

Silent Valley Waste Services Limited

Issue

2019 Annual Monitoring Report

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This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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1 Introduction

This 2019 Annual Monitoring Report presents the surface water, groundwater, landfill gas and leachate results for the monitoring undertaken in the period January to December 2019 in accordance with the Silent Valley Environmental Permit (Permit no. MP3835SV, Ref. [1]) and the Aftercare Phase Environmental and Infrastructure Monitoring Program (Ref. [4]).

A total of seven groundwater wells, seventeen surface water locations, fifteen gas monitoring wells and nine leachate monitoring wells/drain outfalls have been monitored during this period. The assessment of the monitoring results against relevant screening criteria is also presented.

Ground Investigation work was undertaken in September/ October 2019 to install a new groundwater monitoring well, GW11B, to replace GW11 and 11A and a new ground gas monitoring well was also installed, GMW14A, this was to replace GMW14. Further detail is provided within this report.

The data has been collected as referenced in Schedule 3 of the Consolidated Permit (Ref. [1]).

This report makes reference to the 2018 Annual Monitoring Report (Ref. [2]) and the 2019 First, Second and third Quarter Monitoring Reports (Ref [14, 15 and 16]).

2 The Site

2.1 Site Location and Description

The site is currently occupied by Silent Valley Landfill and is located at National Grid Reference SO185 071, as shown on **Figure 1**.

The landfill area is bounded by steep valley sides to the west, north and east. The Cwm Merddog Nature Reserve, which is a designated SSSI site, is located to the south. The Nant Merddog stream runs down the valley and to the south of the site. Where the landfill is present, it has been diverted into a pipeline that passes to the east of the landfill.

Access to the landfill site is via a minor road which ascends the hillside from the village of Waun Lwyd, Cwm, Ebbw Vale.

The site lies in a partially infilled valley at a level of between 300m AOD and 420m AOD. The landfilled waste rises from the southern toe in a mound with an approximate maximum elevation of 405m AOD. The southern toe line of the landfill crosses the valley with levels ranging approximately from 310m AOD to 360m AOD and gradients of between 1 in 4 and 1 in 2.

No waste has been accepted at the landfill since August 2011.

The earthworks for the capping of the Phase 1 Landfill, that was found to not have a Landfill Directive compliant capping, was completed in September 2015. The capping is preventing infiltration into the Phase 1 landfill and consequently is expected to achieve a reduction in leachate production within the landfill (refer to **Appendix A**).

2.2 Summary of cut-off and Monitoring systems

As part of the engineered mitigation measures pursuant to conditions included in the Permit for the site (Ref.[1]), a groundwater cut-off has been implemented by installing a line of pumping wells at the southern toe of the landfill to prevent the migration of any leachate-impacted groundwater downstream of landfill.

Phase 1 of this scheme was carried out in 2005 with the installation of eleven trial pumping and two monitoring wells. Phase 2 works were carried out between November 2006 and February 2007 and the pumping system was installed and commissioned in October 2007.

The system has been maintained and improved since October 2007, with the installation of an automatic water level monitoring system in 2009 and the addition of a stand-by compressor in 2010. Replacement pumps and low-draw pumps were also installed in a number of wells in early 2009.

In November 2009, new leachate monitoring wells were installed following a series of pumping tests at three locations. Between June and July 2010, further works have been undertaken to install additional monitoring and pumping wells and to replace one monitoring well.

Details of these improvement works are provided in **Appendix A**.

In September/ October 2019, further works have been undertaken to replace groundwater monitoring well GW11 and gas monitoring well GMW14. Pumping tests on leachate well LC5A are scheduled for early 2020. Monitoring of these locations has been undertaken as part of this quarter's monitoring regime and further details and results are included within this report.

On-going non-compliance with regards to the non-hazardous species of ammoniacal nitrogen and chloride at one of the compliance wells, GW9, has been identified, as discussed in previous monitoring reports. Investigation works have been undertaken to address this and are presented in the issued report (Ref. [3]) and summarised in **Appendix A**. These works included a walkover of the area downstream of the site within the SSSI, with the relevant permissions of the NRW, to investigate the presence and quality of potential groundwater breakouts and streams inputting to the Nant Merddog. The walkover identified two break-outs and a monitoring regime has since been implemented at sampling locations SW1 to SW10 (refer to Section 3.3.1) with the objective to sample and analyse these waters for the presence of landfill leachate species. A full year of monitoring was completed in January 2015 and the findings of this monitoring are presented and discussed in an updated issue version of the GW9 report, originally submitted to NRW in September 2013 and issued in May 2015 (Ref. [3]). Monitoring of the outbreak locations has now been included within the permit requirements until further review in 2020.

2.3 Topographical Surveys

Topographical surveys of Silent Valley Landfill are undertaken every two years. The most recent site survey was undertaken in August 2019 and included surveying the groundwater and leachate monitoring well heights. The previous survey was undertaken in July 2017. The results of the most recent 2019 survey have been incorporated into this report. The new groundwater well, GW11B, will be surveyed during the next survey due to take place in 2021.

Any changes in well heights are discussed below:

2.3.1 Groundwater Wells

The pre-existing seven groundwater monitoring wells were surveyed with both their ground level and well top height taken. The following table shows the 2017 and 2019 well heights along with the difference in height between the two surveys.

Well ID	2019 Well Height (mAOD)	2017 Well Height (mAOD)	Difference in Height (m)
GW3A	375.94	-	-
GW4	418.84	-	-
GW6	306.88	306.83	0.05
GW7	303.77	303.73	0.04

Well ID	2019 Well Height (mAOD)	2017 Well Height (mAOD)	Difference in Height (m)
GW9	330.34	330.31	0.03
GW10	346.72	346.69	0.03
GW12	322.37	322.34	0.03

It can be seen from the table above that the well heights have changed very little between the 2017 and 2019 surveys, however they have all recorded an increase in height by an average of 3.6mm.

2.3.2 Leachate Wells

All seven monitored leachate wells were surveyed with both their ground level and well top height taken. The following table shows the 2017 and 2019 well heights along with the difference in height between the two surveys.

Well ID	2019 Well Height (mAOD)	2017 Well Height (mAOD)	Difference in Height (m)
LC1A	398.85	398.84	0.01
LC2A	401.12	401.15	-0.03
LC4A	401.14	401.22	-0.08
LC5A	380.75	380.71	0.04
L1	357.00	356.99	0.01
L1A	355.79	355.79	0.00
L1B	354.80	354.81	-0.01

As with the groundwater wells, the leachate well heights show very little difference from the 2017 survey to the 2019 survey. Well LC4A has been surveyed at 8mm lower than in 2017 with well LC5A recording an increase of 4mm.

2.3.3 Summary

The well heights would not be expected to increase as the landfill along with the wells are likely to settle over time. However, the very small differences may be due to slight variations in the well head survey point used or the datum used may have differed between 2017 and 2019.

3 Monitoring Regime

The monitoring regime is undertaken in accordance with the Aftercare Phase Environmental and Infrastructure Monitoring Program (Ref. [4]) which has been summarised within the following sections. Refer to Figure 2 for monitoring locations.

3.1 Rainfall

Rainfall is measured at intervals of 0.5hrs daily, and measurements are used in the assessment of leachate and groundwater monitoring results.

3.2 Leachate

Monitoring of leachate for both leachate quality and leachate levels (to confirm leachate heads) is undertaken in accordance with sections S3.1 and S3.7 of the Consolidated Permit (Ref. [1]).

3.2.1 Monitoring locations and frequency of monitoring

The following locations are monitored:

- Monitoring wells LC1A, LC2A, LC4A, LC5A, for leachate quality and leachate levels:
 - LC1A is located within Cell 1 of the landfill, on the eastern flank of the valley, in an area where the final level was completed by 1996;
 - LC2A is located in Cell 2, on the northern flank of the landfill. This well is near to the base of the old valley bottom. Leachate in this area may be slightly diluted by groundwater ingress but this is not considered as significant as that present at the landfill toe. The waste in this area was placed around the year 2000;
 - LC4A is located in Cell 4, on the north-western flank of the landfill, in refuse waste placed around 2002. Similarly, to LC1A, this well is located away from the valley 'drain';
 - LC5A is located in Cell 5, on the western flank of the landfill. Waste in this area was last placed in August 2011;
- Monitoring wells L1A and L1B, for leachate quality and L1A, L1B and L1 for leachate levels (leachate levels from these wells are no longer considered in the assessment of leachate head – see Section 3.2.2 below);
- Leachate drain outfalls LP3A and LP4 feeding into a concrete holding leachate lagoon at the toe of the landfill, for leachate quality only. LP4 directly outfalls into the lagoon including the leachate pumped directly from Cell 5. LP3A monitors the combined leachate from several pipes/drains, which is collected in a sump and then pumped to the lagoon from where it is discharged to the foul sewer. The following flows are monitored from LP3A:
 - LP1: BSC outfall pipe at the toe of the landfill;

- LP2: Armco outfall pipe at the toe of the landfill;
- LP2A: combined outfall from LP2 and other groundwater (weep hole) inputs from LP3, LP5, LP6 and LP7.

LP1 and LP2A are also monitored individually in addition to the monitoring locations agreed in the Permit (Ref. [1]). The results from these are discussed as part of the results obtained from LP3A.

The locations of the monitoring wells and leachate lagoons are presented on **Figure 2**.

Monitoring for leachate quality is undertaken quarterly in LC1A, LC2A, LC4A, LC5A, L1A, L1B, LP3A and LP4 for the determinand suite included in Table 6 and Table 7 of the Aftercare Phase Environmental and Infrastructure Monitoring Program report (Ref. [4]), as required by the Permit (Ref. [1]). A hazardous substance suite is to be carried out every four years in LC1A, LC2A, LC4A, LC5A, L1A, L1B, LP3A and LP4 if there is an increase in contamination, as per the Permit (Ref. [1]).

Monitoring for leachate levels at LC1A, LC2A, LC4A, LC5A, L1A, L1B and L1 are undertaken **quarterly** with levels from L1A, L1B and L1 not used in the leachate head assessment. L1 is consistently recorded dry.

3.2.2 Compliance criteria

Assessment limits have been set for leachate head and composition as agreed in the Aftercare Phase Environmental and Infrastructure Monitoring Program report (Ref. [4]) and in the Hydrogeological Risk Assessment (Ref. [5]). These are summarised in Tables 3.1 and 3.2 below.

3.2.2.1 Leachate head

As noted in Table 3.1, it is required that the monthly average leachate head level above the base of the landfill in LC1A, LC2A, LC4A and LC5A is less than 3m. The average leachate head compliance value was derived from the Hydrogeological Risk Assessment (Ref. [5]) undertaken in 2004, when limited leachate monitoring results were available and it was necessary to assume a probability density function for modelling the leachate head. The 3m head is considered the maximum head at which the landfill would be acting as if a liner had been placed at the bottom of the landfill in the 1980s.

Table 3.1: Leachate Assessment Limits

Measurement	Assessment limit	Assessment Test
Leachate Head/Level	Maximum head assumed in risk assessment (3m)	Mean leachate head measured in wells as set out in the Permit, exceeds assessment limit on three consecutive surveys.
Leachate Composition	Maximum concentration assumed in risk assessment	Mean concentration from wells in waste mass exceeds assessment limit on three consecutive surveys.

3.2.2.2 Leachate quality

Assessment limits for the determinants for leachate quality, listed in Table 3.2, have also been set out in the Hydrogeological Risk Assessment (Ref. [5]), based on data from leachate wells L1, L1A and L1B.

Leachate quality is assessed from leachate wells L1A, L1B, LC1A, LC2A, LC4A and LC5A. Assessment of leachate quality is also undertaken in LP3A and LP4 but the results are not included in the assessment. For monitoring leachate quality, a reduced suite of contaminants is tested for on a quarterly basis as per the permit [1]. The revised suite of determinants tested are present below:

- Manganese (mg/l)
- Mercury (mg/l)
- Nickel (mg/l)
- Zinc (mg/l)
- pH (pH units)
- Conductivity (uS/cm)
- Alkalinity as CaCO₃ (mg/l)
- Ammoniacal Nitrogen (mg/l)
- Chloride (mg/l)
- Sulphate (mg/l)
- Redox Potential (mV)
- Total Organic Carbon (TOC) (mg/l)
- Dissolved Oxygen (DO) (mg/l)
- Suspended Solids (mg/l)
- Dissolved Solids (mg/l)

The assessment limits are compared with the calculated mean contaminant concentrations from the monitoring wells in waste the mass. If the mean concentrations from wells in the waste mass exceed the assessment levels on three consecutive surveys, contingency actions will be triggered, as described in the Aftercare Phase Environmental and Infrastructure Monitoring Program report (Ref. [4]) and summarised in Table 3.3.

Table 3.2 Leachate Acceptable Maximum Concentrations AMCs (from Ref. [8])

Contaminant	Acceptable Maximum Concentration AMCs (mg/l)
NH ₃	526
Chloride	1408
Sulphate	999
Nickel	0.0681
Zinc	1.38/
Mercury	0.56 µg/l

Table 3.3: Leachate Monitoring Contingency Actions (from Ref. [8])

Contingency Action	Response Time
Report to NRW including initial assessment of possible causes	1 month
Report to NRW on re-appraisal of risk to groundwater and surface water and options for corrective measures	3 months
If risks are acceptable revise assessment criteria as appropriate. Continue monitoring. If risks are not acceptable implement agreed corrective actions (i.e. increase monitoring and frequency as agreed with the NRW)	6 months

3.3 Surface Water

Surface water sampling of the Nant Merddog is undertaken in accordance with the sampling protocols defined in the Aftercare Phase Environmental and Infrastructure Monitoring Program Report (Ref. [4]).

3.3.1 Monitoring locations and frequency of monitoring

Monitoring of surface water quality is currently being undertaken at the locations listed in Table 3.4 in order to identify any adverse impact resulting from escape of leachate from the landfill, particularly in relation to the Nant Merddog.

Monitoring point locations are marked on **Figure 2** and **Figure 3**.

Table 3.4: Surface Water Monitoring Locations

Monitoring Point		Location
Upstream locations	SWU	On the Nant Merddog, north (upstream) of landfill
	SW2AI	On drainage ditch system on northern perimeter of landfill. The ditch intercepts surface water run-off from the area north of the landfill and discharges to the Nant Merddog
	SWW4	On drainage ditch system north of the landfill, at point where the northern perimeter ditch system joins the eastern perimeter ditch system
	SWW1	On ditch system north-west of the landfill
	SWW2	On ditch system north-west of the landfill
Downstream locations	SWD	On the Nant Merddog, approximately 70m downstream of the landfill (15m downstream of the point where the diverted stream joins its original course).
	SWD1	On the Nant Merddog, approximately 300m downstream of SWD
	SW1, SW2, SW3, SW9 and SW10	A stream, feeding into the Nant Merddog some 190m downstream of SWD issuing on the eastern slope of the valley
	SW4, SW5, SW6	A potential groundwater out-break, feeding into the Nant Merddog some 155m downstream of SWD issuing on the eastern slope of the valley
	SW7	Nant Merddog immediately downstream of the above confluence
	SW8	Nant Merddog immediately downstream of the above stream confluence

Surface water sampling locations SW1 to SW10 have been set up and monitored since December 2013 following the recommendations made in the Arup 2011 report on investigations into the western flank of the cut-off system (Ref. [6]) and a walkover through the SSSI south of the landfill in November 2013. The monitoring regime was implemented in order to confirm the presence of landfill

leachate species in these groundwater breakouts and the impact to the Nant Merddog.

The regime for surface water monitoring is in accordance to the requirements of the Permit (Ref. [1]), as follows:

- **quarterly** monitoring for locations SWD and SWD1;
- **six-monthly** monitoring for locations SWU, SWW1, SWW2, SW2AI, SWW4;
- **monthly** monitoring of the surface water monitoring locations SW1 to SW10.

3.3.2 Compliance criteria

The compliance criteria for surface water quality are the Environmental Quality Standards (EQS) which are appropriate for the Nant Merddog for all contaminants for which these are available, as defined in Table 13 of the Aftercare Phase Environmental and Infrastructure Monitoring Program report (Ref. [4]).

The following suite of contaminants are tested for on a monthly basis for SW1 to SW10, as per the permit [1].

- Ammoniacal Nitrogen (mg/l)
- Chloride (mg/l)
- Mercury (mg/l)

The following suite of contaminants are tested for on a quarterly basis for SWD and SWD1 and six-monthly basis for SWU, SWW1, SWW2, SW2AI and SWW4, as per the permit [1], with the addition of calcium which is required for determining the bioavailable metal concentration, as described below.

- | | |
|--|---|
| • Manganese (mg/l) | • Ammoniacal Nitrogen (mg/l) |
| • Mercury (mg/l) | • Chloride (mg/l) |
| • Nickel (mg/l) | • Sulphate (mg/l) |
| • Zinc (mg/l) | • Redox Potential (mV) |
| • pH (pH units) | • Total Organic Carbon, filtered (TOC) (mg/l) |
| • Conductivity (uS/cm) | • Dissolved Oxygen (DO) (mg/l) |
| • Alkalinity as CaCO ₃ (mg/l) | • Suspended Solids (mg/l) |
| • Calcium (mg/l) | |

Previously, site specific EQS values for freshwater had been derived, for nickel, manganese and zinc, based on the annual average concentration of water hardness in the Nant Merddog, downstream of the landfill. The Water Framework Directive [Ref12] has subsequently been updated with a number of the EQS compliance criteria no longer relying on hardness values. Instead, for a number of heavy metal species the EQSs are now based on the bioavailable concentrations which are derived from the recorded dissolved concentrations.

The bioavailability of a metal depends on a number of physico-chemical factors which govern both metal behaviour and the interactions of the toxic forms of the metals with a biological receptor. The Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG) have developed a model

known as the “Metal Bioavailability Assessment Tool (M-BAT) [Ref 13] which predicts the bioavailable concentration from dissolved concentrations.

To calculate the bioavailable concentration of the specific metals, calcium (Ca) and dissolved organic carbon (DOC) levels need to be obtained and input into the M-BAT tool along with pH and the recorded dissolved metal concentrations.

All compliance criteria values, including the updated heavy metals, are set out in **Table 3.5**.

Table 3.5: Compliance Criteria for the Nant Merddog

Contaminant	EQS (µg/l)	Notes
Ammoniacal Nitrogen (unionised)	15	EQS
Sulphate	400 mg/l	EQS
Chloride	250 mg/l	EQS
Nickel (Dissolved)	4	EQS
Zinc (Total)	13.7*	EQS
Mercury (Total)	1	EQS
Manganese	123	EQS

Notes:

- * This level is based on the standard EQS value 10.9ug/l plus the Ambient Background Concentration (AMC) of the River Taff of 2.8ug/l [Ref. (12)].

3.3.3 Contingency Actions

As discussed in the Aftercare Phase Environmental and Infrastructure Monitoring Program report (Ref. [4]), background water quality monitoring upstream of the landfill indicates that concentrations of some determinants may exceed the compliance criteria in some cases. The assessment of breaches of compliance criteria therefore includes an assessment of background levels. Such breaches may be acceptable in cases where they result from background levels. No Assessment Levels are set, but assessment is made by monitoring the data for trends of increasing contaminant concentrations.

If a significant trend of increasing contaminant concentration is identified, then the following contingency actions and timescales should be followed.

Table 3.6: Surface Water Monitoring Contingency Actions (from Ref. [8])

Contingency Action	Response Time
Advise NRW with initial assessment of possible causes e.g. unusual activities, leachate discharges etc.	1 month
Report to NRW on re-appraisal of risk to the Nant Merddog and report on monitoring since the increasing trend was identified.	3 months
If risks are acceptable continued monitoring and assessment will be undertaken with three monthly reporting and risk re-appraisal concerning the contaminants of concern until such time as no continued potentially unacceptable risk is considered to exist.	6 months

Contingency Action	Response Time
If risks are unacceptable agreed corrective measures will be implemented (i.e. increase monitoring location points and increase frequency as agreed with the NRW)	

If there is a particular incident that may result in surface water pollution additional monitoring will be agreed with the NRW.

3.4 Groundwater

Monitoring of groundwater is undertaken in accordance with Table S3.9 of the Permit (Ref. [1]), the Environment Agency guidance on groundwater monitoring (Ref. [7]) and in line with the monitoring schedule agreed with the NRW, as discussed in the 2010 Annual Monitoring Report (Ref. [8]).

3.4.1 Monitoring locations and frequency of monitoring

The following locations are currently monitored on a quarterly basis:

- Monitoring wells GW3A and GW4, located upstream of the landfill (referred to as 'upstream wells');
- Monitoring wells GW6, GW7, GW9, GW10, and GW12, located downstream of the landfill (referred to as 'downstream wells' or 'compliance wells');

As detailed in section 2.2 GW11A has been replaced and has now been included in the monitoring regime. The locations of the monitoring wells are presented on Figure 2.

For details of previous monitoring undertaken at the site, refer to **Appendix B**.

3.4.2 Compliance criteria

Control and Trigger Levels have been developed for those contaminants addressed in the Hydrogeological Risk Assessment (Ref. [5]) as shown in **Table 3.6**. These contaminants cover a range of substances indicative of landfill leachate contamination which are potentially harmful to downstream groundwater and to the aquatic environment of the Nant Merddog.

The Control Levels allow the identification of any unexpected or adverse trends in the monitoring data and should be treated as an early warning system to enable investigative or corrective measures to be implemented, particularly where Trigger Levels might be breached.

Trigger Levels are specific compliance levels, or regulatory standards. They are defined as criteria at which significant adverse environmental effects and/or breaches of legislation have occurred. Such effects would be consistent with the groundwater having been polluted.

As discussed in the Hydrogeological Risk Assessment Supplementary Revision (Ref. [9]), during routine reviews of the groundwater monitoring results, it was noted that for certain contaminants (e.g. mercury, zinc and manganese),

background concentrations measured upstream of the landfill in groundwater and surface water exceeded the applied Control and Trigger Levels (or in the case of manganese, the corresponding EQS), particularly following high rainfall events. As a result, a review of the background levels and their likely origin was undertaken and revised Control and Trigger Levels (or in the case of manganese, assessment level) were proposed and agreed with the Environment Agency, as presented in Table 3.7. The HRA for the site has been reviewed and revised in the context of a review of the background levels monitored since the last HRA was undertaken and the findings of this shall be implemented on confirmation with NRW.

Table 3.7: Groundwater Control and Trigger Levels (and Assessment Level for manganese)

Determinand	Control Levels (mg/l)		Trigger Level (mg/l)
	A	B	
Ammoniacal Nitrogen	0.8*	0.9*	1.0*
Chloride	210*	230*	250*
Mercury	0.0001**	0.00015**	0.0002**
Nickel	0.03*	0.04*	0.05*
Sulphate	300*	350*	400*
Zinc	0.02**	0.035**	0.05**
Manganese	-	-	1.0**

Notes:

* From Hydrogeological Risk Assessment (Ref. [8]).

** From Hydrogeological Risk Assessment Supplementary Revision (Ref. [9]) and Groundwater Monitoring: Trigger Levels report (Ref. [10]).

3.4.3 Contingency Actions

If the Control or Trigger levels are exceeded on three consecutive monitoring rounds, contingency actions will be triggered, as described in the Aftercare Phase Environmental and Infrastructure Monitoring Program report (Ref. [4]) and summarised in Table 3.8.

Table 3.8: Groundwater Monitoring Contingency Actions (from Ref. [8])

Contingency Action	Response Time
Advise NRW with initial assessment of possible causes e.g. unusual activities.	1 month
Report to NRW on re-appraisal of risks to the Nant Merddog based on risk assessment review and Nant Merddog monitoring and further groundwater monitoring subsequent to breach.	3 months
If risks are acceptable the assessment criteria may be re-evaluated. If monitoring shows concentrations to have fallen back to below the control/trigger levels no further action may be necessary.	6 months
If risks are unacceptable agreed corrective measures will be implemented. The corrective measures if required and appropriate may include additional monitoring (frequency and location).	

If there is a particular incident that may result in groundwater pollution additional monitoring will be agreed with the NRW.

3.5 Landfill Gas

Landfill gas monitoring is carried out in accordance with the requirements of the Permit (Ref. [1]).

3.5.1 Monitoring locations and frequency of monitoring

The following locations are monitored for landfill gas (methane and carbon dioxide):

- GWM1 to GMW10;
- GMW12 to GMW14A;
- GMW17 and GMW18.

These wells are located around the site perimeter, as shown on **Figure 2**.

The original well GMW1 was damaged at some point in the past and was replaced with GAS01 in February 2007. For ease of reference, this well is now referred to as GMW1. Well GMW14 was replaced by GMW14A in September 2019 due to continuing access issues.

3.5.2 Compliance criteria

Control and Trigger Levels for landfill gas have been established by Golder Associates (Ref. [10]).

For each monitored well, up to three monitoring points (valves) have been installed at different depths. Trigger and Control Levels have therefore been set for each monitoring point, where appropriate.

Currently, no Control and Trigger Levels are set for GMW1, GMW8, GMW9, GMW10, GMW17 and GMW18. Boreholes GMW8, 9 and 10 are located within 20m of the waste mass, in conflict with the Environment Agency's guidance on

landfill gas management (Ref. [11]), which recommends perimeter wells be located at a distance greater than 20m from the boundary of the waste. To overcome this, additional wells (GWM12, 13, 14A, 17 and 18) were installed at a greater distance from the landfill boundary, and Trigger Levels derived for GWM12, GWM13 and GMW14A. Monitoring at GMW1, GMW17 and GMW18 is now required by the Permit (Ref. [1]), however there are still no Control and Trigger Levels for these locations.

As stated by Golder Associates (Ref. [10]), single exceedances need no immediate action. However, ongoing exceedances require informing the relevant people and organisation and appropriate measures of identification and solutions identified.

4 Monitoring Results

4.1 Rainfall

Measured rainfall data is illustrated in **Appendix C, Figures C1 to C3**.

Figure C1 shows daily rainfall totals for the period January 2013 to December 2019 and highlights the dates when samples have been taken for analysis from the downstream compliance wells GW6, GW7, GW9, GW10, and GW12.

Figure C2 shows monthly rainfall totals for the same period in 2019, with monthly leachate head average data for comparison, as further discussed in Section 4.2.2.

Figure C3 shows monthly rainfall from July 2010 to December 2019.

Fourth quarter summary

October recorded the highest monthly rainfall of the quarter with 202.7mm, and also the highest daily rainfall total with 41.1mm. December recorded the lowest monthly rainfall of the quarter with 154.0mm. The values recorded in October have seen a considerable increase from previous years, recording the highest value for this month since October 2013. November and December readings also recorded higher than those previously recorded for the same quarter over past years (refer to previous monitoring reports).

Annual summary

The combined total for the year 2019 is 1291.20mm, which is above the long-term average for the region of 1260mm (Ref [9]) and the highest annual recorded rainfall since 2014. This is compared to the annual total for 2018 of 929.7mm, which was the lowest recorded rainfall since 2011.

October recorded the highest month of rainfall during 2019 with a level of 202.7mm recorded, previous data shows October as a relatively drier month. June, March, August, September, November and December also recorded rainfall levels over 100mm. The lowest rainfall was recorded in May with a level of 36.9mm.

The last three quarters of 2019 were wetter than 2018, which was an exceptionally dry year, with the first quarter of 2019 recording lower rainfall levels than previous years.

4.2 Leachate

4.2.1 Leachate Quality Monitoring

Leachate quality monitoring results from within the waste body and from leachate standpipes are presented in **Appendix D, Table D1** and include contaminant concentration averages and Acceptable Maximum Concentrations (AMCs) for mercury, nickel, zinc, ammoniacal nitrogen, chloride and sulphate. For the respective AMCs refer to **Table 3.2**.

In accordance with the Permit requirements, the leachate quality monitoring has been undertaken quarterly since March 2015. Leachate well LC1A continues to be unsampled in the fourth quarter due to lack of leachate present, although a sample was obtained in the third quarter and well L1A was recorded as dry. Samples were obtained from L1A (third quarter only), L1B, LC2A, LC4A and LC5A.

Fourth quarter summary

With the exception of ammoniacal nitrogen, the average concentrations for the monitored contaminants from the fourth quarter all recorded below the AMC values. Well LC5A has continued to record the highest ammoniacal nitrogen concentration, with a value of 2180mg/l, although this is lower than last quarter's value of 2330mg/l. This has resulted in the average value of ammoniacal nitrogen being 800.075mg/l which is above the AMC of 526mg/l and higher than the average concentration recorded last quarter. This has likely been driven by higher concentrations being recorded in the other wells which has subsequently raised the overall AMC value. Although ammoniacal nitrogen levels remain above the AMC, there is no identifiable increasing or decreasing trend with levels constantly fluctuating.

The average nickel concentration was recorded as 0.0667mg/l, higher than last quarter where the average concentration of 0.06056mg/l was recorded, but below the AMC value of 0.0681mg/l. Zinc levels have remained elevated in LC4A but have also increased in LC2A, both higher than last quarter. Chloride and sulphate have both decreased in LC5A. However, other than ammoniacal nitrogen, none of the other contaminants monthly averages exceeded their respective AMCs.

Mercury concentrations in wells LC2A, LC4A and LC5A were unable to be determined due to matrix interference in the sample, likely due to the presence of sediment, recorded by the laboratory. However, where a result has been obtained this year it has remained below level of detection, a continuing trend of since 2013. Consequently, the monitored concentrations of mercury have not only been below the Acceptable Maximum Concentration (refer to **Table 3.2**), but also below the Trigger Level set for the groundwater compliance wells (see **Table 3.6**).

Annual summary

The average values for the monitored contaminants have been recorded below their respective AMCs throughout 2019 with the exception of ammoniacal nitrogen and nickel. The average value of ammoniacal nitrogen had been fluctuating throughout 2017 and 2018, hitting a high of 854mg/l in April 2017 proceeding to a low of 593.36mg/l in October 2017. The levels have continued to fluctuate throughout 2019 with January recording the highest AMC of 812mg/l and July recording the lowest AMC of 659.51mg/l. However, ammoniacal nitrogen levels continue to be recorded below level of detection in the downstream compliance wells.

The average concentration of nickel was recorded above the AMC during the second quarter only. This may be due to LC5A recording a higher than normal level of nickel with the remaining wells remaining fairly consistent.

The continuing high levels of ammoniacal nitrogen recorded will be reviewed in the context of the proposed investigations into LC5A.

For the respective AMCs refer to **Table 3.2**.

4.2.2 Leachate Level Monitoring

Field monitoring readings report the depths to leachate from the top of each well casing. The leachate head for each well is calculated as follows:

The leachate level (mAOD) is calculated by subtracting the depth to leachate (m) from the well head elevation (mAOD). The leachate level (mAOD) is then subtracted from the base of landfill level (mAOD).

The well height and ground level elevations were re-surveyed in August 2019 in accordance with the requirements of the permit [Ref.1]. There was very little change in well height from the previous survey undertaken in 2017 with well LC5A recording an increase of 4mm and well LC4A a decrease of 8mm, as described in **Section 2.3**. The slight change in well height levels are not deemed to have impacted on the leachate head levels recorded. The graph in Figure C2 shows the leachate levels, allowing for the revised well heights.

Leachate level monitoring results are presented in **Appendix D, Table D2**.

Quarterly Leachate Head

The quarterly leachate head averages have been increasing since 2013 and even during dry periods the leachate head has continued to remain higher than pre-2013. Figure C2, Appendix C, shows the monthly rainfall plotted against the leachate head averages. Since the Cell 5 capping was completed in November 2011 and later the Phase 1- completed in September 2015, the leachate head levels within LC5A have not decreased as would have been expected but have actually increased, specifically since July 2016.

Taking into account the updated survey levels, the fourth quarter of 2019 recorded a maximum leachate head of 5.05m in LC5A, a 0.53m increase from the previous quarter, and the average leachate head for this quarter has been recorded as 2.74m which has increased from last quarter. Since 2017, each year the leachate averages have increased each quarter throughout the year. This year the average leachate levels were showing a decreasing trend prior to an increase recorded in the final quarter.

Although the monthly average level for all the wells remains below the required 3.0m, as per the Permit (Ref[1]), it is still considered that there is an increasing trend in the average leachate head, with the potential to reach the 3m limit in the future. Well LC5A has continued to be the only well recording high leachate levels which is driving the increase in average leachate head, with the rest of the wells remaining constant. Investigations are expected to be undertaken during the first quarter of 2020, which include well pump testing, the results of which will be reported within the subsequent quarterly report.

Wells located in the Phase 1 cell, specifically L1 have continued to record low levels of leachate, with not enough to collect samples for testing.

Annual Average Leachate Head

The average leachate head per year had decreased last year, the first time since it started increasing year on year since 2013, however this subsequently increased again this year, as detailed in Table 4.1 below.

Table 4.1: Annual Average Leachate Head

Year	Maximum Leachate Head	Average Leachate Head	Average Leachate Head <3m
2013	2.45m	1.01m	Yes
2014	3.95m	1.14m	Yes
2015	4.96m	1.81m	Yes
2016	4.83m	2.54m	Yes
2017	5.09m	2.70m	Yes
2018	5.36m	2.58m	Yes
2019	5.05m	2.74m	Yes

The annual leachate head has increased year on year until 2018 in which a slight decrease was recorded, likely due to an unusually dry year. The annual leachate head increases again in 2019, continuing to show an increasing trend. This will be reviewed at the beginning of 2020, when further investigation is planned for LC5A.

4.3 Surface Water

4.3.1 Surface Water Quality Monitoring

The surface water quality monitoring results are presented in **Appendix D, Tables D3 and D4**, and graphically in **Appendix C, Figure C4**.

Commentaries are provided for upstream and downstream monitoring points in the Nant Merddog, including locations SW1 to SW10 located downstream of the landfill, as discussed below.

4.3.1.1 SWU, SW2A1, SWW4, SWW1 and SWW2 (upstream of the landfill)

In accordance with the Permit requirements, these locations are monitored on a six-monthly basis, as set out in Section 3.

Fourth quarter summary

Mercury, zinc and ammoniacal nitrogen were all recorded below the limit of detection at all locations. Unionised ammoniacal nitrogen was recorded well below the assessment criteria at all locations with the exception of SWW4 which recorded marginally above the EQS value of 0.015mg/l.

Nickel was recorded marginally above the freshwater EQS level in SWW1 with a level of 0.0043mg/l recorded, however the bioavailable concentrations of nickel was recorded as 0.00225mg/l, well below the freshwater EQS value of 0.004mg/l.

Manganese was recorded below level of detection in SWU, SW2AI and SWW2 with the remaining concentrations all well below the EQS level of 0.123mg/l.

Chloride and sulphate concentrations have continued to be recorded below the freshwater EQS value of 250mg/l and 400mg/l respectively. Chloride was recorded between 5.3mg/l in SWU and 8.0mg/l in SWW1 and sulphate concentrations were recorded between 12.6mg/l in SWU and 255.0mg/l in SW2AI.

Annual summary

Ammoniacal nitrogen levels have remained below the laboratory detection level of 0.41mg/l since 2014 with the majority of the unionised concentrations recorded below the screening level of 0.015mg/l throughout 2019. This is with the exception of slight exceedances recorded in SWW2 in April and SWW4 in October.

Chloride and sulphate concentrations have continued to be recorded below their respective EQS freshwater screening levels and all metals were recorded below their applied Freshwater EQS assessment criteria for 2019., although nickel and zinc have exceeded the EQS assessment criteria in previous years.

4.3.1.2 SWD and SWD1 (downstream of the landfill)

A full suite of determinands is analysed on downstream samples SWD and SWD1 on a quarterly basis, as discussed in **Section 3.3.1**.

Fourth quarter summary

Ammoniacal nitrogen has remained below the measured level of detection of 0.41mg/l in both locations. Unionised ammoniacal nitrogen was recorded below the assessment criteria of 0.015mg/l at SWD1 but was marginally above this level in SWD1, recording a concentration of 0.0159mg/l.

Chloride and sulphate concentrations were reported well below the applied EQS levels, with recorded chloride values of 4.9mg/l at SWD and 10.1mg/l at SWD1 and recorded sulphate concentrations of 47.6mg/l and 43.3mg/l at SWD and SWD1 respectively. This is a decrease from last quarter for both chloride and sulphate.

Nickel, zinc, mercury and manganese concentrations have all been recorded below the EQS assessment criteria in both SWD and SWD1.

Annual Summary

Ammoniacal nitrogen levels have continued to remain below the laboratory detection level of 0.41mg/l and have done since 2014. The majority of the unionised concentrations were recorded below the screening level of 0.015mg/l with the exception of October when a level of 0.0159mg/l was recorded.

Chloride and sulphate concentrations have continued to be recorded below their respective EQS freshwater screening levels throughout 2019.

All results for manganese, mercury, nickel and zinc were recorded below the EQS freshwater screening levels in 2019 with the majority of results recorded below their respective levels of detection, which has been mirrored in the Nant Merddog.

4.3.1.3 SW1 to SW10 (downstream of the landfill)

Surface water sampling of the groundwater break outs at SW1 to SW10 has been carried out since December 2013 on a monthly basis, comprising rounds of sampling for testing of ammoniacal nitrogen, chloride and mercury. Samples were collected from the majority of locations from January to December 2019. Sample locations SW1 and SW10 were dry in July and SW5, SW9 and SW10 were dry during August.

Fourth quarter summary

During the reporting period, ammoniacal nitrogen was measured below the laboratory detection limit of 0.41mg/l at all monitored locations during October and December and the majority of locations in November. Concentrations of ammoniacal nitrogen above the level of detection were recorded in SW4, SW5 and SW6, 5.46mg/l, 4.31mg/l and 2.36mg/l respectively, however these are located within tributaries and not the Nant Merddog itself. The last levels recorded above <0.41mg/l were in December 2018, at the same three locations with recorded concentrations of 2.26mg/l, 1.33mg/l and 0.87mg/l. The three monitoring points are located along the same tributary, closest to the landfill and the concentrations decrease as it flows towards the Nant Merddog, dropping to <0.41mg/l where the tributary joins the river. Chloride levels have also slightly increased at each of these locations, decreasing the closer they get to the river. This suggests there is a potential impact from the landfill on this tributary but not on the Nant Merddog. There was a higher than usual rainfall volume during October along with a pump failure which may have affected the levels within this tributary, however these dropped back to <0.41mg/l in December.

Mercury was recorded below the laboratory detection limit at all monitored locations with the exception of SW1 and SW5 in October in which levels of 0.016ug/l and 0.017ug/l were recorded, still well below the assessment criteria of 1.0ug/l.

Chloride was measured well below the EQS limit during the fourth quarter with levels fluctuating between the highest point of 76.5mg/l in SW4 in November and the lowest point of 6.6mg/l in SW7 in October. SW4 recorded the highest concentrations of chloride in all three months, a continuing trend.

These break outs are from the same groundwater body as that monitored by GW9 and therefore it is considered that currently the non-compliance at GW9 continues to show no discernible impact on the Nant Merddog.

Annual summary

Ammoniacal nitrogen was recorded below the level of detection throughout 2019 with the exception of SW4, SW5 and SW6 in November. Ammoniacal nitrogen levels were showing a decreasing trend in GW9, until a slight increase in November, however this was still lower than many of the levels recorded in previous years. Also, the first monitoring point of the surface water monitoring locations, SW1 and subsequent locations SW2 and SW3 have shown no signs of impact. The elevated levels are the first elevations recorded since December 2018 and prior to this, February 2016. Chloride levels increased slightly more than usual at these locations in 2019, suggesting a possible impact from the landfill, however there was a higher than usual increase in rainfall in October which may have contributed to the exceedances and these levels dropped again in December.

Chloride levels remain below the freshwater EQS level of 250mg/l throughout the year with the highest level of 83.6mg/l recorded in SW4 in January. The levels are fairly consistent at each location with little variation on impact from landfill.

Mercury levels have continued to remain below the level of detection since May 2014, with the exception of August and October 2019 where very low levels were recorded above level of detection but remaining below 1ug/l.

4.4 Groundwater

4.4.1 Groundwater Quality Monitoring

Groundwater quality monitoring results are presented in graphical format in **Appendix C, Figures C6 and C7** and in tabular format in **Appendix D, Table D5**.

Chloride and ammoniacal nitrogen are the two main indicators of groundwater contamination by landfill leachate at the site. Chloride, in particular, is not attenuated in the groundwater by processes other than dilution and would be expected to be present wherever leachate contamination occurs.

Commentaries are provided for both upstream and downstream compliance wells. As reported in previous monitoring reports, the results from the latter have been compiled in relation to the different sandstone strata in which they are installed, i.e. S1, S2 and S3.

The groundwater quality monitoring results for the fourth quarter are detailed in the following sub-sections along with an annual review of the results. It should be noted that the pumping system had broken down on the 12th and 13th October.

4.4.1.1 Upstream Groundwater wells GW3A, GW4 and GW11B

GW3A and GW4 monitor the sandstone strata classified as S3-East, and the newly installed GW11B had been placed in the sandstone strata classified as S2-West.

Fourth quarter summary

Ammoniacal nitrogen concentrations continue to be measured below the laboratory limit of detection of 0.41mg/l in GW3A, GW4 and GW11B and chloride has continued to be measured at low concentrations of 9.7mg/l for GW3A, 8.3mg/l for GW4 and 6.7mg/l for GW11B.

Mercury was recorded at less than the level of detection in GW4 and below screening criteria in GW11B with a level of 0.044mg/l. Following a reduction in mercury last quarter in GW3A, the level has increased to 0.426mg/l, the highest recorded since May 2014. On review of past results, mercury has continuously been exceeding the screening criteria applied to the downstream groundwater and has fluctuated throughout the previous years.

Manganese concentrations continue to be elevated in GW4, recording a level of 1.82mg/l, an increase from last quarter's level of 1.58mg/l. In GW11B a manganese concentration of 4.74mg/l was recorded. This is the first result recorded for this new well and is higher than the wider groundwater manganese levels, therefore this should be monitored closely during 2020.

Nickel concentrations have continued to be low in GW4 with GW3A recording 0.0078mg/l and 0.0042mg/l respectively, a slight increase from last quarter. Nickel concentrations in GW11B were also low with a level of 0.0143mg/l recorded.

Zinc has continued to be below the level of detection, <0.018mg/l in both GW3A and GW4 and for GW11B. Sulphate concentrations also remain low at 68.4mg/l in GW4, 102mg/l in GW3A and 15.5mg/l in GW11B.

The elevated mercury and manganese concentrations are considered to be outside the influence of the landfill and therefore representative of the environment external to the landfill.

Annual Summary

Ammoniacal nitrogen, chloride and nickel levels have been recorded below the assessment criteria applied to the landfill throughout 2019, with the exception of a single elevated level of nickel recorded in GW3A in April which is considered to be an anomaly. Elevated concentrations of mercury above the trigger level have been recorded in GW3A, a trend which has occurred in past results.

Elevated levels of zinc in both upstream groundwater and surface water have been recorded since mid-2010 until 2018, however the concentrations have reduced below the limit of detection throughout 2019. This suggests the zinc source has reduced and this source is other than the landfill.

Manganese concentrations continue to be above the Trigger Levels in GW4 and has been recorded above the Trigger Level in GW11B. As with zinc, the source of manganese is considered to be from an offsite source such as mine drainage which is considered to be impacting the groundwater in the locale of the landfill.

Sulphate concentrations remain below the assessment criteria throughout 2019.

4.4.1.2 Downstream Groundwater well GW10

GW10 has been installed in the sandstone strata classified as S3-East.

Fourth quarter summary

Ammoniacal nitrogen and zinc have continued to record below level of detection while mercury was measured at 0.063mg/l which is below the screening criteria.

Nickel concentrations were recorded at 0.0047mg/l, a slight increase from last quarter but remaining well below the screening criteria.

Manganese concentrations have continued to record below the Assessment Level of 1mg/l, with a level of 0.188mg/l recorded. This is an increase from the previous quarter which recorded a level of 0.122mg/l and considerably lower than October 2018 which recorded a level of 5.63mg/l.

Chloride and sulphate concentrations were measured at 12.6mg/l and 64.3mg/l respectively, well below the assessment criteria.

Annual summary

Ammoniacal nitrogen, manganese, mercury, nickel, zinc, chloride and sulphate levels have been recorded below the assessment criteria throughout 2019.

For mercury, the first three quarters recorded below the level of detection of <0.2ug/l which is above the assessment criteria, however this was confirmed by the lab to be due to interference within the sample likely due to the presence of sediment.

4.4.1.3 Downstream Groundwater well GW9

GW9 has been installed in the sandstone strata classified as S2-East.

GW9 continues to be non-compliant for ammoniacal nitrogen in relation to the Trigger Level of 1mg/l (refer to previous monitoring reports, Reference [2]). Investigation works to address this have been undertaken in 2014 and are presented in a separate report (Reference [6]).

Fourth quarter summary

Ammoniacal nitrogen was recorded above the trigger level with a concentration of 5.39mg/l, an increase from the previous quarter's result of 4.09mg/l. This does not follow the same trend as shown throughout 2017 and 2018 where higher results were recorded in the first quarter, decreasing throughout the year. Increased levels of ammoniacal nitrogen were also recorded in November within the tributaries, although not within the Nant Merddog itself. However, October was a particular wet month and the results still suggest the impact is greatest in the wetter months of the year. The pump system had broken down prior to sampling, however this is unlikely to have greatly affected the results due to the failure occurring so close to the sampling date and the extent of the increase is smaller than concentrations recorded in July 2018.

Mercury was recorded below screening criteria with a level of 0.02ug/l. The previous three quarter's recorded <0.2ug/l, due to laboratory matrix interference with the sample.

Zinc has continued to record levels below the level of detection of <0.0180mg/l and has done so since July 2018.

Nickel was recorded at 0.0049mg/l, a slight increase from last quarter, but concentrations continue to record well below the assessment criteria.

Manganese remains below the assessment level of 1.0mg/l with a level of 0.771mg/l recorded, an increase from last quarter which was the lowest recorded since October 2017.

The chloride concentration was 54.3mg/l, an increase from last quarter's result of 29.5mg/l and the sulphate level was 20.1mg/l which is slightly lower than last quarter's result of 31.9mg/l, both still well below the control and Trigger Levels.

Annual summary

The trigger level for ammoniacal nitrogen has continued to be exceeded throughout 2019, with last quarter's recording an increase from the previous quarter. However, the concentrations have continued to show a decreasing trend since January 2016, with the occasional fluctuations. The higher rainfall and pumping system issues during the final quarter may have impacted the results.

Elevated levels of zinc in both upstream groundwater and surface water have been recorded since mid-2010, however the concentrations have reduced below the limit of detection throughout 2019. The upstream wells have also shown this decrease over the past year.

Manganese concentrations have remained below the assessment level of 1.0mg/l throughout 2019. Manganese concentrations should continue to be closely monitored during 2020 as elevated background manganese concentrations have been observed in the upstream groundwater wells during the reporting period.

Mercury, chloride and sulphate concentrations continue to be recorded below the assessment level throughout 2019.

4.4.1.4 Downstream Groundwater well GW12

GW12 has been installed in the sandstone strata classified as S2-West.

Fourth quarter summary

Ammoniacal nitrogen has been recorded below level of detection, the same as last quarter. Both the first and second quarter results showed an increase concentration of ammoniacal nitrogen, suggesting an increasing trend was forming, however this is not the case.

Mercury has been recorded below the level of detection of <0.1ug/l. Mercury concentrations have fluctuated over the past couple of years, therefore the decrease in concentration should be closely monitored during 2020.

Zinc has continued to be recorded below the level of detection of <0.0180mg/l, a continuation from last quarter while nickel has been recorded slightly higher than last quarter's result with a concentration of 0.0161mg/l, remaining below the screening criteria.

A sulphate level of 328mg/l was recorded, which is above the Control Level A of 300mg/l and slightly higher than last quarter's result of 327mg/l but remaining below 400mg/l. Consistently levels have been recorded above 300mg/l since 2013 and have been fluctuating between the control and trigger levels.

Manganese has been reported at a concentration of 1.77mg/l, a significant increase from last quarter's result of 0.0208mg/l and the highest recorded manganese concentration in this well since monitoring began.

Annual summary

Ammoniacal nitrogen levels have been recorded below level of detection within the last two quarters of 2019 having recorded above the Control Level A criteria during the first two quarters. The elevated levels are considered to be anomalies.

Mercury results were recorded above the Trigger Level during the first quarter, dropping to below the detection level of 0.2ug/l in the second and third quarters. The higher limit of detection was deemed to be due to the presence of sediment within the samples. The fourth quarter was recorded below the detection level of 0.1mg/l.

Zinc in both upstream groundwater and surface water have been recorded at concentrations below the limit of detection for the year. The upstream wells also show this decreasing trend, which indicates the zinc source has reduced.

Manganese concentrations have been recorded below the assessment level of 1.0mg/l for the majority of the year, with the exception of the fourth quarter which was significantly higher, the highest recorded since monitoring began. Occasional fluctuations have been recorded in the past and the failure of the pumping system may have impacted the result, therefore this may be an anomaly. Manganese concentrations should be closely monitored during 2020 as elevated background manganese concentrations have been observed in the upstream groundwater wells during the reporting period.

Sulphate was recorded above the Control Levels throughout 2019, however the results are showing a decreasing trend. The sulphate levels have been fluctuating since April 2016 but have remained below the Trigger level (400mg/l). Sulphate levels should be reviewed and monitored closely in 2020.

4.4.1.5 Downstream Groundwater wells GW6 and GW7

GW6 and GW7 have been installed in the centre of the valley in the sandstone strata classified as S1.

Fourth quarter summary

Ammoniacal nitrogen concentrations were recorded below the analytical detection limit in both wells, which is consistent with previous quarters with the exception of a single exceedance of 0.78mg/l recorded in GW7 in January.

Sulphates were measured below compliance levels in both wells, with 87.2mg/l recorded at GW6 and 73.5mg/l at GW7.

GW6 and GW7 recorded mercury levels of 0.033ug/l and <0.01ug/l respectively, well below the assessment criteria.

The manganese concentration in GW6 was recorded as 0.662mg/l compared to 0.261mg/l in the previous quarter, remaining below the assessment criteria. The manganese level in GW7 has been recorded as 1.92mg/l, above the assessment level of 1.0mg/l but a decrease from the last quarter which had a concentration of 2.51mg/l. Manganese levels have historically been known to fluctuate within this well, and it is considered that the concentrations are also impacted by the upstream groundwater.

Nickel, zinc and chloride have continued to record well below assessment criteria in both wells, with nickel showing a slight increase in level from the previous quarter.

Annual Summary

Ammoniacal nitrogen concentrations have remained below the trigger and control levels throughout 2019 in both wells. In GW7 a concentration of 0.78mg/l was recorded, the first time since April 2017 a concentration has been recorded greater than <0.41mg/l.

Sulphate, Nickel, Mercury and Chloride concentrations have remained below compliance levels all year.

No exceedances of manganese were recorded in GW6, a continuing trend from 2016. Manganese concentrations were recorded in GW7 above the assessment level of 1.0mg/l throughout 2019 with the highest level of 2.51mg/l recorded in July. Elevated background manganese concentrations have been observed at similar levels at the upstream groundwater wells GW4 and GW11B, suggesting a source of manganese other than the landfill.

GW6 shows zinc remaining below detectable levels throughout 2019, similar to other downstream and upstream wells which are also showing this decreasing trend, indicating the zinc source has reduced. GW7 exceeded the Control Level A level (0.02mg/l) in January 2019 with a level of 0.023mg/l, with the remaining levels recorded below the level of detection. The slight exceedance recorded is likely to be an anomaly.

4.4.2 Groundwater Levels Monitoring

Groundwater levels are monitored on a quarterly basis in the compliance wells GW6, GW7, GW9, GW10 and GW12, as discussed in **Section 3.4**. Groundwater levels are also monitored in the upstream wells GW3A, GW4 and GW11B. The monitoring results are illustrated graphically in **Appendix C, Figure C8**.

The table below summarises the groundwater level changes in each well. The readings from July onwards are based on the 2019 survey levels which are only marginally different to those taken from the 2017 survey and therefore are not deemed to have a significant effect on the groundwater levels over the year. This is discussed further in **Section 2.3**.

Table 4.2: Groundwater level changes – 2019

Well	GW Level m below top of well [mAOD]			
	January	April	July	October
GW3A	30.1	30.09	30.14 [345.80]	30.0 [345.94]
GW4	11.06	10.99	11.4 [407.44]	10.9 [407.94]
GW6	5.45 [301.38]	5.36 [301.47]	5.57 [301.26]	4.89 [301.94]
GW7	2.34 [301.39]	2.33 [301.40]	2.45 [301.32]	2.07 [301.70]
GW9	17.44 [312.87]	17.24 [313.07]	17.21 [313.10]	17.29 [313.02]
GW10	7.65 [339.04]	7.70 [338.99]	7.77 [338.95]	7.57 [338.75]
GW11B	-	-	-	10.62
GW12	7.73 [314.61]	7.72 [314.62]	8.0 [314.37]	7.39 [314.98]

The groundwater levels in October have increased compared to last quarter with the exception of GW9 and GW10, in which a small decrease was recorded. October generally recorded the highest groundwater levels in 2019 which is likely due to higher rainfall than usual for this month and a pump system break down, prior to the levels being recorded on the 14th October.

Overall the ground water levels have remained fairly constant over the year. The smallest change was recorded in upstream well GW3A which varied by 0.14m with the biggest change recorded in the downstream well GW6 which varied by 0.68m. All wells, with the exception of GW9 recorded the lowest readings during July, which is likely due to the dry weather.

4.5 Landfill Gas

4.5.1 Landfill Gas Quality Monitoring

The landfill gas monitoring results are presented in **Appendix D, Table D6** for the period January to December 2019. The results are discussed in detail in the sub-sections below for both monitored gases (methane and carbon dioxide).

Work was carried out in August/ September to install a new monitoring well, GMW14A. The previous well, GMW14, could not be accessed due to its location within a cattle quarantine area. Its location is shown on **Figure 2**.

4.5.1.1 Methane

Fourth quarter summary

Methane concentrations were recorded below the respective Control and Trigger Levels in all monitoring locations where assessment levels have been set, with levels recorded between 0% and 0.3%.

GMW14A was recorded as flooded in September, however concentrations of between 0.2% and 0.7% were recorded during the fourth quarter, all below the respective Control and Trigger Levels.

Methane levels in GMW10 recorded very similar levels to those recorded prior to May 2019, after which the levels rose through the second and third quarters.

Elevated levels of methane continue to be measured in monitoring wells GMW8 and GMW9 (yellow valve). The maximum recorded concentrations for GMW8 and GMW9 were 9.6% in December and 35.6% in October, respectively. GMW1 readings decreased during the fourth quarter, with October recording the lowest of the year.

As discussed in **Section 3.5.1**, GMW8, 9 and 10 are located within 20m of the waste mass, where elevated methane concentrations are anticipated.

Methane was scarcely detected in GMW17 or GMW18, for which no Control or Trigger Levels are available.

Annual summary

Throughout 2019 methane levels have remained below the respective Control and Trigger Levels (where available) in all monitoring locations.

GMW1 has recorded low methane levels in the red and white valves throughout 2019. In the yellow valve, the levels are much higher with the highest level of 37.4% recorded in May. However, these levels are similar to those recorded in 2018, with a slightly higher peak in comparison with the 36.2% recorded in August 2018.

Higher levels of methane were detected in all three valves of GMW10 during the months of May to September, compared to January - April and October where 0% methane was recorded. In 2018 only November and December recorded 0% methane. In GMW9 the elevated levels recorded in the yellow valve have generally been lower in 2019 compared to 2018, with April to July recording below 30%. Year on year from 2017 the levels of methane have been reducing. This typically corresponds to low or very low concentrations being measured in the well's red and white valves. For both of these, no Control/Trigger Levels are available.

Elevated levels of methane continue to be measured in the monitoring well GMW8 (yellow valve) during 2019. The highest levels were recorded in the fourth quarter with 9.6% recorded in December. The concentrations generally fluctuate throughout the year with the lowest concentration of 2.7% recorded in June. The levels recorded during 2019 are similar to 2018 with a peak in Spring and again in Winter.

As discussed in **Section 3.5.1**, GMW8, 9 and 10 are located within 20m of the waste mass, where elevated methane concentrations are anticipated.

Very low or no levels of methane were detected in GMW17 and GMW18, where Control or Trigger Levels are also not available.

4.5.1.2 Carbon Dioxide

Fourth quarter summary

Carbon dioxide concentrations were recorded below the respective Control and Trigger Levels, where available, in the majority of monitoring locations with the exception of GMW5, GMW13 and GMW14A.

Levels of carbon dioxide were recorded above the trigger level in the white valve of GMW5 for both September and November with recorded levels of 5.4% and 5.3% respectively. The control level was also exceeded for the months of October and December, both recording 4.7%. With the exception of August, the results from the first and second quarters were all below the control and trigger levels. In the yellow valve, concentrations have fallen to below the trigger and control levels, recording nearly half of the previous quarter concentrations. The previous results for 2019 have continually exceeded the control and trigger levels. This change in pattern should be closely monitored during the first quarter of 2020.

In GMW13, the level recorded in December was above the trigger level of 6.0% in the yellow valve, recording a result of 6.1%. This was only a slight exceedance with similar readings being recorded throughout the year.

Monitoring has been undertaken on the newly installed GMW14A from August 2019. The well was recorded as flooded in September, however readings were able to be taken for October to December. Carbon dioxide levels exceeded the trigger level in the red valve during all three months of the fourth quarter, with the highest concentration of 4% recorded in December. This well should be monitored closely in 2020 to determine if these levels remain consistent.

Carbon dioxide continues to be present and measurable in GMW1, GMW8, GMW9, GMW10, GMW17 and GMW18. However, no Control/Trigger Levels have been derived for these locations which are in close proximity to the waste mass. Gas monitoring will continue in accordance with the agreed programme and the relevant Permit conditions.

Two additional gas pumping wells were drilled in the vicinity of GMW1 in February 2015 in the hope that it would reduce the levels of carbon dioxide. The levels recorded since then were similar to those recorded prior to the installation of the additional wells. However, this last quarter the levels have seen a drop in carbon dioxide. The wells are still under extraction and are intermittently pumped.

Annual summary

In GMW2 the trigger level of 1.5% was exceeded in July in the red valve with a recorded level of 1.6%. The last recorded trigger level exceedance was in July 2018 with 1.6%. The control level of 1% in the red valve of GMW2 was also

exceeded in May, June and August with a maximum level of 1.4% recorded. This is similar to 2018 with higher recordings during the summer months.

The trigger level of 4.8% in the GMW5 white valve was exceeded in August, September and November with levels of 5.3%, 5.4% and 5.3%, respectively. The control level of 4.3% was exceeded in October and December with a level of 4.7% recorded. The white valve exceedances are similar to 2018 with exceedances recorded in the latter part of the year. In GMW5 the trigger level of 4.1% in the yellow valve was exceeded in January, February, May, July and August with a maximum of 4.6% recorded. The control level was exceeded with 4% in both April and June and 4.1% in March. Exceedances were first recorded in 2018 in the yellow valve, continuing through 2019 until the last quarter when they fell below both the trigger and control levels.

The red valve trigger level of 4.3% was exceeded in GMW6 in July with a recorded level of 4.6%. The control level was exceeded in January, May and August with a maximum level of 4.2% recorded in August. These exceedances have occurred within similar months to 2018 however the levels have dropped, with all but one exceedance below the trigger level.

In GMW7 there was a control level exceedance in both the yellow and white valves during July. However, no exceedances have been recorded in other months throughout the year. The same happened in 2018 with results exceeding the control level recorded in the month of August only.

The yellow valve trigger level for GMW13 was exceeded in December 2019 with a maximum value of 6.1% and the control level was exceeded from May to August with a maximum level of 6.0%. Similar exceedances have been observed in GMW13 in the past. GMW13 is located on the north-western flank of the valley, outside the waste mass. It is considered likely that this well is detecting ground gas concentrations from the local bedrock geology and marsh land in the vicinity of the well.

GMW14A was installed in August 2019 with one set of quarterly readings undertaken. The well was flooded in September, followed by three readings above the trigger level of 1.5%, with a maximum of 4.0% recorded in December. On review of the installation work, recent repairs have been undertaken to this well. Therefore, further readings are required to enable an appropriate review of the gassing regime of this well.

The levels recorded in GMW1 ranged from 0.3% in December to 7.4% in February in the red valve, 0.0% in November to 10.8% in July in the yellow valve, and 0.0% in February and September to November to 1.3% in March and December in the white valve. No Trigger Levels have been set for this location as not required by the permit [1].

Elevated levels of carbon dioxide continue to be recorded in GMW8 and GMW9, however no Control/Trigger Levels have been derived for these locations. In GMW8 the highest reading in the reporting period were measured in January at 11.8%, while at GMW9 a level of 14.9% was recorded in July, both in the yellow valve. The carbon dioxide concentrations measured in GWM9 are higher than those measured within any of the gas monitoring wells, a trend continuing from

2014. Elevated carbon dioxide concentrations in the yellow valve in GMW9 were recorded since August 2013, when levels rose to 31.6% and remained above 20% for the remainder of the year. In the first half of 2013, carbon dioxide was recorded between 0 and 3.3%.

The carbon dioxide levels in GMW10 have varied throughout the year. Levels above 9% have been recorded in the red, yellow and white valves from May to August with the maximum of 12.6% recorded in July. Recorded levels then reduce throughout the second half of the year with a slight rise in all valves in December. However, no control or Trigger Levels have been derived for this monitoring location.

Readings were not taken in April for GMW17 and GMW18, but readings have been taken the rest of the year. The highest recorded carbon dioxide level in GMW17 was 6.5% in the yellow valve in October, which is slightly lower than the peak level last year. A high of 6.5% was recorded in the white valve in July and August in GMW18. No Trigger Levels have been set for this location as they are not required by the permit [1].

As stated by Golder Associates (Ref. [10]) and in Section 3.5.2, single exceedances do not require to be actioned. However, if ongoing exceedances are recorded then the relevant people require to be informed and appropriate measures of identification and solutions identified. In regard to GMW2 and GMW13, four consecutive exceedances had been recorded in the third quarter. However, in GMW2 the levels have dropped below the control level in the fourth quarter, suggesting last quarter's results were not representative of the gassing regime within this well. For GMW13, the levels dropped below the control level from September to November before increasing again in December. These wells should be reviewed following receipt of next quarter's readings. Well GMW5 has continued to record exceedances throughout 2019. However, the exceedances initially recorded in the yellow valve have reduced to below the trigger and control levels in the fourth quarter. Exceedances have since been recorded in the white valve as of August, continuing through the fourth quarter. With the changes in concentrations occurring in different valves, the readings for the first quarter of 2020 should be closely monitored to determine if these remain consistent.

Gas monitoring will continue in accordance with the agreed programme and the relevant Permit conditions.

5 Conclusions

The monitoring regime has been undertaken in accordance with the Aftercare Phase Environmental and Infrastructure Monitoring Program report (Ref. [4]) with monitoring and testing done in accordance with the Permit (Ref. [1]). The following section concludes the assessments for leachate, surface water, groundwater and landfill gas.

5.1 Leachate

5.1.1 Leachate Quality

The majority of the determinands recorded average concentrations well below their respective AMC values except for ammoniacal nitrogen and a single nickel exceedance.

Although individual exceedances were recorded, ammoniacal nitrogen and nickel were the only determinands to record an average concentration above its AMC value, due to LC5A continuing to record high ammoniacal nitrogen results, up to 3 times greater than the next highest reading. The average ammoniacal nitrogen concentration has continued to fluctuate throughout 2019.

In accordance with the Aftercare Phase Environmental and Infrastructure Monitoring Program report (Ref. [4]) and summarised in Table 3.3., the contingency plan is to be implemented after three consecutive exceedances have been recorded. One of the options for implementing corrective measures to well LC5A was to de-silt or pump the well, however the requirement for this will be reviewed on completion of the forthcoming pumping tests proposed on LC5A.

5.1.2 Leachate Head Monitoring

The quarterly average leachate heads were calculated at between 2.62m and 2.74 across 2019, within the 3m limit stipulated in the Permit (Ref. [1][1]). However, an increasing trend in leachate head has been continually recorded in LC5A, with the leachate level generally rising from 2013 to 2018, however the leachate head levels dropped to 5.05m in October 2019 from 2.84m in October 2018. The average level is continuing to increase and therefore has the potential to reach the 3m limit within the near future. It is therefore proposed to undertake pumping tests within well LC5A with the possibility of installing a second well within Cell 5 which will help to correlate the leachate head level across the cell. This should help determine whether well LC5A is performing efficiently or whether the leachate head levels are due to an issue within this well.

The leachate head recorded in the remaining wells has remained stable with all maximum leachate values recorded in LC5A.

The wells located in the Phase 1 cell, specifically LC1A have recorded low levels of leachate with not enough to collect samples for testing and well L1 has consistently been recorded as dry.

A topographical survey at the location of each leachate monitoring well along with the re-measurement of the current heights of each well's casing in relation to the current ground level was undertaken in 2019 in order to verify any potential settlement or change to the well's arrangement. These levels have been adopted in to the leachate head calculations. Monitoring of leachate will continue in accordance with the agreed programme and the relevant Permit conditions.

5.2 Surface Water

The monitoring results for surface water generally indicate that the majority of the determinants are recorded at less than the detectable limit levels at both upstream and downstream monitoring locations, and the evidence indicates that there is currently no discernible impact on surface water receptors by the landfill.

5.2.1 SWU, SW2AI, SWW1, SWW2 and SWW4

Monitoring of these upstream locations is conducted six-monthly as per the permit [1].

The measured concentrations of ammoniacal nitrogen, zinc, mercury, nickel, sulphate and chloride were all within the set EQS values (or below the laboratory detection limit in the case of ammoniacal nitrogen and mercury) in the upstream section of the landfill, throughout 2019. Two elevated levels of unionised ammoniacal nitrogen were recorded in SWW2 in April and SWW4 in October, marginally above the Freshwater EQS level.

5.2.2 SWD and SWD1

The surface water results for the monitoring points located downstream of the landfill indicate no significant environmental impact on this receptor. Ammoniacal nitrogen, mercury, nickel, zinc, manganese and chloride measured below their respective Freshwater EQS.

Concentrations of sulphate are showing a general decreasing trend throughout 2019 with a slight increase in the third quarter, similar to 2018, but the concentrations are still well below the EQS freshwater level with a highest value of 85.6mg/l being recorded at SWD1 in January 2019. Low levels of sulphate have been detected in the groundwater upstream wells during the reporting period, therefore suggesting a source of sulphate other than the landfill.

5.2.3 SW1 – SW10

Monitoring of these downstream locations is still conducted monthly as per the amended permit [1]. Sampling could not be undertaken at locations SW1, SW5, SW9 and SW10 on a number of occasions throughout 2019 due to being recorded as dry.

Ammoniacal nitrogen concentrations were recorded in the downstream locations SW4, SW5 and SW6 above the detection level in November during the fourth quarter, with a maximum of 5.46mg/l recorded in SW4 with all remaining levels

recorded below level of detection. The same happened in December 2018 at the same three sampling locations. Ammoniacal nitrogen levels recorded in GW9 increased in the fourth quarter, although only slightly and the concentrations in GW9 were lower in 2018 when elevations were also recorded in the surface waters. Therefore, it is unlikely that GW9 is impacting on the surface waters and it's possible the higher than usual volume of rainfall in October may have contributed to these exceedances. However, the levels at these surface water locations should be reviewed during the first quarter of 2020 to clarify if this is an anomaly or if further investigation is required.

Mercury levels were recorded below the limit of detection at all monitoring locations during 2019 with the exception of the months of August and October where very low levels were recorded in SW1, SW2 and SW5, although well below the EQS freshwater level.

Chloride levels remained well below the EQS freshwater concentration level of 250mg/l with a maximum of 83.6mg/l recorded in SW4 in January. This shows that the pumps are effective at stopping the leachate, which has high levels of chloride, from leaching into the Nant Merddog downstream of the landfill.

The results indicate that the continuing non-compliance at GW9, which is showing a decreasing trend, is not having a discernible environmental impact on the Nant Merddog downstream of the landfill.

5.3 Groundwater

The background groundwater quality monitoring continues to record elevated levels of mercury, sulphates and manganese indicating other sources than the landfill for these determinants. The new upstream well GW11B has been installed to replace GW11A with monitoring being undertaken from October.

5.3.1 Upstream Wells

The upstream wells GW3A, GW4 and GW11B have generally recorded low levels of contaminants throughout the year. A slight exceedance of nickel was recorded in GW3A during the second quarter.

Manganese has continually been recorded in GW4 above the assessment level throughout 2019. Manganese has also been recorded in GW11B, four times higher than those recorded in GW4, however this will be reviewed once further data is obtained.

Mercury has generally been recorded below the detection limit in GW4, during the third quarter of GW3A and below the assessment criteria in GW11B but have been recorded above the trigger level, which is applied to the downstream groundwater, in GW3A throughout the rest 2019. However, temporary fluctuations have occurred in the past suggesting these are associated with the environment outside of the influence of the landfill.

The elevated concentrations recorded upstream likely to be from steel works waste deposited to the north of the landfill and old mine workings in the area.

Manganese is a typical contaminant of mine drainage, which is considered to be impacting the groundwater in the locale of the landfill.

5.3.2 Downstream Wells / Compliance Wells

The results from the compliance wells indicate that generally the pumping system at the toe of the landfill is continuing to successfully control the potential egress of leachate from the landfill. Although the pump within the cut-off system failed on the 12th and 13th October 2019.

5.3.2.1 Compliance well GW10

Ammoniacal nitrogen, nickel, zinc and mercury were recorded below assessment criteria, although mercury has been recorded higher than the control levels due to sample matrix interference. Chloride and sulphate recorded below all assessment criteria.

5.3.2.2 Compliance well GW9

GW9 is continuing to be non-compliant due to ammoniacal nitrogen reporting above the Trigger Level. Monitoring results have been showing a general decreasing trend, especially since the completion of the Phase 1 capping in 2015. However, the fourth quarter recorded the highest result of the year, although this was still much lower than previous years readings. This exceedance may be due to the breakdown of the pump system during this quarter, this can be confirmed on review of next quarter's results.

Metal concentrations along with sulphate and chloride levels have been recorded below their respective assessment levels and have done so since July 2018.

The monitoring of the downstream environmental impact of the non-compliance at GW9 (sampling and analysis of the Nant Merddog and identified stream and break outs in the SSSI) is currently on-going. The monitoring results to date show that the concentrations of ammoniacal nitrogen and chloride are not detectable in these streams, and no discernible impact on the Nant Merddog has been shown. As discussed in the updated GW9 report (Ref. [6]), it is considered that the on-going non-compliance at GW9 is due to the heavily fractured stratum in that locale that prevents the pumping system from intercepting all leachate-impacted groundwater. The current course of action is to continue monitoring of the surface water breakout locations followed by a further review of GW9.

5.3.2.3 Compliance well GW12

Groundwater contained within the sandstone strata S2-west is monitored by GW12. The ammoniacal nitrogen concentration was recorded marginally above the Control Level value in the first two quarters, however these returned to below level of detection during the final two quarters of 2019, suggesting the two exceedances were anomalies.

Mercury was recorded above the trigger level in the first quarter, following on from exceedances recorded at the end of 2018. However, the levels then dropped

to below level of detection for the remainder of 2019, although above the control level in the second and third quarters due to matrix interference. The levels have fluctuated in the past; however, a decreasing trend may be emerging and should be monitored closely in 2020.

Sulphate levels have generally been above assessment criteria since 2015, although fluctuating above and below the different assessment criteria. However, a general decreasing trend seems to be forming with the final two quarters recording very similar levels which are the lowest of 2019. The elevated levels do not seem to have a direct correlation with elevated rainfall or increase in water level and are not recorded in any other monitoring well.

Nickel and zinc have continued to be below all assessment criteria. However, manganese was recorded above assessment level in the fourth quarter, the first since monitoring began. This may be an anomaly and should be monitored closely in 2020.

5.3.2.4 Wells GW6 and GW7

Zinc continues to be recorded below level of detection within sandstone strata S1, monitored by GW6 and GW7, with the exception of a marginal exceedance in the first quarter in GW7. Levels have been shown to fluctuate over the past year in GW7 and therefore should continue to be closely monitored to ascertain that concentrations remain low. The upstream wells also show this decreasing trend, which indicates the zinc source has reduced.

Manganese concentrations continue to be recorded above assessment level in GW7, fluctuating throughout the year. Elevated background manganese concentrations have been observed at similar levels at the upstream groundwater well GW4, suggesting a source of manganese other than the landfill.

No concentrations of nickel, ammoniacal nitrogen, chloride or sulphate have been recorded in either well above the assessment criteria. Mercury was recorded at less than level of detection, although this was above the Control Levels for the first three quarters due to matrix interference.

5.4 Landfill Gas

The gas monitoring results showed compliance with the set Control and Trigger Levels in the majority of gas monitoring locations.

5.4.1 Methane

Methane concentrations continue to be recorded below the respective Control and Trigger Levels (where available) in all monitoring locations.

Elevated levels of methane continue to be measured in monitoring wells GW1, GMW8 and GMW9 in the yellow valve, although levels have been shown to drop in GW1 in the last quarter. Elevated levels were also recorded in GMW10 in all three valves from May to September. However, no Control/Trigger Levels are

available for these locations. Very low levels of methane were detected in GMW17 or GMW18, where Control or Trigger Levels are also not available.

The newly installed well GMW14A was recorded as flooded in September, with low levels of methane recorded throughout the fourth quarter.

5.4.2 Carbon dioxide

Carbon dioxide levels have been recorded above the Control and/or Trigger Levels in a number of wells throughout 2019.

GMW2 and GMW6 recorded slight increases in carbon dioxide levels in the red valve and GMW13 in the yellow valve from May to August, with a single exceedance in GMW13 in December, which is generally consistent with the same period over the past few years. All three wells have shown fluctuating readings with exceedances historically being recorded during the summer and autumn months. GMW13 is considered to be impacted by the presence of marshland and bedrock geology on which this is located.

Elevated concentrations of carbon dioxide have continued to be recorded in the yellow valve of GMW5 during the first three quarters, recording above the trigger level on five occasions. These levels have remained fairly consistent in this valve since July 2018, however they have shown a decrease in the final quarter of 2019. An increase in the white valve has also been recorded from August through to December, with the first seven months recording below the trigger and control levels. This may be an anomaly, however these levels should be monitored closely in 2020 to determine if the levels in the white valve continue to increase while the yellow valve levels decrease.

GMW7 has recorded carbon dioxide slightly above the control level in both the yellow and white valves for the month of July only. This is the first time an exceedance has been recorded since August 2018 in which a single elevation was recorded in both valves for that year. It is likely that this result is an anomaly.

Monitoring of the newly installed GMW14A has been undertaken since August with this replacing well GMW14 at a new location, whilst maintaining the same monitoring parameters. For August 0% carbon dioxide was recorded in all three valves with the well recorded as flooded in September. During the last quarter, carbon dioxide levels increased in all three valves although remaining below the trigger and control levels in the yellow and white valves. Readings above the trigger level was recorded in the red valve for the full quarter. On review of the installation work, recent repairs were undertaken to this well. Therefore, further readings are required to understand the gassing regime of this well.

Elevated levels of carbon dioxide continue to be measured in GMW1, GMW8, GMW9, GMW10, GMW17 and GMW18, although in GMW1 and GMW10 these are much lower in the spring and winter months. However, no Control/Trigger Levels have been derived for these locations as they are in close proximity to the waste mass. Gas monitoring will continue in accordance with the agreed programme and the relevant Permit conditions.

In accordance with the Golder Associates Report (Ref. [10]) and in Section 3.5.2, single exceedances do not require to be actioned. However, ongoing exceedances require the relevant people to be informed and appropriate measures of identification and solutions identified. Wells GMW2 and GMW13 had recorded consecutive exceedances since May, however, the levels have decline during the last quarter and should be reviewed during next quarter prior to any further recommendations being made. Well GMW5 has continued to record exceedances throughout 2019 in the yellow valve, however no exceedances were recorded in the final quarter although exceedances have now been recorded in the white valve. Therefore, next quarter's results should be reviewed to determine if this continues.

In order to mitigate the elevated levels of carbon dioxide previously recorded in GMW1, two additional gas pumping wells were drilled in its vicinity in February 2015. The elevated levels recorded during the majority of this year are similar to those recorded prior to the installation of the additional pumping wells, however levels have shown to drop within the fourth quarter.

5.5 Summary

The monitoring data and interpretation produced in this report has not identified any significant issues relating to contaminant levels recorded above the screening criteria within the leachate and groundwater. Where limited minor exceedances have been identified there is no evidence to suggest they are having a discernible impact on the surrounding environment and the landfill continues to comply with the requirements of the permit.

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- [16] Arup, Silent Valley Landfill, 2019 Third Quarter Monitoring Report, 30th October 2019.

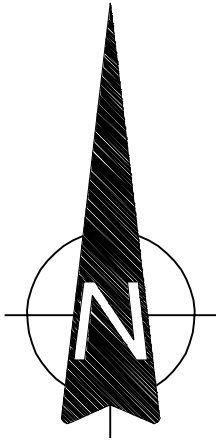
Figures

Figure 1 Site Location Plan

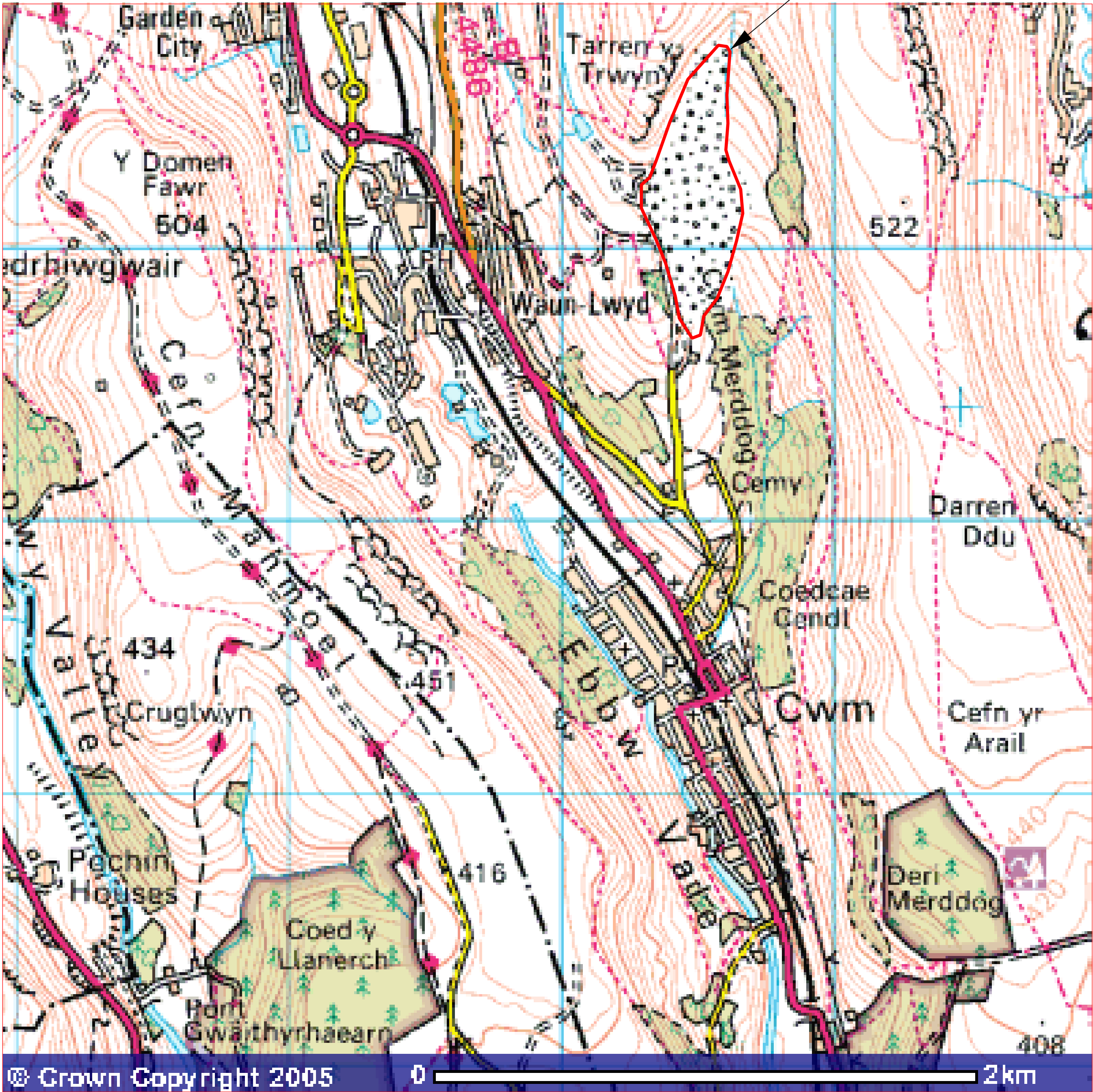
Figure 2 Layout of Monitoring System

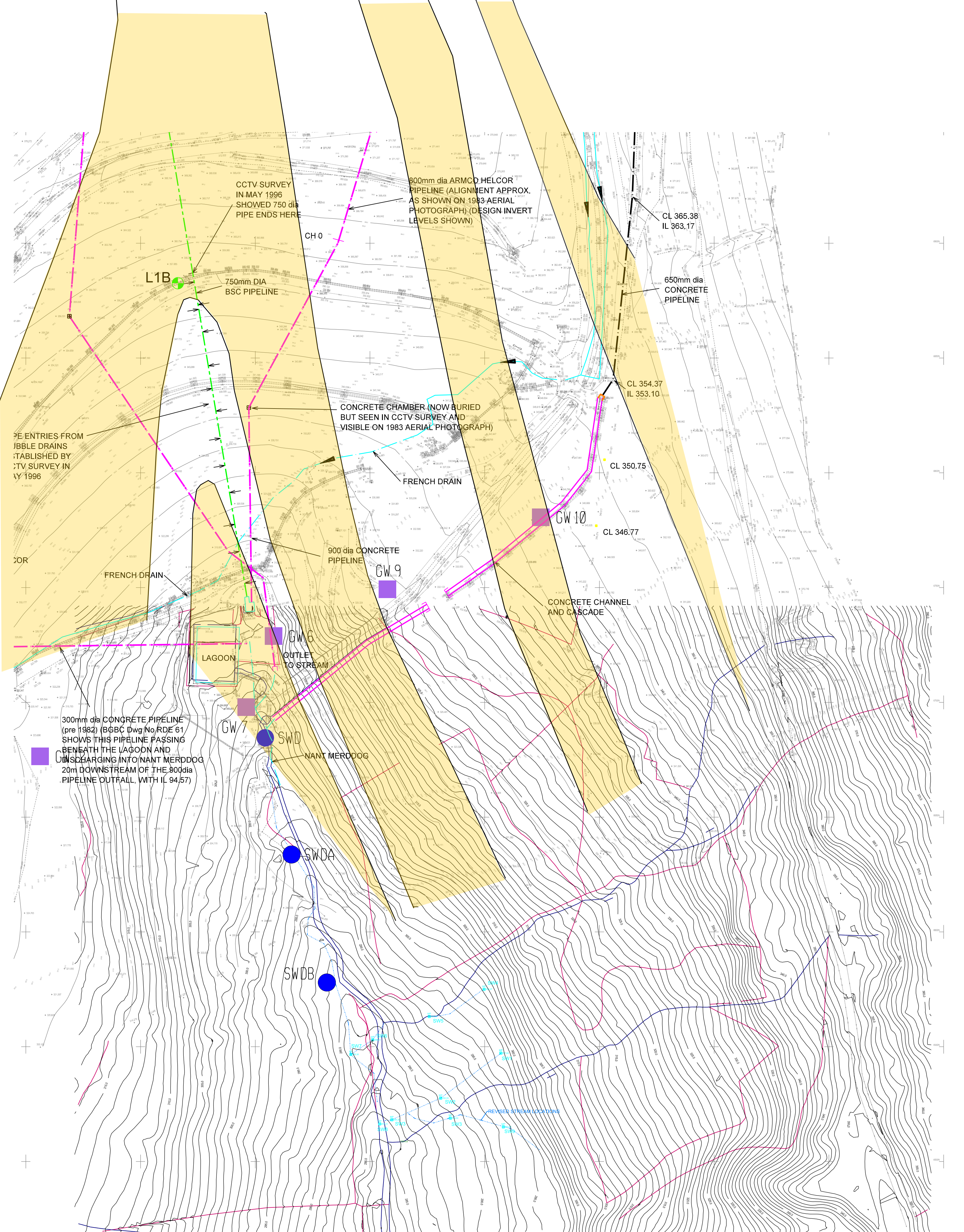
Figure 3 Location of Additional Surface Water Monitoring Locations

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Appendix A

Details of cut-off and monitoring systems

A1 Pumping cut-off system and monitoring

The following is a summary of the activities that have taken place at the site in relation to the pumping and monitoring system since its installation in 2007.

2007 October: The pumping system became operational.

2008 November/December: A programme of inspection and maintenance was undertaken to check the level and performance of each well and pump following the findings of the January to September 2008 interim report, which indicated that the cut-off system operated less efficiently post high rainfall events, with concentrations within the compliance wells temporarily increasing. A number of wells were found to be silting up and required cleaning. Details are presented in the Annual Monitoring Report 2008.

2009 January: The majority of wells were successfully cleaned. The base of wells TW2, TW7, PW4 and PW10 were found to be above the depth shown on the logs. Deeper replacement wells were installed at TW2, TW6 and TW7, (called TW2A, TW6A and TW7A), construction details as shown in the sketch at the end of this Appendix;

February: Low-draw pumps were installed to improve the situation at PW4, PW7, PW10 and PW14;

March: Existing pumps were replaced with more robust pumps, to cope with silting and iron hydroxide deposition;

April: Pumping from these replacement wells commenced;

November/December: The pumps in wells TW2A and TW6A were overwhelmed during periods of very heavy rainfall, producing impacts in the compliance wells downstream, at GW9 and GW12 and monthly average leachate heads often in excess of permitted values. There was concern that the monitored heads may have been influenced by perched leachate bodies, the monitoring wells having been constructed with slag gravel response zones extending through the body of the landfill. As a result, two more pumping wells were installed alongside each of wells TW2A and TW6A, with the aim that these wells would provide support to the existing wells and prevent further migration of leachate. Pumping tests and the installation of new leachate monitoring wells at the locations of LC1, LC2 and LC4 (LC1A, LC2A and LC4A) were undertaken to obtain additional information on the leachate heads. The new wells were installed with 3m long response zones in contact with the base of the landfill and isolated from potential perched leachate bodies higher up within the landfill mass. As such, they are representative for measuring the hydrostatic head of leachate that acts on the base of the landfill and potentially drives leakage. The wells have consistently indicated leachate heads that are much lower than those measured previously in the corresponding former monitoring wells LC1, LC2 and LC4. This is

considered strong evidence that the average leachate heads derived previously were influenced by perched leachate bodies.

2010 February: Wells TW2B, TW2C, TW6B and TW6C were installed alongside wells TW2A and TW6A. The monitoring results indicate there has been an improvement of water quality in GW12 in relation to ammoniacal nitrogen and chloride (i.e. in TW2A, only one exceedance of the compliance limit for ammoniacal nitrogen and no exceedances for chloride were recorded since the installation of the new pumps). However, this improvement was not replicated at GW9 downstream of TW6A, B and C. Extensive investigations including sampling and laboratory analyses have been undertaken to confirm the source of the leachate species encountered in GW9 and measures to address this issue have been undertaken (see Reference [8]). The investigations identified an uncapped plateau area on the eastern flank of the landfill and concluded that one of the sources of the leachate monitored in GW9 may be groundwater infiltrating into the waste body from this uncapped area and flowing towards GW9 within fractured mudstone and sandstone layers, in line with the geological and hydrogeological model also presented in the report. Part of the leachate body in the uncapped waste was also considered to be flowing towards a gabion mattress-lined ditch located on the eastern flank of the landfill. This leachate was found to be diluted by the surface waters flowing in the ditch and potentially by groundwater from the valley sides, and was also considered likely to be impacting GW9. The capping of the eastern plateau was completed in August 2011 (see below).

June/July: A replacement monitoring well LC5A was drilled adjacent to LC5. A back-up compressor has been installed to provide support to the compressor currently in use at Silent Valley.

August: The new leachate well, LC5A, was commissioned and subsequently monitored in accordance with the quarterly monitoring regime.

2011 Leachate pumping was temporarily ceased due to bio-fouling of the pumps and wells. The pumping was shortly after reinstated using gas extraction wells and the pumping continues to date.

August: The capping of the eastern plateau was completed. Since its installation, the levels of ammoniacal nitrogen and chloride in GW10 were observed to have significantly reduced towards the end of 2011; however, these continued to be above the compliance level in GW9 and further sampling was recommended to monitor the trend.

2012: No specific maintenance or upgrades on the monitoring infrastructure were required or undertaken in 2012.

2013 March to July: The pump in PW12, which pumps from sandstone strata S3, was found to be not working. Following a number of maintenance works, the pump was still found to be failing. On reinstatement of the electronic groundwater monitoring system in July (see further details

below), it was evident that the pump in this location was continuing to have issues. The pump was consequently changed in August and the groundwater levels within the well have since returned to the required level. Maintenance issues were also recorded in the eastern section of the cut-off system, wells between April and September 2013 in TW10.

December: Although there is no current evidence to suggest issues with the efficacy of the BSC pipe located in the southern flank of Phase 1 landfill, SVWS commissioned the installation of four additional leachate monitoring wells (BH1 to BH4) along the alignment of the BSC pipe in December. The objective is for these boreholes to be monitored to confirm both the nature and level of leachate within the Phase 1 area and any long-term trends in leachate level (note that monitoring has temporarily ceased due to the works undertaken for the capping of Phase 1 landfill – see following sentence). During the installation of these wells, observations indicated that the capping of Phase 1 landfill was not typical of a low permeability capping system and further investigations, including the excavation of 19no shallow trial pits, confirmed that the existing capping was likely to not be preventing infiltration of rainwater. SVWS are currently undertaking works to improve the capping of the Phase 1 area in order to achieve a reduction in the leachate production and achieve regulatory compliance (see below).

2014 July: Earthworks for the installation of the capping system in Phase 1 landfill commenced. A combination of cut and fill is used to slacken the existing landfill slope angles to a maximum gradient of 1V:2.5H to achieve a stable angle for the capping system.

July to September: Further issues were identified within the eastern section of the cut-off system, particularly in TW11, and also in TW10 and PW14, all installed within the Sandstone S3 stratum. Pump failure was recorded in TW11 from July the 7th till September the 4th. After a number of attempts, the pump was finally retrieved and further delay in a pump reinstatement was caused by the delivery of required replacement parts. In addition, pumps installed in TW10 and PW14 repeatedly failed after service, however are now fully operational.

2015 January: capping of Phase 1 landfill is ongoing, with the earthworks largely complete. In addition to the new capping, improvements are also being made to both the surface water drainage and the leachate drain at the toe of the landfill. A new access track has also been constructed across the landfill to provide access for construction and future maintenance.

A1.1 Electronic Monitoring System

Since April/May 2009, the water levels within the pumping wells have been continuously monitored using electronic devices installed within the wells, so-called 'divers'. These send water level data at a specified frequency directly to an office-based computer, allowing continuous remote monitoring of the efficiency of the cut-off system. This has enabled immediate investigation and remedial actions to be taken when the water level within any well has risen unacceptably or abnormally.

In March 2013, however, problems have occurred with some of the modems, devices collecting data and sending this information to the office-based computer. During the repair period, the efficiency of parts of the pumping system was monitored manually. The modems have been successfully reinstalled in July 2013 and no further issues have been recorded since then.

A1.2 Future maintenance and reinforcement

The pumping well cut-off system is considered to be both robust and flexible. There is considerable redundancy in its design, both in terms of the spacing of the wells and the capacity of the pumps. The system can be easily modified or augmented by the addition of new wells as necessary (as has already taken place in 2008, 2009 and early 2010). In addition to this, the electronic monitoring system, together with routine on-going maintenance of the wells and pumps and provision of replacement pumps, enables corrective actions to be taken in advance of any acute problem that could have an adverse impact on the local groundwater environment. It is clear that for the significant majority of the site, the pumping system is preventing the impact of leachate species from within the body of the waste (or discharge zone as per the Groundwater Regulations 2009 incorporated into EPN2012) on the groundwater. Where there is the one non-compliance, GW9, Silent Valley has undertaken extensive investigations and works (References [7] and [8]).

Appendix B

Previous Site Monitoring

B1 Groundwater Monitoring

There are eight monitoring wells located upstream of the landfill site, where background groundwater quality monitoring has been carried out. These are GW2A, GW3A, GW4, GW11A and EC1 to EC4. Of these, GW2A, EC3 and EC4 were frequently dry and therefore a sample could not always be collected. The EC wells were installed in April 2008 as part of the initial feasibility study into an eastern pumping cut-off system and were included into routine monitoring in October 2008 until June 2010.

B2 Surface Water Monitoring

Locations S1 to S6 and SW2AO (see table below) were monitored from October 2008 to April 2010 to check the background quality of groundwater emerging from the eastern hillside, to supplement existing information and particularly identify any trends associated with the passage of water through abandoned mine workings and associated mudstone/seat- earth strata. Each of the monitoring locations comprised a perennial stream originating from groundwater issues.

Table B1: Former surface water monitoring locations

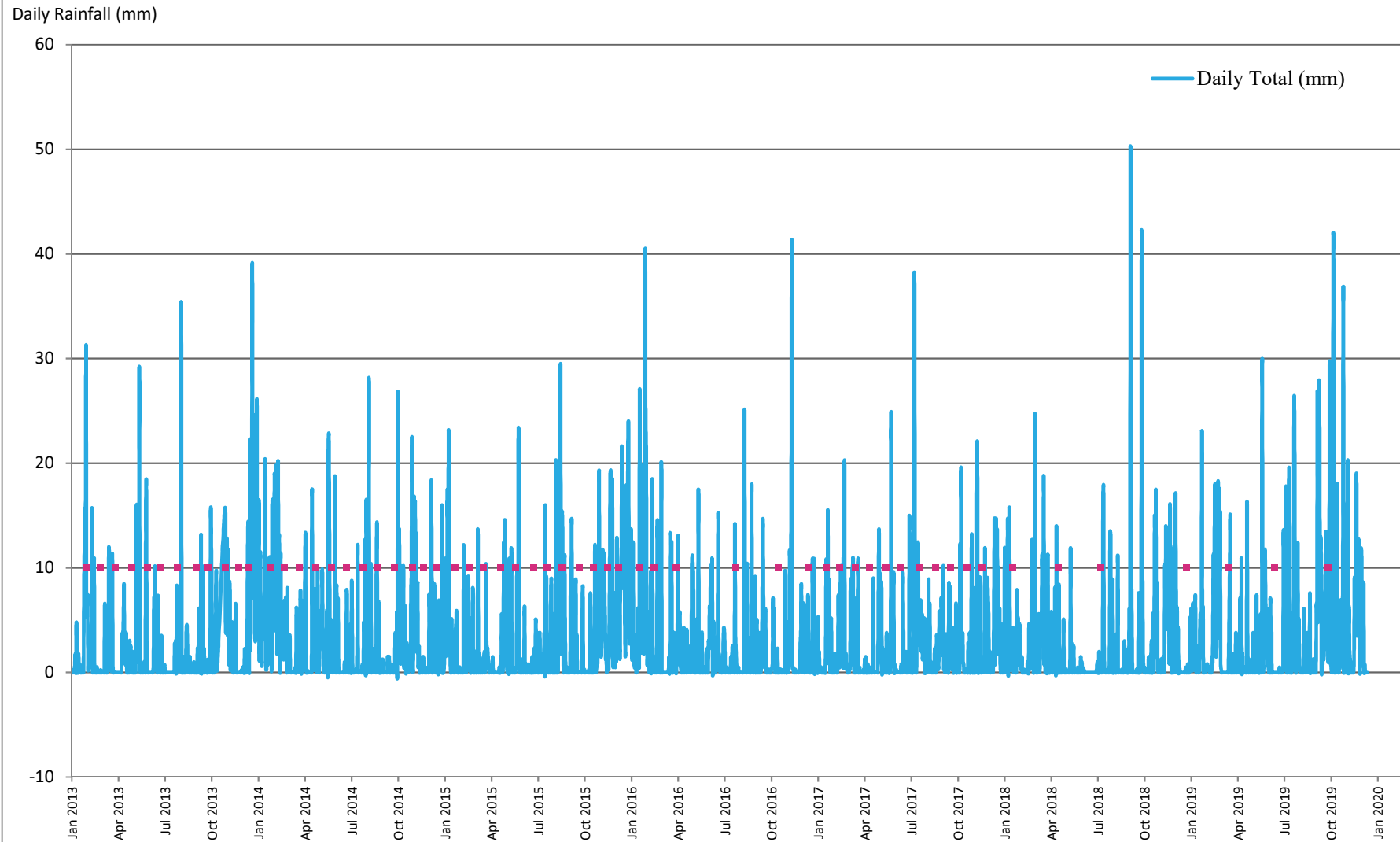
Monitoring Point	Location
S1	A stream, located 20m east of the landfill; approximately 100m north of the recorded landslide; emerging from the backfill of a former opencast site.
S2	A stream, located 20m east of the landfill; 100m south of S1, emerging from within the recorded landslide.
S3	A stream, located 350m downstream of the point where the diverted Nant Merddog joins its original course; the sampling point S3 is located approximately 150m upstream of the confluence with the Nant Merddog; the stream originates from issues downhill of the Old Tramway Path.
S4	A stream, located 650m south-east of the landfill, issuing from the foot of a cliff above the Old Tramway Path; the sampling point S4 is located approximately 10-20m above the path.
S5	A stream, located 70m south of S4; the stream crosses the pathway; the sampling point is located directly downstream of the path.
S6	A stream, located just outside the fence perimeter, the sampling point is located some 20m south of compliance well GW10.
SW2AO	Aqua-pipe outfall discharging to Nant Merddog (pipe buried beneath landfill in north-south direction) – sampling point abandoned, pipe is collapsed and collecting leachate from landfill, and was subsequently diverted into the leachate lagoon sump.

Between February and April 2010, water hardness in the Nant Merddog was undertaken in monthly rounds in order to select appropriate hardness dependant EQS levels. Previously, hardness data used was for the River Ebbw Fawr at the confluence of the Nant Big and the Nant Merddog.

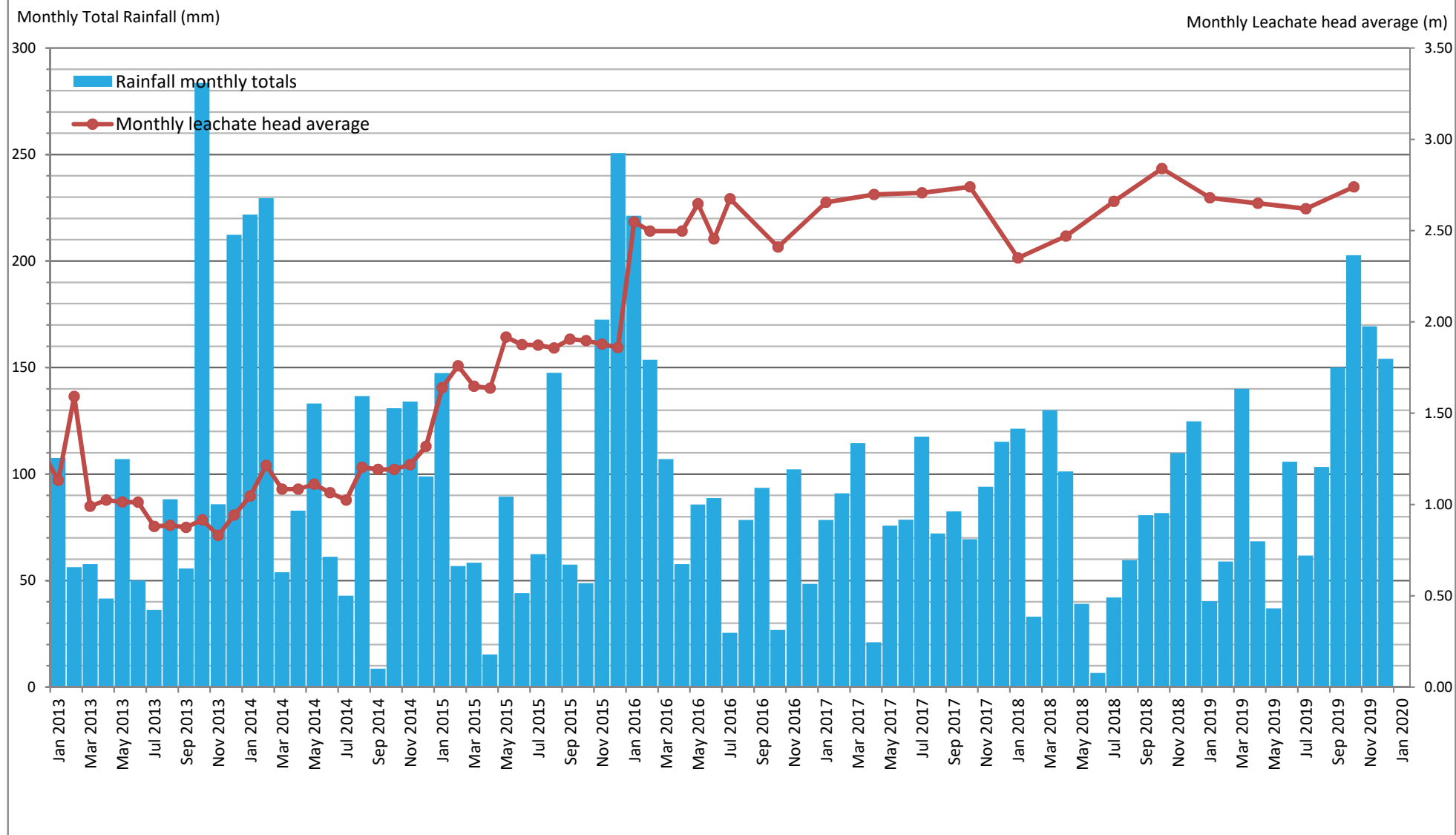
Appendix C

Monitoring Results - Graphs

Appendix C
Figure C1
Daily rainfall totals and sampling events (January 2013 - December 2019)

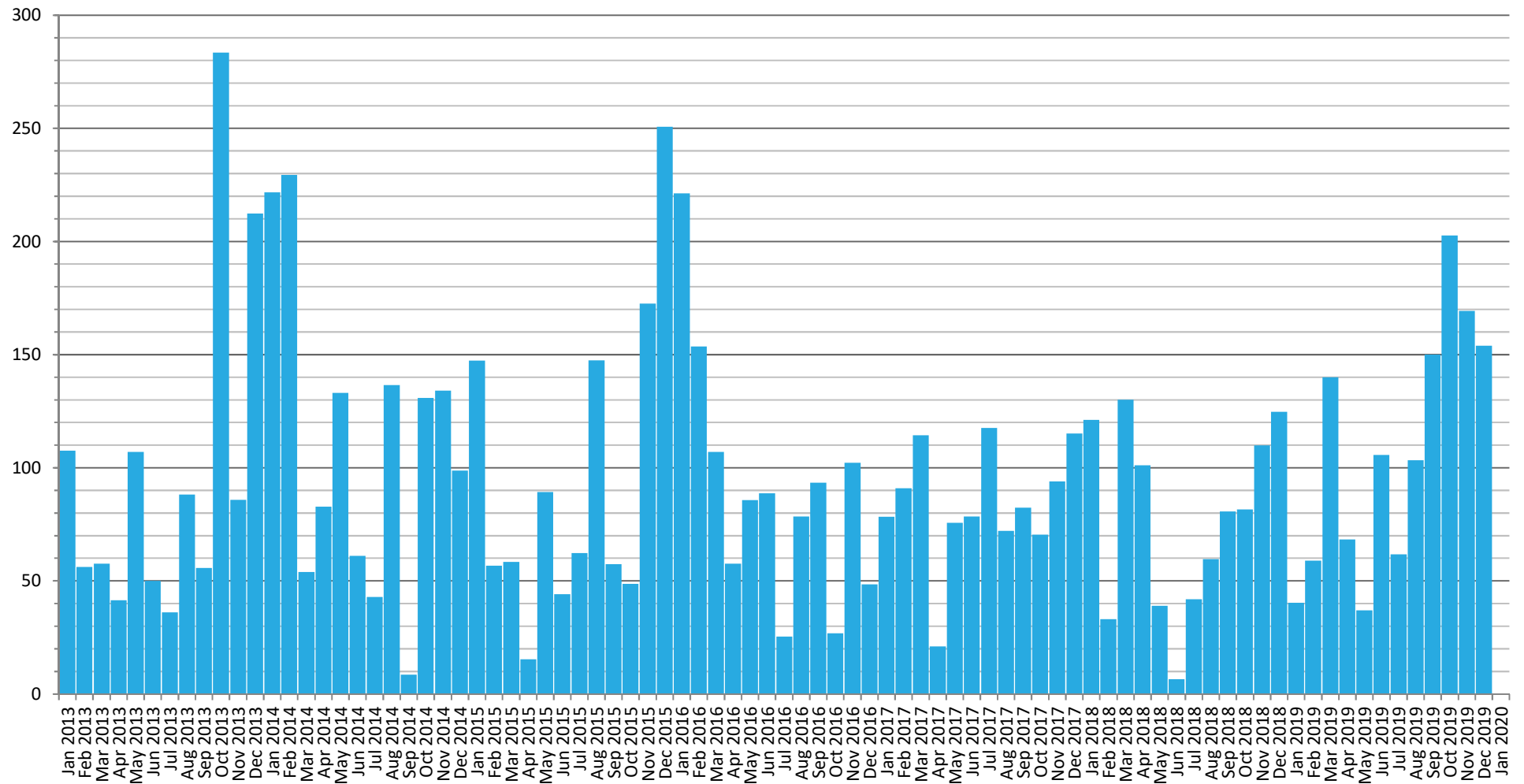


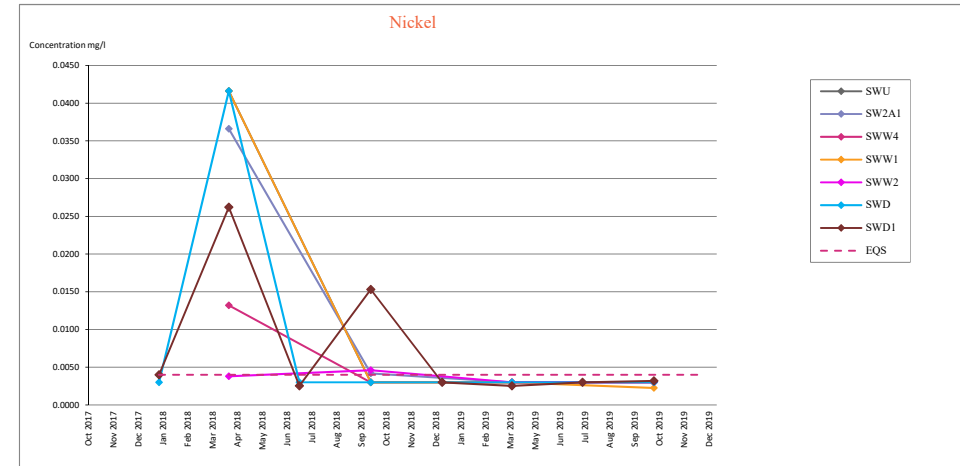
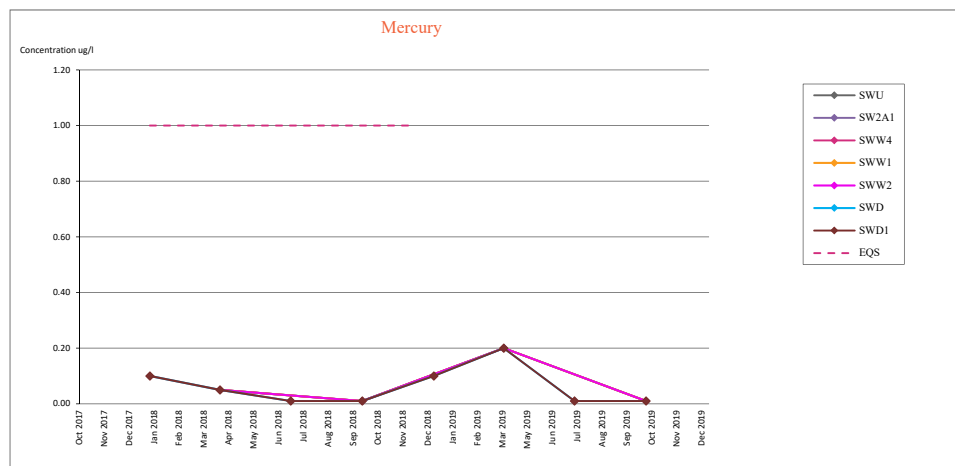
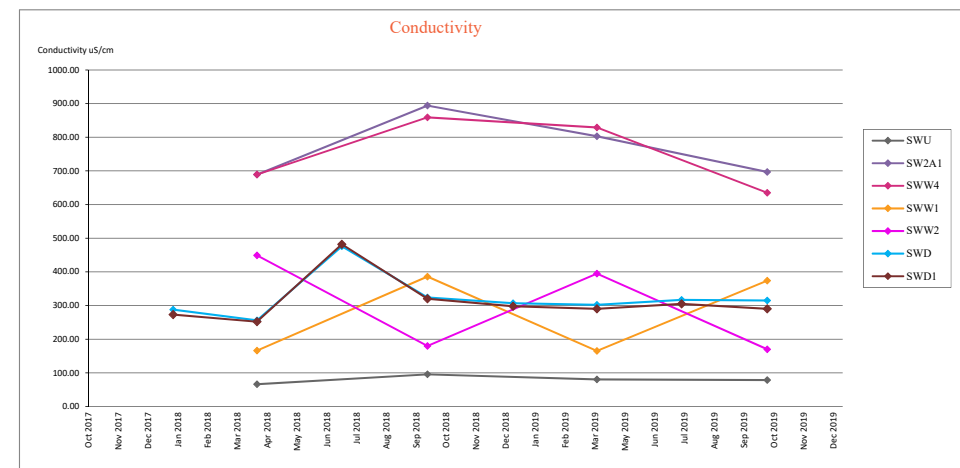
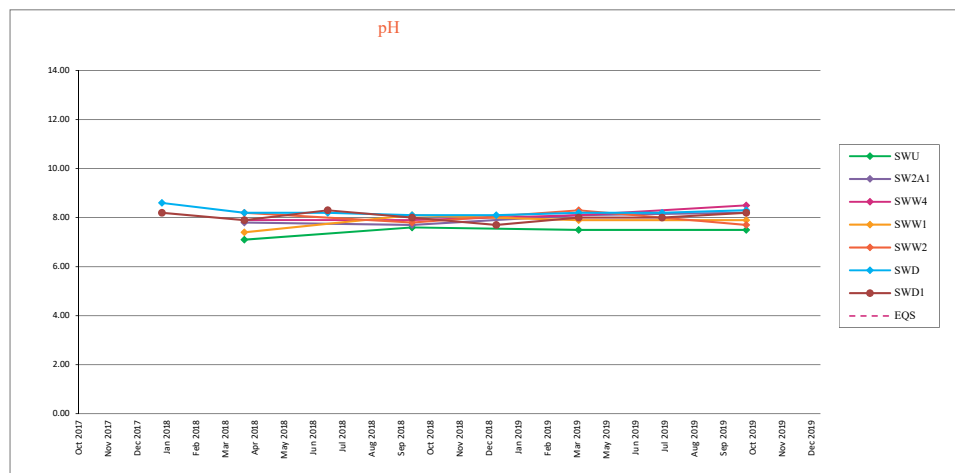
Appendix C
Figure C2
Monthly rainfall totals (January 2013 - December 2019)

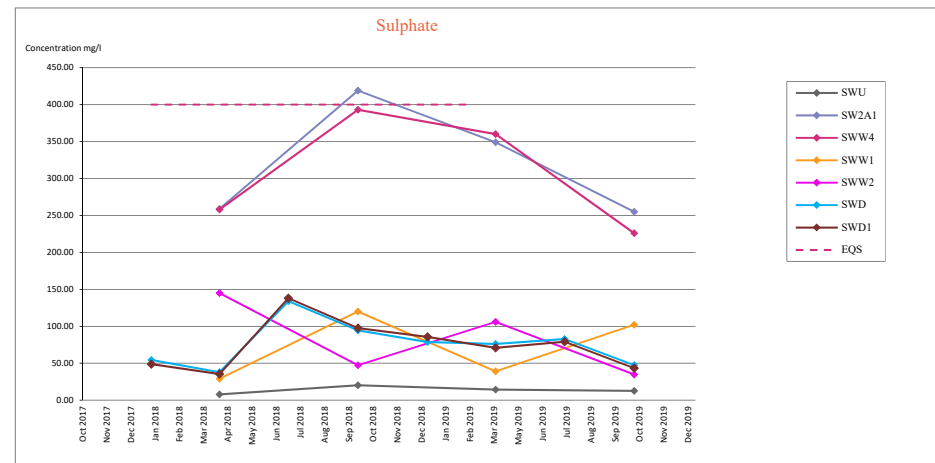
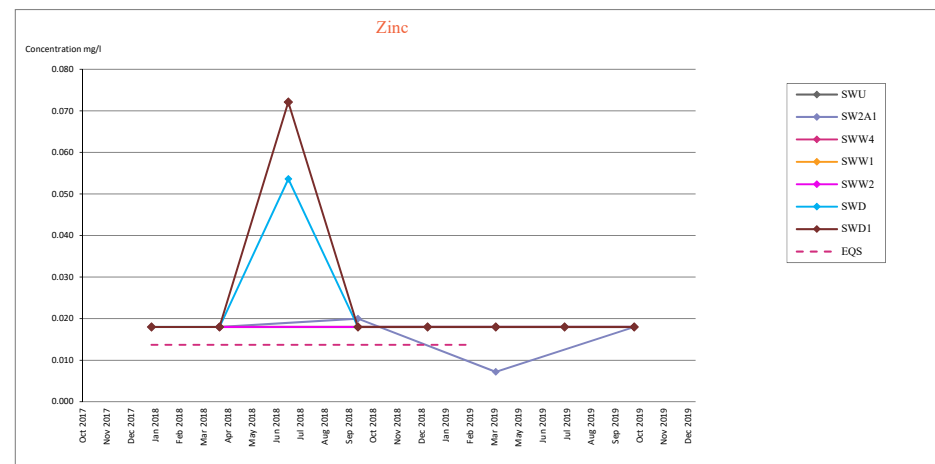


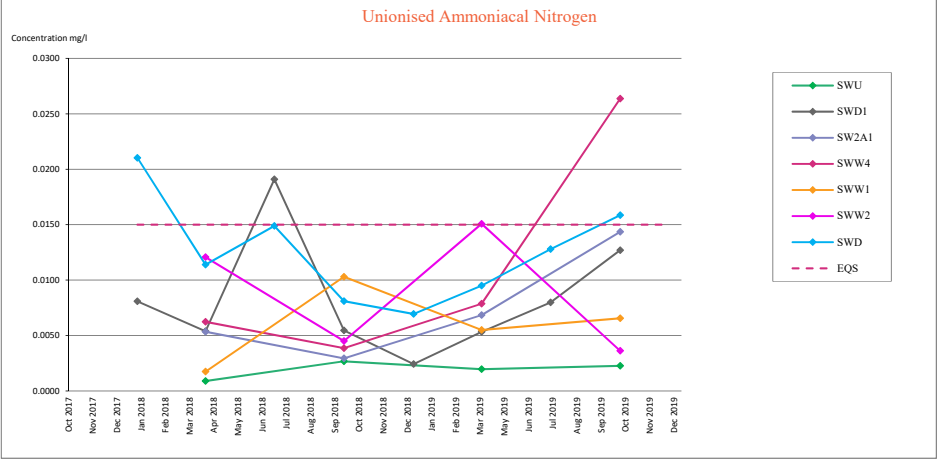
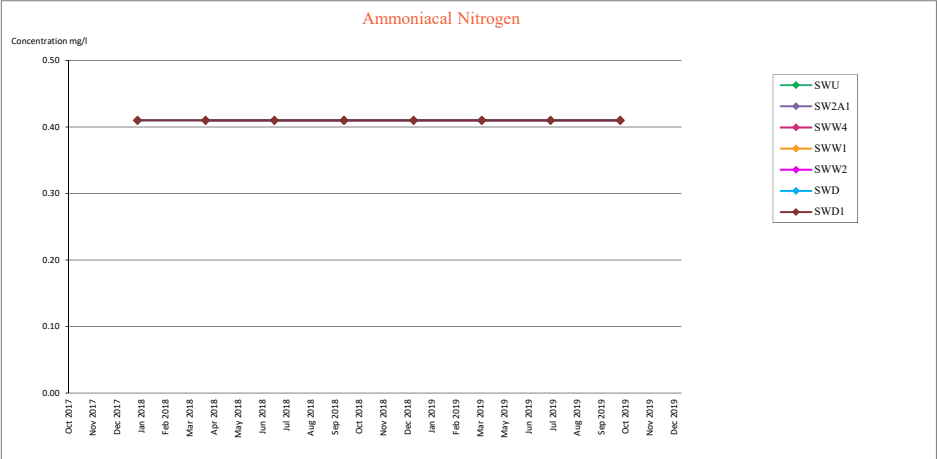
Appendix C
Figure C3
Monthly total rainfall (January 2013 - December 2019)

Monthly Total Rainfall (mm)









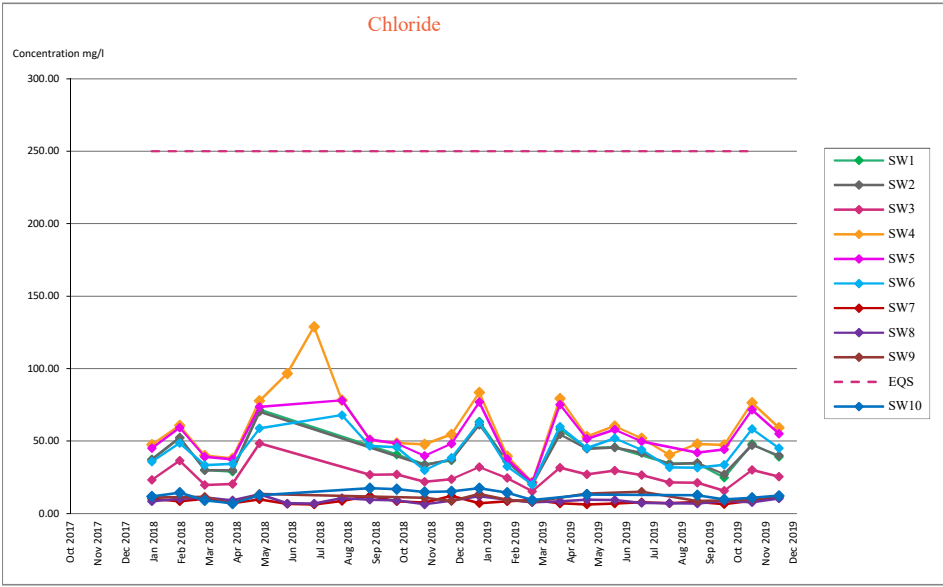
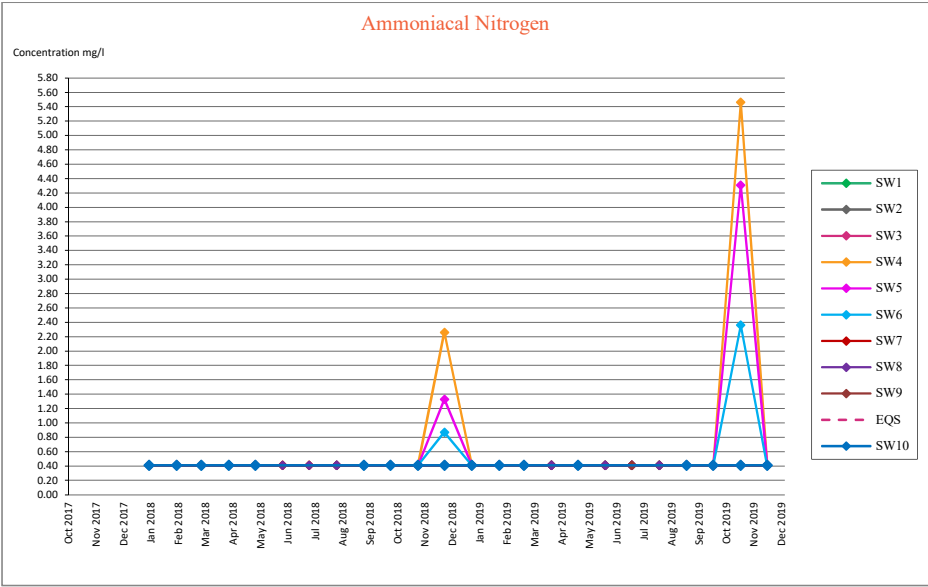
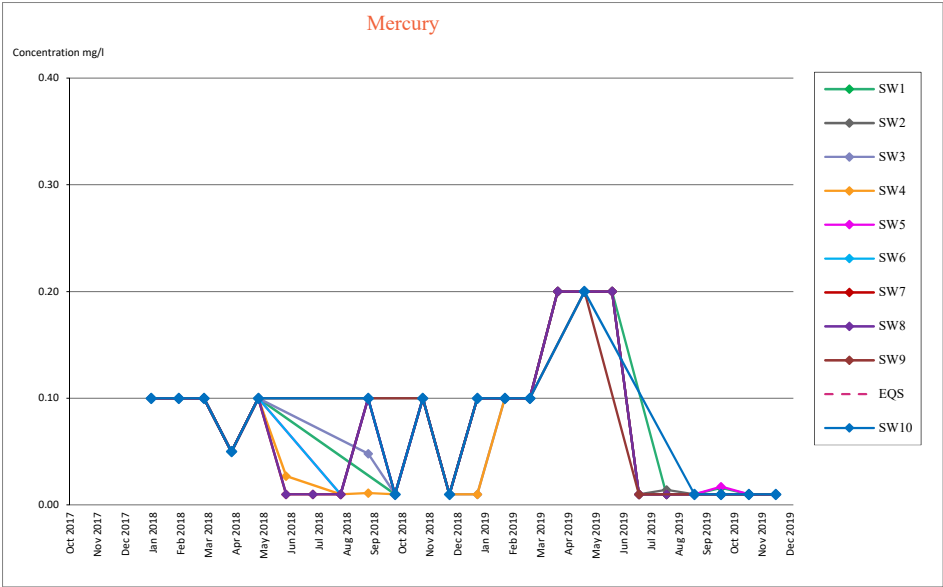


Figure C6
Groundwater quality monitoring results - Compliance wells graphs

Compliance wells graphs

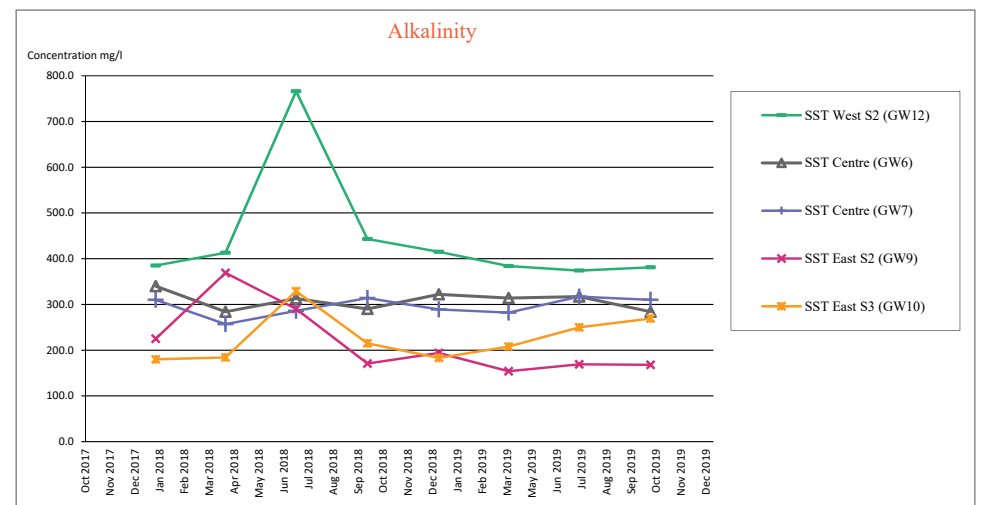
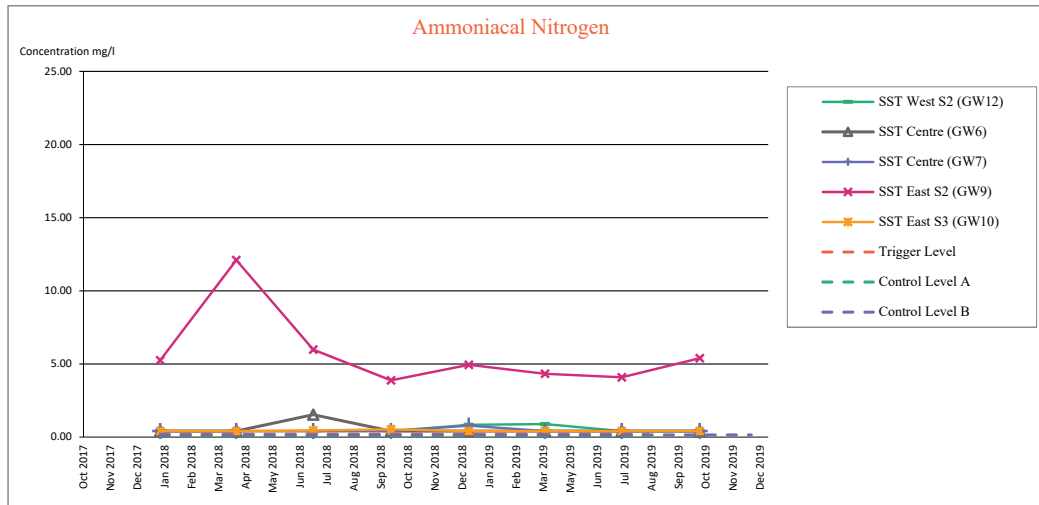
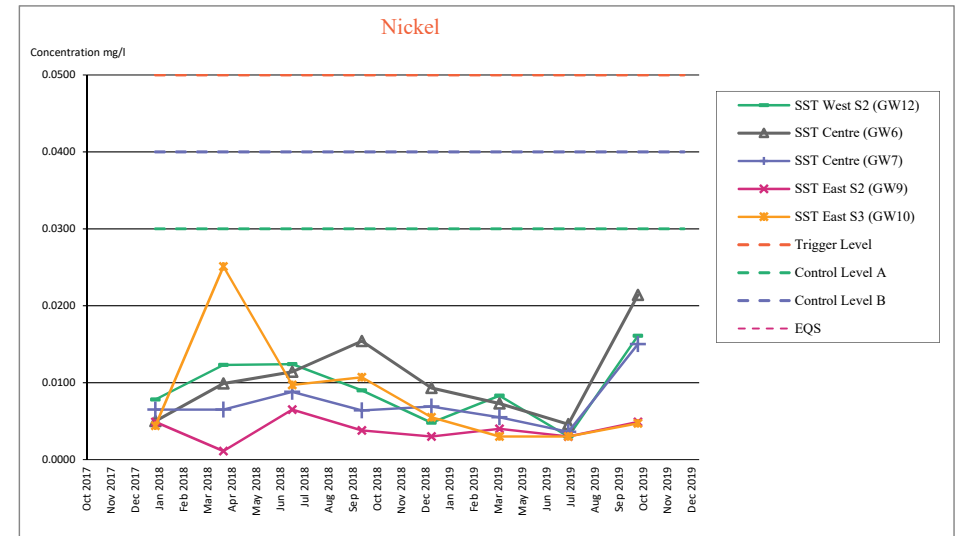


Figure C6
Groundwater quality monitoring results - Compliance wells graphs

Compliance wells graphs

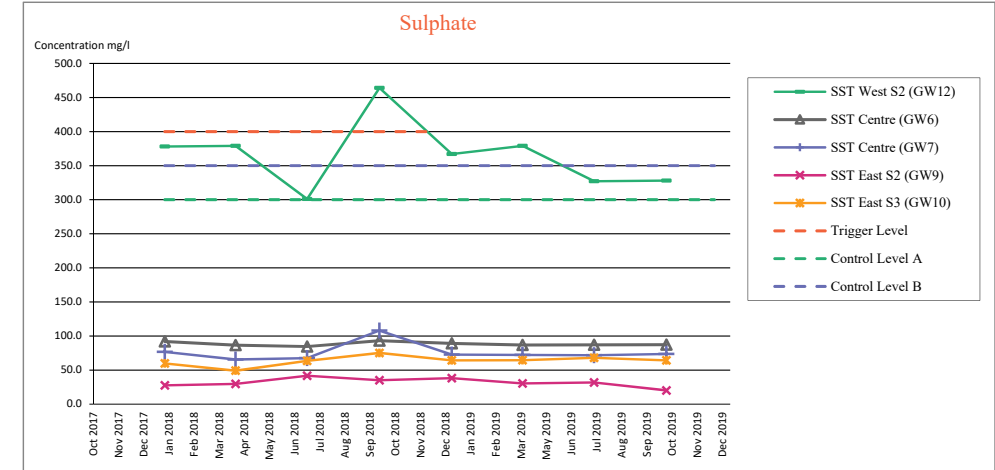
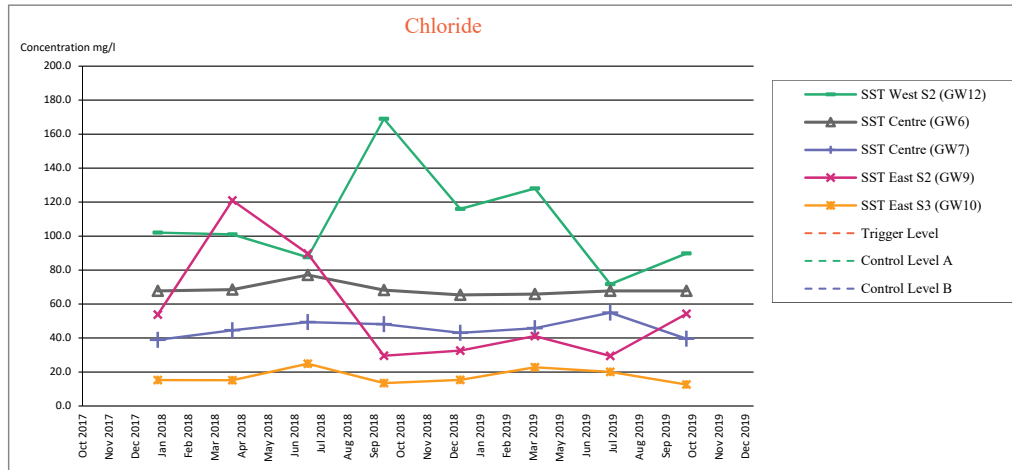
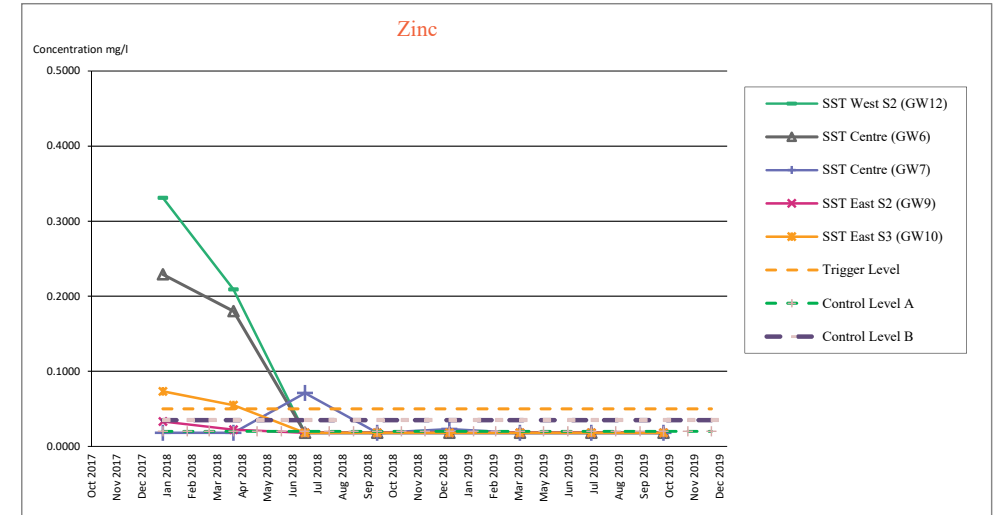
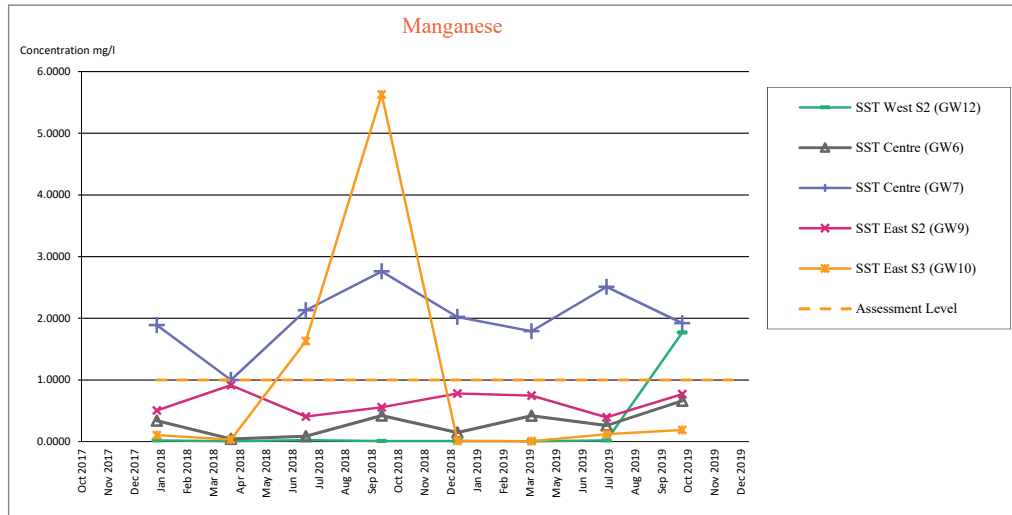


Figure C6
Groundwater quality monitoring results - Compliance wells graphs

Compliance wells graphs

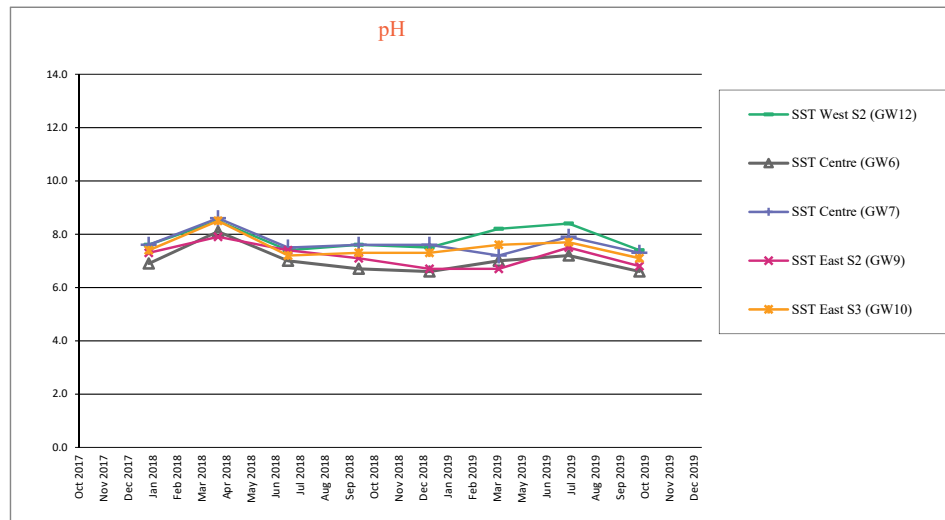


Figure C7

Groundwater quality monitoring results - Upstream wells graphs

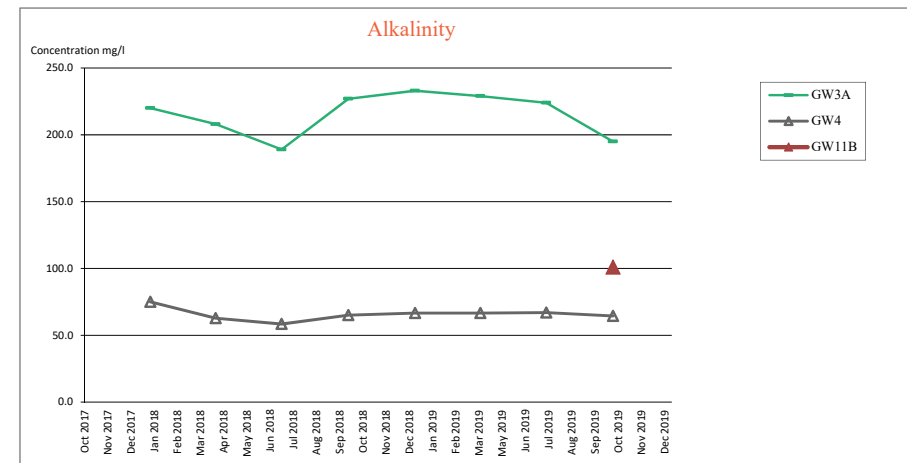
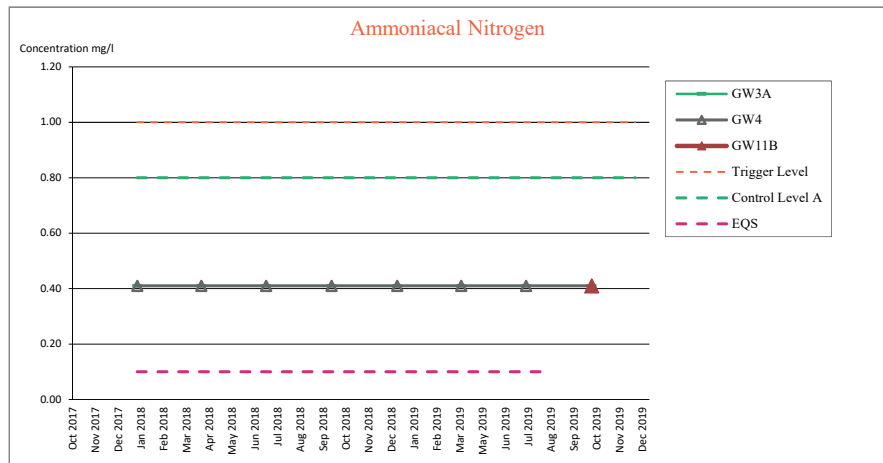
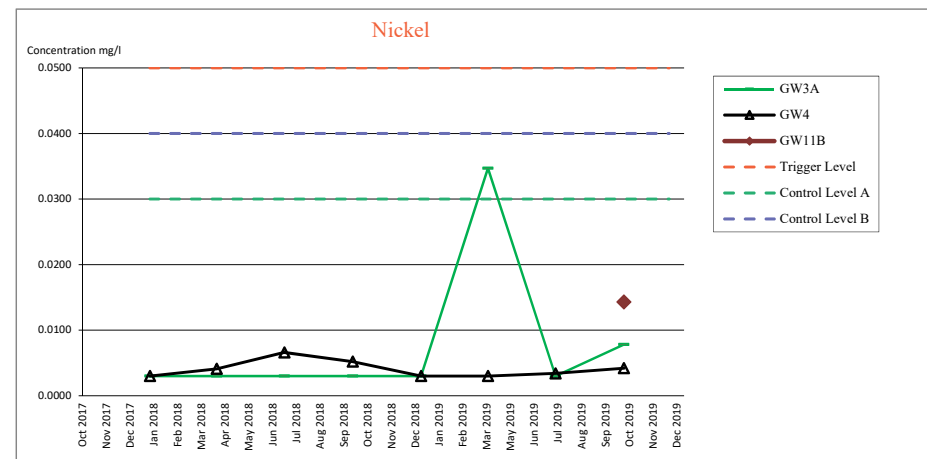
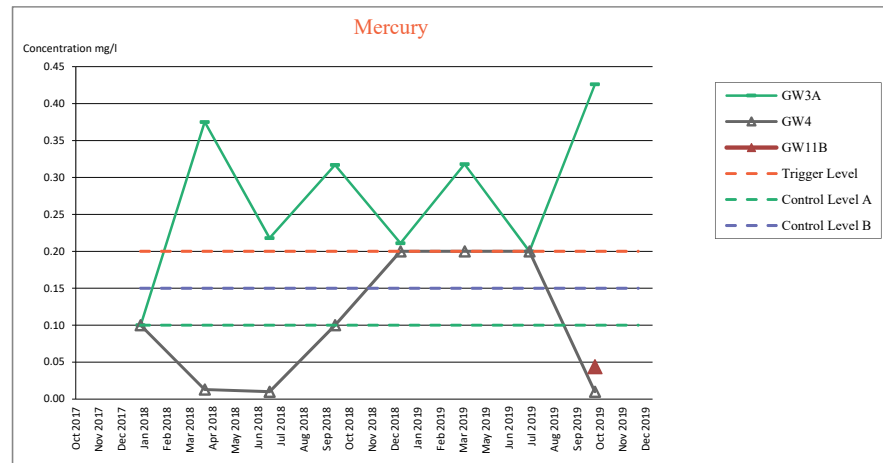


Figure C7

Groundwater quality monitoring results - Upstream wells graphs

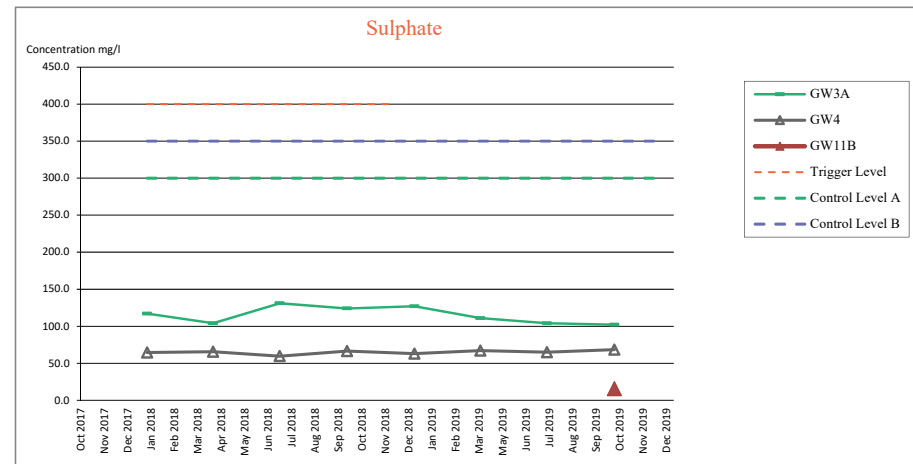
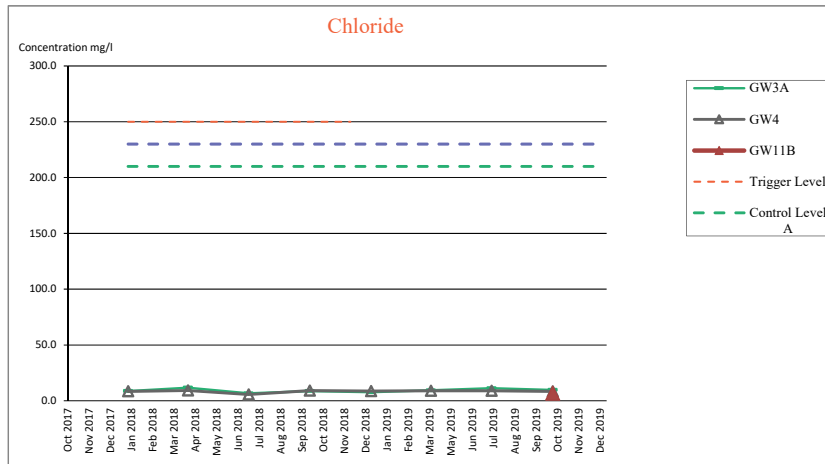
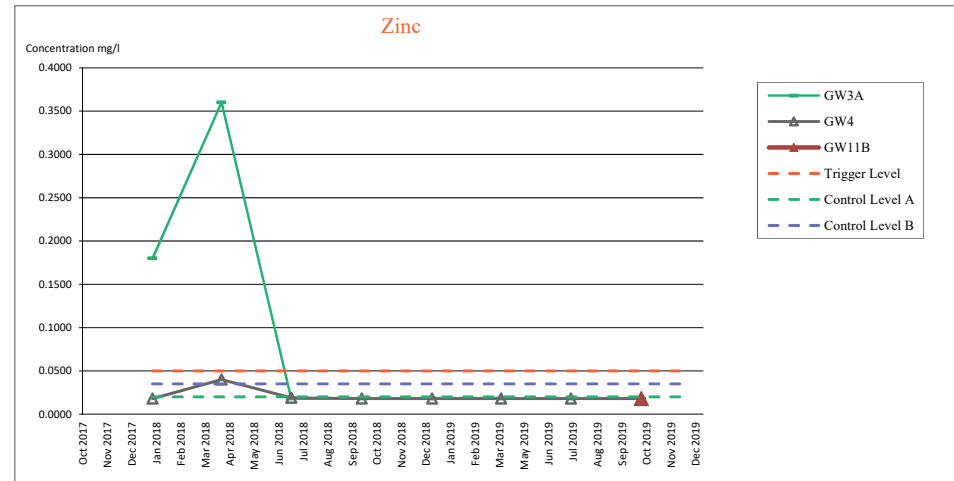
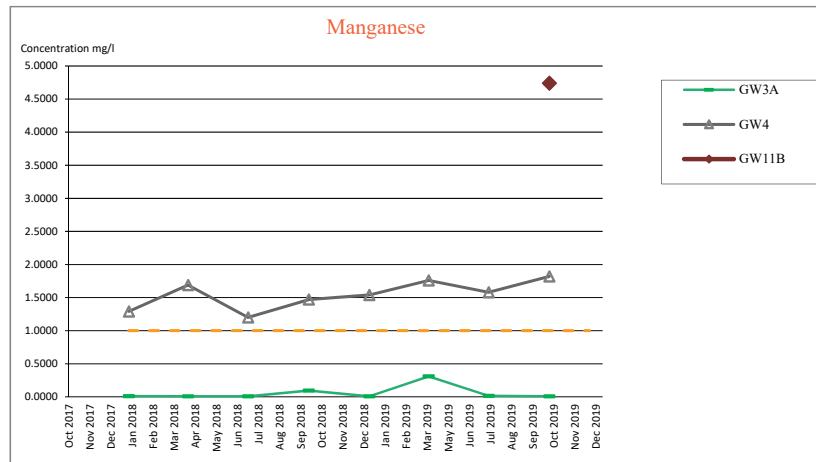
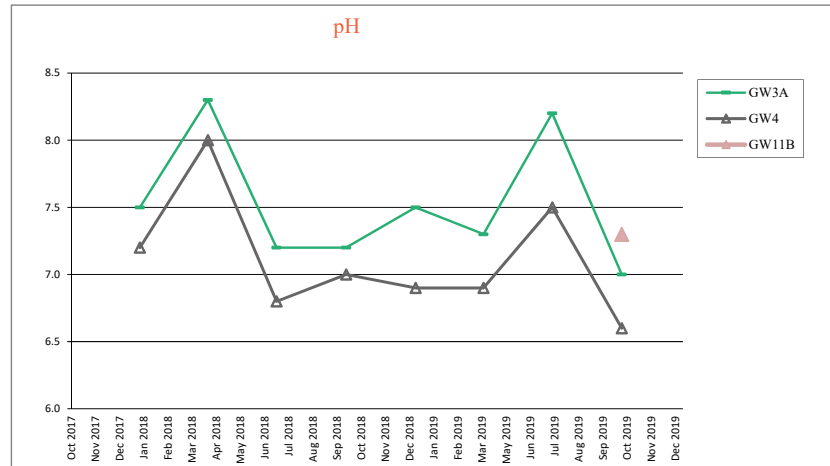
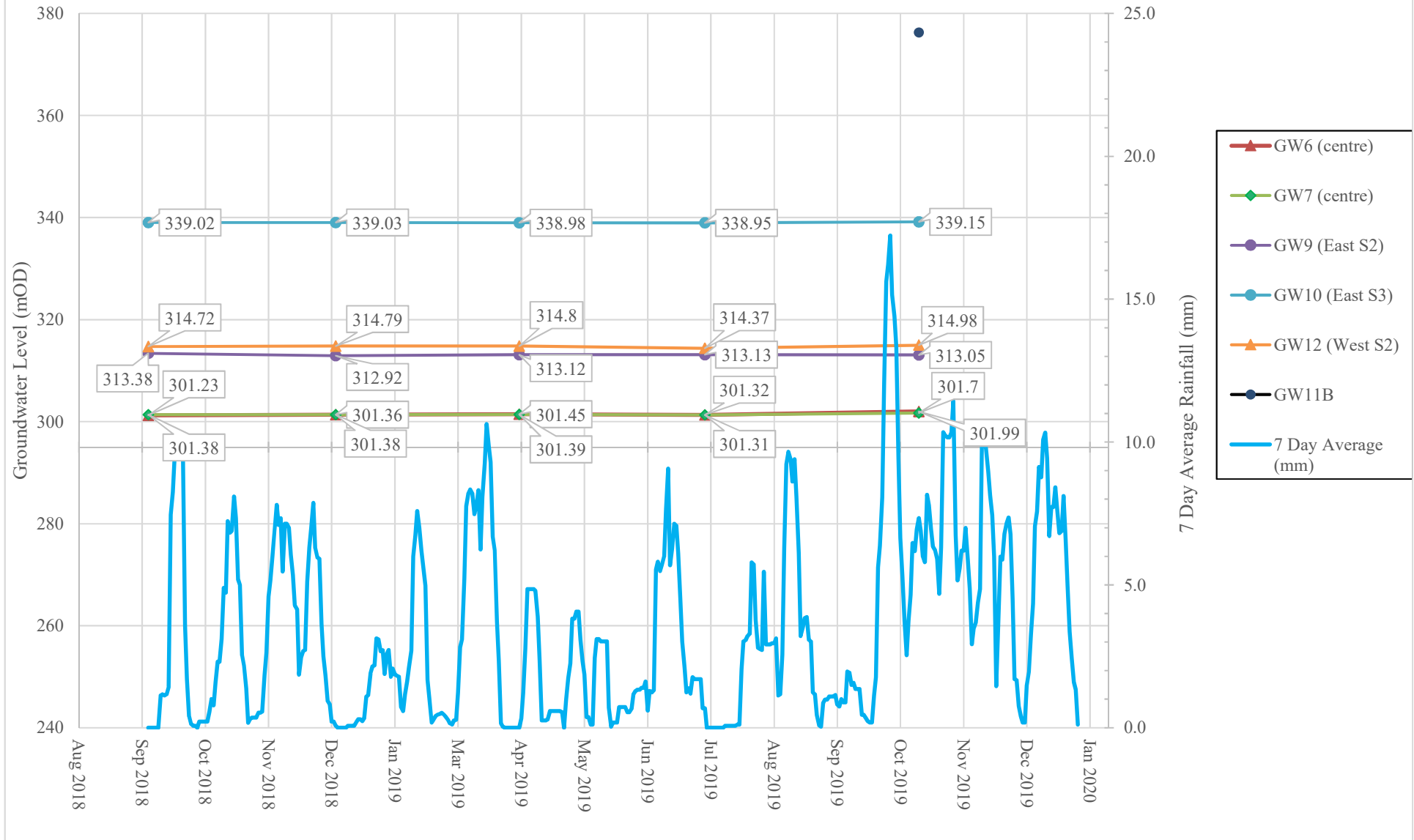


Figure C7
Groundwater quality monitoring results - Upstream wells graphs



Appendix C
Figure C8
Groundwater monitoring levels downstream of compliance wells



Appendix D

Monitoring Results - Tables

Appendix D
Table D1
Leachate Monitoring Results

October 2019												
LOCATION	Units	L1A	L1B	LC1A	LC2A	LC4A	LC5A	Maximum concentration (mg/l)	Average concentration (mg/l)	Acceptable Maximum Concentration (AMC) (mg/l)	LP3A	LP4
Date Sampled	-											
Manganese in filtrate as Mn	mg/l	N/S	0.292	N/S	0.11	0.783	0.221	0.783	0.3515	--	0.0111	0.17
Mercury, filt trace as Hg	mg/l	N/S	< 0.0001	N/S				0.000	0.0001	0.00056	< 0.0001	< 0.0001
Nickel in filtrate as Ni	mg/l	N/S	0.0135	N/S	0.094	0.0142	0.145	0.145	0.0667	0.0681	0.0074	0.0083
Zinc, ultra-low filtered as Zn	mg/l	N/S	0.0562	N/S	1.6	2.31	0.0998	2.310	1.0165	1.38	0.0206	0.0424
pH	pH Units	N/S	8.1	N/S	8.4	7.6	8.3	8.400	8.10	--	8.3	8.2
Conductivity- Electrical 20C	uS/cm	N/S	2330	N/S	10700	4200	24800	24800	10507.5	--	1560	1970
Alkalinity as CaCO3	mg/l	N/S	534	N/S	542	2450	14200	14200	4431.5	--	406	606
Ammoniacal Nitrogen as N	mg/l	N/S	11.3	N/S	741	268	2180	2180	800.075	526	1.85	12.9
Chloride as Cl	mg/l	N/S	206	N/S	850	207	2120	2120	845.8	1408	125	138
Sulphate as SO4	mg/l	N/S	483	N/S	243	< 4.4	463	483	298.350	999	242	298
Redox Potential ¹ (see note 4)	mV	N/S	108	N/S	113	61	-5	113	69.3	--	102	99
Total Suspended Solids	mg/l	N/S	17	N/S	2270	2360	74	2360	1180.3		4	4
Solids, Total Dissolved 180 deg C	mg/l	N/S	1780	N/S	5080	1780	10900	10900	4885		1120	1440
Dissolved Oxygen, Fixed	mg/l	N/S	< 0.5	N/S	< 0.5	< 0.5	< 0.5	0.5	0.50		< 0.5	< 0.5
TOC (filtered)	mg/l	N/S	22.5	N/S	316	56.5	1810	1810	551.3		13.9	15.9

Notes

- < denotes 'less than'.
 - L1A,L1B, LC1A, LC2A,LC4A, LC5A: Wells in Waste.
 - denotes 'no acceptable maximum concentration available'.
 - The redox potential was not measured on site and there is a possibility that it has changed between sampling and analysis.
 - LC5A is a replacement for LC5 well.
 - NS denotes 'not sampled'.
- No monthly average leachate levels above Maximum Acceptable Concentration (MAC)

Appendix D
Table D1
Leachate Monitoring Results

July 2019												
LOCATION	Units	L1A	L1B	LC1A	LC2A	LC4A	LC5A	Maximum concentration (mg/l)	Average concentration (mg/l)	Acceptable Maximum Concentration (AMC) (mg/l)	LP3A	LP4
Date Sampled -												
Manganese in filtrate as Mn	mg/l	0.234	0.316	N/S	0.125	0.802	0.245	0.802	0.3444	--		
Mercury, filt trace as Hg	mg/l	< 0.0002	< 0.0002	N/S	< 0.0002	< 0.0002	< 0.0002	0.0002	0.0002	0.00056		
Nickel in filtrate as Ni	mg/l	0.0317	0.0104	N/S	0.105	0.0107	0.145	0.145	0.06056	0.0681		
Zinc, ultra-low filtered as Zn	mg/l	0.624	0.0743	N/S	1.12	2.25	0.107	2.25	0.83506	1.380		
pH	pH Units	7.9	8	N/S	8.3	7.6	8.3	8.3	8.02	--		
Conductivity- Electrical 20C	uS/cm	2530	2130	N/S	10300	4070	24900	24900	8786	--		
Alkalinity as CaCO3	mg/l	1090	519	N/S	458	2490	13000	13000	3511.4	--		
Ammoniacal Nitrogen as N	mg/l	< 0.41	7.13	N/S	701	259	2330	2330	659.508	526		
Chloride as Cl	mg/l	252	180	N/S	824	194	2180	2180	726	1408		
Sulphate as SO4	mg/l	82.5	434	N/S	231	7.3	77.2	434	166.4	999		
Redox Potential ^(see note 4)	mV	44	-75	N/S	-43	-45	-17	44	-27.2	--		
Total Suspended Solids	mg/l	840	46	N/S	1290	2080	34	2080	858	--		
Solids, Total Dissolved 180 deg C	mg/l	1760	1630	N/S	5160	1780	12400	12400	4546	--		
Dissolved Oxygen, Fixed	mg/l	< 0.5	2.5	N/S	< 0.5	< 0.5	< 0.5	2.5	0.9	--		
TOC (filtered)	mg/l	22.3	22.7	N/S	314	59.1	2220	2220	527.62	--		

Notes

1. < denotes 'less than'.
 2. L1A,L1B, LC1A, LC2A,LC4A, LC5A: Wells in Waste.
 3. -- denotes 'no acceptable maximum concentration available'.
 4. The redox potential was not measured on site and there is a possibility that it has changed between sampling and analysis
 5. LC5A is a replacement for LC5 well.
 6. NS denotes 'not sampled'.
- No monthly average leachate levels above Maximum Acceptable Concentration (MAC)

Appendix D
Table D1
Leachate Monitoring Results

115825

April 2019											
LOCATION	Units	L1A	L1B	LC1A	LC2A	LC4A	LC5A	Maximum concentration (mg/l)	Average concentration (mg/l)	Acceptable Maximum Concentration (AMC) (mg/l)	
Date Sampled	-									-	
Manganese in filtrate as Mn	mg/l	N/S	0.268	N/S	0.134	0.659	0.196	0.6590	0.3143	--	
Mercury, filt trace as Hg	mg/l	N/S	< 0.0002	N/S	-	< 0.0002	-	0.0002	0.0002	0.00056	
Nickel in filtrate as Ni	mg/l	N/S	0.0083	N/S	0.0895	0.0147	0.193	0.1930	0.0764	0.0681	
Zinc, ultra-low filtered as Zn	mg/l	N/S	0.0192	N/S	0.951	1.59	0.22	1.590	0.695	1.380	
pH	pH Units	N/S	7.7	N/S	8.2	7.4	8.3	8.30	7.9	--	
Conductivity- Electrical 20C	uS/cm	N/S	1920	N/S	9690	4320	23900	23900	9958	--	
Alkalinity as CaCO3	mg/l	N/S	473	N/S	5060	2580	12900	12900	5253	--	
Ammoniacal Nitrogen as N	mg/l	N/S	9.44	N/S	680	290	2170	2170.00	787.36	526	
Chloride as Cl	mg/l	N/S	133	N/S	830	207	2220	2220	848	1408	
Sulphate as SO4	mg/l	N/S	437	N/S	102	7.4	27.8	437	143.6	999	
Redox Potential (see note 4)	mV	N/S	120	N/S	90	82	-110	120	45.5	--	
Total Suspended Solids	mg/l	N/S	21	N/S	2070	2270	94	2270	1113.8		
Solids, Total Dissolved 180 deg C	mg/l	N/S	1330	N/S	4380	1730	9280	9280	4180.0		
Dissolved Oxygen, Fixed	mg/l	N/S	2.4	N/S	< 0.5	< 0.5	< 0.5	2	1.0		
TOC (filtered)	mg/l	N/S	20.3	N/S	281	55.2	1430	1430	446.6		

Notes

1. < denotes 'less than'.
2. L1A,L1B, LC1A, LC2A,LC4A, LC5A: Wells in Waste.
3. -- denotes 'no acceptable maximum concentration available'.
4. The redox potential was not measured on site and there is a possibility that it has changed between sampling and analysis
5. LC5A is a replacement for LC5 well.
6. NS denotes 'not sampled'.
7. * denotes 'no result for filtered mercury analysis due to interference from sample matrix'.

Appendix D
Table D1
Leachate Monitoring Results

115825

January 2018											
LOCATION	Units	L1A	L1B	LC1A	LC2A	LC4A	LC5A	Maximum concentration (mg/l)	Monthly Average (mg/l)	Acceptable Maximum Concentration (AMC) (mg/l)	LP3A LP4
Date Sampled	-							-	-	-	
Manganese in filtrate as Mn	mg/l	N/S	0.23	N/S	0.107	0.695	0.156	0.695	0.297	--	
Mercury, filt trace as Hg	mg/l	N/S	< 0.0001	N/S				< 0.00010	< 0.00010	0.00056	
Nickel in filtrate as Ni	mg/l	N/S	0.012	N/S	0.0782	0.0128	0.166	0.166	0.0673	0.0681	
Zinc, ultra-low filtered as Zn	mg/l	N/S	0.0324	N/S	2.11	2.32	0.175	2.32	1.159	1.380	
pH	pH Units	N/S	7.7	N/S	8.2	7.4	8.3	8.30	7.900	--	
Conductivity- Electrical 20C	uS/cm	N/S	2360	N/S	9610	4190	23300	23300.0	9865.0	--	
Alkalinity as CaCO3	mg/l	N/S	603	N/S	5250	2360	12600	12600.0	5203.3	--	
Ammoniacal Nitrogen as N	mg/l	N/S	27.4	N/S	646	283	2290	2290.0	812	526	
Chloride as Cl	mg/l	N/S	203	N/S	766	208	2020	2020.0	799	1408	
Sulphate as SO4	mg/l	N/S	430	N/S	4.5	< 4.4	27	430.0	116	999	
Redox Potential ^{1 (see note 4)}	mV	N/S	80	N/S	85	63	-3	85.0	56.3	--	
Total Suspended Solids	mg/l	N/S	32	N/S	2040	1650	84	2040.0	951.5		
Solids, Total Dissolved 180 deg C	mg/l	N/S	1600	N/S	4520	1810	10300	10300.0	4557.5		
Dissolved Oxygen, Fixed	mg/l	N/S	1.8	N/S	< 0.5	< 0.5	< 0.5	1.80	0.8		
TOC (filtered)	mg/l	N/S	27.1	N/S	330	64	1160	1160.0	395.3		

Notes

1. < denotes 'less than'.
2. L1A,L1B, LC1A, LC2A,LC4A, LC5A: Wells in Waste.
3. -- denotes 'no acceptable maximum concentration available'.
4. The redox potential was not measured on site and there is a possibility that it has changed between sampling and analysis
5. LC5A is a replacement for LC5 well.
6. NS denotes 'not sampled'.

Appendix D
Table D2
Leachate Head Levels

		Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
LC1A	Elevation of base of landfill mAOD	357.62			357.62			357.62			357.62		
	Elevation at top of casing mAOD	398.88			398.84			398.85			398.88		
	Depth to leachate from top of casing (m)	40.38			40.34			40.48			40.50		
	Leachate elevation (mAOD)	358.50			358.50			358.37			358.38		
	Calculated leachate head (m)	0.88			0.88			0.75			0.76		
LC2A	Elevation of base of landfill mAOD	362.49			362.49			362.49			362.49		
	Elevation at top of casing mAOD	401.26			401.15			401.12			401.15		
	Depth to leachate from top of casing (m)	35.75			35.75			35.42			35.61		
	Leachate elevation (mAOD)	365.51			365.40			365.70			365.54		
	Calculated leachate head (m)	3.02			2.91			3.21			3.05		
LC4A	Elevation of base of landfill mAOD	372.27			372.27			372.27			372.27		
	Elevation at top of casing mAOD	401.24			401.22			401.14			401.22		
	Depth to leachate from top of casing (m)	26.90			26.88			26.88			26.87		
	Leachate elevation (mAOD)	374.34			374.34			374.26			374.35		
	Calculated leachate head (m)	2.07			2.07			1.99			2.08		
LC5A	Elevation of base of landfill mAOD	350.14			350.14			350.14			350.14		
	Elevation at top of casing mAOD	380.98			380.71			380.75			380.71		
	Depth to leachate from top of casing (m)	26.10			25.84			26.09			25.52		
	Leachate elevation (mAOD)	354.88			354.87			354.66			355.19		
	Calculated leachate head (m)	4.74			4.73			4.52			5.05		
L1	Casing height (mAOD)	356.80			356.99			357.00			357.00		
	Leachate (mbgl)	21.02			21.03			21.04					
	Leachate (m AOD)	335.78			335.96			335.96			-		
	Base of landfill (m AOD)	336.80			336.80			336.80			336.80		
	Depth of well from top of casing (m)	21.03			21.03			21.04					
	Base of well (m AOD)	335.77			335.96			335.96			357.00		
	Calculated leachate head (m)	-1.02			-0.84			-0.84			Dry		
L1A*	Casing height (mAOD)	354.84			355.79			355.79			355.79		
	Leachate (mbgl)	20.61			19.92			19.62			20.87		
	Leachate (m AOD)	334.23			335.87			336.17			334.92		
	Base of landfill (m AOD)	316.64			316.64			316.64			316.64		
	Depth of well from top of casing (m)	20.91			20.93			20.93			20.88		
	Base of well (m AOD)	333.93			334.84			333.93			334.84		
	Calculated leachate head (m)	17.59			19.23			19.53			18.28		
L1B*	Casing height (mAOD)	354.34			354.81			354.80			354.80		
	Leachate (mbgl)	24.73			24.73			25.43			24.45		
	Leachate (m AOD)	329.61			330.08			329.37			330.35		
	Base of landfill (m AOD)	319.60			319.60			319.60			319.60		
	Depth of well from top of casing (m)	34.86			34.86			34.88			34.86		
	Base of well (m AOD)	319.48			319.34			319.48			319.34		
	Calculated leachate head (m)	10.01			10.48			9.77			10.75		

2019	Quarterly Leachate Head Averages (m)
January	2.68
February	N/S
March	N/S
April	2.65
May	N/S
June	N/S
July	2.62
August	N/S
September	N/S
October	2.74
November	N/S
December	N/S

Minimum monthly leachate head average
Maximum monthly leachate head average

Notes:

Top of casings were re-surveyed in August 2019

- LC1A top of casing is 1710mm above ground level.
- LC2A top of casing is 820mm above GL.
- LC4A top of casing is 1040mm above GL.
- LC5A top of casing is 1050mm above GL.

* Well not included in monthly average.

Note: L1 is generally dry or with very little water in it.

Month	Location	Date	Mercury, ultra-low total as Hg	Redox Potential	Manganese in filtrate as Mn	Nickel in filtrate as Ni	Bioavailable Ni	Zinc, ultra- low total as Zn	Bioavailable Zn	pH	Conductivity- Electrical 20°C	Alkalinity as CaCO3	Ammoniacal Nitrogen as N	Unionised Ammoniacal Nitrogen **	Measured surface water	Chloride as Cl	Sulphate as SO4	Solids, Suspended	Dissolved oxygen	TOC (Filtered)	Calcium		
A u g u s t	Upstream of Landfill	SWU SW2A1 SWW4	Six-monthly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
				N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S			
				N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S			
	NW Ditch System	SWW1 SWW2	Six-monthly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
				N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
	Downstream of Landfill	SWD SWD1	Quarterly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
S e p t e m b e r	Upstream of Landfill	SWU SW2A1 SWW4	Six-monthly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
				N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
				N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
	NW Ditch System	SWW1 SWW2	Six-monthly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
				N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
	Downstream of Landfill	SWD SWD1	Quarterly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
O c t o b e r	Upstream of Landfill	SWU SW2A1 SWW4	Six-monthly	16/10/2019	< 0.01	105	< 0.0070	< 0.0030	< 0.0180	7.50	78.50	78.50	< 0.41	0.0023	9.30	5.30	12.60	1	10.1	0.9	6.1		
				16/10/2019	< 0.01	129	< 0.0070	< 0.0030	< 0.018	8.20	697.00	109	< 0.41	0.0144	12.80	7.10	255.00	20	9.3	6.1	107		
				16/10/2019	< 0.01	152	0.0074	< 0.0030	< 0.018	8.50	635.00	101	< 0.41	0.0264	12.10	7.70	226.00	4	9.1	6.9	91.5		
		NW Ditch System	SWW1 SWW2	Six-monthly	16/10/2019	< 0.01	104	0.0179	0.0043	0.00225	< 0.018	7.90	374.00	90	< 0.41	0.0066	11.30	8.00	102.00	1	9	1.6	49.5
					16/10/2019	< 0.01	163	< 0.0070	< 0.0030	< 0.018	7.70	170.00	40	< 0.41	0.0036	9.40	6.40	34.80	2	10.1	<0.7	18.6	
		Downstream of Landfill	SWD SWD1	Quarterly	16/10/2019	< 0.01	15	0.0109	< 0.0030	< 0.018	8.30	315.00	124	< 0.41	0.0159	11.10	4.90	47.60	4	10.1	2.7	52.8	
	N o v e m b e r	Upstream of Landfill	SWU SW2A1 SWW4	Six-monthly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	
					N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	
					N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	
		NW Ditch System	SWW1 SWW2	Six-monthly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	
					N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	
		Downstream of Landfill	SWD SWD1	Quarterly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	
D e c e m b e r	Upstream of Landfill	SWU SW2A1 SWW4	Six-monthly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
				N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
				N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
	NW Ditch System	SWW1 SWW2	Six-monthly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
				N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
	Downstream of Landfill	SWD SWD1	Quarterly	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S		
M i n i m u m	Maximum	<	0.0100	-76.0	<	0.007	<	0.003	<	0.0180	7.5	78.5	14.40	<	0.41	0.0020	4.00	4.70	12.60	8.90	6.00		
			<	0.1000	163.0		0.019		0.005		0.0256	8.5	829.0	124.00	<	0.41	0.03	12.80	11.10	360.00	122.00	12.60	27.50

Appendix D
Table D4
Surface water monitoring SW1 to SW10

115825

MONTH	LOCATION	DATE	Mercury, ultra-low total as Hg	Ammoniacal Nitrogen as N	Chloride as Cl
			ug/l	mg/l	mg/l
Freshwater EQS			1	n/a	250
J a n u a r y	SW1	10/01/2019	< 0.10	< 0.41	63.6
	SW2	10/01/2019	< 0.10	< 0.41	61.4
	SW3	10/01/2019	< 0.01	< 0.41	32.1
	SW4	10/01/2019	< 0.01	< 0.41	83.6
	SW5	10/01/2019	< 0.10	< 0.41	76.9
	SW6	10/01/2019	< 0.10	< 0.41	62.8
	SW7	10/01/2019	< 0.10	< 0.41	7.2
	SW8	10/01/2019	< 0.10	< 0.41	12
	SW9	10/01/2019	< 0.10	< 0.41	13.7
SW10	10/01/2019	< 0.10	< 0.41	17.6	
F e b r u a r y	SW1	05/02/2019	< 0.10	< 0.41	35.9
	SW2	05/02/2019	< 0.10	< 0.41	36.4
	SW3	05/02/2019	< 0.10	< 0.41	24.7
	SW4	05/02/2019	< 0.10	< 0.41	39.7
	SW5	05/02/2019	< 0.10	< 0.41	37.6
	SW6	05/02/2019	< 0.10	< 0.41	32.7
	SW7	05/02/2019	< 0.10	< 0.41	8.5
	SW8	05/02/2019	< 0.10	< 0.41	9.7
	SW9	05/02/2019	< 0.10	< 0.41	9.7
SW10	05/02/2019	< 0.10	< 0.41	14.6	
M a r c h	SW1	07/03/2019	< 0.10	< 0.41	20.60
	SW2	07/03/2019	< 0.10	< 0.41	20.20
	SW3	07/03/2019	< 0.10	< 0.41	15.50
	SW4	07/03/2019	< 0.10	< 0.41	21.60
	SW5	07/03/2019	< 0.10	< 0.41	21.50
	SW6	07/03/2019	< 0.10	< 0.41	20.10
	SW7	07/03/2019	< 0.10	< 0.41	9.40
	SW8	07/03/2019	< 0.10	< 0.41	7.80
	SW9	07/03/2019	< 0.10	< 0.41	8.00
SW10	07/03/2019	< 0.10	< 0.41	9.40	
A p r i l	SW1	03/04/2019	< 0.20	< 0.41	58.20
	SW2	03/04/2019	< 0.20	< 0.41	54.80
	SW3	03/04/2019	< 0.20	< 0.41	31.70
	SW4	03/04/2019	< 0.20	< 0.41	79.50
	SW5	03/04/2019	< 0.20	< 0.41	75.20
	SW6	03/04/2019	< 0.20	< 0.41	60.00
	SW7	03/04/2019	< 0.20	< 0.41	7.10
	SW8	03/04/2019	< 0.20	< 0.41	8.60
	SW9	03/04/2019	Dry		
SW10	03/04/2019	Dry			
M a y	SW1	01/05/2019	< 0.20	< 0.41	45.20
	SW2	01/05/2019	< 0.20	< 0.41	44.70
	SW3	01/05/2019	< 0.20	< 0.41	27.10
	SW4	01/05/2019	< 0.20	< 0.41	53.10
	SW5	01/05/2019	< 0.20	< 0.41	51.60
	SW6	01/05/2019	< 0.20	< 0.41	45.30
	SW7	01/05/2019	< 0.20	< 0.41	6.30
	SW8	01/05/2019	< 0.20	< 0.41	9.60
	SW9	01/05/2019	< 0.20	< 0.41	13.90
SW10	01/05/2019	< 0.20	< 0.41	13.10	
J u n e	SW1	04/06/2019	< 0.20	< 0.41	45.90
	SW2	04/06/2019	< 0.20	< 0.41	45.70
	SW3	04/06/2019	< 0.20	< 0.41	29.70
	SW4	04/06/2019	< 0.20	< 0.41	60.40
	SW5	04/06/2019	< 0.20	< 0.41	58.00
	SW6	04/06/2019	< 0.20	< 0.41	52.00
	SW7	04/06/2019	< 0.20	< 0.41	7.00
	SW8	04/06/2019	< 0.20	< 0.41	9.40
	SW9	04/06/2019	Dry		
SW10	04/06/2019	Dry			
J u l y	SW1	03/07/2019	Dry	Dry	Dry
	SW2	03/07/2019	< 0.01	< 0.41	41.80
	SW3	03/07/2019	< 0.01	< 0.41	26.70
	SW4	03/07/2019	< 0.01	< 0.41	52.1
	SW5	03/07/2019	< 0.01	< 0.41	49.80
	SW6	03/07/2019	< 0.01	< 0.41	44.10
	SW7	03/07/2019	< 0.01	< 0.41	7.9
	SW8	03/07/2019	< 0.01	< 0.41	7.4
	SW9	03/07/2019	< 0.01	< 0.41	15.20
SW10	03/07/2019	Dry	Dry	Dry	

Appendix D
Table D4
Surface water monitoring SW1 to SW10

115825

MONTH	LOCATION	DATE	Mercury, ultra-low total as Hg	Ammoniacal Nitrogen as N	Chloride as Cl
			ug/l	mg/l	mg/l
	Freshwater EQS		1	n/a	250
A u g u s t	SW1	28/08/2019	< 0.01	< 0.41	34.60
	SW2	28/08/2019	0.014	< 0.41	34.10
	SW3	28/08/2019	< 0.01	< 0.41	21.60
	SW4	28/08/2019	< 0.01	< 0.41	40.5
	SW5	28/08/2019	Dry	Dry	Dry
	SW6	28/08/2019	< 0.01	< 0.41	31.9
	SW7	28/08/2019	< 0.01	< 0.41	7.2
	SW8	28/08/2019	< 0.01	< 0.41	7.3
	SW9	28/08/2019	Dry	Dry	Dry
	SW10	28/08/2019	Dry	Dry	Dry
S e p t e m b e r	SW1	25/09/2019	< 0.01	< 0.41	34.70
	SW2	25/09/2019	< 0.01	< 0.41	35.10
	SW3	25/09/2019	< 0.01	< 0.41	21.4
	SW4	25/09/2019	< 0.01	< 0.41	48
	SW5	25/09/2019	< 0.01	< 0.41	42.1
	SW6	25/09/2019	< 0.01	< 0.41	31.8
	SW7	25/09/2019	< 0.01	< 0.41	8
	SW8	25/09/2019	< 0.01	< 0.41	7
	SW9	25/09/2019	< 0.01	< 0.41	8.70
	SW10	25/09/2019	< 0.01	< 0.41	12.7
O c t o b e r	SW1	16/10/2019	0.016	< 0.41	24.9
	SW2	16/10/2019	< 0.01	< 0.41	27.20
	SW3	16/10/2019	< 0.01	< 0.41	15.90
	SW4	16/10/2019	< 0.01	< 0.41	47.50
	SW5	16/10/2019	0.017	< 0.41	44.40
	SW6	16/10/2019	< 0.01	< 0.41	33.80
	SW7	16/10/2019	< 0.01	< 0.41	6.60
	SW8	16/10/2019	< 0.01	< 0.41	8.80
	SW9	16/10/2019	< 0.01	< 0.41	9.20
	SW10	16/10/2019	< 0.01	< 0.41	9.9
N o v e m b e r	SW1	13/11/2019	< 0.010	< 0.41	48.10
	SW2	13/11/2019	< 0.010	< 0.41	47.30
	SW3	13/11/2019	< 0.010	< 0.41	30.20
	SW4	13/11/2019	< 0.010	5.46	76.50
	SW5	13/11/2019	< 0.010	4.31	71.60
	SW6	13/11/2019	< 0.010	2.36	58.50
	SW7	13/11/2019	< 0.010	< 0.41	9.00
	SW8	13/11/2019	< 0.010	< 0.41	7.80
	SW9	13/11/2019	< 0.010	< 0.41	9.60
	SW10	13/11/2019	< 0.010	< 0.41	10.90
D e c e m b e r	SW1	10/12/2019	< 0.010	< 0.41	39.20
	SW2	10/12/2019	< 0.010	< 0.41	40.20
	SW3	10/12/2019	< 0.010	< 0.41	25.50
	SW4	10/12/2019	< 0.010	< 0.41	59.40
	SW5	10/12/2019	< 0.010	< 0.41	55.10
	SW6	10/12/2019	< 0.010	< 0.41	45.30
	SW7	10/12/2019	< 0.010	< 0.41	11.20
	SW8	10/12/2019	< 0.010	< 0.41	10.60
	SW9	10/12/2019	< 0.010	< 0.41	12.50
	SW10	10/12/2019	< 0.010	< 0.41	12.40
Minimum			< 0.0100	< 0.41	6.30
Maximum			0.20	5.46	83.60
Count			111.00	111.00	111.00

Location	Month	Date	Test reference number	Redox Potential	Mercury, filtrate as Hg	Manganese in filtrate as Mn	Nickel in filtrate as Ni	Zinc, ultra-low filtered as Zn	pH	Electrical Conductivity 20C	Alkalinity as CaCO3	Ammoniacal Nitrogen as N	Unionised Ammoniacal Nitrogen ***	Measure water temperature	Chloride as Cl	Sulphate as SO4	Calcium	D.O. concentration	TOC (Filtered)					
				mV	ug/l	mg/l	mg/l	mg/l	pH units	uS/cm	mg/l	mg/l	mg/l	°C	mg/l	mg/l	mg/l	mg/l	mg/l					
Trigger Level					(0.2*)		0.05	(0.05*)	--	--	--	1	--	--	250	400	--	--	--					
Control Level A					(0.1**)	--	0.03	(0.02**)	--	--	--	0.8	--	--	210	300	--	--	--					
Control Level B					(0.15**)	--	0.04	(0.035**)	--	--	--	0.9	--	--	230	350	--	--	--					
Assessment Level					--	(1.0*)	--	--	--	--	--	--	--	--	--	--	--	--	--					
SST Centre																								
GW6	Jan-18	30/01/18	16812272	166	<	0.10	0.3390	0.0050	6.9	930.0	340.0	<	0.41	0.0007	12.1	67.7	91.9	90.4	3.2	3.6				
	Feb-18		Quarterly																					
	Mar-18																							
	Apr-18	01/05/18	17084461	72		0.08	0.0440	0.0099	<	0.1800	8.1	881.0	284.0	<	0.41	68.5	86.6	75.2	5.0	3.5				
	May-18		Quarterly																					
	Jun-18																							
	Jul-18	24/07/18	17349965	110		0.03	0.0868	0.0114	<	0.0180	7.0	977.0	313.0	1.53	77.1	84.5	85.0	2.8	3.7					
	Aug-18		Quarterly																					
	Sep-18																							
	Oct-18	29/10/18	17637859	124		0.03	0.4230	0.0154	<	0.0180	6.7	801	290	<	0.41	68.2	93.1	51.3	4.6	5.7				
	Nov-18		Quarterly																					
	Dec-18																							
GW7	Jan-19	08/01/19	17839310	47	<	0.20	0.1480	0.0093	<	0.0180	6.6	764.0	322.0	<	0.41	65.4	89.1	50.6	4.5	3.6				
	Feb-19		Quarterly																					
	Mar-19																							
	Apr-19	01/04/19	18095227	95	<	0.20	0.4210	0.0073	<	0.0180	7.0	832.0	314.0	<	0.41	65.9	86.7	56.2	2.6	5.0				
	May-19		Quarterly																					
	Jun-19																							
	Jul-19	01/07/19	18369028	-63	<	0.20	0.2610	0.0046	<	0.0180	7.2	821.0	317.0	<	0.41	67.7	86.9	58.1	2.7	5.9				
	Aug-19		Quarterly																					
	Sep-19																							
	Oct-19	14/10/19	18694533	176		0.033	0.6620	0.0214	<	0.0180	6.6	788	284	<	0.41	67.7	87.2	44.5	7.3	4.1				
	Nov-19		Quarterly																					
	Dec-19																							
GW7	Jan-18	30/01/18	16812273	173	<	0.10	1.8900	0.0065	<	0.0180	<	7.6	870.0	310.0	<	0.41	0.0031	10.4	38.9	76.7	69.0	3.0	5.0	
	Feb-18		Quarterly																					
	Mar-18																							
	Apr-18	01/05/18	17084462	87	<	0.01	1.0000	0.0065	<	0.0180	8.6	786.0	257.0	<	0.41	44.6	65.5	63.5	3.9	5.5				
	May-18		Quarterly																					
	Jun-18																							
	Jul-18	24/07/18	17349966	122		0.01	2.1300	0.0088	0.0710	7.5	837.0	286.0	<	0.41	49.4	67.5	84.9	2.8	5.8					
	Aug-18		Quarterly																					
	Sep-18																							
	Oct-18	29/10/18	17637860	133	<	0.01	2.7600	0.0064	<	0.0180	7.6	892.0	314	<	0.41	48.1	108	85.5	3.3	6.8				
	Nov-18		Quarterly																					
	Dec-18																							
GW7	Jan-19	08/01/19	17839311	90	<	0.10	2.0200	0.0069	0.0230	7.6	766.0	289.0	0.78		43.1	72.7	71.0	4.9	5.6					
	Feb-19		Quarterly																					
	Mar-19																							
	Apr-19	01/04/19	18095228	104	<	0.20	1.7900	0.0055	<	0.0180	7.2	794.0	282.0	<	0.41	45.8	72.3	70.4	3.5	5.7				
	May-19		Quarterly																					
	Jun-19																							
	Jul-19	01/07/19	18369029	-33	<	0.20	2.5100	0.0036	<	0.0180	7.9	875.0	317.0	<	0.41	54.9	71.7	80.4	3.0	5.8				
	Aug-19		Quarterly																					
	Sep-19																							
	Oct-19	14/10/19	18694534	195	<	0.01	1.9200	0.0150	<	0.0180	7.3	815.0	310	<	0.41	39.6	73.5	72.5	8.3	5.2				
	Nov-19		Quarterly																					
	Dec-19																							
SST East S2																								
GW9	Jan-18	30/01/18	16812274	166	<	0.10	0.5050	0.0049	0.0331	7.3	691.0	225.0	5.25	0.0218	11.6	53.8	27.6	38.8	3.4	5.2				
	Feb-18		Quarterly																					
	Mar-18																							
	Apr-18	01/05/18	17084463	86		0.05	0.9150	0.0011	0.0222	7.9	1190.0	369.0	12.10		121.0	29.7	74.6	3.0	14.0					
	May-18		Quarterly																					
	Jun-18																							
	Jul-18	24/07/18	17349967	121		0.035	0.4080	0.0065	<	0.0180	7.4	936.0	290.0	5.98	89.7	41.7	54.7	3.1	8.9					
	Aug-18		Quarterly																					
	Sep-18																							
	Oct-18	29/10/18	17637861	123		0.016	0.5570	0.0038	<	0.0180	7.1	477.0	171.0	3.88	29.6	35.1	30.5	2.9	3.9					
	Nov-18		Quarterly																					
	Dec-18																							
GW9	Jan-19	08/01/19	17839312	58	<	0.20	0.7810	<	0.0030	<	0.0180	6.7	520.0	194.0	4.94	32.6	38.1	34.1	2.6	2.9				
	Feb-19		Quarterly																					
	Mar-19																							
	Apr-19	01/04/19	18095229	92	<	0.20	0.7470	0.0040	<	0.0180	6.7	557.0	154.0	4.33	41.2	30.4	35.8	2.3	4.7					
	May-19		Quarterly																					
	Jun-19																							
	Jul-19	01/07/19	18369030	-71	<	0.200	0.3940	<	0.0030	<	0.0180	7.5	467.0	169.0	4.09	29.5	31.9	30.1	3.6	3.0				
	Aug-19		Quarterly																					
	Sep-19																							
	Oct-19	14/10/19	18694535	179		0.020	0.7710	0.0049	<	0.0180	6.8	613.0	168.0	5.39	54.3	20.1	32.7	8.4	7.4					
	Nov-19		Quarterly																					
	Dec-19																							

Location	Month	Date	Test reference number	Redox Potential	Mercury, filtrate as Hg	Manganese in filtrate as Mn	Nickel in filtrate as Ni	Zinc, ultra-low filtered as Zn	pH	Electrical Conductivity 20C	Alkalinity as CaCO3	Ammoniacal Nitrogen as N	Unionised Ammoniacal Nitrogen ***	Measure water temperature	Chloride as Cl	Sulphate as SO4	Calcium	D.O. concentration	TOC (Filtered)			
				mV	ug/l	mg/l	mg/l	mg/l	pH units	uS/cm	mg/l	mg/l	mg/l	°C	mg/l	mg/l	mg/l	mg/l	mg/l			
	Trigger Level				(0.2*)		0.05	(0.05*)	--	--	--	0.8	--	--	250	400	--	--	--			
	Control Level A				(0.1*)	--	0.03	(0.02*)	--	--	--	0.8	--	--	210	300	--	--	--			
	Control Level B				(0.15*)	--	0.04	(0.035*)	--	--	--	0.9	--	--	230	350	--	--	--			
	Assessment Level				--	(1.0*)	--	--	--	--	--	--	--	--	--	--	--	--	--			
SST East S3																						
	Jan-18	30/01/18	16812275	158	<	0.10	0.1050	0.00440	0.0733	7.4	500.0	180.0	<	0.41	0.0020	10.5	15.3	59.8	55.9	10.0	4.2	
	Feb-18		Quarterly																			
	Mar-18																					
	Apr-18	01/05/18	17084464	54		0.066	0.0336	0.0251	0.0548	8.5	477.0	184.0	<	0.41	0.0223	9.7	15.2	49.1	53.0	8.6	4.2	
	May-18		Quarterly																			
	Jun-18																					
	Jul-18	24/07/18	17349968	112		0.036	1.6300	0.0097	<	0.0180	7.2	795.0	329.0		0.45		24.9	63.5	94.0	4.6	9.4	
	Aug-18		Quarterly																			
	Sep-18																					
GW10	Oct-18	29/10/18	17637862	114	<	0.10	5.6300	0.0107	<	0.0180	7.3	530.0	215.0		0.53		13.5	75.1	67.7	5.8	6.1	
	Nov-18		Quarterly																			
	Dec-18																					
	Jan-19	08/01/19	17839313	60	<	0.20	0.0125	0.00550	<	0.0180	7.3	471.0	183.0	<	0.41		15.4	64.2	63.2	8.1	4.8	
	Feb-19		Quarterly																			
	Mar-19																					
	Apr-19	01/04/19	18095230	88	<	0.200	0.0075	<	0.0030	<	0.0180	7.6	563.0	208.0	<	0.41		22.8	64.5	89.1	6.5	6.8
	May-19		Quarterly																			
	Jun-19																					
Jul-19	01/07/19	18369031	-29	<	0.200	0.1220	<	0.0030	<	0.0180	7.7	615.0	250.0	<	0.41		20.1	67.9	74.8	8.5	7.9	
Aug-19		Quarterly																				
Sep-19																						
Oct-19	14/10/19	18694536	184		0.063	0.1880	0.0047	<	0.0180	7.1	612.0	269.0	<	0.41		12.6	64.3	85.8	8.1	5.3		
Nov-19		Quarterly																				
Dec-19																						

	Exceedance of Control Level
	Exceedance of Trigger Level
	Exceedance of Assessment Level

Notes

* The redox potential was not measured on site and there is a possibility that it has changed between sampling and analysis (*²)
 ** Unionised ammoniacal nitrogen based on measured Temperature and pH; unionised ammoniacal nitrogen = total ammonia(1+10^{(10.055-(0.024*²T)-pH))}), where T°C is measured water temperature.
 ^ Ammonia result confirmed on duplicate analysis.
 ^^ Reporting limits raised for EH analysis due to sample matrix.
 NM temperature not measured on site therefore 10°C is applied for the unionised ammoniacal nitrogen calculation

Empty* denotes not enough water in well for sample

METHANE (% by Volume)														CARBON DIOXIDE (% by Volume)														
Location	Valve	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Comments		
Date monitored		17/01/19	14/02/19	28/03/19	07/05/19	05/06/19	10/07/19	07/08/19	10/10/19	31/10/19	19/11/19	04/12/19	19/12/19	17/01/19	14/02/19	28/03/19	07/05/19	05/06/19	10/07/19	07/08/19	10/10/19	31/10/19	19/11/19	04/12/19	19/12/19			
GMW2	Red Valve	0	0	0	0	0	0	0.1	0	0	0	0.1	0.2	0.7	0.3	0.6	0.8	1.4	1.4	1.6	1.1	0.8	0.6	0.7	0.5	Red Valve, 25.5m depth		
	Yellow Valve	0	0	0	0	0	0	0.1	0	0	0	0.2	0.2	0.1	0	0.1	0.3	0.3	0.5	0.2	0	0	0	0.1	0	Yellow Valve,14m depth		
	White Valve	0	0	0	0	0	0	0.1	0	0	0	0.1	0.2	3.5	0	0	0	0	1.2	0	1.2	0	0	0	0	White Valve, 4m depth		
	Trigger Levels	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-			
	Control Levels	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-	-			
	Trigger Level Red	-	-	-	-	-	-	-	-	-	-	-	-	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5			
	Trigger Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3			
	Trigger Level White	-	-	-	-	-	-	-	-	-	-	-	-	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1		
	Control Level Red	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1		
	Control Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8		
	Control Level White	-	-	-	-	-	-	-	-	-	-	-	-	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6		
GMW3	Red Valve	0	0	0	0	0	0	0.1	0	0	0.2	0.1	0.2	2.6	3.7	3.9	4.3	3.1	3.8	1.9	1.9	3.9	4.7	3.7	4	Red Valve, 19m depth		
	Yellow Valve	0	0	0	0.1	0	0	0.1	0	0	0.2	0.2	0.2	0.1	0.2	0.4	0.6	0.1	0.5	0.8	0.2	0.4	0.3	0.5	0	Yellow Valve,9m depth		
	White Valve	0.2	0	0	0	0.1	0	0.1	0	0	0.2	0.2	0.2	6.5	0.9	0.2	0.6	17.2	0.5	4.1	16.4	2.4	1.7	0.4	19.2	White Valve, 3.5m depth		
	Trigger Levels	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-			
	Control Levels	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-	-			
	Trigger Level Red	-	-	-	-	-	-	-	-	-	-	-	-	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3		
	Trigger Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67		
	Trigger Level White	-	-	-	-	-	-	-	-	-	-	-	-	24.02	24.02	24.02	24.02	24.02	24.02	24.02	24.02	24.02	24.02	24.02	24.02	24.02		
	Control Level Red	-	-	-	-	-	-	-	-	-	-	-	-	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8		
	Control Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17		
	Control Level White	-	-	-	-	-	-	-	-	-	-	-	-	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5		
GMW4	Red Valve	0	0	0	0	0	0.1	0.1	0	0	0.2	0.2	0.2	0.1	0	0.1	0.2	0.4	0.5	0.9	0.1	0.1	0.1	0	0	Red Valve, 30m depth		
	Yellow Valve	0	0	0	0	0	0	0.1	0	0	0.2	0.2	0.2	0.2	0	0	0	0.3	0.1	0.2	0	0.1	0	0	0	Yellow Valve,20m depth		
	White Valve	0	0	0	0	0	0	0.1	0	0	0.2	0.2	0.2	0.1	0	0.1	0.1	0.3	0.3	0.3	0	0	0	0	0	White Valve, 5m depth		
	Trigger Levels	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Control Levels	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Trigger Level Red	-	-	-	-	-	-	-	-	-	-	-	-	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5		
	Trigger Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3		
	Trigger Level White	-	-	-	-	-	-	-	-	-	-	-	-	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1		
	Control Level Red	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1		
	Control Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8		
	Control Level White	-	-	-	-	-	-	-	-	-	-	-	-	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6		
GMW5	Red Valve	0	0	0	0	0	0	0.1	0	0	0.2	0.1	0.2	6.1	5.4	5.2	5.2	5.8	5.5	6	6	6.1	6.3	6	5.9	Red Valve, 26.3m depth		
	Yellow Valve	0	0	0	0	0	0	0.1	0	0	0.2	0.1	0.2	4.6	4.2	4.1	4	4.3	4	4.4	4.5	0.9	1.6	2	2.3	Yellow Valve,15m depth		
	White Valve	0	0	0	0	0	0	0.1	0	0	0.2	0.1	0.2	4.2	4.1	3.6	4	2.8	2.6	3.3	5.3	5.4	4.7	5.3	4.7	White Valve, 5m depth		
	Trigger Levels	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Control Levels	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Trigger Level Red	-	-	-	-	-	-	-	-	-	-	-	-	8.48	8.48	8.48	8.48	8.48	8.48	8.48	8.48	8.48	8.48	8.48	8.48	8.48		
	Trigger Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1		
	Trigger Level White	-	-	-	-	-	-	-	-	-	-	-	-	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8		
	Control Level Red	-	-	-	-	-	-	-	-	-	-	-	-	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98	7.98		
	Control Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		
	Control Level White	-	-	-	-	-	-	-	-	-	-	-	-	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3		
GMW6	Red Valve	0	0	0	0	0	0.1	0.1	0	0	0.2	0.1	0.1	3.9	2.6	2.6	2.9	4	3.6	4.6	4.2	3.8	3.8	3.8	3.8	Red Valve, 26.3m depth		
	Yellow Valve	0	0	0	0	0	0.1	0.1	0	0	0.2	0.1	0.2	1.4	2.9	2.4	3.1	1.5	2.1	1.9	3.5	3.3	3.6	3.2	3.2	Yellow Valve,15m depth		
	White Valve	0	0	0	0	0	0	0.1	0	0	0.1	0.2	0.2	2	1.4	1.3	1.4	1.7	1	1.4	1.6	1.7	1.9	1.8	1.8	White Valve, 5m depth		
	Trigger Levels	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Control Levels	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Trigger Level Red	-	-	-	-	-	-	-	-	-	-	-	-	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3		
	Trigger Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	5	5	5	5	5	5	5	5	5	5	5	5	5		
	Trigger Level White	-	-	-	-	-	-	-	-	-	-	-	-	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76		
	Control Level Red	-	-	-	-	-	-	-	-	-	-	-	-	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8		
	Control Level Yellow	-	-	-	-	-	-	-	-	-	-	-	-	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5		
	Control Level White	-	-	-																								

METHANE (% by Volume)													CARBON DIOXIDE (% by Volume)													
Location	Valve	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Comments
GMW12	Red Valve	0	0	0	0	0	0	0.1	0	0	nt	0.2	0.2	0.1	0.2	0.1	0.8	0.2	0.2	0.3	0.2	0.3	nt	1.8	0.8	Red Valve, 26.3m depth
	Yellow Valve	0	0	0	0	0	0	0.1	0	0	nt	0.2	0.2	0.1	0.8	0.3	0.2	0.3	0.2	0.3	0.1	0.1	nt	0	0.4	Yellow Valve,15m depth
	White Valve	0	0	0	0	0	0	0.1	0	0	nt	0.3	0.2	0.1	0.3	0.2	1.1	0.5	0.3	0.4	0.5	0.4	nt	1.3	1.1	White Valve, 5m depth
	Trigger Level Red	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
	Trigger Level Yellow	1	1	1	1	1	1	1	1	1	1	1	1	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
	Trigger Level White	1	1	1	1	1	1	1	1	1	1	1	1	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
	Control Level Red	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	4	4	4	4	4	4	4	4	4	4	4	4	4
	Control Level Yellow	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Control Level White	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5	5	5	5	5	5	5	5	5	5	5	5	5	
GMW13	Red Valve	0	0	0	nt	0	0	0.1	0	0	0.1	0.2	0.2	1.5	1.2	1	nt	1.2	1.4	1.4	1.3	1.6	1.3	1.2	1.2	Red Valve, 26.3m depth
	Yellow Valve	0.1	0	0.1	nt	0	0.1	0.2	0.1	0	0.2	0.2	0.2	5.1	5.5	5.4	nt	5.8	5.7	6	5.6	5.1	5.2	5.2	6.1	Yellow Valve,15m depth
	White Valve	0	0	0	nt	0	0.1	0.1	0	0	0.1	0.2	0.2	0	0.5	0.3	nt	3	3.7	3.9	3.9	3.5	3.6	3.5	2.7	White Valve, 5m depth
	Trigger Level Red	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
	Trigger Level Yellow	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	6	6	6	6	6	6	6	6	6	6	6	6	6
	Trigger Level White	1	1	1	1	1	1	1	1	1	1	1	1	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82
	Control Level Red	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
	Control Level Yellow	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Control Level White	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.32	5.32	5.32	5.32	5.32	5.32	5.32	5.32	5.32	5.32	5.32	5.32	5.32	
GMW14/14A	Red Valve	nt	nt	nt	nt	nt	nt	nt	0	well flooded	0.3	0.2	0.2	nt	nt	nt	nt	nt	nt	nt	0	well flooded	3.4	3.4	4	Red Valve, 26.3m depth
	Yellow Valve	nt	nt	nt	nt	nt	nt	nt	0.3	well flooded	0.7	0.5	0.3	nt	nt	nt	nt	nt	nt	nt	0	well flooded	2.1	3.1	2.8	Yellow Valve,15m depth
	White Valve	nt	nt	nt	nt	nt	nt	nt	0.3	well flooded	0.6	0.4	0.3	nt	nt	nt	nt	nt	nt	nt	0	well flooded	2.6	3.7	3.5	White Valve, 5m depth
	Trigger Level Red	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Trigger Level Yellow	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
	Trigger Level White	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
	Control Level Red	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1
	Control Level Yellow	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Control Level White	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	
GMW1**	Red Valve	1.7	4.3	2	2	8.6	3.4	3.6	2.8	0.7	0	0.1	0.2	4.6	7.4	6.4	3.4	6.3	4.4	7.1	4.7	3.6	0.7	0.4	0.3	Red Valve, 23.5m depth
	Yellow Valve	3.7	10.7	9.8	28.4	37.4	19.4	6.9	10.7	4.5	0	0.1	0.7	6.5	3.4	3.9	5.5	10.1	10.6	10.8	3.7	1.5	0.1	0	2.7	Yellow Valve,14.7m depth
	White Valve	0	0.1	0.1	0.1	0.2	0.1	0.1	0	0	0	0.1	0.7	0.1	0	1.3	0.1	0.1	0.6	0.1	0.3	0	0	0	1.3	White Valve, 6.5m depth
GMW8*	Yellow Valve	8.3	6.7	7.2	5.3	3.3	2.7	4.4	4.9	5.2	6.5	8.3	9.6	11.8	11.4	10.4	8.8	7.5	6.6	9.2	10.7	10.5	10.4	10.1	10.1	Yellow Valve,17.5m depth
	White Valve	0	0	0	0	0	0	0.1	0	0	0.1	0.2	0.2	5.5	5.1	4.4	4.6	5.3	5	5.1	5.9	5.8	5.7	5.5	5.3	White Valve, 5.7m depth
GMW9*	Red Valve	0	0	0	0	0	0.1	0.1	0	0	0.1	0.2	0.2	2.3	2	1.8	1.8	1.9	1.8	2	2.2	2.2	1.3	1.6	1.9	Red Valve, 27m depth
	Yellow Valve	33.5	30.8	31.8	25.9	22	26.9	24.7	31.6	33.8	35.6	35.4	34.2	13.3	13.5	11.4	12.8	13.5	14.2	14.9	14.8	13.3	11.8	11.2	11.6	Yellow Valve,15m depth
	White Valve	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.3	0.3	0.2	0.2	0.2	0.1	0.2	White Valve, 8.5m depth
GMW10*	Red Valve	0	0	0	0	9.4	10.1	17.7	39.9	11.1	0	0.1	0.2	1.5	1.6	2.3	2.7	10.3	11.1	12.4	9.3	8.1	5.2	5.3	6.9	Red Valve, 19.5m depth
	Yellow Valve	0	0	0	0	3.7	4.6	12.9	34.9	8.2	0	0.1	0.2	1.5	1.6	2.2	2.6	10.6	11	12.6	9.4	7	4.4	4.8	6.4	Yellow Valve,15m depth
	White Valve	0	0	0	0	0	0.3	0.8	27.1	28	0	0.2	0.3	1.5	1.6	2.5	8.3	10	9.2	9.3	9.6	8.5	8.4	9.8	9.2	White Valve, 8m depth
GMW17**	Red Valve	0	0	0	nt	0	0	0.1	0	0	0.1	0.2	0.2	1.6	1.4	1.2	nt	1.3	1.2	1.4	1.5	1.5	1.6	1.5	1.6	Red Valve, 26.3m depth
	Yellow Valve	0	0	0	nt	0	0	0.1	0	0	0.1	0.2	0.2	4.6	3.6	3.5	nt	0.1	3.2	3.8	5.8	6	6.5	6.2	6.3	Yellow Valve,15m depth
	White Valve	0	0	0	nt	0	0	0.1	0	0	0.1	0.2	0.1	5.6	3.1	2.7	nt	5.2	4.5	4.3	4.8	2.9	2.6	3.5	4.6	White Valve, 5m depth
GMW18**	Yellow Valve	0	0	0	nt	0	0	0	0	0	0.1	0.2	0.2	2.2	2.4	0	nt	2.2	2.5	1.6	0	1.3	0	0	3	Yellow Valve,12 depth
	White Valve	0	0	0	nt	0	0	0.1	0	0	0.1	0.2	0.1	6.1	6.3	6	nt	4.9	5.3	4.3	6.5	6.2	6.2	6.3	6.5	White Valve, 5m depth

- Notes:
1. Water denotes 'water in well - reading abandoned'.
2. NT denotes 'reading not taken'.
3. NT in GMW14 is due to cattle quarantine paddock around well location.
4. Where the asterisc (*) is present, no trigger levels have been set, as high levels of methane and carbon dioxide gas are recorded. This is likely to be associated with the presence of bog/marshland.
5. Where two asteriscs (**) are present, no trigger levels have been set, as not require by the Permit (Reference [2]).

	Exceedance of Trigger
	Exceedance of Control