	**P**	**P**
Root uptake	N/A	**P**	N/A	N/A	N/A	**P**	N/A
Migration to groundwater	N	**P**	N	N	N	**P**	**P**

5. ASSESSMENT CRITERIA

The criteria adopted for the assessment of surface water contamination are sourced from the following references:

- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999, as amended 2013* (NEPC, 2013).
- National Health and Medical Research Council (NHMRC) (2001) *National Resource Management Ministerial Council (NRMMC) Australian Drinking Water Guidelines 6, Version 3.6 updated March 2021*, (ADWG, 2011).
- National Health and Medical Research Council (NHMRC), *National Resource Management Ministerial Council (NRMMC) Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008).
- Department of Environment and Conservation (DEC) *Guidelines for the Assessment and Management of Groundwater Contamination* (DEC, 2007).
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018) (available at www.waterquality.gov.au/anz-guidelines).
- Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000).
- *Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW, Site specific criteria – Protection of human health and terrestrial and/or aquatic ecosystems* (EnRiskS, 2020).

5.1 Rationale for Application of Guidelines

The relevance of guidelines was determined based on iterative screening from the broadest and most sensitive water usage scenario which occurs in the Mulwaree River back through agricultural land and public roads to the least sensitive scenario which occurs at the Site.

All results from Mulwaree River samples (SW8 to SW10) have been screened against Tier 1 / screening guidelines relevant to human health (incidental ingestion), freshwater ecology, irrigation and stock watering as each of these receptors occur within the receiving waters (the Mulwaree River). Should results exceed screening guidelines and indicate site contamination as the source, it would be appropriate to apply the guidelines that were exceeded to sampling locations upstream as this would inform further assessment of the Site as the potential source. Previous monitoring results do not indicate site contamination is adversely affecting the Mulwaree River. Site-specific guidelines were developed for Arsenic, Cadmium, Lead, Manganese and Nickel (EnRiskS, 2020) that integrate the ephemeral nature of surface water features between the Mulwaree River and the Site. Additionally, several technical refinements were identified and are relevant to guideline application. These were:

- ADWG (2011) Section 6.3.1 states that guideline values refer to the total amount of the substance present, regardless of its form (e.g., in solution or attached to suspended matter) and so analytical results from unfiltered samples should be assessed against human health criteria. The primary human health risk from contaminants in surface water from the Site is via recreational use. NHMRC (2008) suggests that 10-times the ADWG values may provide a conservative estimate of acceptable recreational exposure guidelines values. This approach was applied to derive recreational exposure criteria.
- ANZG (2018) guidelines for metals in freshwater are adopted from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) which states the major toxic effect of metals comes from the dissolved fraction, so it is valid to filter samples (e.g., to 0.45 µm) and compare the filtered concentration against the trigger values.
- Water hardness is identified as a physical parameter with quantifiable effects. Correction factors are defined in the guidelines to address the effect of water hardness on the bioavailability of cadmium, chromium, lead, nickel and zinc.

To define appropriate hardness correction factors, water was conservatively presumed to be moderately hard based on the Goulburn Mulwaree Regional State of the Environment Report 2004-2009 (Goulburn Mulwaree Council, 2009). Hardness correction factors were adopted from Table 3.4.4 of the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000) to refine Tier 1 criteria as described in **Table 5-1** below.

Table 5-1: Hardness Corrections for Tier 1 Freshwater Ecology Guidelines

	Original guideline value (mg/L)	Hardness Correction Factor	Corrected guideline value (mg/L)
Cadmium	0.0002	2.7	0.00054
Chromium	0.001	2.5	0.0025
Lead	0.0034	4	0.0136
Nickel	0.011	2.5	0.0275
Zinc	0.008	2.5	0.02

Application of guidelines at each sampling point is summarised in **Table 5-2**.

Table 5-2: Guidelines Applied to Sampling Points

Sampling Point	Location	Human Health - Site Specific[1]	Ecology - Site Specific[1]	Human Health - Recreational Sceening[2]	Ecology – Screening[3]	Irrigation – Screening[3]	Stock Water – Screening[3]
SW1-UP	Upstream of Southern Culvert (offsite)	✓	✓	✓	✓	-	-
SW1	Upstream of Southern Culvert	✓	✓	✓	✓	-	-
SW2	Downstream of Southern Culvert	✓	✓	✓	✓	-	-
SW3	Upstream of Middle Culvert	✓	✓	✓	✓	-	-
SW4	Downstream of Middle Culvert	✓	✓	✓	✓	-	-
SW5	Upstream of Northern Culvert	✓	✓	✓	✓	-	-
SW6	Downstream of Northern Culvert	✓	✓	✓	✓	-	-
SW7	Dam on farm downstream of Northern Culvert (offsite)	-	-	✓	✓	✓	✓
SW8	Mulwaree River upstream of Middle and Northern Culvert Discharge	-	-	✓	✓	✓	✓
SW9	Mulwaree River upstream of Southern Culvert Discharge	-	-	✓	✓	✓	✓
SW10	Mulwaree River downstream of Middle and Northern Culvert Discharge	-	-	✓	✓	✓	✓

[1] *EnRiskS (2021)*

[2] *ANZG (2018)*

[3] *ANZECC (2000)*

Assessment criteria adopted under each guideline are presented in **Table 5-3**.

Table 5-3: Guideline Criteria (mg/L)

Contaminant	Human Health - Site Specific Criteria	Human Health - Recreation Screening	Ecology - Site Specific Criteria	95% Fresh water (ANZG 2018)	Irrigation - Screening	Stock Water - Screening
Total Metals						
Aluminium	-	2	NA	NA	NA	NA
Arsenic	7	0.1	NA	NA	NA	NA
Barium	-	2	NA	NA	NA	NA
Beryllium	-	0.6	NA	NA	NA	NA
Cadmium	1.4	0.002	NA	NA	NA	NA
Chromium	-	0.5	NA	NA	NA	NA
Cobalt	-	-	NA	NA	NA	NA
Copper	-	20	NA	NA	NA	NA
Iron	-	3	NA	NA	NA	NA
Lead	7	0.1	NA	NA	NA	NA
Manganese	350	5	NA	NA	NA	NA
Mercury	-	0.01	NA	NA	NA	NA
Nickel	14	0.2	NA	NA	NA	NA
Zinc	-	30[h]	NA	NA	NA	NA
Dissolved Metals						
Aluminium	NA	NA	5	0.055[a]	20	5
Arsenic	NA	NA	0.5	0.024[b]	2	0.5-5
Barium	NA	NA	-	-	-	-
Beryllium	NA	NA	-	-	0.5	-
Cadmium	NA	NA	10	0.00054[g]	0.05	0.01
Chromium	NA	NA	-	0.002.5[g]	1	1
Cobalt	NA	NA	-	0.0014	0.1	1
Copper	NA	NA	0.5	0.0014	5	0.4-5
Iron	NA	NA	-	-	10	not sufficiently toxic
Lead	NA	NA	0.1	0.0034	5	0.1
Manganese	NA	NA	-	1.9	10	not sufficiently toxic
Mercury	NA	NA	-	0.00006[d, e]	0.002	0.002
Nickel	NA	NA	1	0.0275[g]	2	1
Zinc	NA	NA	20	0.02[g]	5	20

NA – not applicable

blank cell denoted with – indicates no criterion available.

[a] *Aluminium guidelines for pH > 6.5, based on the pH of groundwater measured at the Site and surrounding area. This is an aesthetic criteria only based on post flocculation problems*

[b] *Guideline value for arsenic (III).*

[c] *Guideline value for chromium (VI).*

[d] *Guideline value for inorganic mercury.*

[e] *99% species protection level DGV has been adopted to account for the bioaccumulating nature of this contaminant.*

[f] *Guideline value for m-xylene. Guideline values also exist for both o-xylene and p-xylene as per ANZG (2018). The default guideline value for m-xylene guideline has been adopted as it is the most conservative*

[g] *Hardness correction factor applied to the threshold value as detailed in ANZG 2018*

[h] *Calculated using the ADWG (2011) aesthetic guideline. Insufficient data to set a guideline value based on health considerations*

6. DATA QUALITY OBJECTIVES

To achieve the objectives and purpose of the surface water monitoring program, both the field and laboratory programs must result in data that is representative of the conditions at the site. As such, specific Data Quality Objectives (DQOs) have been developed for the tasks to be completed to validate the remediation of the site. The DQO process is a systematic, seven step process that defines the criteria that the validation sampling should satisfy in accordance with the *Guidelines for the NSW Site Auditor Scheme (3rd Edition)* (NSW EPA 2017).

The seven step DQOs process comprises:

1. Step 1: State the problem;
2. Step 2: Identify the decisions/ goal of the study;
3. Step 3: Identify the information inputs;
4. Step 4: Define the boundaries of the study;
5. Step 5: Develop the decision rules or analytical approach;
6. Step 6: Specify the performance or acceptance criteria;
7. Step 7: Develop the plan for obtaining data.

The seven step DQO process has been completed for surface water monitoring to be completed before, during and after site remediation.

6.1 Step 1: State the problem

Due to historic loadout of ore concentrate surface water flow over ore impacted soils has been identified to result in migration of total and dissolved metal concentrations from the site. The site has been declared significantly contaminated land by the NSW EPA and a VMP has been prepared to describe how associated risks to human health and the environment will be managed.

6.1.1 Contaminants of Concern

Contaminant of Concern relevant to receiving surface waters appear limited to metals (aluminium, cadmium, copper, lead, nickel, zinc) which exceed the adopted relevant health and/or ecological assessment criteria.

6.2 Step 2: Identify the decisions / goal of the study

The goal of the study is to assess the migration of metal(loid) contamination from the site in surface waters and the impact of migration to surface waters off site.

Based on the decision-making process for assessing urban redevelopment sites, detailed in the *NSW Site Auditor Guidelines, 3rd Edition 2017*, the following decisions must be made with respect to the targeted validation goals:

1. Is the data collected of sufficient quality to meet the project objectives?
2. Is the data reliable?
3. What is the fate and transport of contaminant offsite?
4. What are the potential risks to human health and the environment?

6.3 Step 3: Identify the information inputs

Inputs to the decisions will be sourced from:

1. Review of historical surface water monitoring results
2. Physico-chemical properties collected for each of the 10 surface water sampling locations
3. Sampling of surface water and analysis for contaminants of concern

4. Analytical results for metal(loid)s in surface water samples from each of the 10 sampling locations
5. Quality Assurance / Quality Control data review
6. Comparison of the above samples to the assessment criteria outlined in **Section 5**.
7. All sample analyses conducted using National Association of Testing Authorities (NATA) registered methods in accordance with ANZECC (1996) and NEPC (1999) guidelines
8. All samples appropriately preserved and handled in accordance with the sampling methodology
9. PQLs less that the adopted assessment criteria

6.4 Step 4: Definition of the Study Boundary

The spatial boundaries are shown on **Figure 1** and include:

1. Three tributaries of the Mulwaree River, one located approximately 100 m west of the rail corridor at CH. 262.600, one adjacent to a culvert on the western side of the rail line at CH 262.600 and one adjacent a culvert on the eastern side of the rail line at CH 262.600.
2. Four locations adjacent to culverts, one western side of the rail line at CH 262.300, one on the eastern side of the rail line at CH 262.300, one on the western side of the rail line at CH 262.000 and one on the eastern side of the rail line at CH 262.000.
3. The dam located downgradient from the site northern rail culvert forming part Lot A DP 440822, and three locations along the Mulwaree River

The vertical boundaries are limited to the depth of surface waters encountered and accessible.

The temporal boundary includes historical surface water results as well as data collected under this SAQP comprising quarterly monitoring events over pre-remediation, remediation and post-remediation periods. Two post remediation surface water monitoring events will be included in the validation report.

6.5 Step 5: Develop the decision rules or analytical approach

The decisions rules for this investigation are as follows:

1. Has contaminant migration via surface water been adequately assessed?
2. Have contaminant impacts to surface water off site been adequately assessed?
3. Is the data reliable?
4. Does the data define clear presence / absence of unacceptable risk when assessed against Tier 1 criteria?
5. If Tier 1 assessment of risk is not clear, then does Tier 2 / Tier 3 risk assessment define absence of unacceptable risk?
6. Are there any remaining data gaps?

6.6 Step 6: Specify the performance or acceptance criteria

6.6.1 The tolerable limits on decision errors are as follows:

1. Probability that 95% of data will satisfy the DQIs, therefore a limit on decision error will be 5% that a conclusive statement may be incorrect:

a. A 5% probability of a false negative (i.e. assessing that the average concentration of contaminants of concern are less than the assessment criteria when they are not); and
b. A 5% probability of a false positive (i.e. assessing that the average concentration of contaminants of concern are more than the assessment criteria when they are not).

The potential for significant errors will be minimised by:

1. Completion of QA/QC measures of the investigation data to assess if the data satisfies the DQIs.
2. Assessment of whether appropriate sampling and analytical densities were completed for the purposes of the investigation.
3. Ensuring that the criteria set for the investigation were appropriate for the land use.

DQIs have been established to set acceptance limits on field and laboratory data collected as part of the investigation and are discussed further below.

6.6.2 Evaluation of Analytical Data

Acceptable limits and the manner of addressing possible decision errors for laboratory analysis associated with water quality monitoring and verification of imported materials are outlined below.

Accuracy: Accuracy is defined as the nearness of a result to the true value, where all random errors have been statistically removed. Internal accuracy is measured using percent recovery '%R' and external accuracy is measured using the Relative Percent Difference '%RPD'.

Internal accuracy will be tested utilising:

Surrogates	Surrogates are QC monitoring spikes, which are added to all field and QA/QC samples at the beginning of the sample extraction process in the laboratory, where applicable. Surrogates are closely related to the organic target analytes being measured, are to be spiked at similar concentrations, and are not normally found in the natural environment;
Laboratory control samples	An externally prepared and supplied reference material containing representative analytes under investigation. These will be undertaken at a frequency of one per analytical batch.
Matrix spikes	Field samples which are injected with a known concentration of contaminant and then tested to determine the potential for adsorption onto the matrix. These will be undertaken at a frequency of 5%.

Recovery data shall be categorised into one of the following control limits:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

External accuracy will be determined by the submission of inter-laboratory duplicates at a frequency of 5%. Data will be analysed in accordance with the following control limits:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

Precision: The degree to which data generated from replicate or repetitive measurements differ from one another due to random errors. Precision is measured using the standard deviation 'SD' or Relative Percent Difference '%RPD'.

Internal precision will be determined by the undertaking of laboratory duplicates, where two sub samples from a submitted sample are analysed. These will be undertaken at a frequency of 10%. A RPD analysis is calculated and results compared to:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

External precision will be determined by the submission of intra-laboratory duplicates at a frequency of 5%. The external duplicate samples are to be obtained by mixing and then splitting the primary sample to create two identical sub samples. Field duplicate samples are to be labelled with a unique identification that does not reveal the association between the primary and duplicate samples e.g., QA1.

It must be noted that significant variation in duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity or concentrations reported near the Practical Quantification Limit (PQL).

A RPD analysis is calculated and results compared to:

- 70%-130%R confirming acceptable data, note that there are some larger %R for intractable substances.

Any data which does not conform to these acceptance criteria will be examined for determination of suitability for the purpose of site characterisation.

Blank samples will be submitted with the analytical samples and analysed for the contaminants of concern One field blank will be collected and analysed per matrix type for each batch samples/each day.

The laboratory will additionally undertake a method blank with each analytical batch of samples. Laboratory method blank analyses are to be below the PQLs. Results shall be examined, and any positive results shall be examined. Positive blank results may not be subtracted from sample results.

Positive results may be acceptable if sample analyte concentrations are significantly greater than the amount reported in the blank (ten times for laboratory reagents such as methylene chloride, chloroform, and acetone etc., and five times for all other analytes). Alternatively, the laboratory PQL may be raised to accommodate blank anomalies provided that regulatory guidelines are not compromised by any adjustment made to the PQL.

Completeness: The completeness of the data set shall be judged as:

1. The percentage of data retrieved from the field compared to the proposed scope of works. The acceptance criterion is 95%.
2. The percentage of data regarded as acceptable based on the above data quality objectives. 95% of the retrieved data must be reliable.
3. The reliability of data based on cumulative sub-standard performance of data quality objectives.
4. All PQLs are below adopted assessment criteria.

Where two or more data quality objectives indicate less reliability than what the acceptance criteria dictates, the data will be considered with uncertainty.

Representativeness: Sufficient samples must have been collected.

Samples must be collected and preserved in accordance with the sampling methodology proposed in Step 7 to ensure that the sample is representative of the assessed stratum.

Comparability: The data must show little to no inconsistencies with results and field observations and include likely associates e.g. TPH C6-C9 and BTEX.

Decision Error Protocol

If the data received is not in accordance with the defined acceptable limits outlined in Step 6, it may be considered to be an estimate or be rejected. Determination of whether this data may be used or if re-sampling is required will be based on the following considerations:

1. Closeness of the result to the guideline concentrations.
2. Specific contaminant of concern (e.g. response to carcinogens may be more conservative).
3. The area of site and the potential lateral and vertical extent of questionable information.
5. Whether the uncertainty can be effectively incorporated into site management controls.

6.7 Step 7: Develop a plan for obtaining data

The overall design of the sampling plan considers migration of surface water from the site. Further detail is provided in **Section 7**.

7. SAMPLING PLAN

The sampling plan for surface water quality will be based on quarterly monitoring events over pre-remediation, remediation and post-remediation periods. Two post remediation surface water monitoring events will be included in the validation report.

Surface water sampling will target conditions upstream and downstream of three culverts which direct surface water beneath the rail formation onsite. Surface water at the site only occurs after rainfall and is received to the surrounding environment as follows:

1. Water passing through the northern culvert discharges to an adjacent agricultural property and during high rainfall events to a dam on the agricultural property.
2. Water passing through the middle culvert discharges across a causeway on Boyd Street to an adjacent vacant block.
3. Water passing through the southern culvert discharges beneath Goulburn Street to agricultural land in a tributary to the Mulwaree River (approximately 550m east of site)

Surface water samples will be collected upstream and downstream of each culvert and in receiving water bodies as shown on **Figure 1**, **Appendix 1**.

7.1.1 Water Quality Monitoring Performance Criteria

Surface water sampling will be completed in accordance with performance criteria defined in **Table 7-1**.

Table 7-1 Performance Criteria

Category	Validation Criteria
Accuracy: Accuracy in the collection of field data will be controlled by:	1. Calibrated measurement equipment used. The water quality meter will be calibrated by the technical rental company prior to use. 2. Appropriate sampling methodologies utilised and complied with. Works to be completed with regard for AS NZS 5667.6-1998 Water quality - Sampling - Guidance on sampling of rivers and streams. 3. Collection of one intra-laboratory duplicate for surface water. 4. Rinsate samples are not proposed to be collected due to surface water samples being collected directly into dedicated sampling containers (or field filtered using single use syringes and filters) using disposable nitrile gloves.
Precision: The degree to which data generated from replicate or repetitive measurements differ from one another due to random errors. Precision of field data will be maintained by:	1. A new pair of disposable nitrile gloves to handle each sample. 2. Samples will be placed immediately into laboratory supplied and appropriately preserved sampling vessels. 3. Samples will be stored in chilled, insulated containers with ice for transportation to the laboratory. 4. Sample numbers, preservation and analytical requirements will be recorded on chain of custody documents. 5. Samples will be transported to the laboratory under chain of custody conditions.
Completeness: The completeness of the data set shall be judged by:	1. All locations sampled as outlined in **Sections 7.1.1** and **Figure 1, Appendix 1.** 2. Sampling completed by experienced personnel. 3. Field documentation completed correctly.
Representativeness: The representativeness of the field data will be judged by:	1. Non-disposable sampling equipment, such as the grab sampler and water quality meter, will be thoroughly decontaminated between locations using Decon 90 solution and deionised rinsate water. 2. At each location, a pair of disposable nitrile gloves will be worn while sampling and handling the sample; gloves will be replaced between each successive sample. 3. Surface water analytical samples will be collected directly into the sampling vessels using an extendable pole sampler where appropriate.
Comparability: Comparability to existing field data will be maintained by:	1. Use of the same appropriate sampling methodologies. 2. Same sampling depths for surface water (where practical). 3. Field water quality parameters will be obtained using a calibrated water quality meter and recorded on a field sheet, comprising pH, temperature, total dissolved solids (TDS), dissolved oxygen (DO), redox potential and electrical conductivity (EC).

Category	Validation Criteria
	4. Samples for dissolved metal analysis will collected in dedicated disposable 50 mL plastic syringes and field filtered through 0.45 µm filters directly into a sample bottle containing acid preservative. 5. Visual and olfactory observations will also be recorded on the field sheet. 6. Photographs will be taken of sampling location conditions at the time of sampling.

8. REPORTING

On completion of each monitoring event, a report will be prepared documenting the completed sampling, trend analysis, quality assurance / quality control and laboratory reports.

The report shall include the following:

1. Executive summary
2. Introduction
3. Objectives and scope of work
4. Summary of completed field sampling and laboratory analysis
5. QA/QC review
6. Temporal trend analysis
7. Conclusions

9. REFERENCES

ADWG (2011). National Health and Medical Research Council (NHMRC) (2001) National Resource Management Ministerial Council (NRMMC) Australian Drinking Water Guidelines 6, Version 3.5 updated August 2018.

ANZECC (2000). Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

EnRiskS (2021). *Advice on risks to human health and the environment: Boyd Street and publicly accessible areas, Tarago NSW*.

NEPM (2013). National Environment Protection Council (NEPC), National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013

NHMRC (2008). National Health and Medical Research Council (NHMRC), National Resource Management Ministerial Council (NRMMC) Guidelines for Managing Risks in Recreational Water

NSW DEC (2007). Contaminated Sites – Guidelines for the Assessment and Management of Groundwater Contamination, Department of Environment and Conservation NSW, Sydney, March 2007.

NSW EPA (2017). *Contaminated Land Management - Guidelines for the NSW Site Auditor Scheme (3rd Edition),* New South Wales Environment Protection Authority, Sydney, NSW, October 2017.

APPENDIX 1
FIGURES

RAMBOLL AUSTRALIA - GIS MAP file - 318000780_GIS_P018_T22_RAPs_02_RAP_RailCorridor | F003_SurfaceWaterSamples_V01 | 13/04/2021

A4
1:10,000

Legend

- Surface water sampling location
- Rail corridor
- Rail corridor fence
- Area of lead exceedance (within rail corridor)
- Indicative surface water flow path (ie: not ephemeral)
- Indicative ephemeral surface water flow path

Figure 2-1: Surface Water Monitoring Locations