NANT Y CAWS
PHASE 1
CLOSED LANDFILL

ENVIRONMENTAL PERMIT 34183

Environmental Monitoring Review

Report Number 2280r1v1d0822

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1 INTRODUCTION

Carmarthenshire County Council (CCC) maintains Nant y Caws (NYC) Phase I Landfill which is located east of Carmarthen and west of Cross Hands (see Figure 1). The landfill is in Aftercare and has not accepted waste since March 1997. The landfill has been partially restored, with a full FML (Flexible Membrane Liner) placed over the capped area. The site is regulated by Natural Resources Wales (NRW) through Permit No. EA WML 34183.

The Permit requires routine environmental monitoring to be undertaken. Geotechnology Ltd (Geotechnology) has been commissioned by CCC to undertake the monitoring since April 2013 and to report the results. This annual review of the monitoring data is based on the available data gathered up to March 2022.

This report includes data provided to Geotechnology by third parties.

2 OVERVIEW OF SITE ACTIVITY

Key dates relating to the operation, closure, capping and regulatory control of the landfill are provided in Table 2-1. A detailed site plan showing surface topography and monitoring infrastructure is provided in Figure 2.

Table 2-1 Summary of Key Dates

Date	Activity
1984	Phase 1 Landfill designed
12 Dec 1985	Waste Disposal Plan (WDP) issued by Carmarthen District Council
1 May 1994	WDP converted to a Waste Management Licence (WML)
1997	Cessation of landfilling operations
1998	Installation of gas and groundwater monitoring infrastructure
Dec 1999	Final FML capping completed
1 Jan 2002	Modification to WML by Environment Agency
2002/2003	Geotechnology undertakes hydrogeological risk assessment and prepares monitoring action plans based on limited data set
2009	Leachate Breakout on Southern Bund – Remedial measures implemented
6 April 2010	WML automatically became an Environmental Permit in accordance with the Environmental Permitting Regulations (England and Wales) 2010
2010	Leachate treatment system undergoing improvements
20 Jan 2015	Landfill formally taken into Aftercare by NRW
2016	Permit Variation issued to operator of leachate treatment system (EPR/PP3338CQ) CWM Environmental placed soils over central part of aimed at restoring surface drainage patterns
July 2020	Investigation of capping soil thickness for CWM Environmental

Key features of the site are highlighted on Figures 2 and 3. The latter figure is a conceptual site model previously developed for a Hydrogeological Risk Assessment by Geotechnology.

2.1 Landfilling

The landfill was designed in 1984 by W.S. Atkins and Partners and was based on a containment principle. However, there are no details available to demonstrate that any form of engineered containment was adopted. Instead, the design is considered to rely on the in-situ glacial till to provide an impermeable base. A series of leachate interceptor drains are shown on the original site plans. The design drawings also show that Phase 1 was divided into a series of working cells with a total of 25 shown on the plan.

This original plan also describes the working method, which involved vertical layering with working faces of 2 to 2.5m which are then capped with 300mm of inert fill. Subsequent working faces were pushed over each completed layer to form four layers, giving a total landfill thickness of between approximately 8 and 10m. This data was broadly confirmed in subsequent drilling for internal gas wells in 1998, though a maximum waste thickness of 14m was obtained. It is known that over-tipping and further waste layering was undertaken at the site in late 1994 and early 1995 which may account for the increased thickness observed. The original design also shows that at the site boundary a cut-off ditch was constructed which is further isolated from the refuse by a clay bund.

Landfilling ceased in March 1997 and the landfill has not received any wastes since then.

2.2 Capping

During the operational period, measures were undertaken to reduce the leachate yield from the site in the form of FML applications to the flanks. Initially, a 0.5mm polypropylene membrane was used on the southwestern flank though this has been replaced by a 2mm

double textured HDPE. All the flanks of the landfill now have a 2mm textured HDPE cover, which in turn is welded to a 1mm smooth HDPE liner on the plateau cap. Prior to the final capping work being completed in December 1999, an intermediate layer of 0.5m of clay soil cover was placed, though it is locally thicker in hollows.

The Phase 1 landfill has therefore been capped since December 1999.

At the request of the CWM Environmental, an inspection of the capping was undertaken during July 2020. The assessment was aimed at assessing the thickness of soil cover at the site as part of a feasibility study evaluating using part of the site as a solar farm.

2.3 Restoration

The agricultural restoration of the Phase 1 landfill continued from 1999 up until 2003, although there are no precise records. The restoration process involved the importation of sub-soils from many extraneous sources. Geotechnology undertook a soil audit of the areas completed up till November 2002. This is documented in Geotechnology report 237/0/1102 issued in November 2002. Geotechnology was not involved in the final stages of restoration at the landfill.

Agricultural post and wire fencing was placed and the surface was seeded to encourage surface soil stabilisation on the restored cap. The fields created by the fences are present today. The vegetation within the fields is, however, overgrown and does not appear to be being grazed or managed in accordance with the intention of the Post Closure Working Plan.

Following the removal of several stockpiles, CWM Environmental placed materials over the central part of the site during 2016. These works were aimed at reinstating the landfill landform and protection of the capping systems.

2.4 Leachate Management

The leachate at the site is collected by a gravity fed under waste drainage system comprising a 225mm diameter spine drain receiving inflows from 150mm diameter spur drains. The drainage system is accessed from the landfill surface by leachate inspection chambers, which rise through the waste. The chambers allow inspection of the leachate system and permit access for routine maintenance, leachate level measurement and cleaning. The position of each chamber has been re-surveyed by Geotechnology and is shown on Figure 2. Leachate inspection chambers 9 and 16 could not be found during the survey.

In addition to the under drainage works undertaken during the infilling, further leachate drains were installed at the toe of the flanks to intercept perched leachate which was historically observed to break out along the flanks. This work was completed during the capping period of the restoration in 1999. Both the toe drains and under drain system flow under gravity to the pumping sump from where the leachate is pumped, either to the nearby concrete lined leachate lagoon or the treatment plant. Following treatment, the leachate is discharged to the Afon Bantwen under discharge consent. An application to vary the Permit was prepared by Geotechnology, at the request of CCC in 2015, and this was accepted by NRW in 2016.

3 REGULATORY FRAMEWORK

The Aftercare Management Plan sets out the relevant regulatory framework against which the environmental protection measures should be evaluated. These criteria are summarised in the following sections.

3.1 Leachate Level Limit

The maximum level of leachate that should be observed from a leachate inspection chamber is 0.5m as measured from the base of the chamber.

3.2 Leachate Chemistry Control Levels

Control levels for assessing leachate chemistry are provided in Table 3-1.

Table 3-1 Leachate Control Levels

	Ammoniacal Nitrogen	Chloride	Potassium
	mg l^{-1}	mg l^{-1}	mg l^{-1}
Current Discharge Consent from Effluent Treatment Plant	**4**		
Leachate Quarterly Control Level for L1	70	250	140
Daily Leachate Control Levels	4		

3.3 Groundwater Compliance Levels

Current groundwater trigger and control levels are summarised in Table 3-2.

Table 3-2 Trigger Levels for Emissions to Groundwater

	Ammoniacal Nitrogen	Chloride	Potassium
	mg l^{-1}	mg l^{-1}	mg l^{-1}
Groundwater Trigger Level BH101, 103, 104, 105 and 117	10	250	40
Groundwater Control level BH101, 103, 104, 105 and 117	4	150	30

3.4 Surface Water Control Levels

Current surface water control levels are summarised in Table 3-3.

Table 3-3 Control Levels for Emissions to Surface Water

	Ammoniacal Nitrogen	Chloride	Suspended Solids
Location	mg l^{-1}	mg l^{-1}	mg l^{-1}
SW1	0.6	150	
Cap run-off discharge			50 mg/l
French Drain Discharge	4		

3.5 Perimeter Gas Compliance Levels

Currently applicable emission limits for the perimeter gas wells are summarised in Table 3-4.

Table 3-4 Landfill Gas in External Monitoring Boreholes Emission Limits

Perimeter gas position	Carbon Dioxide Action Level (% v/v)	Methane Compliance Limit (% v/v)
All positions	3	1

Action levels are for internal use by CCC while methane compliance limits are a Permit requirement.

4 MONITORING NETWORK PERFORMANCE

To demonstrate that the site is functioning as designed, a monitoring programme is being implemented. The current programme is managed by CCC with the monitoring of leachate quality, downgradient groundwater, surface water and external landfill gas currently undertaken by Geotechnology. Upgradient groundwater wells are sampled by the current operators of the adjacent operational landfill, CWM Environmental. The available monitoring infrastructure is shown on Figure 2.

A summary of the current monitoring programme is provided in Table 4-1.

Table 4-1 Current Monitoring Programme

Item	Monitoring Point	Type of Monitoring	Monitoring Frequency	Relevant Working Plan	Party Responsible
A	Landfill leachate level	Level and Conditional Observations	Monthly for 12 months starting 2014 and then quarterly	See WP10	Needs to be clarified*
B	Landfill leachate – L1	Composition	Six monthly	See WP10	Geo (access required)
C	Leachate Breakout - Phase 1 flanks (including toe drain)	Visual	Quarterly	See WP10	Geo
D	Upgradient Groundwater – BH203, BH205	Composition		Data provided by CWM Environmental	CCC/CWM
E	Downgradient Groundwater – BH101, 103, 104, 105, 117	Level	Quarterly	See WP11	Geo
F	Downgradient Surface Water – SW1, SW4	Composition	Quarterly	See WP12	Geo
G	Internal landfill gas	Composition	Monthly	See WP13	Infinis
H	French Drain	On-site measurement of composition	When observed to be flowing during inspections by WEBS	See WP12	Needs to be clarified *
I	Run-off Discharge	Composition	Quarterly	See WP12	Geo
J	Leachate Discharge	Composition	Monthly	See WP10	Needs to be clarified *
K	Contingency Surface Water Sample Points	Composition		See WP12	Geo
L	Perimeter landfill gas - BH102, 106, 107, 109, 110, 111, 113, 114, 115, 118, 119, 120	Composition	Quarterly	See WP14	Geo
M	Monitoring infrastructure integrity	Observational	Inspect each point when sampling	See WP10 – WP14	Geo
N	Topographic Survey and Settlement Assessment	Topographic Survey	Every 5 years starting 2015	See WP15	Geo
Note: * Geotechnology understands that CCS has appointed a new contractor to manage the leachate treatment system. It is unknown if the new contractor has been requested to continue to undertake the monitoring identified – this monitoring was previously undertaken by WEBS					

4.1 Monitoring Network

Each time Geotechnology undertakes the monitoring, an inspection of the monitoring infrastructure is also completed. Since 2013, clearance of vegetation along the northwestern edge of the landfill has taken place. Routine control of the vegetation significantly aids the safe collection of samples but this has unfortunately not been undertaken in recent months. As a consequence, SW1 is not easily or safely accessible.

Other minor repairs have been undertaken as required to headworks of several wells. Several headworks still, however, require improvement.

4.2 Sample Analysis & Laboratory Performance

Samples collected for laboratory testing were submitted to UKAS registered ALS laboratories in cooler boxes. The results from the laboratory analysis have been compiled as follows:

- Appendix 1: Laboratory Certificates
- Appendix 2: Leachate Chemistry
- Appendix 3: Groundwater Chemistry
- Appendix 4: Surface water Chemistry

In previous years, the operators of the leachate treatment plant undertook more frequent monitoring of the leachate prior to and following treatment. They also monitored the quality of a French drain along the southern perimeter of the site that was previously installed to collect leachate outbreaks. It is unclear if this data is still being gathered by the new contractor.

4.3 Site Observations

During the first round of sampling in April 2013, an oil sheen was noticed on the surface of the sample taken from BH104. This has not been observed since.

The restored landfill cap is largely covered by good vegetative cover and appears largely visibly stable. On the eastern flanks and most of the plateau, the landfill is parcelled into grassed fields. In some areas, drainage appears to be poor with reeds developing.

In recent years, the western and northern portions of the landfill have been reprofiled by CWM Environmental. Most of the flanks in the northern and western boundary of the landfill have self-seeded, resulting in the proliferation of many dwarf trees (mainly willow), gorse, broom and other flora. Whilst this is not in accordance with the species proposed in the Post Closure Working Plan, they have had the desired effect of stabilising the slopes, especially the near surface restoration soils. No evidence of instability, failure or leachate breakout was observed in the walkovers undertaken during 2020 and 2021.

Leachate breakout has previously occurred on the southern bund of the landfill. Measures to collect and treat excess leachate have been implemented by CCC. In the same corner, the capping membrane HDPE is exposed and damaged over an area of approximately $1m^2$. Based on visible vehicle tracks, Geotechnology suspects that trafficking has primarily caused the damage rather than any failure of the soil cover. In the southeastern corner of the landfill, Geotechnology suspects perching of leachate within the waste as the ground surface is soft and fully saturated.

The access road down to the leachate treatment plant is tarmacadam and is in good condition.

4.4 Topographic Survey

The landform at Phase 1 has been surveyed on many occasions, the most recent of which was in 2019 by Geotechnology, at the request of CWM environmental. Given this recent survey, the next topographic survey should be scheduled for 2024. An isopachyte comparing the 2019 land surface with the 2015 land surface is provided in Appendix 5.

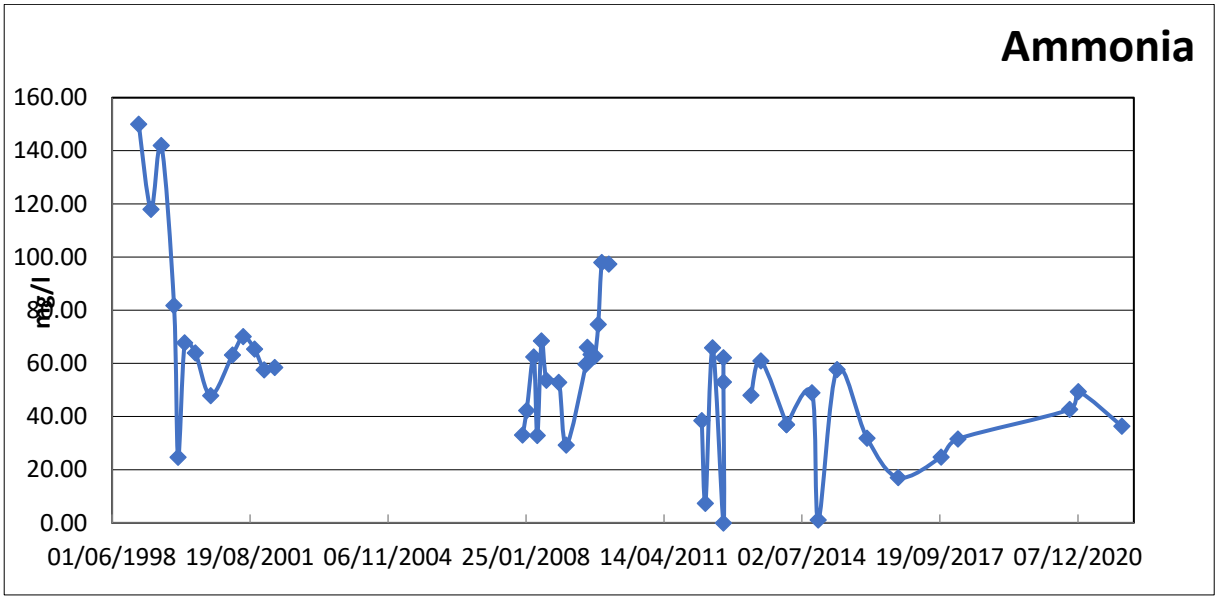
5 LEACHATE

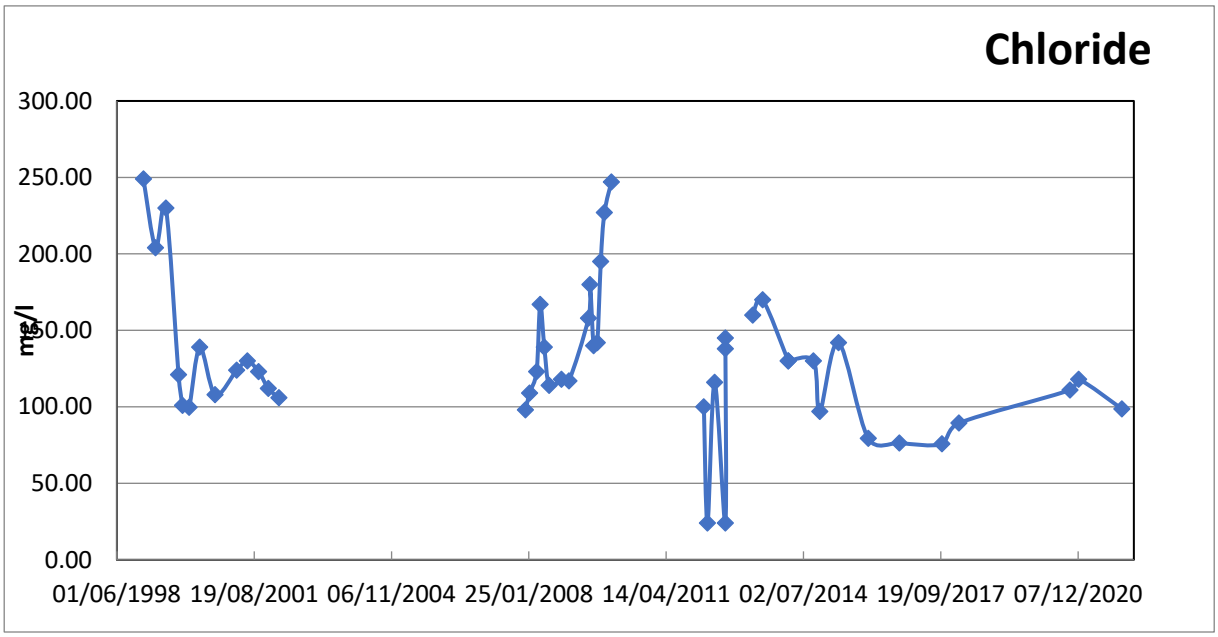
All the leachate results are presented in Appendix 2.

5.1 Leachate Quality

Leachate chemistry has been monitored between 1998 and 2002 and from December 2007 to 2022. The results are graphically illustrated in Appendix 2. More frequent monitoring of the leachate quality and discharge quality is undertaken by the contractor appointed by CCC to operate the leachate treatment plant. This data is reported in a separate annual report.

Leachate continues to be moderately mineralised with electrical conductivity of approximately 1000-1300 microS/cm. The dominant contaminants within the leachate are ammonia and potassium. The concentration of these parameters and others is variable but appears to be declining with time, as shown below.





Trace metals within the leachate remained at very low concentrations during 2020 and 2021, with several non-detectable and all below freshwater Environmental Quality Standards (EQS). Low level trace organics have also been detected in recent years. For instance, in 2017, <0.001 mg/l total PAH and 0.0012 mg/l mecoprop was detected and in 2018 0.00255 mg/l mecoprop. In 2020 and 2021, mecoprop was below the level of analytical detection and the only PAH detected was Benzo(a)pyrene at 0.00000302 mg/l.

Given the potentially declining source concentrations, Geotechnology suggests that CCC maintains scrutiny of the leachate treatment requirements to ensure resources are being effectively used. The treatment goals and operation of the leachate treatment plant and the potential for cost savings using alternate techniques should be regularly considered at least every 5 years.

5.2 Assessment against Control Levels

The spot samples collected by Geotechnology to date indicate that leachate quality falls below the control levels (see Table 5-1). The more detailed routine monitoring undertaken by the leachate treatment operator should also be scrutinised.

Table 5-1 Evaluation of Leachate Chemistry

	Ammoniacal Nitrogen	**Chloride**	**Potassium**
	mg l^{-1}	**mg l^{-1}**	**mg l^{-1}**
Leachate Quarterly Control Level for L1	**70**	**250**	**140**
2016 Maximum value from spot sampling at L1	31.9	79.4	37.6
2017 Maximum value from spot sampling at L1	24.8	75.8	31.1
2018 Maximum value from spot sampling at L1	31.6	89.4	30.7
2020 Maximum value from spot sampling at L1	49.4	118	47.4
2021 Maximum value from spot sampling at L1	36.4	98.7	34.5

6 GROUNDWATER

All the groundwater results are provided in Appendix 3.

To assist with describing the hydrochemistry of groundwater within the vicinity of Phase I, several borehole groupings have been created. The groupings are summarised below and are based on the position of each monitoring position relative to Phase I (see Figure 2).

- BH203 and BH205 – Up-gradient of Phase 1
- BH117 – across gradient from Phase 1 on Eastern side
- BH108 – across gradient from Phase 1 on Western side
- BH101, BH103, BH104 and BH105 – Down-gradient of Phase 1

Results for BH108 and BH117 are only available since 2008, whereas downgradient monitoring records are available since 1998.

6.1 Groundwater Quality

The persistent relatively low electrical conductivity (350-550 microS/cm) of the circumneutral downgradient groundwater indicates that groundwater is of relatively good quality despite the proximity of the monitoring positions to the unlined landfill. Groundwater is less mineralised than leachate but does become locally, slightly more mineralised in the wells along the southern edge of the landfill. In recent years, ammonia has failed to be detected in any groundwater wells downgradient of the site (apart from 0.676 mg/l at BH117 in September 2020) and potassium has been below 1.0 mg/l.

Trace metals have been detected, at times, in groundwater downgradient of the landfill but at low concentrations. In 2021, no substances were found above their freshwater EQS. Speciated PAHs were, however, detected.

Hazardous substance cadmium has previously been detected in groundwater upgradient and downgradient of the landfill but at a concentration lower than the freshwater EQS. Neither cadmium, mercury or lead were detected during the latest year of monitoring. Nickel was detected on one occasion, at BH104 as noted previously, but at concentrations below freshwater EQS.

Given the low TOC content of leachate, all groundwater samples have previously been found to contain <25 mg/l TOC, suggesting that the landfill is not a significant source of organic contaminants. In 2021, speciated PAHs were detected upto a total of 0.000386mg/l. Mecoprop has not been found above the detection limit in any samples tested since 2019.

6.2 Assessment against Compliance Levels

The groundwater chemistry observed in 2021 is similar to that observed previously and no breaches of the control and trigger levels occurred, as shown by the summary in Table 6-1.

Table 6-1 Comparison of Groundwater Chemistry with Compliance Levels

	Potassium	Ammoniacal Nitrogen	Chloride
	mg/l	mg/l	mg/l
Trigger Levels (BH101, 103, 104, 105 and 117)	40	10	250
Control Levels (BH101, 103, 104, 105 and 117)	30	4	150
Maximum Value in Groundwater (2016)	4.39	0.631	26.8
Maximum Value in Groundwater (2017)	1.21	0.39	25.6
Maximum Value in Groundwater (2018)	0.966	0.261	25.3
Maximum Value in Groundwater (2019)	1.13	<0.2	25.3
Maximum Value in Groundwater (2020)	1.23	<0.2	24.5
Maximum Value in Groundwater (2021)	1.02	<0.2	20.4

7 SURFACE WATER

All the surface water results are presented in Appendix 4.

7.1 Contributions

Sample points SW1, SW2, SW3 and SW4 monitor the stream that runs west to east along the southern boundary of the landfill. The location of the surface water sample points is shown on Figure 2.

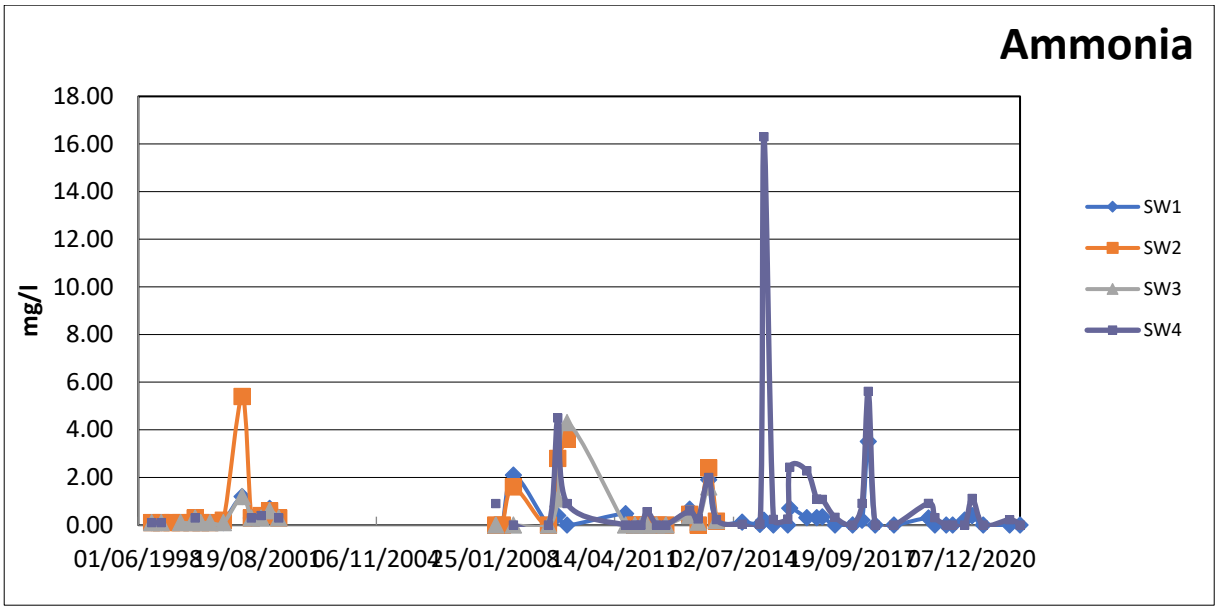
Surface water quality is primarily influenced by input from the CWM treatment lagoons west of the site, the level of leachate treatment achieved at the Phase I treatment plant and surface run-off containing elevated suspended solids from the landfill upgradient of Phase I.

7.2 Quality

Surface water quality observed during 2020 and 2021 is similar to that observed previously.

The quality of surface water leaving the site at SW1 (the furthest point monitored downgradient of the site) is typically improved (more dilute) than the quality issuing into the stream just upstream of SW4 from the settlement lagoons to the west. As highlighted by the graphs reproduced below and further graphs in Appendix 4, this is best observed by comparing the higher concentration of several parameters observed at SW4 with the lower concentrations at SW1. This evaluation demonstrates that water quality at SW1 is dominated by the water quality at SW4 which in-turn is directly downgradient of the CWM settlement lagoons and not related to the Phase I closed landfill or leachate treatment.

Increased concentrations of suspended solids, potassium and chloride are sometimes observed at SW1. This is considered to be due to run-off from the upgradient phases of landfill that enters the stream just above the sample point. This run-off enters from the north and can be traced back to sources upgradient of the Phase I landfill – primarily mobilisation of sediment from access tracks / open areas. This input can be clearly seen in Plate 7-1.


Ammonia
mg/l
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
01/06/1998
19/08/2001
06/11/2004
25/01/2008
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02/07/2014
19/09/2017
07/12/2020
SW1
SW2
SW3
SW4

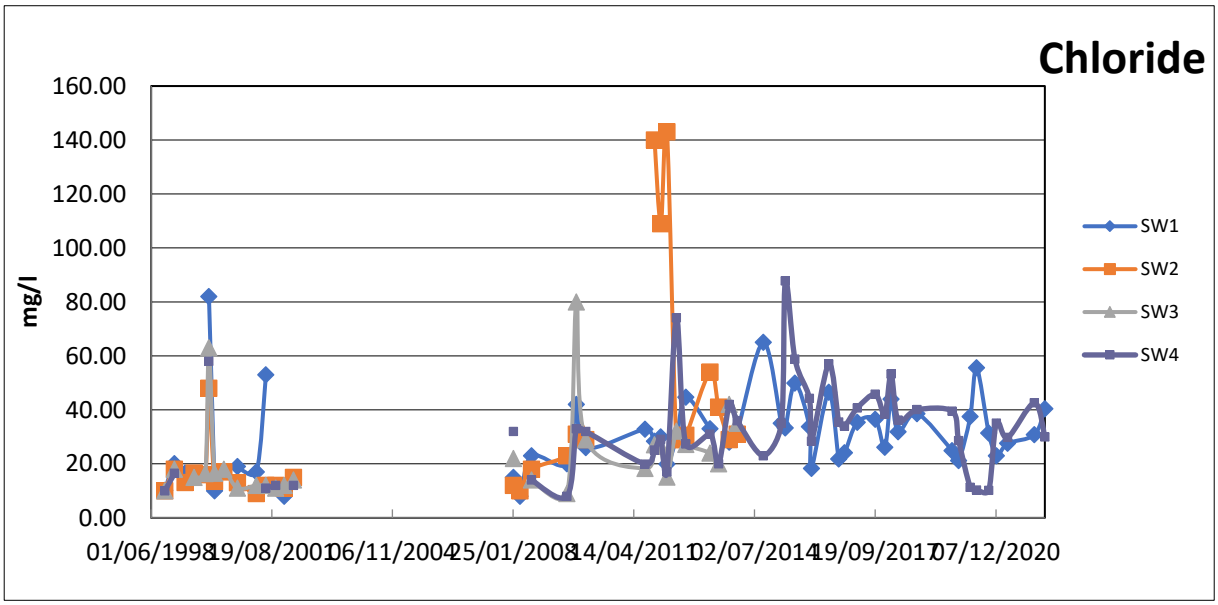
Chloride
mg/l
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
SW1
SW2
SW3
SW4

Plate 7-1 View north over confluence just above sample point SW1

7.3 Assessment against Control Levels

All recent surface water quality was below the emission limits, as summarised in Table 7-1, apart from elevated ammonia. As can be seen by reviewing the graph above, the cause of the increased ammonia at SW1 is due to elevated ammonia upstream of the landfill at SW4. This is linked to the discharge from the lagoons to the west of the site.

Table 7-1 Comparison of Surface Water Data with Emission Levels

	Ammoniacal Nitrogen as N	Chloride	Suspended solids
	mg/l	mg/l	mg/l
	Ammoniacal Nitrogen	Chloride	Suspended Solids
Location	mg l^{-1}	mg l^{-1}	mg l^{-1}
Control Levels			
SW1	0.6	150	
Cap run-off discharge			50
Max values in 2017			
SW1	0.2	26.1	
Max value in cap runoff			5.95
Max values in 2018			
SW1	3.51	44	
Max values in 2019			
SW1	0.299	24.9	25.9
Cap run-off	-	-	12
Max values in 2020			
SW1	0.399	55.6	
Cap run-off			<2
Max values in 2021			
SW1	<0.2	30.8	9.5
Cap run-off			<2

8 PERIMETER GROUND GAS

During the quarterly monitoring undertaken since April 2013, all methane concentrations have been below the Permit threshold. Methane has been below 0.3% at all monitoring positions since 2014 apart from during 2020 when 0.4% was reported by the instrument.

Carbon dioxide (CO_2) has been detected at several positions along the eastern boundary (BH114, BH115, BH116 & BH118). The latest monitoring is broadly similar to the previous results with all wells found to contain ground gas with less than 0.4% carbon dioxide apart from BH116. At this position, 2.4% was detected at the end of Q3 and 4.8% in Q4 2019. In 2020, 4.8% was detected again at BH116 and 3.7& at BH117. Gas flow was measured to be <0.1 l/h on all occasions apart from a reading of 0.3l/h at BH116.

As each of the shallow gas wells contain groundwater, the data should be viewed with caution as monitoring gas in wells containing groundwater is not ideal.

9 SUMMARY AND RECOMMENDATIONS

9.1 Environmental Protection

The available data reveals a declining leachate source term. Consequently, the risk to the environment is reducing. With this in mind, CCC should regularly review the operation of the leachate treatment plant to ensure it is an efficient use of resources.

Groundwater and surface water monitoring completed in support of the Permit at Phase I has shown that the landfill is currently having limited impact. The available information shows that the quality of groundwater has not significantly deteriorated since the start of monitoring in 1998.

Potassium is a key contaminant within leachate and despite the mobility of this element it is not significantly elevated in downgradient groundwater. The reason that the landfill is not having a significant impact on groundwater is suspected to be because groundwater has a higher piezometric surface than the basal drainage system of the landfill. The basal drainage system, therefore, intercepts any leachate and groundwater. Consequently, the landfill is largely considered to be hydraulically isolated. The inward groundwater flow may not, however, prevent some outward diffusive transport, as contaminants move from an area of higher concentration to a lower one i.e. from the leachate to the aquifer. This process does not appear to be having a significant impact.

This model is further confirmed by the surrounding groundwater quality which shows little obvious impact from the landfill.

The quality of surface water within the vicinity of the landfill appears to be variable but generally good and is governed by inputs from the surface water treatment lagoons to the west and run-off from the north.

Along the southern flank of the landfill, leachate breakout is known to have previously occurred, but this situation is now being actively managed and controlled by CCC.

9.2 Decommissioning and Surrender

Ahead of the development of the site for the disposal of waste, CCC leased the land from a Mr D Davies as part of a 50-year lease, starting in 1983. Since this time, CWM has purchased the land and is now the landlord. Geotechnology understands that the long-term plan of CCC was to start the process of handing the land lease back to CWM once the materials being stored on the surface have been removed and any remedial works completed. Now that this work has been undertaken Geotechnology suggests that this next stage should be initiated.

During the next phase of site management, Geotechnology understands that CCC will continue to monitor the site and treat leachate and that CWM will continue to be responsible for landfill gas collection and management. Monitoring will continue to be coordinated by CCC until there is no risk to the environment. At that point, a Permit Surrender application will be submitted to NRW bringing together the lines of evidence that demonstrate the site no longer poses a risk to the environment and the infrastructure can be decommissioned. During this period, regular consideration should be given to the performance and suitability of the leachate treatment plant.

Figure 1 Site Location Plan

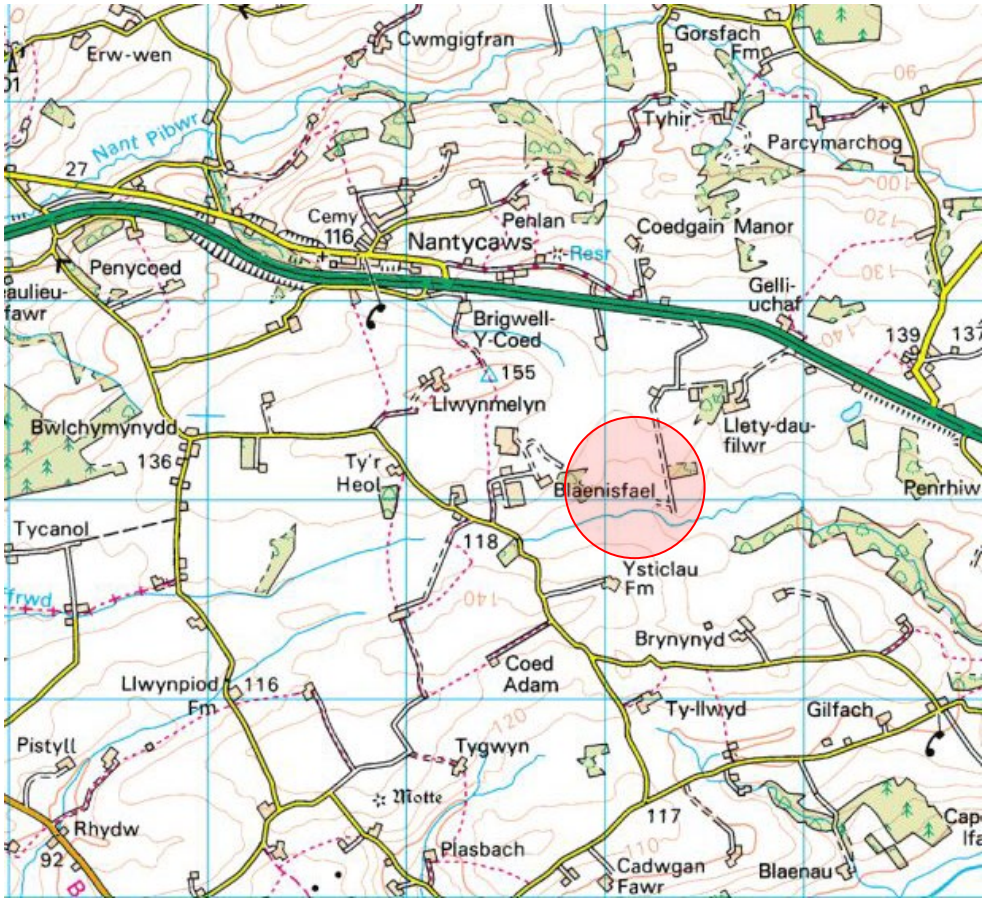

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Figure 2 Available Monitoring Network

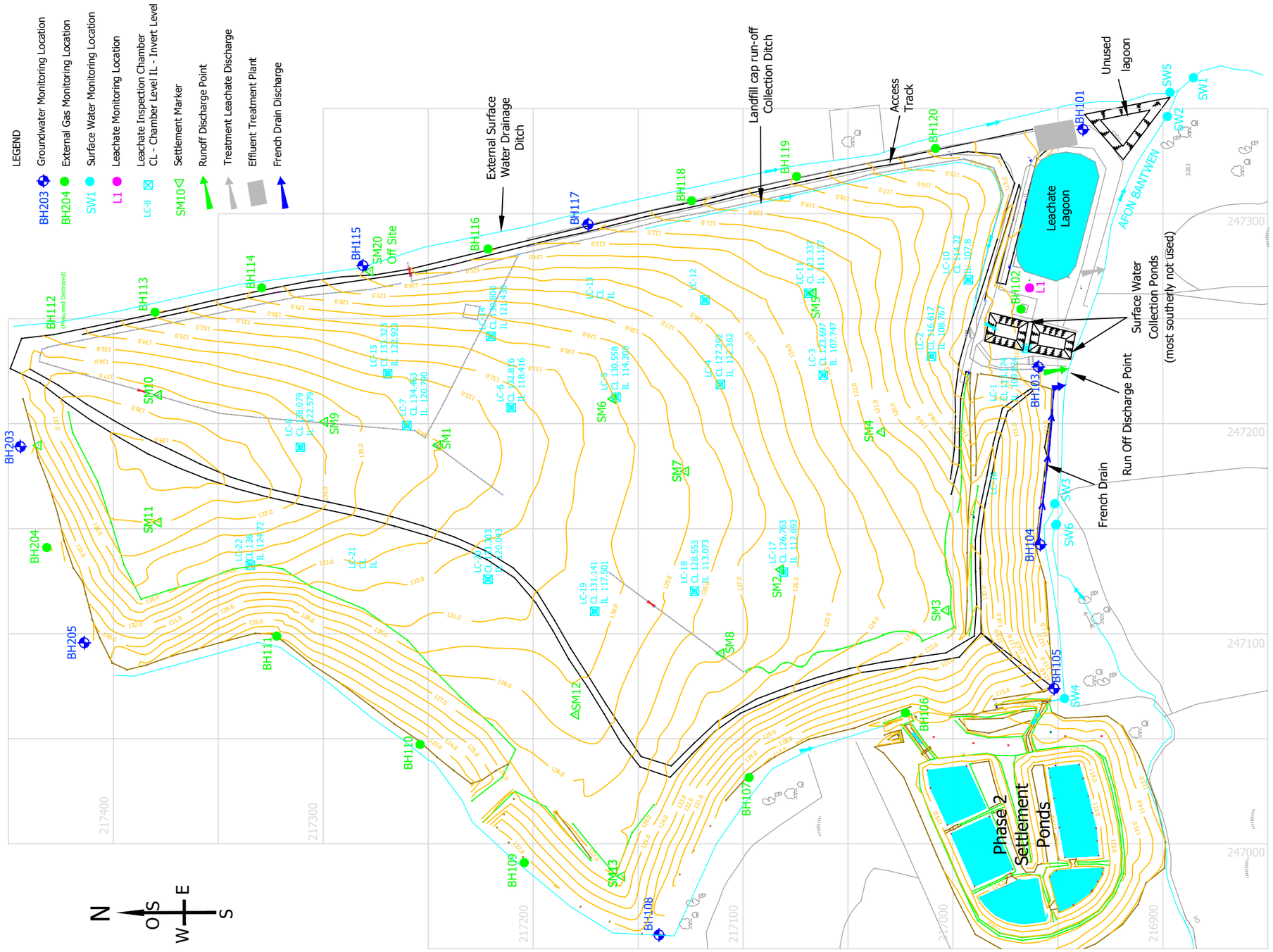
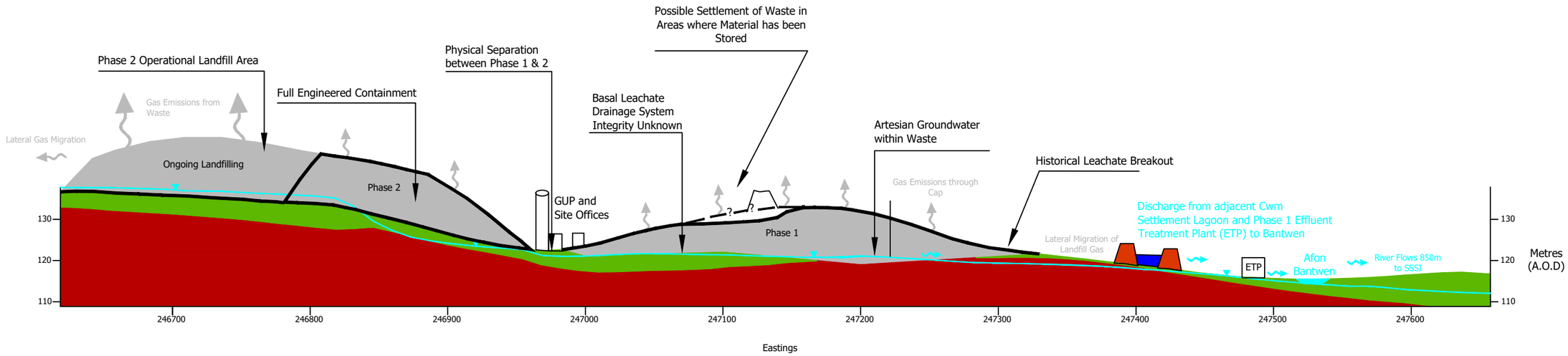


Figure 3 Conceptual Site Model



Legend

- Waste
- Glacial Drift
- Devonian Bedrock
- Potential Landfill Gas Emission
- Potential Seepage to Controlled Water

GUP Gas Utilisation Plant
ETP Effluent Treatment Plant

Note:
Landfill gas can give rise to odour and migrate laterally

NANT Y CAWS
PHASE 1
CLOSED LANDFILL

ENVIRONMENTAL
PERMIT 34183

Environmental
Monitoring Review

Appendix 1
Laboratory Certificates

Report Number 2280r1v1d0822

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Geotechnology
5 Cefn-yr-Allt
Aberdulais
Neath
West Glamorgan
SA10 8HE

Attention: Ben Rees

CERTIFICATE OF ANALYSIS

Date of report Generation:	07 April 2021
Customer:	Geotechnology
Sample Delivery Group (SDG):	210327-32
Your Reference:	
Location:	Carmarthen
Report No:	593047

We received 5 samples on Saturday March 27, 2021 and 5 of these samples were scheduled for analysis which was completed on Wednesday April 07, 2021. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan

Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	210327-32	**Client Reference:**		**Report Number:**	593047
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
23983747	BH10			26/03/2021
23983746	LAGOON IN			26/03/2021
23983745	LAGOON OUT			26/03/2021
23983744	SW2			26/03/2021
23983743	SW4			26/03/2021

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG:	210327-32	**Client Reference:**		**Report Number:**	593047
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)				23983747			23983746			23983745			23983744			23983743		
Customer Sample Reference				BH10			LAGOON IN			LAGOON OUT			SW2			SW4		
AGS Reference																		
Depth (m)																		
Container				500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)
Sample Type				GW	GW	GW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW
Alkalinity as CaCO3	All	NDPs: 0 Tests: 2											X			X		
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 5			X			X			X			X			X	
Anions by Kone (w)	All	NDPs: 0 Tests: 5		X			X			X			X			X		
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 5		X			X			X			X			X		
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 5				X			X			X			X			X
pH Value	All	NDPs: 0 Tests: 5		X			X			X			X			X		
Suspended Solids	All	NDPs: 0 Tests: 4					X			X			X			X		

Validated

CERTIFICATE OF ANALYSIS

SDG:	210327-32	**Client Reference:**		**Report Number:**	593047
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-4+§@	Sample deviation (see appendix)

Customer Sample Ref.			BH10	LAGOON IN	LAGOON OUT	SW2	SW4
Depth (m)			.	.	.	.	.
Sample Type			Ground Water (GW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)
Date Sampled			26/03/2021	26/03/2021	26/03/2021	26/03/2021	26/03/2021
Sample Time			08:10:00	07:55:00	07:45:00	07:35:00	07:20:00
Date Received			27/03/2021	27/03/2021	27/03/2021	27/03/2021	27/03/2021
SDG Ref			210327-32	210327-32	210327-32	210327-32	210327-32
Lab Sample No.(s)			23983747	23983746	23983745	23983744	23983743
AGS Reference							
Component	**LOD/Units**	**Method**					
Suspended solids, Total	<2 mg/l	TM022		34.5 #	11.3 #	18.1 #	47.7 #
Alkalinity, Total as CaCO3	<2 mg/l	TM043				260 #	44.4 #
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	148 #	30.9 #	41.4 #	<0.2 #	<0.2 #
Conductivity @ 20 deg.C	<0.02 mS/cm	TM120	2.38 #	0.944 #	1.03 #	0.465 #	0.136 #
Potassium (Dis.Filt)	<0.2 mg/l	TM152	74.4 #	22.9 #	25.8 #	6.34 #	1.38 #
Chloride	<2 mg/l	TM184	215 #	87.4 #	102 #	20.8 #	18.4 #
pH	<1 pH Units	TM256	7.52 #	8.06 #	7.89 #	8.43 #	7.84 #

Table of Results - Appendix

Method No	Reference	Description
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981;BS EN 872	Determination of total suspended solids in waters
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

Validated

CERTIFICATE OF ANALYSIS

SDG:	210327-32	**Client Reference:**		**Report Number:**	593047
Location:	Carmarthen	**Order Number:**		**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	23983747	23983746	23983745	23983744	23983743
Customer Sample Ref.	BH10	LAGOON IN	LAGOON OUT	SW2	SW4
AGS Ref.					
Depth					
Type	Ground Water	Surface Water	Surface Water	Surface Water	Surface Water
Alkalinity as CaCO3				31-Mar-2021	01-Apr-2021
Ammoniacal Nitrogen	07-Apr-2021	01-Apr-2021	07-Apr-2021	01-Apr-2021	01-Apr-2021
Anions by Kone (w)	30-Mar-2021	30-Mar-2021	30-Mar-2021	30-Mar-2021	30-Mar-2021
Conductivity (at 20 deg.C)	01-Apr-2021	01-Apr-2021	01-Apr-2021	01-Apr-2021	31-Mar-2021
Dissolved Metals by ICP-MS	01-Apr-2021	01-Apr-2021	01-Apr-2021	01-Apr-2021	01-Apr-2021
pH Value	31-Mar-2021	31-Mar-2021	31-Mar-2021	31-Mar-2021	31-Mar-2021
Suspended Solids		28-Mar-2021	29-Mar-2021	29-Mar-2021	29-Mar-2021

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

18. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

19. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.
Standing Committee of Analysts, *The Quantification of Asbestos in Soil (2017).*

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Unit 7-8 Hawarden Business Park
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Hawarden
Deeside
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Tel: (01244) 528700
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email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Geotechnology
5 Cefn-yr-Allt
Aberdulais
Neath
West Glamorgan
SA10 8HE

Attention: Ben Rees

CERTIFICATE OF ANALYSIS

Date of report Generation:	09 April 2021
Customer:	Geotechnology
Sample Delivery Group (SDG):	210402-36
Your Reference:	
Location:	Nantycaws Landfill
Report No:	593461

We received 8 samples on Friday April 02, 2021 and 8 of these samples were scheduled for analysis which was completed on Friday April 09, 2021. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan

Operations Manager

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
24018945	BH101			31/03/2021
24018944	BH103			31/03/2021
24018943	BH104			31/03/2021
24018942	BH105			31/03/2021
24018950	BH117			31/03/2021
24018948	RUNOFF			31/03/2021
24018947	SW1NYC			31/03/2021
24018946	SW4NYC			31/03/2021

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG:	210402-36	**Client Reference:**		**Report Number:**	593461
Location:	Nantycaws Landfill	**Order Number:**		**Superseded Report:**	

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			24018945			24018944			24018943			24018942			24018950			24018948			24018947
Customer Sample Reference			BH101			BH103			BH104			BH105			BH117			RUNOFF			SW1NYC
AGS Reference																					
Depth (m)																					
Container			500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	1lplastic (ALE221)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	1lplastic (ALE221)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	1lplastic (ALE221)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)
Sample Type			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	SW	SW	SW	SW
Alkalinity as CaCO3	All	NDPs: 0 Tests: 7	X			X			X			X			X				X		
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 7		X			X			X			X			X				X	
Anions by Kone (w)	All	NDPs: 0 Tests: 7	X			X			X			X			X				X		
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 8	X			X			X			X			X			X	X		
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 7			X			X			X			X			X				X
pH Value	All	NDPs: 0 Tests: 8	X			X			X			X			X			X	X		
Suspended Solids	All	NDPs: 0 Tests: 3																X	X		

24018946	SW4NYC			HNO3 Filtered (ALE204)	SW										X				
				H2SO4 (ALE244)	SW				X										
				1lplastic (ALE221)	SW		X				X		X				X		X

Validated

CERTIFICATE OF ANALYSIS

SDG:	210402-36	**Client Reference:**		**Report Number:**	593461
Location:	Nantycaws Landfill	**Order Number:**		**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-4+§@	Sample deviation (see appendix)

Customer Sample Ref.			BH101	BH103	BH104	BH105	BH117	RUNOFF
Depth (m)			.	.	.	.	.	.
Sample Type			Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Surface Water (SW)
Date Sampled			31/03/2021	31/03/2021	31/03/2021	31/03/2021	31/03/2021	31/03/2021
Sample Time			13:10:00	12:40:00	12:25:00	12:10:00	13:50:00	12:55:00
Date Received			02/04/2021	02/04/2021	02/04/2021	02/04/2021	02/04/2021	02/04/2021
SDG Ref			210402-36	210402-36	210402-36	210402-36	210402-36	210402-36
Lab Sample No.(s)			24018945	24018944	24018943	24018942	24018950	24018948
AGS Reference								
Component	**LOD/Units**	**Method**						
Suspended solids, Total	<2 mg/l	TM022						<2 #
Alkalinity, Total as CaCO3	<2 mg/l	TM043	225 #	215 #	282 #	272 #	259 #	
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	<0.2 #	<0.2 #	<0.2 #	<0.2 #	<0.2 #	
Conductivity @ 20 deg.C	<0.02 mS/cm	TM120	0.44 #	0.422 #	0.527 #	0.504 #	0.508 #	0.51 #
Sodium (Dis.Filt)	<0.076 mg/l	TM152	14.7 #	12.7 #	10.3 #	11.7 #	13.1 #	
Potassium (Dis.Filt)	<0.2 mg/l	TM152	1.02 #	0.849 #	0.82 #	0.964 #	0.661 #	
Chloride	<2 mg/l	TM184	13.7 #	13.2 #	9.8 #	9.6 #	20.4 #	
pH	<1 pH Units	TM256	8.05 #	7.68 #	7.58 #	7.34 #	7.61 #	8.07 #

10:23:22 09/04/2021

Validated

CERTIFICATE OF ANALYSIS

SDG:	210402-36	**Client Reference:**		**Report Number:**	593461
Location:	Nantycaws Landfill	**Order Number:**		**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-4+§@	Sample deviation (see appendix)

Customer Sample Ref.			SW1NYC	SW4NYC				
Depth (m)			.	.				
Sample Type			Surface Water (SW)	Surface Water (SW)				
Date Sampled			31/03/2021	31/03/2021				
Sample Time			13:30:00	12:15:00				
Date Received			02/04/2021	02/04/2021				
SDG Ref			210402-36	210402-36				
Lab Sample No.(s)			24018947	24018946				
AGS Reference								
Component	**LOD/Units**	**Method**						
Suspended solids, Total	<2 mg/l	TM022	6.95 #	10.2 #				
Alkalinity, Total as CaCO3	<2 mg/l	TM043	154 #	176 #				
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	<0.2 #	<0.2 #				
Conductivity @ 20 deg.C	<0.02 mS/cm	TM120	0.403 #	0.44 #				
Potassium (Dis.Filt)	<0.2 mg/l	TM152	15.5 #	24 #				
Chloride	<2 mg/l	TM184	27.6 #	29.8 #				
pH	<1 pH Units	TM256	8.21 #	8.29 #				

10:23:22 09/04/2021

Table of Results - Appendix

Method No	Reference	Description
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981;BS EN 872	Determination of total suspended solids in waters
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

Validated

CERTIFICATE OF ANALYSIS

SDG:	210402-36	**Client Reference:**		**Report Number:**	593461
Location:	Nantycaws Landfill	**Order Number:**		**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	24018945	24018944	24018943	24018942	24018950	24018948	24018947	24018946
Customer Sample Ref.	BH101	BH103	BH104	BH105	BH117	RUNOFF	SW1NYC	SW4NYC
AGS Ref.								
Depth								
Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Surface Water	Surface Water
Alkalinity as CaCO3	07-Apr-2021	03-Apr-2021	07-Apr-2021	03-Apr-2021	03-Apr-2021		07-Apr-2021	03-Apr-2021
Ammoniacal Nitrogen	09-Apr-2021	09-Apr-2021	09-Apr-2021	08-Apr-2021	08-Apr-2021		09-Apr-2021	09-Apr-2021
Anions by Kone (w)	06-Apr-2021	06-Apr-2021	06-Apr-2021	06-Apr-2021	06-Apr-2021		06-Apr-2021	06-Apr-2021
Conductivity (at 20 deg.C)	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021
Dissolved Metals by ICP-MS	08-Apr-2021	08-Apr-2021	08-Apr-2021	08-Apr-2021	08-Apr-2021		08-Apr-2021	08-Apr-2021
pH Value	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021	07-Apr-2021
Suspended Solids						06-Apr-2021	06-Apr-2021	06-Apr-2021

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

18. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

19. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.
Standing Committee of Analysts, *The Quantification of Asbestos in Soil (2017).*

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Geotechnology
5 Cefn-yr-Allt
Aberdulais
Neath
West Glamorgan
SA10 8HE

Attention: Ben Rees

CERTIFICATE OF ANALYSIS

Date of report Generation:	04 January 2022
Customer:	Geotechnology
Sample Delivery Group (SDG):	211218-65
Your Reference:	
Location:	Carmarthen
Report No:	628143
Order Number:	

We received 14 samples on Saturday December 18, 2021 and 14 of these samples were scheduled for analysis which was completed on Tuesday January 04, 2022. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan

Operations Manager

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
25560740	BH10			16/12/2021
25560736	BH14			16/12/2021
25560730	BH101			16/12/2021
25560728	BH103			16/12/2021
25560726	BH104			16/12/2021
25560724	BH105			16/12/2021
25560735	LAGOON IN			16/12/2021
25560738	LAGOON OUT			16/12/2021
25560729	LEACHATE			16/12/2021
25560727	RUN OFF			16/12/2021
25560731	SW1			16/12/2021
25560725	SW4			16/12/2021
25560734	WERN SW2			16/12/2021
25560732	WERN SW4			16/12/2021

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG: 211218-65 **Report Number:** 628143 **Superseded Report:**
Client Ref.: **Location:** Carmarthen

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)																						
Customer Sample Reference																						
AGS Reference																						
Depth (m)																						
Container			500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	250ml Amber Gl. PTFE/PE (ALE219)	500ml Plastic (ALE208)	H2SO4 (ALE244)	0.5l glass bottle (ALE227)	250ml Amber Gl. PTFE/PE (ALE219)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	0.5l glass bottle (ALE227)	250ml Amber Gl. PTFE/PE (ALE219)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	0.5l glass bottle (ALE227)	250ml Amber Gl. PTFE/PE (ALE219)	500ml Plastic (ALE208)
Sample Type			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Acid Herbicides by GCMS	All	NDPs: 0 Tests: 6				X			X					X					X			
Alkalinity as CaCO3	All	NDPs: 0 Tests: 10					X				X					X						X
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 13		X				X				X					X					
Anions by Kone (w)	All	NDPs: 0 Tests: 13	X				X				X					X						X
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 14	X				X				X					X						X
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 13			X		X						X					X				X
Mercury Dissolved	All	NDPs: 0 Tests: 6					X						X					X				X
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 6				X				X					X					X		
pH Value	All	NDPs: 0 Tests: 14	X				X				X					X						X
Phosphate by Kone (w)	All	NDPs: 0 Tests: 6					X				X					X						X
Suspended Solids	All	NDPs: 0 Tests: 8	X																			
Total Metals by ICP-MS	All	NDPs: 0 Tests: 5									X					X						X

25560731	SW1			H2SO4 (ALE244)	SW			X										
				500ml Plastic (ALE208)	SW												X	
				330ml plastic bottle (ALE503)	SW		X		X	X					X			
25560727	RUN OFF			500ml Plastic (ALE208)	SW					X					X		X	
25560729	LEACHATE			HNO3 Filtered (ALE204)	LE						X	X						
				H2SO4 (ALE244)	LE			X										
				500ml Plastic (ALE208)	LE		X		X	X					X	X		X
				250ml Amber Gl. PTFE/PE (ALE219)	LE									X				
				0.5l glass bottle (ALE227)	LE	X												
25560738	LAGOON OUT			HNO3 Filtered (ALE204)	SW						X							
				H2SO4 (ALE244)	SW			X										
				500ml Plastic (ALE208)	SW				X	X					X		X	
25560735	LAGOON IN			HNO3 Filtered (ALE204)	SW						X							
				H2SO4 (ALE244)	SW			X										
				500ml Plastic (ALE208)	SW				X	X					X		X	
25560724	BH105			HNO3 Filtered (ALE204)	GW						X	X						
				H2SO4 (ALE244)	GW			X										
				500ml Plastic (ALE208)	GW		X		X	X					X	X		X
				250ml Amber Gl. PTFE/PE (ALE219)	GW									X				
				0.5l glass bottle (ALE227)	GW	X												
25560726	BH104			H2SO4 (ALE244)	GW			X										

Validated

CERTIFICATE OF ANALYSIS

SDG: 211218-65 **Report Number:** 628143 **Superseded Report:**
Client Ref.: **Location:** Carmarthen

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			25560731	25560725				25560734			25560732		
Customer Sample Reference			SW1	SW4				WERN SW2			WERN SW4		
AGS Reference													
Depth (m)													
Container			HNO3 Filtered (ALE204)	330ml plastic bottle (ALE503)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)
Sample Type			SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW
Alkalinity as CaCO3	All	NDPs: 0 Tests: 10		X				X			X		
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 13				X			X			X	
Anions by Kone (w)	All	NDPs: 0 Tests: 13		X				X			X		
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 14		X				X			X		
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 13	X				X			X			X
pH Value	All	NDPs: 0 Tests: 14		X				X			X		
Suspended Solids	All	NDPs: 0 Tests: 8			X			X			X		

Validated

CERTIFICATE OF ANALYSIS

SDG: 211218-65 **Report Number:** 628143 **Superseded Report:**
Client Ref.: **Location:** Carmarthen

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+$@ Sample deviation (see appendix)

Customer Sample Ref.			BH10	BH14	BH101	BH103	BH104	BH105
Depth (m)			.	.	.	.	.	.
Sample Type			Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
Date Sampled			16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Sample Time			14:00:00	13:10:00	10:10:00	10:02:00	09:45:00	09:20:00
Date Received			18/12/2021	18/12/2021	18/12/2021	18/12/2021	18/12/2021	18/12/2021
SDG Ref			211218-65	211218-65	211218-65	211218-65	211218-65	211218-65
Lab Sample No.(s)			25560740	25560736	25560730	25560728	25560726	25560724
AGS Reference								
Component	**LOD/Units**	**Method**						
Suspended solids, Total	<2 mg/l	TM022	219 #					
Alkalinity, Total as CaCO3	<2 mg/l	TM043		488 #	228 #	212 #	315 #	275 #
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	194 #	9.67 #	<0.2 #	<0.2 #	<0.2 #	<0.2 #
Conductivity @ 20 deg.C	<0.02 mS/cm	TM120	3.03 #	1.49 #	0.425 #	0.406 #	0.54 #	0.476 #
Arsenic (diss.filt)	<0.5 µg/l	TM152		0.678 2 #	<0.5 #	0.617 #	<0.5 2 #	<0.5 #
Barium (diss.filt)	<0.2 µg/l	TM152		219 2 #	118 #	54.3 #	14.5 2 #	57.1 #
Beryllium (diss.filt)	<0.1 µg/l	TM152		<0.1 2 #	<0.1 #	<0.1 #	<0.1 2 #	<0.1 #
Boron (diss.filt)	<10 µg/l	TM152		83.2 2 #	<10 #	<10 #	<10 2 #	<10 #
Cadmium (diss.filt)	<0.08 µg/l	TM152		<0.08 2 #	<0.08 #	<0.08 #	<0.08 2 #	<0.08 #
Chromium (diss.filt)	<1 µg/l	TM152		<1 2 #	<1 #	<1 #	<1 2 #	<1 #
Copper (diss.filt)	<0.3 µg/l	TM152		<0.3 2 #	<0.3 #	<0.3 #	0.945 2 #	<0.3 #
Lead (diss.filt)	<0.2 µg/l	TM152		<0.2 2 #	<0.2 #	<0.2 #	<0.2 2 #	<0.2 #
Manganese (diss.filt)	<3 µg/l	TM152		1000 2 #	<3 #	3.08 #	7.96 2 #	28.6 #
Nickel (diss.filt)	<0.4 µg/l	TM152		3.49 2 #	<0.4 #	<0.4 #	0.509 2 #	<0.4 #
Phosphorus (diss.filt)	<10 µg/l	TM152			<10 #	15.9 #	<10 2 #	14.1 #
Zinc (diss.filt)	<1 µg/l	TM152		5.53 2 #	<1 #	2.24 #	1.87 2 #	1.52 #
Sodium (Dis.Filt)	<0.076 mg/l	TM152		104 2 #	13.2 #	12.2 #	7.39 2 #	8.83 #
Magnesium (Dis.Filt)	<0.036 mg/l	TM152		7.76 2 #	10.2 #	6.65 #	9.12 2 #	8.08 #
Potassium (Dis.Filt)	<0.2 mg/l	TM152	96.7 #	7.38 2 #	0.85 #	0.807 #	0.743 2 #	0.864 #
Calcium (Dis.Filt)	<0.2 mg/l	TM152		214 2 #	75.8 #	74.8 #	112 2 #	96.3 #
Iron (Dis.Filt)	<0.019 mg/l	TM152		10.4 2 #	<0.019 #	<0.019 #	<0.019 2 #	<0.019 #
Hardness, Total as CaCO3 unfiltered	<0.35 mg/l	TM152			234 2	224 2	319 2	290 2
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 2 #	<0.01 #	<0.01 #	<0.01 2 #	<0.01 #
Sulphate	<2 mg/l	TM184		17.6 #	8.7 #	6.5 #	14.4 #	5.5 #
Chloride	<2 mg/l	TM184	205 #	232 #	14 #	13.6 #	8.6 #	10 #
Phosphate (Ortho as P)	<0.02 mg/l	TM184		<0.02 #	<0.02 #	<0.02 #	<0.02 #	<0.02 #
pH	<1 pH Units	TM256	7 #	6.81 #	7.82 #	7.82 #	7.35 #	7.43 #
Mecoprop	<0.04 µg/l	TM411		<0.04	<0.04	<0.04	<0.04	<0.04

12:43:08 04/01/2022

Validated

CERTIFICATE OF ANALYSIS

SDG: 211218-65 **Report Number:** 628143 **Superseded Report:**
Client Ref.: **Location:** Carmarthen

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+$@ Sample deviation (see appendix)

Customer Sample Ref.			LAGOON IN	LAGOON OUT	LEACHATE	RUN OFF	SW1	SW4
Depth (m)			.	.	.	.	.	.
Sample Type			Surface Water (SW)	Surface Water (SW)	Land Leachate (LE)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)
Date Sampled			16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Sample Time			12:45:00	12:40:00	08:45:00	09:55:00	10:20:00	09:30:00
Date Received			18/12/2021	18/12/2021	18/12/2021	18/12/2021	18/12/2021	18/12/2021
SDG Ref			211218-65	211218-65	211218-65	211218-65	211218-65	211218-65
Lab Sample No.(s)			25560735	25560738	25560729	25560727	25560731	25560725
AGS Reference								
Component	**LOD/Units**	**Method**						
Suspended solids, Total	<2 mg/l	TM022	9.2 #	9.5 #		<2 #	9.5 #	4.49 #
Alkalinity, Total as CaCO3	<2 mg/l	TM043			455 #		137 #	195 #
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	34.8 #	30.7 #	36.4		<0.2 #	0.225 #
Conductivity @ 20 deg.C	<0.02 mS/cm	TM120	1.35 #	1.25 #	1.1 #	0.567 #	0.399 #	0.568 #
Arsenic (diss.filt)	<0.5 µg/l	TM152			0.649 #			
Barium (diss.filt)	<0.2 µg/l	TM152			108 #			
Beryllium (diss.filt)	<0.1 µg/l	TM152			<0.1 #			
Boron (diss.filt)	<10 µg/l	TM152			157 #			
Cadmium (diss.filt)	<0.08 µg/l	TM152			<0.08 #			
Chromium (diss.filt)	<1 µg/l	TM152			<1 #			
Copper (diss.filt)	<0.3 µg/l	TM152			0.988 #			
Lead (diss.filt)	<0.2 µg/l	TM152			0.975 #			
Manganese (diss.filt)	<3 µg/l	TM152			300 #			
Nickel (diss.filt)	<0.4 µg/l	TM152			3.48 #			
Phosphorus (diss.filt)	<10 µg/l	TM152			14.7 #			
Zinc (diss.filt)	<1 µg/l	TM152			7.86 #			
Sodium (Dis.Filt)	<0.076 mg/l	TM152			57.8 #			
Magnesium (Dis.Filt)	<0.036 mg/l	TM152			13.7 #			
Potassium (Dis.Filt)	<0.2 mg/l	TM152	20.3 #	18.8 #	34.5 #		14.8 #	35.9 #
Calcium (Dis.Filt)	<0.2 mg/l	TM152			116 #			
Iron (Dis.Filt)	<0.019 mg/l	TM152			0.154 #			
Hardness, Total as CaCO3 unfiltered	<0.35 mg/l	TM152			350 2			
Mercury (diss.filt)	<0.01 µg/l	TM183			<0.01 #			
Sulphate	<2 mg/l	TM184			17.1			
Chloride	<2 mg/l	TM184	90.4 #	84.5 #	98.7		30.8 #	42.6 #
Phosphate (Ortho as P)	<0.02 mg/l	TM184			<0.02			
pH	<1 pH Units	TM256	7.64 #	7.77 #	7.82 #	8.02 #	8.05 #	7.95 #
Mecoprop	<0.04 µg/l	TM411			<4			

12:43:08 04/01/2022

Validated

CERTIFICATE OF ANALYSIS

SDG: 211218-65 **Report Number:** 628143 **Superseded Report:**
Client Ref.: **Location:** Carmarthen

Results Legend

#	ISO17025 accredited.
M	mCERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted - refer to subcontractor report for accreditation status.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-4+§@	Sample deviation (see appendix)

Customer Sample Ref.			WERN SW2	WERN SW4				
Depth (m)			.	.				
Sample Type			Surface Water (SW)	Surface Water (SW)				
Date Sampled			16/12/2021	16/12/2021				
Sample Time			12:35:00	12:25:00				
Date Received			18/12/2021	18/12/2021				
SDG Ref			211218-65	211218-65				
Lab Sample No.(s)			25560734	25560732				
AGS Reference								
Component	**LOD/Units**	**Method**						
Suspended solids, Total	<2 mg/l	TM022	<2 #	4.35 #				
Alkalinity, Total as CaCO3	<2 mg/l	TM043	353 #	132 #				
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	<0.2 #	1.22 #				
Conductivity @ 20 deg.C	<0.02 mS/cm	TM120	0.663 #	0.322 #				
Potassium (Dis.Filt)	<0.2 mg/l	TM152	5.51 #	3.52 #				
Chloride	<2 mg/l	TM184	15.3 #	21 #				
pH	<1 pH Units	TM256	8.05 #	7.84 #				

12:43:08 04/01/2022

Validated

CERTIFICATE OF ANALYSIS

SDG: 211218-65 **Report Number:** 628143 **Superseded Report:**

Client Ref.: **Location:** Carmarthen

PAH Spec MS - Aqueous (W)

Results Legend

- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+§@ Sample deviation (see appendix)

Customer Sample Ref.			BH14	BH101	BH103	BH104	BH105	LEACHATE
Depth (m)			.	.	.	.	.	.
Sample Type			Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Land Leachate (LE)
Date Sampled			16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021	16/12/2021
Sample Time			13:10:00	10:10:00	10:02:00	09:45:00	09:20:00	08:45:00
Date Received			18/12/2021	18/12/2021	18/12/2021	18/12/2021	18/12/2021	18/12/2021
SDG Ref			211218-65	211218-65	211218-65	211218-65	211218-65	211218-65
Lab Sample No.(s)			25560736	25560730	25560728	25560726	25560724	25560729
AGS Reference								
Component	**LOD/Units**	**Method**						
Naphthalene (aq)	<0.01 µg/l	TM178	<0.05 #	<0.01 #	0.137 #	0.0441 #	0.0589 #	0.0607
Acenaphthene (aq)	<0.005 µg/l	TM178	0.0614 #	<0.005 #	0.14 #	0.01 #	0.0134 #	0.0225
Acenaphthylene (aq)	<0.005 µg/l	TM178	<0.025 #	<0.005 #	0.011 #	0.0325 #	<0.005 #	<0.005
Fluoranthene (aq)	<0.005 µg/l	TM178	0.397 #	<0.005 #	0.0136 #	0.0263 #	<0.005 #	<0.005
Anthracene (aq)	<0.005 µg/l	TM178	0.0317 #	<0.005 #	<0.005 #	0.0069 #	<0.005 #	<0.005
Phenanthrene (aq)	<0.005 µg/l	TM178	0.227 #	<0.005 #	0.032 #	0.0144 #	0.0082 #	0.0081
Fluorene (aq)	<0.005 µg/l	TM178	0.0785 #	<0.005 #	0.0327 #	0.0091 #	0.0057 #	0.0087
Chrysene (aq)	<0.005 µg/l	TM178	0.193 #	<0.005 #	<0.005 #	<0.005 #	<0.005 #	<0.005
Pyrene (aq)	<0.005 µg/l	TM178	0.319 #	<0.005 #	0.0102 #	0.0257 #	<0.005 #	<0.005
Benzo(a)anthracene (aq)	<0.005 µg/l	TM178	0.117 #	<0.005 #	<0.005 #	<0.005 #	<0.005 #	<0.005
Benzo(b)fluoranthene (aq)	<0.005 µg/l	TM178	0.236 #	<0.005 #	0.009 #	0.0362 #	<0.005 #	<0.005
Benzo(k)fluoranthene (aq)	<0.005 µg/l	TM178	0.0907 #	<0.005 #	<0.005 #	0.0136 #	<0.005 #	<0.005
Benzo(a)pyrene (aq)	<0.002 µg/l	TM178	0.126 #	<0.002 #	<0.002 #	0.0208 #	<0.002 #	<0.002
Dibenzo(a,h)anthracene (aq)	<0.005 µg/l	TM178	0.0341 #	<0.005 #	<0.005 #	<0.005 #	<0.005 #	<0.005
Benzo(g,h,i)perylene (aq)	<0.005 µg/l	TM178	0.197 #	<0.005 #	<0.005 #	0.0137 #	<0.005 #	<0.005
Indeno(1,2,3-cd)pyrene (aq)	<0.005 µg/l	TM178	0.199 #	<0.005 #	<0.005 #	<0.005 #	<0.005 #	<0.005
PAH, Total Detected USEPA 16 (aq)	<0.082 µg/l	TM178	2.31 #	<0.082 #	0.386 #	0.253 #	0.0862 #	0.1

Table of Results - Appendix

Method No	Reference	Description
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981;BS EN 872	Determination of total suspended solids in waters
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter
TM152	ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS)	Analysis of Aqueous Samples by ICP-MS
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4, Standard Methods for the examination of waters and wastewaters 20th Edition, PHA, Washington DC, USA. ISBN 0-87553-235-7 and The Determination of Alkalinity and Acidity in water HMSO, 1981, ISBN 0 11 751601 5.	Determination of pH, EC, TDS and Alkalinity in Aqueous samples
TM411	Acid_Herbs_GCMS	Acid Herbs in Water by GCMS

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

Validated

CERTIFICATE OF ANALYSIS

SDG: 211218-65 **Report Number:** 628143 **Superseded Report:**
Client Ref.: **Location:** Carmarthen

Test Completion Dates

Lab Sample No(s)	25560740	25560736	25560730	25560728	25560726	25560724	25560735	25560738	25560729	25560727
Customer Sample Ref.	BH10	BH14	BH101	BH103	BH104	BH105	LAGOON IN	LAGOON OUT	LEACHATE	RUN OFF
AGS Ref.										
Depth										
Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Surface Water	Land Leachate	Surface Water
Acid Herbicides by GCMS		31-Dec-2021	31-Dec-2021	31-Dec-2021	24-Dec-2021	24-Dec-2021			31-Dec-2021	
Alkalinity as CaCO3		24-Dec-2021	24-Dec-2021	24-Dec-2021	22-Dec-2021	24-Dec-2021			24-Dec-2021	
Ammoniacal Nitrogen	23-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021	23-Dec-2021	23-Dec-2021	
Anions by Kone (w)	29-Dec-2021	29-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021	
Conductivity (at 20 deg.C)	23-Dec-2021	23-Dec-2021	23-Dec-2021	22-Dec-2021	22-Dec-2021	22-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021	22-Dec-2021
Dissolved Metals by ICP-MS	30-Dec-2021	31-Dec-2021	31-Dec-2021	31-Dec-2021	31-Dec-2021	31-Dec-2021	30-Dec-2021	30-Dec-2021	31-Dec-2021	
Mercury Dissolved		04-Jan-2022	04-Jan-2022	04-Jan-2022	31-Dec-2021	04-Jan-2022			04-Jan-2022	
PAH Spec MS - Aqueous (W)		29-Dec-2021	29-Dec-2021	29-Dec-2021	29-Dec-2021	29-Dec-2021			29-Dec-2021	
pH Value	24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021
Phosphate by Kone (w)		24-Dec-2021	24-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021			24-Dec-2021	
Suspended Solids	24-Dec-2021						24-Dec-2021	24-Dec-2021		23-Dec-2021
Total Metals by ICP-MS			24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021			24-Dec-2021	

Lab Sample No(s)	25560731	25560725	25560734	25560732
Customer Sample Ref.	SW1	SW4	WERN SW2	WERN SW4
AGS Ref.				
Depth				
Type	Surface Water	Surface Water	Surface Water	Surface Water
Alkalinity as CaCO3	24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021
Ammoniacal Nitrogen	23-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021
Anions by Kone (w)	23-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021
Conductivity (at 20 deg.C)	23-Dec-2021	23-Dec-2021	23-Dec-2021	23-Dec-2021
Dissolved Metals by ICP-MS	30-Dec-2021	30-Dec-2021	30-Dec-2021	30-Dec-2021
pH Value	24-Dec-2021	24-Dec-2021	24-Dec-2021	24-Dec-2021
Suspended Solids	24-Dec-2021	23-Dec-2021	24-Dec-2021	24-Dec-2021

Appendix

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

General

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

20. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Geotechnology
5 Cefn-yr-Allt
Aberdulais
Neath
West Glamorgan
SA10 8HE

Attention: Ben Rees

CERTIFICATE OF ANALYSIS

Date of report Generation:	09 April 2022
Customer:	Geotechnology
Sample Delivery Group (SDG):	220330-33
Your Reference:	
Location:	Carmarthen
Report No:	641717
Order Number:	

This report has been revised and directly supersedes 641468 in its entirety.

We received 13 samples on Wednesday March 30, 2022 and 10 of these samples were scheduled for analysis which was completed on Saturday April 09, 2022. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:

Sonia McWhan

Operations Manager

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
26048760	BH10			28/03/2022
26048761	BH14			28/03/2022
26048754	BH101			28/03/2022
26048752	BH103			28/03/2022
26048751	BH104			28/03/2022
26048748	BH105			28/03/2022
26048755	BH117			28/03/2022
26048759	LAGOON IN			28/03/2022
26048758	LAGOON OUT			28/03/2022
26048753	SW1			28/03/2022
26048749	SW4			28/03/2022
26048757	WERN SW2			28/03/2022
26048756	WERN SW4			28/03/2022

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG: 220330-33 **Report Number:** 641717 **Superseded Report:** 641468

Client Ref.: **Location:** Carmarthen

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			26048760			26048761			26048748			26048755			26048759			26048758			26048753		
Customer Sample Reference			BH10			BH14			BH105			BH117			LAGOON IN			LAGOON OUT			SW1		
AGS Reference																							
Depth (m)																							
Container			1lplastic (ALE221)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	1lplastic (ALE221)	H2SO4 (ALE244)	250ml Amber Gl. PTFE/PE (ALE219)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	1lplastic (ALE221)	H2SO4 (ALE244)	1lplastic (ALE221)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	1lplastic (ALE221)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	250ml Amber Gl. PTFE/PE (ALE219)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)
Sample Type			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Alkalinity as CaCO3	All	NDPs: 0 Tests: 6						X			X								X			
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 10		X			X		X			X		X			X			X		
Anions by Kone (w)	All	NDPs: 0 Tests: 10	X			X			X		X		X			X				X		
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 10			X	X				X	X				X			X			X
pH Value	All	NDPs: 0 Tests: 10	X			X		X			X		X			X			X			
Suspended Solids	All	NDPs: 0 Tests: 6											X			X			X			

26048756	WERN SW4			HNO3 Filtered (ALE204)	GW																		
				H2SO4 (ALE244)	GW				X														
				1lplastic (ALE221)	GW							X											
26048757	WERN SW2			HNO3 Filtered (ALE204)	GW																		
				H2SO4 (ALE244)	GW				X														
				1lplastic (ALE221)	GW							X											
26048749	SW4			HNO3 Filtered (ALE204)	GW																		
				H2SO4 (ALE244)	GW				X														
				250ml Amber Gl. PTFE/PE (ALE219)	GW							X											

Validated

CERTIFICATE OF ANALYSIS

SDG: 220330-33 **Report Number:** 641717 **Superseded Report:** 641468

Client Ref.: **Location:** Carmarthen

Results Legend

- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+$@ Sample deviation (see appendix)

Customer Sample Ref.			BH10	BH14	BH105	BH117	LAGOON IN	LAGOON OUT
Depth (m)			.	.	.	.	.	.
Sample Type			Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)
Date Sampled			28/03/2022	28/03/2022	28/03/2022	28/03/2022	28/03/2022	28/03/2022
Sample Time			12:40:00	13:10:00	08:48:00	10:20:00	12:20:00	12:10:00
Date Received			30/03/2022	30/03/2022	30/03/2022	30/03/2022	30/03/2022	30/03/2022
SDG Ref			220330-33	220330-33	220330-33	220330-33	220330-33	220330-33
Lab Sample No.(s)			26048760	26048761	26048748	26048755	26048759	26048758
AGS Reference								
Component	**LOD/Units**	**Method**						
Suspended solids, Total	<2 mg/l	TM022					33.3 #	12.2 #
Alkalinity, Total as CaCO3	<2 mg/l	TM043			280 #	230 #		
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	157 #	17.1 #	<0.2 #	<0.2 #	48.8 #	44.5 #
Sodium (Dis.Filt)	<0.076 mg/l	TM152			10.5 #	8.95 2 #		
Potassium (Dis.Filt)	<0.2 mg/l	TM152	80.2 #	11.3 2 #	0.957 #	0.785 2 #	26.8 #	25.8 #
Chloride	<2 mg/l	TM184	242 #	293 #	10.5 #	18.4 #	124 #	120 #
pH	<1 pH Units	TM256	7.64 #	7.32 #	7.77 #	7.61 #	7.86 #	7.71 #
Conductivity @ 20 deg.C	<0.02 mS/cm	TM256	2.43 #	1.59 #	0.486 #	0.436 #	1.25 #	1.17 #

15:54:14 09/04/2022

Validated

CERTIFICATE OF ANALYSIS

SDG: 220330-33 **Report Number:** 641717 **Superseded Report:** 641468

Client Ref.: **Location:** Carmarthen

Results Legend

- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+§@ Sample deviation (see appendix)

Customer Sample Ref.			SW1	SW4	WERN SW2	WERN SW4		
Depth (m)			.	.	.	.		
Sample Type			Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)		
Date Sampled			28/03/2022	28/03/2022	28/03/2022	28/03/2022		
Sample Time			09:40:00	09:00:00	11:55:00	11:43:00		
Date Received			30/03/2022	30/03/2022	30/03/2022	30/03/2022		
SDG Ref			220330-33	220330-33	220330-33	220330-33		
Lab Sample No.(s)			26048753	26048749	26048757	26048756		
AGS Reference								
Component	**LOD/Units**	**Method**						
Suspended solids, Total	<2 mg/l	TM022	<9 #	5.15 #	<2 #	<2 #		
Alkalinity, Total as CaCO3	<2 mg/l	TM043	180 #	190 #	316 #	211 #		
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	<0.2 #	<0.2 #	<0.2 #	<0.2 #		
Potassium (Dis.Filt)	<0.2 mg/l	TM152	18.7 #	23.5 #	6.04 #	1.8 #		
Chloride	<2 mg/l	TM184	40.4 #	30 #	16.8 #	17.6 #		
pH	<1 pH Units	TM256	8.36 #	8.51 #	8.25 #	8.45 #		
Conductivity @ 20 deg.C	<0.02 mS/cm	TM256	0.52 #	0.48 #	0.501 #	0.433 #		

15:54:14 09/04/2022

Table of Results - Appendix

Method No	Reference	Description
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981;BS EN 872	Determination of total suspended solids in waters
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM152	ISO 17294-2:2016 Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS)	Analysis of Aqueous Samples by ICP-MS
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4, Standard Methods for the examination of waters and wastewaters 20th Edition, PHA, Washington DC, USA. ISBN 0-87553-235-7 and The Determination of Alkalinity and Acidity in water HMSO, 1981, ISBN 0 11 751601 5.	Determination of pH, EC, TDS and Alkalinity in Aqueous samples

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

Validated

CERTIFICATE OF ANALYSIS

SDG: 220330-33 **Report Number:** 641717 **Superseded Report:** 641468

Client Ref.: **Location:** Carmarthen

Test Completion Dates

Lab Sample No(s)	26048760	26048761	26048748	26048755	26048759	26048758	26048753	26048749	26048757	26048756
Customer Sample Ref.	BH10	BH14	BH105	BH117	LAGOON IN	LAGOON OUT	SW1	SW4	WERN SW2	WERN SW4
AGS Ref.										
Depth										
Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Alkalinity as CaCO3			06-Apr-2022	06-Apr-2022			08-Apr-2022	06-Apr-2022	07-Apr-2022	07-Apr-2022
Ammoniacal Nitrogen	01-Apr-2022	01-Apr-2022	01-Apr-2022	01-Apr-2022	01-Apr-2022	01-Apr-2022	01-Apr-2022	01-Apr-2022	01-Apr-2022	01-Apr-2022
Anions by Kone (w)	05-Apr-2022	05-Apr-2022	05-Apr-2022	05-Apr-2022	05-Apr-2022	05-Apr-2022	05-Apr-2022	05-Apr-2022	05-Apr-2022	05-Apr-2022
Dissolved Metals by ICP-MS	06-Apr-2022	06-Apr-2022	06-Apr-2022	06-Apr-2022	06-Apr-2022	06-Apr-2022	06-Apr-2022	06-Apr-2022	06-Apr-2022	06-Apr-2022
pH Value	07-Apr-2022	06-Apr-2022	07-Apr-2022	06-Apr-2022	06-Apr-2022	06-Apr-2022	04-Apr-2022	06-Apr-2022	07-Apr-2022	06-Apr-2022
Suspended Solids					06-Apr-2022	06-Apr-2022	06-Apr-2022	09-Apr-2022	06-Apr-2022	06-Apr-2022

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

20. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials andd soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

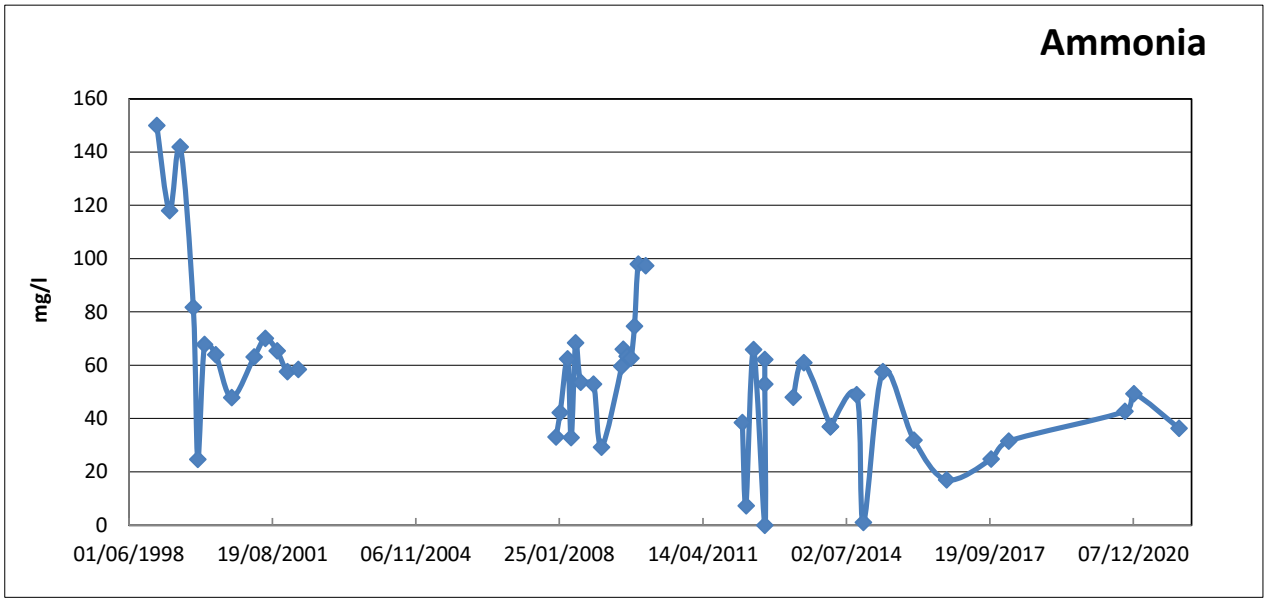
NANT Y CAWS
PHASE 1
CLOSED LANDFILL

ENVIRONMENTAL
PERMIT 34183

Environmental
Monitoring Review

Appendix 2
Leachate Chemistry

Report Number 2280r1v1d0822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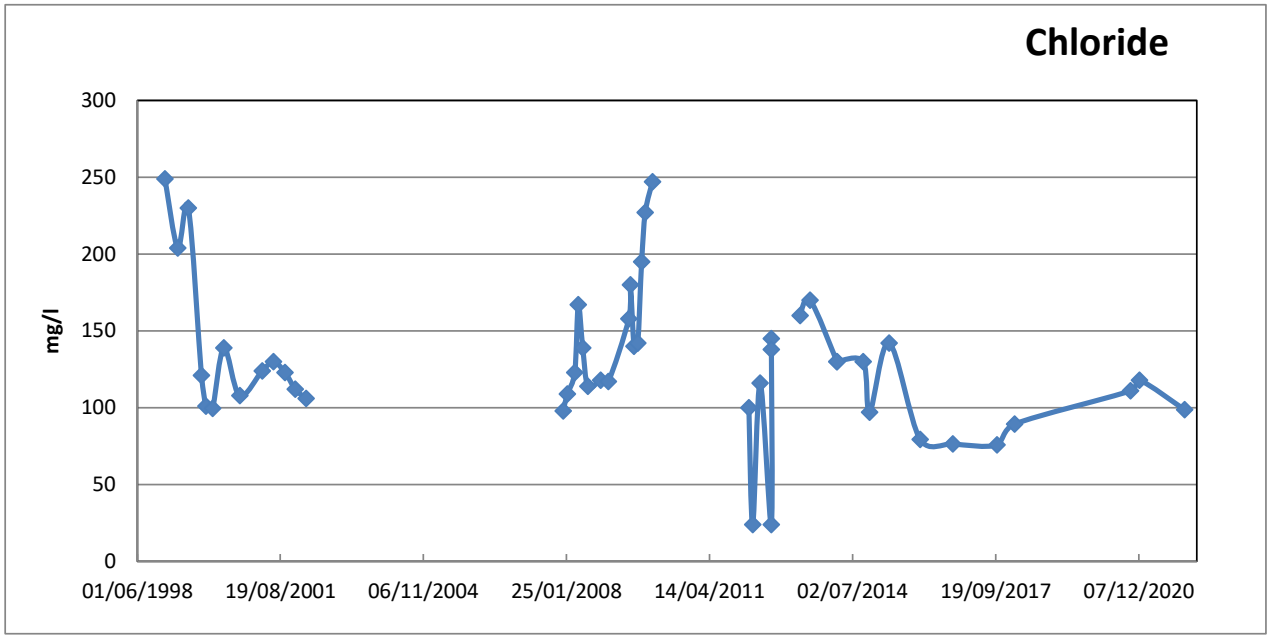
02/07/2014
19/09/2017
07/12/2020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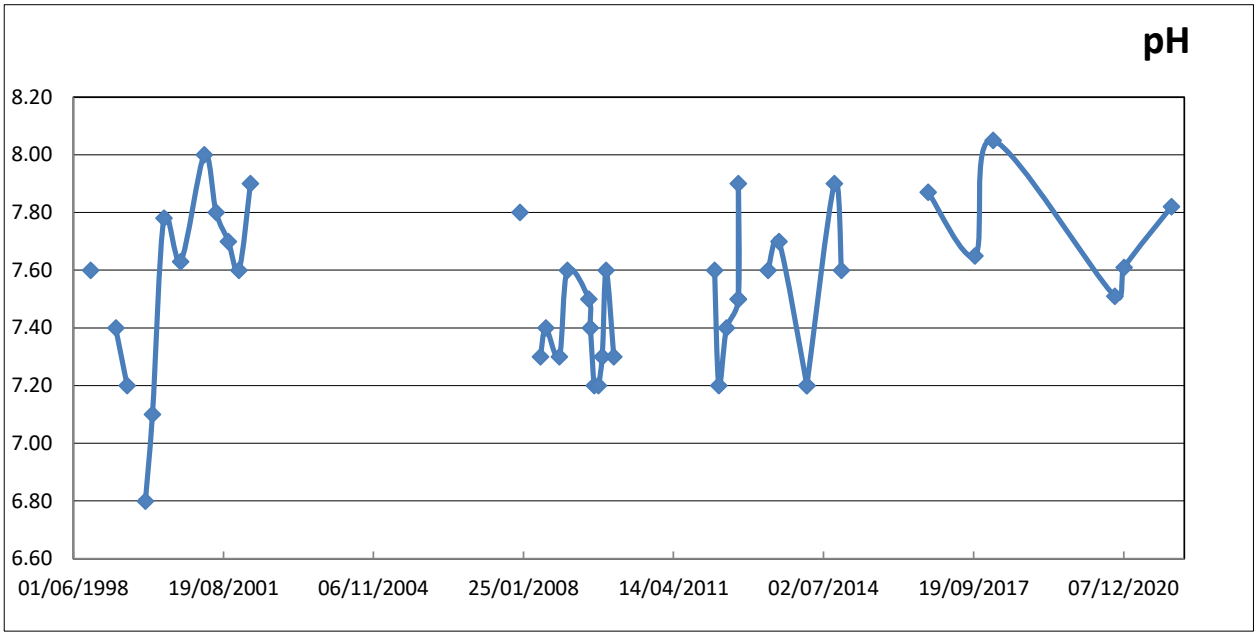
07/12/2020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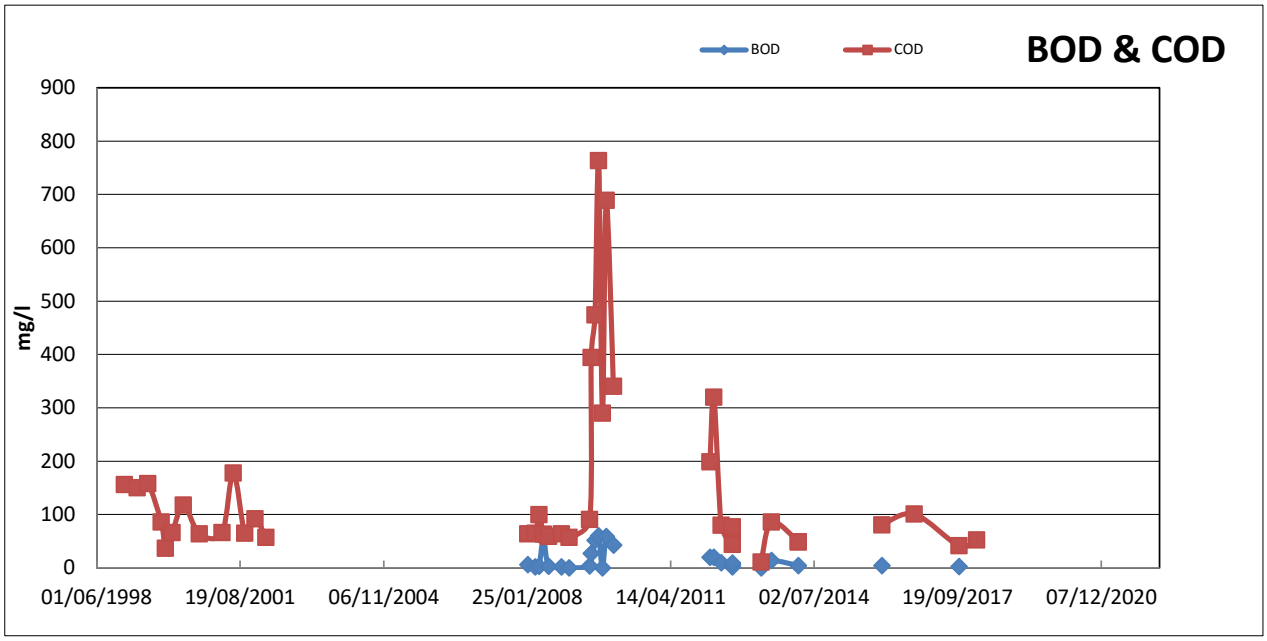
07/12/2020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COD
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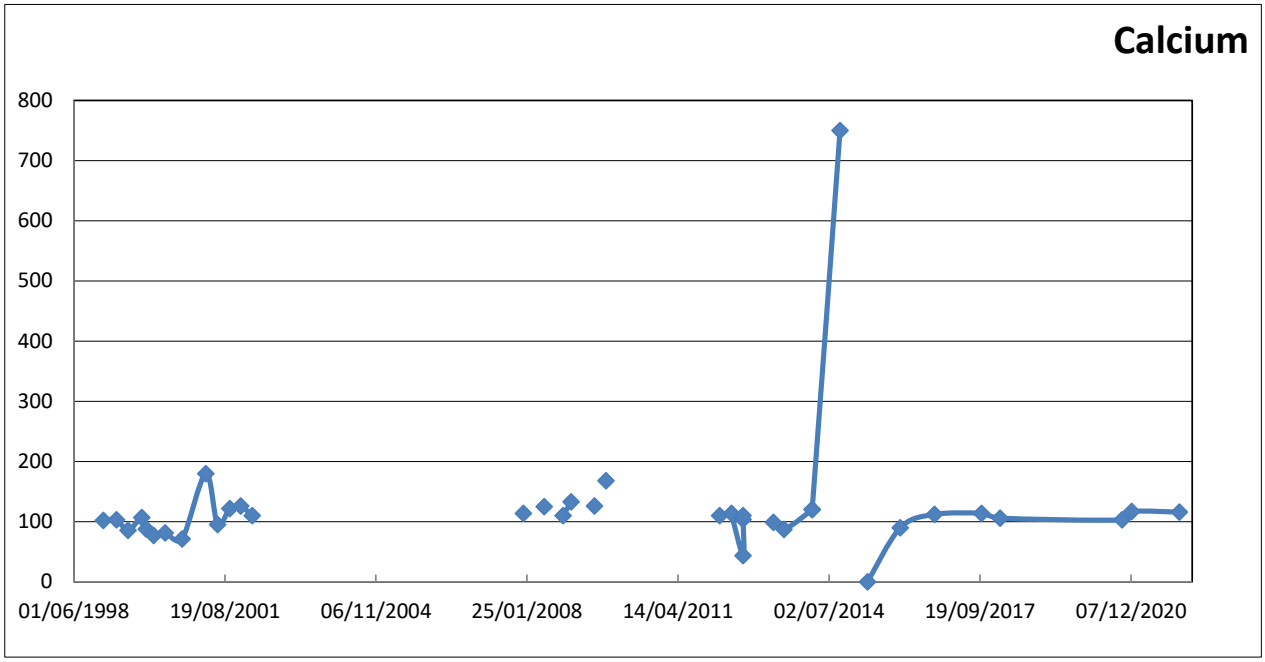
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020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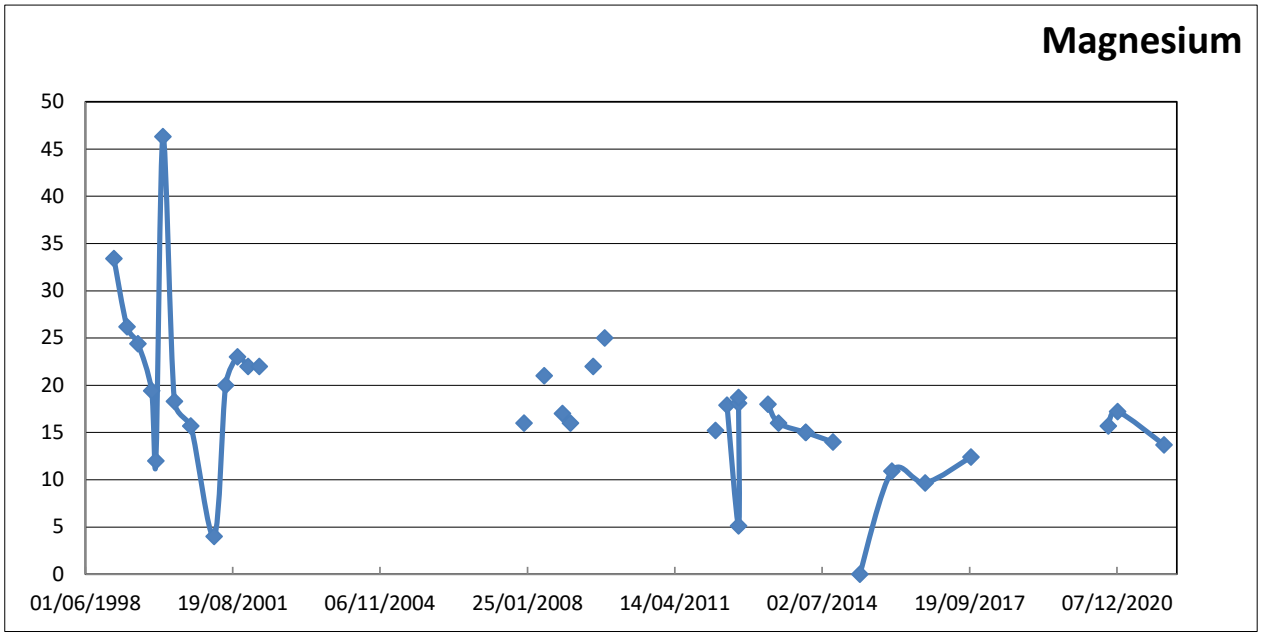
07/12/2020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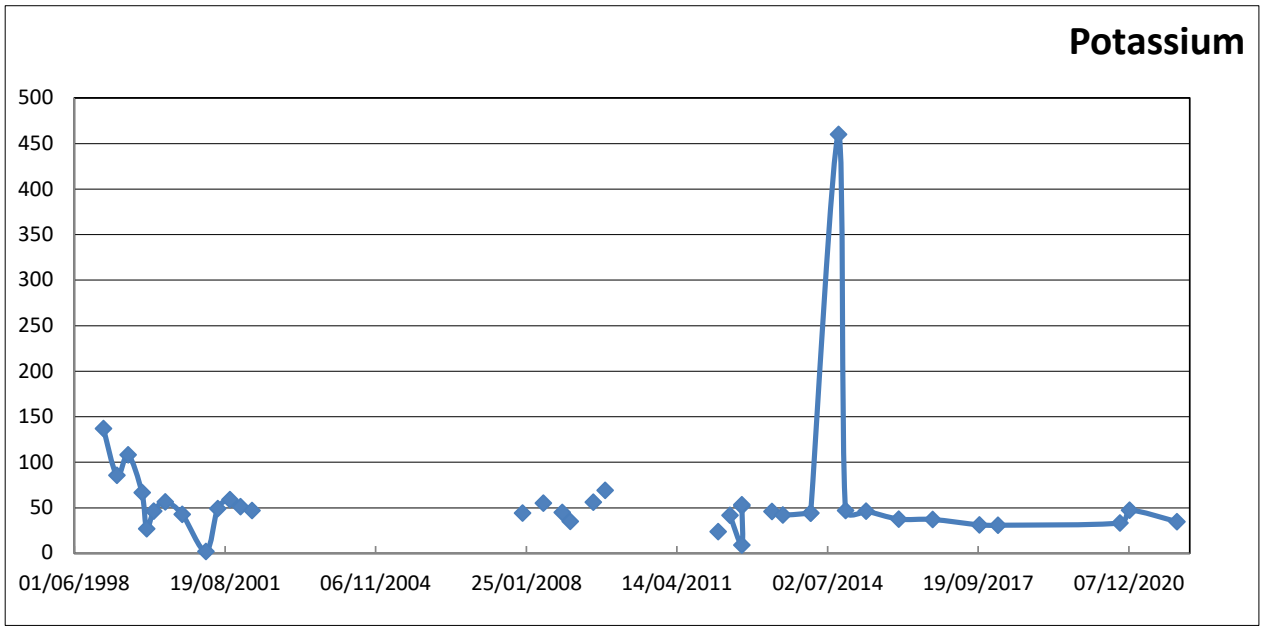
02/07/2014
19/09/2017
07/12/2020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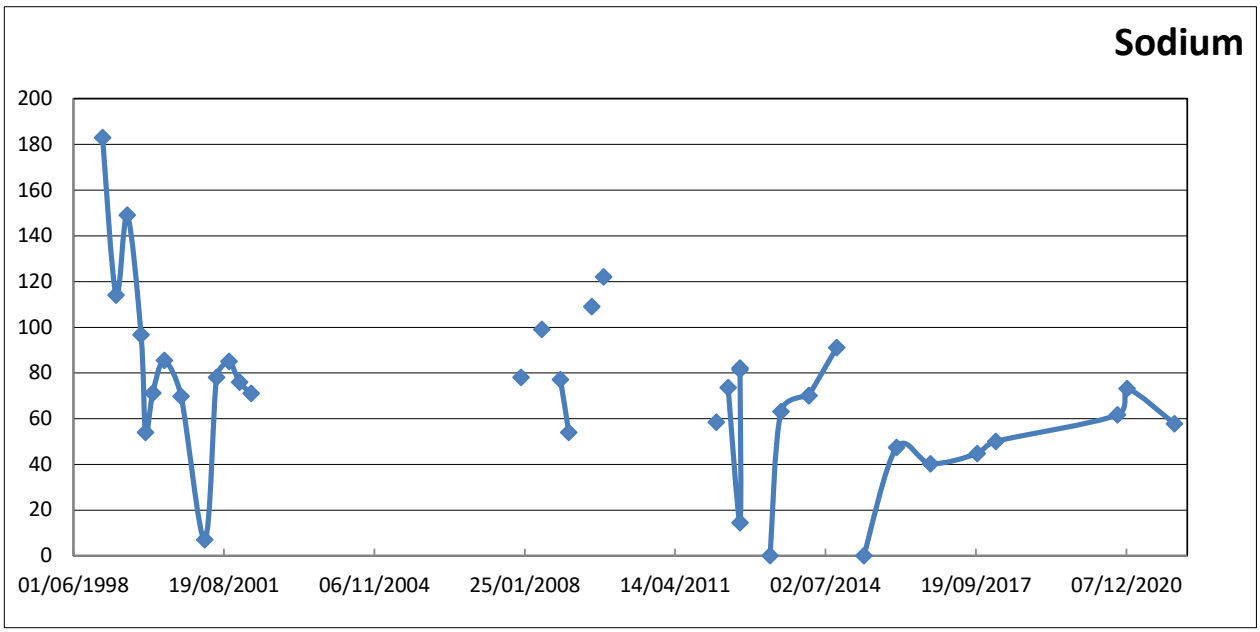
07/12/2020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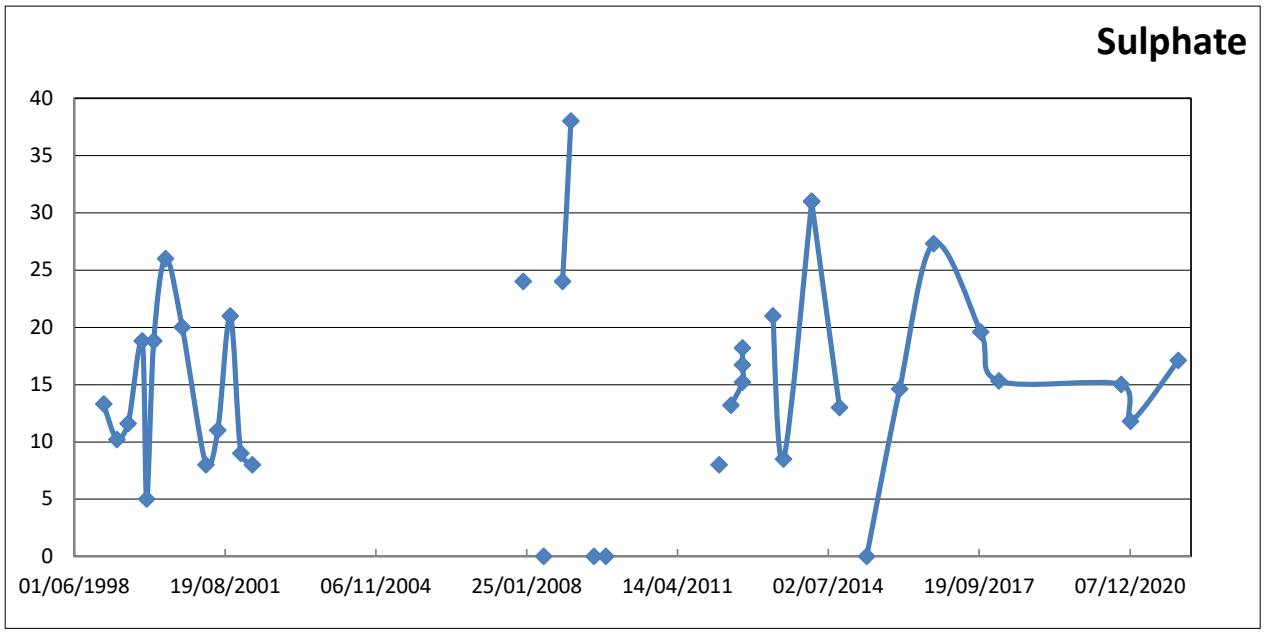
14/04/2011
02/07/2014
19/09/2017
07/12/2020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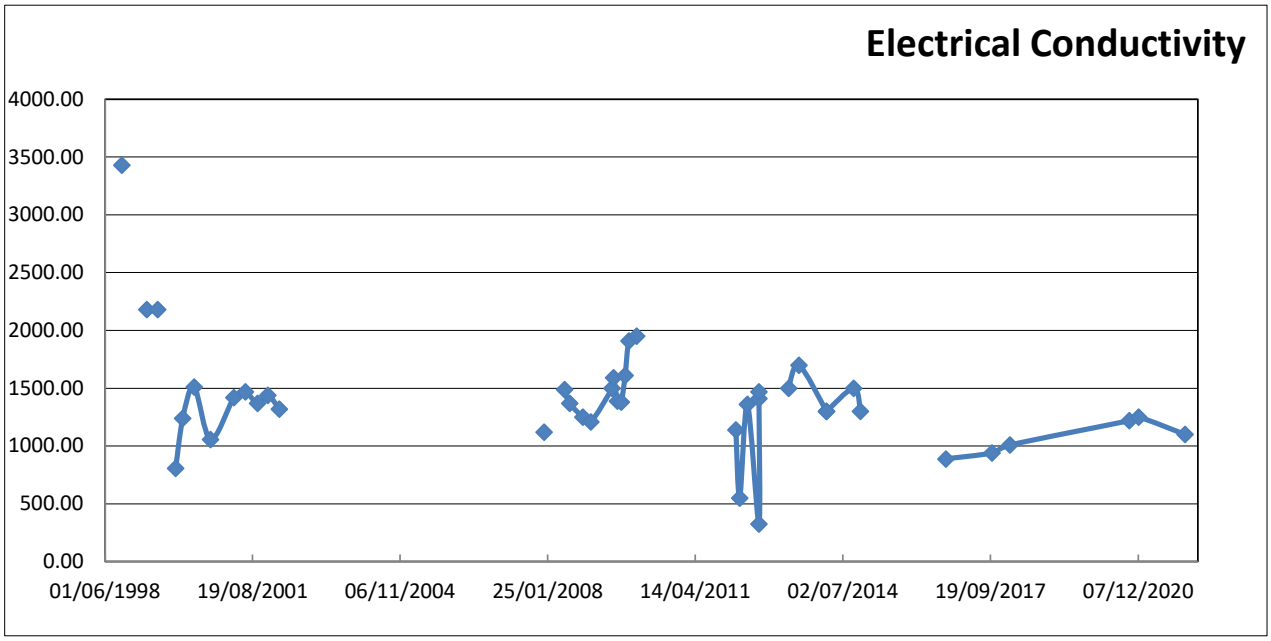
07/12/2020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25/01/2008
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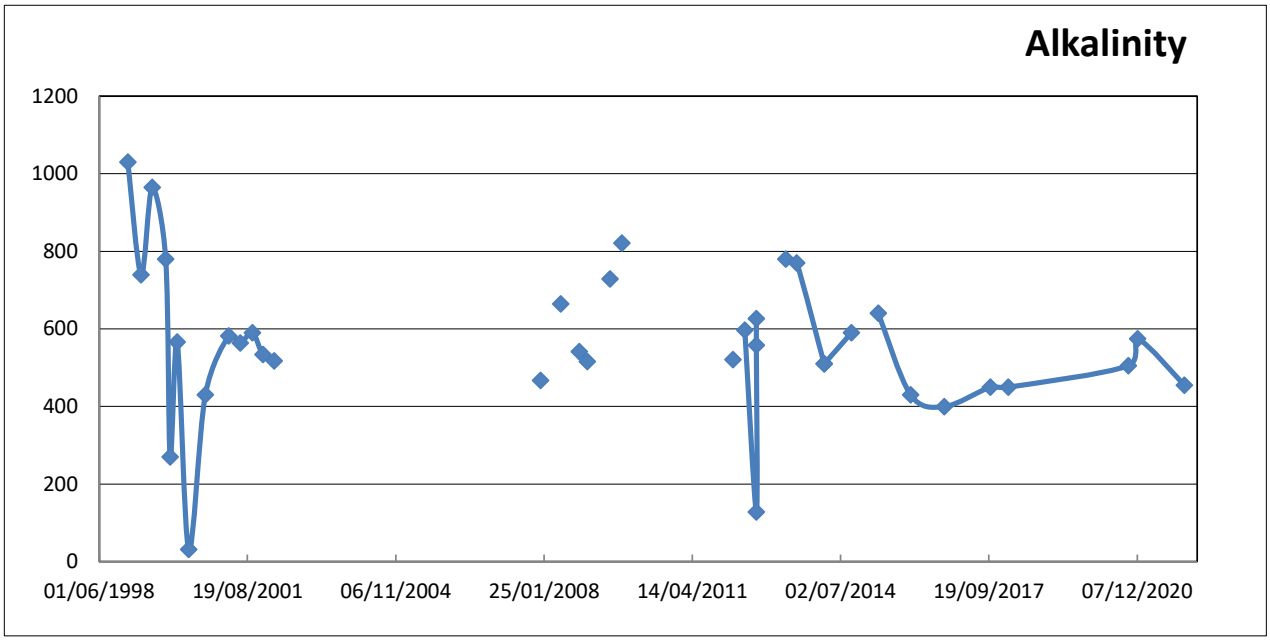
02/07/2014
19/09/2017
07/12/2020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25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020

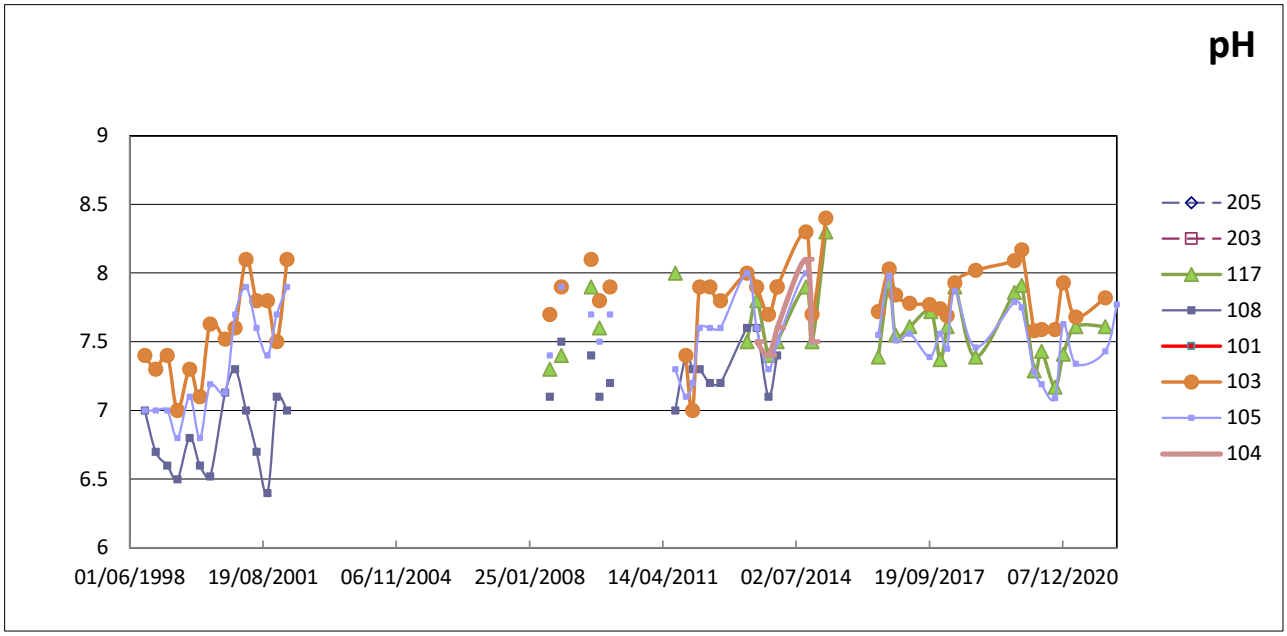
NANT Y CAWS
PHASE 1
CLOSED LANDFILL

ENVIRONMENTAL
PERMIT 34183

Environmental Monitoring Review

Appendix 3 Groundwater Chemistry

Report Number 2280r1v1d0822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06/11/2004
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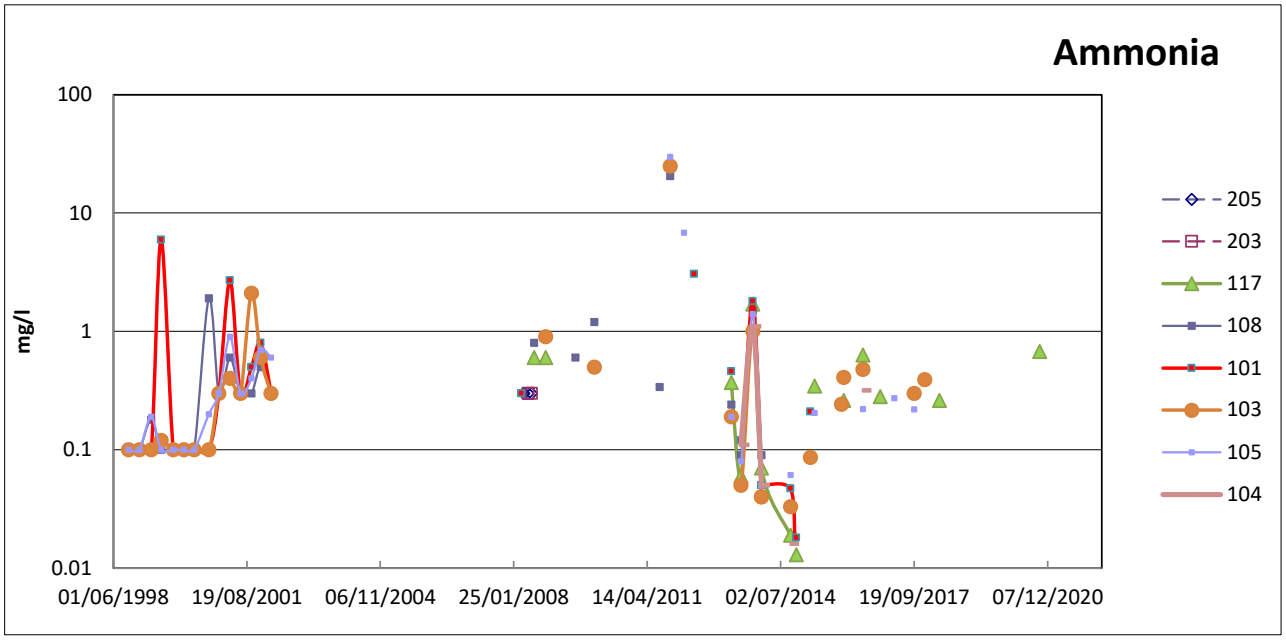
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06/11/2004
25/01/2008
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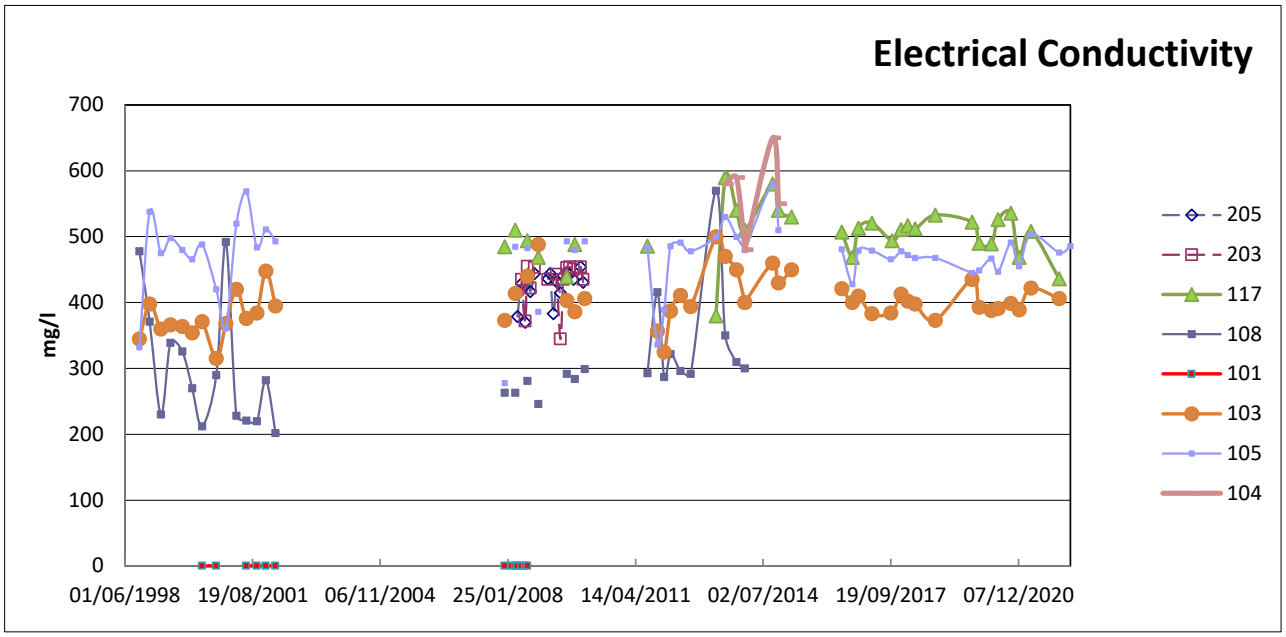
101
103
105
104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mg/l
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600
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400
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200
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01/06/1998
19/08/2001
06/11/2004
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07/12/2020
205
203
117
108
101
103
105
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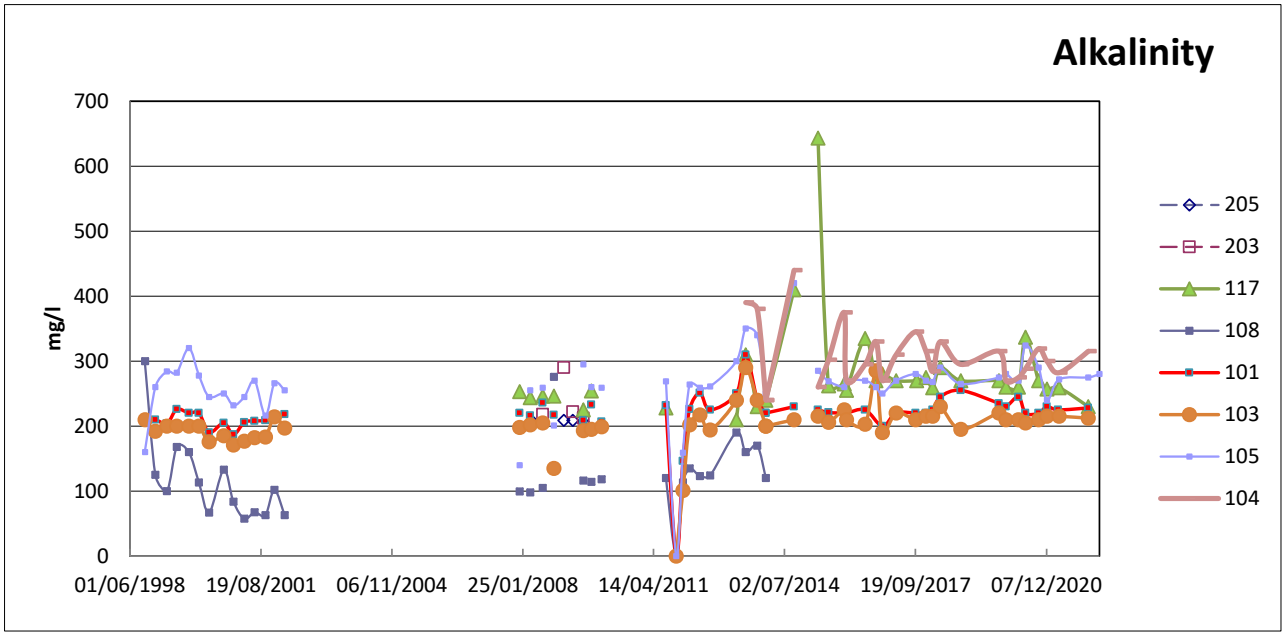
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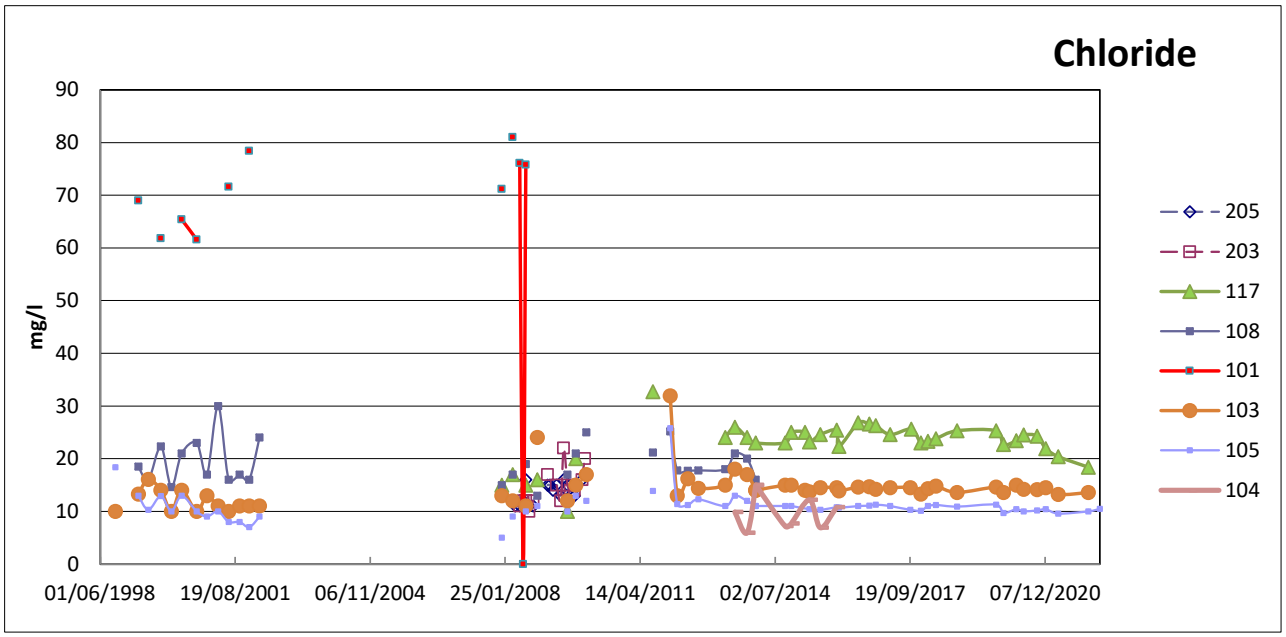
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mg/l
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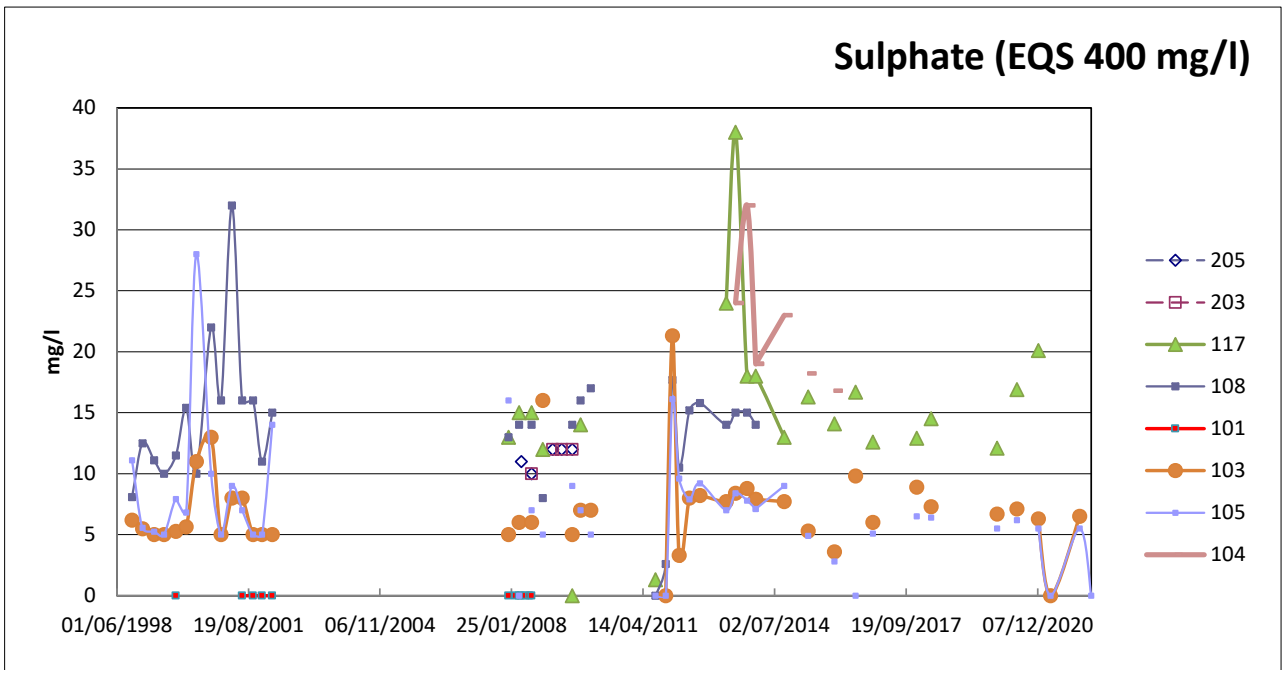
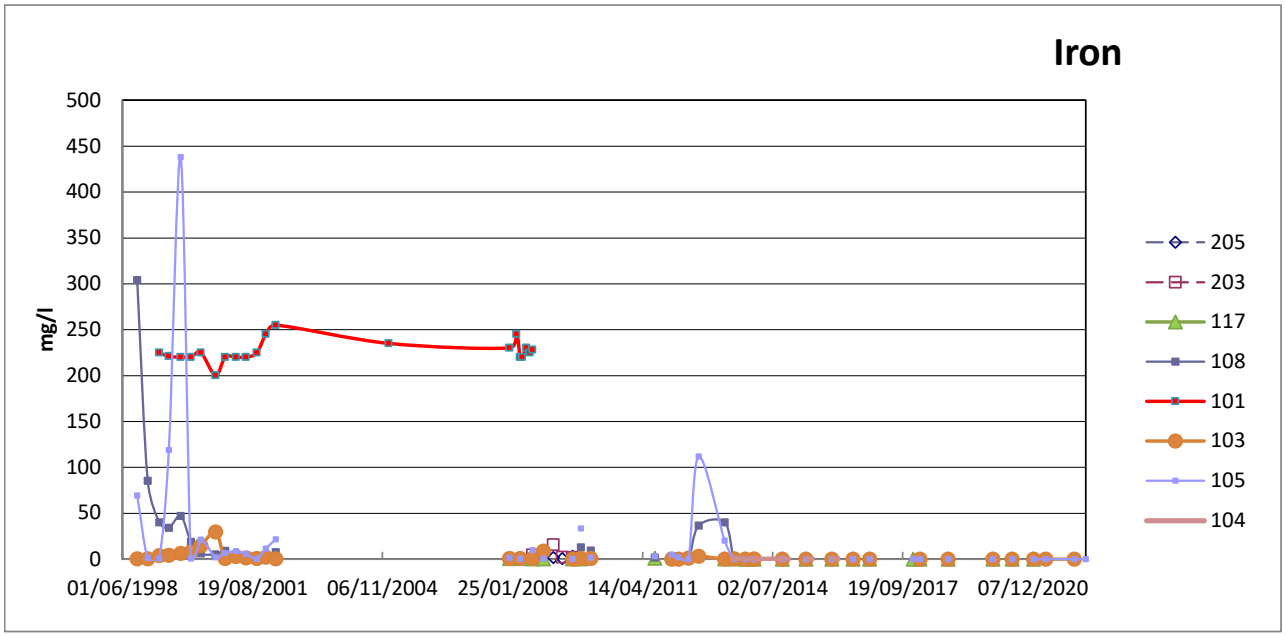
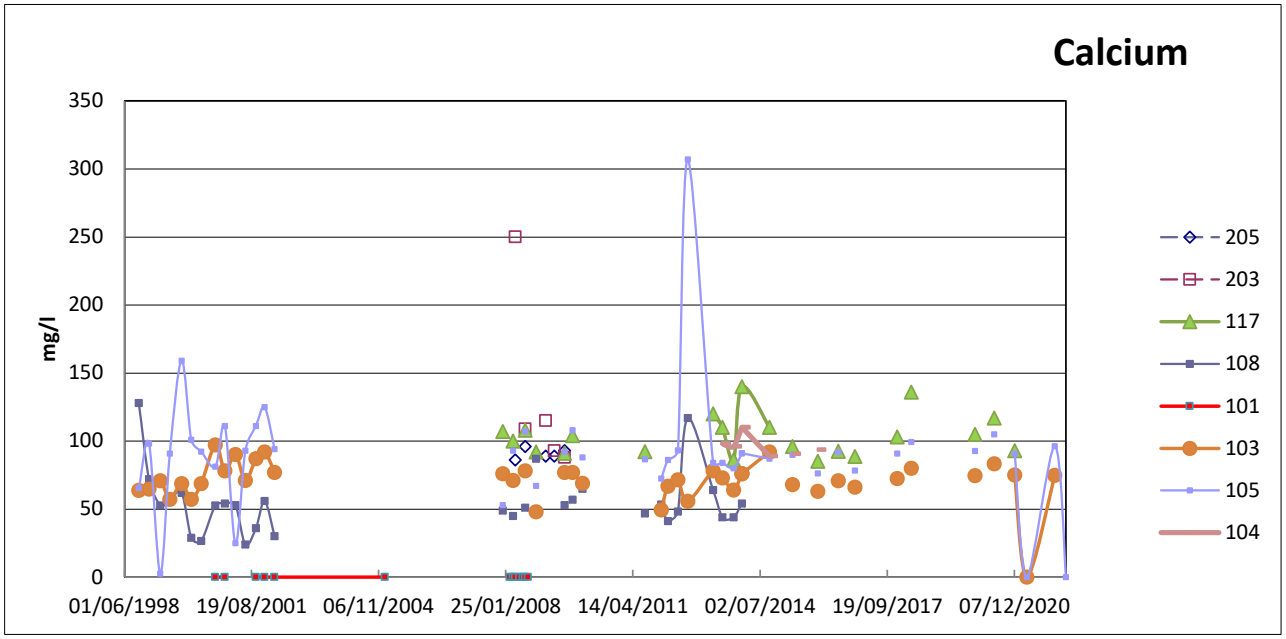
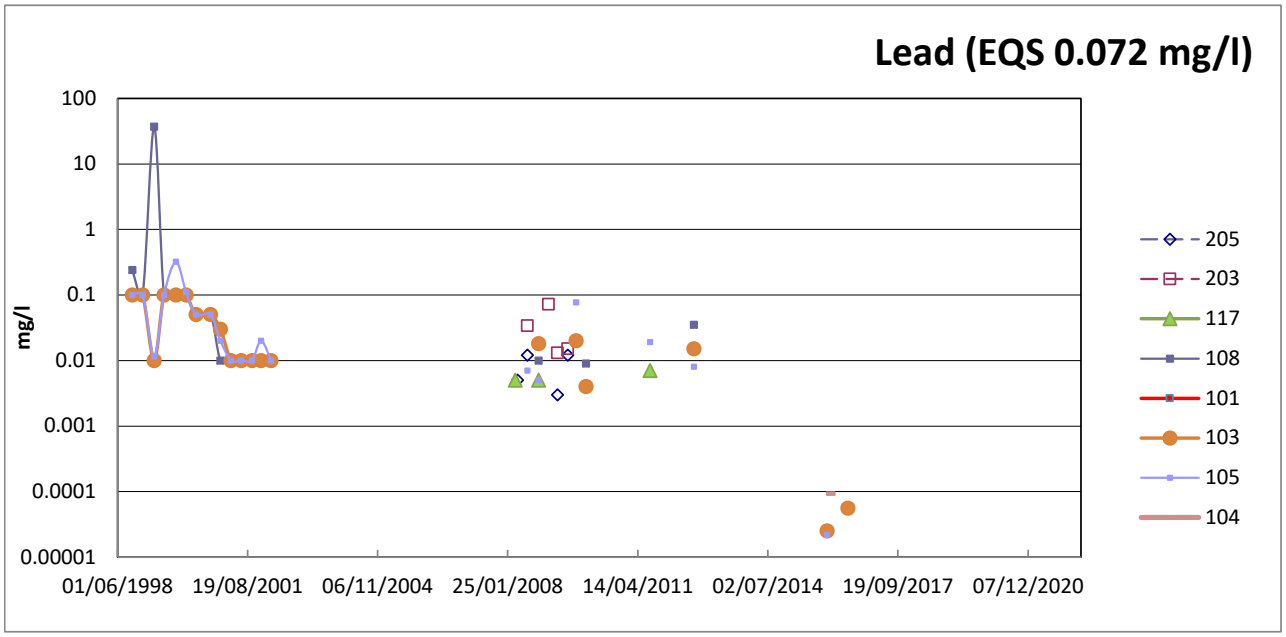
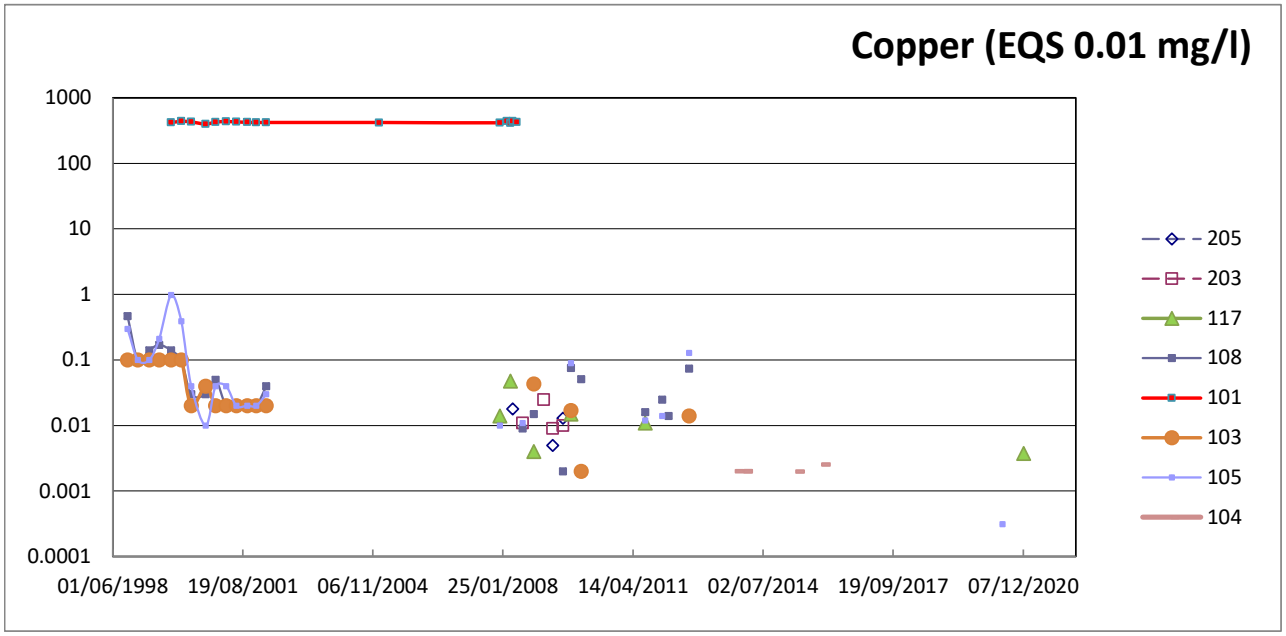
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
205
203
117
108
101
103
105
104

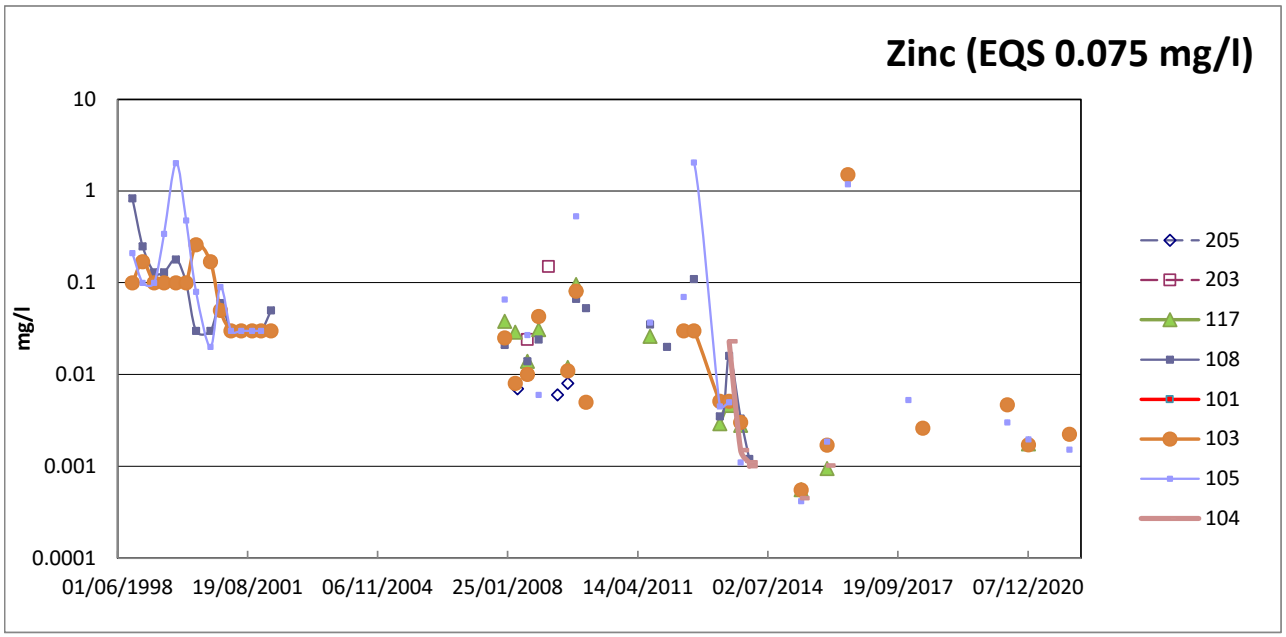

Sulphate (EQS 400 mg/l)
mg/l
40
35
30
25
20
15
10
5
0
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
205
203
117
108
101
103
105
104

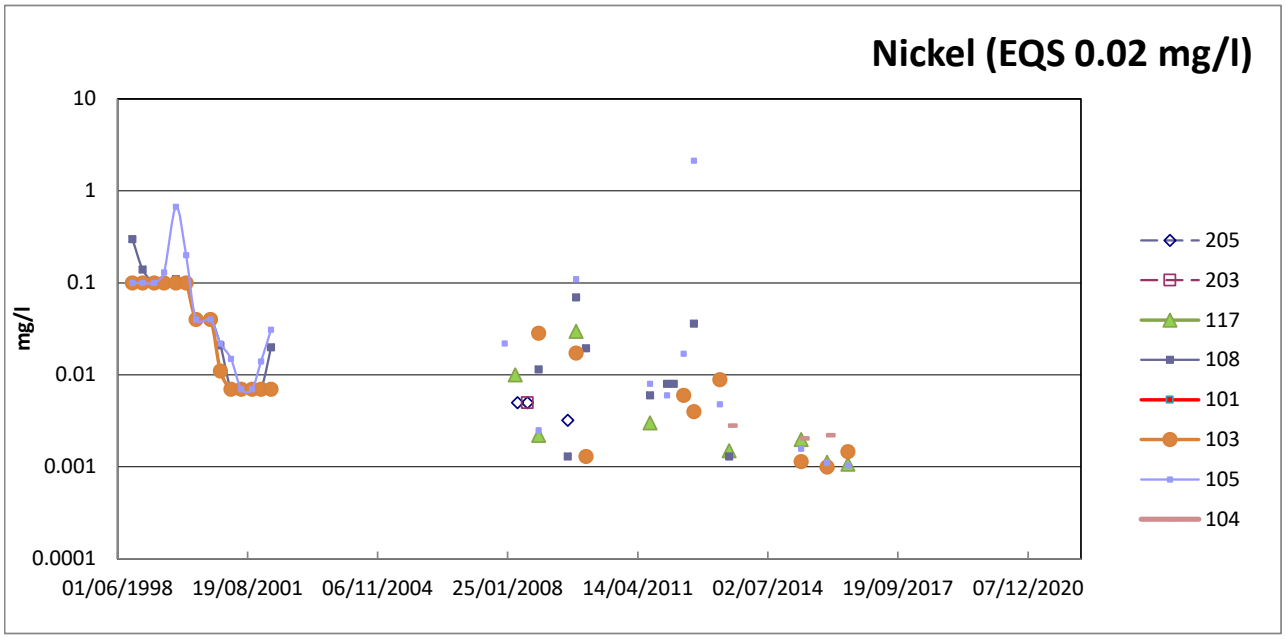

Iron
mg/l
500
450
400
350
300
250
200
150
100
50
0
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
205
203
117
108
101
103
105
104

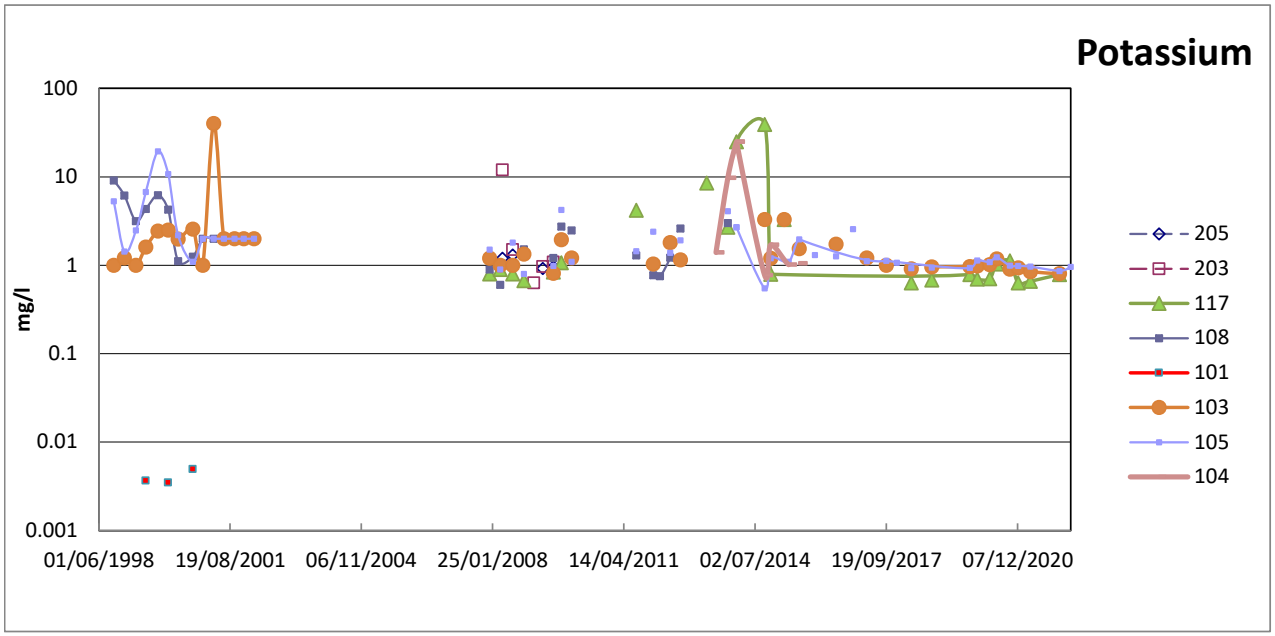

Calcium
mg/l
350
300
250
200
150
100
50
0
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
205
203
117
108
101
103
105
104


Lead (EQS 0.072 mg/l)
mg/l
100
10
1
0.1
0.01
0.001
0.0001
0.00001
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
205
203
117
108
101
103
105
104


Copper (EQS 0.01 mg/l)
1000
100
10
1
0.1
0.01
0.001
0.0001
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
205
203
117
108
101
103
105
104


Zinc (EQS 0.075 mg/l)
mg/l
10
1
0.1
0.01
0.001
0.0001
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
205
203
117
108
101
103
105
104


Nickel (EQS 0.02 mg/l)
mg/l
10
1
0.1
0.01
0.001
0.0001
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
205
203
117
108
101
103
105
104


Potassium
100
10
1
0.1
0.01
0.001
mg/l
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
205
203
117
108
101
103
105
104

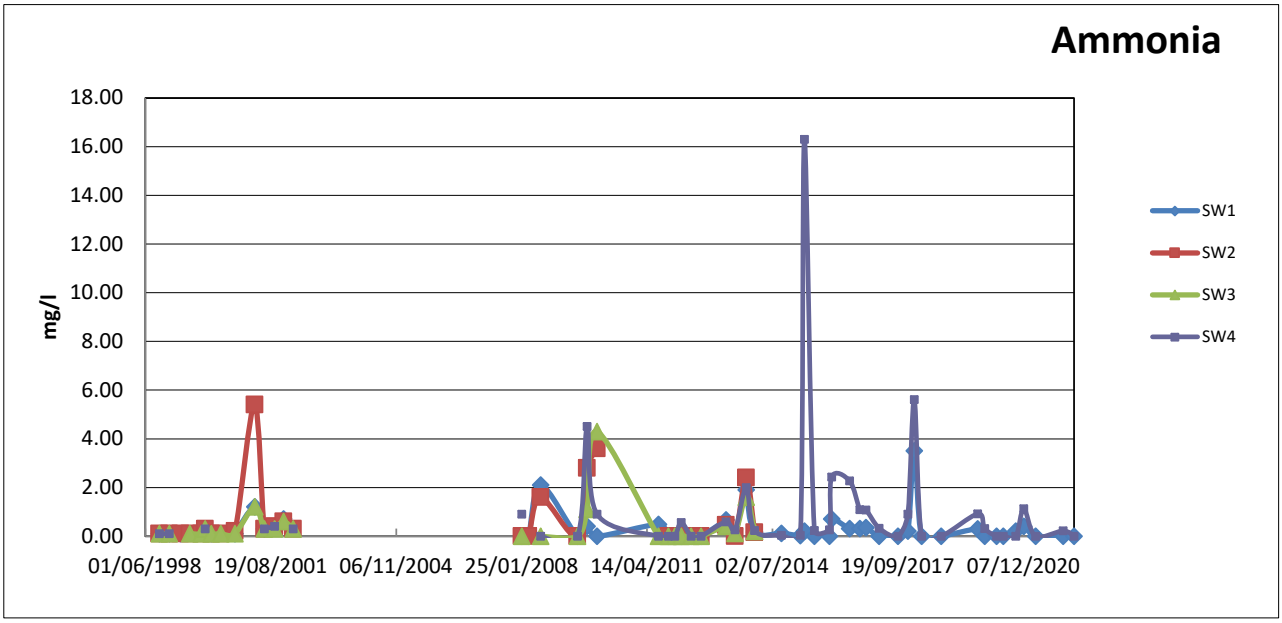
NANT Y CAWS
PHASE 1
CLOSED LANDFILL

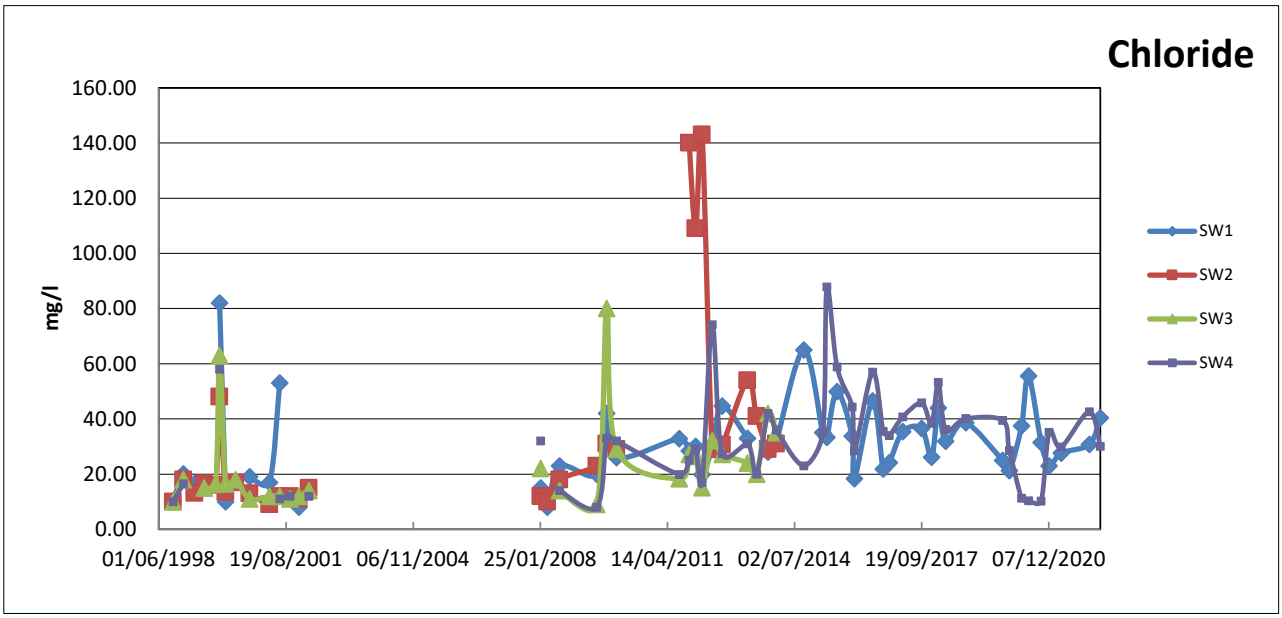
ENVIRONMENTAL
PERMIT 34183

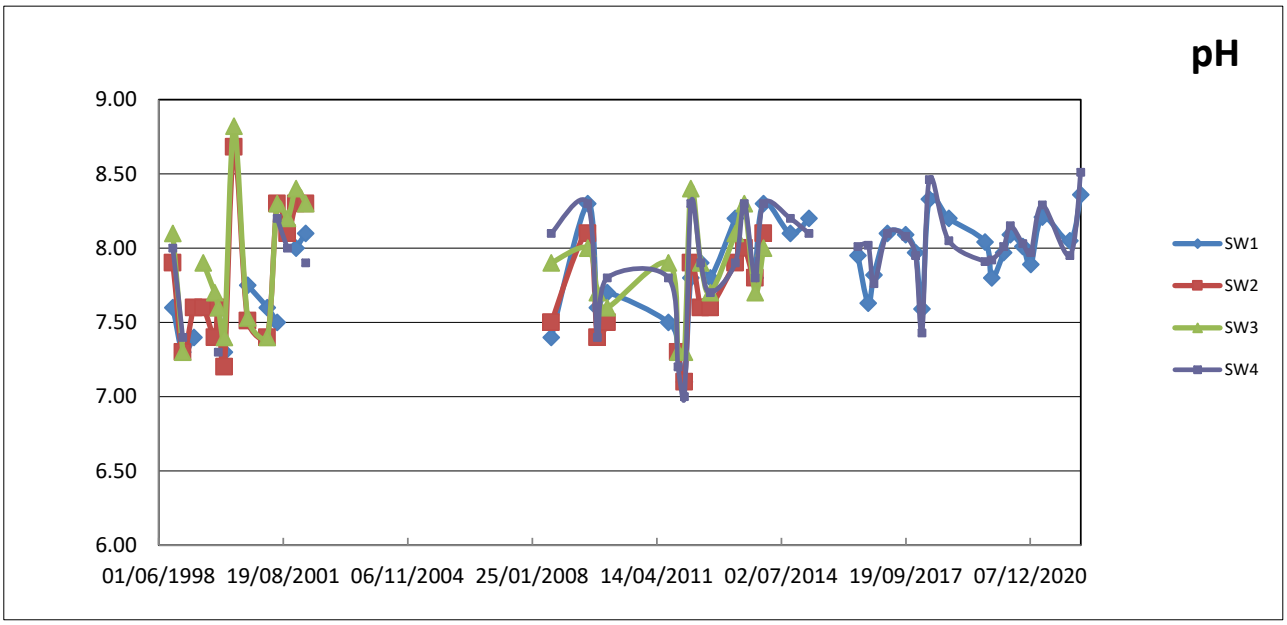
Environmental Monitoring Review

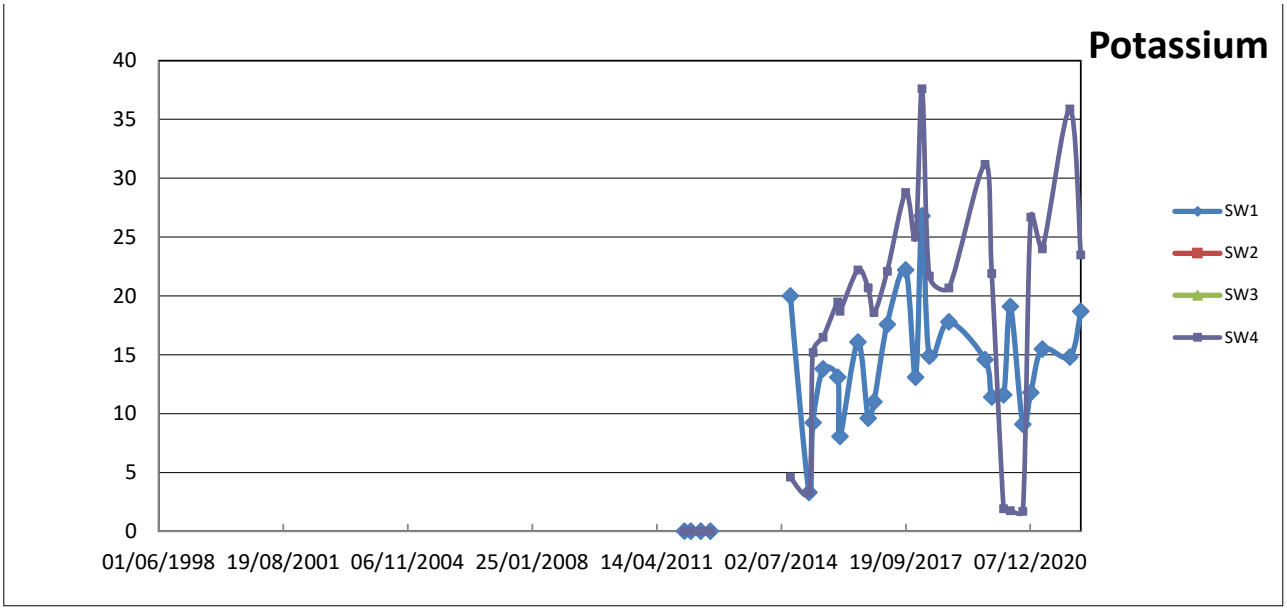
Appendix 4
Surface Water Chemistry

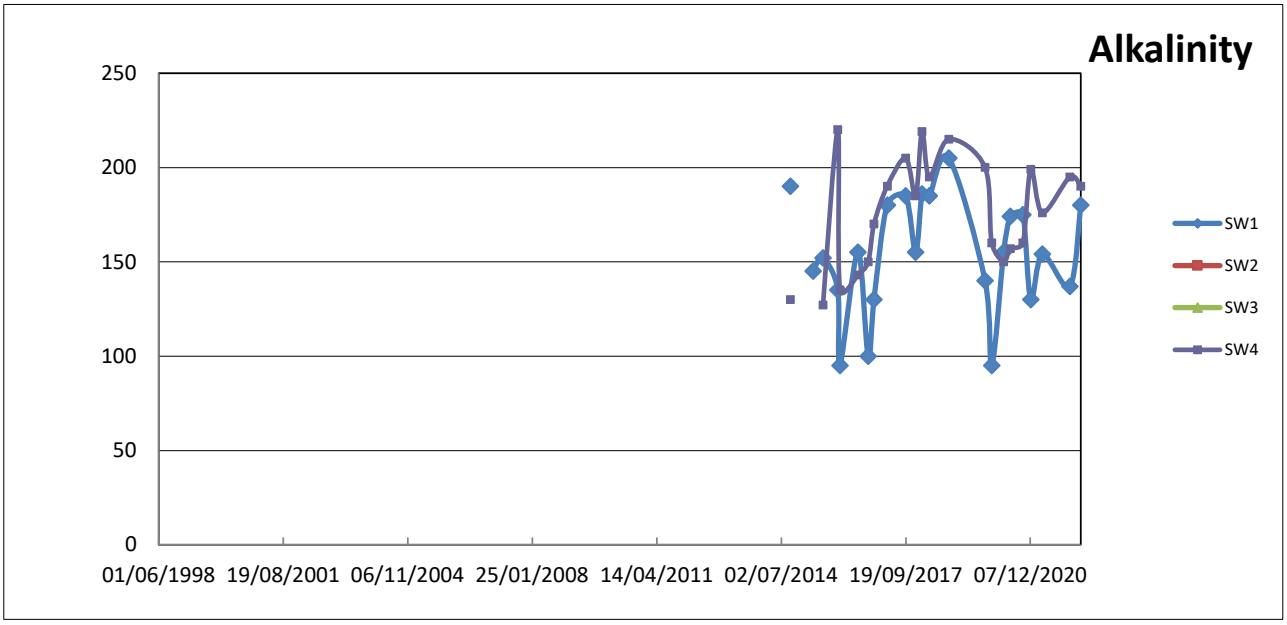
Report Number 2280r1v1d0822

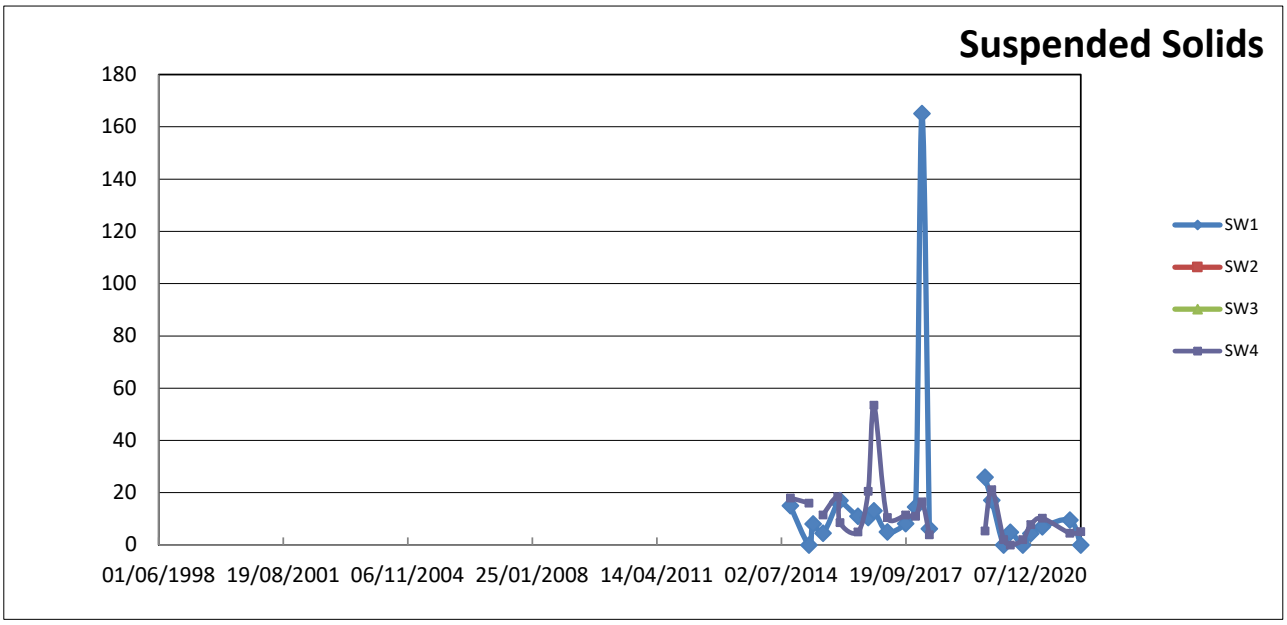

Ammonia
mg/l
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
SW1
SW2
SW3
SW4


Chloride
mg/l
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
SW1
SW2
SW3
SW4


pH
9.00
8.50
8.00
7.50
7.00
6.50
6.00
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
SW1
SW2
SW3
SW4


Potassium
40
35
30
25
20
15
10
5
0
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
SW1
SW2
SW3
SW4


Alkalinity
250
200
150
100
50
0
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
SW1
SW2
SW3
SW4


Suspended Solids
180
160
140
120
100
80
60
40
20
0
01/06/1998
19/08/2001
06/11/2004
25/01/2008
14/04/2011
02/07/2014
19/09/2017
07/12/2020
SW1
SW2
SW3
SW4

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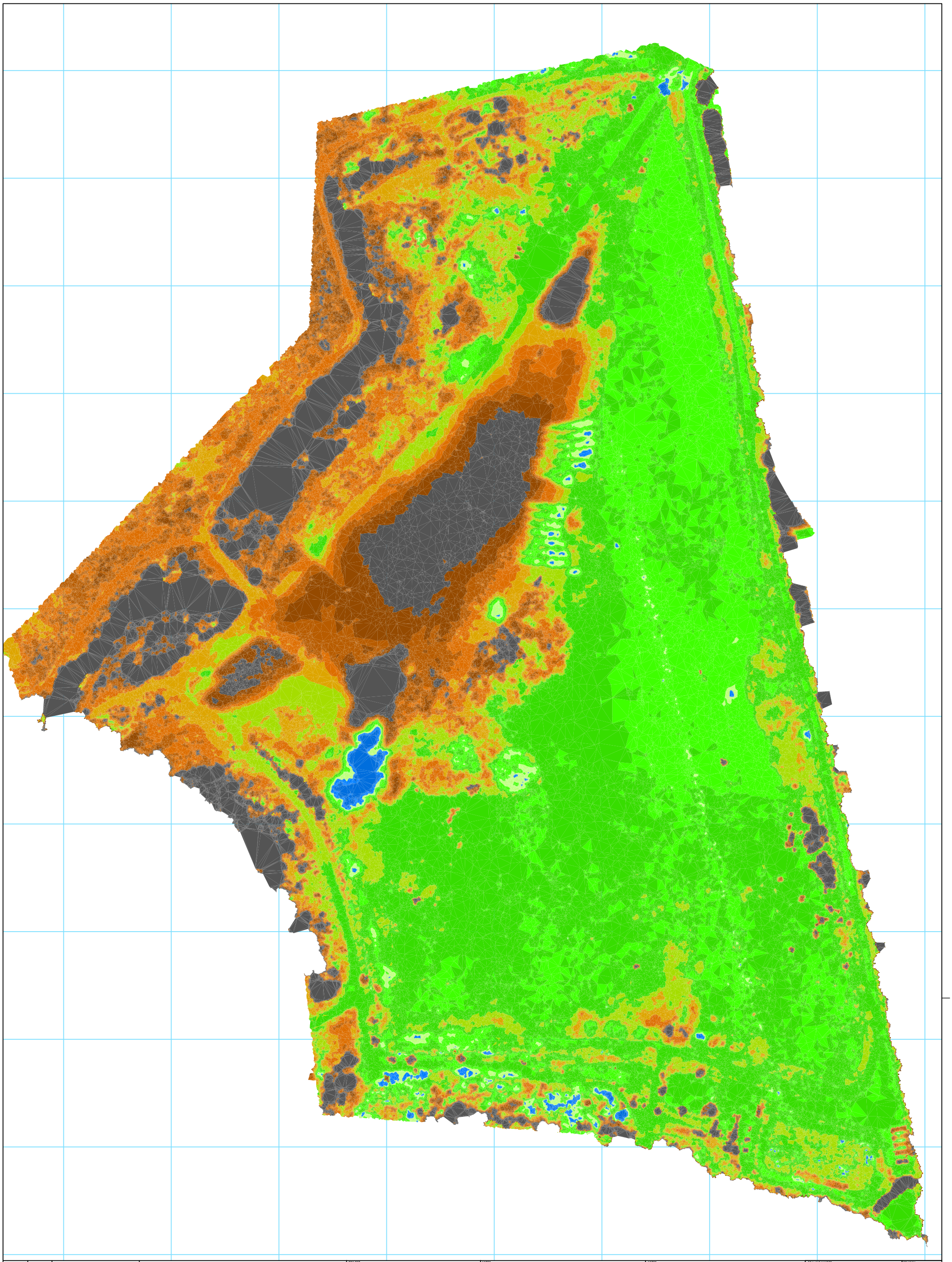
Appendix 5
Isopachyte of Topographic Surface

Report Number 2280r1v1d0822



Rev	Date	Status/Ammendments

CLIENT

CWM Environmental Ltd

Legend

Fill Levels	Cut Levels
2.4	0.0
2.0	-0.4
1.6	-0.8
1.2	-1.2
0.8	-1.6
0.4	-2.0
0.0	-2.4

FILL - 2019 > 2015
CUT - 2015 > 2019

PROJECT

Nantycaws Annual Topographic Survey - 2019

TITLE

Nantycaws 2019 - 2015 Drone Survey Isopachyte

NOTES

Survey Imagery acquired with Yuneec H520 hexcopter on 23/09/2019.

Isopachyte has been generated by subtracting the 2015 Digital Surface Model (DSM) from the September 2019 DSM. Digital surface model includes structures, vehicles and other equipment present at the time of survey.

As both surface models include vegetation and structures, some areas of cut or fill on the plan are likely the result of changes in these features between the two surveys.

NOTES

DRAWING NUMBER			REVISION
1952 Drawing 2			**0**
SCALE AT A1	DATE	DRAWN	CHECKED
1:750	**11.19**	**KJT**	**DRAFT**

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