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TEMPORARY WATER TREATMENT PLANT WATER QUALITY MONITORING PROGRAM

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TEMPORARY WATER TREATMENT PLANT
WATER QUALITY MONITORING PROGRAM

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Description	**This report provides a program for monitoring of water quality while treated leachate is discharged into the existing surface water management and irrigation system at the former Hydro Aluminium Kurri Kurri Smelter in Loxford, NSW. Discharge of treated leachate will occur during the operation of a Temporary Water Treatment Plant as part of the Engineered Containment Cell and Remediation Project, to be undertaken between 2021 and 2023.**

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APPENDICES

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Appendix 2
EPA Consultation

Measures	Description
%	per cent
µg/L	Micrograms per Litre
ha	Hectare
km	Kilometres
m	Metre
mg/L	Milligrams per Litre
AEP	Annual Exceedance Probability
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
COC	Chain of Custody
CWS	Capped Waste Stockpile
DQI	Data Quality Indicator
DQO	Data Quality Objective
ECC	Engineered Containment Cell
EEC	Endangered Ecological Community
EPA	Environment Protection Authority (NSW)
GHD	GHD Pty Ltd
LCS	Laboratory Control Sample
LOR	Limit of Reporting
MS	Matrix Spike
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
n	Number of Samples
pH	A measure of acidity, hydrogen ion activity
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
RWEMP	Remediation Works Environmental Management Plan
SAQP	Sampling Analysis and Quality Plan
SEE	Statement of Environmental Effects
SWMP	Soil and Water Management Plan
TWTP	Temporary Water Treatment Plant
TV	Trigger Value
USEPA	United States Environmental Protection Agency
WQMP	Water Quality Monitoring Program
-	On tables is "not calculated", "no criteria" or "not applicable"

1. INTRODUCTION

Ramboll Australia Pty Ltd (Ramboll) was engaged by Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) to prepare and implement a Water Quality Monitoring Program (WQMP) to fulfil regulatory requirements for discharging treated leachate into the existing surface water management system at the former Hydro Aluminium Kurri Kurri Smelter on Hart Road, Loxford, New South Wales (NSW).

The existing surface water management system comprises a series of holding dams at the former Smelter before water is applied to land by irrigation within the Buffer Zone. The former Smelter, herein referred to as the 'Smelter Site', and the surrounding Buffer Zone owned by Hydro occupy an area of approximately 2,000 ha as shown in **Figure 1, Appendix 1**.

1.1 Context

The Smelter commenced operations in 1969 and smelting activities ceased in September 2012. Closure of the Smelter was announced in May 2014 following a two-year period of care and maintenance. Remediation of the Smelter Site has commenced and will be undertaken between 2021 and 2023. Remediation is outlined in the Smelter Site Remedial Action Plan (Smelter RAP) (Ramboll, 2018) and broadly comprises construction of an Engineered Containment Cell (ECC) and excavation and placement of contaminated materials within the ECC.

A component of the remediation is relocation of a mixed waste stockpile in the eastern portion of the Smelter Site to the ECC. During past operations at the Smelter, mixed smelter materials were stockpiled on site and ultimately capped with clay. The stockpile is referred to as the Capped Waste Stockpile (CWS). Past exposure of these waste materials to surface water and groundwater has resulted in the generation of leachate characterised by elevated fluoride, cyanide and sodium concentrations and a high pH. During relocation of the CWS, leachate within the materials including leachate generated from rainfall occurring during the relocation process requires capture and treatment.

The on-site treatment methodology is detailed in Ramboll (2021) Statement of Environmental Effects (SEE) which was submitted as an amendment to the existing development consent for off-site treatment and disposal of CWS leachate. The amendment was approved after GHD (2018) was able to demonstrate through modelling that the proposed modification could effectively and cost efficiently treat the leachate on-site.

The methodology for on-site treatment of CWS leachate comprises a Temporary Water Treatment Plant (TWTP) specifically designed by GHD (2018) to treat the leachate, which was sampled and characterised by Ramboll (2021). The treated leachate will then be discharged to the existing water management system and subsequently applied to land through irrigation in the Buffer Zone Irrigation Area.

Approval conditions for on-site leachate treatment require Hydro or a representative to prepare and implement a Water Quality Monitoring Program (WQMP) for the duration of leachate treatment. Hydro has nominated Ramboll as the representative to prepare and implement WQMP.

1.2 Objective of the WQMP

The objectives of this WQMP are to:

- Prepare a program outlining surface water monitoring locations, timing and frequency of surface water sampling of the existing water management system and downstream receiving environments to assess changes to water quality while treated leachate is discharged to the existing water management system
- Document reporting requirements associated with the WQMP

The WQMP relates to the management of treated leachate once it is discharged from the TWTP to the onsite stormwater management system. An Operational Management Plan (Enviropacific Services (September 2021) Water Treatment Plant Management Plan) will be separately developed that details the operations of the TWTP and the discharge criteria to be met by the treatment process.

1.1 Program requirements

Table 1-1 lists the requirements of Condition B19D from Modification 1 to the development consent for SSD 6666, and where they are addressed in this plan.

As required by Condition B19D Hydro consulted with the Environment Protection Authority (EPA) during preparation of this WQMP. NSW EPA had no comments on specific content for the WQMP. Agency consultation is included in **Appendix 2**.

Table 1-1 Modification 1 Irrigation Management Plan Requirements

Condition	Where addressed
B19C. Prior to operation of the TWTP, the applicant must prepare a Water Quality Monitoring Program in consultation with the EPA that informs the Irrigation Management Plan and Trigger Action Response Plans. The monitoring program should include, at a minimum:	
(a) water quality monitoring locations (including but not limited to the North Dam and downstream receiving environment)	
(b) analyte list for all pollutants with the potential to cause non-trivial harm (including all the 'Treated Leachate Target Values' (Document: Hydro Kurri Kurri Aluminium Smelter Remediation-Mod-1 (SSD-6666-Mod-1).	Section 5.3 and Section 5.4
(c) sampling method for each location	Section 5.2

2. BACKGROUND

2.1 Capped Waste Stockpile

The CWS is an on-site stockpile comprising mixed smelter wastes that were capped in 1995. The stockpile originated during early site operations between 1969 and 1992, when smelter wastes were stored within onsite storage facilities situated along the eastern smelter boundary.

In the mid-1980s changes to legislation regarding the storage of aluminium smelter wastes resulted in the improvement of storage and waste management on the Smelter Site. These improvements resulted in the consolidation of wastes into one stockpile and the capping of that stockpile, now referred to as the CWS. The capping of the CWS in 1995 was designed to reduce ongoing leachate generation.

From comprehensive site records and site knowledge, the CWS is known to contain:

- Spent pot lining
- Carbon Plant shot blast refuse, including grit and dust
- Carbon Plant dust collector product
- Collar mix (coke, pitch) spillage
- Carbon Plant floor sweepings
- Packing coke oversize
- Contaminated bath
- Rotary breaker oversize
- Pot lining mix (hot ramming paste)
- Rodding mix (coke, graphite, pitch and anthracene oil)
- Consumable gaskets and insulation material (synthetic mineral fibre and asbestos)
- Pitch spills/ pencil pitch
- Aluminium swarf
- Scrap aluminium billets
- Anode cover material
- Butt from spent anodes
- Ahead of schedule anodes
- Dross
- Pot bottom aluminium
- Stud joining mix
- General rubbish, including plastic, wood and steel

Ramboll undertook an intrusive (core drilling) investigation in October/November 2015 at the CWS. The objective of the investigation was to provide an assessment on the composition of the waste material, the underlying soil, and the groundwater conditions beneath the CWS. A total of six boreholes were drilled and subsequently developed with groundwater monitoring wells. Waste, soil, and groundwater were collected and analysed in a laboratory for a wide range of Contaminants of Concern. The results of the untreated leachate sample analysis showed high concentrations of benzo(a)pyrene, Total Polyaromatic Hydrocarbons (PAHs), arsenic, lead, cyanide and fluoride among detectable concentrations of other contaminants.

Following the approval of the proposed modification to SSD 6666, leachate will be treated on-site as opposed to being transported to an off-site facility for treatment. The TWTP has been designed based on the physico-chemical parameters of the leachate in order to reduce contaminants to acceptable concentrations before being discharged into the existing water management system at the Smelter Site.

The location of the CWS and the proposed TWTP is shown in **Figure 2, Appendix 1**.

2.2 Existing Water Management System

Existing surface water infrastructure includes:

- Subsurface and open surface water drainage throughout the Smelter Site
- Three surge ponds: one surge pond in the west of the Smelter (West Surge Pond), one in the east of the Smelter (East Surge Pond) and one in the south of the Smelter (South Surge Pond). These are the initial collection and treatment points for the water.
- Two ponds located to the north of the Smelter: The northern surge dams are collectively known as the North Dam however it is comprised of two dams, the North West Dam and North East Dam. The North Dam has previously been, and continues to be, used as the major element of the water collection and treatment system for the Smelter Site.
- Irrigation Area: To the north east of the Smelter in the Buffer Zone is an irrigation area that receives water from the North Dam. The Irrigation Area is operated in accordance with the requirements of Environmental Protection License (EPL) 1548.

A water quality monitoring schedule is in place for weekly and monthly monitoring of water quality at on-site and off-site locations to fulfil regulatory requirements of the EPL associated with the application of collected surface water to land at the irrigation site. Water quality parameters recorded include pH, Electrical Conductivity (EC), Total dissolved Solids (TDS), Total Suspended Solids (TSS), free cyanide, and fluoride.

The Smelter Site is permitted to apply water to land as per EPL 1548. Irrigation rates ensure that the rate of irrigation will not cause visible pooling of water or runoff.

3. ENVIRONMENTAL SETTING

3.1 Topography

Review of Google Earth satellite imagery identified regional topography characterised by low residual hills to the west (20 – 30 m Australian Height Datum (AHD)) and low-lying swampy land to the north and east (8 –14 m AHD). The Site appears to have been filled to create a flat, elevated platform at 14 – 17 m AHD.

The Irrigation Area is located approximately 300 m north-east of the North East Dam. The Irrigation Area slopes gently down from north-west to south-east towards Swamp Creek and is within approximately 30 m of Swamp Creek at the south-eastern corner. The location of the Irrigation Area is shown in **Figure 2, Appendix 1**.

3.2 Direction of Surface Water Runoff

Surface runoff at the Smelter Site is generally directed to one of two dams – either the West Surge Pond or East Surge Pond. The TWTP will discharge treated leachate to the East Surge Pond which is connected in series to the North East Dam and North West Dam. Water is held at the North East Dam and North West Dam until it can be applied to land by irrigation. Irrigation is undertaken at a grassed paddock located north east of the North Dam known as the Irrigation Area.

The nearest surface water receptor to the Irrigation Area is Swamp Creek, located approximately 175 m east of the Irrigation Area. Swamp Creek generally runs south to north from the point at which it rises in the Broken Back Range and travelling down through suburbs such as Kearsley and Neath, towards the township of Abermain where it is joined with Deep Creek. From Abermain, Swamp Creek continues to Kurri Kurri where it passes by the Site before draining into Wentworth Swamp. The Wentworth Swamp is an EEC under the Biodiversity Conservation Act (2016) meeting the definition of EEC *Freshwater Wetland on Coastal Floodplains of New South Wales North Coast, Sydney Basin and South East Corner Bioregions*.

In the event that the North Dam overtops due to a significant rainfall event, surface water flows north into Wentworth Swamp via Black Waterholes Creek. Black Waterholes Creek is located approximately 360 m north of the North Dam. Black Waterholes Creek flows into Wentworth Swamp in the west, while Swamp Creek flows into Wentworth Swamp in the east.

A review of a management plan developed by the Department of Environment and Climate Change (2007) for the middle Hunter River catchment describes Swamp Creek, Black Waterholes Creek and Wentworth Swamp as disturbed ecosystems. The introduction of pest species has diminished native vegetation cover however is still listed as an Endangered Ecological Community (EEC). Sections of Swamp Creek preserve remnants of several other EECs while other sections, namely 5 kms between Abermain and Loxford are highly disturbed and have been channelised. In addition, two wastewater treatment works are known to discharge treated effluent into Wentworth Swamp which contribute to elevated phosphorus in the water body.

3.3 Flood Potential

The majority of the Smelter Site is located on low lying swampy ground that has been filled. Low lying areas of the Smelter Site remain susceptible to flooding.

Swamp Creek has a history of significant flooding, notably the February 1990, June 2007 (“the Pasha Bulker storm”), June 2011, February-March and November 2013, April 2015, and January 2016 (WMA Water, 2019). A study found that upstream of the Hunter Expressway, flows were likely to break out of the channel in a 20% Annual Exceedance Probability (AEP) event (38.9mm rainfall/hr) and inundate urban areas in a 10% AEP event (47.2mm rainfall/hr). However,

downstream of the Hunter Expressway where the Site is located, is swamp area and water levels remain fairly constant (WMA Water, 2019).

Risks associated with contaminated runoff and additional leachate generated during peak rainfall at the CWS will be mitigated by containing runoff and leachate in two 1 Mega Litre (ML) storage ponds. In addition, the ECC and CWS each have 1 ML capacity equalling a total of 4 ML of contaminant runoff and leachate storage capacity (GHD, 2018).

4. SAMPLING AND ANALYSIS QUALITY PLAN

4.1 Data Quality Objectives

Ramboll developed Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs) for the WQMP using the US EPA seven-step DQO process, endorsed in Schedule B2 of NEPM (2013). The DQOs set quality assurance and quality control parameters for the field and laboratory program to ensure data of appropriate reliability will be used to assess surface water quality at on- and off-site locations.

Table 4-1 Data Quality Objectives

DQO	Outcome
State the Problem	During the decommissioning and decontamination of the CWS, leachate from the CWS will be treated through a TWTP to meet set criteria outlined in the TWTP Management Plan (Enviropacific Services (September 2021) Water Treatment Plant Management Plan). Once achieved, treated leachate will be discharged into the existing water management system via an open drain that flows into the East Surge Pond. Water quality monitoring of the North Dam is required to ensure North East Dam Target Values are being met before water is applied to land at the Irrigation Area. Monitoring at off-site locations in the down-gradient surface water receptors of Swamp Creek and Wentworth Swamp is also required to ensure the irrigation of water to the Irrigation Area is not impacting the down-gradient receiving environment.
Identify the Decision	Decision that are required as part of the WQMP are as follows: 1. Are sampling locations adequate for monitoring on-site and off-site water quality impacts? 2. Is the data collected of sufficient quality to identify impacts to meet the project objectives? 3. Does the on-site water quality data comply with the North East Dam Target Values? 4. Is there an impact to water quality in the down-gradient receiving environment?
Identify Inputs to the Decision	The following inputs are required: 1. Physico-chemical properties at on-site and off-site sampling locations per sampling round 2. Analytical results for each on-site and off-site sampling location per sampling round 3. Quality assurance/ quality control (QA/QC) data review 4. Comparison of on-site data against historical observations and North East Dam Target Values outlined in **Section 6** 5. Comparison of downstream data against background/upstream locations to identify impacts to downstream receiving environments 6. All sample analyses are to be conducted using National Association of Testing Authorities (NATA) registered methods in accordance with ANZECC (1996) and NEPC (1999) guidelines 7. All samples are to be appropriately preserved and handled in accordance with the sampling methodology outlined in **Table 5-3.** 8. PQLs are to be less that the adopted assessment criteria 9. Duplicates, spikes, blanks and control samples are to meet the DQIs presented in **Section 4.2**
Define the Study Boundaries	Spatial boundaries are shown in **Figure 1, Appendix 1** and include: 1. North Dams – North East Dam and North West Dam 2. Down-gradient Swamp Creek 3. Down-gradient Wentworth Swamp 4. Down-gradient Black Waterholes Creek 5. Up-gradient Swamp Creek Vertical boundaries: Vertical boundaries are limited to surface waters. Temporal boundaries: The temporal boundary is limited to data to be collected under this WQMP which is to include (at a minimum) monthly sampling, and post heavy rainfall sampling for the duration of operation of the TWTP.
Develop a Decision Rule	The decision rules for this investigation are as follows:

DQO	Outcome
	1. If it is determined that the data generated is reliable, complete, comparable, accurate and representative then this information will be used to address the WQMP objectives. 2. If it is determined that the data generated is not suitable, comprehensive or reliable for use in achieving the goals of the EMP, then further works may be recommended to reduce uncertainties. 3. If it is determined that insufficient information is available to make conclusions on the effects of treated leachate of the existing water management system and downstream receiving environments, then further information may be required.
Specify Limits on Decision Errors	To assess the usability of the data prior to making decisions, the data will be assessed against pre-determined DQIs in relation to precision, accuracy, representativeness, comparability and completeness. The DQIs and data assessment criteria are outlined in **Table 4-2**.
Optimise the Design for Obtaining Data	The overall design of the WQMP is to assess water quality in the North Dams and off site water quality monitoring during the operation of the TWTP. Further detail is provided in the field and laboratory methodologies in **Section 5**.

4.2 Data Quality Indicators

DQIs have been established to set acceptance limits on field and laboratory data collected as part of the surface water program. The DQIs are outlined **Table 4-2**.

Table 4-2 Data Quality Indicators

DQI	Field	Laboratory
Completeness – a measure of the amount of useable data from a data collection activity	All critical locations sampled Experienced sampler Documentation is correct and complete	All critical samples analysed All analysis completed according to standard operating procedures. Appropriate methods
Comparability – the confidence that data may be considered to be equivalent for each sampling and analytical event	Experienced sampler Climatic conditions noted during sampling Same types of samples collected using approved sampling methods Samples collected into laboratory-supplied sample bottles	Same analytical methods used Same sample PQLs Same NATA accredited laboratories used Same units
Representativeness – the confidence that data are representative of each medium present onsite.	Appropriate media sampled	All samples analysed according to standard operating procedures
Precision – a quantitative measure of the variability of the data.	Collection of intra-laboratory duplicates at a rate of 1 in 20 primary samples Collection of inter-laboratory duplicate samples at a rate of 1 in 20 primary samples Collection of 1 field blank per sampling round	Analysis of field duplicate samples, relative percent difference (RPDs) to be $\leq$30% Laboratory duplicates analysed, RPDs to be $\leq$ 30%
Accuracy – a quantitative measure of the closeness of the reported data to the “true” value.	Sampling methodologies appropriate and complied with Collection of one field blank sample each day of sampling.	Analysis of: • Method blanks. • Matrix spikes. • Surrogate spikes. • Laboratory control samples. • Results for blank samples to be non-detect. • Results for spike samples to be between 70% and 130%
Sensitivity - is a measure of the suitability of the laboratory results against the adopted assessment criteria.	Collection of sufficient sample volume	Appropriate Practical Quantitation Limits (PQLs) Appropriate units

5. SAMPLING PROGRAM – FIELD AND LABORATORY METHODOLOGY

5.1 WQMP Sampling Program

Hydro continues to implement a long-term surface water sampling program in accordance with its Soil and Water Management Plan (SWMP), which forms part of its Remediation Works Environmental Management Plan (RWEMP). This includes the North East Dam, other dams within the Smelter Site, and upstream and downstream locations in adjoining waterbodies (including adjacent to the Irrigation Area) in the Buffer Zone. Hydro's current monitoring program includes the following:

- Monthly monitoring of East Surge Pond, West Surge Pond, South Surge Pond, North Dams, Swamp Creek and Wentworth Swamp for pH, electrical conductivity, fluoride, free cyanide, TSS and TDS

This surface water monitoring is the continuation of monitoring that has been undertaken for more than 25 years, which has not identified significant adverse impacts from this historical use of the Irrigation Area.

Supplementary water quality monitoring required in relation to the discharge of treated leachate from the TWTP is outlined in **Table 5-1**.

Table 5-1 Supplementary Water Quality Monitoring Program

WQMP Sampling Program	Requirements
Sampling Locations	Surface water receptors are: • East Surge Pond • North East Dam • Swamp Creek down-gradient of the Irrigation Area • Wentworth Swamp Suitable sampling locations have been identified at the down-gradient receptors, as outlined in **Table 5-2.** A background sampling location has also been identified at an upgradient location in Swamp Creek, as outlined in **Table 5-2**.
Sampling Frequency – Routine Sampling	Routine sampling is to be completed monthly, in the third week of the month. Routine sampling is to commence in October 2021 and continue until cessation of leachate treatment through the TWTP.
Sampling Frequency – Event-Based Sampling	Event-based sampling is to be completed at the following times: • Following rainfall events of >30 mm in a 24-hour period, with sampling to be completed within 24 hours of the cessation of rain, where it is safe to access the sampling locations.
Contaminants of Concern – Field Parameters	Samples collected during routine and event-based sampling events are to be tested in the field for the following parameters: • pH • Electrical conductivity • Visual observation of oil and grease

WQMP Sampling Program	Requirements
Contaminants of Concern – Laboratory Analysis	Samples collected during routine and event-based sampling events are to be analysed for Contaminants of Concern within the leachate that require treatment through the TWTP, including: • Fluoride • Cyanide • Total Recoverable Hydrocarbons (TRH) • Polycyclic Aromatic Hydrocarbons (PAH) • Per- and Polyfluoroalkyl Substances (PFAS) • Heavy metals – total and dissolved (full list shown in **Table 6-1**) • Total dissolved solids • Total suspended solids

Table 5-2 Surface Water Sampling Locations

Location	Sample ID	Easting	Northing
Onsite			
East Surge Pond	E Dam 1	358202.6658	6371193.557
North East Dam	NE Dam 2	357936.4993	6371485.385
Offsite			
Swamp Creek – Upgradient	Swamp Creek 4	357869.0028	6370020.893
Swamp Creek – down gradient	Swamp Creek 5	359039.3505	6371944.736
Wentworth Swamp	62	360405.7194	6373845.988
Unnamed Creek	9	358083.6073	6372217.735

5.2 Field Sampling Methodology

Sampling methodology for the collection of surface water samples is outlined in **Table 5-3**. For health and safety reasons, all sampling should be completed by a two-person field team following a Health and Safety Plan and Safe Work Method Statement prepared specifically for the tasks to be undertaken.

Table 5-3 Sampling Methodology

Sampling Methodology	Assessment
Sample Depths	Surface water samples are to be collected from 100 mm beneath the surface as far away from the embankment as is practicable. A sampling arm may be used where appropriate however, every effort should be made to avoid disturbing sediments.
Field Records	Each sample shall be labelled with a unique identification or sample ID, as presented in **Table 5-2.** Water quality parameters including pH, temperature, EC, dissolved oxygen, redox potential, turbidity and total dissolved solids (TDS) are to be measured and recorded for each of the sampling locations. Visual observations of surface water and photographic records shall be collected during each sampling event.
Sample Collection Method	Surface water samples are to be collected directly into laboratory-supplied sample bottles with appropriate preservatives. Disposable nitrile gloves shall be worn by the sampler and offsider. Gloves are to be changed between sampling locations. One set of samples for heavy metals are to be filtered in the field using a 0.45µm filter.

Sampling Methodology	Assessment
Decontamination Procedures	Non disposable sampling equipment i.e. water quality meter and sampling arm, shall be decontaminated between sampling locations using a decontamination solution (i.e. Decon90®) and laboratory supplied rinsate water.
Sample Collection and Storage	Surface water samples are to be collected directly into laboratory-supplied sample bottles. The bottles are to be stored in a chilled Esky in the field and during transit to the laboratory.
Chain of Custody	Samples are to be promptly submitted to a NATA accredited laboratory under Chain of Custody conditions.
Calibration of Field Equipment	The water quality meter may be rented from an equipment hire company or provided by Ramboll. Where supplied by Ramboll, the water quality meter will be calibrated prior to use and calibration records will be provided as proof of calibration. The water quality meter will be calibrated prior to hire and the calibration certificate shall be retained for proof of calibration.

5.3 Field Parameters

The following field parameters are to be recorded at each sampling location using a calibrated water quality meter:

- pH
- EC
- Redox
- Dissolved oxygen
- Turbidity
- Temperature

5.4 Laboratory Analytical Methodology

Surface water samples are to be analysed at a laboratory NATA accredited for the analysis required. From a previous Ramboll investigation described in **Section 2.1**, Contaminants of Concern associated with the CWS that are at non-trivial concentrations:

- Fluoride
- Cyanide
- PAHs
- TRH/BTEX
- PFAS
- Heavy Metals – total and dissolved

To ensure DQIs are met for laboratory analysis, **Table 5-4** shows the analytical method corresponding practical quantitation limit (PQL) for each assessment criteria listed in **Table 6-1** and **Table 6-3**. As per the DQIs, the PQL must be less than the assessment criteria.

Table 5-4 Analytical Methods and PQLs for water samples

Analyte	Method Code	PQL
Heavy Metals		
Aluminium	ICP-MS	0.01 mg/L
Arsenic	ICP-AES	0.01 mg/L
Beryllium	ICP-AES	0.1 mg/L
Boron	ICP-AES	0.1 mg/L
Cadmium	ICP-MS	0.1 mg/L

Analyte	Method Code	PQL
Chromium	Ultra Trace ICP-AES	0.01 mg/L
Cobalt	ICP-MS	0.001 mg/L
Copper	ICP-MS	0.001 mg/L
Iron	ICP-AES	0.05 mg/L
Lead	ICP-MS	0.001 mg/L
Lithium	ICP-MS	0.001 mg/L
Manganese	ICP-AES	0.01 mg/L
Mercury	ICP-MS	0.0001 mg/L
Nickel	ICP-MS	0.001 mg/L
Selenium	ICP-AES	0.01 mg/L
Uranium	Ultra Trace ICP-AES	0.05 mg/L
Vanadium	Ultra Trace ICP-AES	0.2 mg/L
Zinc	ICP-MS	0.005 mg/L
Petroleum Hydrocarbons		
TRH >C10 – C40 Sum	Capillary GC/FID[1]	100 µg/L
Benzene	Capillary GC/FID[1]	1 µg/L
Toluene	Capillary GC/FID[1]	2 µg/L
Ethyl benzene	Capillary GC/FID[1]	2 µg/L
o-xylene	Capillary GC/FID[1]	2 µg/L
m-xylene	Capillary GC/FID[1]	2 µg/L
p-xylene	Capillary GC/FID[1]	2 µg/L
PAHs		
Naphthalene	Capillary GC/MS[1]	0.005
PAHs	Capillary GC/MS[1]	0.001 [2]
PFAS		
PFAS - Trace	LTM-ORG-2100 Per- and Polyfluoroalkyl Substances (PFAS) - low level	0.005 µg/L[3]
Fluoride		
Fluoride	Ion Selective Electrode (ISE)	0.01 mg/L
Cyanide		
Free Cyanide	Segmented Flow Analyser	0.004 mg/L

Analyte	Method Code	PQL
Total Cyanide	Segmented Flow Analyser	0.004 mg/L

[1] Compliant with NEPM Schedule B(3)

[2] Highest PQL of all PAH analytes is 1 µg/L

[3] Highest PQL for all PFAS analytes is 0.005 µg/L

6. ASSESSMENT CRITERIA

6.1 North East Dam

North East Dam Target Values were developed as part of Ramboll (2021) Statement of Environmental Effects, Modification 1 to SSD 6666 Temporary Water Treatment System. Comparison of analytical results from monthly surface water monitoring events to North East Dam Target Values will be used to assess suitability of surface water for irrigation during the operation of the TWTP and discharge of treated leachate. North East Dam Target Values are shown in **Table 6-1**.

Table 6-1 North East Dam Target Values

Parameter	Units	Limit
Conductivity	µS/cm	4,000 [1]
pH	-	6.5-8 [2]
Fluoride	mg/L	15 [2]
Free cyanide	mg/L	<0.005
Total oils and grease	-	No visual sheen [3]
Total Dissolved Solids (TDS)	mg/L	None specified
Total Suspended Solids (TSS)	mg/L	<50 [3]
Total polyaromatic hydrocarbons (PAHs)	µg/L	LOR (<1)
Total Recoverable Hydrocarbons (TRH)	µg/L	LOR (<100)
Perfluorooctane sulfonate (PFOS)	µg/L	0.21 [2]
Heavy metals		
Aluminium	mg/L	5 [4]
Arsenic	mg/L	0.1 [4]
Beryllium	mg/L	0.1 [4]
Boron	mg/L	0.5 [4]
Cadmium	mg/L	0.01 [4]
Chromium	mg/L	0.1 [4]
Cobalt	mg/L	0.05 [4]
Copper	mg/L	0.2 [4]
Iron	mg/L	0.2 [4]
Lead	mg/L	2 [4]
Lithium	mg/L	2.5 [4]
Manganese	mg/L	0.2 [4]
Mercury	mg/L	0.002 [4]
Molybdenum	mg/L	0.01 [4]
Nickel	mg/L	0.2 [4]
Selenium	mg/L	0.02 [4]
Uranium	mg/L	0.01 [4]
Vanadium	mg/L	0.1 [4]
Zinc	mg/L	2 [4]

[1] Use Of Effluent By Irrigation, Department of Local Government, 1998

[2] Historical value in North Dams

[3] Managing Urban Stormwater: Soils and Construction, 2004

[4] Long-term trigger values for heavy metals and metalloids in irrigation sourced from ANZECC, 2000.

6.2 Off-Site Receiving Waters

In the absence of sufficient background data for Swamp Creek and Wentworth Swamp, default trigger values for physical and chemical stressors, and toxicants have been adopted from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ARMCANZ & ANZECC , 2000) and will be used as a guideline for the assessment of off-site water quality.

Additionally, an upstream (background) location will be sampled to compare against downstream receiving environment water quality. Upstream water quality monitoring will be used to supplement the default trigger values in order to provide context to any discrepancies in the downstream receiving environment when compared to the adopted default trigger values.

Based on the contaminants associated with the CWS leachate, default trigger values for physical and chemical stressors for lowland rivers in South-East Australia (ARMCANZ & ANZECC , 2000) have been selected and are summarised in **Table 6-2** for off-site receiving waters.

Table 6-2 Default Trigger Values for Physico-Chemical Parameters

		Slightly Disturbed Lowland Rivers in South-East Australia	
Parameter	**Units**	**Lower Limit**	**Upper Limit**
pH		6.5	7.5
DO	%	85	110
Salinity	µS/cm	125	2200
Turbidity	NTU	6	50

Based on the contaminants associated with the CWS leachate, default trigger values for toxicants for 95% level of species protection in freshwater ecosystems (ARMCANZ & ANZECC , 2000) have been selected and are summarised in **Table 6-3** for off-site receiving waters.

Table 6-3 Default Toxicant Trigger Values

Analyte	Units	Freshwater Aquatic Ecosystem 95% Species Protection
Aluminium	mg/L	0.055
Arsenic (III)	mg/L	0.024
Arsenic (V)	mg/L	0.013
Beryllium	mg/L	*0.00013* [2]
Boron	mg/L	0.370 [1]
Cadmium	mg/L	0.002
Chromium (III)	mg/L	*0.0033*
Chromium (VI)	mg/L	0.001 [1]
Cobalt	mg/L	*0.0028*
Copper	mg/L	0.0014

Analyte	Units	Freshwater Aquatic Ecosystem 95% Species Protection
Iron	mg/L	*0.300* [2]
Lead	mg/L	0.0034
Manganese	mg/L	1.9 [1]
Mercury (inorganic)	mg/L	0.0006
Mercury (methyl)		ID
Molybdenum	mg/L	*0.034*
Nickel	mg/L	0.011
Selenium (Total)	mg/L	0.011
Uranium	mg/L	*0.0005*
Vanadium	mg/L	*0.006*
Zinc	mg/L	0.008
Cyanide	mg/L	0.007
Benzene	mg/L	0.950
o-xylene	mg/L	0.350
Naphthalene	mg/L	0.016

ID - Insufficient data to derive a reliable trigger value and no low reliability trigger value available
Italics - indicate low reliability value
[1] may not protect key test species from acute toxicity (and chronic)
[2] Interim working value used in the absence of low or moderate reliability value

7. REPORTING

7.1 Monthly Reporting

Reporting is to be completed on a monthly basis following monthly sampling. Each report must contain the following components:

- Updated cumulative monitoring data summary table
- Details of additional monthly monitoring i.e. monitoring prior to irrigation or after rainfall
- Assessment of monitoring results against criteria
- Comment on the concentrations of contaminants observed
- Identification of any exceedance of the contaminants observed and identification if further investigation or action is required.

7.2 Final Report

Following the cessation of the TWTP, a report will be prepared documenting the completed sampling, trend analysis, quality assurance / quality control and monthly reports.

The report shall include the following:

- Executive summary
- Introduction
- Objectives and scope of work
- Summary of WQPP monthly reports
- Summary of completed field sampling and laboratory analysis
- QA/QC review
- Results
- Conclusion
- Monthly reports are to be included as an appendix

8. REFERENCES

ARMCANZ & ANZECC . (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Biodiversity Conservation Act No. 63. (2016). NSW: https://legislation.nsw.gov.au/view/html/inforce/current/act-2016-063#statusinformation

Department of Environment and Climate Change NSW. (2007). Management Plan for the Green and Golden Bell Frog Key Population in the Middle Hunter

GHD (2018) *Hydro Aluminium Kurri Kurri Pty Ltd Containment Cell Design Report.*

Landcom (2004) Managing Urban Stormwater: Soils and Construction

National Environment Protection Council (NEPC) (2013) National Environment Protection (Assessment of Site Contamination) Measure 1999

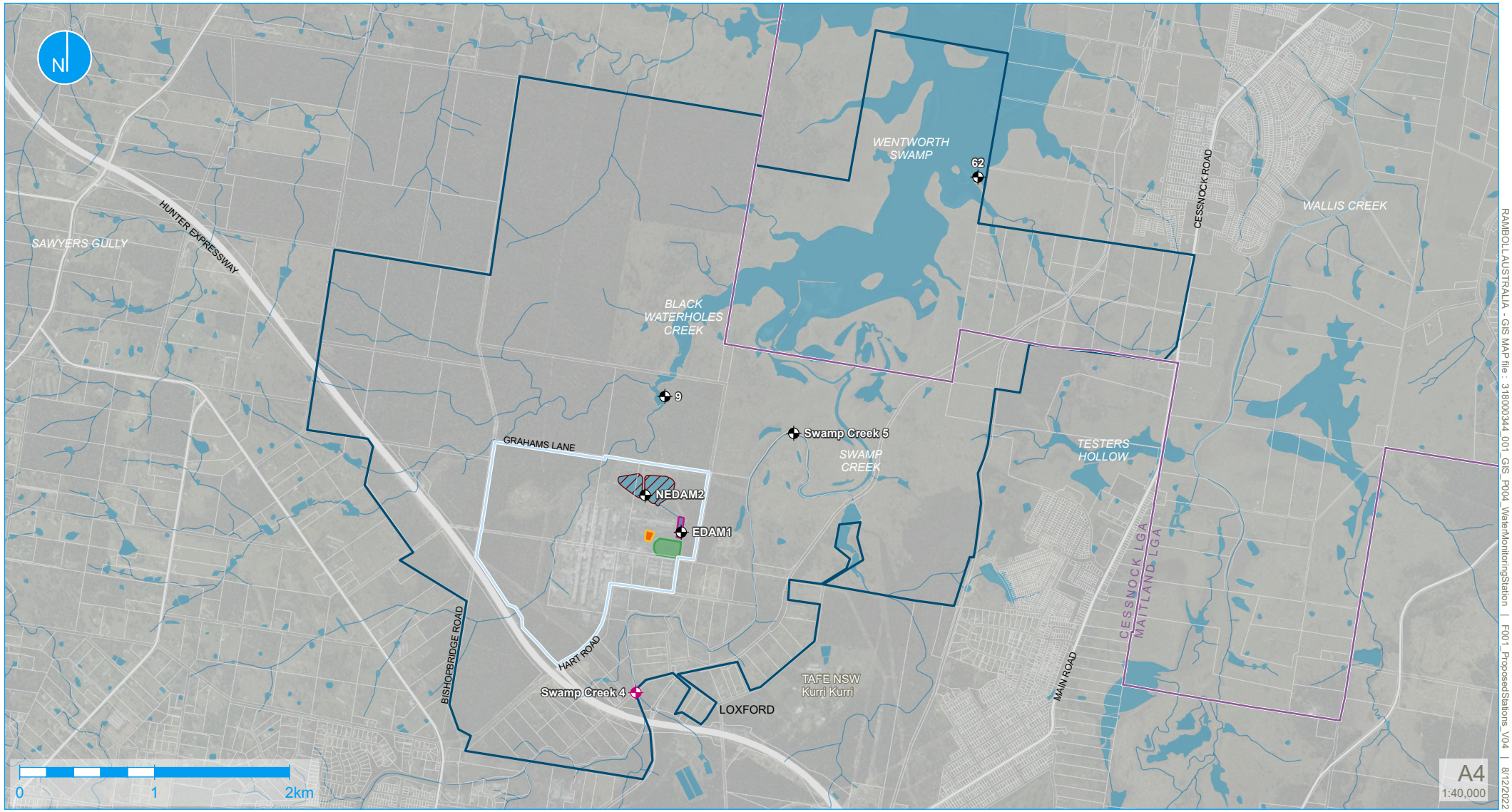
NSW EPA (2004) *Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales*

Ramboll (2018) *Remedial Action Plan, Hydro Aluminium Kurri Kurri*

Ramboll (2021) *Statement of Environmental Effects: Modification 1 to SSD 6666 - Temporary Water Treatment System*

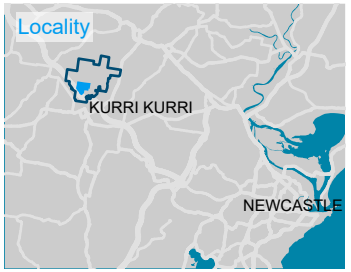
WMA Water (2019) Wallis and Swamp Fishery Creek Flood Study

APPENDIX 1
FIGURES



RAMBOLL AUSTRALIA - GIS MAP file - 318000344_001_GIS_P004_WaterMonitoringStation | F001_ProposedStations_V04 | 8/12/2022

Imagery © Department of Customer Service 2020



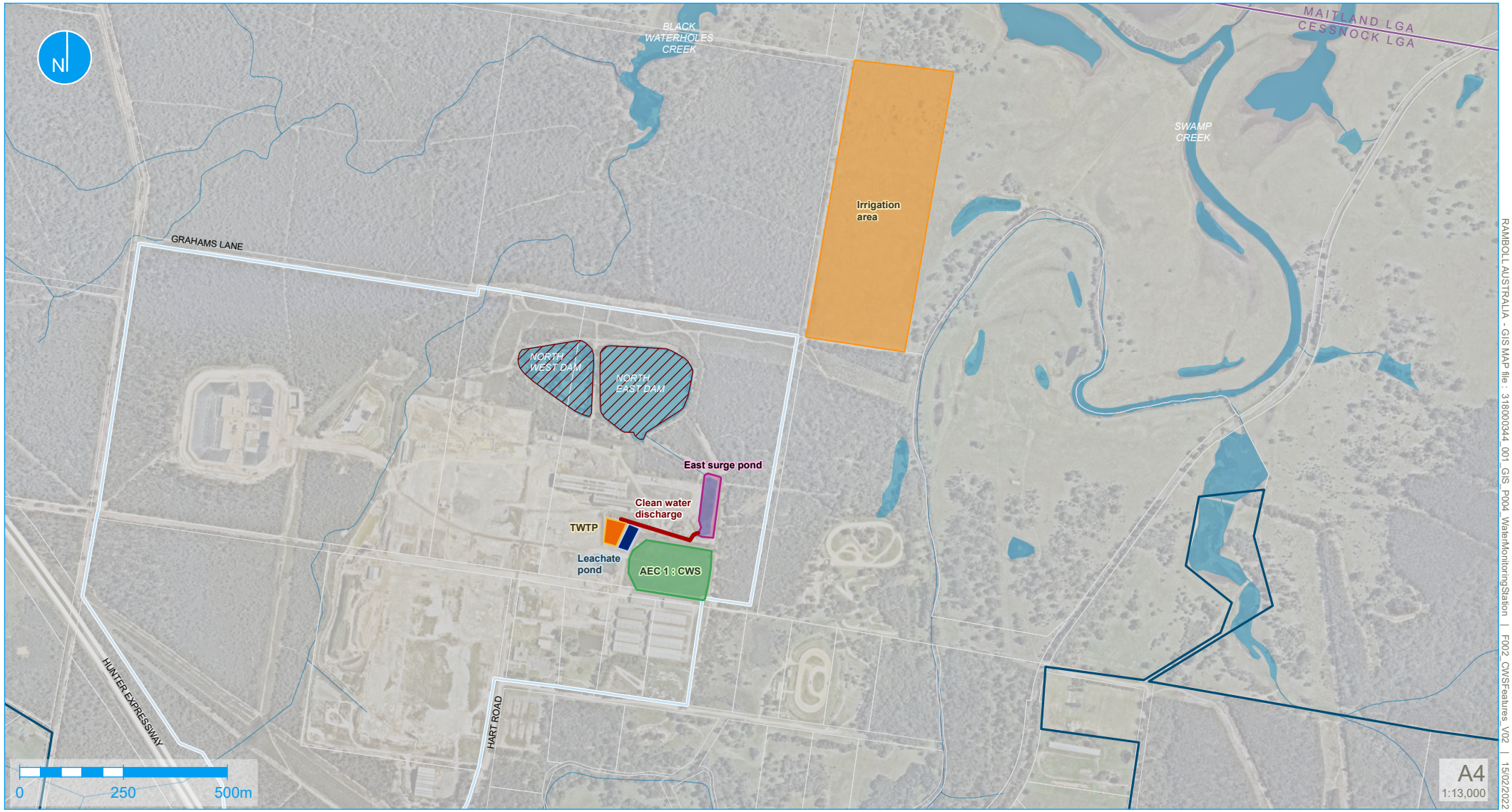
Legend

- Hydro owned land
- Smelter site
- LGA boundary
- AEC 1 : Capped waste stockpile (CWS)
- Temporary water treatment plant (TWTP)
- East Surge pond
- North dams
- Water body (NSW Spatial Serivce, 2021)

Sample locations

- Downstream sample location
- Upstream sample location

Figure 1 | Proposed Water Quality Monitoring Sampling Locations



RAMBOLL AUSTRALIA - GIS MAP file : 318000344_001_GIS_P004_WaterMonitoringStation | F002_CWSFeatures_V02 | 15/02/2022

Aerial imagery from Nearmap 15.12.2021

Legend

- Hydro owned land
- Smelter site
- LGA boundary
- AEC 1 : Capped waste stockpile (CWS)
- Temporary water treatment plant (TWTP)
- East surge pond
- North dams
- Irrigation area
- Clean water discharge
- Leachate pond
- Water body (NSW Spatial Serivce, 2021)

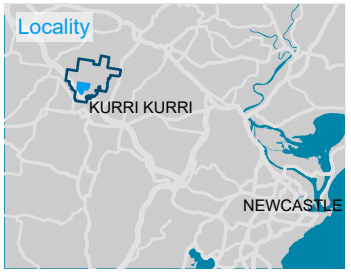


Figure 2 | Location of Capped Waste Stockpile (CWS), Treated Leachate Discharge Point and Irrigation Area

APPENDIX 2
AGENCY CONSULTATION

DOC22/33303-1

Ramboll Australia Pty Ltd.
PO Box 435
THE JUNCTION NSW 2291

Email: staylor@ramboll.com

Attention: Mr Shaun Taylor

20 January 2022

Dear Mr Taylor,

HYDRO ALUMINIUM REMEDIATION PROJECT – DRAFT MANAGEMENT PLANS

I refer to your email to the Environment Protection Authority (EPA), received on 18 January 2022, inviting the EPA to comment on the draft Temporary Water Treatment Plant Management Plan, draft Irrigation Management Plan and draft Water Quality Monitoring Program being prepared in respect of the Hydro Aluminium Remediation Project.

The EPA encourages the development of such plans to ensure that proponents and licensees have determined how they will meet their statutory obligations and designated environmental objectives.

Being a regulatory authority, the EPA's role is to administer and regulate statutes for environmental management and protection. As such the EPA does not directly get involved in the development of strategies to achieve those objectives and does not review or comment on such plans. Accordingly, the EPA has not reviewed and offers no comments on the above management plans.

If you have any questions about this matter, please contact Hamish Rutherford on (02) 4908 6824 or email info@epa.nsw.gov.au.

Yours sincerely

CLAIRE MILES
Acting Manager Metro North
Environment Protection Authority

cc. Mr Richard Brown
Hydro Aluminium Kurri Kurri Pty Ltd
Email: richard.brown@hydro.com

Department of Planning and Environment

Mr Richard Brown
Director
Hydro Aluminium Kurri Kurri Pty Ltd
PO Box 1
Kurri Kurri NSW 2327

22/03/2022

Dear Mr Brown

Hydro Kurri Kurri Aluminium Smelter Remediation (SSD-6666)
Temporary Water Treatment Plant Water Quality Monitoring Program

I refer to the **Temporary Water Treatment Plant Water Quality Monitoring Program** which was prepared to satisfy Condition B19D of Schedule 2 of the consent for SSD-6666 and submitted to the Department on 24 February 2022.

The Department acknowledges the receipt of this document, noting that it does not require approval from the Planning Secretary.

If you wish to discuss the matter further, please contact Zoe Halpin on (02) 9995 6430 or via zoe.halpin@planning.nsw.gov.au.

Yours sincerely

Sheelagh Laguna
Principal Planning Officer
Industry Assessments

As nominee of the Secretary