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BURNIE WASTE MANAGEMENT CENTRE

WETLAND EPN 9421/2 ANNUAL ENVIRONMENTAL REVIEW
JULY 2022 – OCTOBER 2023

December 2023

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ABBREVIATIONS

The following terms are used in the document.

Abbreviation or acronym	***What it stands for***
AEST	*Australian Eastern Standard Time*
BCC	*Burnie City Council*
BoM	*Bureau of Meteorology*
BWMC	*Burnie Waste Management Centre*
EFF1	*Monitoring Location – Effluent 1*
EFF2	*Monitoring Location – Effluent 2*
EPN	*Environmental Protection Notice*
GW01	*Monitoring Location – Groundwater 1*
INF	*Monitoring Location – Header Tank*
IB	*Infiltration Basin(s) - Wet Infiltration Forest*
LOR	*Limit of Reporting*
MH01	*Monitoring Location – Manhole 1*
QA/QC	*Quality Assurance/Quality Control*
SB04	*Monitoring Location – also EFF1*
SYR	*Syrinx Environmental*

EXECUTIVE SUMMARY

The Burnie Waste Management Centre (BWMC) at 289 Mooreville Rd, Burnie, Tasmania operates a Leachate Treatment Wetland system for treatment and disposal of leachate generated from Stage 1 landfill. The wetland operates under Environmental Protection Notice (EPN) 9421/2 (draft revision of EPN 9421/1) which governs the operation of the system and provides specific water quality trigger values to assess compliance. This report is the Annual Wetland Environmental Review required under Condition G8.

Annual water quality sampling was undertaken by Syrinx Environmental PL during the reporting period of July 2022 to October 2023 to determine the compliance of the system with the conditions of the EPN. During the reporting period, the mean concentration of the key water quality parameters (ammonia, chromium, copper, nickel, and zinc) did not exceed trigger concentrations set out within the EPN (see Table 1). As such, the **system was deemed compliant** with the water quality conditions in the Environmental Protection Notice 9421/2 during the reporting period.

Table 1. System compliance with the water quality trigger limits listed in EPN 9421/2

Date range of data: Sep-22 to Oct-23

Water Quality Parameter	EPN Condition	Sampling Location	Mean Concentration **	Maximum Concentration	EPN Trigger Limit	Unit	Compliance with EPN 9421/2
Ammonia	EF1 - 1	EFF2	0.193	0.510	1.61	mg/L	✓
	EF2 - 1	EFF1	0.692	1.200	1.61		✓
Chromium (total)	EF2 - 3*	EFF1	0.0005	< 0.001	0.0010		✓
Copper (total)			0.0006	< 0.001	0.0014		✓
Nickel (total)			0.0055	0.0060	0.0110		✓
Zinc (total)			0.0025	<0.005	0.0080		✓

Legend

✓ Water quality parameter is below the respective trigger limit defined in EPN 9421/1

✘ Water quality parameter exceeds the respective trigger limit defined in EPN 9421/1

* It has been assumed that the EPN trigger limits for metals were intended to be in µg/L rather than mg/L as was printed in the EPN. The higher, less stringent values printed in the EPN have been converted accordingly by a factor of 1000 and have been used in the above table.

** The arithmetic mean was used to calculate these values. Where a concentration was below the limit of detection, the concentration was taken at 50% of the limit of detection to enable the calculation.

ANNUAL WETLAND ENVIRONMENTAL REVIEW

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

Burnie City Council (BCC) owns and operates the Burnie Waste Management Centre (BWMC) at 289 Mooreville Road, Burnie Tasmania (hereafter, "the site"). Within the BWMC, a Leachate Treatment Wetland system (hereafter referred to as "the system") has been constructed to treat and dispose of leachate generated from the Stage 1 landfill area. The system was constructed in late 2016 with the commissioning period completed in June 2017; the operational phase commenced in July 2017.

An overall site map is provided in Figure 1 showing the various components and sampling locations within the system. A brief description of the wetland function is provided in Section 2.1 and is discussed in greater detail in previous Annual Environmental Reports.

Since July 2022 the site has operated under Environmental Protection Notice (EPN) 9421/2 (hereafter, "the EPN"), which is a draft revised edition of the original EPN 9421/1, issued on the 5th of February 2016 by the Tasmanian Environmental Protection Agency (EPA). The revised EPN included all of the same conditions as the original, except for a reduction in sampling frequencies to annual for all analytes not already monitored remotely. This reduction was granted based on the system's ongoing and consistent performance since commissioning.

1.2 EPN 9421/2 MONITORING AND REPORTING REQUIREMENTS

A summary of the EPN Conditions that relate to the Annual Environmental Review is presented in Table 2 This Annual Wetland Environmental Review covers the reporting period from the 1st of July 2022 to the 31st of October 2023 in fulfilment of Condition G of the EPN. Continuous (telemetric) monitoring and annual sampling are performed as required by the EPN to ensure system compliance and efficacy. These requirements are fully outlined in the EPN and discussed in further detail in previous Annual Environmental Reports.

Note, the last report produced for EPN 9421/1 covered the then annual reporting period of July 2021 – June 2022. Since then, sampling was conducted in July, August, September, and October of 2022, and most recently in October 2023 (full annual sampling suite). As such, the period of time from July - October 2022 lies outside of this 'annual' reporting period. For the ease of interpretation, many graphs and statistics within this report have been organised to cover the previous 12 or 24 months from October 2023, and do not strictly cover the July – October 2022 period (*i.e.,* rainfall and flows). Despite this, chemical analytes which have an EPN condition associated have been reported on to fully include the July – October 2022 period (*i.e.,* effluent water quality), allowing for a full interpretation of the data collected since the last report was produced against EPN conditions.

This report should be read in conjunction with several other documents which include:

- Burnie Waste Management Centre Stage 1 Landfill Leachate Treatment Wetland Development Proposal & Environmental Management Plan (DPEMP);

- Relevant technical drawings;
- Environmental Protection Notice 9421/1;
- Environmental Protection Notice 9421/2 (draft version);
- BWMC Operation and Maintenance Manual (O & M Manual); and
- Previous annual report(s).

The DPEMP contains detailed design information, historical water quality and volumetric data including the modelling used to inform the system's design. The O & M Manual contains information about the system layout and operational details. All water quality data collected during monitoring events is compiled into a comprehensive, system-specific database which is used to assess performance and any changes within the treatment system.

Table 2 Summary of EPN 9421/2 (draft) Conditions that relate to the Annual Environmental Review

G8 - Annual Environmental Review	
1	Unless otherwise specified in writing by the Director, a publicly available Annual Environmental Review for the activity must be submitted to the Director each year within three months of the end of the reporting period. Without limitation, each Annual Environmental Review must include the following information:
1.1	A statement by the General Manager, Chief Executive Officer or equivalent for the activity acknowledging the contents of the Annual Environmental Review;
1.2	Subject to the Personal Information Protection Act 2004, a list of all complaints received from the public during the reporting period concerning actual or potential environmental harm or environmental nuisance caused by the activity and a description of any actions taken as a result of those complaints;
1.3	Details of environment-related procedural or process changes that have been implemented during the reporting period;
1.4	A summary of the amounts (tonnes or litres) of both solid and liquid wastes produced and treatment methods implemented during the reporting period. Initiatives or programs planned to avoid, minimise, re-use, or recycle such wastes over the next reporting period should be detailed;
1.5	Details of all non-trivial environmental incidents and/or incidents of non compliance with these conditions that occurred during the reporting period, and any mitigative or preventative actions that have resulted from such incidents;
1.6	A summary of the monitoring data and record keeping required by these conditions. This information should be presented in graphical form where possible, including comparison with the results of at least the preceding reporting period. Special causes and system changes that have impacted on the parameters monitored must be noted. Explanation of significant deviations between actual results and any predictions made in previous reports must be provided;
1.7	Identification of breaches of limits specified in these conditions and significant variations from predicted results contained in any relevant DPEMP or EMP, an explanation of why each identified breach of specified limits or variation from predictions occurred and details of the actions taken in response to each identified breach of limits or variance from predictions;
1.8	A list of any issues, not discussed elsewhere in the report, that must be addressed to improve compliance with these conditions, and the actions that are proposed to address any such issues;
1.9	A summary of fulfilment of environmental commitments made for the reporting period. This summary must include indication of results of the actions implemented and explanation of any failures to achieve such commitments; and
1.10	A summary of any community consultation and communication undertaken during the reporting period.

1.2.1 Relationship with Other EPN's and Compliance Documents

The EPA has issued two Environmental Protection Notices and one Environmental Approval in relation to activities onsite at the BWMC:

- Environmental Protection Notice No. 9161/2, known as the 'Site EPN' which comprises quarterly monitoring (7 locations on site), and annual reporting.

- Environmental Approval M481808 ck (hereafter, "EA M481808 ck"), which relates to EPA approval to treat and apply manganese-contaminated sludge on site. On the 4th July 2019, the EPA approved BCC to continue the onsite storage, treatment, and reuse of manganese-contaminated sludge from the landfill leachate wetlands treatment system subject to the conditions of "EA M481808 ck".

This report is a requirement under 'draft EPN 9421/2' which specifically covers the Stage 1 Leachate Treatment Wetland system.

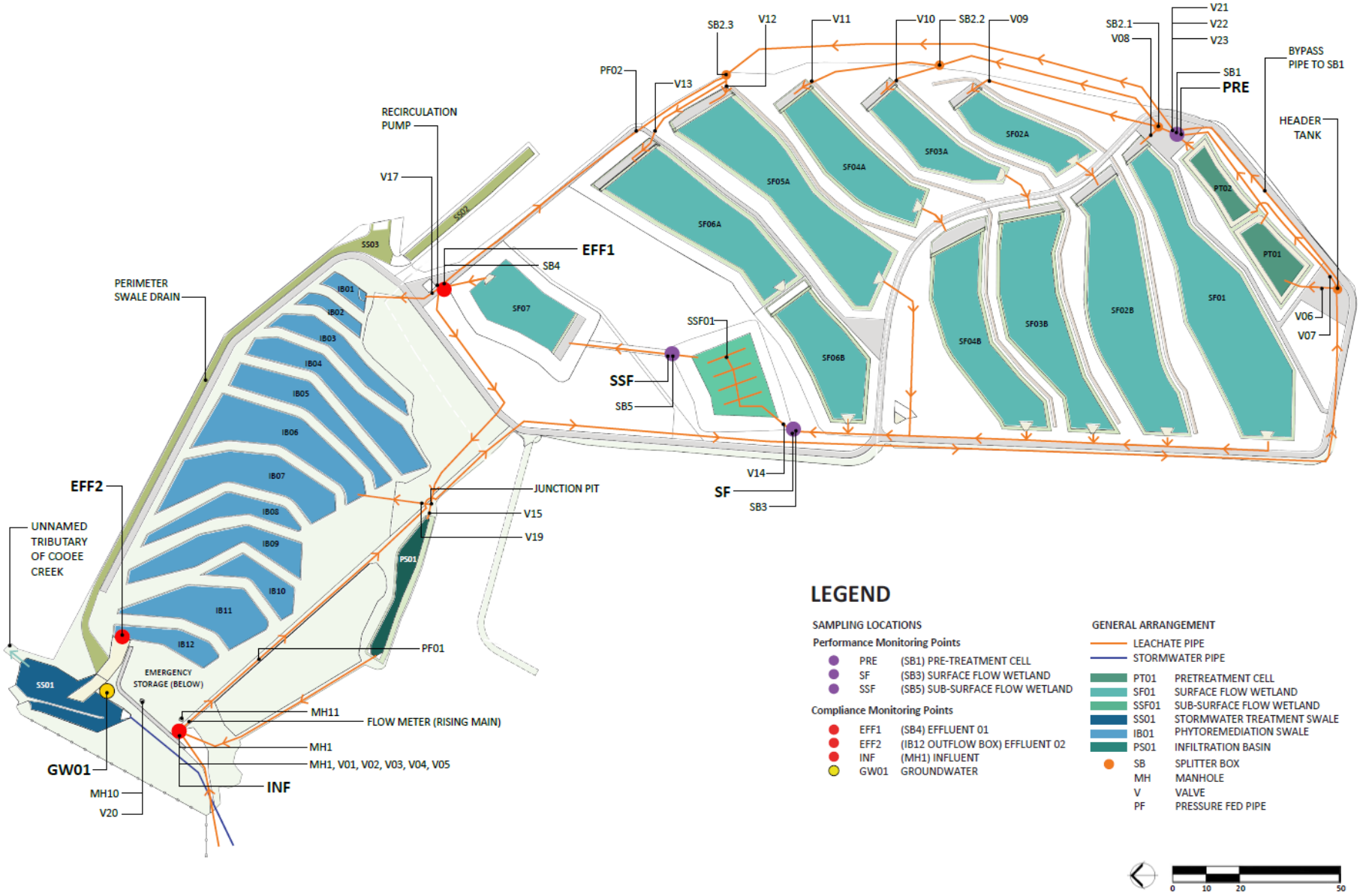


Figure 1: Schematic of the treatment system and compliance monitoring locations sampled to satisfy EPN 9421/2.

2.0 SYSTEM MONITORING SAMPLING PLAN (CONDITIONS G8 1.6, M2, M3, M4, M5, M6)

2.1 SITE DETAILS

A site map depicting system components and sampling locations within the system is shown in Figure 1. Stage 1 landfill leachate is collected within Manhole 1 (MH1) from where it is pumped to the Header Tank (the "INF" monitoring location). Leachate is treated throughout the system and eventually flows to the Wet Infiltration Forest (EFF1) before discharging into an unnamed tributary of Cooee Creek at EFF2. The system's function is discussed in greater detail in previous annual reports (Syrinx, 2022a & Syrinx, 2022b).

2.2 REFERENCES TO GUIDELINES (CONDITIONS M3-1.1)

Sample collection was conducted by qualified Syrinx Environmental (Syrinx) staff in line with the methodology outlined in the Australian/New Zealand Standards for Water Quality Sampling (AS/NZS 5667.1:1998).

2.3 SAMPLING LOCATIONS AND FREQUENCY

The original iteration of the EPN outlined a suite of surface water and groundwater sampling with various parameters being sampled from a monthly to annual frequency. On the 21st of February 2023, the EPA issued a draft update of EPN 9421/2. The primary change included in this update was a reduction of all surface water and groundwater sampling frequencies to annual, for all parameters except for those which are monitored remotely (ammonia, electrical conductivity, pH, temperature, and flow) as required by Condition M2 of the EPN (Appendix 1).

The four monitoring locations are shown in Figure 1 and include:

- ***Influent (INF):*** influent leachate;
- ***Effluent point 1 (EFF1):*** treated leachate, released to the Wet Infiltration Forest;
- ***Effluent point 2 (EFF2):*** treated leachate, released as surface water to the creek; and
- ***Groundwater location* (GW01)*:*** artesian bore, released to creek

Note that the INF sample was taken from the header tank rather than via the MH1 manhole, as the header tank is more easily accessible and the risk of falling or tripping into MH1 is then avoided.

2.4 ANALYTICAL LABORATORY DETAILS (CONDITION M3-1.2, M4-1.1)

The analytical laboratory used to carry out the water quality testing presented in this report was ALS Environmental Services in Springvale, VIC, Australia. ALS is a NATA certified laboratory.

2.5 QUALITY ASSURANCE (QA) / QUALITY CONTROL (QC)

The duplicate sampling rate objective for the reporting period was 1 in per 20 primary samples. Two duplicate samples were taken during the reporting period to satisfy this objective. A summary of the QA/QC samples collected is provided in Section 3.3.9.

2.6 RESPONSIBLE PERSONNEL (CONDITION M4-1.2)

The contact details for the personnel undertaking monitoring program are shown in Table 3 below.

Table 3. Personnel undertaking monitoring program for the reporting period

Person	Company	Role	Contact Email	Phone
Lachlan Stemp	Syrinx	Data analysis, reporting	lstemp@syrinx.net.au	0481 098 647
Suzanne Walker	Syrinx	Water quality sampling	swalker@syrinx.net.au	0487 095 409
Dr Annachiara Codello	Syrinx	Report Review / Quality Assurance	acodello@syrinx.net.au	08 9227 9355

3.0 ANNUAL MONITORING RESULTS

3.1 FLOWS (CONDITION M4-1.3)

To satisfy condition M4-1.3 of the EPN, the volumes and flows of leachate entering and leaving the system during the reporting period were recorded by the telemetry system and have been summarised in tabulated and graphical form in the sections below. Throughout this document the term “volume” is used to describe the amount of leachate calculated (hereafter, “measured”) at the INF, EFF1 and EFF2 locations.

Volumes and flows of leachate through the system are influenced by rainfall. As such, rainfall data for the reporting period is discussed in Section 3.1.1 to provide additional context to the flow monitoring results.

3.1.1 Rainfall

Rainfall is expected to increase the volume of treated leachate measured at EFF1 and EFF2, and prolonged and substantial rainfall is also expected to impact (reduce) the infiltration capacity of the Wet Infiltration Forest. Rainfall data is measured at the BWMC site and is shown in Figure 2. A tabulated summary of monthly rainfall data from the BWMC site is provided in Table 4. In the current reporting period (November 2022 – October 2023) there were 158 rainfall days, one less than the previous 12 months (Table 4). Despite this similarity in rainfall days, there was 30% less rainfall in the current reporting period than in the previous, a reduction of 366 mm.

Figure 2 displays the daily rainfall over the previous 24 months. Most of the current reporting period’s rainfall fell from June – August 2023, although November 2022 was also relatively wet (Table 4, Figure 2).

The long-term (2007 – 2022) mean annual rainfall is 1,098 mm (± 225 mm), with the current reporting period (November 2022 – October 2023) falling well below this at 869 mm.

Table 4 : Rainfall measured on the BWMC Site current and previous reporting periods.

	Month	Daily Rainfall (mm) Range	Number of Days with Rainfall	Total Rainfall (mm)
November 2021 - October 2022	November 2021	0.0 - 10.0	14.0	61.0
	December 2021	0.0 - 7.0	4.0	11.0
	January 2022	0.0 - 30.0	12.0	112.0
	February 2022	0.0 - 25.0	5.0	42.0
	March 2022	0.0 - 46.0	8.0	109.0
	April 2022	0.0 - 30.0	11.0	62.0
	May 2022	0.0 - 22.0	17.0	118.0
	June 2022	0.0 - 42.0	19.0	145.0
	July 2022	0.0 - 15.0	15.0	59.0
	August 2022	0.0 - 23.0	22.0	155.0
	September 2022	0.0 - 21.0	16.0	98.0
	October 2022	0.0 - 58.0	16.0	263.0
	November 2021 - October 2022 Summary		**159**	**1235**
November 2022 - October 2023	November 2022	0.0 - 34.0	16.0	135.0
	December 2022	0.0 - 7.0	5.0	15.0
	January 2023	0.0 - 9.0	7.0	26.0
	February 2023	0.0 - 15.0	5.0	42.0
	March 2023	0.0 - 16.0	16.0	72.0
	April 2023	0.0 - 20.0	12.0	56.0
	May 2023	0.0 - 7.0	15.0	32.0
	June 2023	0.0 - 30.0	26.0	180.0
	July 2023	0.0 - 27.0	17.0	116.0
	August 2023	0.0 - 23.0	15.0	95.0
	September 2023	0.0 - 12.0	12.0	46.0
	October 2023	0.0 - 15.0	12.0	54.0
	November 2022 - October 2023 Summary		**158**	**869**
	Percentage difference		**1%**	**30%**

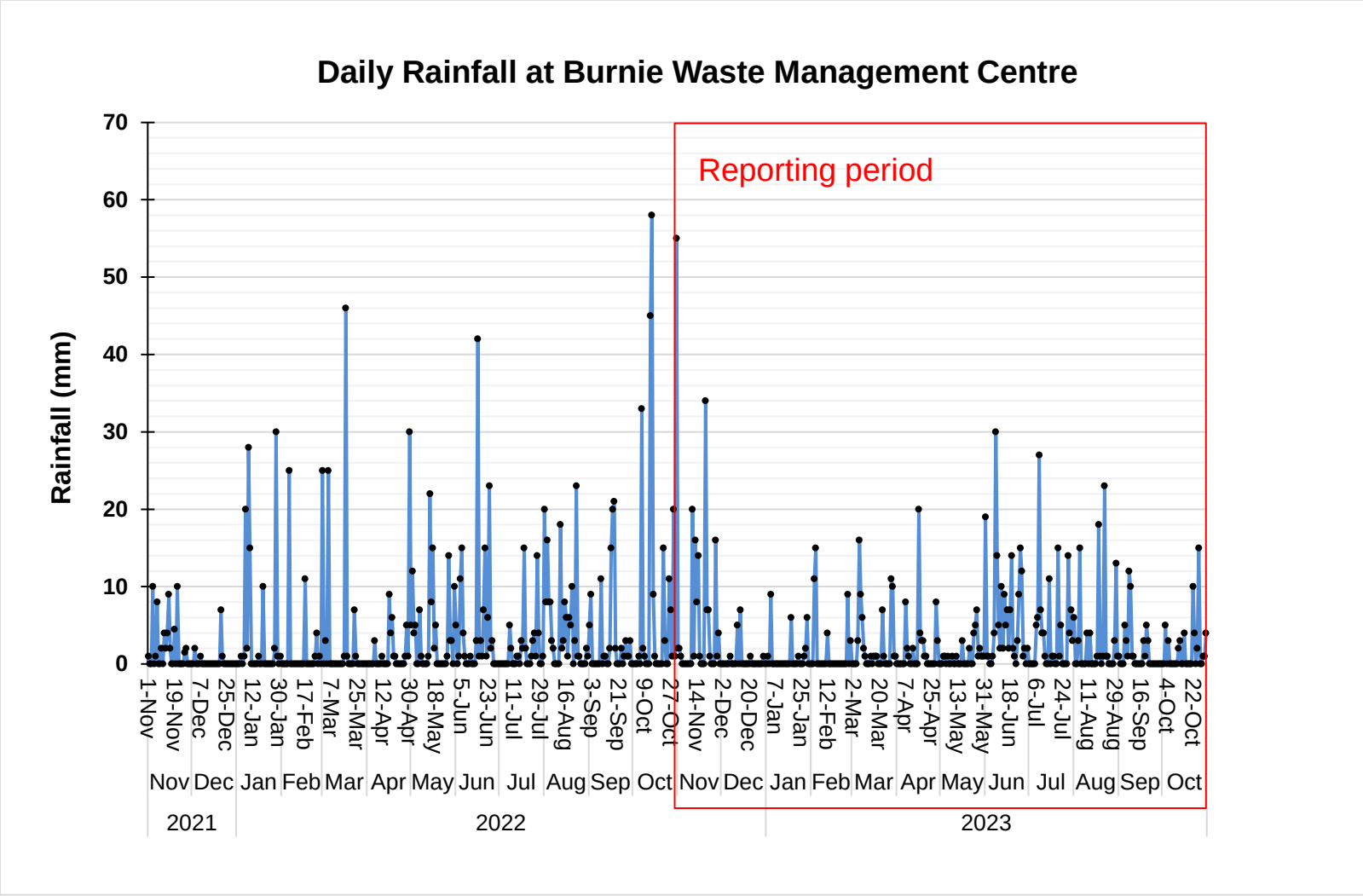


Figure 2. Daily rainfall data recorded at the Burnie Waste Management Centre (Source: Burnie City Council).

3.1.2 System Flows (Condition G8 1.4, 1.6)

Untreated Leachate Inflows – INF

The daily volumes of landfill leachate entering the system at MH01 via INF are presented in Figure 3. These volumes showed seasonal fluctuations primarily reflecting seasonal changes in rainfall, as has been observed in the past.

An increase in daily leachate volumes was observed from June 2023 through to September 2023 (range 164.55 – 523.10 kL/day, mean = 272 kL/day); this increase was much lower compared to the last reporting period (Figure 3). Last year this period had considerably higher rainfall than the same time in this reporting period (Figure 2). A total volume of 133 ML entered the wetland in this reporting period.

Treated Leachate Volumes - EFF1

The volume of treated leachate discharging to the Wet Infiltration Forest is measured at EFF1 (Figure 1). The Wet Infiltration Forest receives, and infiltrates treated leachate into the soils, with overflows being discharged into the unnamed creek system.

The daily volume (kL/day) of leachate treated by the system and exiting via EFF1 is shown in Figure 4. The general trend of flows through EFF1 correspond to the flows entering the system at INF. Spikes in volume at EFF1 are attributed to direct addition of rainfall into treatment cells and the addition of run-off. The total volume of treated leachate as measured at EFF1 during the reporting period was 102 ML. The 'wet year' leachate volume prescribed in *Development Proposal & Environmental Management Plan* (DPEMP, 2015) is any year totalling > 45 ML.

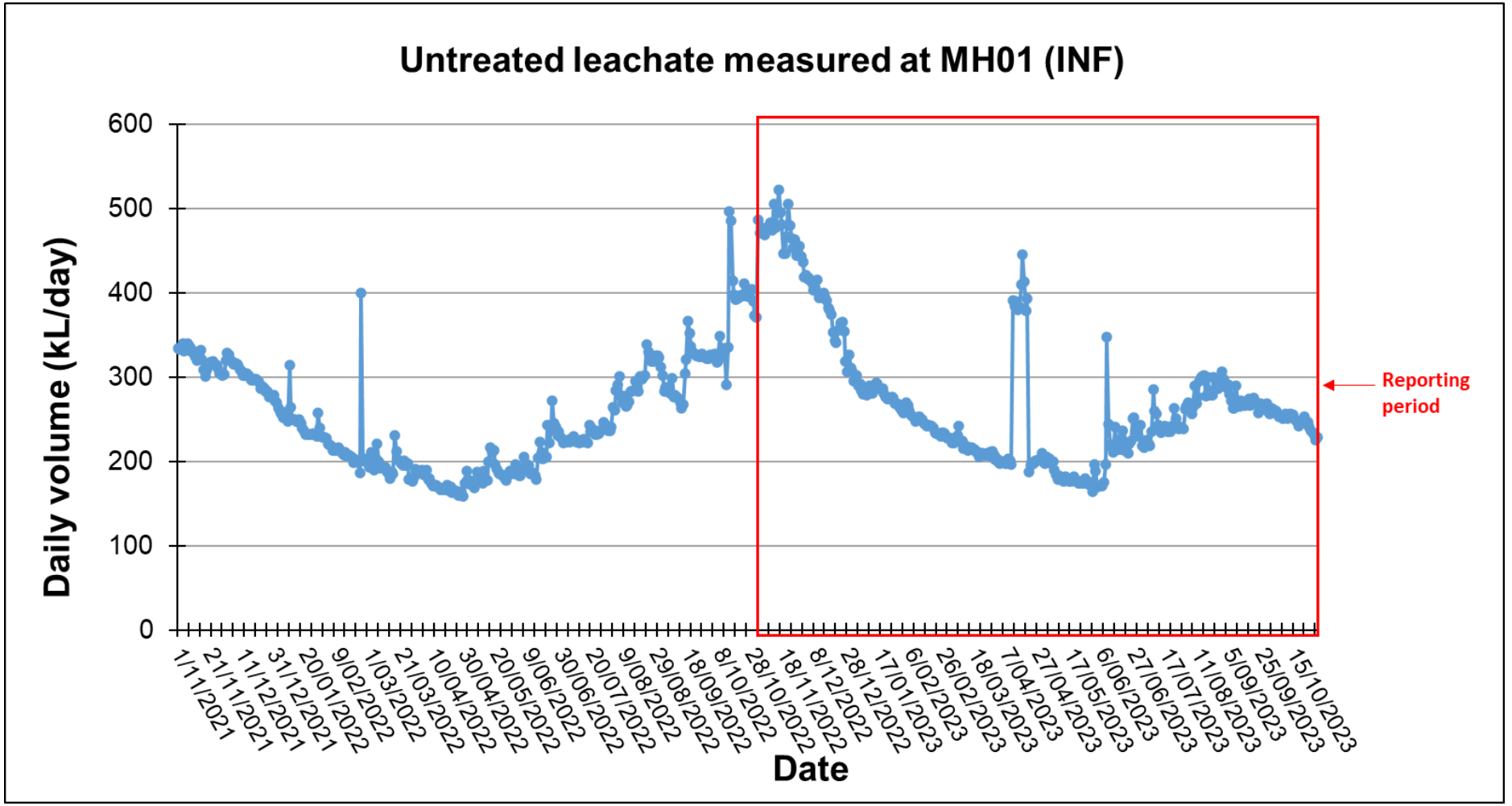


Figure 3. Daily volumes of influent (untreated) landfill leachate pumped via INF into the treatment wetland.

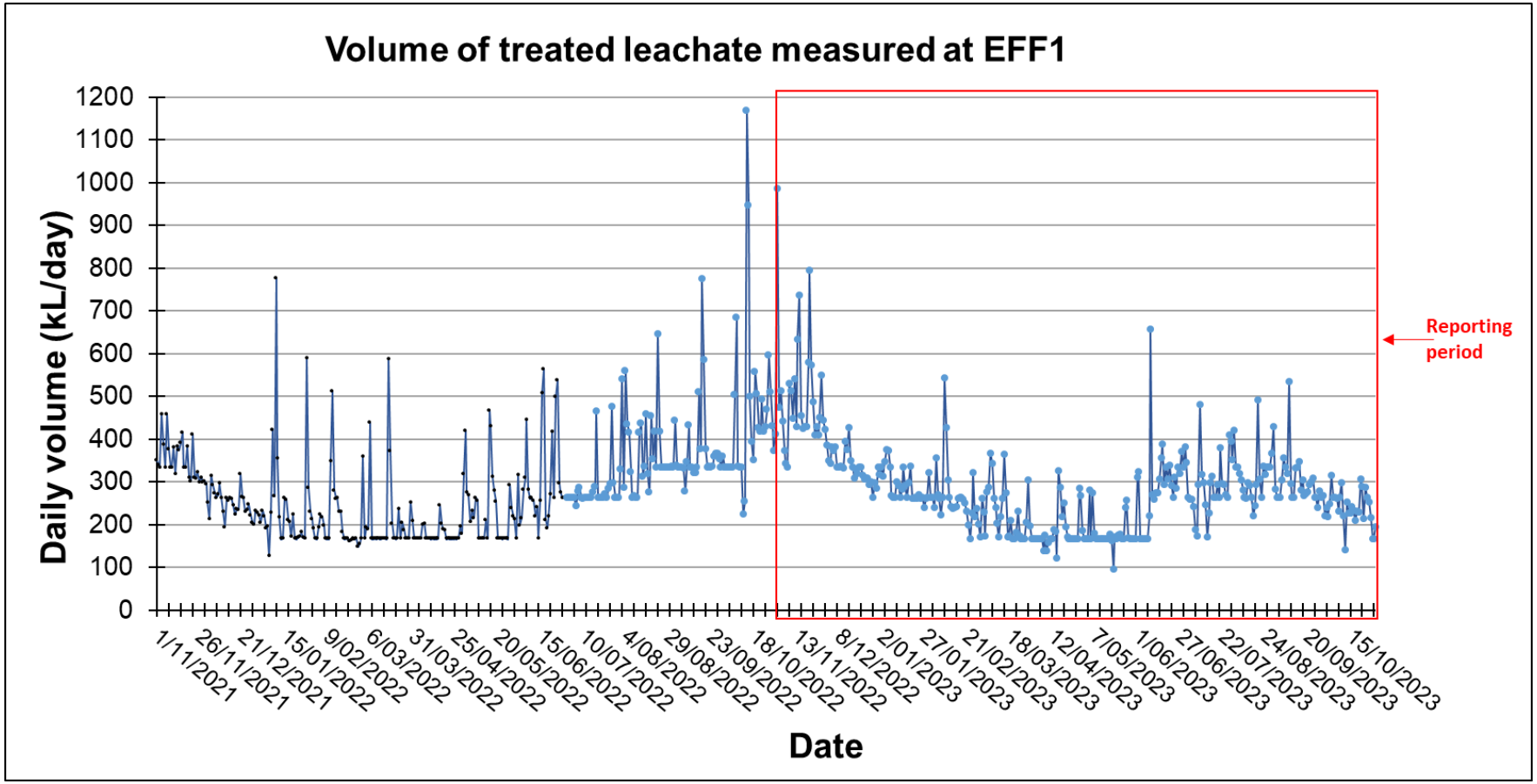


Figure 4. Daily volumes of treated leachate which passed through EFF1 prior to infiltration in the Wet Infiltration Forest.

Outlet of Wet Infiltration Forest - EFF2

EFF2 measures the volume of leachate exiting the Wet Infiltration Forest (Figure 5). The daily volume of treated leachate discharged (by overland flow) via EFF2 to the unnamed tributary of Cooee Creek is shown in Figure 5. Peaks shown in Figure 5 (EFF2) mirror those in Figure 4 (EFF1). Differences in treated volume between EFF2 and EFF1 are attributed to rainfall captured within the Wet Infiltration Forest which results in overland flow discharging into EFF2. The total volume of leachate flow through EFF2 during this reporting period was 52 ML.

3.1.3 Summary of Volumes Measured Through the System

Mean and median daily treated leachate volumes and total volumes for the reporting period are summarised in Table 5. Untreated leachate entering the system (INF) has a more stable flow than treated leachate exiting the system (EFF1). This is apparent when comparing the mean, standard deviation, and range of flows between INF and EFF1, where INF has a low mean, lower median, and much more constricted range, indicating more steady flow with less spikes or anomalous highs. These differences were attributed to direct rainfall inputs which coincided with increased volumes at EFF1 (Figure 2, Figure 4).

Direct rainfall accounted for the net increase in volume of 3.5 ML during this reporting period or 3.4% of the total volume measured via EFF1 assuming no evapotranspiration (Table 5). 49.2 ML or 49.1% of the total treated leachate which passed through EFF1 was infiltrated within the Wet Infiltration Forest. The remaining 51.0 ML was discharged by overland flow to the unnamed tributary of Cooee Creek. The net volume added into the treatment system from rainfall inputs during the current reporting period was 9.1 ML lower than previous 12-month period, as reflected in the decreased rainfall recorded on site (Table 4).

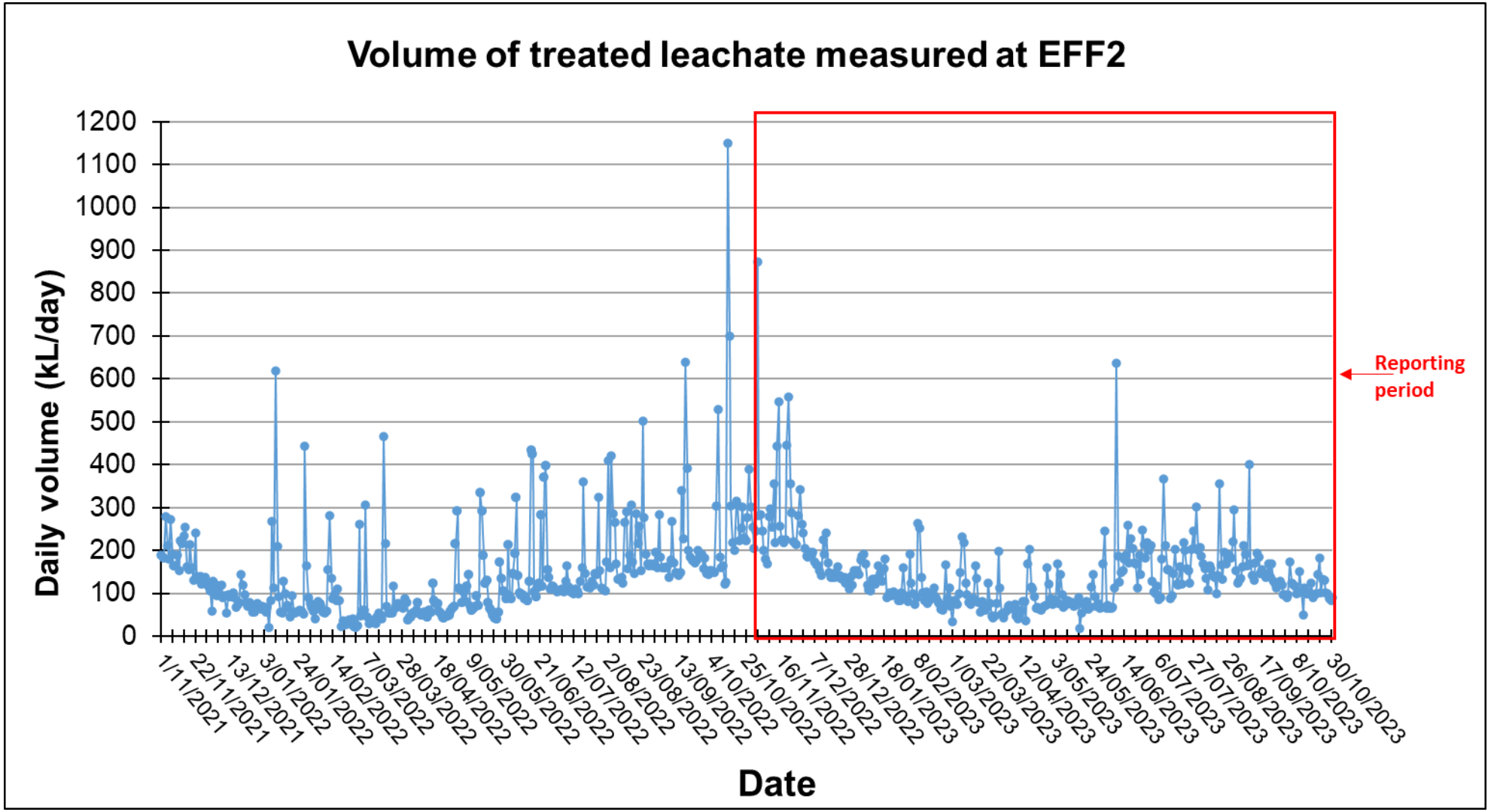


Figure 5. Daily volumes of treated leachate which passed through the V-notch weir at EFF2 prior to discharging to the unnamed tributary of Cooee Creek.

Table 5. Volumes of leachate and treated leachate measured current reporting period and the previous 12 months.

Flows in previous 12 months (November 2021 - October 2022)

Location	Volume				Sum volume over reporting period (kL)
	Mean ± St. Dev	Median	Range	Unit	
INF (A)	255 ± 65	240	158 - 497	kL/day	92,763
EFF1 (B)	289 ± 124	263	128 - 1,167		105,287
EFF2 (C)	144 ± 115	115	20 - 1,150		52,536
Net volume added to the treatment system by rainfall (B-A)					12,524
Net volume added to the treatment system (B-A) as a % of total flows at (B)					11.9%
Net volume of treated leachate infiltrated via the Infiltration Wet Forest (B-C)					52,750
Net volume infiltrated (B-C) as a percentage of total flows at (B)					50.1%

Flows in current reporting period (November 2022 - October 2023)

Location	Volume				Sum volume over reporting period (kL)
	Mean ± St. Dev	Median	Range	Unit	
INF (A)	260 ± 70	247	158 - 411	kL/day	96,790
EFF1 (B)	301 ± 127	264	128 - 797		100,247
EFF2 (C)	154 ± 112	120	21 - 645		50,999
Net volume added to the treatment system by rainfall (B-A)					3,457
Net volume added to the treatment system (B-A) as a % of total flows at (B)					3.4%
Net volume of treated leachate infiltrated via the Infiltration Wet Forest (B-C)					49,247
Net volume infiltrated (B-C) as a percentage of total flows at (B)					49.1%

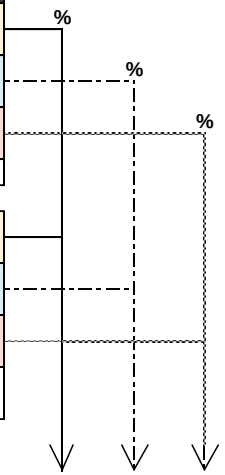
3.1.4 Estimated Leachate Volumes Versus Measured Leachate Volumes

Table 6 compares the differences in volume between the estimated average daily volumes at EFF1 and EFF2 as described in the DPEMP (2015) with the actual volumes measured during the period 1st November 2022 to 31st October 2023. This table shows that annual mean volume measured at EFF1 was 19% less than the estimated volume. At EFF2, the measured volume was 128% greater than the volume estimated to be discharged (Table 6). It is assumed that this discrepancy is due to the soils in the Infiltration Wet Forest (silty clays and sandy clays) reaching their infiltration capacity (saturation), resulting in a reduced capacity to consistently infiltrate the soil. As a result, the actual average daily infiltrated volume was reduced by 51% compared to the estimates (Table 6). This observation was consistent with the assumptions described in the DPEMP which stated that discharge via overland flows to the unnamed Creek would occur during high or prolonged seasonal rainfall events, as soil profiles would be saturated. Further, the total volume of treated leachate measured at EFF1 during the reporting period (100 ML, Table 5) was greater than the volume contemplated in the DPEMP to represent a wet year (46 ML) (DPEMP, 2015). Overall infiltration was 7% less than in the previous reporting period.

It is worth noting that the discrepancy from the DPEMP assumptions in this reporting period are consistent with long-term trends.

Table 6 Comparison of estimated volumes of treated leachate (DPEMP, 2015) versus measured volumes of treated leachate for the period 1st November 2022 to 31st October 2023.

		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Annual mean
Estimated mean daily volume (kL/day)	EFF1 (DPEMP, 2015)	383.9	314.5	255.4	225.3	264.5	264.5	312.6	322.7	327.3	526.2	556.8	482.1	**353.0**
	EFF2 (DPEMP, 2015)	38.2	177.6	187.0	123.4	49.8	24.5	35.3	15.9	24.4	17.7	36.5	40.9	**64.3**
	Mean volume infiltrated	345.7	136.9	68.4	101.9	214.7	240.0	277.3	306.8	302.9	508.5	520.3	441.2	**288.7**
	% volume infiltrated	90%	44%	27%	45%	81%	91%	89%	95%	93%	97%	93%	92%	**78%**
Measured mean daily volume (kL/day)	EFF1 (2022 - 2023)	503.6	336.3	292.3	267.6	224.8	193.9	179.0	298.5	296.1	313.6	295.9	239.5	**286.8**
	EFF2 (2022 - 2023)	309.4	160.3	128.9	108.3	96.7	85.6	82.5	179.0	165.3	177.6	156.3	109.9	**146.7**
	Mean volume infiltrated	194.2	176.0	163.4	159.3	128.1	108.3	96.5	119.5	130.8	136.0	139.6	129.6	**140.1**
	% of mean volume infiltrated	39%	52%	56%	60%	57%	56%	54%	40%	44%	43%	47%	54%	**50%**



Comparison of estimated versus measured volume

EFF1	Percentage difference in volume measured at EFF1 compared to the estimated volume	**19%**	less volume than estimated
EFF2	Percentage difference in volume measured at EFF2 compared to the estimated volume	**128%**	more volume than estimated
Volume infiltrated	Percentage difference in volume infiltrated by the Infiltration Wet Forest as a percentage of the estimated infiltrated volume	**51%**	less volume than estimated

3.2 RECIRCULATION EVENTS (CONDITION M4-1.6)

3.2.1 Background to the requirement for recirculation

Condition EF2-1 of the EPN states that:

"…treated leachate within the polishing pond must be recirculated back into the treatment system if ammonia is detected at concentrations greater than 1.61 mg/L, and discharge is occurring to the unnamed tributary, as measured at EFF 2…"

To meet this condition the continuously monitoring telemetry system housed within the SB04 control shed (Figure 1) recirculates leachate when an ammonia reading of > 1.61 mg/L is measured at the outlet to the polishing wetland (EFF1) in conjunction with measured discharge of flows from the outlet of the infiltration forest (EFF2). During the recirculation event, the leachate is recirculated from EFF1 back into SF05A and SF06A for further treatment (see Figure 1).

3.2.2 Recirculation events during the monitoring period

No recirculation occurred from July 2022 – October 2023. The system was fully compliant with the EPN conditions relating to recirculation.

3.3 WATER QUALITY (CONDITIONS M2, M4-1.4, 1.5)

3.3.1 Water Quality Data – Continuous Monitoring

Continuous water quality monitoring was undertaken by a set of probes and a telemetry system at the outlet of polishing wetland monitoring point (EFF1), which provided hourly data for ammonia, electrical conductivity, pH, and temperature. An arithmetic mean for these parameters was calculated at each hourly interval.

In situ Ammonia Monitoring

Based on the pH and temperature of the system measured throughout the reporting period, a great proportion (>90%) of the total ammonia was the non-toxic ammonium form. Therefore, the *in-situ* ammonia probe measurements can be used to assess the total ammonia nitrogen concentration. Hereafter, the term "ammonia" is used in discussions regarding the *in-situ* monitoring to refer to total ammonia nitrogen (both the ionised and unionised forms).

The concentration of ammonia during the reporting period is shown in Figure 6. For all the reporting period, ammonia concentrations were below the trigger limit of 1.61 mg/L. As can be seen in Figure 6, ammonia concentrations were approximately 0.13 mg/L for the reporting period (median and mean value of 0.13 mg/L). A spike in ammonia concentration was detected on the 6th of October 2022. This spike was due to a brief technical error and is reflected in a simultaneous dip in the electrical conductivity reading (Figure 7). Importantly, no recirculation events were triggered and as such **the system was compliant at EFF1 for ammonia.**

3.3.2 *In situ* Electrical Conductivity Monitoring

The electrical conductivity (EC) measurements across the reporting period were on average 397.4 µS/cm (Figure 7). Fluctuations in EC coincided with rainfall events and increased flows. There were no extreme increases in EC and hence no indication that there were any adverse impacts to water quality during the reporting period.

A transmitter glitch from the 18th of August 2022 – the 6th of October 2022 went undetected due to the gap in reporting and resulted in no EC data being transmitted for this period of time.

3.3.3 *In situ* Temperature Monitoring

Temperature measurements across the previous and current reporting periods are shown in Figure 8. During this period average temperature was 13.2 ºC with a range of 0.9 ºC to 27.6 ºC which followed the expected seasonal trends.

3.3.4 *In situ* pH Monitoring

pH of the treated leachate was generally in a circumneutral range during the reporting period, as demonstrated by the *in-situ* pH measurements at EFF1 (Figure 9). *In situ* pH measurements were comparable to laboratory pH values and were not of concern.

Anomalous pH records were recorded from 07/11/22 – 12/01/23. These spikes often lead to the pH record exceeding 8.0 (upper limit) for up to four consecutive readings (hours). This corresponds with a period of software issues with the hosting service, as noted by the telemetry service provider Cromarty. Further, the pH probe failed an initial calibration test in March 2023, which may have been a contributing factor to the errors.

These data points have been included in the reporting, although they are believed to be false and solely due to software / hardware issues, rather than a true indication of water quality. As can be seen in Figure 9, the overall trend for pH is maintained despite these spikes. There are 174 data points (1.07%) which recorded a pH ≥ 8.0 during the reporting period from a total of 16,243 data points for pH. Removing this data considerably smooths the data and demonstrates that the values do not reflect an actual trend in water quality (Figure 10).

3.3.5 Issues and Maintenance Undertaken on the *in-situ* Probes (Condition M3-1.4)

Scheduled maintenance on the in-situ probes was conducted by Cromarty.

pH in situ probe

As can be seen in Figure 9, pH measurements steadily increased after calibration events which was attributed to the measurement drift of the instrument (sensor drift) rather than an actual increase in pH. The data was cross checked with the handheld field probe readings and laboratory pH measurements (Appendix 3) which showed comparable results following calibration. Sudden spikes / dips in the pH measurements shown in Figure 9 were attributed to external disruptions to the probe such as power outages or recalibration events.

In summary, based on the *in-situ* monitoring results and taking into consideration effects associated with probe drift, effects on data from calibration events, and power outages, the **system was fully compliant with the EPN conditions related to *in-situ* monitoring.**

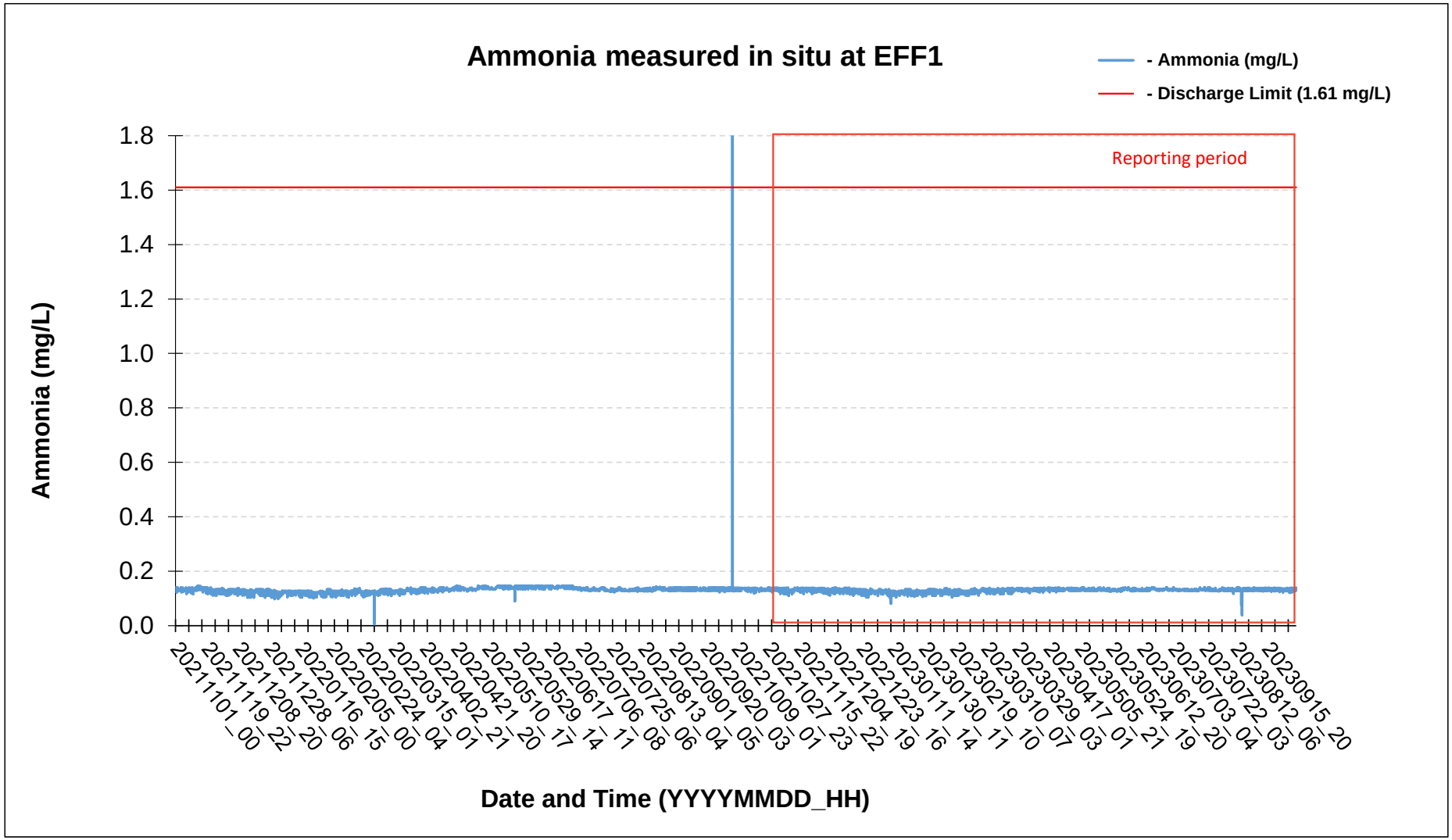


Figure 6. Hourly ammonia concentrations as measured by an *in-situ* water quality probe at EFF1

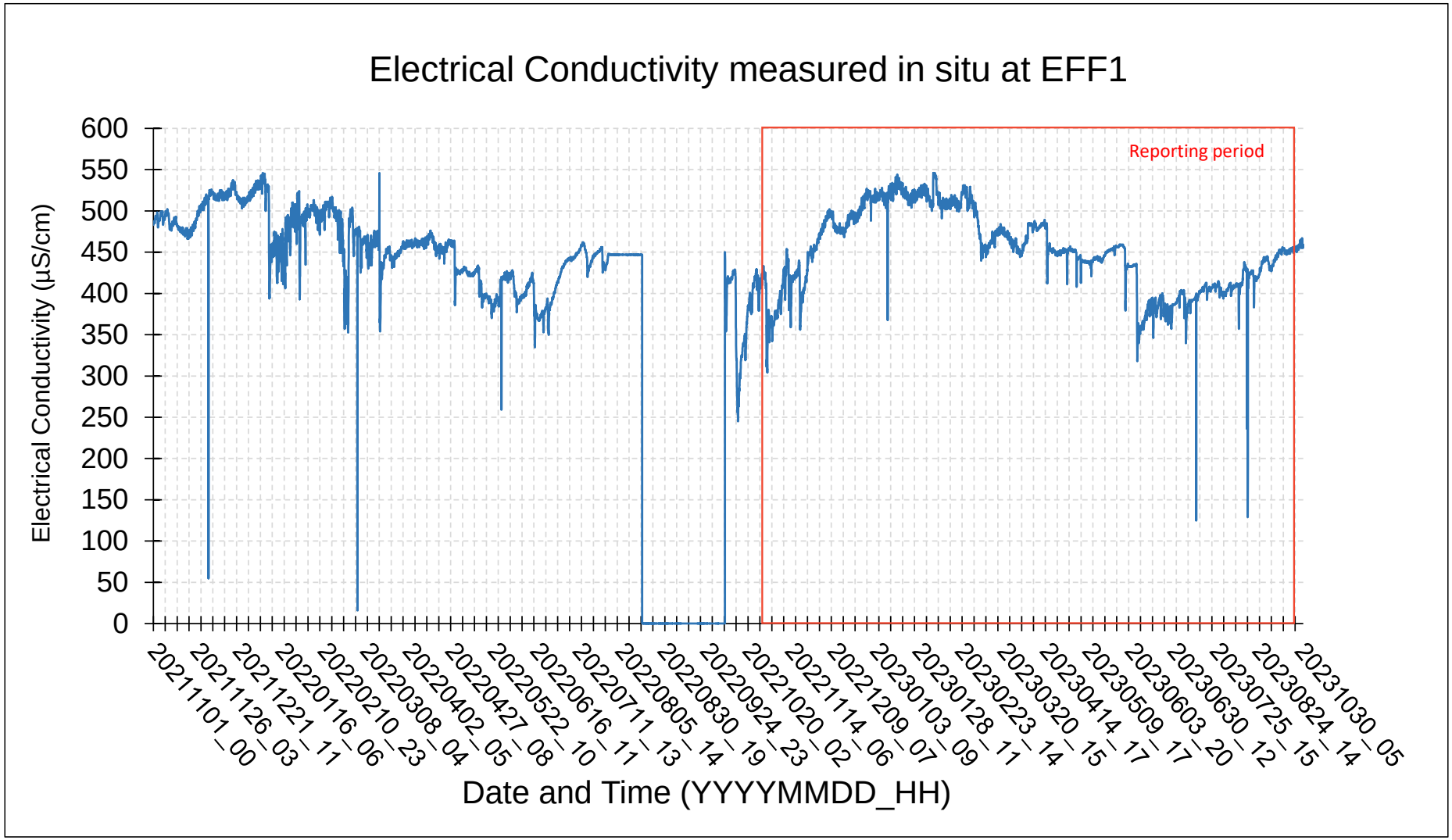


Figure 7. Hourly electrical conductivity concentrations as measured by an *in-situ* water quality probe at EFF1.

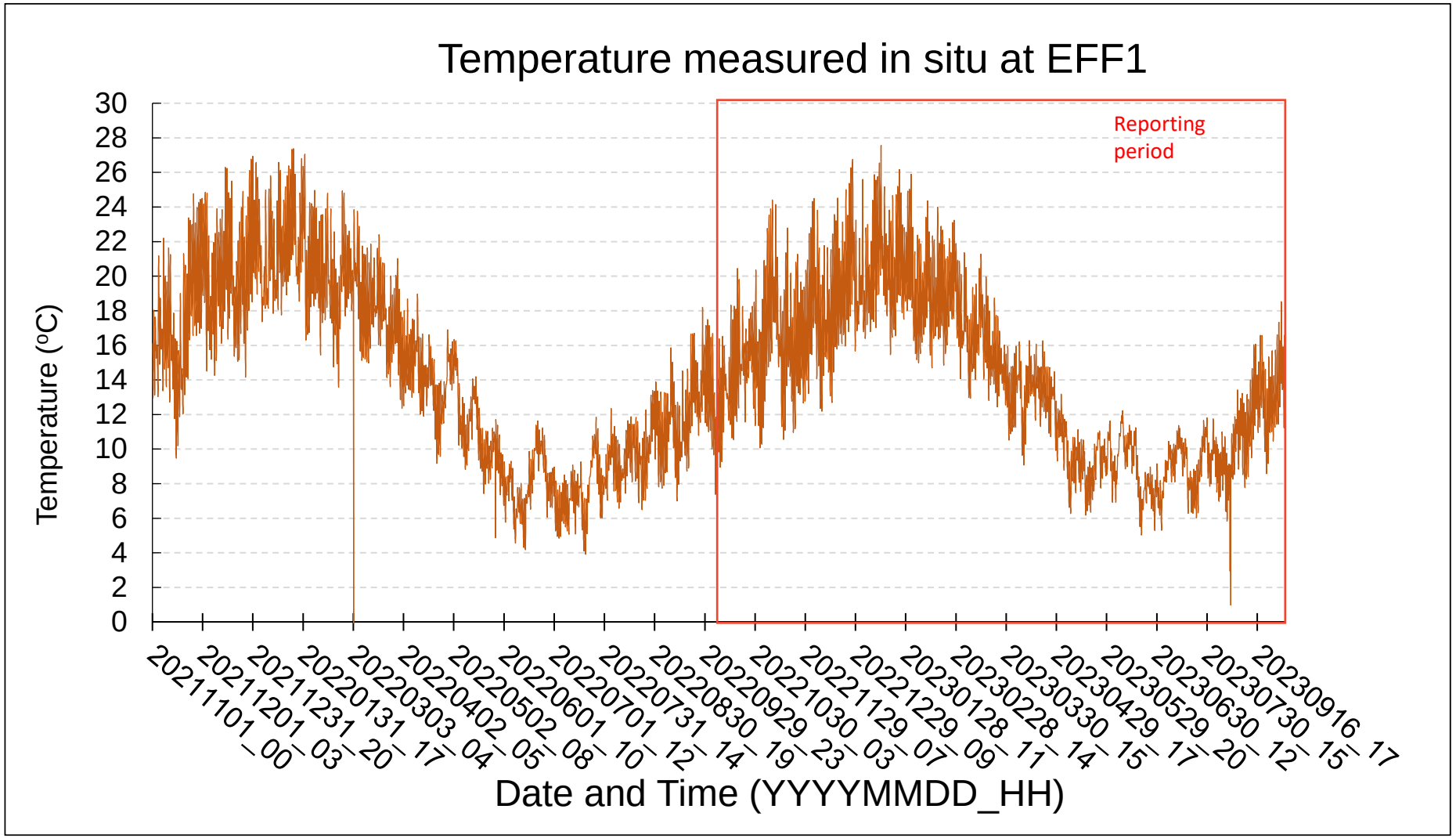


Figure 8. Hourly temperature measurements as measured by an *in-situ* water quality probe at EFF1.

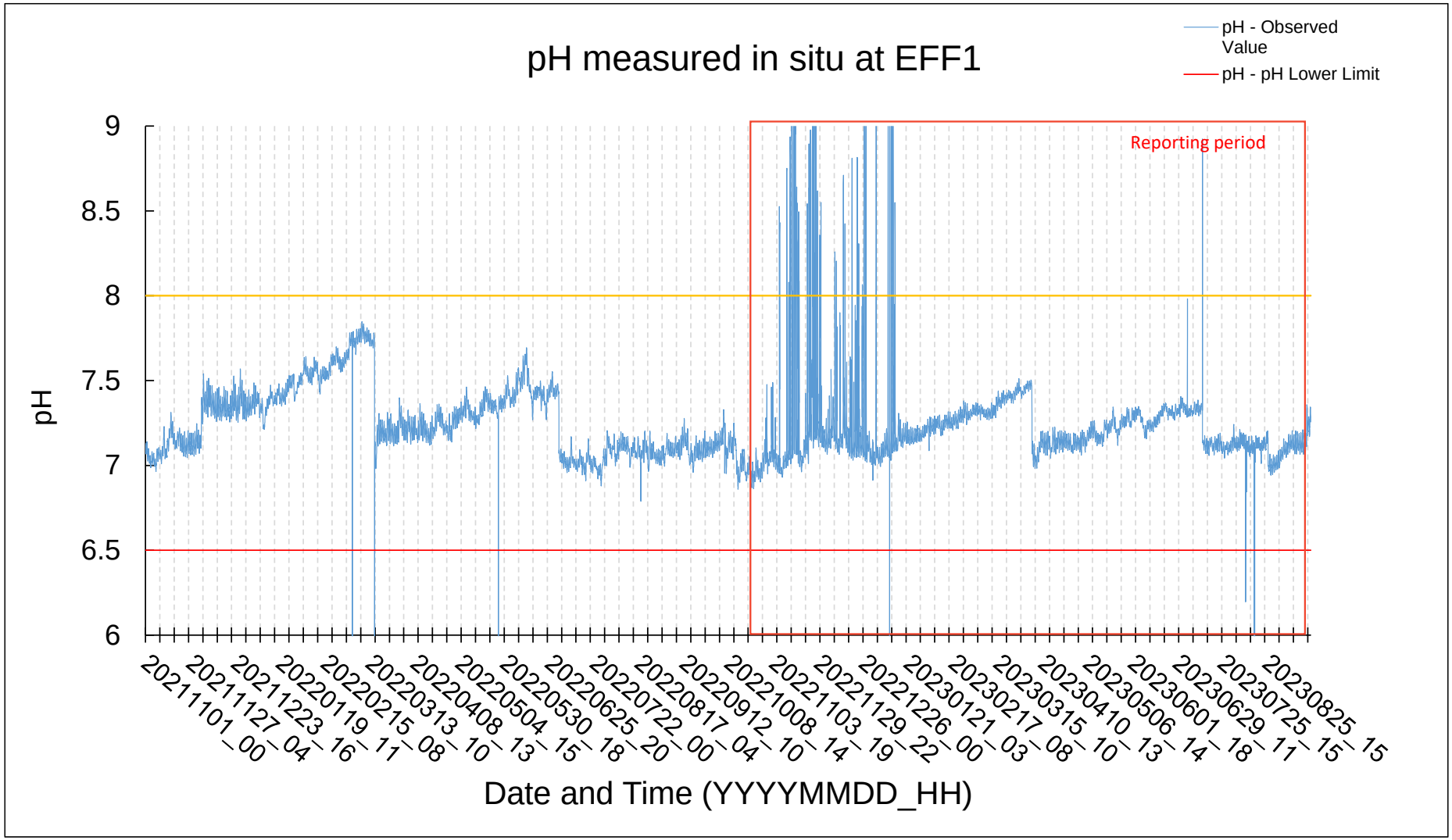


Figure 9. Hourly pH measurements as determined by *in-situ* water quality probe at EFF1.

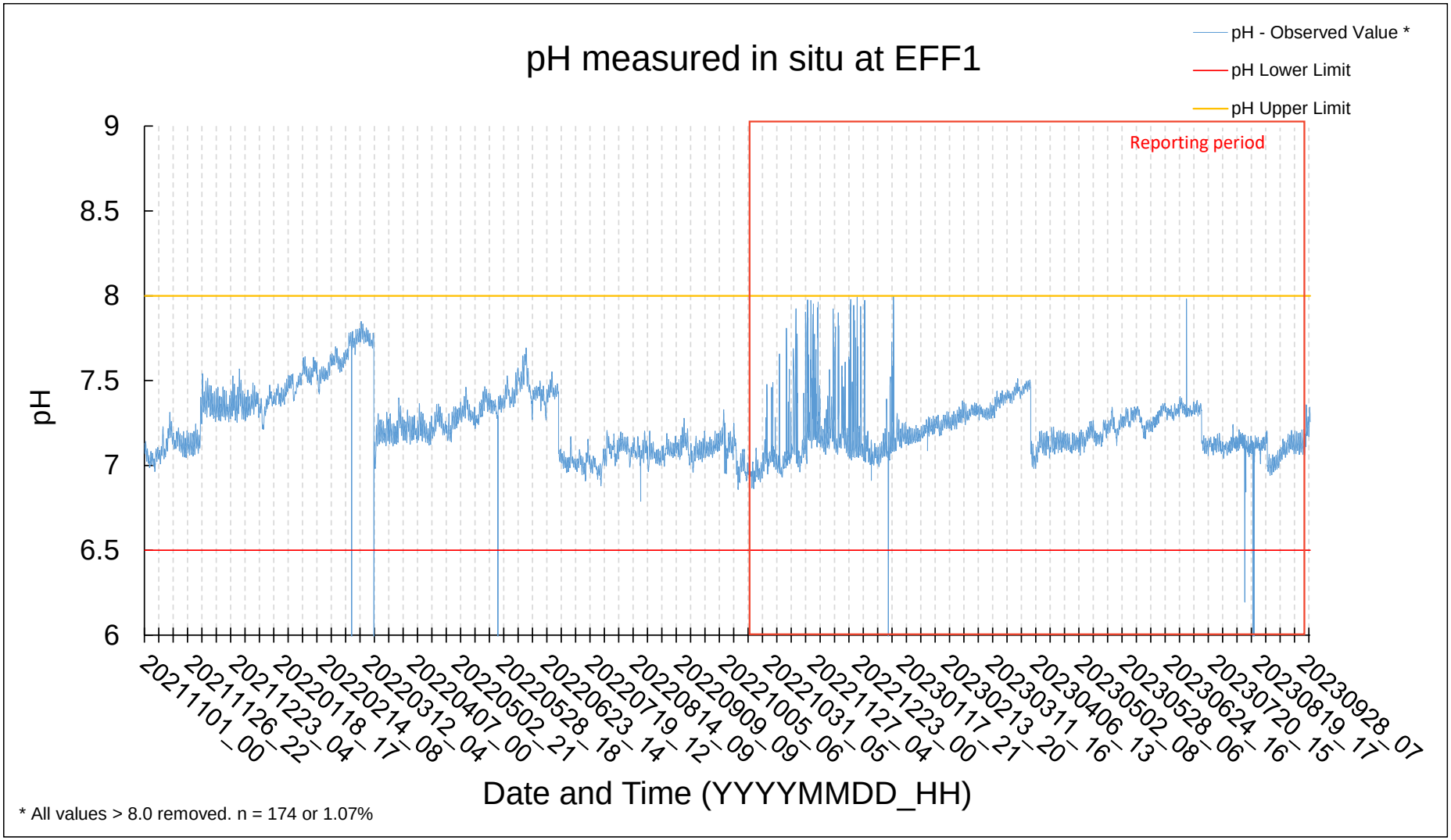


Figure 10. Hourly pH measurements as determined by *in-situ* water quality probe at EFF1 with all values > 8.0 removed.

3.3.6 Water Quality Data – Laboratory Results (Condition G8 1.6)

As outlined in Section 2.3, water quality sampling was conducted yearly at the INF, EFF1, EFF2 and GW01 sampling locations. A suite of parameters was sampled in accordance with the requirements of the EPN (see Appendix 1 for the EPN monitoring requirements). The documentation for the laboratory analysis undertaken is provided in Appendix 2, with tabulated water quality laboratory and field results provided in Appendix 3.

The five key water quality parameters with respect to the EPN (described under Conditions E1-1, EF2-3) were ammonia, copper, nickel, zinc, and chromium, with their respective trigger values shown in Table 7.

Table 7 Water quality trigger limits as set in the EPN 9421/2

Water Quality Parameter	Unit*	EPN Trigger Limit	EPN Condition
Ammonia	mg/L	1.61	EF1 - 1
Chromium (total)	mg/L	0.001	EF2 - 3
Copper (total)	mg/L	0.0014	EF2 - 3
Nickel (total)	mg/L	0.011	EF2 - 3
Zinc (total)	mg/L	0.008	EF2 - 3

*It has been assumed that the EPN trigger limits for metals were intended to be in µg/L rather than mg/L as was printed in the EPN. The higher, less stringent values printed in the EPN have been converted accordingly by a factor of 1000 and are shown in the above table.

A summary graph for ammonia concentrations measured via laboratory analysis is shown in Figure 11. As evident in this figure, the system was fully compliant with respect to ammonia i.e., EFF1 and EFF2 ammonia concentrations were below 1.61 mg/L during the monitoring period.

The concentrations of the four total metal parameters (chromium, copper, nickel and zinc) were also below their respective trigger values as shown in Figure 12, Figure 13, Figure 14 and Figure 15.

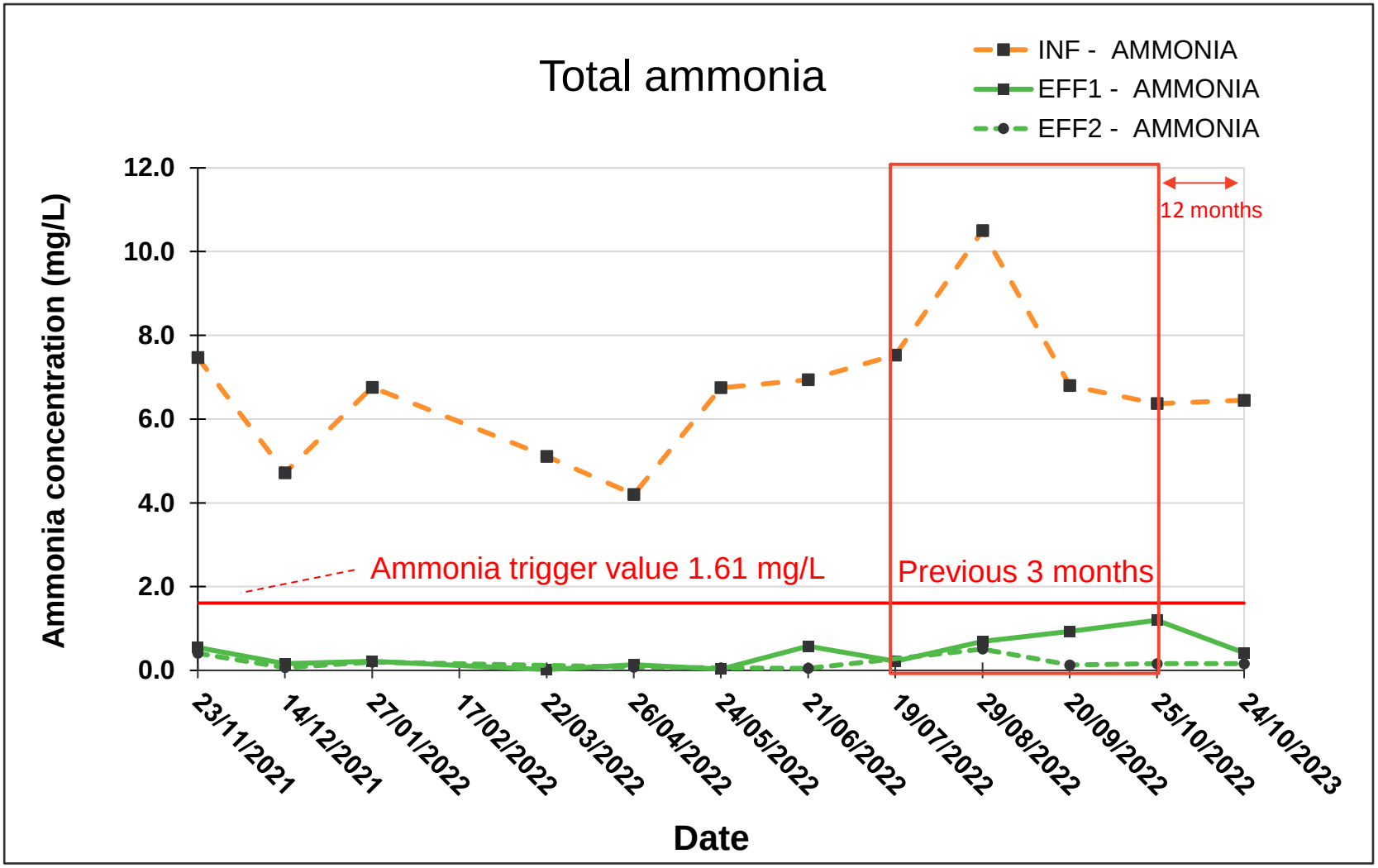


Figure 11. Ammonia concentrations in the influent (INF), discharge from the surface wetlands (EFF1) and effluent discharge to the unnamed tributary to Cooee creek (EFF2).

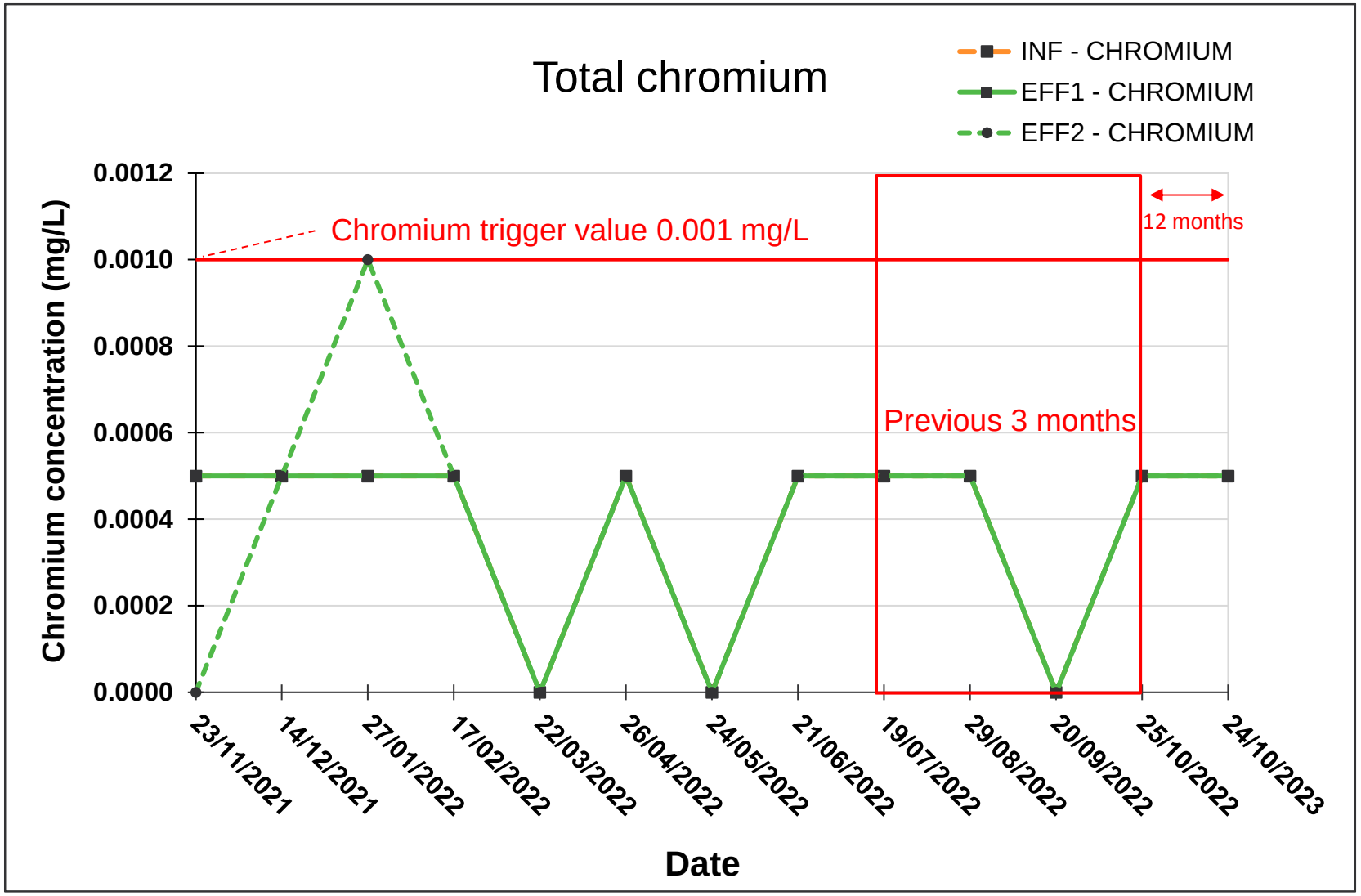


Figure 12. Total chromium concentrations in the influent (INF), discharge from the surface wetlands (EFF1) and effluent discharge to the unnamed tributary to Cooee creek (EFF2).

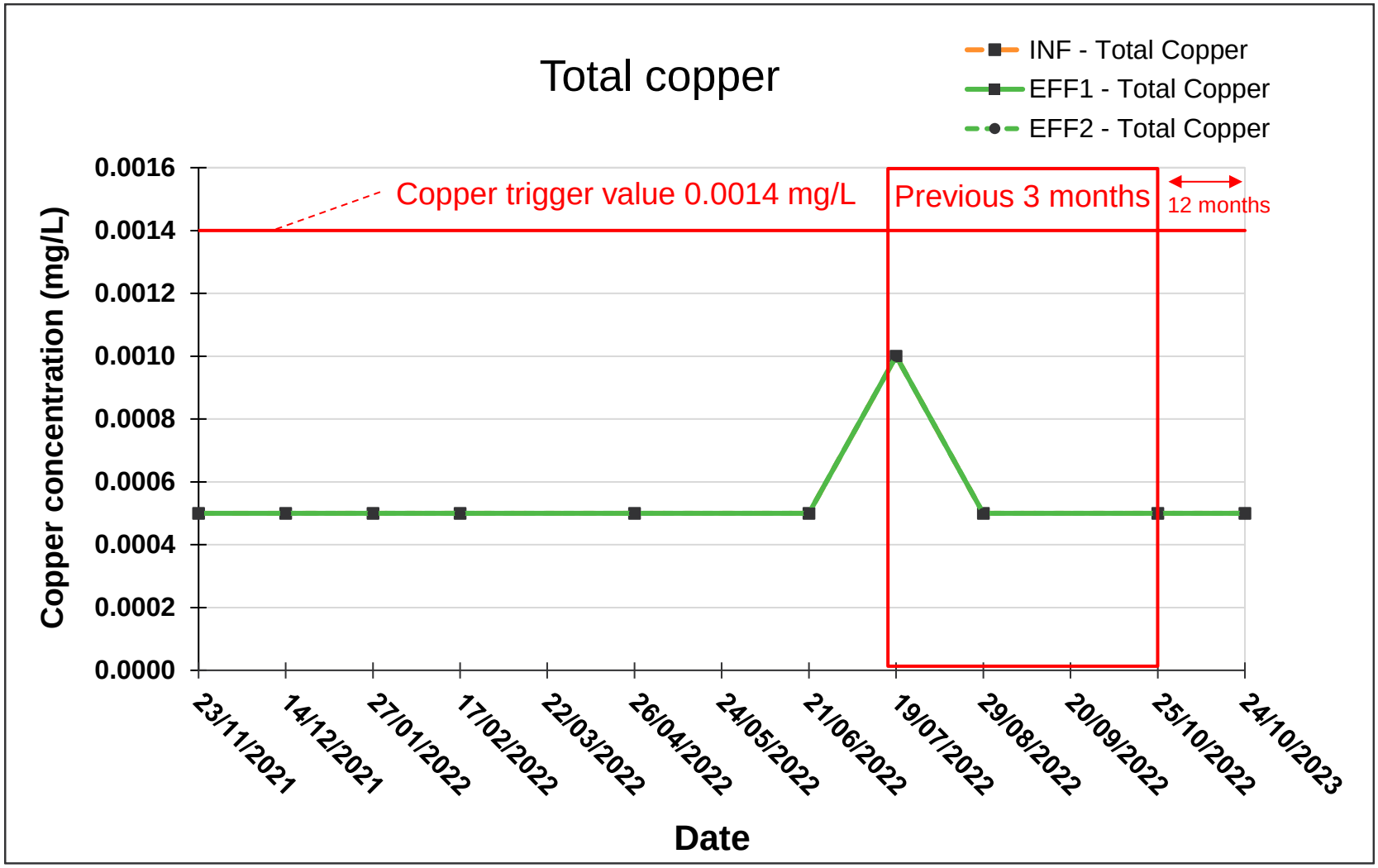


Figure 13. Total copper concentrations in the influent (INF), discharge from the surface wetlands (EFF1) and effluent discharge to the unnamed tributary to Cooee creek (EFF2).

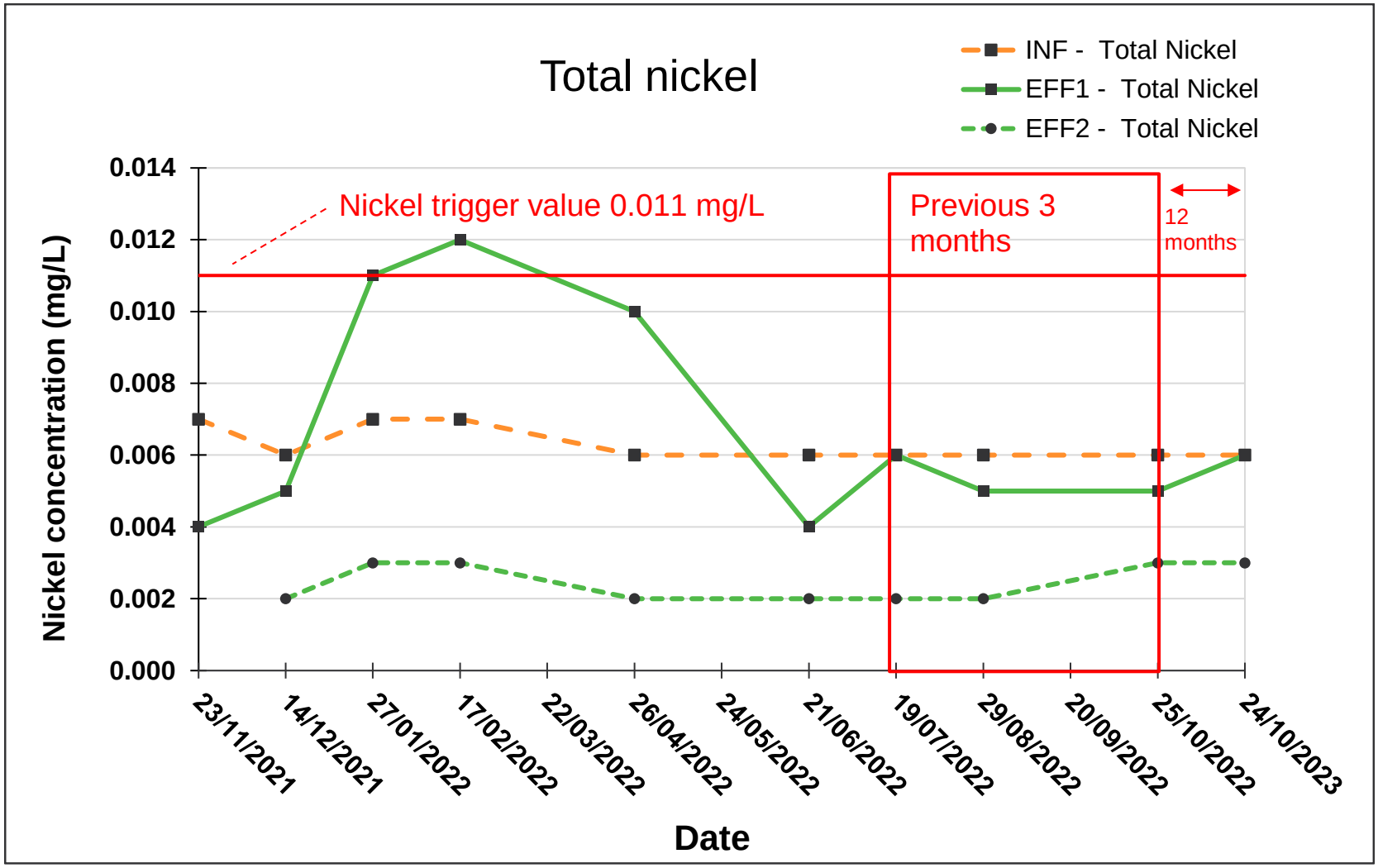


Figure 14. Total nickel concentrations in the influent (INF), discharge from the surface wetlands (EFF1) and effluent discharge to the unnamed tributary to Cooee creek (EFF2).

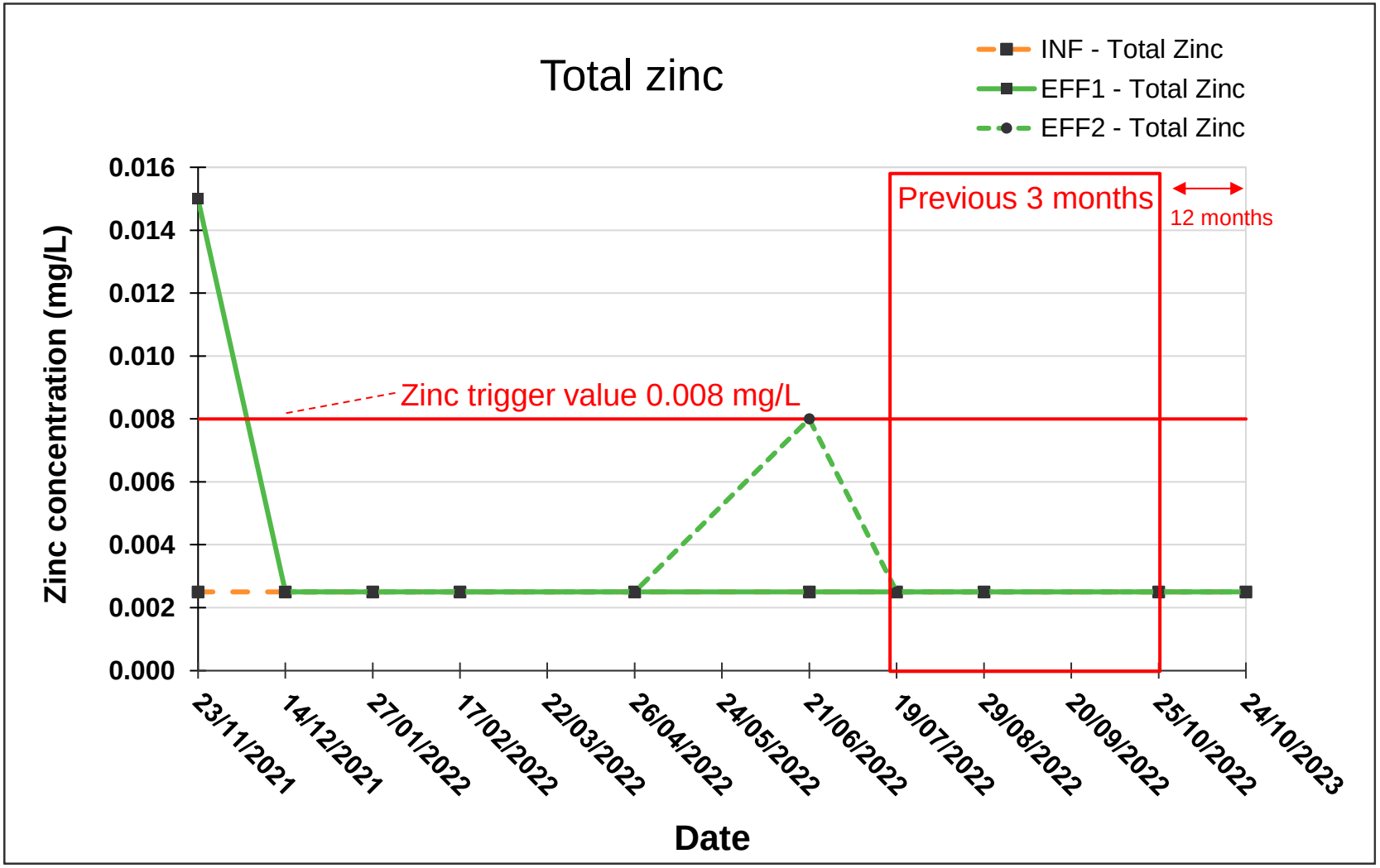


Figure 15. Total zinc concentrations in the influent (INF), discharge from the surface wetlands (EFF1) and effluent discharge to the unnamed tributary to Cooee creek (EFF2). The red line shows the EPN trigger limit.

Summary statistics for ammonia, chromium, copper, nickel, and zinc have been provided in Table 8 against their respective EPN trigger values. The arithmetic mean of the data has been presented in the table, and where the data for a parameter was below the limit of laboratory detection (e.g., <0.001 mg/L for chromium), a value of half the limit of detection (e.g., 0.0005 mg/L for chromium) was used to perform numerical calculations. As can be seen in Table 8, no water quality parameters were found to exceed water quality trigger limits of the EPN (as a mean concentration for the reporting period or as a maximum recorded value), hence **the system is fully compliant with EPN requirements in terms of water quality.**

Table 8. System compliance with the water quality trigger limits listed in EPN 9421/2.

Date range of data: Sep-22 to Oct-23

Water Quality Parameter	EPN Condition	Sampling Location	Mean Concentration **	Maximum Concentration	EPN Trigger Limit	Unit	Compliance with EPN 9421/2
Ammonia	EF1 - 1	EFF2	0.193	0.510	1.61	mg/L	✓
	EF2 - 1	EFF1	0.692	1.200	1.61		✓
Chromium (total)	EF2 - 3*	EFF1	0.0005	< 0.001	0.0010		✓
Copper (total)			0.0006	< 0.001	0.0014		✓
Nickel (total)			0.0055	0.0060	0.0110		✓
Zinc (total)			0.0025	<0.005	0.0080		✓

Legend

✓ Water quality parameter is below the respective trigger limit defined in EPN 9421/1

✘ Water quality parameter exceeds the respective trigger limit defined in EPN 9421/1

* It has been assumed that the EPN trigger limits for metals were intended to be in µg/L rather than mg/L as was printed in the EPN. The higher, less stringent values printed in the EPN have been converted accordingly by a factor of 1000 and have been used in the above table.

** The arithmetic mean was used to calculate these values. Where a concentration was below the limit of detection, the concentration was taken at 50% of the limit of detection to enable the calculation.

3.3.7 Water Quality Investigations Conducted During the Reporting Period (G8 1.7)

No water quality investigations were required to be undertaken during the reporting period.

3.3.8 Groundwater Quality Results

Groundwater quality results from the GW01 sampling location are tabulated in Appendix 3. Similar to previous the reporting period, groundwater quality at GW01 during the current reporting period (including July – October 2022) was generally good and characterised by low ammonia, high nitrate, low TP, and very limited and low-level detections of metals (aluminium and nickel) which all fell below the ANZECC water quality trigger values. There were no concerning trends in any water quality parameters during the reporting period.

Physico-chemical

Groundwater at GW01 was found to have a circumneutral pH (range = 7.03 – 7.49). TDS (range = 274 – 281 mg/L) and EC (range = 461 - 573 µS/cm) measurements were consistent throughout the reporting period. TSS were not detected. Bicarbonate alkalinity averaged 163 mg/L, which indicates a good acidity buffering capacity. These values are within the historical range since 2017.

Nutrients

Ammonia concentrations ranged from below the Limit of Reporting (LoR) – 0.13 mg/L at GW01. The mean nitrate concentration was 1.70 mg/L, with little variation across the reporting period. Total nitrogen concentrations averaged 2.0 mg/L (range = 1.9 – 2.1 mg/L). These results are comparable to the previous reporting period, highlighting the stability of the groundwater conditions. The slightly elevated nitrate concentrations at GW01 were likely reflective of the wider nitrate issues in groundwater across the BWMC site, the source of which extends up-gradient, beyond the boundaries of the BWMC site (off-site contamination). Ammonia, nitrate, and nitrogen concentrations have remained stable at GW01 since 2017.

The total phosphorus (TP) concentration at GW01 averaged 0.10 mg/L during this reporting period. Since measurements began in 2017, TP concentrations have i) stabilised, and ii) reduced on average.

Metals

Total arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, selenium, tin, and zinc were not detected at GW01. This is consistent with previous reporting periods. Minimal (0.01 mg/L) aluminium was detected in August 2022, although all other sampling rounds reported < LoR. Nickel concentrations ranged from < LoR – 0.002 mg/L and remained well below the ANCEZZ & ARMCANZ freshwater trigger value for 99% species protection for this analyte (0.008 mg/L). Both aluminium and nickel concentrations have been consistent since at least 2017.

3.3.9 Quality Control

Duplicate Sample(s)

A total of two duplicate samples were taken during the reporting period and were analysed for total metals to assess the variability of laboratory results between samples. As summarised in Table 9, 100% of QA/QC sample analysed were determined to be reflective of the primary sample concentrations, i.e. within ± 30% of the primary result or within ± 50% if the result was within 5 fold the limit of reporting (data provided in Appendix 2). The results of the QA/QC analysis provide confidence in the accuracy and precision of the analytical results captured during this reporting period.

Table 9 Summary of data from QA/QC samples and an assessment against their primary sample

Sample location	Date taken	Lab ID	Duplicate data was within ± 30% of primary result? *
GW01 Dupe	19/07/2022	EM2213812011	**Yes** - **PASS**
GW01 Dupe	17/10/2023	EM2318569008	**Yes** - **PASS**

** Or within ± 50% if result was < 5x the LOR.*

Sample Non-Compliance

The laboratory used for analysis (ALS in Victoria) advised of holding time non-compliance for the pH and redox analysis across all sampling events, as these parameters have a short holding time of 6 hours (laboratory reports are provided in Appendix 2). The holding time non-compliance for these analytes was as a result the overnight transport of samples from Tasmania to the laboratory in Victoria

and as such were unavoidable. Field measurements were taken to supplement this data where possible.

3.4 RESULTS OF LANDFILL SETTLEMENT (CONDITION M4-1.7)

EPN Condition M4-1.7 states that the results of all settlement monitoring shall be included within the annual review. The height of each settlement survey marker has been summarised and presented in Table 10, with the tabulated results provided in Appendix 4

No settlement monitoring has been conducted since March 2021 due to ongoing management changes at BWMC. BCC has confirmed that they are seeking to urgently have surveyors attend site to perform a settlement monitoring survey.

For further information regarding the site-specific landfill settlement monitoring, consult the Leachate Treatment Wetland Settlement Monitoring Plan (Burnie Waste Management Centre, March 2016).

Table 10: Summary of the height of each settlement survey marker in mAHD.

				SURVEY MARKER IDENTIFIER							
				ABOLT	BBOLT	CBOLT	DBOLT	EBOLT	FBOLT	GBOLT	HBOLT
STAGE (Frequency)	**SURVEY No.**	**Responsibility**	**Date Completed**	**HEIGHT (mAHD)**							
Pre-construction (Initial survey 2 weeks prior to construction commencing)	Survey # 1	BCC	9/02/2016	153.299	158.332	163.272	160.809	158.943	156.789	152.541	152.122
Construction (Fortnightly)	Survey # 2	Batchelor (Contractor)	26/04/2016	153.299	158.334	163.277	160.813	158.944	156.791	152.543	152.124
	Survey # 3	Batchelor (Contractor)	16/05/2016	153.299	158.334	163.278	160.812	158.945	156.791	152.549	152.128
	Survey # 4	Batchelor (Contractor)	31/05/2016	153.293	158.327	163.272	160.805	158.937	156.784	152.542	152.121
	Survey # 5	Batchelor (Contractor)	14/06/2016	153.297	158.330	163.276	160.809	158.940	156.789	152.551	152.127
	Survey # 6	Batchelor (Contractor)	01/07/2016	153.296	158.329	163.276	160.808	158.940	156.788	152.551	152.126
Post Construction (Fortnightly - after constriction for a 2 month period)	Survey # 9	BCC	6/12/2016	153.297	158.321	163.273	160.797	*Removed*	156.786	152.551	152.125
	Survey # 10	BCC	22/12/2016	153.298	158.321	163.274	160.797	*Removed*	156.782	152.551	152.125
	Survey # 11	BCC	9/01/2017	153.297	158.323	163.276	160.798	*Removed*	156.784	152.551	152.125
	Survey # 12	BCC	23/01/2017	153.297	158.323	163.278	160.798	*Removed*	156.786	152.554	152.127
Post Construction (Monthly - thereafter for a 4 month period)	Survey # 13	BCC	23/02/2017	153.298	158.328	163.286	160.804	*Removed*	156.791	152.558	152.130
	Survey # 14	BCC	21/03/2017	153.298	158.327	163.287	160.803	*Removed*	156.789	152.557	152.128
	Survey # 15	BCC	27/04/2017	153.298	158.328	163.288	160.800	*Removed*	156.786	152.559	152.129
	Survey # 16	BCC	23/05/2017	153.298	158.328	163.288	160.798	*Removed*	156.785	152.559	152.129
Post Project Completion (Annual Inspections)	Survey # 17	BCC	11/12/2017	153.298	158.326	163.291	160.795	*Removed*	156.784	152.565	152.130
	Survey # 18	BCC	1/02/2019	153.294	158.327	**Disturbed**	160.795	*Removed*	156.786	152.578	152.131
	Survey # 19	BCC	12/02/2020	153.291	158.328	163.321	160.796	159.041	156.788	152.592	152.133
	Survey # 20	BCC	10/03/2021	153.288	158.332	163.356	160.803	159.069	156.834	152.621	-

3.5 RESULTS OF PIEZOMETER MONITORING (CONDITION M4-1.7)

The results of all piezometer monitoring (leachate level monitoring) are presented in Figure 16 to fulfil EPN Condition M4-1.7. Generally, levels measured within each of the monitoring bores during the reporting period were consistent with the trends identified during the previous reporting period. As shown in Figure 16:

- MW20 (installed within the geosynthetic clay liner unlined cap) was unusually variable, when compared to the previous 36 months of data (Figure 16). The measured leachate level ranged from 143.89 – 145.73 m AHD from 02/11/22 – 26/10/23. Leachate levels decreased from November 2022 to April 2023, and remained relatively stable from April 2023 to October 2023, although a brief spike was noted between July and August 2023 (+ 0.65 m).

- MW23 (installed within the geosynthetic clay lined cap of the Stage 1 landfill) remained relatively stable over the reporting period. A minor decline (~ 0.3 m) followed by a small spike (~ 0.5 m) was noted between June and August 2023, before the leachate level stabilised at its normal level of approximately 152 m AHD.

- MW24 (installed outside the extent of the geosynthetic clay liner unlined cap) followed the same pattern as MW20 and declined by a similar amount.

Piezometer measurement and monitoring is the responsibility of Burnie City Council. Note that two piezometers (MW21 and MW22) were removed during construction of the wetland system.

4.0 ENVIRONMENTAL PERFORMANCE

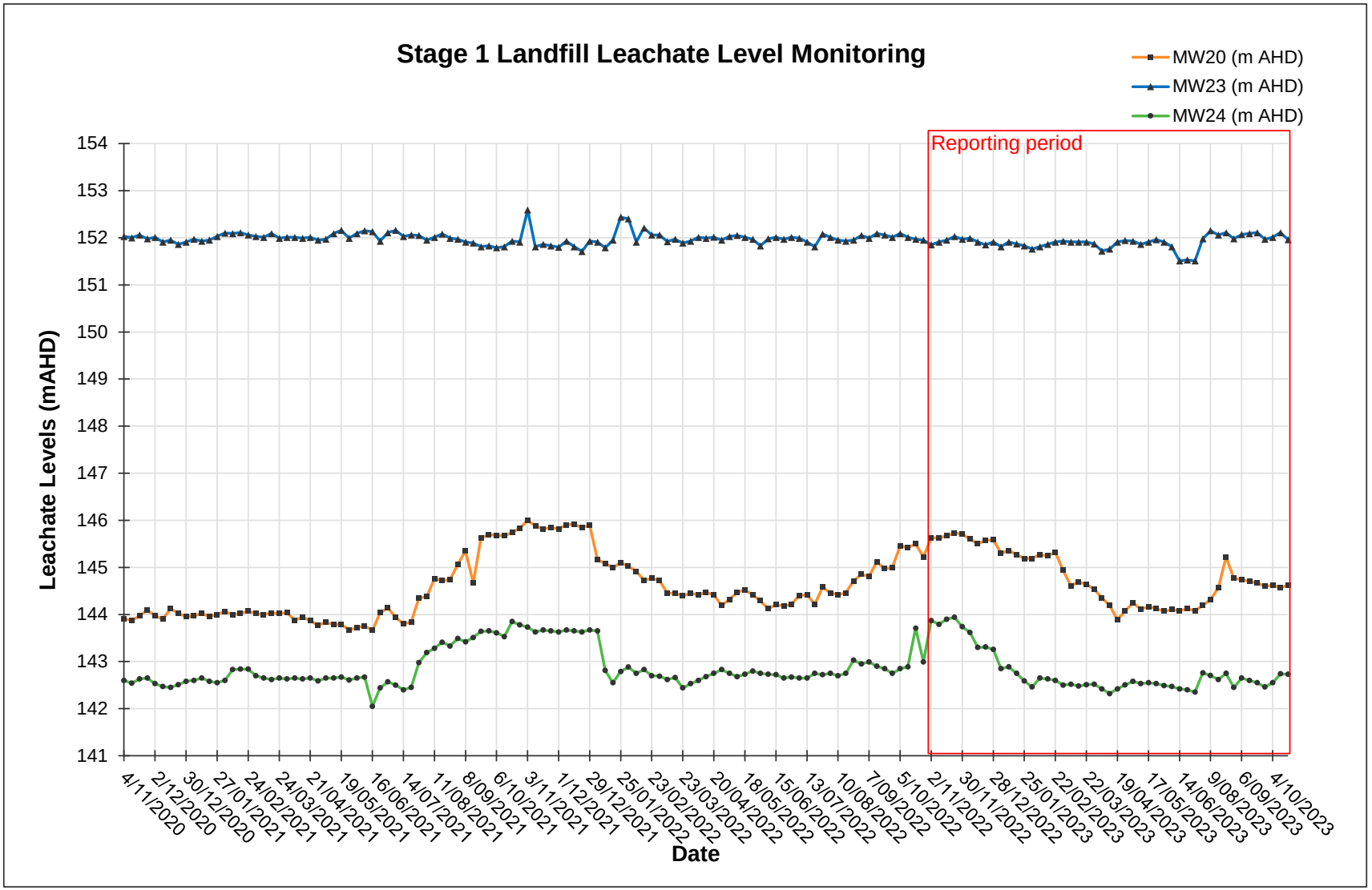
4.1 PUBLIC COMPLAINTS (EPN CONDITION G8 1.2)

No public complaints were received during the reporting period.

4.2 PROCEDURAL OR PROCESS CHANGES (EPN CONDITION G8 1.3)

No procedural or process-related changes were undertaken during the reporting period.

Figure 16: Leachate levels as measured by piezometers at several locations surrounding the landfill cap. Note that piezometers at MW21 and MW22 were removed during construction of the wetland.



4.3 WASTE MINIMISATION INITIATIVE (EPN CONDITION G8 1.4)

One (1) waste minimisation initiative was implemented during the reporting period which involved:

- Harvesting of sludge from within the pre-treatment cell PT01 and MH01 (Figure 1); and
- Treatment of harvested sludge with hardwood chips.

The initiative was carried out under EPA Approval G3 of the EPN 9421/1 and document EA M481808 ck which stipulates the conditions required to treat sludge material to meet the category of Level 1 Fill Material as described in *Information Bulletin No. 105 – Classification and Management of Contaminated Soil for Disposal* (EPA Tas, 2018). The initiative is anticipated to continue in subsequent reporting periods under the standard procedure documented within the Operations and Maintenance Manual (Syrinx, 2019).

4.3.1 Sludge removal, treatment, and reuse

Several rounds of desludging and mixing occurred throughout the reporting period. The treated sludge is currently held in a secure bunded area on site. In only one sampling event (17/08/23) did the mean manganese concentration fall below the Information Bulletin No. 105 limit for Mn of 500 mg/kg (as required by the EPN for reuse on site; Table 11). In all other instances of laboratory testing, the mean Mn value was greater than 500 mg/kg.

4.4 DETAILS OF INCIDENTS OR NON-COMPLIANCE WITH THE EPN (EPN CONDITION G8 1.5)

There were no incidents or events of water quality non-compliance/breaches with respect to the EPN 9421/2 during the reporting period. The water quality effluent trigger limits described under EPN Conditions EF1 and EF2 were not breached during the reporting period (see Section 3.3.6).

4.5 SUMMARY OF COMMUNITY CONSULTATION / COMMUNICATION (CONDITION G8 1.10)

No community consultation or communication was required or undertaken during the reporting period.

Table 11: Results from the treatment and testing of manganese contaminated sludge.

Sample Description	Sample Date	Laboratory ID	Moisture Content (%)	Manganese (mg/kg)	Mean Manganese ± SD (mg/kg)	Compliant with Level 1 Fill Material? (< 500 mg/kg)
Treated sludge (1)	29/11/2022	EM2223760001	60.8	1170	1150 ± 28	No.
Treated sludge (2)	29/11/2022	EM2223760002	55.5	1170		
Treated sludge (3)	29/11/2022	EM2223760003	57.1	1110		
PT02 Sludge	4/04/2023	ES2308950004	6.0	661	656.5 ± 6	No.
Legacy	4/04/2023	ES2308950003	3.5	652		
PT02 Sludge	30/05/2023	ES2318290001	4.2	511		No.
PT02 Sludge (1)	19/07/2023	ES2324690001	3.6	605	677 ± 67	No.
PT02 Sludge (2)	19/07/2023	ES2324690002	3.5	689		
PT02 Sludge (3)	19/07/2023	ES2324690003	3.7	737		
PT02 Remix (1)	15/08/2023	ES2329178004	4.5	559	563 ± 120	No.
PT02 Remix (2)	15/08/2023	ES2329178005	4.2	**445**		
PT02 Remix (3)	15/08/2023	ES2329178006	4.2	685		
MH01 treated sludge (1)	17/08/2023	ES2329178001	4.3	**403**	**359** ± 45	**Yes.**
MH01 treated sludge (2)	17/08/2023	ES2329178002	15.5	**313**		
MH01 treated sludge (3)	17/08/2023	ES2329178003	6.2	**360**		
PT01 Mix (1)	10/10/2023	ES2336069001	1.9	567	589 ± 58	No.
PT01 Mix (2)	10/10/2023	ES2336069002	1.0	655		
PT01 Mix (3)	10/10/2023	ES2336069003	1.4	545		
PT01 Remix (1)	16/11/2023	ES2340239001	4.5	718	710 ± 46	No.
PT01 Remix (2)	16/11/2023	ES2340239002	4.3	751		
PT01 Remix (3)	16/11/2023	ES2340239003	3.6	661		

5.0 SUMMARY OF RESULTS AND COMPLIANCE (CONDITION G8 1.9)

The results of the monitoring data collected during the reporting period are summarised below.

Volume of untreated and treated leachate processed by the system

- The total volume of untreated leachate entering the system via INF was 97 ML, and the treatment system discharged 100 ML via EFF1, which was greater (3 ML or 3 %) than the volume entering the treatment system at INF. The difference was attributed to the rainfall captured by the system over the period.
- 51 ML of effluent was discharged at downstream boundary of the Wet Infiltration Forest (EFF2), indicating that 49 ML (49 % of total treated flows) were infiltrated during the reporting period.
- As for previous years, the total volume of treated leachate discharged by the system at EFF2 was more than anticipated in the DPEMP. The infiltration capacity of the Wet Infiltration Forest was likely reduced by more intense rainfall and is expected to increase when rainfall stops for a sustained period.

Water quality monitoring data

- The water quality data collected during the monitoring period demonstrated full system compliance with respect to ammonia, chromium, copper, nickel, and zinc trigger values as detailed within the EPN 9421/2 (draft version). The laboratory data for these parameters are compared to the trigger limits in Table 8.
- There were no recirculation events due to water quality breaches during the reporting period.
- The quality of groundwater at GW01 during the reporting period was consistent with the previous reporting period and as such did not show a deterioration in water quality.

6.0 CONCLUSIONS

The system was fully compliant with the conditions of the EPN 9421/2 (draft version) with respect to water quality trigger limits, as the system provided adequate treatment of leachate during the annual reporting period of 1st of July 2022 to the 31st of October 2023.

REFERENCES

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National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended 2013.

Natural Environment Services Tasmania (2014). Natural Values Assessment Unnamed Tributary of Cooee Creek

Syrinx Environmental PL (2015). Burnie Waste Management Centre Stage 1 Landfill Leachate Treatment Wetland Development Proposal & Environmental Management Plan (DPEMP)

Syrinx Environmental PL (2019). Burnie Waste Management Centre Stage 1 Landfill Leachate Treatment Wetland Operations and Maintenance Manual

Syrinx Environmental PL (2021a). BWMC “Site” EPN 9161/2 Annual Environmental Review August 2021 – July 2022

Syrinx Environmental PL (2021b). BWMC “Wetland” EPN 9421/1 Annual Environmental Review July 2021 – June 2022

APPENDICES

APPENDIX 1 TABLE OF MONITORING PARAMETERS AND FREQUENCIES

Surface water monitoring

Parameter	Units	Location	Frequency	Method
Flow	m^3/day	INF, EFF1, EFF2	continuous	Field –online flow meter
Temp	°C		annually	Field
pH		EFF1	continuous	Field
		INF, EFF2	annually	lab
Conductivity	µS/cm	EFF1	continuous	Field
		INF, EFF2	annually	lab
Alkalinity total	mg $CaCO^3$/L	INF, EFF1, EFF2	annually	lab
Total suspended solids	mg/L		annually	
Total dissolved solids				
Dissolved oxygen				Field
Dissolved oxygen content			annually	lab
Chemical oxygen demand			annually	
Oxidation reduction potential	Eh mV		annually	
Cyanide total	µg/L		annually	
PCB	µg/L		annually	
Ammonia	mg/l	EFF1	continuous	Field
		INF, EFF1, EFF2	annually	lab

Nitrate Nitrite Total nitrogen Total phosphorus Phosphorous dissolved reactive		INF, EFF1, EFF2	annually	lab
Chloride Sulphate			annually	
Mg, K, Na				
Al, As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, Zn	µg/L		annually	
E.coli	Org / 100 mls	INF, EFF1, EFF2	annually	
Enterococci				
Acenaphthene Acenaphthylene Anthracene Benzene Benzo(a)anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(b&k)fluoanthene Benzo(ghi)perylene Chrysene Dibenzo(ah)anthracene Fluranthrene	µg/L	INF, EFF1, EFF2	annually	

Fluorene Indeno(123-cd)pyrene Naphthalene Phenanthrene Pyrene				
Ethylbenzene, Om&p Xylene, Toluene, Total BTEX	µg/L	INF, EFF1, EFF2	annually	lab

Groundwater monitoring

Parameter	**Units**	**Location**	**Frequency**	**Method**
Water level	m^3/day	GW1	annually	Field
Temp	°C		annually	Field
pH			annually	
				lab
Conductivity	µS/cm		annually	Field
Alkalinity total	mg $CaCO^3$/L		annually	lab
Total suspended solids	mg/L		annually	
Total dissolved solids				
Dissolved oxygen				Field
Dissolved oxygen content			annually	lab
Chemical oxygen demand			annually	
Oxidation reduction potential	Eh mV		annually	

Cyanide total	µg/L		annually	
PCB	µg/L		annually	
Ammonia	mg/l		continuous	
			annually	
Nitrate Nitrite Total nitrogen Total phosphorus Phosphorous dissolved reactive			annually	
Chloride Sulphate			annually	
Mg, K, Na				
Al, As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, Zn	µg/L		annually	

APPENDIX 2 LABORATORY ANALYTICAL DATA

ATTACHED SEPARATELY

APPENDIX 3 TABULATED FIELD AND LABORATORY DATA

Sample ID	Sample Date	PHYSICAL PARAMETERS															INORGANICS					
		ELECTRICAL CONDUCTIVITY	DO (mg/L)	DO (%)	TEMPERATURE	Eh (199 mV offset)	REDOX POTENTIAL (No offset)	REDOX (Lab)	pH	pH Redox	SALINITY	TOTAL DISSOLVED SOLIDS	TOTAL SUSPENDED SOLIDS	CHEMICAL OXYGEN DEMAND	TURBIDITY	DISSOLVED ORGANIC CARBON	TOTAL ORGANIC CARBON	ALKALINITY (TOTAL)	ALKALINITY (BICARBONATE)	ALKALINITY (CARBONATE)	ALKALINITY (HYDROXIDE)	HARDNESS as CaCO3	CHLORIDE
		µS/cm	mg/L	%	°C	mV	mV		pH units	pH units	PPT	mg/L	mg/L	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
INF	19/07/2022	502	4.99	48.7	14.3	----	-48.3	----	6.66	6.66	0.28	246	45	<10	----	13.7	----	162	162	<1	<1	----	49
EFF2	19/07/2022	383	12.09	89.4	2.8	----	271	----	7.88	7.88	0.19	206	<1	<10	----	12.9	----	105	105	<1	<1	----	41
EFF1	19/07/2022	----	9.55	73.7	3.7	----	183	----	----	7.12	0.2	220	3	<10	----	14.8	----	108	108	<1	<1	----	40
GW01	19/07/2022	495	2.4	23	13.3	----	248	----	7.06	7.06	0.25	281	<1	<10	----	1.5	----	162	162	<1	<1	----	46
SW01	19/07/2022	170	11.01	91.6	7.3	----	258	----	7.3	7.3	0.1	112	1	<10	----	12	----	32	32	<1	<1	----	17
SW02	19/07/2022	241	6.93	59.7	7.5	----	264	----	6.91	6.91	0.13	163	32	62	----	20	----	45	45	<1	<1	----	23
SW03	19/07/2022	165	6.85	57.4	6.5	----	286	----	6.83	6.83	0.09	97	<1	<10	----	7	----	29	29	<1	<1	----	17
L02	19/07/2022	542	6.78	62.7	11.2	----	310	----	6.86	6.86	0.16	373	32	38	----	15	----	175	175	<1	<1	----	45
GW02	19/07/2022	120	----	----	----	----	295	----	6.07	6.07	----	96	----	<10	----	6	----	14	14	<1	<1	----	14
GW03	19/07/2022	175	----	----	----	----	335	----	5.8	5.8	----	112	----	<10	----	4	----	5	5	<1	<1	----	14
GW04	19/07/2022	358	----	----	----	----	326	----	6.48	6.48	----	228	----	60	----	11	----	94	94	<1	<1	----	12
DUPE	19/07/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
INF	29/08/2022	555	----	----	----	----	-102	6.92	6.92	----	----	262	47	----	----	12.6	----	187	187	<1	<1	----	----
PRE	29/08/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SF	29/08/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SSF	29/08/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
EFF1	29/08/2022	----	----	----	----	----	1.7	7.15	----	----	----	230	<5	----	----	13.8	----	120	120	<1	<1	----	----
EFF2	29/08/2022	426	----	----	----	----	138	7.88	7.88	----	----	204	<5	----	----	14.4	----	114	114	<1	<1	----	----
GW01	29/08/2022	----	----	----	----	----	176	7.28	7.28	----	----	276	<5	----	----	----	----	165	165	<1	<1	----	53
INF	20/09/2022	528	----	----	----	----	126	----	7.17	6.51	----	254	46	----	----	11.8	----	175	175	<1	<1	----	----
EFF1	20/09/2022	----	----	----	----	----	154	----	----	7.12	----	193	<1	----	----	12.9	----	214	214	<1	<1	----	----
EFF2	20/09/2022	376	----	----	----	----	161	----	7.84	7.81	----	196	<1	----	----	14.5	----	109	109	<1	<1	----	----
GW01	20/09/2022	----	----	----	----	----	----	----	7.49	----	----	279	<1	----	----	----	----	166	166	<1	<1	----	47
INF	25/10/2022	535	----	----	----	----	-77.3	----	7.66	6.46	----	222	60	<10	----	11.8	----	172	172	<1	<1	----	55
EFF1	25/10/2022	----	----	----	----	----	208	----	----	7.15	----	200	2	16	----	14	----	129	129	<1	<1	----	42
EFF2	25/10/2022	412	----	----	----	----	110	----	8.07	7.76	----	188	3	17	----	14.5	----	122	122	<1	<1	----	40
INF	29/11/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
EFF1	29/11/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
EFF2	29/11/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
GW01	17/10/2023	461	1.93	19.4	14.5	----	460	7.16	7.03	7.66	----	274	<1	<10	----	0.8	----	159	159	<1	<1	----	42
INF	24/10/2023	479	5.14	51.2	14.9	----	6.8	----	6.78	6.29	0.38	567	22	18	----	----	----	156	156	<1	<1	----	38
EFF1	24/10/2023	----	----	----	----	----	487.7	----	----	6.79	0.32	297	<1	19	----	----	----	153	153	<1	<1	----	40
EFF2	24/10/2023	423	7.17	68.1	13	----	476.7	----	7.72	7.05	0.31	247	4	<10	----	----	----	146	146	<1	<1	----	41
GW01	24/10/2023	573	2.4	24.1	15	----	512.3	----	7.82	----	0.35	469.6			----	----	----	----	----	----	----	----	----

Sample ID	Sample Date	INORGANICS											DISSOLVED MAJOR CATIONS				NUTRIENTS						
		ALKALINITY (TOTAL)	ALKALINITY (BICARBONATE)	ALKALINITY (CARBONATE)	ALKALINITY (HYDROXIDE)	HARDNESS as CaCO3	CHLORIDE	SULFATE (AS SO4 -)	CYANIDE TOTAL	TOTAL ANIONS	TOTAL CATIONS	IONIC BALANCE	CALCIUM	MAGNESIUM	SODIUM	POTASSIUM	AMMONIA (AS N)	NITRATE (AS N)	NITRITE (AS N)	NITRITE + NITRATE	TOTAL KJELDAHL NITROGEN AS N	ORGANIC NITROGEN (calc)	NITROGEN (TOTAL)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
INF	19/07/2022	162	162	<1	<1	----	49	11	<0.004	4.85	4.37	5.17	18	21	36	7	7.53	0.31	<0.01	0.31	6.8	6.79	7.1
EFF2	19/07/2022	105	105	<1	<1	----	41	12	<0.004	3.5	3.89	5.17	16	18	34	5	<0.01	2.01	0.02	2.03	0.6	0.59	2.6
EFF1	19/07/2022	108	108	<1	<1	----	40	12	<0.004	3.54	3.99	6.07	17	19	34	4	0.22	2.55	0.03	2.58	0.8	0.85	3.4
GW01	19/07/2022	162	162	<1	<1	----	46	3	<0.004	4.6	5.08	4.96	35	26	25	4	<0.01	1.77	<0.01	1.77	0.2	0.23	2
SW01	19/07/2022	32	32	<1	<1	----	17	10	<0.004	1.33	1.52	----	6	4	17	6	0.02	1.17	0.01	1.18	0.4	0.43	1.6
SW02	19/07/2022	45	45	<1	<1	----	23	21	<0.004	1.98	2.04	1.39	10	5	16	17	1.49	1.17	0.11	1.28	3	3.13	4.3
SW03	19/07/2022	29	29	<1	<1	----	17	10	<0.004	1.27	1.45	----	4	4	17	7	<0.01	0.81	<0.01	0.81	0.3	0.29	1.1
L02	19/07/2022	175	175	<1	<1	----	45	13	<0.004	5.04	4.6	4.56	29	13	39	15	12.8	0.55	<0.01	0.55	13.1	13.05	13.6
GW02	19/07/2022	14	14	<1	<1	----	14	3	<0.004	0.74	1.03	----	4	4	11	1	<0.01	2.33	<0.01	2.33	0.2	0.17	2.5
GW03	19/07/2022	5	5	<1	<1	----	14	1	<0.004	0.52	1.18	----	3	4	15	2	<0.01	7.02	<0.01	7.02	0.5	0.48	7.5
GW04	19/07/2022	94	94	<1	<1	----	12	32	----	2.88	3.27	6.29	33	9	15	9	3.92	5.58	0.09	5.67	4.1	4.22	9.8
DUPE	19/07/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	#VALUE!	----
INF	29/08/2022	187	187	<1	<1	----	----	----	----	----	----	----	----	----	----	----	10.5	0.23	<0.01	0.23	11.4	11.37	11.6
PRE	29/08/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	#VALUE!	----
SF	29/08/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	3.38	2.16	0.06	2.22	3.4	3.44	5.6
SSF	29/08/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.14	2.56	0.05	2.61	1.6	1.64	4.2
EFF1	29/08/2022	120	120	<1	<1	----	----	----	----	----	----	----	----	----	----	----	0.69	2.61	0.05	2.66	1.3	1.39	4
EFF2	29/08/2022	114	114	<1	<1	----	----	----	----	----	----	----	----	----	----	----	0.51	2.35	0.03	2.38	0.7	0.75	3.1
GW01	29/08/2022	165	165	<1	<1	----	53	3	----	4.85	4.84	0.19	34	24	25	3	0.07	1.62	<0.01	1.62	0.5	0.48	2.1
INF	20/09/2022	175	175	<1	<1	----	----	----	----	----	----	----	----	----	----	----	6.8	0.23	<0.01	0.23	9.2	9.17	9.4
EFF1	20/09/2022	214	214	<1	<1	----	----	----	----	----	----	----	----	----	----	----	0.93	2.1	0.04	2.14	1.2	1.20	3.3
EFF2	20/09/2022	109	109	<1	<1	----	----	----	----	----	----	----	----	----	----	----	0.13	1.7	0.03	1.73	0.6	0.60	2.3
GW01	20/09/2022	166	166	<1	<1	----	47	3	----	4.7	4.82	1.19	34	24	24	4	0.13	1.74	<0.01	1.74	0.3	0.26	2
INF	25/10/2022	172	172	<1	<1	----	55	12	<0.004	----	----	----	20	19	38	8	6.37	0.19	<0.01	0.19	8.4	8.41	8.6
EFF1	25/10/2022	129	129	<1	<1	----	42	9	<0.004	----	----	----	19	18	34	6	1.2	0.79	0.03	0.82	1.4	1.41	2.2
EFF2	25/10/2022	122	122	<1	<1	----	40	9	<0.004	----	----	----	18	17	33	6	0.16	0.73	0.03	0.76	0.6	0.67	1.4
INF	29/11/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
EFF1	29/11/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
EFF2	29/11/2022	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
GW01	17/10/2023	159	159	<1	<1	----	42	3	----	----	----	----	37	26	23	4	0.02	1.68	<0.01	1.68	0.2	0.22	1.9
INF	24/10/2023	156	156	<1	<1	----	38	11	<0.004	----	----	----	21	21	32	6	6.45	0.31	<0.01	0.31	6.8	6.79	7.1
EFF1	24/10/2023	153	153	<1	<1	----	40	3	<0.004	----	----	----	24	22	36	6	0.42	0.23	0.01	0.24	0.8	0.77	1
EFF2	24/10/2023	146	146	<1	<1	----	41	4	<0.004	----	----	----	23	22	36	7	0.16	0.24	<0.01	0.24	0.2	0.16	0.4
GW01	24/10/2023	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

NUTRIENTS		TOTAL METALS														DISSOLVED METALS					
PHOSPHORUS (TOTAL)	PHOSPHORUS DISSOLVED REACTIVE (AS P)	TOTAL ALUMINIUM	TOTAL ARSENIC	TOTAL CADMIUM	TOTAL CHROMIUM	TOTAL COPPER	TOTAL COPPER ORC-ICP-MS	TOTAL IRON	TOTAL LEAD	TOTAL MANGANESE	TOTAL MERCURY	TOTAL NICKEL	TOTAL SELENIUM	TOTAL TIN	TOTAL ZINC	DISSOLVED ALUMINIUM	DISSOLVED ARSENIC	DISSOLVED CADMIUM	DISSOLVED TRIVALENT CHROMIUM	DISSOLVED HEXAVALENT CHROMIUM	DISSOLVED CHROMIUM
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
0.01	<0.01	0.02	<0.001	<0.0001	<0.001	0.001	----	----	<0.001	3.72	<0.0001	0.006	<0.01	<0.001	<0.005	----	----	----	----	----	----
<0.01	<0.01	0.06	<0.001	<0.0001	<0.001	0.001	----	----	<0.001	0.023	<0.0001	0.002	<0.01	<0.001	<0.005	----	----	----	----	----	----
<0.01	<0.01	0.02	<0.001	<0.0001	<0.001	0.001	----	----	<0.001	0.286	<0.0001	0.006	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.09	0.14	<0.01	<0.001	<0.0001	<0.001	<0.001	----	<0.05	<0.001	<0.001	<0.0001	0.002	<0.01	<0.001	<0.005	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001
<0.01	<0.01	<0.01	<0.001	<0.0001	<0.001	0.001	----	<0.05	<0.001	0.274	<0.0001	0.001	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.38	<0.01	4.56	<0.001	<0.0001	0.013	0.006	----	0.1	<0.001	0.666	<0.0001	0.012	<0.01	<0.001	0.02	----	----	----	----	----	----
0.01	<0.01	0.33	<0.001	<0.0001	<0.001	0.001	----	<0.05	<0.001	0.258	<0.0001	0.001	<0.01	<0.001	0.006	----	----	----	----	----	----
0.25	<0.01	0.37	0.002	<0.0001	0.002	0.005	----	<0.05	0.004	2.22	<0.0001	0.006	<0.01	<0.001	0.039	----	----	----	----	----	----
<0.01	<0.01	0.57	<0.001	<0.0001	0.002	0.003	----	<0.05	<0.001	0.027	<0.0001	0.009	<0.01	<0.001	0.026	0.02	<0.001	<0.0001	<0.001	<0.001	<0.001
0.02	<0.01	0.82	<0.001	<0.0001	0.006	0.003	----	<0.05	0.002	0.019	<0.0001	0.013	<0.01	0.001	0.033	0.01	<0.001	<0.0001	0.002	<0.001	0.002
0.34	<0.01	15.5	<0.001	<0.0001	0.041	0.026	----	0.06	0.011	0.69	<0.0001	0.045	<0.01	<0.001	0.219	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001
----	----	<0.01	<0.001	<0.0001	<0.001	<0.001	----	----	<0.001	<0.001	<0.0001	0.002	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.01	<0.01	0.01	<0.001	<0.0001	<0.001	<0.001	----	26.4	<0.001	4.28	<0.0001	0.006	<0.01	<0.001	<0.005	----	----	----	----	----	----
----	----	0.03	<0.001	<0.0001	<0.001	<0.001	----	21.5	<0.001	4.8	<0.0001	0.005	<0.01	<0.001	<0.005	----	----	----	----	----	----
<0.01	<0.01	0.01	<0.001	<0.0001	<0.001	<0.001	----	0.21	<0.001	0.399	<0.0001	0.006	<0.01	<0.001	0.035	----	----	----	----	----	----
0.01	<0.01	0.02	<0.001	<0.0001	<0.001	<0.001	----	0.13	<0.001	0.352	<0.0001	0.006	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.01	<0.01	0.02	<0.001	<0.0001	<0.001	<0.001	<0.5	0.08	<0.001	0.247	<0.0001	0.005	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.01	<0.01	0.06	<0.001	<0.0001	<0.001	<0.001	<0.5	0.13	<0.001	0.031	<0.0001	0.002	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.12	0.14	0.01	<0.001	<0.0001	<0.001	<0.001	----	<0.05	<0.001	<0.001	<0.0001	0.002	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.02	<0.01	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
<0.01	<0.01	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
<0.01	<0.01	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
0.1	0.14	<0.01	<0.001	<0.0001	<0.001	<0.001	----	<0.05	<0.001	<0.001	<0.0001	0.002	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.11	<0.01	0.01	<0.001	<0.0001	<0.001	<0.001	----	36.9	<0.001	4.64	----	0.006	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.02	<0.01	0.01	<0.001	<0.0001	<0.001	<0.001	----	0.42	<0.001	0.524	----	0.005	<0.01	<0.001	<0.005	----	----	----	----	----	----
0.02	<0.01	0.33	<0.001	<0.0001	<0.001	<0.001	----	0.79	<0.001	0.162	----	0.003	<0.01	<0.001	<0.005	----	----	----	----	----	----
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0.08	0.13	<0.01	<0.001	<0.0001	<0.001	<0.001	----	<0.05	<0.001	<0.001	----	0.001	<0.01	<0.001	<0.005	<0.01	<0.001	<0.0001	----	----	<0.001
0.04	<0.01	0.02	<0.001	<0.0001	<0.001	<0.001	----	19.6	<0.001	3.35	<0.0001	0.006	<0.01	----	<0.005	<0.01	<0.001	<0.0001	<0.01	<0.01	<0.001
<0.01	<0.01	<0.01	0.001	<0.0001	<0.001	<0.001	----	0.84	<0.001	1.74	<0.0001	0.006	<0.01	----	<0.005	<0.01	<0.001	<0.0001	<0.01	<0.01	<0.001
<0.01	<0.01	0.06	<0.001	<0.0001	<0.001	<0.001	----	0.61	<0.001	0.354	<0.0001	0.003	<0.01	----	<0.005	0.01	<0.001	<0.0001	<0.01	<0.01	<0.001
----	----	<0.01	<0.001	<0.0001	----	<0.001	----	<0.05	<0.001	<0.001	<0.0001	<0.001	<0.01	----	<0.005	<0.01	<0.001	<0.0001	----	----	----

DISSOLVED METALS										MICROBIOLOGICAL		
DISSOLVED COPPER	DISSOLVED COPPER ORC-ICP-MS	DISSOLVED IRON	DISSOLVED LEAD	DISSOLVED MANGANESE	DISSOLVED MERCURY	DISSOLVED NICKEL	DISSOLVED SELENIUM	DISSOLVED TIN	DISSOLVED ZINC	TOTAL COLIFORMS	ENTEROCOCCI	E. COLI
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU / 100mL	orgs /100mL	CFU / 100mL
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<0.001	----	<0.05	<0.001	<0.001	<0.0001	0.002	<0.01	<0.001	<0.005	----	----	----
----	----	<0.05	----	----	----	----	----	----	----	200	----	----
----	----	0.1	----	----	----	----	----	----	----	>24000	----	----
----	----	<0.05	----	----	----	----	----	----	----	180	----	----
----	----	<0.05	----	----	----	----	----	----	----	83	----	----
0.002	----	<0.05	<0.001	0.015	<0.0001	0.008	<0.01	<0.001	0.014	----	----	----
0.002	----	<0.05	<0.001	0.003	<0.0001	0.011	<0.01	<0.001	0.011	----	----	----
0.001	----	0.06	<0.001	0.48	<0.0001	<0.001	<0.01	<0.001	0.02	----	----	----
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----	----	----	----	----	----	----	----	----	----	870	1200	870
----	----	----	----	----	----	----	----	----	----	----	----	----
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0.01	----	<0.05	<0.05	<0.001	----	0.002	<0.01	<0.001	<0.005	----	----	----
0.001	----	15.1	<0.001	3.2	<0.0001	0.005	<0.01	----	<0.005	0	1	0
0.001	----	<0.05	<0.001	1.63	<0.0001	0.006	<0.01	----	<0.005	650	73	520
0.002	----	<0.05	<0.001	0.334	<0.0001	0.003	<0.01	----	<0.005	870	1600	770
<0.001	----	<0.05	<0.001	<0.001	<0.0001	<0.001	<0.01	----	<0.005	----	----	----

APPENDIX 4 LEACHATE TREATMENT WETLAND SETTLEMENT MONITORING DATA

BASELINE MEASUREMENTS 9/02/2016			
POINT ID	EASTING	NORTHING	HEIGHT
ABOLT	405859.730	5451541.880	153.299
BBOLT	405903.058	5451409.390	158.332
CBOLT	406017.621	5451409.262	163.272
DBOLT	406022.459	5451480.852	160.809
EBOLT	406002.965	5451530.346	158.943
FBOLT	405986.464	5451587.495	156.789
GBOLT	405879.230	5451632.967	152.541
HBOLT	405856.516	5451600.399	152.122
SCODH	405633.677	5451519.799	148.097
SCKERB	405724.340	5451516.620	148.891

MEASUREMENTS 26/04/2016				DIFFERENCES TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
160426.A	405859.723	5451541.880	153.299	-0.007	0.000	0.000
160426.B	405903.047	5451409.390	158.334	-0.011	0.000	0.002
160426.C	406017.611	5451409.258	163.277	-0.010	-0.004	0.005
160426.D	406022.449	5451480.846	160.813	-0.010	-0.006	0.004
160426.E	406002.958	5451530.342	158.944	-0.007	-0.004	0.001
160426.F	405986.460	5451587.489	156.791	-0.004	-0.006	0.002
160426.G	405879.224	5451632.967	152.543	-0.006	0.000	0.002
160426.H	405856.508	5451600.399	152.124	-0.008	0.000	0.002

MEASUREMENTS 16/05/2016				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
160516.A	405859.723	5451541.876	153.299	0.000	-0.004	0.000	-0.007	-0.004	0.000
160516.B	405903.055	5451409.387	158.334	0.008	-0.003	0.000	-0.003	-0.003	0.002
160516.C	406017.617	5451409.26	163.278	0.006	0.002	0.001	-0.004	-0.002	0.006
160516.D	406022.453	5451480.849	160.812	0.004	0.003	-0.001	-0.006	-0.003	0.003
160516.E	406002.959	5451530.344	158.945	0.001	0.002	0.001	-0.006	-0.002	0.002
160516.F	405986.461	5451587.49	156.791	0.001	0.001	0.000	-0.003	-0.005	0.002
160516.G	405879.223	5451632.964	152.549	-0.001	-0.003	0.006	-0.007	-0.003	0.008
160516.H	405856.512	5451600.394	152.128	0.004	-0.005	0.004	-0.004	-0.005	0.006

Note: unable to be accurately survey the week of the 9th due to severe weather.

MEASUREMENTS 31/05/2016				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
160531.A	405859.727	5451541.881	153.293	0.004	0.005	-0.006	-0.003	0.001	-0.006
160531.B	405903.056	5451409.391	158.327	0.001	0.004	-0.007	-0.002	0.001	-0.005
160531.C	406017.619	5451409.263	163.272	0.002	0.003	-0.006	-0.002	0.001	0.000
160531.D	406022.456	5451480.851	160.805	0.003	0.002	-0.007	-0.003	-0.001	-0.004
160531.E	406002.962	5451530.347	158.937	0.003	0.003	-0.008	-0.003	0.001	-0.006
160531.F	405986.466	5451587.496	156.784	0.005	0.006	-0.007	0.002	0.001	-0.005
160531.G	405879.23	5451632.969	152.542	0.007	0.005	-0.007	0.000	0.002	0.001
160531.H	405856.517	5451600.398	152.121	0.005	0.004	-0.007	0.001	-0.001	-0.001

MEASUREMENTS 14/06/2016				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
160614.A	405859.726	5451541.88	153.297	0.001	0.001	0.004	0.004	0.000	-0.002
160614.B	405903.057	5451409.389	158.33	-0.001	0.002	0.003	0.001	0.001	-0.002
160614.C	406017.624	5451409.264	163.276	-0.005	-0.001	0.004	-0.003	-0.002	0.004
160614.D	406022.459	5451480.854	160.809	-0.003	-0.003	0.004	0.000	-0.002	0.000
160614.E	406002.965	5451530.352	158.94	-0.003	-0.005	0.003	0.000	-0.006	-0.003
160614.F	405986.463	5451587.5	156.789	0.003	-0.004	0.005	0.001	-0.005	0.000
160614.G	405879.226	5451632.969	152.551	0.004	0.000	0.009	0.004	-0.002	0.010
160614.H	405856.512	5451600.399	152.127	0.005	-0.001	0.006	0.004	0.000	0.005

MEASUREMENTS 01/07/2016				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
160701A	405859.728	5451541.882	153.296	-0.002	-0.002	-0.001	0.002	-0.002	-0.003
160701B	405903.064	5451409.393	158.329	-0.007	-0.004	-0.001	-0.006	-0.003	-0.003
160701C	406017.619	5451409.262	163.276	0.005	0.002	0	0.002	0.000	0.004
160701D	406022.456	5451480.851	160.808	0.003	0.003	-0.001	0.003	0.001	-0.001
160701E	406002.963	5451530.349	158.94	0.002	0.003	0	0.002	-0.003	-0.003
160701F	405986.464	5451587.502	156.788	-0.001	-0.002	-0.001	0.000	-0.007	-0.001
160701G	405879.222	5451632.973	152.551	0.004	-0.004	0	0.008	-0.006	0.010
160701H	405856.509	5451600.4	152.126	0.003	-0.001	-0.001	0.007	-0.001	0.004

MEASUREMENTS 6/12/2016				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
161206A	405859.728	5451541.884	153.297	0.000	-0.002	0.001	0.002	-0.004	-0.002
161206B	405903.063	5451409.405	158.321	0.001	-0.012	-0.008	-0.005	-0.015	-0.011
161206C	406017.627	5451409.276	163.273	-0.008	-0.014	-0.003	-0.006	-0.014	0.001
161206D	406022.455	5451480.865	160.797	0.001	-0.014	-0.011	0.004	-0.013	-0.012
E (DESTROYED)									
161206F	405986.458	5451587.512	156.786	0.006	-0.010	-0.002	0.006	-0.017	-0.003
161206G	405879.222	5451632.979	152.551	0.000	-0.006	0.000	0.008	-0.012	0.010
161206H	405856.507	5451600.408	152.125	0.002	-0.008	-0.001	0.009	-0.009	0.003

MEASUREMENTS 22/12/2016				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
161222A	405859.725	5451541.88	153.298	-0.003	-0.004	0.001	-0.005	0.000	-0.001
161222B	405903.066	5451409.393	158.321	0.003	-0.012	0.000	0.008	0.003	-0.011
161222C	406017.625	5451409.264	163.274	-0.002	-0.012	0.001	0.004	0.002	0.002
161222D	406022.451	5451480.849	160.797	-0.004	-0.016	0.000	-0.008	-0.003	-0.012
E (DESTROYED)									
161222F	405986.459	5451587.502	156.782	0.001	-0.010	-0.004	-0.005	0.007	-0.007
161222G	405879.228	5451632.971	152.551	0.006	-0.008	0.000	-0.002	0.004	0.010
161222H	405856.511	5451600.402	152.125	0.004	-0.006	0.000	-0.005	0.003	0.003

MEASUREMENTS 9/01/2017				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
170109A	405859.727	5451541.882	153.297	0.002	0.002	-0.001	-0.003	0.002	-0.002
170109B	405903.056	5451409.398	158.323	-0.010	0.005	0.002	-0.002	0.008	-0.009
170109C	406017.616	5451409.266	163.276	-0.009	0.002	0.002	-0.005	0.004	0.004
170109D	406022.443	5451480.851	160.798	-0.008	0.002	0.001	-0.016	-0.001	-0.011
170109F	405986.456	5451587.497	156.784	-0.003	-0.005	0.002	-0.008	0.002	-0.005
170109G	405879.229	5451632.968	152.551	0.001	-0.003	0.000	-0.001	0.001	0.010
170109H	405856.511	5451600.403	152.125	0.000	0.001	0.000	-0.005	0.004	0.003

Note: Heights highlighted blue located using 1" robotic total station to lesser accuracy than digital level.

MEASUREMENTS 23/01/2017				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
170123A	405859.733	5451541.88	153.297	0.006	-0.002	0.000	0.003	0.000	-0.002
170123B	405903.067	5451409.391	158.323	0.011	-0.007	0.000	0.009	0.001	-0.009
170123C	406017.626	5451409.264	163.278	0.010	-0.002	0.002	0.005	0.002	0.006
170123D	406022.455	5451480.852	160.798	0.012	0.001	0.000	-0.004	0.000	-0.011
170123F	405986.468	5451587.494	156.786	0.012	-0.003	0.002	0.004	-0.001	-0.003
170123G	405879.235	5451632.97	152.554	0.006	0.002	0.003	0.005	0.003	0.013
170123H	405856.516	5451600.403	152.127	0.005	0.000	0.002	0.000	0.004	0.005

MEASUREMENTS 23/02/2017				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
170223A	405859.732	5451541.886	153.298	-0.001	0.006	0.001	0.002	0.006	-0.001
170223B	405903.062	5451409.395	158.328	-0.005	0.004	0.005	0.004	0.005	-0.004
170223C	406017.621	5451409.26	163.286	-0.005	-0.004	0.008	0.000	-0.002	0.014
170223D	406022.451	5451480.846	160.804	-0.004	-0.006	0.006	-0.008	-0.006	-0.005
170223F	405986.464	5451587.496	156.791	-0.004	0.002	0.005	0.000	0.001	0.002
170223G	405879.231	5451632.973	152.558	-0.004	0.003	0.004	0.001	0.006	0.017
170223H	405856.514	5451600.406	152.13	-0.002	0.003	0.003	-0.002	0.007	0.008

MEASUREMENTS 21/03/2017				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
170321A	405859.731	5451541.881	153.298	-0.001	-0.005	0.000	0.001	0.001	-0.001
170321B	405903.057	5451409.394	158.327	-0.005	-0.001	-0.001	-0.001	0.004	-0.005
170321C	406017.619	5451409.256	163.287	-0.002	-0.004	0.001	-0.002	-0.006	0.015
170321D	406022.446	5451480.842	160.803	-0.005	-0.004	-0.001	-0.013	-0.010	-0.006
170321F	405986.464	5451587.491	156.789	0.000	-0.005	-0.002	0.000	-0.004	0.000
170321G	405879.231	5451632.967	152.557	0.000	-0.006	-0.001	0.001	0.000	0.016
170321H	405856.513	5451600.404	152.128	-0.001	-0.002	-0.002	-0.003	0.005	0.006

MEASUREMENTS 27/04/2017				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
170427A	405859.735	5451541.881	153.298	0.004	0.000	0.000	0.005	0.001	-0.001
170427B	405903.059	5451409.392	158.328	0.002	-0.002	0.001	0.001	0.002	-0.004
170427C	406017.616	5451409.253	163.288	-0.003	-0.003	0.001	-0.005	-0.009	0.016
170427D	406022.449	5451480.835	160.8	0.003	-0.007	-0.003	-0.010	-0.017	-0.009
170427F	405986.468	5451587.488	156.786	0.004	-0.003	-0.003	0.004	-0.007	-0.003
170427G	405879.238	5451632.971	152.559	0.007	0.004	0.002	0.008	0.004	0.018
170427H	405856.52	5451600.406	152.129	0.007	0.002	0.001	0.004	0.007	0.007

MEASUREMENTS 23/05/2017				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
170523A	405859.735	5451541.882	153.298	0.000	0.001	0.000	0.005	0.002	-0.001
170523B	405903.059	5451409.396	158.328	0.000	0.004	0.000	0.001	0.006	-0.004
170523C	406017.617	5451409.256	163.288	0.001	0.003	0.000	-0.004	-0.006	0.016
170523D	406022.447	5451480.838	160.798	-0.002	0.003	-0.002	-0.012	-0.014	-0.011
170523F	405986.47	5451587.491	156.785	0.002	0.003	-0.001	0.006	-0.004	-0.004
170523G	405879.233	5451632.964	152.559	-0.005	-0.007	0.000	0.003	-0.003	0.018
170523H	405856.517	5451600.399	152.129	-0.003	-0.007	0.000	0.001	0.000	0.007

MEASUREMENTS 11/12/2017				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
171211A	405859.73	5451541.877	153.298	-0.005	-0.005	0.000	0.000	-0.003	-0.001
171211B	405903.059	5451409.393	158.326	0.000	-0.003	-0.002	0.001	0.003	-0.006
171211C	406017.617	5451409.251	163.291	0.000	-0.005	0.003	-0.004	-0.011	0.019
171211D	406022.442	5451480.836	160.795	-0.005	-0.002	-0.003	-0.017	-0.016	-0.014
171211F	405986.466	5451587.484	156.784	-0.004	-0.007	-0.001	0.002	-0.011	-0.005
171211G	405879.233	5451632.964	152.565	0.000	0.000	0.006	0.003	-0.003	0.024
171211H	405856.513	5451600.395	152.13	-0.004	-0.004	0.001	-0.003	-0.004	0.008

MEASUREMENTS 1/02/2019				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
010219A	405859.729	5451541.874	153.294	-0.001	-0.003	-0.004	-0.001	-0.006	-0.005
010219B	405903.06	5451409.393	158.327	0.001	0.000	0.001	0.002	0.003	-0.005
010219C	DISTURBED								
010219D	406022.433	5451480.834	160.795	-0.009	-0.002	0.000	-0.026	-0.018	-0.014
010219E	DESTROYED								
010219F	405986.463	5451587.486	156.786	-0.003	0.002	0.002	-0.001	-0.009	-0.003
010219G	405879.226	5451632.96	152.578	-0.007	-0.004	0.013	-0.004	-0.007	0.037
010219H	405856.512	5451600.395	152.131	-0.001	0.000	0.001	-0.004	-0.004	0.009

MEASUREMENTS 12/02/2020				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
010219A	405859.732	5451541.869	153.291	0.003	-0.005	-0.003	0.002	-0.011	-0.008
010219B	405903.066	5451409.392	158.328	0.006	-0.001	0.001	0.008	0.002	-0.004
010219C- Adjus	406017.627	5451409.245	163.321						
010219D	406022.43	5451480.829	160.796	-0.003	-0.005	0.001	-0.029	-0.023	-0.013
010219E- New	406002.894	5451530.313	159.041						
010219F	405986.455	5451587.482	156.788	-0.008	-0.004	0.002	-0.009	-0.013	-0.001
010219G	405879.218	5451632.949	152.592	-0.008	-0.011	0.014	-0.012	-0.018	0.051
010219H	405856.501	5451600.383	152.133	-0.011	-0.012	0.002	-0.015	-0.016	0.011

MEASUREMENTS 10/03/2021				DIFFERENCE TO LAST			DIFFERENCE TO BASELINE		
POINT ID	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT	EASTING	NORTHING	HEIGHT
100321A	405859.733	5451541.871	153.288	0.001	0.002	-0.004	0.003	-0.009	-0.012
100321B	405903.064	5451409.394	158.332	-0.002	0.002	0.004	0.006	0.004	0.000
100321C	406017.609	5451409.243	163.356	-0.018	-0.002	0.035			
100321D	406022.427	5451480.820	160.803	-0.004	-0.009	0.007	-0.033	-0.032	-0.006
100321E	406002.885	5451530.308	159.069	-0.009	-0.005	0.028			
100321F	405986.437	5451587.479	156.834	-0.018	-0.003	0.046	-0.027	-0.016	0.045
100321G	405879.246	5451632.960	152.621	0.028	0.010	0.028	0.016	-0.008	0.079

Note: Measurements derived from averaged GPS static observations to lesser accuracy from previous surveys due to vegetation growth.

PLEASE QUOTE
Your Ref:
Our Ref: 34/12/8; 7629573; 23/27562

Enquiries: Raymond Mee (RM:JYC)

80 Wilson Street, Burnie Tasmania
PO Box 973, Burnie TAS 7320
ABN: 29 846 979 690
Phone: (03) 6430 5700
Email: burnie@burnie.tas.gov.au
Web: www.burnie.tas.gov.au

We value your feedback on our service.
Tell us about it at www.burnie.tas.gov.au/feedback

BURNIE CITY COUNCIL

20 December 2023

Mr Wes Ford
Director
Environment Protection Authority Tasmania
GPO Box 1550
HOBART TAS 7001

Email: enquiries@epa.tas.gov.au; tanya.mijak@epa.tas.gov.au
A hard copy will not be sent unless requested

Dear Wes,

BURNIE WASTE MANAGEMENT CENTRE – WETLAND
ANNUAL ENVIRONMENTAL REVIEW 2022-2023

The Burnie City Council commissioned Syrinx Environmental to undertake the Annual Environmental Review in accordance with EPN 9421/2 applicable to the Burnie Waste Management Centre Wetland.

The annual review report for 2022-23 is ***attached*** and will be placed on Council's website. This review covers the matters listed in EPN 9421/2, in particular Condition G8.

I look forward to receiving your advice that this review satisfies Council's obligations.

Please refer feedback and discussion regarding this report to Mr Raymond Mee, Manager Works on (03) 6430 5853 or email: rmee@burnie.tas.gov.au

Yours sincerely,

Belinda Lynch
ACTING GENERAL MANAGER

Enc: BWMC Wetland EPN 9421/2 – Annual Environmental Review 2022/2023