

16 January 2020

Shellharbour City Council

PO Box 155
Shellharbour Square
Shellharbour City Centre NSW 2529

Attention: **Joel Coulton**
Waste & Resource Recovery Manager

Dear Joel

November 2019 Quarterly Environmental Monitoring – Dunmore Recycling and Waste Disposal Depot, Dunmore, New South Wales.

Please find enclosed a copy of our report entitled as above. Thank you for the opportunity to undertake this work

1 Introduction

Environmental monitoring is undertaken on a quarterly basis at the Dunmore Recycling Waste Disposal Depot, Dunmore, NSW (the site), in accordance with Environment Protection Licence (EPL) No. 5984, refer to Figure 1 (**Appendix A**). The monitoring includes sampling groundwater bores, a leachate pond, surface water bodies, a dust gauge and landfill gas at the landfill surface to detect any potential impacts of land filling activities on the environment.

2 Scope of work

On the 19 and 20 November 2019 groundwater, surface water, leachate, gas and dust samples were collected in and around the site.

Groundwater samples were collected from 14 monitoring bores (BHA, BH1c, BH2, BH3, BH4, BH12-R, BH13, BH14, BH15, BH16, BH17-R, BH19-R, BH20 and BH20s). At BH9 and BH10 only the standing water level (SWL) was measured and no samples were taken.

Surface water was collected from the leachate pond (LP1), three on site retention ponds (SWP1, SWP2, and SWP4) and Rocklow Creek at four points (SWC2, SWC_Up, SWC_Down and SWC_Down_2). No samples were taken at BH14 and SWP5 as both locations were dry.

A dust gauge bottle was collected to the north of the site (DDG) and a gas walkover of all site buildings and the landfill cap was also undertaken. Landfill gas was measured in the field using a Flame Ionisation Detector (FID) and a GA5000 Landfill Gas Analyser (GS5000). Sampling locations are shown on Figure 2 (**Appendix A**).



3 Objective

The objective of the works is to investigate the potential risks as a result of legacy and contemporary landfilling activities posed by landfill gas and leachate accumulation and migration to onsite and offsite receptors.

Objectives will be met by providing Shellharbour City Council (Council) with quarterly environmental monitoring data of various media including landfill gas, leachate, surface water and groundwater in accordance with Environmental Protection License (EPL) 5984.

4 Field activities

Environmental Earth Sciences undertook monitoring and sampling activities in accordance with Council's request and EPL 5984. The number of sampling points and methodologies are summarised in **Table 1**.

Table 1: Monitoring works completed

Medium	Number of monitoring points	Monitoring points completed	Sampling method	comments
Landfill Gas (Surface)	Across the landfill cap within onsite buildings / structures		GA5000 gas analyser using quick connect fitting recording flow, pressure and peak and stable gas concentrations and 25 m transects using parts per million (ppm) resolution instrument	The transects were completed with good coverage, all buildings and structures were successfully inspected.
Surface Water			In accordance with NSW EPA standard practice	
Leachate			In accordance with NSW EPA standard practice	
Groundwater			In accordance with NSW EPA standard practice	

Notes:

*Technique in accordance with Environmental Guidelines: Solid Waste Landfills 2016 second edition

4.1 Water quality sampling

Water quality sampling was undertaken at the locations illustrated in Figure 2 (**Appendix B**) except for SWP5 and BH14 which were dry.

The following field parameters were recorded using a calibrated water quality meter:

- pH, electrical conductivity (EC), oxidation/reduction potential (ORP), dissolved oxygen and temperature.
- Colour and odour of water samples were also noted.

Where possible, at each borehole location:

- Groundwater levels were dipped prior to purging and sampling to ascertain the standing water level (SWL).
- Groundwater was purged and collected using wattera tubing or a submersible pump.
- A water quality meter was used during purging and sampling to record the abovementioned water quality parameters.
- Collection of groundwater samples representative of the aquifer were undertaken either when field parameters stabilise ($\pm 5\%$) or after wells are purged dry and allowed to recover.

Field parameters for surface water, groundwater and leachate are presented in **Table 4**. They were measured with a calibrated YSI Professional Plus water quality meter and the calibration certificate are provided in **Appendix C**.

4.2 Sample collection and equipment decontamination

Samples were placed directly into clean glass/plastic containers, to avoid inclusion of solid/particulate matter where practicable and collected in a manner that avoids aeration of the sample.

Samples were then immediately placed in an ice cooled esky following collection. At the completion of field work, samples were couriered to the National Association of Testing Authorities (NATA) accredited laboratory. Where considered necessary (e.g. where cross contamination may occur) all reusable sampling equipment was decontaminated with biodegradable surfactant between sample locations.

4.3 Landfill gas

4.3.1 Surface gas sampling

Surface gas monitoring was undertaken with a calibrated GA5000 landfill gas analyser and Inspectra Laser. The Inspectra Laser is used for the detection of low-level methane at ppm concentrations whilst the GA5000 is used to measure the following gases:

Gases measured in parts per million (ppm):

- hydrogen sulfide (H₂S).
- carbon monoxide (CO).

Gases measured in percent volume / volume (% v/v):

- carbon dioxide (CO₂).
- oxygen (O₂).
- methane (CH₄); and
- balance (%).

Measurements were taken within and around all buildings in a 250 m radius from the current landfill cell as well as across the landfill cap (gas walkover grids of the November 2019 round are indicated in Figure 2, **Appendix A**). Weather conditions observed during gas monitoring on 19 November 2019, based on readings from the weather station at Albion Park¹ are summarised in **Table 2**.

Table 2: Weather conditions – November 2019

Temperature °C (Min and Max)		Wind speed and direction			Relative humidity	
12.6°C	33.4°C	9am	28 km/h	W	9am	18%
		3pm	28 km/h	ENE	3pm	33%

5 Laboratory analysis

The scheduled laboratory analyses are summarised below. Sample analysis was performed by Sydney Analytical Laboratories (SAL) which is a NATA accredited laboratory.

5.1 Groundwater

- Groundwater - ionic balance (pH, total dissolved salts (TDS), sodium, calcium, potassium, magnesium, fluoride, chloride, ammonium, sulfate, bicarbonate, phosphate and nitrate), total organic carbon (TOC), biological oxygen demand (BOD), total and soluble iron, and soluble manganese.

¹ <http://www.bom.gov.au/climate/dwo/201911/html/IDCJDW2001.201911.shtml>, accessed 19 December 2019

5.2 Surface water

- Surface water (SWC_Up, SWC_Down and SWC_Down_2) – ionic balance, total and soluble iron, turbidity, nitrate, ammonium and bicarbonate.
- Surface water (SWC2) – ammonium, nitrate, bicarbonate and total and soluble iron.
- Surface water (SWP1, SWP2 and SWP4) – ionic balance, total and soluble iron and turbidity.
- Additional analyses for SWP4 – TOC and BOD.

5.3 Leachate

- Leachate tank (LP1) – ionic balance, TOC, BOD, total and soluble iron, soluble manganese, and turbidity,

5.4 Dust

- Dust gauge (DG) – ash content, combustible content, insoluble content, soluble content, total solids content, particulates content.

The inorganic laboratory results for groundwater and surface water are shown in **Error! Reference source not found.5 (Appendix B)**. Calculated ratios of principal ions are presented in Table 6 (**Appendix B**), with full laboratory reports and chain of custody presented in **Attachment E**.

6 Results and discussion

6.1 Groundwater flow

Inferred groundwater flow patterns based on the November 2019 standing water level (SWL) measurements were calculated using SWLs from surveyed bores and are an indicative representation of the groundwater flow patterns onsite. Similar to previous monitoring, groundwater flow was towards Rocklow Creek in a southerly direction, refer to Figure 3 (**Appendix A**).

Cumulative rainfall for September 2019 (49.2 mm), October 2019 (47 mm) and November 2019 (14.8 mm) was 111 mm (BOM – Albion Park Shellharbour Airport weather station²) and below 1999-2019 mean rainfall for this period of the year (188 mm). Consequently, groundwater levels were lower in all the wells monitored compared to August 2019 levels, with an average difference of -0.25 m.

2

http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=068241, accessed 19 December 2019

6.2 Leachate tank chemistry

One leachate sample (LP1) was collected from the leachate tanks during the November 2019 monitoring round.

To assess whether leachate generated from the landfill has impacted the environment, leachate characteristics are compared with groundwater and to an extent surface waters. Leachate can be characterised by elevated concentrations on non-native potassium (K⁺), ammonium (NH₄-N) and nitrate (NO₃⁻) relative to native sodium (Na⁺), calcium (Ca₂⁺) and magnesium (Mg₂⁺) (Hem 1985). This comparison is known as the leachate to non-leachate ratio (L/N). An L/N ratio >10 may be indicative of leachate impact depending on the combination with other indicators such as odour, colour, BOD and bicarbonate whereas a significant impact is likely to correspond with a ratio of >20 (**Error! Reference source not found.6, Appendix B**).

To facilitate comparison and discussion, the average of past results collected between October 1998 and August 2019 have been used for field parameter values, alongside the current round's chemical laboratory results.

The results from LP1 have been stable over the past 20 years of monitoring and indicate the following.

- moderately alkaline with field pH of 8.2.
- moderately saline with EC of 8,310 µs/cm.
- mildly reducing ORP of -38.6 mV.
- dissolved oxygen ranging from 0.22 to 49 ppm.
- Cl⁻/SO₄²⁻ dominant with Na⁺ / Ca⁺ subdominant
- TOC of 450 mg/L.

Leachate indicators (non-native K⁺, NH₄-N and TOC) have been detected at LP1, with concentrations remaining generally consistent since October 1998 as shown in LP1 Scholler plot located in **Appendix D**. The average L/N ratio was calculated at 70.89% for LP1.

Comparison to the adopted ANZECC / ARMCANZ (2000) guidelines for 95% freshwater ecosystems indicated that LP1 exceeded the threshold for NH₄-N (1.88 mg/L), reporting concentrations of 915 mg/L (Table 5, **Appendix B**). NH₄-N concentrations have reduced slightly from 970 mg/L detected in the August 2019 round.

In addition, iron (Fe²⁺) concentrations in November of 5.2 mg/L exceeded the site criteria (0.3 mg/L), however this was significantly lower than the 48 mg/L recorded in February 2019.

6.3 Groundwater chemistry

6.3.1 Groundwater sampling locations impacted by leachate

Field and laboratory results from the November 2019 sampling round, specifically from bores BH1c, BH2, BH3, BH12R, BH13, BH17R, BH20 and BH20s displayed chemistry that can be related to leachate impact with high levels of potassium, ammonium and nitrate.

BH1c (EPL monitoring point 3)

Bore BH1c is located near the old unlined landfill cell and intercepts leachate within the cell. As such the chemical signature of this bore has historically contained elevated leachate indicators in comparison to other monitoring bores (Scholler plot BH1c, **Appendix C**). This continued during the current monitoring event and the groundwater was found to have a brown tinge, and leachate odour noted in combination with elevated TDS (4,110 mg/L), K⁺ (210 mg/L) [resulting in low Ca/K ratio – 1.21] and NH₄⁺-N (350 mg/L) concentrations. The very low levels of oxygen (0.33 ppm, **Error! Reference source not found.2 Appendix B**) and presence of soluble Fe²⁺ (3.7 mg/L) indicate an anaerobic environment and biochemical demand in response to microbial respiration. Further evidence of microbial activity / respiration is elevated HCO₃⁻ (3,280 mg/L) resulting in a low Cl/HCO₃⁻ ratio of 0.36 (**Error! Reference source not found.6 Appendix B**). This suggests degradation of the leachate plume continues in this monitoring bore.

BH2 (non-EPL location)

Bore BH2 is located down gradient from the old unlined landfill cell. NH₄⁺-N concentration at BH2 showed an increasing trend since 2010 and reached its historical maximum in August 2017 and November 2017 (49 mg/L in both months). NH₄⁺-N has remained relatively stable, with a concentration of 43 mg/L recorded in November 2019. Bicarbonate (HCO₃⁻), Na⁺ and Mg²⁺ concentrations in groundwater remained relatively stable since February 2019 (Table 5, **Appendix B** and Scholler plot BH2, **Appendix C**). Calcium (Ca²⁺) concentrations have reduced slightly since the last monitoring round (to 160 mg/L) as have potassium (K⁺) and chloride (Cl⁻). Low oxygen and negative redox (**Error! Reference source not found., Appendix B**) continue to suggest microbial respiration and therefore degradation of the leachate is occurring at this location.

BH3 (EPL monitoring point 5)

Bore BH3 is further downgradient from the shallow old landfills within the stable nitrate plume to the south and displayed a L/N ratio of 40 in November 2019. However, due to a low TDS value (900 mg/L), the L/N ration must be used with caution. Concentrations of non-native NH₄⁺-N had decreased slightly (34mg/L mg/L), whilst NO₃⁻ was dominant with 39 mg/L. TDS was lower than the previous round (compared to 1,120 mg/L in August 2019).

BH12R (non-EPL location)

Bore BH12R was reinstalled in July 2019 to the southwest of the leachate tanks and south of the compost stockpiles. This bore was installed to replace BH12 (monitoring point 9 of EPA license number 5984) following the development of the new facilities at Dunmore Resource and Recycling. Field observations recorded a negative redox (-77 mV). The chemical signature of the groundwater at this location is indicative of leachate impact (elevated TDS (1,810 mg/L), K⁺(58 mg/L) (Table 5, **Appendix B**), which is in keeping with the migration of the plume from the main landfill to the southeast. When compared with historic data for BH12, concentrations of other landfill indicators such as Ca/K ratio had increased (9.59 in November 2019 compared to 1.07 in November 2016), K/TDS was higher (3.2 in November

2019 compared to 1.96 in November 2016) (Table 6, **Appendix B**) and $\text{NH}_4^{+}\text{-N}$ had decreased (0.6 mg/L in August 2019 compared to 12 mg/L in November 2016), indicative of degradation of the leachate plume.

BH13 (EPL monitoring point 10)

Bore BH13 is in close proximity to a former night soil disposal area and is adjacent to the current leachate pond area (Figure 1). A slight residual leachate influence has been apparent at this location in the past. Analysis of chemical data from the November 2019 monitoring round shows a continued decrease of L/N ratio of 14.41% from 21.07% in August 2018. Elevated L/N ratios may be attributed to the dominance in NO_3^- of 5 mg/L. Large fluctuations in NO_3^- have previously been observed in the historic data, however, chemical composition of the groundwater has generally remained consistent since monitoring began in 2002 (Schoeller plot BH13, **Appendix C**).

BH15 (non-EPL location)

Bore BH15 has displayed a decreasing L/N ratio trend since November 2017, where the L/N ratio was 109.33%. L/N ratio in November 2019 of 70.3% has doubled since the November 2018 monitoring round. The K^+/TDS ratio of 14.54 % was high when compared to non-leachate influenced sites generally with $\text{K}^+/\text{TDS} < 3$ (Table 6, **Appendix B** and Schoeller plot BH15, **Appendix C**). Ammonium ($\text{NH}_4^{+}\text{-N}$) remains elevated at 89 mg/L, compared to other non-impacted locations at the site, which is consistent with previous monitoring rounds. Field measurements of a negative redox (negative ORP) and low dissolved oxygen are indicative of a reducing environment. Elevated levels of soluble Fe^{2+} (14 mg/L) is an indicator of a reducing environment that is favourable for the degradation of leachate. BH15 is located within a swampy environment where microbiological activity drives reducing reactions that can result in naturally high levels of leachate indicators such as organic carbon and HCO_3^- . However, as L/N ratio has decreased, these indicators have also decreased. It is important to note that bore BH15 is located near a drainage line within the groundwater bearing zone <0.5 m below the ground surface. Groundwater therefore has the potential to be influenced from local onsite and offsite works and surface water.

BH17R (non-EPL location)

BH17R was installed in July 2019 to replace BH17b, following the development of the new facilities at Dunmore Resource & Recycling. Bore 17R is located to the east of the leachate tanks, which provides coverage to the eastern bounds of the site (Figure 1). Results compared with historical data from BH17 (Schoeller plot BH17, **Appendix C**) indicates that the chemical signature has reduced slightly since 2016 but remains broadly stable. The L/N ratio (19.64 %) (Table 6, **Appendix B**) is lower than the August 2019 monitoring round, but still higher than the last recorded value of nearby bore BH17 (7.06%). However, is consistent with values recorded in 2012. Negative ORP (-144 mV) and very low dissolved oxygen (1 ppm) in addition to elevated concentrations of Fe (2.6 mg/L) are indicative of an anaerobic environment and high microbial activity.

BH20 (non-EPL location)

Bore BH20 is located down gradient of the landfill, leachate ponds and shallow old landfill. This bore was positioned to assess the chemical characteristics on the boundary of the landfill site. Field observations at bore BH20 during the November 2019 monitoring round recorded a negative redox (-201.5 mV) with clear groundwater and a very 'rotten egg/sulfuric odour'. The L/N ratio (38.16%) in the November 2019 round had increased from the August 2019 value (26.16%). The TDS remained relatively low (880 mg/L) making the L/N susceptible to natural variations or fluctuations in chemistry. Chemical characteristics of the

bore show groundwater is low in Na^+ , with a moderate Ca/K and K/TDS ratio (Table 6, **Appendix B**). Ammonium levels remained elevated at 43 mg/L however other landfill indicators were low or absent.

BH20s (non EPL location)

Bore BH20s is located directly adjacent to BH20 but at a shallower depth – screened intervals of BH20 and BH20s are 6.0-9.0 mBGL and 1.5-4.5 mBGL respectively. Similarly, this bore was positioned to compare the chemical characteristics on the boundary of the landfill site in order to locate potential transport pathways to Rocklow Creek. In contrast to the August 2019 round, in November 2019, field measurements at bore BH20s recorded a negative redox (-79.8 mV), indicative of a reducing atmosphere within shallow depth. Groundwater was a very light amber and no odour was detected. The decrease in NO_3^- (43 mg/L) and high concentration of K^+ (79 mg/L) led to a reduced but still elevated L/N ratio (59.9%), indicative of potentially high leachate impact at this site. TDS is low (815 mg/L) making the L/N susceptible to natural variations or fluctuations in chemistry. Chemical characteristics of the bore show groundwater was low in Na^+ , with a moderate Ca/K and K/TDS ratio (Table 6, **Appendix B**). As observed within BH3, the relatively low rainfall in over the monitoring period may have impacted the nitrogen species within BH20s, resulting in elevated NO_3^- (43mg/L) concentrations. Ammonium levels (2.0 mg/L) have increased from the August 2019 monitoring round (1.2 mg/L) but remain lower than those seen at the deeper BH20 bore. It was previously thought that high nitrate levels in this shallower bore location was indicative of nitrification throughout the soil profile, however, continued monitoring at this location will be necessary to determine potential leachate transport pathways to Rocklow Creek.

6.3.2 Remaining groundwater sampling locations

During the November 2019 monitoring round, ionic chemistry indicated that bores BHA, BH4, BH16 and BH19R only displayed slight to no leachate influence (Table 5 and Table 6, **Appendix B**). Chemical composition of each of these bores has been depicted in Schoeller plots in **Appendix D**. Full laboratory transcripts are included un **Appendix E**.

BHA (non EPL location)

BHA is located to the east of the landfill to the south of the former BH18 and positioned to be hydraulically upgradient of the leachate plume migrating to the southeast. The L/N ratio was lower than the August 2019 monitoring round, reducing from 9.45% to 8.95%. A redox potential of -149 ppm and dissolved oxygen content of 0.06 ppm is suggestive of a reducing environment. TDS is relatively low (690 mg/L) making the L/N susceptible to natural variation in groundwater chemistry. Both ammonium and nitrate levels were low (0.7 mg/L) and nitrate had reduced by 9 mg/L since the August 2019 monitoring round. In addition, groundwater was also low in Na^+ (86 mg/L) with an elevated Ca/K ratio (11.92) and moderate K/TDS ratio (2.61%) (Table 6 **Appendix B**). Bore BHA is strategically placed up gradient of landfilling activities and should be continually monitored to determine the background water quality.

BH4 (EPL monitoring point 6)

The L/N ratio at bore BH4 continued to decrease in the November 2019 round (7.73%) from the August 2019 round (8.2%). The L/N ratio at this location had not previously exceeded 10% since May 2003. The concentration of NH_4^+ -N had increased slightly when compared to the August 2019 round (8mg/L, compared to 6.70 mg/L) but was half that of that recorded in the November 2018 monitoring round (16.0 mg/L). Concentration of K^+ continued to

decrease (23 mg/L), this is still considered slightly elevated than has been observed historically. High concentrations of K^+ and native ions Na^+ , Ca^{2+} and Mg^{2+} can be attributed to the L/N ratio however this value should be used carefully due to the relatively low TDS (1,240 mg/L). BH4 is placed on the border of an historic shallow landfill site and down gradient of landfilling activities. This area should be continually monitored to determine water quality in this area.

BH16 (non EPL location)

Bore BH16 is located in a swampy area with groundwater field observations recording a light brown colour and a faint H_2S or leachate odour. The sampled redox potential indicates a reducing environment (-281.9 mV), which may have an influence on the historical dominance of NH_4^+-N over NO_3^- . This round NH_4^+-N concentrations were low and stable at 0.3 mg/L. Groundwater sampling in November 2019 indicated limited to no leachate impact at BH16 which was represented by the L/N ratio of 9.32%. The L/N ratio decreased slightly from August 2019 (9.44%), compared to May 2019 (12.81%). Bores BH15 and BH16 are located close to a drainage channel where offsite impacts can readily influence the chemical characteristics of the shallow groundwater and should continue to be monitored for fluctuations.

BH19R (non EPL location)

A blockage in BH19 was recorded in the August 2018 monitoring round. The well was reinstalled in July 2019 and the first round of monitoring was in August 2019. BH19 is in place to determine any potential leachate migration to the south west of site and will continue to be monitored. The November 2019 monitoring round recorded no leachate influence, with a L/N ration of 7.05% and an elevated Ca/K ratio of 18.62 (Table 5, **Appendix B**). NH_4^+-N (5.3 mg/L) was dominant over NO_3^- (0.35 mg/L) and was closely comparable to historical readings.

6.3.3 Groundwater site criteria exceedances

Comparison to relevant guidelines indicated the following results which exceeded thresholds during the November 2019 monitoring round. Water results for all locations are summarised on Table 5, **Appendix B** and full laboratory results are provided in **Appendix E**.

Table 3: Groundwater site criteria exceedances

	Screening Value (SV)* (mg/L)	No. locations exceeding SV	BH reference	Value (mg/L)
NH4-N	1.88	11	LP1	915
			BH1c	350
			BH2	43
			BH3	34
			BH4	8
			BH13	2.7
			BH15	89
			BH17R	15
			BH19R	5.3

	Screening Value (SV)* (mg/L)	No. locations exceeding SV	BH reference	Value (mg/L)
			BH20	43
			BH20s	2
NO3	10.6	3	BH3	39
			BH12R	43
			BH20s	145
Fe	0.3	8	LP1	5.2
			BHA	2.8
			BH1c	3.7
			BH2	0.66
			BH12R	1.9
			BH15	14
			BH17R	2.6

*Screening Value = site derived criteria.

6.4 Surface water monitoring

During the November 2019 monitoring round, samples from Rocklow Creek (SWC2, SWC_Up, SWC_Down and SWC_Down_2) and three surface water ponds (SWP1, SWP2, and SWP4) were collected. Results of surface water analysis (**Error! Reference source not found.** and **Error! Reference source not found.5, Appendix B**) indicate that concentrations of ions were within the historical ranges. As surface water ponds are intended to retain any surface water migrating towards Rocklow Creek, the detection of chemical constituents that may be associated with landfill leachate are expected.

Surface water ponds (SWP1, SWP2, SWP4)

Ammonium levels detected at SWP1 had reduced slightly from 0.7 mg/L in August to 0.2 mg/L. Elevated concentrations of soluble iron (0.63 mg/L) and a negative redox potential (-87.9 mV) in the November 2019 sampling event were indicative of a reducing environment which may have contributed to low levels of dissolved oxygen (1.05ppm).

Surface water sampled at SWP2 showed little to no leachate impact (6.52%, Table 6 **Appendix B**). The surface water pond collects runoff from around the site and potential impacts from site activities are often observed. Ammonium concentration had increased slightly (0.9 mg/L in November 2019 compared to 0.1 mg/L in August 2019), but remained low when compared to May 2018 (1.8 mg/L). Fluctuating ammonium is common at this location with previous monitoring events ranging between 0.01 and 15 mg/L. Nitrate (NO₃⁻) levels had reduced by 0.74 mg/L (0.1 mg/L during November 2019 compared to 0.84 mg/L) during August 2019 and remained below the ANZECC (2000) trigger value (10.6 mg/L) since November 2017. All chemical parameters at this location are within historical ranges.

SWP4 displayed ammonium (NH₄⁺-N) levels (0.9 mg/L) that dropped below the defined trigger level of 1.88 mg/L that was exceeded in August 2019 (2.10 mg/L). Nitrate (NO₃⁻) levels remained stable at 4.20 mg/L which is below the trigger value established by the ANZECC (2000) guidelines (10.6 mg/L). The decrease in NH₄⁺-N concentrations is indicative of the natural process of nitrification by which NH₄-N naturally attenuates. All chemical parameters at this location are within historical ranges.

Rocklow Creek (SWC2, SWC-UP, SWC-Down and SWC-Down 2)

The four surface water creek sites SWC2, SWC_Up, SWC_Down and SWC_Down_2 (Figure 2) were also sampled during the November 2019 sampling event. SWC_Up, SWC_Down and SWC_Down_2 had high concentrations of TDS (>25,000 mg/L), notably Na⁺ and Cl⁻ (Table 5, **Appendix B**); this is due to the tidal nature of these waters and differentiates them from landfill groundwater / surface water.

The low nutrient and L/N ratios recorded during the November 2019 round indicated that there was no leachate impact within Rocklow Creek (Table 6, **Appendix B**). All surface water creek sampling sites (SWC2, SWC_Up, SWC_Down and SWC_Down_2) had concentrations of NH₄⁺-N and NO₃⁻ below the ANZECC (2000) guidelines. All four sites will continue to be monitored to ensure leachate is not impacting upon the Rocklow Creek.

6.5 Quality assurance/quality control

For quality assurance and quality control the following precision and reliability measures were calculated. The charge balance difference between the summed total of anions against cations (milli-equivalent units) was in the range of 0.3% to 1.42. The results are a good indication that all major cations and anions present in the groundwater have been analysed and accounted for, providing confidence in the laboratory results obtained.

Field and laboratory practices were further evaluated by comparing the difference between field and laboratory pH and field measured electrical conductivity (EC) against laboratory total dissolved salts (TDS). The range of most relative percent difference (RPD) of field to laboratory pH measurements was between 0.0 % and 11.0%. The relationship between the field determined EC and laboratory measured TDS relationship ranged between 0.14 and 1.26. RPDs between the intra-laboratory duplicate and the primary sample taken at bore SWC-DOWN2 were all within the acceptable RPD criteria. Thus, the data is considered reliable (**Error! Reference source not found.7, Appendix B**).

6.6 Gas monitoring

All surface gas readings were below the site-specific criteria outlined in EPL no. 5984 as the NSW EPA (1996) reporting threshold of 1.25 % v/v CH₄ within onsite buildings and therefore pose no direct risk.

Readings were below the threshold concentration for closer investigation and potential action (500 ppm or 0.05 % v/v, NSW EPA [1996], Table 5). No landfill gas was detected with the GA5000. Continued monitoring with both the GA5000 and ILU will be undertaken at quarterly monitoring events.

6.7 Dust

Dust deposition levels to the north of the site were 0.3 g/m²/month total solids, which is below the accepted level of 4 g/m²/month (Australian Standards AS3580.10.1 and AS2724.1). Dust deposition levels are within historical ranges and will continue to be monitored to assess the closest sensitive receptor, houses located to the north-west of site.

7 Conclusion and recommendations

Groundwater behaviour across the site since the commencement of quarterly monitoring in 1992 has been generally consistent. As the plume beneath the site is relatively stable, changes in leachate behaviour into the future are not expected to be significant. Changes to

site conditions such as stockpile locations, new landfill cells, new retention ponds and other earth works could potentially impact leachate behaviour on site.

The November 2019 monitoring round found L/N ratios to be generally stable when compared to long-term trends. Decreases in leachate impacted bores were observed in BH12R, BH13 and BH20s, whilst BH1c, BH2, BH3 BH17R and BH20 reported slight increases. Decreased rainfall during the monitoring period may have reduced the 'flushing effect' of leachate from the overlying unconfined waste to groundwater.

Assessment of monitoring bores closest to Rocklow Creek, BH20 and BH20s, has detected the presence of leachate indicators despite the Rocklow Creek samples (SWC-Up, SWC-Down and SWC_Down_2), showing no affect. Although the historical data sets of these bore locations are relatively limited, it appears that on-site activities are not significantly impacting Rocklow Creek. Surface water monitoring indicated that on site activities have had limited impact on water quality at locations SWP1, SWP2 and SWP4. Assessment of Rocklow Creek sampling locations (SWC2, SWC-Up, SWC-Down and SWC_Down_2) reported no concentrations of $\text{NH}_4^+\text{-N}$ and NO_3^- above the ANZECC (2000) trigger value.

Gas concentrations detected at all buildings assessed on site were below guidelines and therefore no action was required. Gas concentrations across the landfill cap were also within the guidelines. However, as landfill gas exceedances were recorded in May 2017, we recommend continued monitoring with an FID or Inspectra Laser Unit and GA5000 Landfill Gas Monitor.

Depositional dust monitoring results continued to be below guidelines (Australian Standards AS3580.10.1 and AS2724.1) and will continue to be monitored to assess the impact that dust poses on nearby residential areas.

8 Limitations

This letter report has been prepared by Environmental Earth Sciences NSW ABN 109 404 006 in response to and subject to the following limitations:

1. The specific instructions received from Shellharbour City Council.
2. The specific scope of works set out in PO117559 issued by Environmental Earth Sciences NSW for and on behalf of Shellharbour City Council.
3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences NSW (which consent may or may not be given at the discretion of Environmental Earth Sciences NSW).
4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason.
5. The report only relates to the site referred to in the scope of works being located at Dunmore Recycling and Waste Disposal Depot located at Buckleys Rd Dunmore, NSW ("the site").
6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities.
7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report,
8. Fill, soil, groundwater and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill if deposited off site.
9. This report is not a geotechnical or planning report suitable for planning or zoning purposes; and
10. Our General Limitations set out at the back of the body of this report.

Should you have any further queries, please contact us on (02) 9922 1777.

On behalf of

Environmental Earth Sciences NSW

Should you have any queries, please do not hesitate to contact us on (02) 9922 1777.

For and on behalf of

Environmental Earth Sciences NSW

Project Manager

Elin Griffiths
Associate Environmental
Scientist

Project Director / Internal Reviewer

Stuart Brisbane
Senior Principal

118109_Nov 2019_V1

9 References

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ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services

The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report

A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change

Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others

Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences NSW. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light, we reserve the right to alter their conclusions.

Obtain regulatory approval

The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability


This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences NSW disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences NSW disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences NSW's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

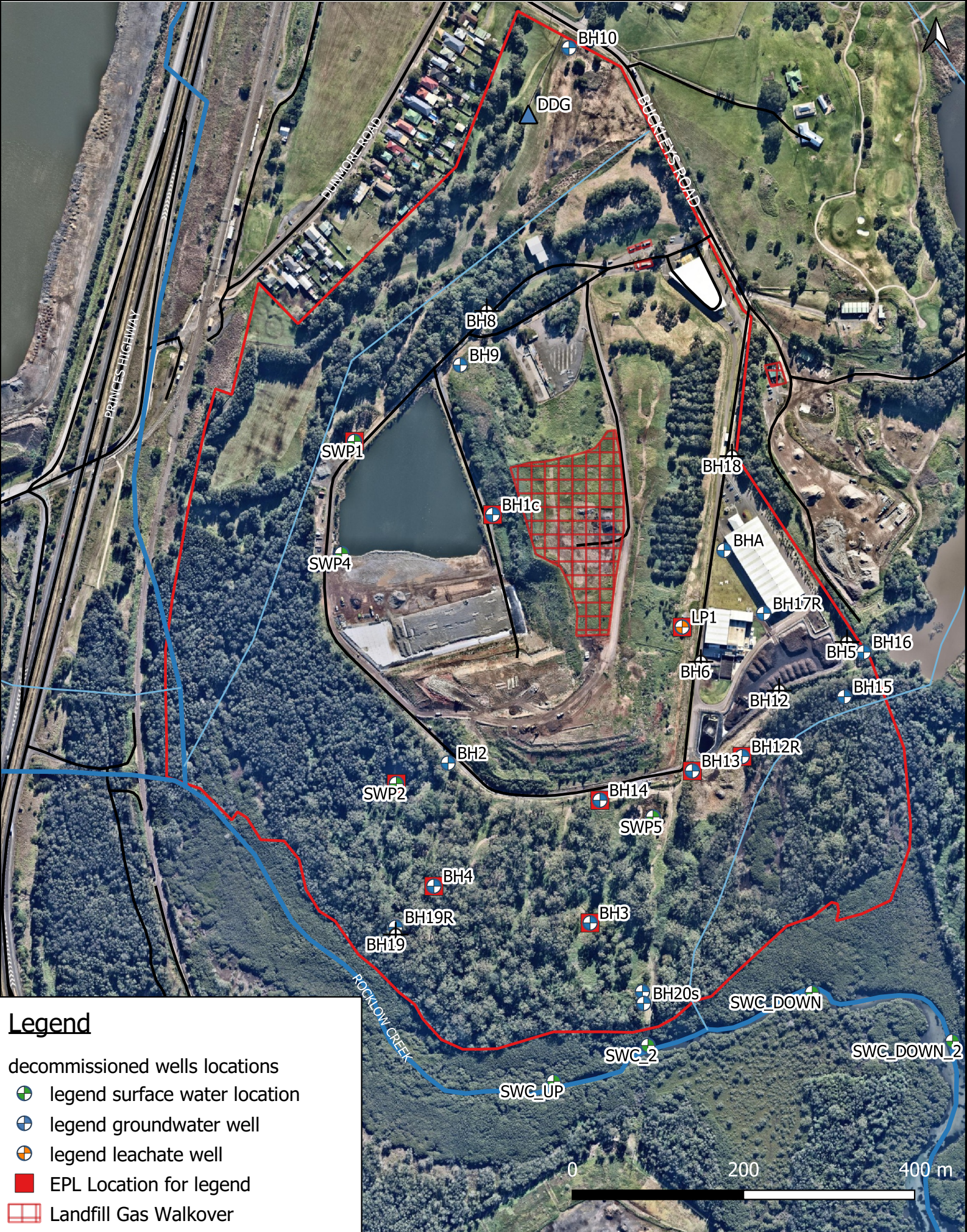
To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

APPENDIX A: FIGURES









Legend
 SITE BOUNDARY

 ENVIRONMENTAL EARTH SCIENCES CONTAMINATION RESOLVED	Drawn by: EG	Date: Oct 2019	Dunmore Resource and Recycling	Figure No. 1
	Proj. Manager: EG	Scale: As shown		
	Job No: 118109	Source: Google	Shellharbour, NSW	Site Locality










Legend

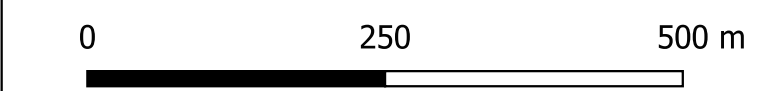
- decommissioned wells locations
-  legend surface water location
-  legend groundwater well
-  legend leachate well
-  EPL Location for legend
-  Landfill Gas Walkover


 ENVIRONMENTAL EARTH SCIENCES <small>CONTAMINATION RESOLVED</small>	Drawn by: MN	Date: Nov 2019	Dunmore Resource and Recycling	Figure No.
	Proj. Manager: EG	Scale: As shown		
	Job No: 118109	Source: Google	Shellharbour, NSW	1



Legend

-  legend surface water location
-  legend groundwater well
-  legend leachate well
-  EPL Location for legend
-  Landfill Gas Walkover
-  dust gauge
-  Inferred groundwater contour (mAHD)



 ENVIRONMENTAL EARTH SCIENCES <small>CONTAMINATION RESOLVED</small>	Drawn by: MN	Date: Jan 2020	Dunmore Recycling and Waste Disposal Depot	Groundwater level contours - Nov 2019	Figure No. 2
	Proj. Manager: EG	Scale: As shown			
	Job No: 118109	Source: Google			

APPENDIX B: TABLES

Table 4: Field measurements – November 2019

Sample	SWL	SWL	pH	EC	ORP	Temp.	DO	Colour	Odour
Units	mAHD	Dip (m)	-	mS/cm	mV	°C	ppm	-	-
BH1c	0.384	3.57	6.84	5.431	-160.8	25.5	0.33	faint green/amber	sweet
BH2	0.682	4.11	7.03	2.807	-158.7	22.5	0.08	brown	faint sweet
BH3	0.424	3.34	7.36	1.483	-131.1	18.7	1.6	clear	none
BH4	0.529	4.49	7.14	1.6	-122	19.2	0.82	clear	none
BHA	0.82	3.37	6.76	0.943	-149.5	19.7	0.06	slightly cloudy grey to clear	none
BH9	0.805	3.58							
BH10	3.621	1.17							
BH12R	0.69	4.51	6.75	2.43	-77.6	22.2	0.71	dark grey becoming brown	none
BH13	0.785	4.51	7.02	1.603	-111.8	20.9	0.6	cloudy grey becoming clear	none
BH17R	0.81	3.64	6.84	1.998	-144.3	19.7	1.06	light cloudy brown	faint sweet
BH15	0.53	0.88	6.63	7.83	-134.6	16.2	0.11	Amber	none
BH16	0.37	1.01	7.18	2.9	-281.9	16.5	9.92	faint cloudy brown	faint H ₂ S
BH19R	0.46	4.64	7.28	1.627	-122.7	19.2	0.08	light grey cloudy	none
BH20	0.4	2.37	7.6	1.479	-201.5	18.9	0.03	clear	faint hydrogen sulfide (eggy)
BH20s	0.33	2.44	7.73	5.64	-79.8	19	3.74	light amber	none
LP1	-		7.71	14.118	-51.1	26.2	3.42	dark brown	strong sweet odour
SWC2	-		8.04	48.02	-18.9	20.9	7.37	clear	none
SWC-Up	-		8.04	48.144	-13.7	20.9	6.94	clear	none
SWC-Down	-		7.85	48.914	-12.4	22	6.87	clear	none
SWC-DOWN_2	-		8.05	47.704	-13.9	20.3	90.4	clear	none

Sample	SWL	SWL	pH	EC	ORP	Temp.	DO	Colour	Odour
SWP1	-		8.24	0.414	-87.9	16.7	1.05	faint brown	none
SWP2	-		7.84	2.251	-144.1	26.6	2.41	light brown	none
SWP4	-		8.43	2.196	-25.2	22.4	6.66	murky green	none
SWP5	-	Dry							

Notes:

SWL Standing Water Level, measured to the top of the monument or casing; RL – reference level; ORP = electron activity; EC= electrolytic conductivity --- not measured; N/A = Not applicable; DO = dissolved oxygen.

Table 5: Water laboratory results – November 2019

Sample	pH	TDS	Na	Ca	K	Mg	NH ₄ -N	Cl	F	NO ₃	NO ₂	SO ₄	HCO ₃	PO ₄	TOC	BOD	Sol. Mn	Sol. Fe	Tot. Fe
		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
BH1c	7.2	4110	680	130	210	120	350	840	0.22	0.1	170	25	3280	160	-	7		3.7	13
BH2	7.2	1780	330	160	45	65	43	395	0.22	0.1	62	130	1140	0.1	-	0.1		0.66	10
BH3	7.4	900	79	155	32	26	34	230	0.13	39	15	90	490	0.1	-	0.1		0.15	1.6
BH4	7.2	1240	160	210	23	37	8	235	0.1	0.35	22	160	750	0.1	0.1	0.1		0.14	4.2
BH12-R	6.9	1810	205	285	58	56	0.6	305	0.18	145	14	330	725	0.1	1.1	-		1.9	8.8
BHA	6.8	690	86	110	18	23	0.7	105	0.17	0.71	20	160	340	120	0.2	-		2.8	13
BH13	7.2	1060	115	190	42	40	2.7	110	0.2	5	23	240	680	0.1	-	0.1		0.16	1.8
BH16	7.3	425	72	32	12	29	0.3	110	0.22	0.1	16	87	150	0.1	-	0.1		0.28	7.8
BH17-R	6.9	1410	210	165	67	46	15	430	0.12	0.58	29	175	535	0.1	0.1	-		2.6	38
BH19-R	7.1	1120	145	210	22	37	5.3	240	0.11	0.35	22	185	585	0.1	0.52	-		0.17	1.4
BH20	7.6	880	60	135	42	28	43	120	0.14	0.1	18	220	460	240	-	0.1		0.15	1.3
BH20s	7.6	815	43	125	79	39	2	58	0.12	43	17	205	430	0.1	-	0.1		0.06	0.32
LP1	7.8	8250	1440	120	450	100	915	1690	0.68	0.1	840	130	6570	20000	-	85		5.2	5.6
SWC2		-	-	-	-	-	0.1	-	-	0.1	-	-	145	-	0.1	-		0.15	0.25
SWP1	7.2	260	43	31	10	11	0.2	68	0.14	0.1	-	10	150	340	-	-		0.63	2.1
SWP2	7.9	1320	320	80	28	45	0.9	355	0.18	0.1	-	180	575	120	-	-		0.01	0.17
SWP4	8.5	1470	335	67	20	68	0.9	400	0.36	4.2	31	320	415	0.1	-	4		0.03	0.16

Sample	pH	TDS	Na	Ca	K	Mg	NH ₄ -N	Cl	F	NO ₃	NO ₂	SO ₄	HCO ₃	PO ₄	TOC	BOD	Sol. Mn	Sol. Fe	Tot. Fe
		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
SWC-UP	8	38700	11900	420	485	1280	0.2	21500	0.55	0.1	-	3060	145	0.1	-	-		0.1	0.11
SWC-DOWN	7.9	35600	10800	390	450	1220	0.1	19000	0.57	0.1	-	2810	145	0.1	-	-		0.11	0.12
SWC-DOWN2	8.1	36000	11000	400	460	1240	0.1	19600	0.58	0.1	-	2850	140	0.1	-	-		0.12	0.11
ANZECC 2000	6.5-8.0	-	-	-	-	-	1.88*	-	-	10.6#	-	-	-	-	-	-	-	0.3	-

Notes:

Results and guidelines are expressed in mg/L

SWC_Do – SWC_Down.

NT- not analysed.

Guidelines levels from ANZECC (2000) – Australian and New Zealand guidelines for fresh and marine water quality for the protection of aquatic ecosystems.

* - guideline from freshwater trigger values as total NH₄-N at different pH values - Table 8.3.7 of ANZECC (2000) - based on average laboratory pH of 7.3 from pH values presented above.

- # - based on the recalculated trigger value for freshwater, Hickey 2013; and values above the guidelines are **bolded**.

Table 6: Ratios of principal ions – November 2019

Bore	Na/Cl	Na/Ca	Mg/Ca	Ca/K	Cl/SO ₄	Cl/HCO ₃	K/TDS	L/N
							(%)	(%)
BH1c	1.25	4.56	1.52	1.21	45.53	0.44	5.11	60.23
BH2	1.29	1.80	0.67	6.94	4.12	0.60	2.53	15.87
BH3	0.53	0.44	0.28	9.45	3.46	0.81	3.56	40.38
BH4	1.05	0.66	0.29	17.81	1.99	0.54	1.85	7.73
BHA	1.26	0.68	0.34	11.92	0.89	0.53	2.61	8.95
BH12R	1.04	0.63	0.32	9.59	1.25	0.72	3.20	37.49
BH13	1.61	0.53	0.35	8.82	0.62	0.28	3.96	14.41
BH15	0.57	2.96	0.76	0.64	10.55	4.29	14.54	70.32
BH16	1.01	1.96	1.49	5.20	1.71	1.26	2.82	9.32
BH17R	0.75	1.11	0.46	4.80	3.33	1.38	4.75	19.64
BH19R	0.93	0.60	0.29	18.62	1.76	0.71	1.96	7.19
BH20	0.77	0.39	0.34	6.27	0.74	0.45	4.77	38.16
BH20s	1.14	0.30	0.51	3.09	0.38	0.23	9.69	59.90
LP1	1.31	10.46	1.37	0.52	17.61	0.44	5.45	82.23
SWP1	0.98	1.21	0.59	6.05	9.21	0.78	3.85	12.12
SWP2	1.39	3.49	0.93	5.57	2.67	1.06	2.12	6.52
SWP4	1.29	4.36	1.67	6.53	1.69	1.66	1.36	5.34
SWC0UP	0.85	24.70	5.03	1.69	9.52	255.21	1.25	3.57
SWC_DOWN	0.88	24.14	5.16	1.69	9.16	225.53	1.26	3.63
SWC_DOWN_2	0.87	23.97	5.11	1.70	9.32	240.96	1.28	3.64

Notes:

% indicates ratios are presented in percentage in that column; and

 L/N = leachate/non-leachate ratio; $[(K + NH_4 + NO_3 + NO_2) / (Ca + Mg + Na)] \times 100$.

Table 7: Summary of gas analysis, CH₄ – November 2019

Location	GA 5000 V/V%	ILU V/V%
Landfill cap	0	0.00038
Main weigh bridge, weigh bridge office and landfill office sheds	0	0.00029
Dunmore Resource & Recycling Services	0	0.0002
GUIDELINES	1.25 % v/v / 0.05 % v/v	1.25 % v/v / 0.05 % v/v

Table 8: Quarterly RPD Table – November 2019

Analytes	SWC-DOWN2	FD1	RPD (%)
pH	8	8.1	1.24
TDS	36000	36000	0.00
Na+	11100	11000	0.90
Ca++	400	400	0.00
Mg++	1230	1240	0.81
K+	460	460	0.00
NH4-N	0.1	0.1	0.00
Cl-	19400	19600	1.03
SO4--	2810	2850	1.41
HCO3-	140	140	0.00
NO3-	<0.1	<0.1	0.00
PO4---	<100	<100	0.00
F-	0.54	0.58	0.00
BOD	2	<2	NC
Fe. D	0.13	0.12	8.00
Fe. T	0.14	0.11	24.00
Mn. D	0.02	-	NC
TOC	<1	-	NC

Notes:

Results are expressed in mg/L.

NC: not calculated

RPD – Relative Percentage Difference

 Values requiring further investigation are **bolded**.

APPENDIX C: CALIBRATION CERTIFICATES



EQUIPMENT CERTIFICATION REPORT

PGN9003823 GAS ANALYSER – LANDFILL

GA2000-3000-5000

Plant Number: 234893

SENSOR	CONCENTRATION	INSTRUMENT READING	TRACEABILITY	PASS
CH4	<u>60</u> %	<u>60</u> %	Lot # <u>1061344</u>	<input checked="" type="checkbox"/>
CO2	<u>40</u> %	<u>40</u> %	Lot # <u>1061344</u>	<input checked="" type="checkbox"/>
O2	<u>15</u> %	<u>15</u> %	Lot # <u>845159</u>	<input checked="" type="checkbox"/>
CO	<u>100</u> ppm	<u>100</u> ppm	Lot # <u>845159</u>	<input checked="" type="checkbox"/>
H2S	<u>40</u> ppm	<u>40</u> ppm	Lot # <u>845159</u>	<input checked="" type="checkbox"/>

Data Cleared

Battery Status <u>100</u> (%)	Temperature <u>22.5</u> °C
Electrical Test & Tag (AS/NZS 3760)	Inlet Filter Cleaned/Replaced

Note: Calibration traceability information is available upon request.

Please clean/decontaminate instrument and accessories before returning. A minimum 'Cleaning Fee' \$55.00 (Inc GST) may apply if instrument is returned contaminated.

Checked By: BRAD ALCOCK Date: 18/11/19 Signed:

Accessories List:

User's Manual & USB	1x Gas Inlet Hoses	1X Gas Inlet Hose With Filter
1x Gas Inlet Hose & Clip Fitting	2x Spare Inlet Filters	1x Flow Through Desiccant
1x Wall Charger	Carry Pouch With Neck Strap	1x USB Comms Cable
Carry Transit Case	Calibration Certificate	



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Multi Parameter Water Meter



airmet

Air-Met Scientific Pty Ltd
1300 137 067

Instrument **YSI Quatro Pro Plus**
Serial No. **18L102024**

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

Certificate of Calibration

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

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. pH 7.00		pH 7.00		320613	pH 6.93
2. pH 4.00		pH 4.00		330734	pH 3.97
3. pH 10.00		pH 10.00		324189	pH 9.73
3. mV		234mV		338782/337308	234.7mV
4. EC		2.76mS		333787	2.75mS
5. D.O		0.00ppm		329994	0.00ppm
6. Temp		19.6°C		MultiTherm	20.2°C

Calibrated by:

Sarah Lian

Sarah Lian

Calibration date:

15/11/2019

Next calibration due:

15/12/2019

Equipment Calibration Record – YSI Pro Plus

This equipment calibration record is to be stored in your job folder

Equipment Type: YSI Pro Plus with Quatro Sensor
Equipment Number: 18L102024
Date Calibrated: 20.11.19
Calibrated By: Lachlan Desautels (name)
Job Number: 119037

Details of Calibration:

Temperature: 20.9 °C
pH at 4.01 Reading: _____
pH at ~~7.00~~ Reading (or 6.88): PH 10 9.67
ORP in Redox solution (240 mV): 257.9 (mV)
Conductivity in ~~2.76~~ 2570 uS/cm mS/cm: 2723 mS/cm
Conductivity in 12.88 mS/cm: _____ mS/cm
Dissolved Oxygen in 0.00 ppm in Sodium sulfate: 1.3 %
Dissolved Oxygen 100% Air Saturation: 112.6 %

Equipment Calibration Record – YSI Pro Plus

2/11/19

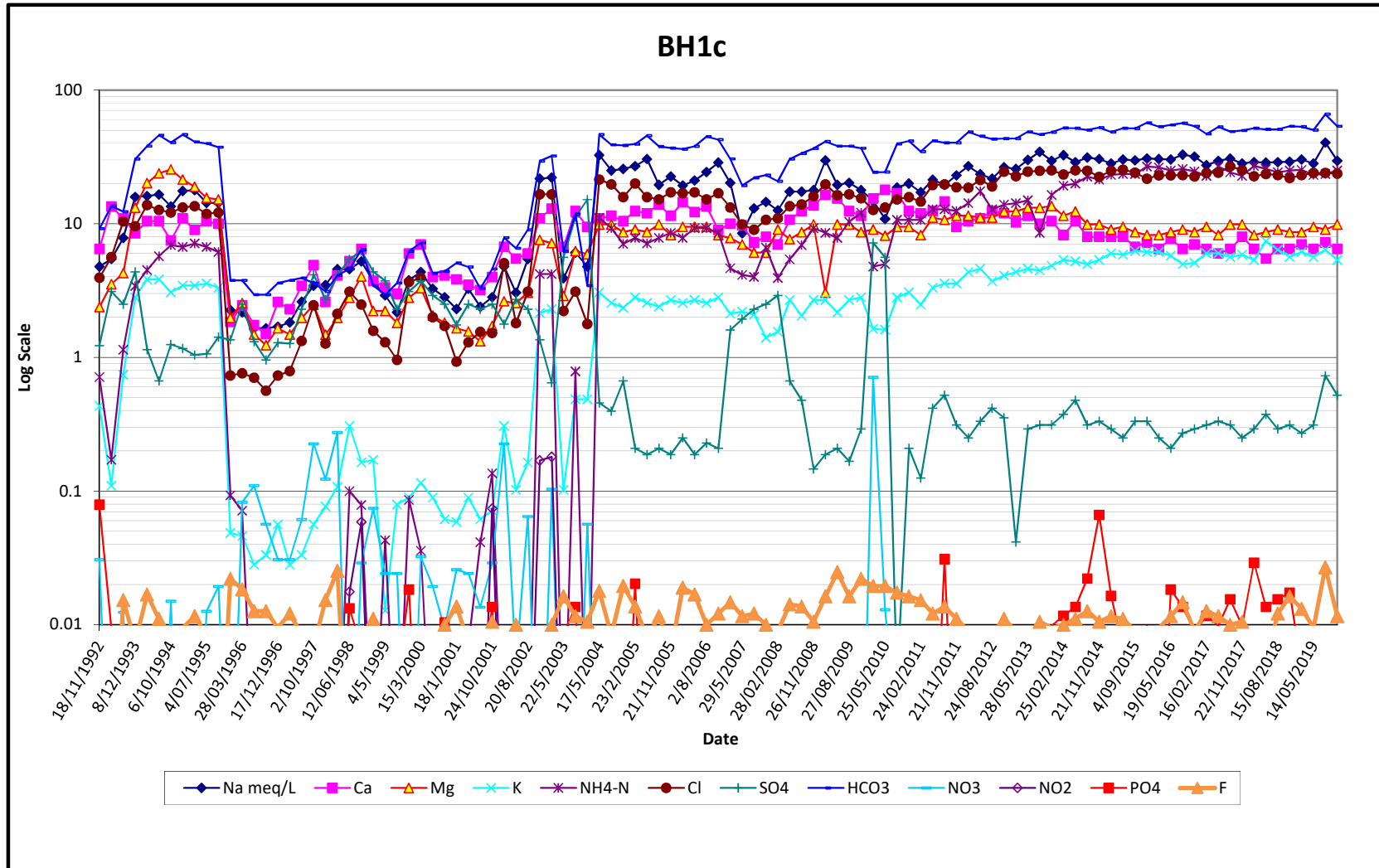
This equipment calibration record is to be stored in your job folder

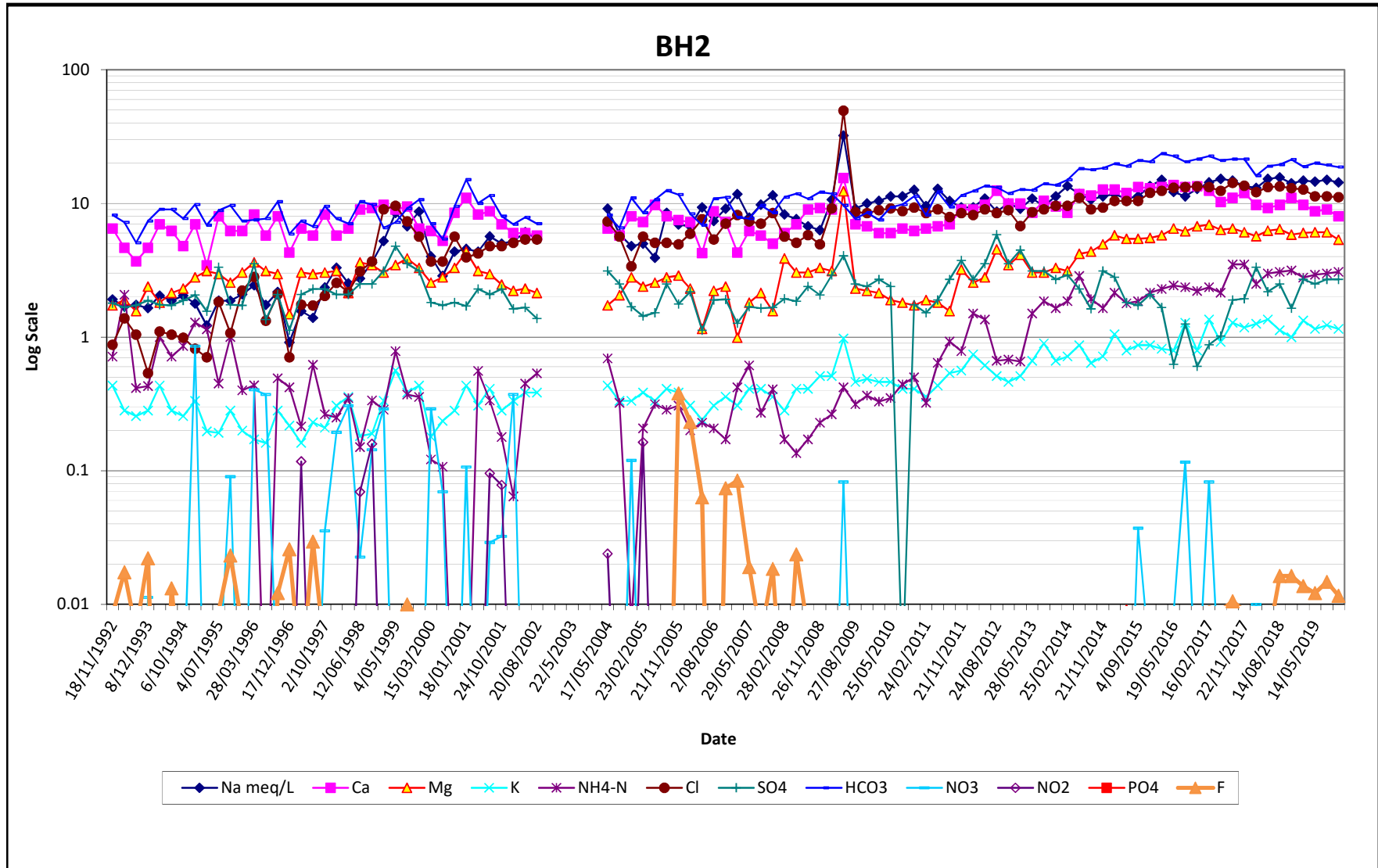
Equipment Type: YSI Pro Plus with Quatro Sensor
Equipment Number: AA
Date Calibrated: AA
Calibrated By: ZZ (name)
Job Number: 119037

Details of Calibration:

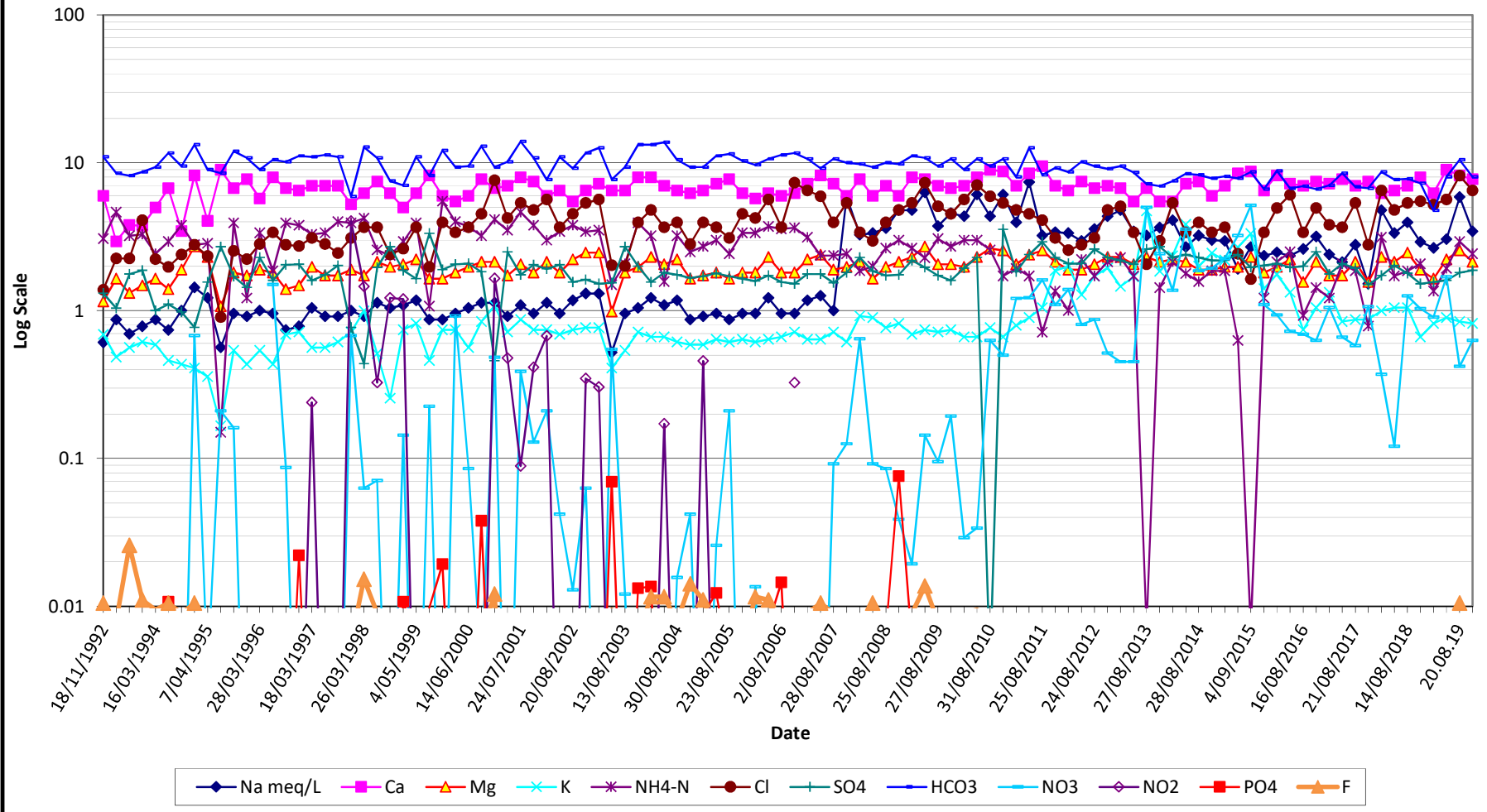
Temperature: _____ °C
pH at ~~4.01~~¹⁰ Reading: 9.65
pH at 7.01 Reading (or 6.88): _____
ORP in Redox solution (240 mV): 247.3 (mV)
Conductivity in 2.76 mS/cm: _____ mS/cm
Conductivity in ~~12.88~~^{2570 μ} mS/cm: 2598 mS/cm
Dissolved Oxygen in 0.00 ppm in Sodium sulfate: 0.06 %
Dissolved Oxygen 100% Air Saturation: 96 %

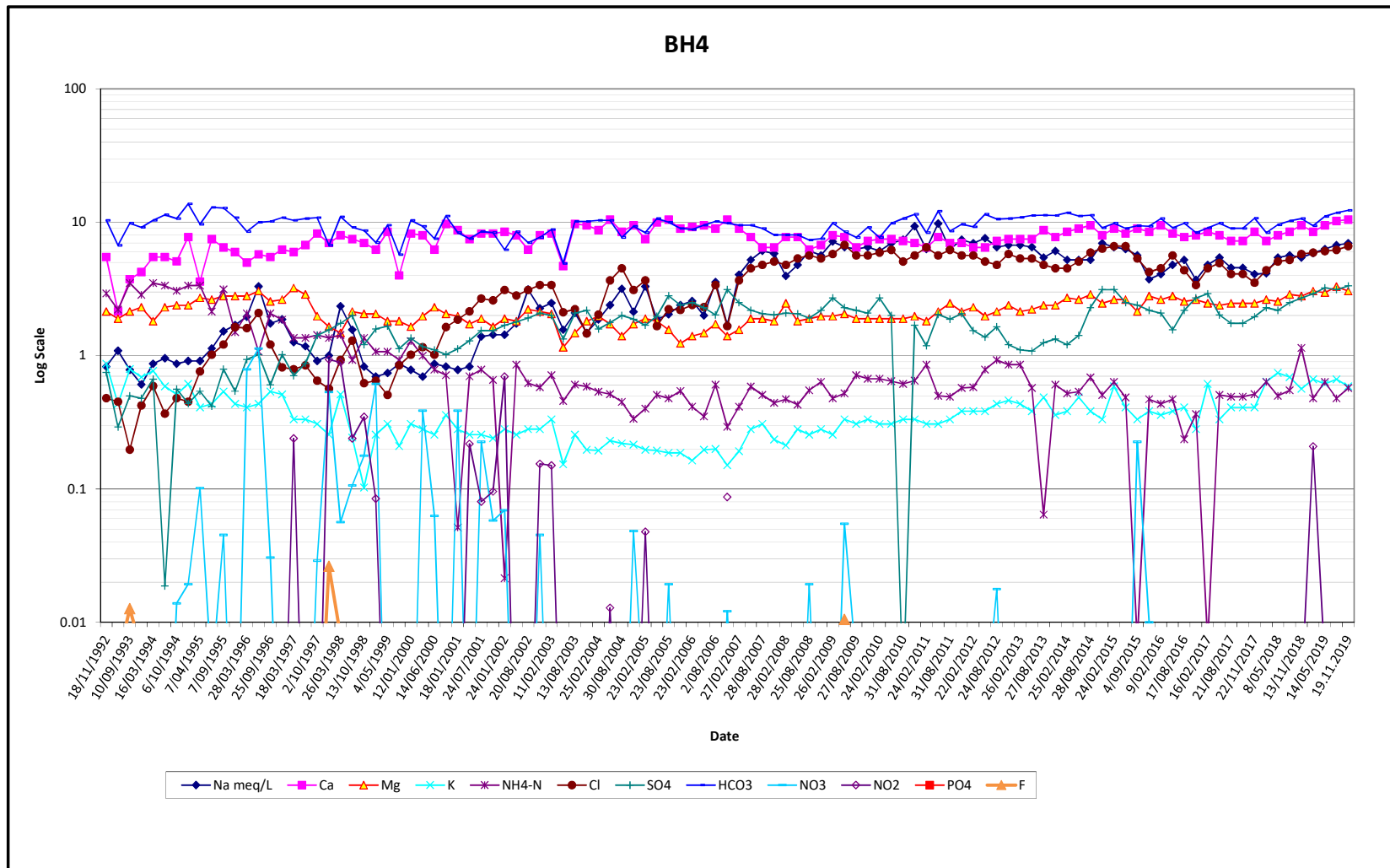
APPENDIX D: SCHOLLER PLOTS

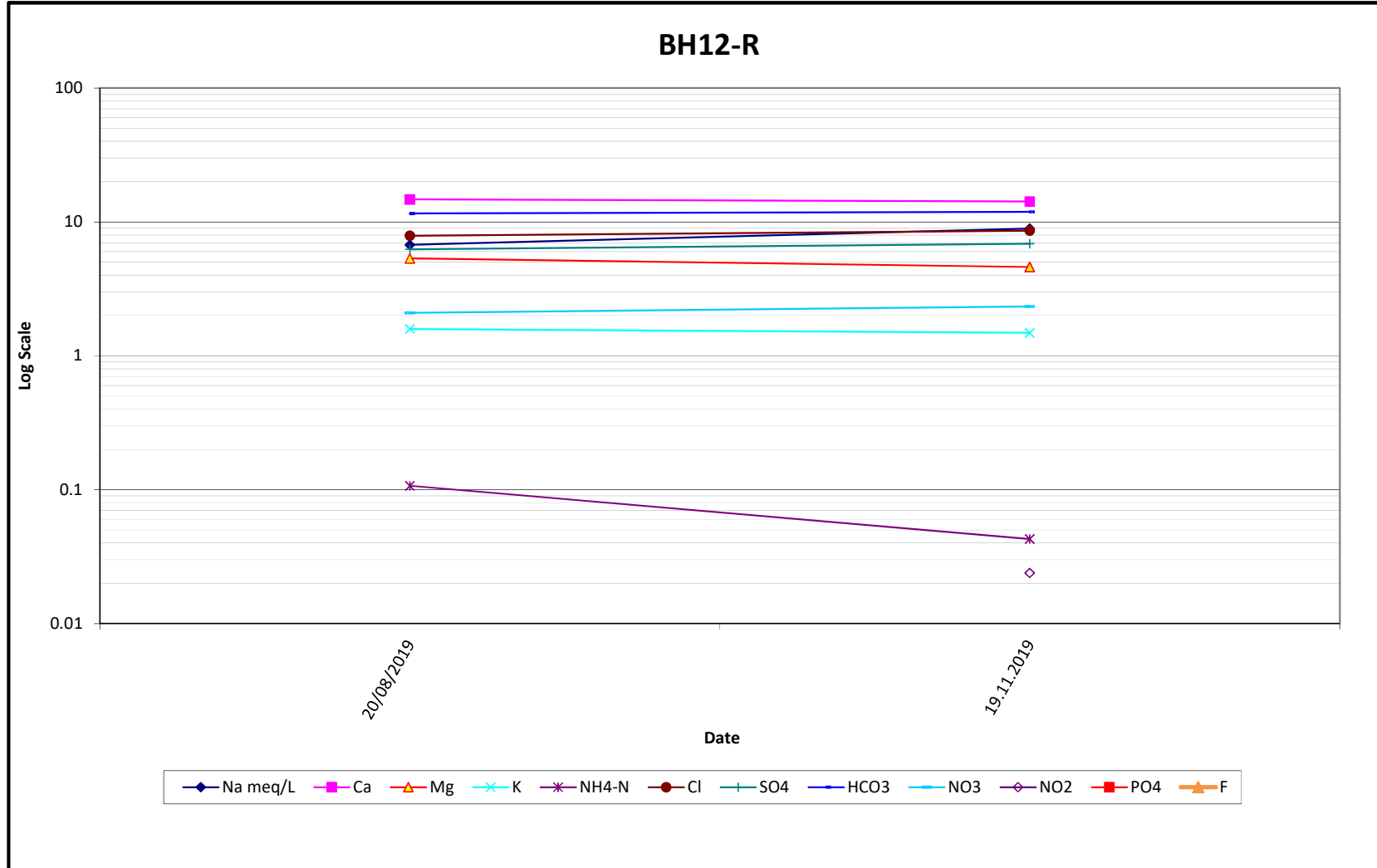




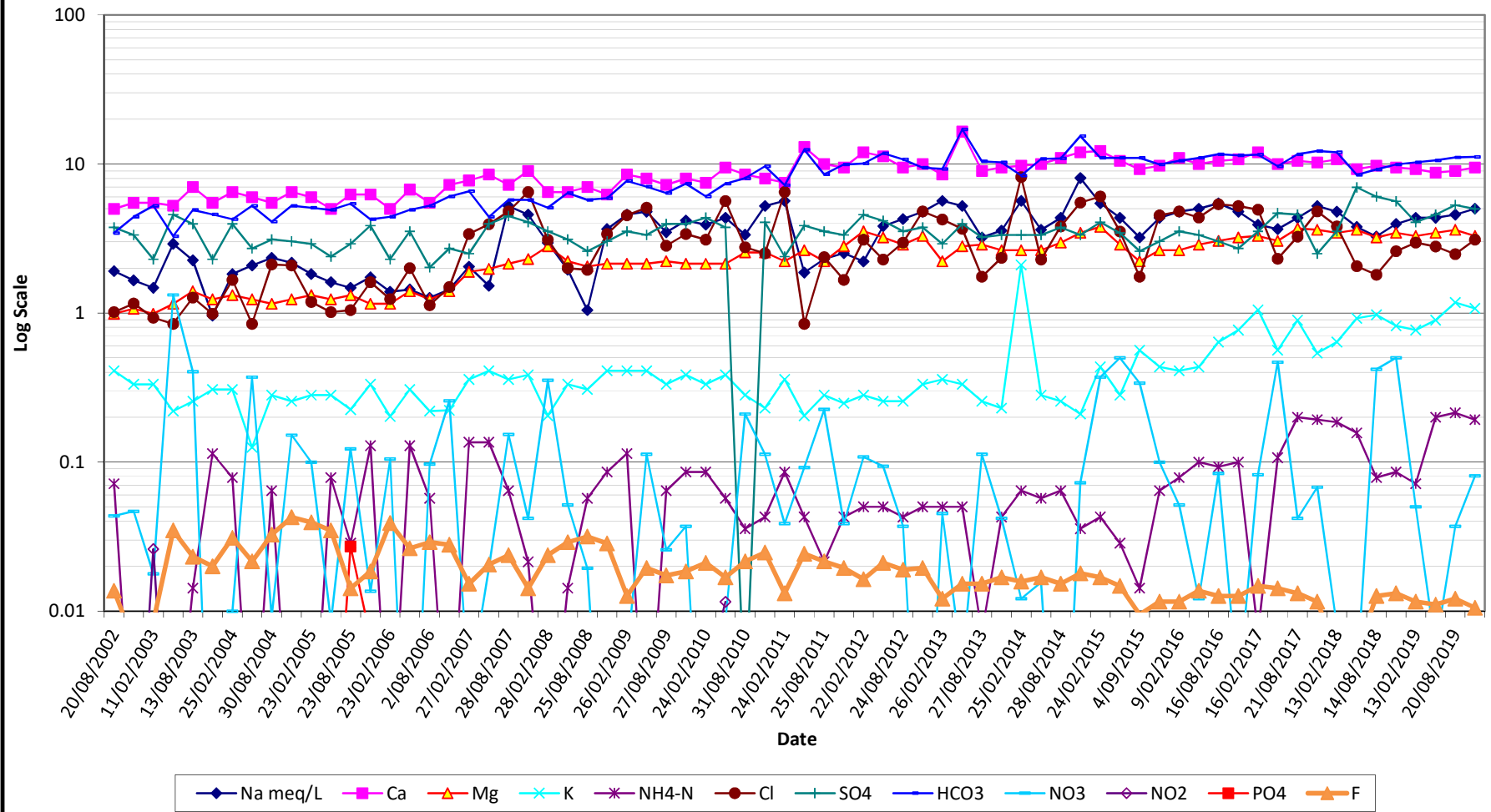
BH3



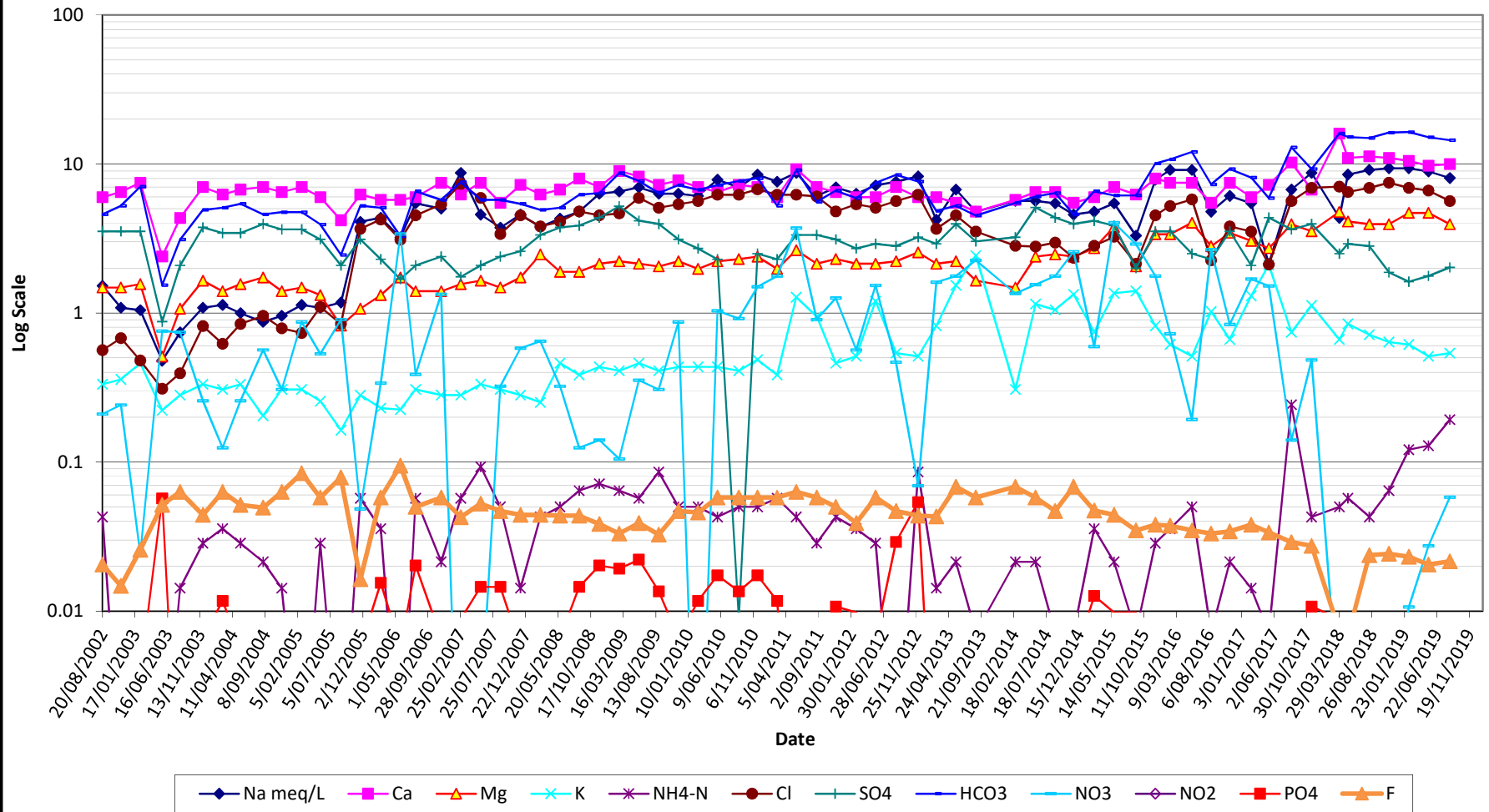




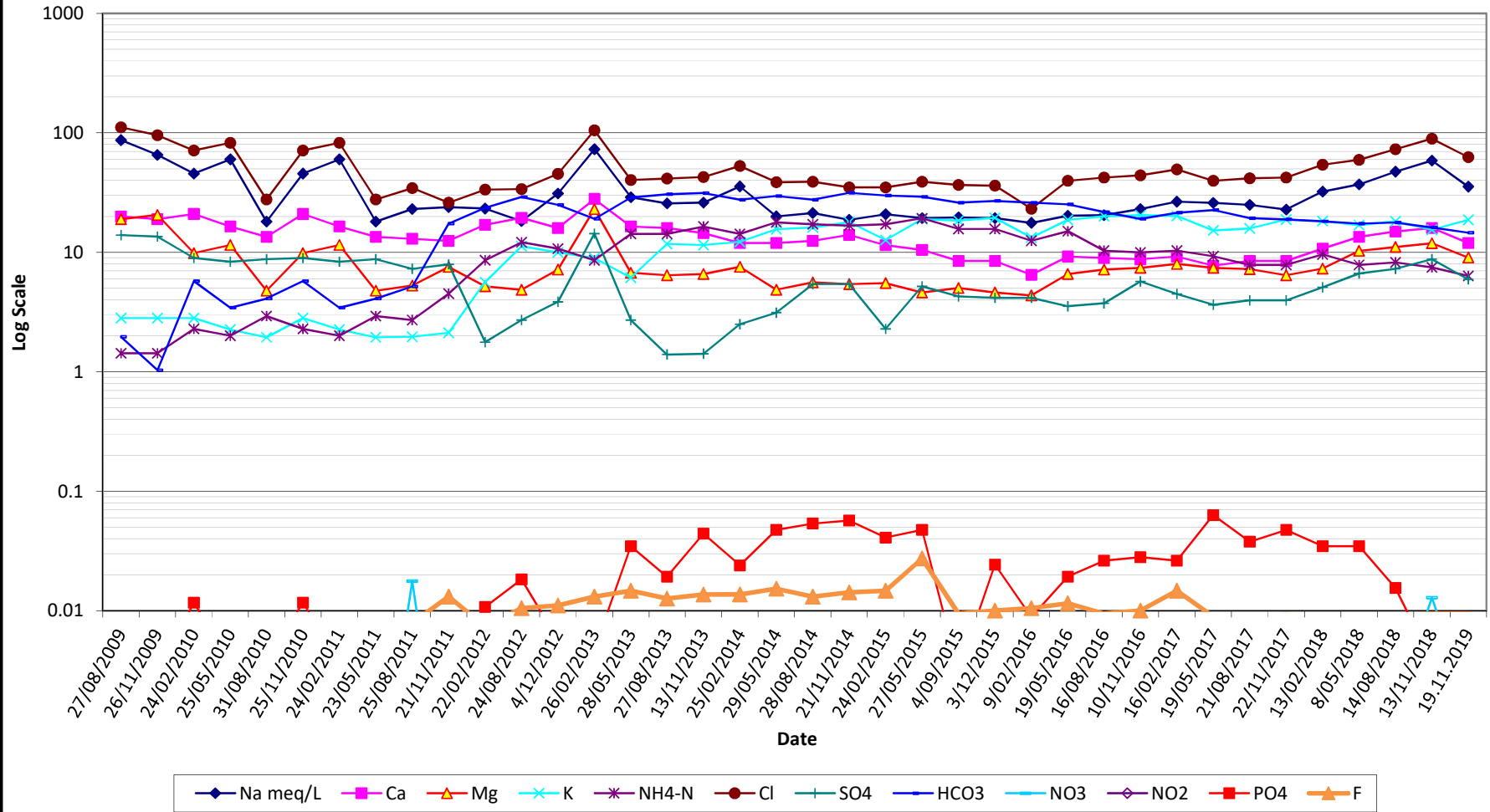
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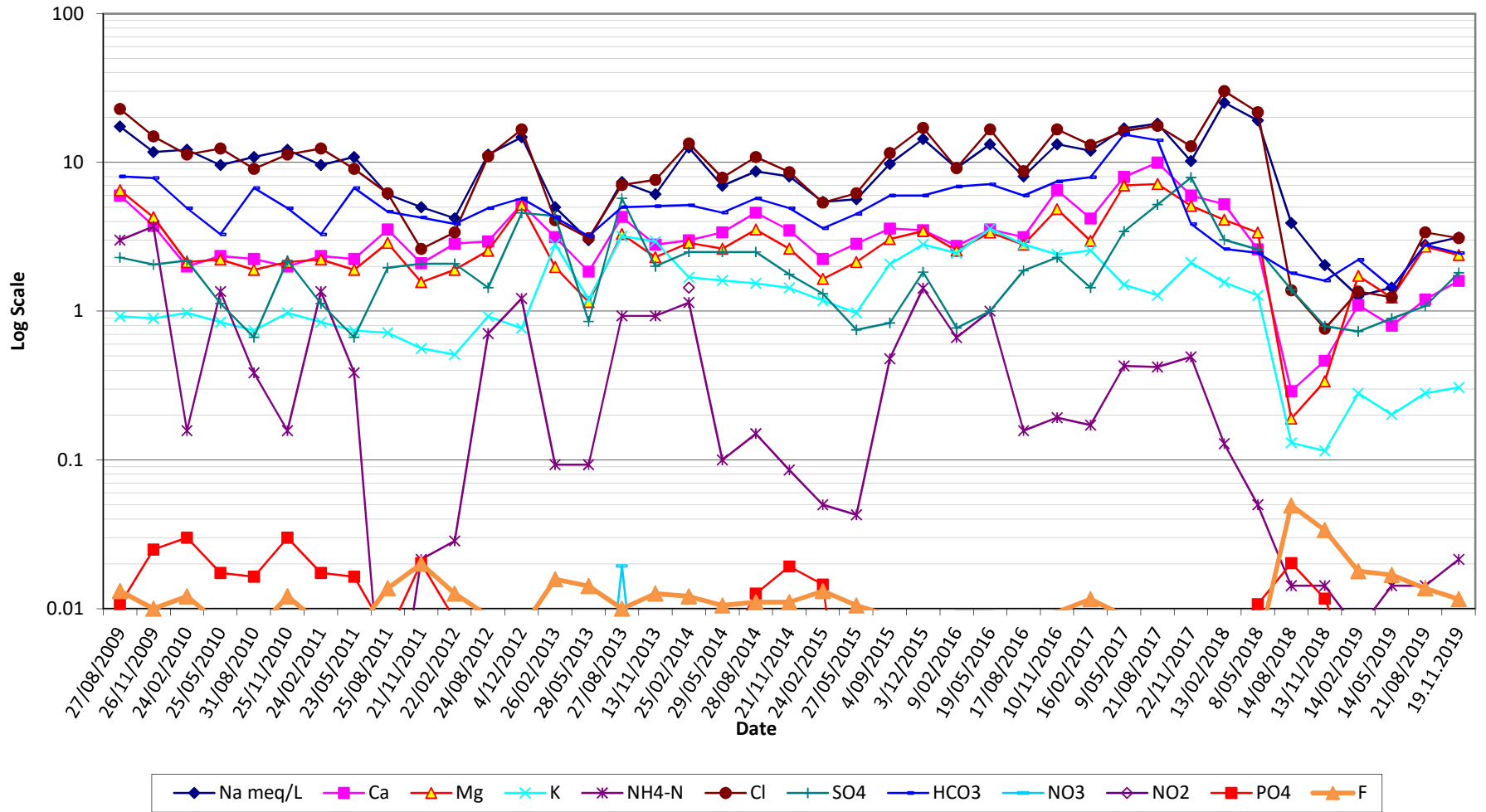
BH14



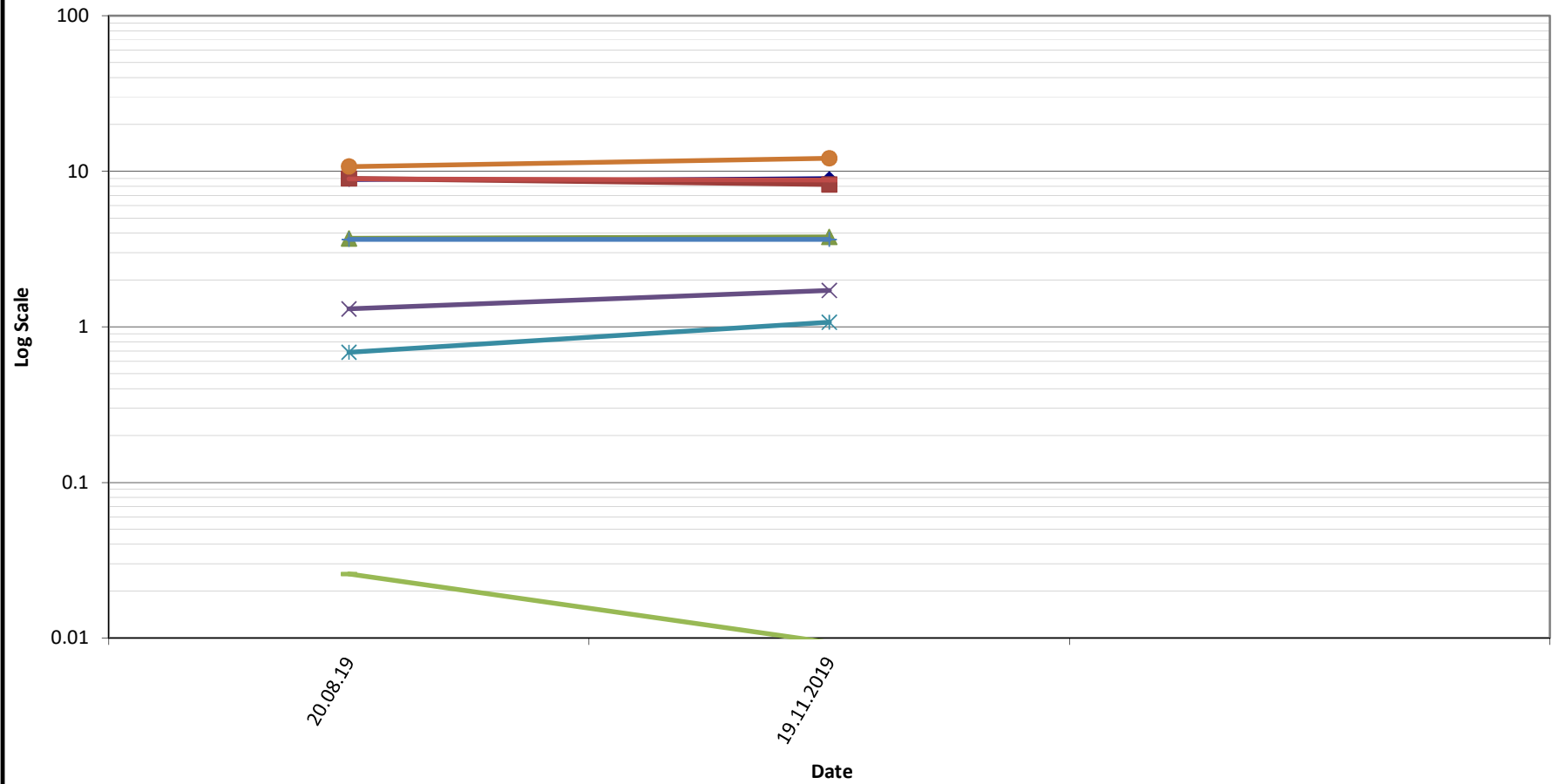
BH15



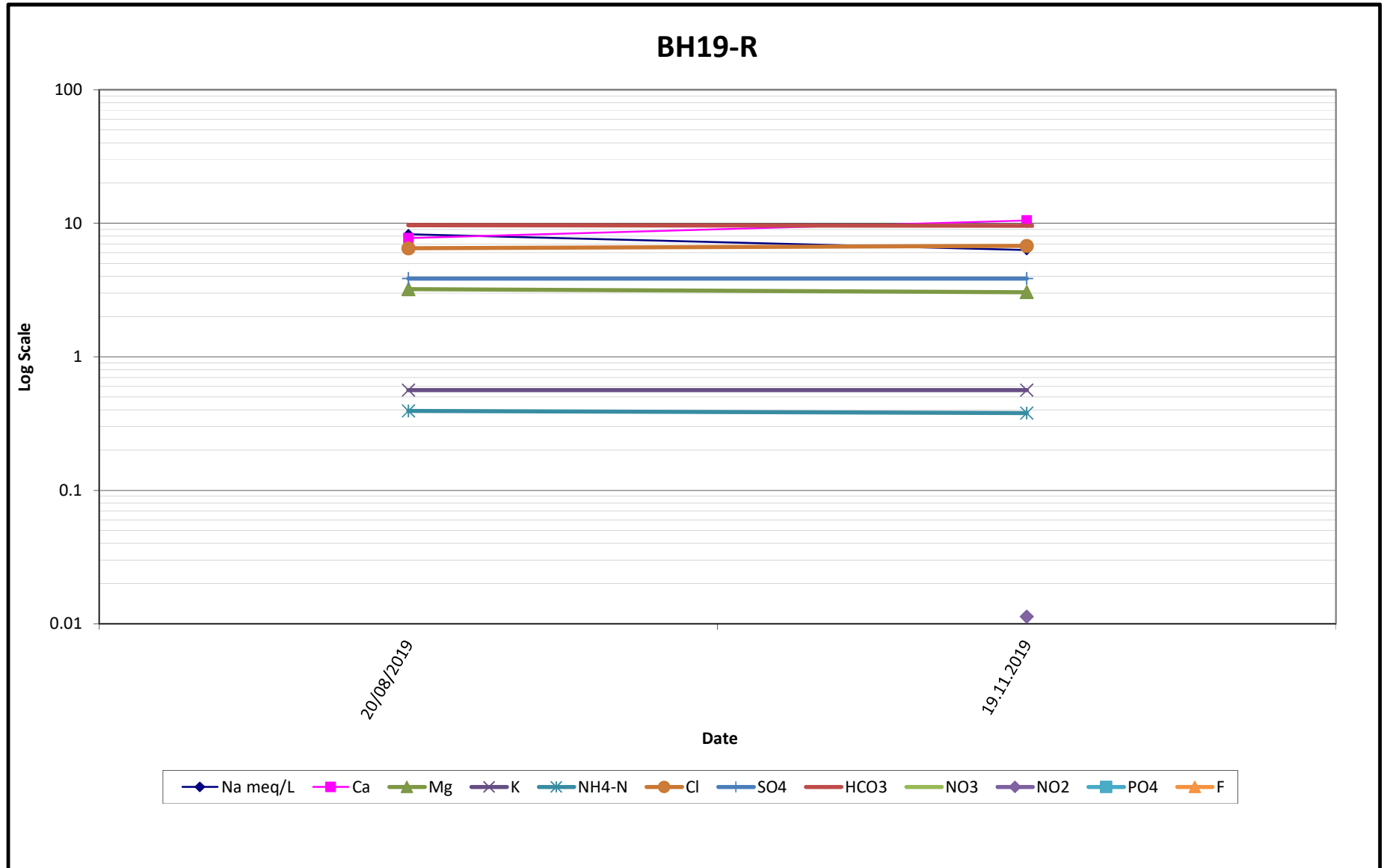
BH16



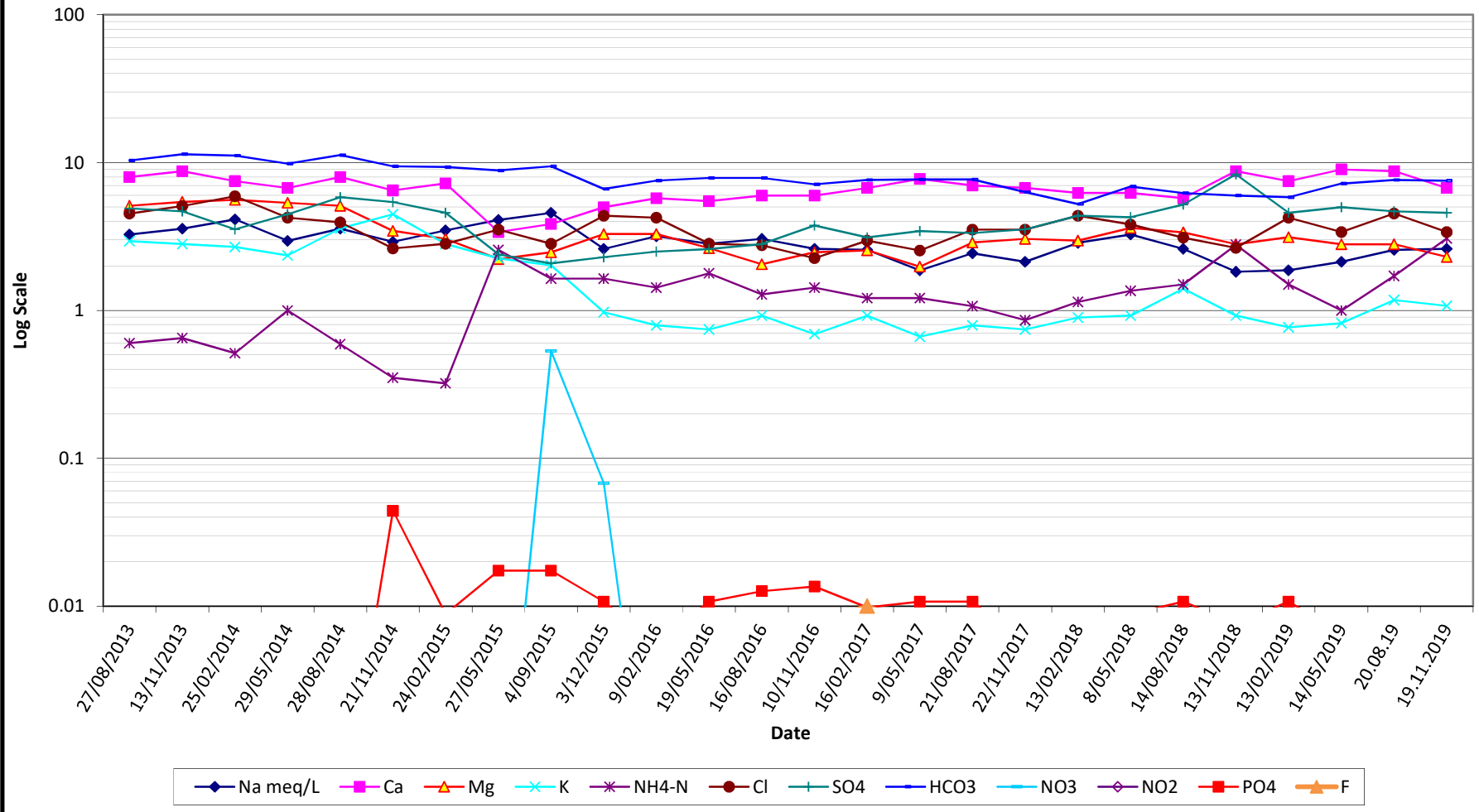
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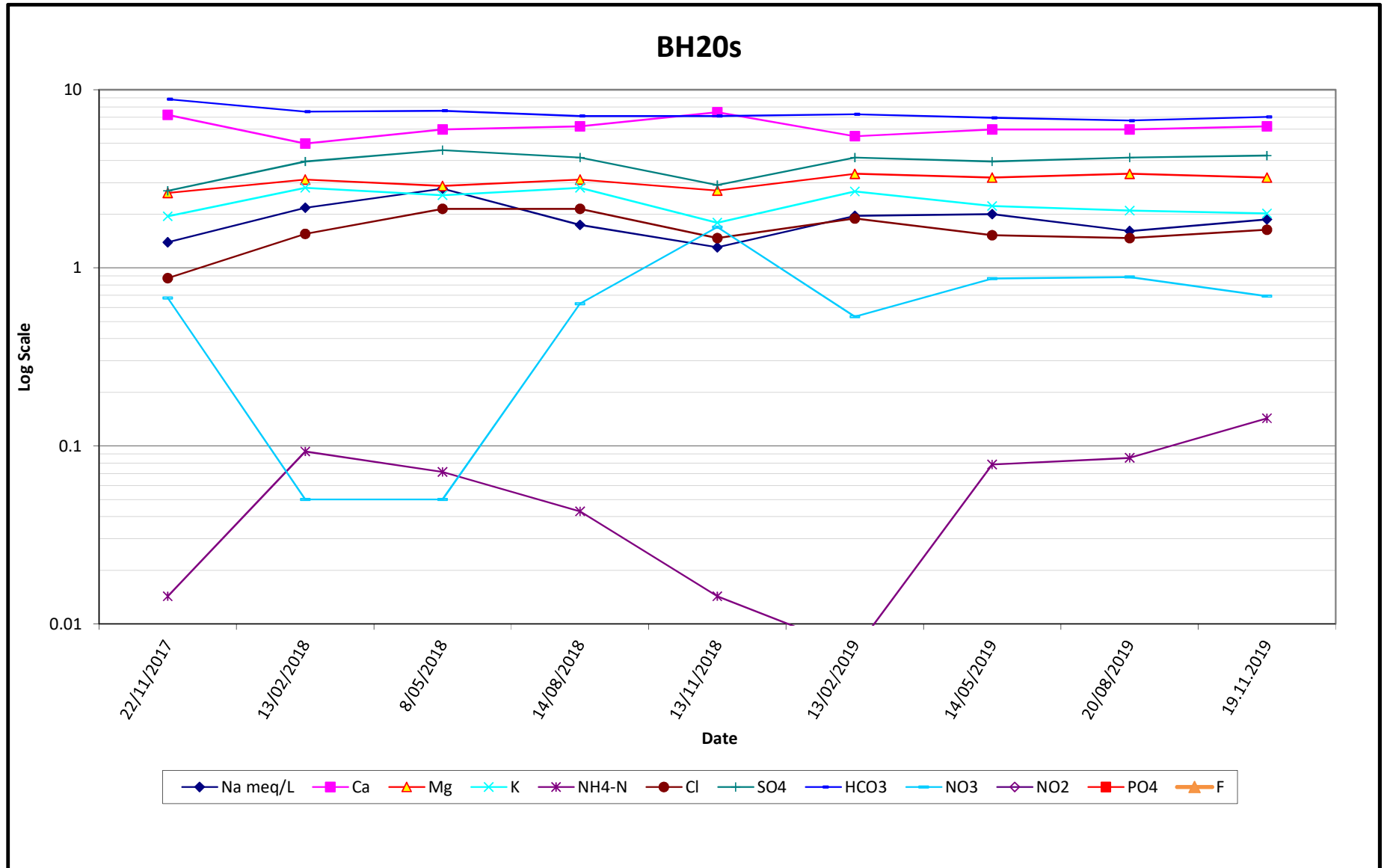


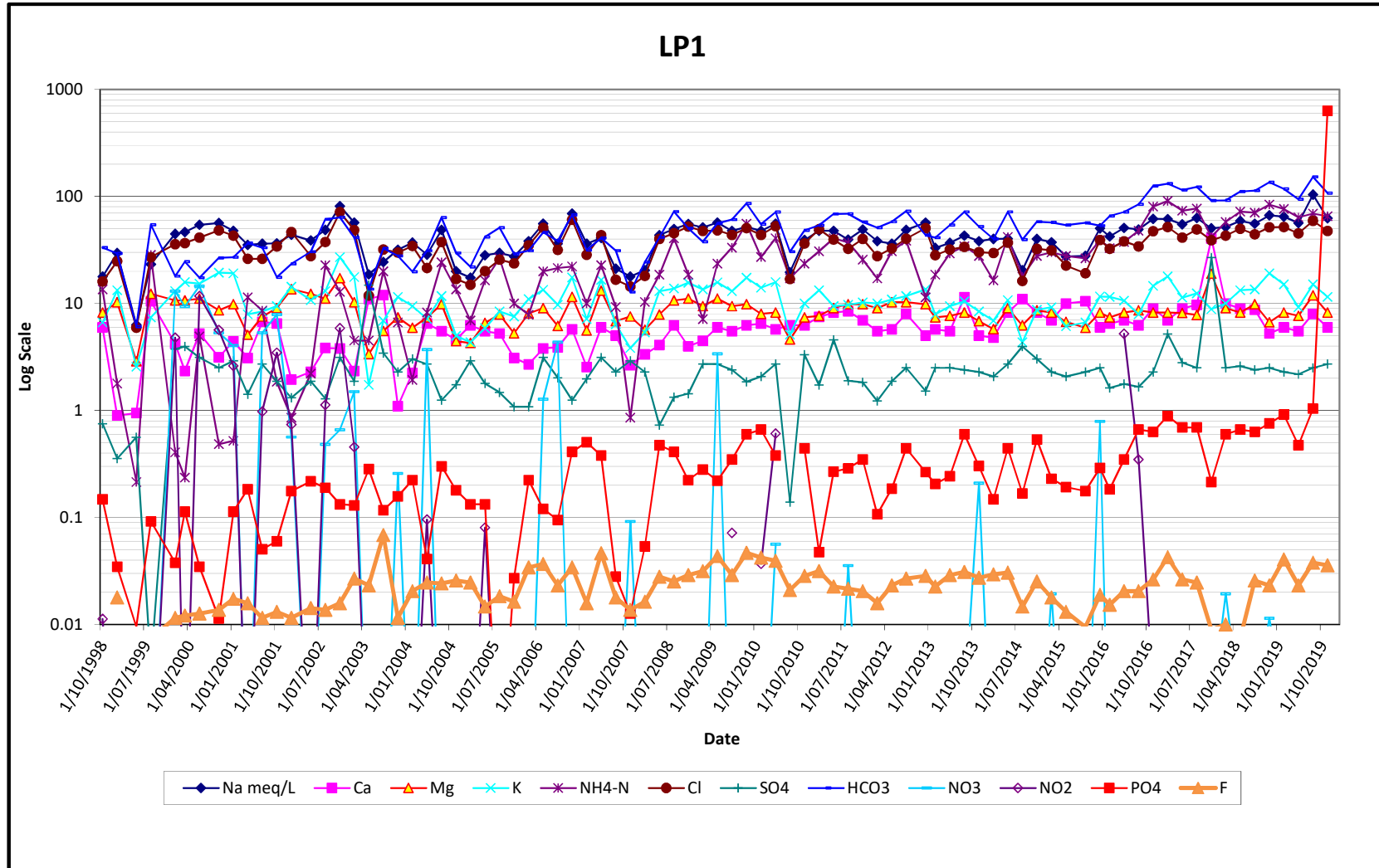
◆ Na meq/L
■ Ca
▲ Mg
✕ K
✱ NH4-N
● Cl
⊕ SO4
— HCO3
— NO3
◆ NO2
■ PO4
▲ F

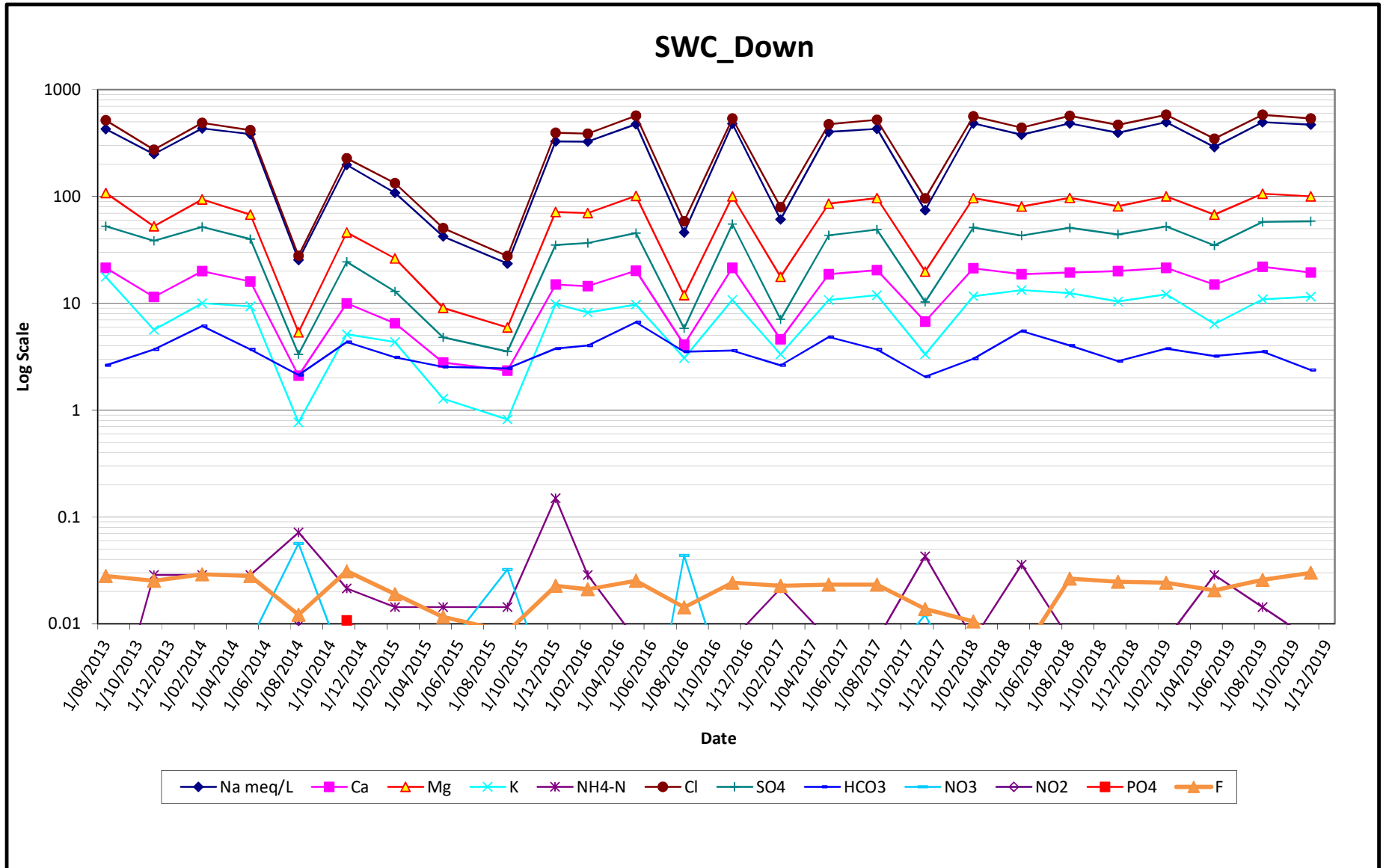


BH20

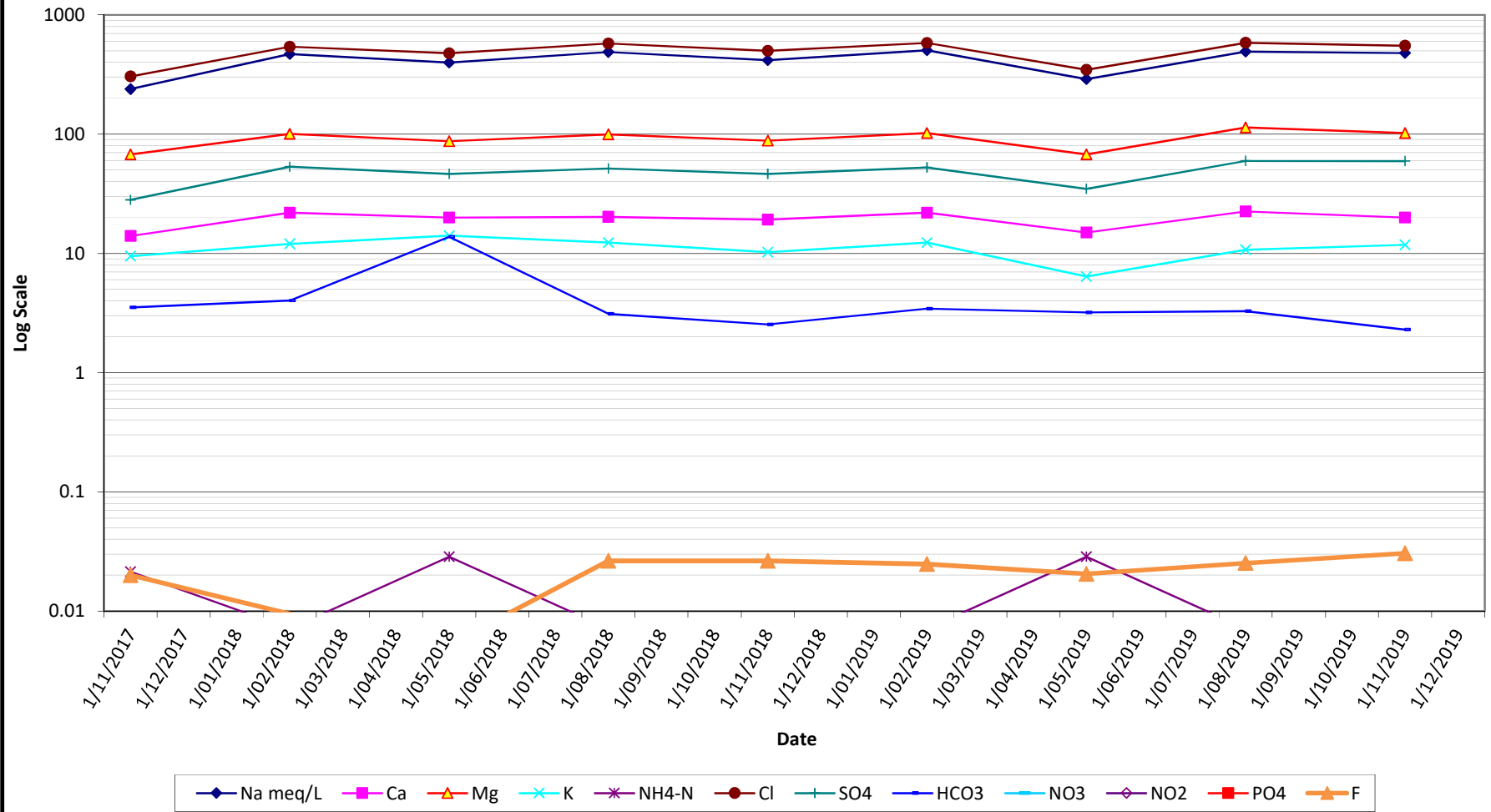


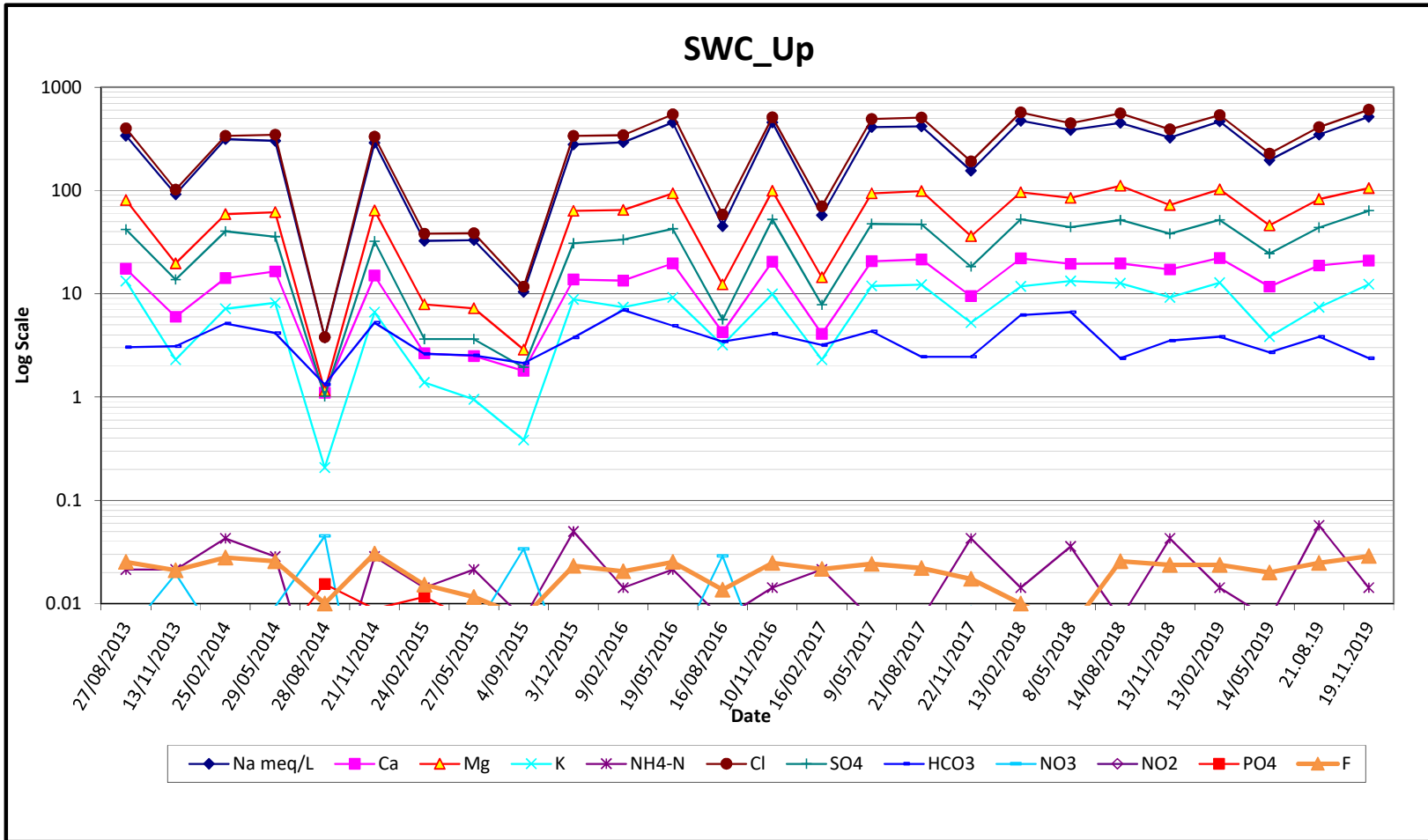


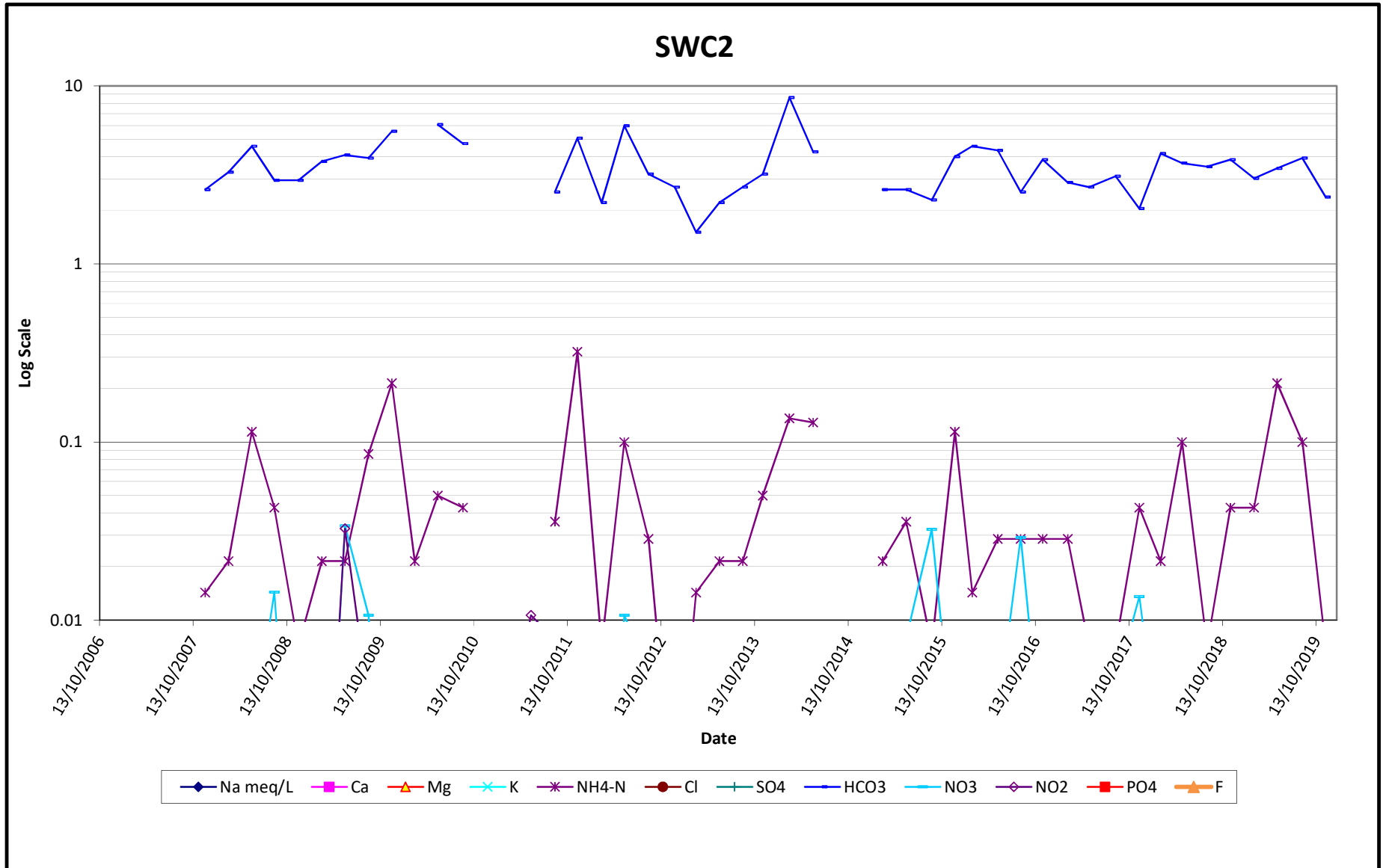




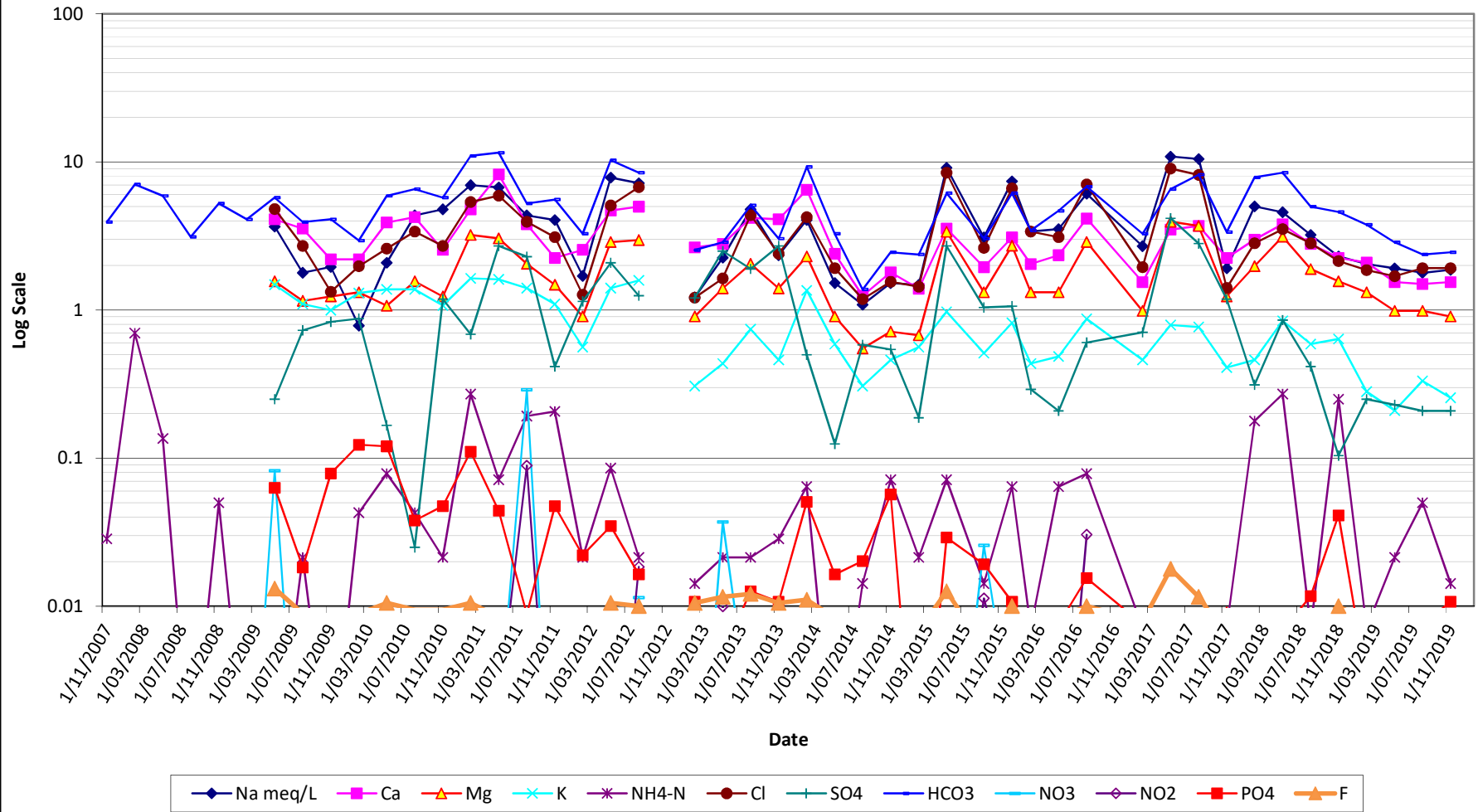
SWC_Down2



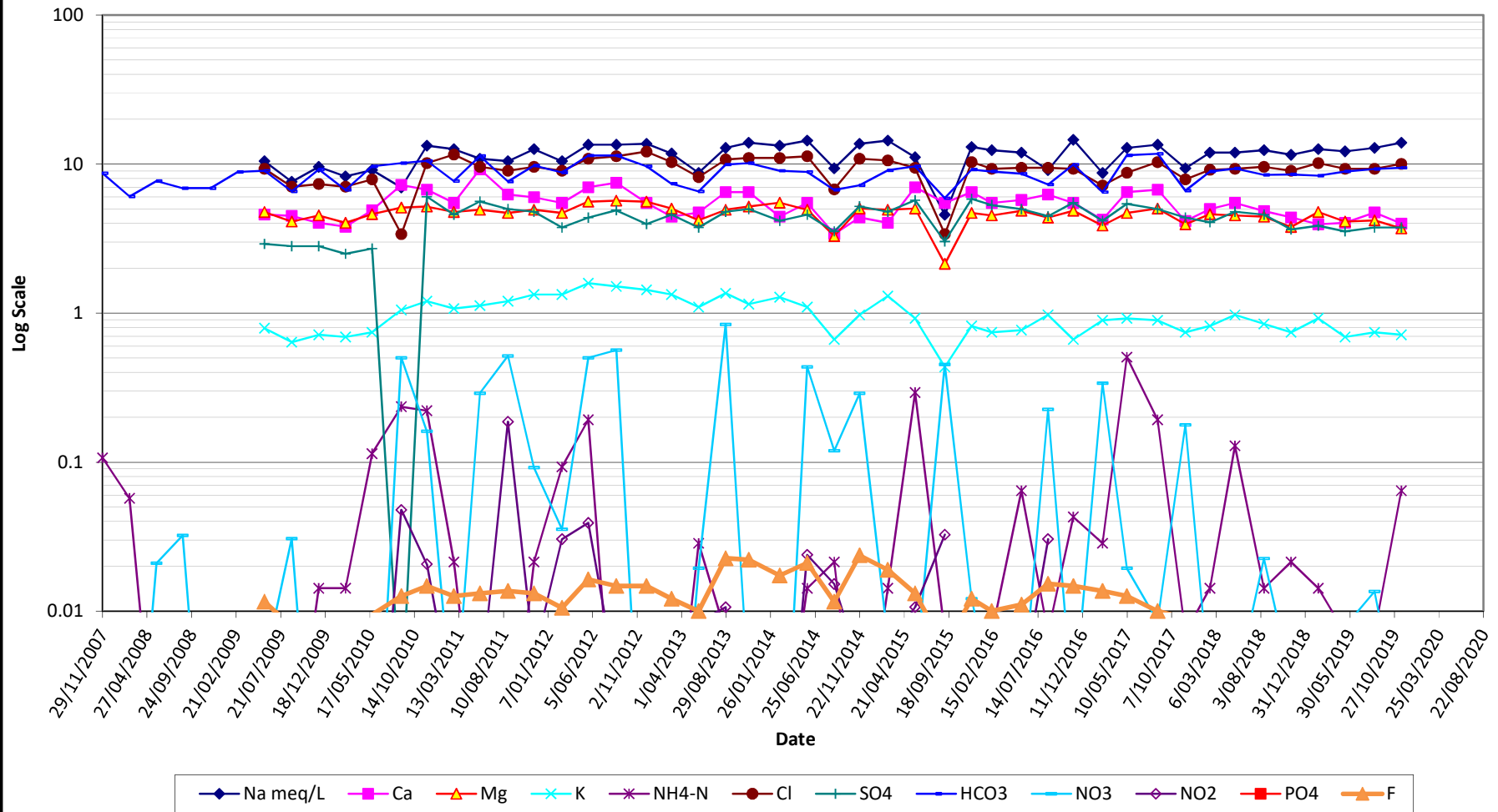




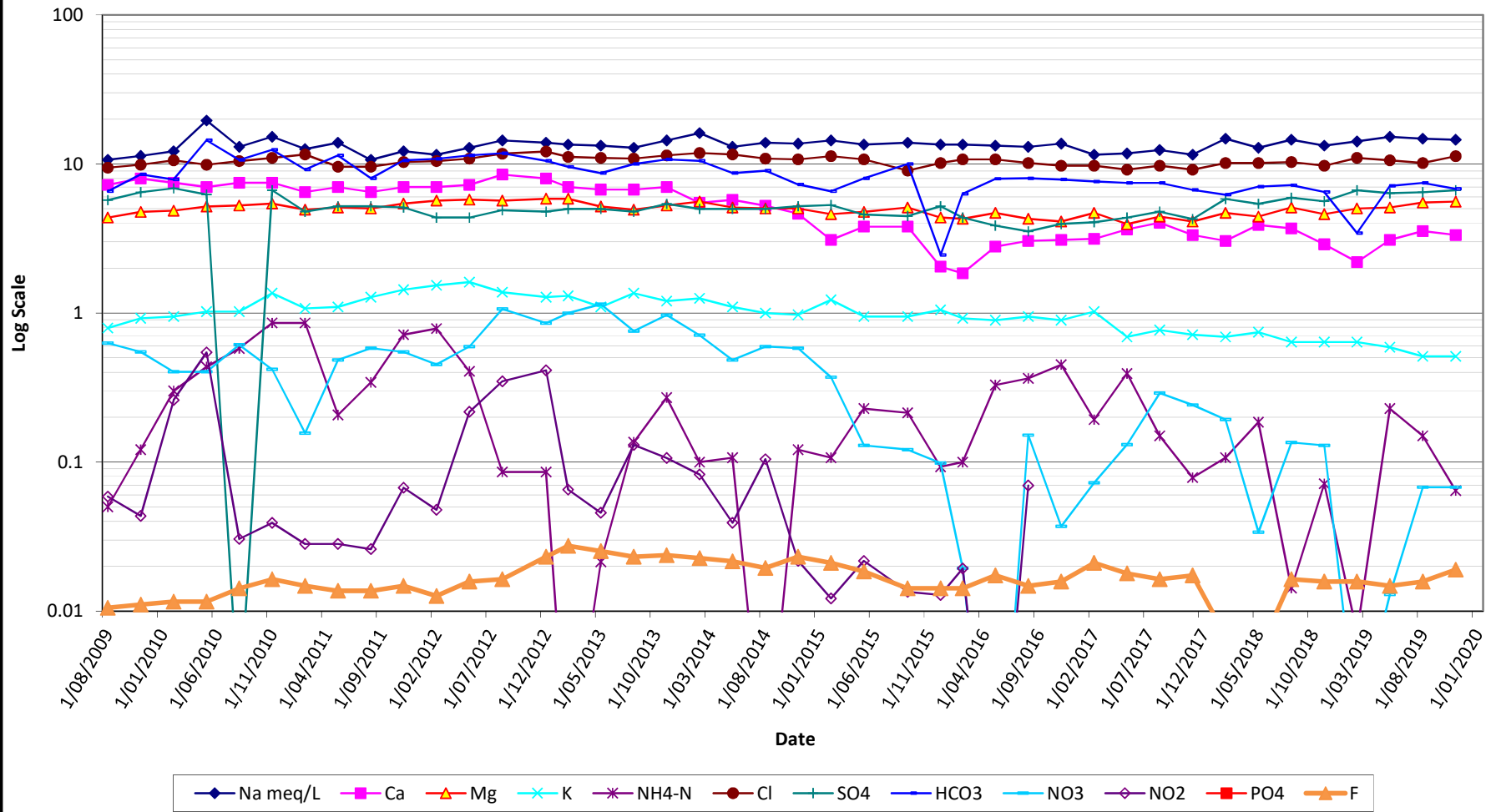
SWP1



SWP2



SWP4



APPENDIX E: LABORATORY RESULTS AND CHAIN OF CUSTODY

CHAIN OF CUSTODY - INORGANIC ANALYSIS REQUEST FORM



Job #: 118109

Site Location: Shellharbour

Sampler: ZZ/LD

Date: 21.11.19

Laboratory: SAL

Sample ID	DATE SAMPLED	Sample Description			Analysis Required													ANTICIPATED RESULTS/TURNAROUND TIME
		SOIL	WATER	SEDIMENT	HEAVY METALS	IONIC BALANCE	TOC	CEC AND EXCHANGEABLES	LEACH PROCEDURE	Sol. Zn	BOD	TURBIDITY	Tot. & Sol. Fe	Sol. Mn	NO3, NO2, HCO3, NH4	Sol. Al		
BH1c	20.11.2019	x			x	x					x		x	x				
BH2	19.11.19		x			x	x				x		x	x				
BH3	19.11.19		x			x	x				x		x	x				
BH4	19.11.19		x			x	x				x		x	x	x			
BH13	19.11.19		x			x	x				x		x	x				
BH14	19.11.19		x			x	x				x		x	x				
BH16	19.11.19		x			x	x				x		x	x				
BH20	19.11.19		x			x	x				x		x	x				
BH20s	19.11.19		x			x	x				x		x	x				
FD1	19.11.19		x			x	x				x		x	x				
LP1	19.11.19		x			x	x				x	x	x	x				
SWP1	20.11.19		x			x						x	x					
SWP2	19.11.19		x			x						x	x					
SWP4	20.11.19		x			x	x				x	x	x					
SWC2	19.11.19		x									x	x		x			
SWC_UP	19.11.19		x			x						x	x					
SWC_down	19.11.19		x			x						x	x					
SWC_down 2	19.11.19		x			x						x	x					
TOTAL																		

Turn Around: **NORMAL** Sheet: 1 of 1

Comments: _____

Report to: egriffith@eesigroup.com mnarracott@eesigroup.com

Invoice to: accounts@eesi.biz egriffith@eesigroup.com

Left EES Site: _____ Time _____ Date 21.11.19 Lab Supervisor: _____

Transported By: _____

Received Lab: _____

Fax Results Rec'd _____

Typed Results Rec'd _____

We can be contacted on:

Phone: (02) 9922 1777

Fax: (02) 9922 1010

**SYDNEY
ANALYTICAL
LABORATORIES**

Page 1 of 17

Office:
PO BOX 48
ERMINGTON NSW 2115

Laboratory:
1/4 ABBOTT ROAD
SEVEN HILLS NSW 2147
Telephone: (02) 9838 8903
Fax: (02) 9838 8919
A.C.N. 003 614 695
A.B.N. 81 829 182 852
NATA No: 1884

ANALYTICAL REPORT for:

ENVIRONMENTAL & EARTH SCIENCES

PO BOX 380
NORTH SYDNEY 2059

ATTN: E.GRIFFITHS

JOB NO: SAL27420
CLIENT ORDER: 118109
DATE RECEIVED: 22/11/19
DATE COMPLETED: 05/12/19
TYPE OF SAMPLES: WATERS
NO OF SAMPLES: 21



.....
Issued on 06/12/19
Lance Smith
(Chief Chemist)

ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION SAMPLES	20/11/19 BH1c	19/11/19 BH2
pH	7.2	7.2
Total Dissolved Solids mg/L	4110	1780
Biochemical Oxygen Demand mg/L	7	<2
Total Organic Carbon mg/L	170	62
Iron (Total) mg/L	13	10
Iron (Dissolved) mg/L	3.7	0.66
Manganese (Dissolved) mg/L	0.11	0.46

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	680	29.580	330	14.355
Calcium Ca++	130	6.487	160	7.984
Potassium K+	210	5.376	45	1.152
Magnesium Mg++	120	9.876	65	5.350
Ammonia (Total)	350	24.990	43	3.070

TOTAL CATIONS		76.309		31.911
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Chloride Cl-	840	23.688	395	11.139
Fluoride F-	0.22	0.012	0.22	0.012
Nitrate NO3-	<0.1		<0.1	
Sulphate SO4--	25	0.520	130	2.704
Bicarbonate HCO3-	3280	53.792	1140	18.696
Phosphate PO4---	0.16	0.005	<0.1	

TOTAL ANIONS		78.017		32.551
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION	19/11/19	19/11/19
SAMPLES	BH3	BH4
pH	7.4	7.2
Total Dissolved Solids	900	1240
Biochemical Oxygen Demand	<2	<2
Total Organic Carbon	15	22
Iron (Total)	1.6	4.2
Iron (Dissolved)	0.15	0.14
Manganese (Dissolved)	0.20	0.24

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	79	3.437	160	6.960
Calcium Ca++	155	7.735	210	10.479
Potassium K+	32	0.819	23	0.589
Magnesium Mg++	26	2.140	37	3.045
Ammonia (Total)	34	2.428	8.0	0.571

TOTAL CATIONS	16.559	21.644
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Chloride Cl-	230	6.486	235	6.627
Fluoride F-	0.13	0.007	<0.1	
Nitrate NO3-	39	0.628	0.35	0.006
Sulphate SO4--	90	1.872	160	3.328
Bicarbonate HCO3-	490	8.036	750	12.300
Phosphate PO4---	<0.1		<0.1	
Nitrite NO2-			<0.1	

TOTAL ANIONS	17.029	22.261
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION SAMPLES		19/11/19 BH13	19/11/19 BH16
pH		7.2	7.3
Total Dissolved Solids	mg/L	1060	425
Biochemical Oxygen Demand	mg/L	<2	<2
Total Organic Carbon	mg/L	23	16
Iron (Total)	mg/L	1.8	7.8
Iron (Dissolved)	mg/L	0.16	0.28
Manganese (Dissolved)	mg/L	0.24	0.09

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	115	5.003	72	3.132
Calcium Ca++	190	9.481	32	1.597
Potassium K+	42	1.075	12	0.307
Magnesium Mg++	40	3.292	29	2.387
Ammonia (Total)	2.7	0.193	0.3	0.021

TOTAL CATIONS		19.044		7.444
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Chloride Cl-	110	3.102	110	3.102
Fluoride F-	0.20	0.011	0.22	0.012
Nitrate NO3-	5.0	0.081	<0.1	
Sulphate SO4--	240	4.992	87	1.810
Bicarbonate HCO3-	680	11.152	150	2.460
Phosphate PO4---	<0.1		<0.1	

TOTAL ANIONS		19.338		7.384
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION SAMPLES	19/11/19 BH20	19/11/19 BH20s
pH	7.6	7.6
Total Dissolved Solids mg/L	880	815
Biochemical Oxygen Demand mg/L	<2	<2
Total Organic Carbon mg/L	18	17
Iron (Total) mg/L	1.3	0.32
Iron (Dissolved) mg/L	0.15	0.06
Manganese (Dissolved) mg/L	0.08	0.05

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	60	2.610	43	1.871
Calcium Ca++	135	6.737	125	6.238
Potassium K+	42	1.075	79	2.022
Magnesium Mg++	28	2.304	39	3.210
Ammonia (Total)	43	3.070	2.0	0.143

TOTAL CATIONS	15.796	13.484
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Chloride Cl-	120	3.384	58	1.636
Fluoride F-	0.14	0.007	0.12	0.006
Nitrate NO3-	<0.1		43	0.692
Sulphate SO4--	220	4.576	205	4.264
Bicarbonate HCO3-	460	7.544	430	7.052
Phosphate PO4---	0.24	0.008	<0.1	

TOTAL ANIONS	15.519	13.650
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION	19/11/19	19/11/19
SAMPLES	FD1	FD1 DUP
pH	8.0	8.0
Total Dissolved Solids	35500	35100
Biochemical Oxygen Demand	<2	<2
Total Organic Carbon	<1	<1
Iron (Total)	0.14	0.13
Iron (Dissolved)	0.13	0.12
Manganese (Dissolved)	0.02	0.02

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	11100	482.850	10900	474.150
Calcium Ca++	400	19.960	410	20.459
Potassium K+	460	11.776	465	11.904
Magnesium Mg++	1230	101.229	1240	102.052
Ammonia (Total)	<0.1		<0.1	

TOTAL CATIONS	615.815	608.565
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Chloride Cl-	19400	547.080	19300	544.260
Fluoride F-	0.54	0.028	0.54	0.028
Nitrate NO3-	<0.1		<0.1	
Sulphate SO4--	2810	58.448	2800	58.240
Bicarbonate HCO3-	140	2.296	140	2.296
Phosphate PO4---	<0.1		<0.1	

TOTAL ANIONS	607.852	604.824
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION	19/11/19	20/11/19
SAMPLES	LP1	SWP1
pH	7.8	7.2
Total Dissolved Solids	mg/L 8250	260
Biochemical Oxygen Demand	mg/L 85	
Total Organic Carbon	mg/L 840	
Turbidity	NTU 30	31
Iron (Total)	mg/L 5.6	2.1
Iron (Dissolved)	mg/L 5.2	0.63
Manganese (Dissolved)	mg/L 0.48	

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	1440	62.640	43	1.871
Calcium Ca++	120	5.988	31	1.547
Potassium K+	450	11.520	10	0.256
Magnesium Mg++	100	8.230	11	0.905
Ammonia (Total)	915	65.331	0.2	0.014

TOTAL CATIONS 153.709 4.593

Chloride Cl-	1690	47.658	68	1.918
Fluoride F-	0.68	0.036	0.14	0.007
Nitrate NO3-	<0.1		<0.1	
Sulphate SO4--	130	2.704	10	0.208
Bicarbonate HCO3-	6570	107.748	150	2.460
Phosphate PO4---	20	0.632	0.34	0.011

TOTAL ANIONS 158.778 4.604

ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION SAMPLES	19/11/19 SWP2	20/11/19 SWP4
pH	7.9	8.5
Total Dissolved Solids mg/L	1320	1470
Biochemical Oxygen Demand mg/L		4
Total Organic Carbon mg/L		31
Turbidity NTU	2.3	13
Iron (Total) mg/L	0.17	0.16
Iron (Dissolved) mg/L	0.01	0.03

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	320	13.920	335	14.573
Calcium Ca++	80	3.992	67	3.343
Potassium K+	28	0.717	20	0.512
Magnesium Mg++	45	3.704	68	5.596
Ammonia (Total)	0.9	0.064	0.9	0.064

TOTAL CATIONS		22.397		24.088
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Chloride Cl-	355	10.011	400	11.280
Fluoride F-	0.18	0.009	0.36	0.019
Nitrate NO3-	<0.1		4.2	0.068
Sulphate SO4--	180	3.744	320	6.656
Bicarbonate HCO3-	575	9.430	415	6.806
Phosphate PO4---	0.12	0.004	<0.1	

TOTAL ANIONS		23.198		24.829
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION	19/11/19	19/11/19
SAMPLES	SWC2	SWC-UP

pH			8.0
Total Dissolved Solids	mg/L		38700
Turbidity	NTU	0.9	0.9
Iron (Total)	mg/L	0.25	0.11
Iron (Dissolved)	mg/L	0.15	0.10

	mg/L	meq/L	mg/L	meq/L
Sodium Na+			11900	517.650
Calcium Ca++			420	20.958
Potassium K+			485	12.416
Magnesium Mg++			1280	105.344
Ammonia (Total)	<0.1		0.2	0.014

TOTAL CATIONS				656.382
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Chloride Cl-			21500	606.300
Fluoride F-			0.55	0.029
Nitrate NO3-	<0.1		<0.1	
Sulphate SO4--			3060	63.648
Bicarbonate HCO3-	145		145	2.378
Phosphate PO4---			<0.1	
Nitrite NO2-	<0.1			

TOTAL ANIONS				672.355
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION	19/11/19	19/11/19
SAMPLES	SWC-DOWN	SWC-DOWN
		2

pH		7.9	8.1
Total Dissolved Solids	mg/L	35600	36000
Turbidity	NTU	1.3	0.4
Iron (Total)	mg/L	0.12	0.11
Iron (Dissolved)	mg/L	0.11	0.12

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	10800	469.800	11000	478.500
Calcium Ca++	390	19.461	400	19.960
Potassium K+	450	11.520	460	11.776
Magnesium Mg++	1220	100.406	1240	102.052
Ammonia (Total)	<0.1		<0.1	

TOTAL CATIONS		601.187		612.288
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Chloride Cl-	19000	535.800	19600	552.720
Fluoride F-	0.57	0.030	0.58	0.031
Nitrate NO3-	<0.1		<0.1	
Sulphate SO4--	2810	58.448	2850	59.280
Bicarbonate HCO3-	145	2.378	140	2.296
Phosphate PO4---	<0.1		<0.1	

TOTAL ANIONS		596.656		614.327
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION 20/11/19 20/11/19
SAMPLES BH12-R BH15

pH		6.9	6.8
Total Dissolved Solids	mg/L	1810	5020
Total Organic Carbon	mg/L	14	175
Iron (Total)	mg/L	8.8	25
Iron (Dissolved)	mg/L	1.9	14
Manganese (Dissolved)	mg/L	0.78	0.76

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	205	8.917	815	35.453
Calcium Ca++	285	14.222	240	11.976
Potassium K+	58	1.485	730	18.688
Magnesium Mg++	56	4.609	110	9.053
Ammonia (Total)	0.6	0.043	89	6.355

TOTAL CATIONS		29.276		81.525
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Chloride Cl-	305	8.601	2220	62.604
Fluoride F-	0.18	0.009	0.18	0.009
Nitrate NO3-	145	2.335	<0.1	
Sulphate SO4--	330	6.864	285	5.928
Bicarbonate HCO3-	725	11.890	890	14.596
Phosphate PO4---	<0.1		0.18	0.006
Nitrite NO2-	1.1	0.024	<0.1	

TOTAL ANIONS		29.723		83.143
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION		20/11/19	20/11/19
SAMPLES		BH17-R	BH19-R
pH		6.9	7.1
Total Dissolved Solids	mg/L	1410	1120
Total Organic Carbon	mg/L	29	22
Iron (Total)	mg/L	38	1.4
Iron (Dissolved)	mg/L	2.6	0.17
Manganese (Dissolved)	mg/L	0.25	0.16

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	210	9.135	145	6.307
Calcium Ca++	165	8.233	210	10.479
Potassium K+	67	1.715	22	0.563
Magnesium Mg++	46	3.786	37	3.045
Ammonia (Total)	15	1.071	5.3	0.378

TOTAL CATIONS		23.940		20.772
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Chloride Cl-	430	12.126	240	6.768
Fluoride F-	0.12	0.006	0.11	0.006
Nitrate NO3-	0.58	0.009	0.35	0.006
Sulphate SO4--	175	3.640	185	3.848
Bicarbonate HCO3-	535	8.774	585	9.594
Phosphate PO4---	<0.1		<0.1	
Nitrite NO2-	<0.1		0.52	0.011

TOTAL ANIONS		24.555		20.233
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION	20/11/19	20/11/19
SAMPLES	BHA	BH17-R DUP
pH	6.8	6.8
Total Dissolved Solids	690	1440
Total Organic Carbon	20	30
Iron (Total)	13	36
Iron (Dissolved)	2.8	2.7
Manganese (Dissolved)	0.11	0.26

	mg/L	meq/L	mg/L	meq/L
Sodium Na+	86	3.741	220	9.570
Calcium Ca++	110	5.489	175	8.733
Potassium K+	18	0.461	70	1.792
Magnesium Mg++	23	1.893	48	3.950
Ammonia (Total)	0.7	0.050	16	1.142

TOTAL CATIONS		11.634		25.187
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Chloride Cl-	105	2.961	460	12.972
Fluoride F-	0.17	0.009	0.11	0.006
Nitrate NO3-	0.71	0.011	0.61	0.010
Sulphate SO4--	160	3.328	165	3.432
Bicarbonate HCO3-	340	5.576	540	8.856
Phosphate PO4---	0.12	0.004	<0.1	
Nitrite NO2-	0.20	0.004	<0.1	

TOTAL ANIONS		11.893		25.276
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ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

DATE OF COLLECTION 20/11/19
SAMPLES BLANK

pH		7.1
Total Dissolved Solids	mg/L	<1
Biochemical Oxygen Demand	mg/L	<2
Total Organic Carbon	mg/L	<1
Turbidity	NTU	<0.2
Iron (Total)	mg/L	<0.01
Iron (Dissolved)	mg/L	<0.01
Manganese (Dissolved)	mg/L	<0.01

	mg/L	meq/L
Sodium Na+	<0.1	
Calcium Ca++	<0.1	
Potassium K+	<0.1	
Magnesium Mg++	<0.1	
Ammonia (Total)	<0.1	

TOTAL CATIONS

Chloride Cl-	<1
Fluoride F-	<0.1
Nitrate NO3-	<0.1
Sulphate SO4--	<2
Bicarbonate HCO3-	<1
Phosphate PO4---	<0.1
Nitrite NO2-	<0.1

TOTAL ANIONS

LABORATORY DUPLICATE REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

Sample Number	Analyte	Units	MDL	Sample Result	Duplicate Result	%RPD
FD1	pH		0.1	8.0	8.0	0
BH17-R	pH		0.1	6.9	6.8	1
FD1	TDS	mg/L	1	35500	35100	1
BH17-R	TDS	mg/L	1	1410	1440	2
FD1	Sodium	mg/L	0.1	11100	10900	2
BH17-R	Sodium	mg/L	0.1	210	220	5
FD1	Calcium	mg/L	0.1	400	410	2
BH17-R	Calcium	mg/L	0.1	165	175	6
FD1	Potassium	mg/L	0.1	460	465	1
BH17-R	Potassium	mg/L	0.1	67	70	4
FD1	Magnesium	mg/L	0.1	1230	1240	1
BH17-R	Magnesium	mg/L	0.1	46	48	4
FD1	Chloride	mg/L	1	19400	19300	1
BH17-R	Chloride	mg/L	1	430	460	7
FD1	Fluoride	mg/L	0.1	0.54	0.54	0
BH17-R	Fluoride	mg/L	0.1	0.12	0.11	8
FD1	Nitrate	mg/L	0.1	<0.1	<0.1	0
BH17-R	Nitrate	mg/L	0.1	0.58	0.61	5
FD1	Sulphate	mg/L	2	2810	2800	0
BH17-R	Sulphate	mg/L	2	175	165	6
FD1	Bicarbonate	mg/L	1	140	140	0
BH17-R	Bicarbonate	mg/L	1	535	540	1
FD1	Phosphate	mg/L	0.1	<0.1	<0.1	0
BH17-R	Phosphate	mg/L	0.1	<0.1	<0.1	0
FD1	Ammonia	mg/L	0.1	<0.1	<0.1	0
BH17-R	Ammonia	mg/L	0.1	15	16	6
BH17-R	Nitrite	mg/L	0.1	<0.1	<0.1	0
FD1	BOD	mg/L	2	<2	<2	0
FD1	TOC	mg/L	1	<1	<1	0
BH17-R	TOC	mg/L	1	29	30	3

LABORATORY DUPLICATE REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

Sample Number	Analyte	Units	MDL	Sample Result	Duplicate Result	%RPD
FD1	Fe (Total)	mg/L	0.01	0.14	0.13	7
BH17-R	Fe (Total)	mg/L	0.01	38	36	5
FD1	Fe Dissolved	mg/L	0.01	0.13	0.12	8
BH17-R	Fe Dissolved	mg/L	0.01	2.6	2.7	4
FD1	Mn Dissolved	mg/L	0.01	0.02	0.02	0
BH17-R	Mn Dissolved	mg/L	0.01	0.25	0.26	4

Acceptance criteria:

RPD <50% for low level (<10xMDL)
RPD <20% for medium level (10-50xMDL)
RPD <10% for high level (>50xMDL)
No limit applies at <2xMDL

MDL = Method Detection Limit

All results are within the acceptance criteria

ANALYTICAL REPORT

JOB NO: SAL27420
CLIENT ORDER: 118109

METHODS OF PREPARATION AND ANALYSIS

The tests contained in this report have been carried out on the samples as received by the laboratory, in accordance with APHA Standard Methods of Water and Wastewater 23rd Edition, or other approved methods listed below:

4500B	pH
2540C	Total Dissolved Solids
3500B	Sodium Na ⁺
3111B	Calcium Ca ⁺⁺
3500B	Potassium K ⁺
3111B	Magnesium Mg ⁺⁺
4500D	Chloride Cl ⁻
4500C	Fluoride F ⁻
4500F	Nitrate NO ₃ ⁻
4110B	Sulphate SO ₄ ⁻⁻
2320B	Bicarbonate HCO ₃ ⁻
4500F	Phosphate PO ₄ ⁻⁻⁻
4500G	Ammonia (Total)
4500B	Nitrite NO ₂ ⁻
5210B	Biochemical Oxygen Demand
5310C	Total Organic Carbon
2130B	Turbidity
3111B	Iron (Total)
3111B	Iron (Dissolved)
3111B	Manganese (Dissolved)

**SYDNEY
ANALYTICAL
LABORATORIES**

Page 1 of 4

Office:
PO BOX 48
ERMINGTON NSW 2115

Laboratory:
1/4 ABBOTT ROAD
SEVEN HILLS NSW 2147
Telephone: (02) 9838 8903
Fax: (02) 9838 8919
A.C.N. 003 614 695
A.B.N. 81 829 182 852
NATA No: 1884

ANALYTICAL REPORT for:

ENVIRONMENTAL & EARTH SCIENCES

PO BOX 380
NORTH SYDNEY 2059

ATTN: E.GRIFFITHS

JOB NO: SAL27420B
CLIENT ORDER: 118109
DATE RECEIVED: 22/11/19
DATE COMPLETED: 05/12/19
TYPE OF SAMPLES: DUST GAUGE
NO OF SAMPLES: 1



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Issued on 06/12/19
Lance Smith
(Chief Chemist)

ANALYTICAL REPORT

JOB NO: SAL27420B
CLIENT ORDER: 118109

SAMPLES	ASH CONTENT g/m2/mth	COMBUSTIBLE CONTENT g/m2/mth	INSOLUBLES CONTENT g/m2/mth	SOLUBLES CONTENT g/m2/mth
DG1	<0.1	0.1	0.1	0.2
MDL	0.1	0.1	0.1	0.1
Method Code	S14	S17	S15	S16
Preparation	P7	P7	P7	P7

ANALYTICAL REPORT

JOB NO: SAL27420B
CLIENT ORDER: 118109

SAMPLES	TOTAL SOLIDS CONTENT g/m2/mth	PARTICULATES CONTENT g/m2/mth	FUNNEL DIAMETER mm	TIME EXPOSURE days
DG1	0.3	<0.1	150	91
MDL	0.1	0.1		
Method Code	S8	S19		
Preparation	P7	P7		

Sampling Dates: 21/08/19-20/11/19

ANALYTICAL REPORT

JOB NO: SAL27420B
CLIENT ORDER: 118109

METHODS OF PREPARATION AND ANALYSIS

The tests contained in this report have been carried out on the samples as received by the laboratory.

- P7 Analysis performed on sample as received (total contents)
- S14 Total Ash Content - AS3580.10.1
- S17 Total Combustibles Content - AS3580.10.1
- S15 Total Insoluble Solids Content - AS3580.10.1
- S16 Total Soluble Solids Content - AS3580.10.1
- S8 Total Solids Content - AS3580.10.1
- S19 Total Particulates Content - AS3580.10.1