SUEZ Recycling and Recovery Pty Ltd

Lucas Heights Resource Recovery Park
Aquatic Habitat Monitoring Plan

April 2021

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1. Introduction

1.1 Background

The following activities are proposed at the Lucas Height Resource Recovery Park (LHRRP) and were approved on 23 January 2017 under SSD 6835:

- Reprofiling of existing landfill areas to provide up to 8.3 million cubic metres of additional landfill airspace capacity.
- Relocation and expansion of the existing garden organics (GO) facility. The existing GO facility will be relocated to the western side of the site adjacent to Heathcote Road.
- Construction and operation of a fully enclosed advanced resource recovery technology (ARRT) facility. The ARRT will be located on the western side of the site adjacent to the GO facility. Establishment of the ARRT facility will be dependent upon SUEZ securing a guaranteed, long-term waste supply to ensure that the substantial upfront investment is able to be recouped.
- Community parkland. Landfilling will cease in 2037 after which time the site will be rehabilitated and converted to community parkland, with capping and landscaping to be completed and the site made available for community use in 2039.

SSD 6835 approved consent condition C33 states:

"The Applicant shall prepare an Aquatic Habitat Monitoring Plan to monitor the stream health of Mill creek within the site. The plan shall:

(a) Be prepared by a suitably qualified and experienced person in consultation with DPI Water;

(b) Be submitted to the Secretary prior to construction of the GO facility and updated and re-submitted to the Secretary prior to construction of the ARRT Facility;

(c) Describe the monitoring locations, frequency and parameters to be measured; and

(d) Detail the measures to be implemented if monitoring indicates that habitat quality of Mill Creek is decreasing as a result of activities on the site."

A locality plan showing the locations of the LHRRP and Mill Creek is provided as Figure 1-1. The key proposed infrastructure are shown in Figure 1-2.

The construction of the GO facility and ARRT facility would be implemented in stages and water management works would similarly be staged. Staging these activities would minimise the impact of the activities by ensuring that disturbances only occur when required. During Stage 1, Mill Creek would be realigned for the development of the GO facility. Following this, further realignment of Mill Creek would occur for the construction of the ARRT facility. The staged realignment of Mill Creek is shown in Figure 1-2.

The Aquatic Habitat Monitoring Plan and Mill Creek Stream Rehabilitation, Stabilisation and Vegetation Management Plan were provided to the Natural Resources Access Regulator (NRAR) for comment. NRAR confirmed that the plans are to be reviewed by the Department of Planning, Industry and Environment (DPIE). Comments were issued by DPIE on 9 March 2020. The comments and their associated responses are included in Appendix A.

1.2 Purpose of the plan

The purpose of the AHMP is to describe the monitoring locations, and monitoring methodology to be undertaken at LHRRP, and to recommend the mitigation measures to be implemented if

the monitoring indicates that adverse effects on the habitat quality in Mill Creek have occurred as a result of activities at the site. Additionally, the AHMP includes monitoring of the effectiveness of the Mill Creek rehabilitation works, as required by Consent Condition C34.

1.3 Authors of this management plan

Qualifications of staff involved in the preparation of this AHMP are detailed below in Table 1-1.

Table 1-1 Staff and qualifications

Name	Position	Qualifications	Relevant experience
Joe Cairns	Senior Environmental Scientist – Aquatic Ecology	BEnvSc(Hons)	9+ years

1.4 Scope and limitations

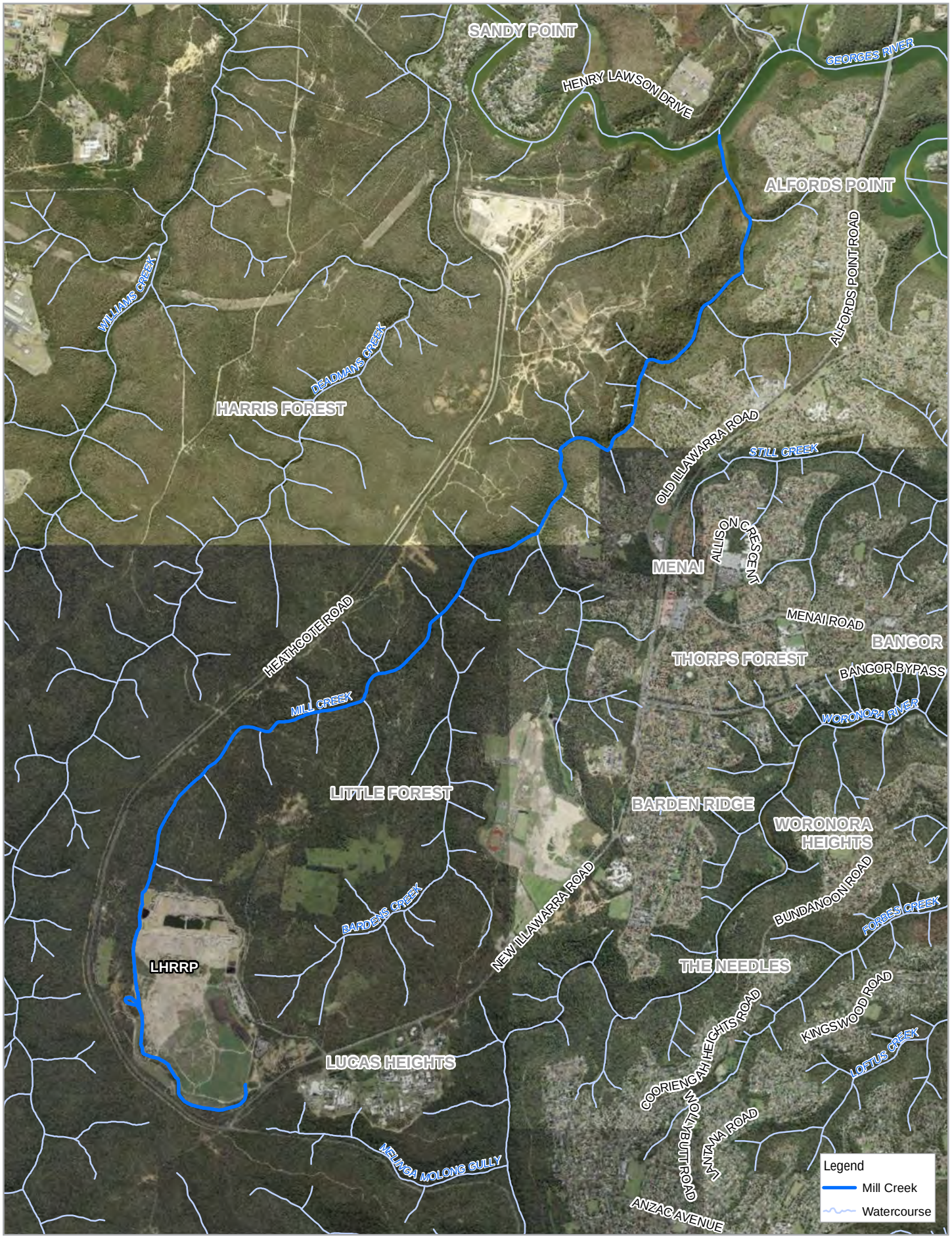
This report: has been prepared by GHD for SUEZ Recycling and Recovery Pty Ltd and may only be used and relied on by SUEZ Recycling and Recovery Pty Ltd for the purpose agreed between GHD and the SUEZ Recycling and Recovery Pty Ltd as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than SUEZ Recycling and Recovery Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.



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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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GHD

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Lucas Heights GO Facility
Aquatic Habitat Monitoring Plan

Project No. 21-12510188
Revision No. 0
Date 23/04/2021

Locality plan

FIGURE 1-1

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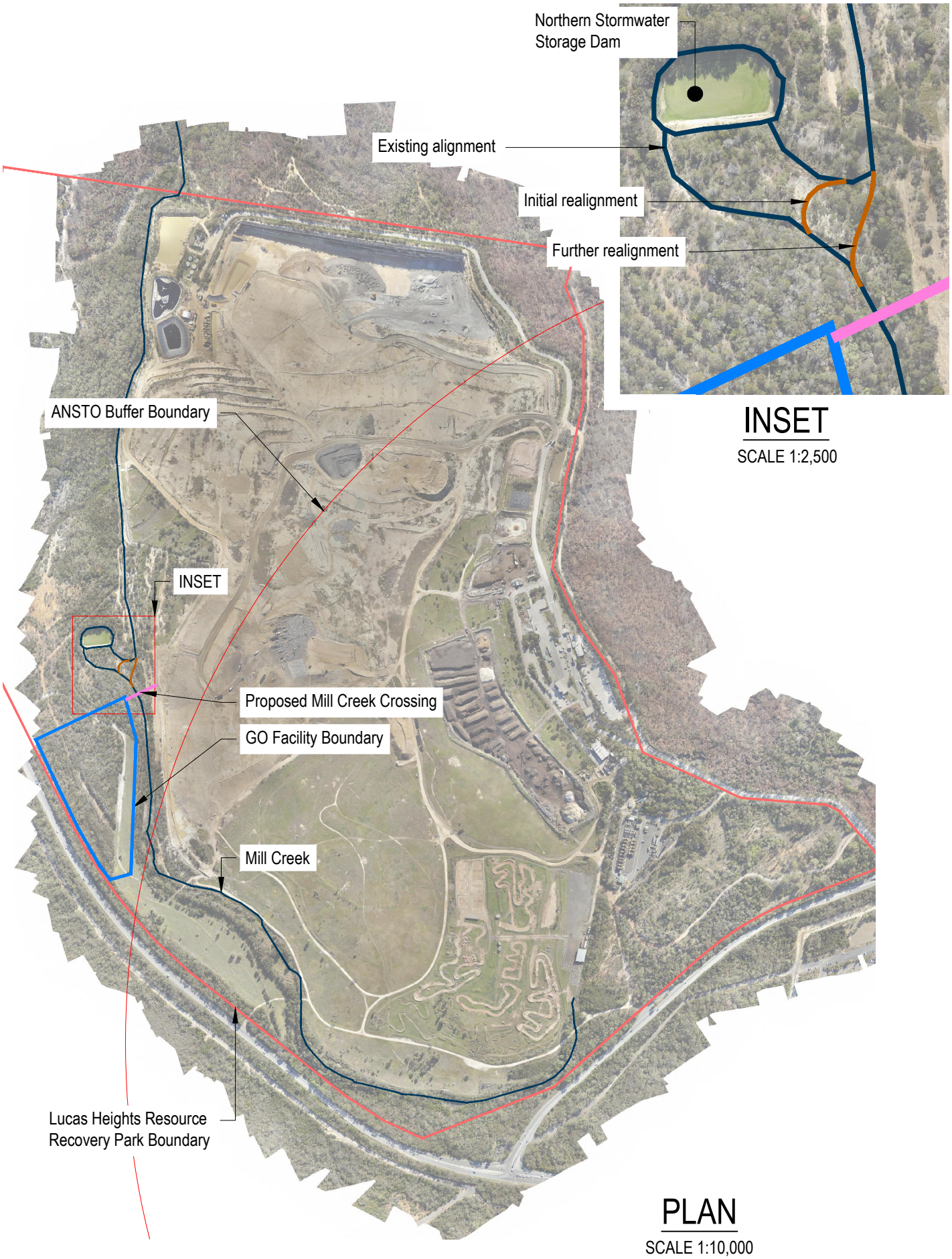

INSET

SCALE 1:2,500

PLAN

SCALE 1:10,000

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Aquatic Habitat Monitoring Plan

Key Proposed Infrastructure

Job Number	12510188
Revision	B
Date	21/04/2021

Figure 1-2

Plot Date: 21 April 2021 - 12:24 PM Plotted by: Fraser Goulding Cad File No: G:\21\12510188\CADD\Drawings\12510188-F1-2_AHMP.dwg

2. Existing environment

2.1 Mill Creek

The LHRRP is located to the north of the intersection of New Illawarra Road and Heathcote Road in Lucas Heights, New South Wales. The headwaters of Mill Creek run along the western boundary of the LHRRP, and the creek ultimately discharges into the Georges River. The locations of the LHRRP and Mill Creek are shown in Figure 1-1.

2.1.1 Hydrology

Clean stormwater runoff from the LHRRP flows towards the perimeter of the site. Surface water in contact with daily and intermediate cover is diverted to sediment and erosion control measures before being released from the site. Water drains from the site into the northerly flowing local watercourses of Mill Creek and Bardens Creek, both of which ultimately drain into the Georges River.

2.1.2 Rainfall

Rainfall data for Bureau of Meteorology station 66078 (Lucas Heights (ANSTO)) show that the average annual rainfall in the area is 1005.2 mm, based on data for 1958 to 2018.

2.2 Previous aquatic habitat monitoring

An aquatic ecosystem investigation was conducted by GHD (2015). The results of this investigation have been summarised below to document existing conditions in Mill Creek. Five sites were assessed for GHD (2015), the locations of these sites are detailed in Table 2-1 shown in Figure 2-1 below.

Table 2-1 GHD (2015) monitoring locations

Site code	Site name and location	Latitude	Longitude
MCUP	Mill Creek upstream of duck pond	-34.05119	150.96673
MC1	Mill Creek immediately downstream of LHRRP	-34.03606	150.96473
MC2	Mill Creek adjacent to MTB track	-34.03205	150.96586
MC3	Mill Creek End of Little Forest road access track	-34.02638	150.97178
MC4	Mill Creek downstream	-34.02367	150.98104

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Aquatic Habitat Monitoring Plan

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Previous aquatic monitoring locations (GHD 2015)

FIGURE 2-1

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Data source: LPI: DTDB, 2017. © Department of Finance, Services & Innovation 2017. Created by: tmorton

2.2.1 Habitat condition

The visual assessment of habitat condition in Mill Creek found that the creek channel was well defined and that the mode stream width varied between about 4 m in the upper reaches to 6 m in the lower reaches. Bank heights ranged from 0.5 to 1.5 m, and bankfull widths ranged from 10 m to 20 m. Substrate materials included bedrock, boulder, gravel, sand and clay/silt, with bedrock and clay/silt being the most common. Flow habitat types included pool and run, the only riffle habitat observed was at the furthest downstream site (MC4), though the habitat was not suitable for macroinvertebrate riffle sampling.

The riparian vegetation zone was continuous, and dominated by native species. Some clearing was observed at MC3 associated with access to the area by recreational users.

Macrophytes in the riparian zone of Mill Creek were generally emergent forms with cover ranging between 5 and 20 percent of the available habitat across the sites.

Modified Riparian, Channel and Environmental (RCE) inventory

The modified RCE inventory was established by Chessman *et al*. (1997) who modified the RCE (Petersen 1992) to suit Australian conditions. The modified RCE assesses aquatic and riparian habitats against thirteen categories providing a score ranging from 0 to 4 for each category.

A modified RCE pro-forma was completed at each site for GHD (2015), and the results have been summarised in Table 2-2. These results indicated that riparian and instream habitats adjacent to the LHRRP were generally considered to be in good condition.

Table 2-2 Summary of RCE assessment results (GHD 2015)

	MCUP	MC1	MC2	MC3	MC4
RCE total score	33	35	38	31	45
RCE status	Very good	Very good	Very good	Good	Excellent

2.2.2 Water quality

GHD (2015) undertook *in situ* water quality monitoring at each of the sites in Figure 2-1. The following parameters were measured:

- Temperature (°C)
- Electrical Conductivity (EC) (µS/cm)
- pH
- Dissolved Oxygen (DO) (% saturation and mg/L)
- Turbidity (NTU)
- Alkalinity (mg/L as $CaCO_3$)

The results of this monitoring are presented in Table 2-3, where they are compared to the ANZECC (2000) default guideline values (DGVs) for lowland rivers in south east Australia.

These results indicated that surface water in Mill Creek was of low salinity and circumneutral pH. Low DO saturations that were below the DGV range were observed at all sites except MC2, which was attributed to the oxidation of organic matter and potentially iron from groundwater contributing baseflows.

Elevated turbidity values were observed at all sites except MCUP. This was attributed to heavy rainfall occurring in the 24 hours prior to the monitoring event, and the results were not considered to reflect turbidity in Mill Creek under baseflow conditions.

Table 2-3 Results of in situ water quality monitoring (GHD 2015)

Site Code	Temp. (°C)	EC (µS/cm)	pH	DO (% sat.)	DO (mg/L)	Turbidity (NTU)	Alkalinity (mg/L)
MCUP	20.3	207	6.59	**39.3**	3.85	27.1	44
MC1	21.4	324	7.66	**81.2**	7.18	**115**	42
MC2	20.7	369	7.59	93.1	8.36	**358**	74
MC3	20.8	274	7.15	**73.8**	6.6	**125**	38
MC4	20.6	269	7.34	**84.5**	7.59	**55**	31
DGV	NA	2200	6.5-8.0	85-110	NA	50	NA

Notes:

NA indicates that there is no applicable DGV for the parameter

Results in **yellow bold** indicate exceedances of the DGVs

2.2.3 Macroinvertebrates

The following macroinvertebrate metrics were calculated by GHD (2015):

- Taxa richness
- EPT Ephemeroptera, Plecoptera, Trichoptera (EPT) richness
- SIGNAL-2 Biotic Index (Chessman 2003)

These metrics are described in detail in Section 4.5.2. The results for these metrics from GHD (2015) are summarised in Table 2-4. These results indicated that:

- Taxa richness was highest at MC2 and lowest at MC4
- There was little variability in EPT richness, which ranged from 2 to 4
- SIGNAL-2 was highest at MC4 and lowest at MCUP

Table 2-4 Summary of macroinvertebrate results (GHD 2015)

Monitoring location	Taxa richness	EPT richness	SIGNAL-2
MCUP	24	2	3.05
MC1	25	4	3.39
MC2	27	2	3.33
MC3	20	3	3.59
MC4	19	4	3.76

The NSW AUSRIVAS autumn edge model (described in Section 4.5.2) was run by GHD (2015), a summary of the results are provided in Table 2-5. These results show that the furthest upstream site, MCUP, had a macroinvertebrate community in reference condition, whereas all of the downstream sites had fewer macroinvertebrate families than expected by the model. This indicated that a potential impact on either water quality or habitat quality or both had resulted in a loss of taxa.

Table 2-5 Summary of NSW AUSRIVAS autumn edge model results (GHD 2015)

Site Code	O/E50	Band	Band Name
MCUP	0.84	A	Reference condition
MC1	0.74	B	Significantly impaired
MC2	0.73	B	Significantly impaired
MC3	0.45	C	Severely impaired
MC4	0.81	B	Significantly impaired

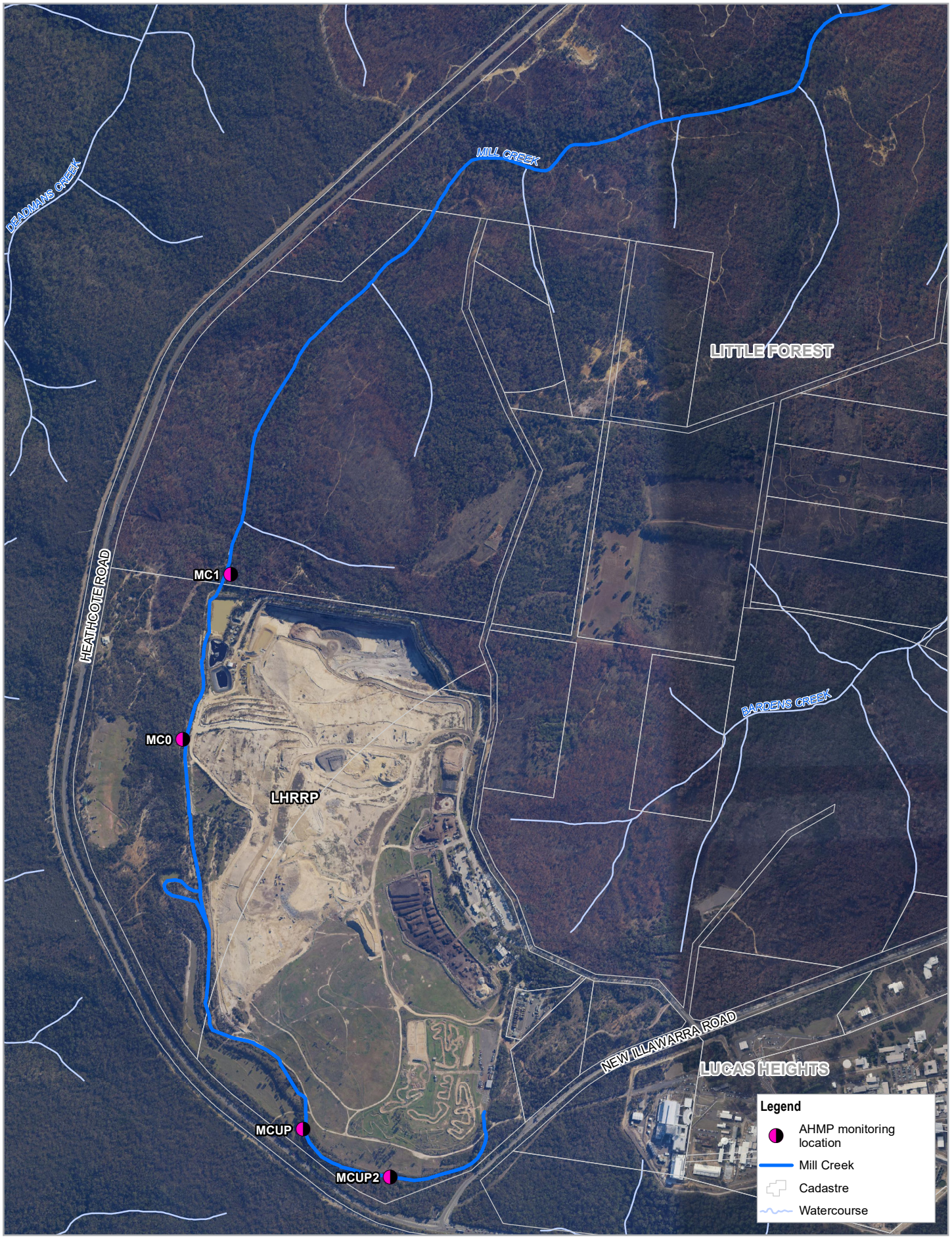
3. Site selection

The sites to be monitored under this AHMP are detailed in Table 3-1, which includes the justifications for the inclusion of the sites in the plan. The locations of these sites are shown in Figure 3-1. It is noted that the location of new site MC0 is indicative at this stage and will be determined during the first monitoring event based on site access and aquatic habitat availability.

Table 3-1 Sites to be monitored under the AHMP

Site Code	Site name	Site type	Latitude	Longitude	Justification
MCUP	Mill Creek upstream of duck pond	Reference	-34.05119	150.96673	Previous monitoring undertaken. Reference site required for assessment of impacts.
MCUP2	Mill Creek further upstream of MCUP	Reference	TBC	TBC	To provide an additional control site. Final location will be selected based on site suitability during first sampling round.
MC0*	Mill Creek downstream of proposed GO and ARRT facilities	Impact	-34.04051	150.96305	New site required for the assessment of potential impacts from the proposed GO and ARRT facilities.
MC1	Mill Creek immediately downstream of LHRRP	Impact	-34.03606	150.96473	Previous monitoring undertaken. Reference site for assessment of impacts

*Location is indicative only and to be confirmed following the first monitoring event under the AHMP. Monitoring will only occur if a suitable site is found. Monitoring of the nearby dam is to be considered if no suitable site is found on Mill Creek.



Paper Size ISO A4

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Aquatic Habitat Monitoring Plan

Project No. **21-12510188**
Revision No. **0**
Date **23/04/2021**

AHMP monitoring locations

FIGURE 3-1

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Print date: 23 Apr 2021 - 12:30

Data source: LPI: DTDB, 2017. . Created by: tmorton

4. Methodology

4.1 Basis of monitoring and assessment

The monitoring and assessment for the AHMP is to be undertaken in accordance with the following manual and guidelines:

- The Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual for New South Wales (Turak *et al.* 2004)
- The ANZECC&ARMCANZ (2000) guidelines for fresh and marine water quality
- The ANZG (2018) guidelines for fresh and marine water quality

Biannual monitoring in spring and autumn will be undertaken for the first two years after approval of the plan. Subsequent to this, as previously recommended by GHD (2015), monitoring should occur once every three years. Monitoring should occur during either the autumn or spring AUSRIVAS field seasons (15 March to 15 June, and 15 September to 15 December respectively) (Turak *et al*. 2004).

The first monitoring event as per this AHMP should occur prior to the construction of the GO facility to allow for the collection of baseline data at new site MC0.

The methodology described herein has been developed to allow for a Before After Control Impact (BACI) design assessment.

4.2 Aquatic habitat assessment

The aquatic habitat at each of the sites will be monitored using modified NSW AUSRIVAS field sheets, based on visual estimates of characteristics such as stream bed composition (percentage of each substrate category e.g. sand and cobble), aquatic and riparian vegetation cover, amount of in-stream detritus, and other types of aquatic micro-habitats. The mean wetted width and mean depth will also be estimated.

Assessments will include sketches of the longitudinal and cross-sectional profiles of the reach assessed, showing each biological sampling site, locations where photos are taken and where *in situ* water quality is measured, and the riparian zone width, type and height. The cross-section sketch will include the approximate bank height, stream width and depth, and the approximate height of riparian vegetation.

A modified RCE proforma (Chessman *et al*. 1997 and Peterson 1992) will be completed based on visual estimates of the following characteristics:

- Streambed composition (percentage of total composition for each substrate category)
- Aquatic and riparian vegetation cover and structure
- Percentage cover of in-stream organic material
- Types of aquatic habitat
- Percentage of canopy cover and shading
- Average width (wetted width in metres)
- Average depth

These field data are to be recorded by qualified and experienced aquatic ecologists.

4.3 Water quality sampling

4.3.1 In situ water quality

The following *in situ* physical and chemical parameters are to be measured at each sampling site using a water quality meter:

- Temperature (°C)
- pH (pH units)
- Electrical Conductivity (EC) (µS/cm) as specific conductance
- Dissolved Oxygen (DO) (mg/L and % saturation)
- Turbidity (NTU)

4.3.2 Laboratory analysis

At each sampling site, grab samples will be collected for analysis at a National Association of Testing Authorities (NATA) accredited laboratory. The analyses to be performed are listed in Table 4-1. Samples requiring analysis of dissolved metals were field filtered using a dedicated high volume 0.45 micrometre (µm) filter prior to collection in the sample bottle.

Table 4-1 Water quality analytes

Category	Analytes
Physical properties/ Organics	pH, EC, Total dissolved solids (TDS), total suspended solids (TSS), dissolved organic carbon (DOC), hardness.
Anions	Chloride (Cl), sulfate (SO_4), alkalinity, fluoride (F).
Cations	Calcium (Ca), magnesium (Mg), sodium (Na), potassium (K).
Metals (total and dissolved)	Aluminium (Al), arsenic (As), boron (B), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), zinc (Zn).
Nutrients	Total nitrogen (TN), total phosphorus (TP), nitrite + nitrate as N (NO_x), nitrate (NO_3), nitrite (NO_2), total kjeldahl nitrogen (TKN), reactive phosphorus, ammonia (NH_3).

4.4 Macroinvertebrate sampling

4.4.1 Field sampling

Field sampling following Rapid Bioassessment (RBA) protocols will be undertaken in accordance with the NSW AUSRIVAS Sampling and Processing Manual (Turak *et al*. 2004). The AUSRIVAS program is a nationally recognised, standardised sampling protocol used to assess the health of Australian Rivers and developed for Australia's National River Health Program. Sampling is to be undertaken using a standard ISO 7828 (1983) design sweep-net with 250 µm mesh. Nets are to be washed thoroughly between sampling events to remove any macroinvertebrates that may be retained on them.

One sample is to be collected from edge habitat at each site (where sufficient water is available). Edge habitat is defined as areas of little or no flow within 0.5 m of the bank including backwaters. Areas of detritus, overhanging vegetation and roots and macrophyte are targeted microhabitats within edge habitat. Sampling of the edge habitat is undertaken by sweeping the net in an upwards direction, perpendicular to the bank. This process is continued over approximately 10 m of edge habitat, working in an upstream direction.

It is considered unlikely that riffle habitat (fast shallow water over rocky substrate) will be encountered in Mill Creek. However, in the case that sufficient riffle habitat is encountered at a site, one riffle sample is to be collected at the site. The collection of the riffle samples is undertaken by the positioning the net immediately downstream of the sample area, followed by the sampler moving upstream whilst disturbing the substrate, making sure to dislodge stones and other debris. Smaller stones are turned and rubbed by hand to dislodge attached macroinvertebrates into the net. Sampling continues until a total distance of 10 m has been covered.

For each RBA sample, the collected material is to be placed into a sorting tray and macroinvertebrates picked for a minimum of 40 minutes by qualified and experienced aquatic ecologists using forceps and pipettes. If new taxa are found between 30 and 40 minutes, sorting is to continue for a further 10 minutes. This processing cycle is continued for up to a total maximum sorting time of 1 hour.

The objective of the RBA sorting protocol is to obtain a sample containing as diverse a fauna as possible (and hence provide a useful measure of taxa richness). Attempts should be made to avoid bias towards abundant taxa and to collect all taxa present in the sample, including rare or cryptic animals. Samples are preserved in 70 percent ethanol and clearly labelled with information including site, habitat, sampling method, date and sampler.

4.4.2 Laboratory processing and identification

Macroinvertebrates are to be identified to family level using published taxonomic keys (Hawking 2000). Identifications should follow standard conventions of the NSW AUSRIVAS sampling and processing manual (Turak *et al.* 2004). Upon completion of identifications all samples are to be returned to 100 percent ethanol for long-term archiving. This process allows samples to be re-examined at a later date if required.

4.5 Data analysis

4.5.1 Water quality

Water quality results are to be compared to Australian and New Zealand Guidelines for Fresh and Marine Water Quality. The following DGVs are recommended for the assessment of water quality:

- DGV ranges for physical and chemical stressors outlined in Table 3.3.2 of the ANZECC (2000) guidelines
- DGV ranges for conductivity (EC) and turbidity outlined in Table 3.3.3 of the ANZECC (2000) guidelines
- Toxicant DGVs for protection of 95 percent of freshwater species as outlined in ANZG (2018)

The ANZECC (2000) and ANZG (2018) DGVs relevant to the project are presented in Table 4-2 below. It is noted that these DGVs are not intended as performance criteria. Exceedance of these DGVs should trigger further investigation into the likely cause, and assessment of monitoring results based on a weight of evidence approach as recommended by ANZG (2018). The relevant Environment Protection Licence (EPL) 5065 100 percentile concentration limits for Licensed Discharge Point (LDP) 1 are also presented in Table 4-2.

Dissolved metal and metalloid concentrations are more applicable for comparison to the DGVs than total metals, as they are more representative of the bioavailable fractions of metals and metalloids within the water. Therefore, it is recommended that only metal and metalloid results be compared to the DGVs.

Table 4-2 ANZECC (2000) and ANZG (2018) DGVs relevant to the project

Analyte	Units	ANZECC (2000)/ ANZG (2018) DGV	EPL 5065 limits for LDP1
Physicochemical parameters			
EC	µS/cm	2200	1500
pH	pH units	6.5-8.0	5.5-8.5
DO	% sat	85-110	NA
Turbidity	NTU	50	NA
Dissolved metals			
Aluminium (pH > 6.5)	mg/L	0.055	NA
Arsenic (AsV)	mg/L	0.013	NA
Boron	mg/L	0.370	NA
Cadmium	mg/L	0.0002	NA
Chromium (CrVI)	mg/L	0.001	NA
Copper	mg/L	0.0014	NA
Lead*	mg/L	0.0034	NA
Manganese	mg/L	1.9	NA
Mercury	mg/L	0.0006	NA
Nickel	mg/L	0.011	NA
Selenium	mg/L	0.011	NA
Zinc	mg/L	0.008	NA
Nutrients			
Ammonia	mg/L	0.9	2.5
Nitrite + Nitrate (NO_x)	mg/L	0.015	NA
Total Nitrogen	mg/L	0.25	NA
Total Phosphorus	mg/L	0.02	NA
Reactive Phosphorus	mg/L	0.015	NA

4.5.2 Macroinvertebrates

Univariate data analysis routines are recommended in order to identify spatial and/or temporal trends in the macroinvertebrate communities of Mill Creek. Univariate indices concentrate mainly on assessing the condition or “health” of the macroinvertebrate community

The univariate techniques employed on macroinvertebrate data are to include:

- Taxa richness
- Ephemeroptera, Plecoptera, Trichoptera (EPT) richness
- SIGNAL-2 Biotic Index (Chessman 2003)
- NSW AUSRIVAS Model

Taxa Richness

Total taxa richness refers to the number of different taxa (usually families) contained in a sample.

EPT richness

The EPT richness is the number of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) families present in a sample. The animals within these three Orders tend to be sensitive to pollution and other disturbances, making them a useful indicator of in-stream health.

SIGNAL-2

SIGNAL-2 (Stream Invertebrate Grade Number Average Level - Version 2) (Chessman 2003) is a simple scoring system for macroinvertebrate communities in Australian rivers. SIGNAL-2 is a biotic index based on pollution sensitivity values (grade numbers) assigned to macroinvertebrate families. Grade numbers have been derived from published and unpublished information on the tolerance of macroinvertebrate families to pollutants such as sewage, salinity and nitrogenous nutrients (Chessman 1995). Each taxon is assigned a grade from 1 (tolerant) to 10 (sensitive) based on the ecotoxicology assessment data. The average of the grades for each site is used as the SIGNAL-2 score. Animals that cannot be identified to family level are excluded from this analysis to avoid “double-counting”.

NSW AUSRIVAS Model

NSW AUSRIVAS Model provides a river health assessment based on predictive models of macroinvertebrate distribution. The AUSRIVAS assessment compares the macroinvertebrates collected at a site (Observed) to those predicted to occur (Expected), based on the physical characteristics of the site, and the ratio derived (the OE50) indicates the condition of the macroinvertebrate community. The upper limits for NSW-combined season-edge are provided in Table 4-3, along with the AUSRIVAS band labels, names and descriptions.

Table 4-3 Eastern NSW combined season edge AUSRIVAS bands and descriptions

Band Label	Upper Limit	Band Name	Band Description
Band X	Infinity	More biologically diverse than reference sites	More taxa found than expected. Potential biodiversity hot-spot. Possible mild organic enrichment.
Band A	1.17	Reference condition	Most/all of the expected families found. Water quality and/or habitat condition roughly equivalent to reference sites. Impact on water quality and habitat condition does not result in a loss of macroinvertebrate diversity.
Band B	0.82	Significantly impaired	Fewer families than expected. Potential impact either on water quality or habitat quality or both, resulting in loss of taxa.
Band C	0.48	Severely impaired	Many fewer families than expected. Loss of macroinvertebrate biodiversity due to substantial impacts on water and/or habitat quality.
Band D	0.14	Extremely impaired	Few of the expected families remain. Extremely poor water and/or habitat quality. Highly degraded.

4.6 Quality assurance

4.6.1 Water quality

One duplicate water sample is to be taken per sampling event. The collection of the duplicate occurs at the same time as the collection of the primary sample. The collection of duplicate water sample allows for the assessment of the potential level of uncertainty associated with sampling method, preservation, transport or laboratory analysis.

4.6.2 Macroinvertebrates

One macroinvertebrate sample per sampling event is to be examined by a second taxonomist to check the accuracy of the identifications made.

4.7 Reporting

Reporting for the AHMP is to occur following each monitoring event.

5. Mitigation measures

If the monitoring for this AHMP indicates that the habitat quality of Mill Creek is decreasing as a result of activities on the site (as indicated by reporting as per Section 4.7), the potential mitigation measures detailed in Table 5-1 are to be considered.

In addition to the mitigation measures detailed in Table 5-1, a construction environmental management plan (CEMP) will be prepared prior to the construction of the GO facility. The CEMP will also detail mitigation measures for the potential impacts of the project, and will include the AHMP as an appendix.

Table 5-1 Mitigation measures for potential impacts to aquatic habitat in Mill Creek

Impact	Mitigation measures
Elevated turbidity observed in Mill Creek during AHMP monitoring.	Investigate potential causes for the elevated turbidity. Install and maintain sediment control devices as per the Erosion and Sediment Control Plan. This should focus on exposed areas and earthworks close to Mill Creek. Avoid use of vehicles within the Mill Creek riparian buffer zone.
Elevated nutrient concentrations associated with the risk of algal blooms	Identify the source of elevated nutrient concentrations and limit runoff or discharge from the source. Consider release of environmental flows from site storages to minimise the risk of low eutrophication and low DO. Install and maintain clean water diversion drains around facilities and construction areas.
Decline in water quality	Investigate the potential cause of the decline in water quality taking into account climatic conditions. Assess and implement measures to improve water quality, e.g. a rip-rap cascade may improve oxygenation and thereby reduce metal concentrations through precipitation.
Introduction of aquatic weeds to Mill Creek	The Mill Creek crossing is to be designed in a manner that minimises the chance of seed dispersal from vehicles carrying unprocessed green waste. Transported loads of unprocessed green waste are to be covered wherever possible. Washdown of trucks will occur prior to the transport of mature product. Removal of any observed aquatic weeds as per the Vegetation and Fauna Management Plan.
Aquatic habitat loss	Minimise the project footprint in riparian zone. The riparian buffer zone will be fenced to establish its boundaries prior to the commencement of construction activities. If habitat loss occurs as a result of elevated flow velocities during construction activities, logs and branches from clearing could be introduced to the watercourse to provide submerged woody habitat. Revegetation of any exposed riparian areas will provide macrophyte, detritus and submerged woody habitats over the longer term.

6. Conclusion

This AHMP has been prepared to meet the SSD 6835 approved consent condition C33. Monitoring is to be undertaken at four locations along Mill Creek initially biannual for the first two years and then every three years, with the first monitoring event to occur prior to the construction of the GO facility. Habitat condition, water quality, and macroinvertebrate community condition are to be assessed, allowing for a weight of evidence and BACI design assessment, in line with the key guidelines for stream health assessments.

Potential mitigation measures have been detailed and are to be implemented in the case that assessment under this AHMP indicates that habitat quality in Mill Creek has decreased as a result of LHRRP activities.

This plan should be reviewed and re-submitted to the Secretary prior to construction of the ARRT Facility, as stipulated by approved consent condition C33.

7. References

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Appendices

Appendix A – DPIE Comments and Response

Table A-1 - DPIE Comments and Associated Responses

Item No	Comment	Provided in plan to NRAR	Response
Aquatic Habitat Monitoring Plan			
1	More frequent sampling of macroinvertebrates and water quality parameters is required. Macroinvertebrate sampling should be undertaken at six-monthly intervals at a minimum.	Monitoring once every three years.	The AHMP has been changed to include biannual monitoring in autumn and spring for the first two years after approval of the plan. Subsequent to this monitoring once every three years would be undertaken.
2	The use of a modified BACI design with multiple local control sites to enable the linking of any impacts to the garden organics facility should be incorporated.	Monitoring of one upstream site and one downstream site, with commencement of monitoring prior to the construction of the GO facility.	An additional control site has been included in the plan. To increase statistical power, an additional site downstream of the GO facility will also be added to the AHMP.
3	The use of quantitative macroinvertebrate sampling techniques, identification to genus taxonomic level and more robust statistical techniques should be incorporated.	Non quantitative sampling. Identification to family taxonomic level. Univariate data analysis only.	GHD believes that the proposed monitoring program is sufficient in terms of the ability to detect impact to macroinvertebrate communities. The proposed monitoring is consistent with the existing NSW guidelines (Turak et al. 2004). The SIGNAL-SG biotic index exists for interpreting genus level macroinvertebrate data, however SIGNAL-SG was developed for use in assessing the impacts of sewage treatment plant discharges, so may not be relevant for assessing the potential impacts of the GO facility on aquatic communities in Mill Creek. The use of SIGNAL-SG is not included in the relevant guidelines (Turak et al. 2004), so further justification of quantitative macroinvertebrate

			sampling techniques and genus level identification would be required before inclusion in the AHMP. Multivariate statistical techniques, such as SIMPER, PERMANOVA and MDS will be included in the AHMP.
4	Water quality sampling after rainfall events which produce runoff from the facility grounds is required.	Responsive sampling not proposed.	Responsive water quality sampling during the construction phase will be detailed in information accompanying the detailed design, as required under consent condition C32c, as well as in ongoing EPL compliance monitoring
Mill Creek Stream Rehabilitation, Stabilisation and Vegetation Management Plan			
5	The management plan outlines the following: a) Two small sections of Mill Creek to be realigned; b) Existing channel to be filled to form access road; c) Culverts to be installed for the access road across Mill Creek and existing culvert and crossing is to be removed; d) Two existing swales to be terminated and removal of right hand bank; e) Construction of an earthern diversion bund; 2 f) The plan outlines suitable vegetation species and densities for revegetation of the site with a 24 month maintenance period;		No response required
6	The plan has not committed to the minimum requirements for a 1st order vegetated riparian zone (VRZ). The project is to review the potential areas where the impacted VRZ can be offset should a minimum VRZ not be achieved	After completion of landfilling at the site a minimum vegetated width of 10 metres outside the top of bank would be provided where not already achieved, other than over waste capping where provision of riparian vegetation would provide a net negative environmental outcome.	In the vicinity of the proposed realignment the 10 m VRZ requirement is generally achieved. In localised areas where not achieved much greater than the VRZ width is achieved on the other side of the realignment. The realignment does not reduce VRZ widths

			with these maximised to their fullest extent by maintaining and providing a riparian zone up to the edge of waste capping.

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	F Li	R Towner	On File	D Gamble	On File	23/04/2021

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