nhulunbuy corporation

Gove Peninsula Waste Management Facility

Leachate, Surface Water, Groundwater and Landfill Gas Monitoring Report 2022

Prepared by

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Table of Revisions for Document No. 115005_REO_008_REV 1

Revision	Date	Description	Author	Reviewer	Approved
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Cover Photo: Aerial Photo of Gove Peninsula Waste Facility ©DPM

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Introduction

1.1 Introduction

East Coast Environmental Pty Limited was commissioned by Nhulunbuy Corporation (NC) to prepare a Leachate, Surface Water, Groundwater and Landfill Gas Monitoring Report for the Gove Peninsula Waste Management Facility, hereafter referred to as the Waters and Gas Monitoring Plan (WGMP).

The preparation of the monitoring report is required to satisfy conditions of the Northern Territory Environmental Protection Licence (EPL236) issued for the facility.

The objective of this monitoring is to identify the movement of any potential contaminants that may emanate from the landfill operations and enter pathways that could potentially affect the human and environment receptors in the local area.

This Monitoring Report provides details on the;

- location undertaken for monitoring,
- methodology for each monitoring type (Leachate, Surface water, Groundwater and Landfill gas)
- parameters monitored for each of the environmental aspects,
- results for the monitoring period.

The Monitoring report has been prepared generally in accordance with;

- Northern Territory Environment Protection Authority (2013) *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory*
- Northern Territory Environment Protection Authority (2016) *Guideline for Reporting on Environmental Monitoring*
- Northern Territory Environment Protection Authority (2013) Guidelines for Consultants Reporting on Environmental Issues
- East Coast Environmental (2016) *Gove Peninsula Waste Management Facility -Conceptual Site Model;*
- East Coast Environmental (2016) *Gove Peninsula Waste Management Facility* - Landfill Gas Assessment

1.2 Outline of the WGMP

The report is structured as follows:

Section 2 – Provides the site context, a description of the sites location and the operational history of the site,

Section 3 – Details the gas sampling methodology undertaken and the modelling approach used for the Landfill Gas Assessment,

Section 4 – Provides a summary of the results of the initial Landfill Gas sampling and landfill Gas generation modelling,

Section 5 – Provides a discussion of the results, landfill gas risk and mitigation/ management measures,

Section 6 – Details the conclusions of the Landfill Gas Assessment.

1.3 Site Context

The site is located approximately 3km southeast of the Nhulunbuy Post Office, approximately 4.3km by road. The site is situated within the current Mineral Reserve RO238 and is adjacent to the Nhulunbuy Speedway on Melville Bay Road.

Figure 1: Locality plan of Gove Peninsula Waste Management Facility.

1.3.1 Site Hydrology and Hydrogeology

Hydrology

No surface water was encountered during the 2003 or 2016 site investigations and the site lacked any natural incised drainage channels or creeks. Evidence of channelised flow was only found along road sides and constructed drainage channels emanating from table drains from the internal access roads and hardstand areas.

Water flow is expected to occur during the wet season as either sheet flow or subsurface water flow, and due to the lack of erosional features or channels is expected to slow, with high percentage of infiltration. The surface water flow direction has been inferred using recent Digital Surface Mapping (DSM) undertaken during the drilling program and baseline groundwater sampling conducted in July 2016. The inferred surface water flow direction is expected to travel in an east to west direction as shown by the direction of surface flows and the DSM is shown in **Figure 2**.

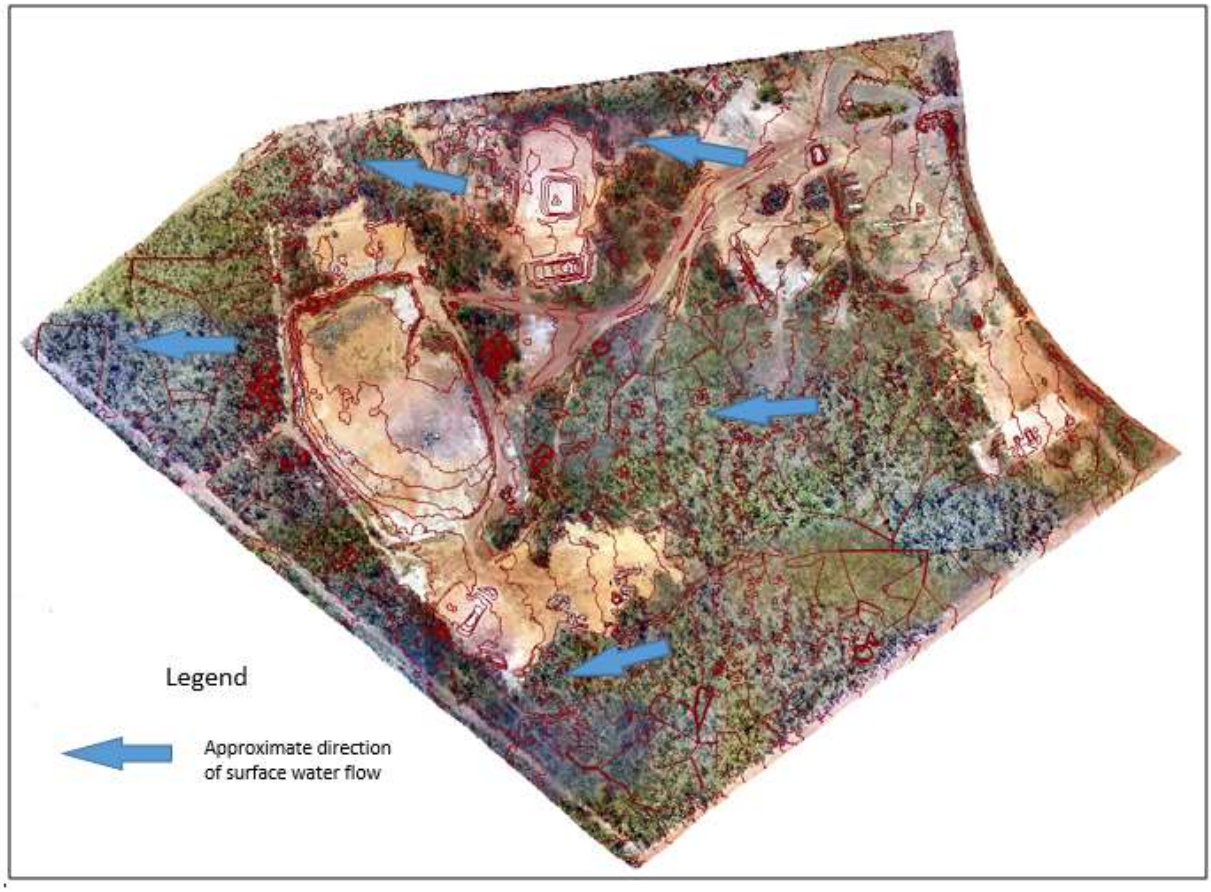

Figure 2: Inferred direction of surface flows and DSM at Gove Peninsula Waste Management Facility

Groundwater and Hydrogeology

Groundwater was encountered at boreholes deeper than 6m below ground level during the 2003 drilling program. The groundwater depth was identified by the “balling” of returned cuttings during the drilling program as standing water was only recorded in one borehole during the program and therefore a peizometric surface could not be determined across the site (GHD 2003).

1.4 Weather and recent Climate

The weather experienced prior to the sampling saw warmer than average days and nights across virtually all of the Northern Territory. Territory-wide, temperatures were above average for every month during the dry season, apart from May. All months of the dry season, apart from September, saw below average rainfall for the NT.

This follows on from back-to-back dry wet seasons and nearly the entire Northern Territory saw below average rainfall totals during the 2019-20 wet season. Both daytime and overnight temperatures both ranked as the second-highest on record as nearly all locations had temperatures in the highest 10% of their long-term record.

1.4.1 Northern Territory Wet Season (October to April 2021-22)

Maximum temperatures were above average across most of the Northern territory, except the far south recording near average mean maxima. For the Territory as a whole, it was the seventh-warmest wet season on record. Minimum temperatures were above average for the northern half and eastern territory.

Rainfall was mixed, with below average rainfall in a large part of the north, while above average rainfall was observed in the south, particularly around Alice Springs, with near average rainfall along the northern coastal areas. Rainfall in the 2021-2022 wet season was 8% below the 1961-1990 average for the Northern Territory. Rainfall was mixed, with a large part of the north extending from the Carpentaria to southern Top End, northern Barkly and Gregory districts recording below average rainfall.

In 2021, Gove Airport received 1566.0mm of rainfall, slightly higher than average (Annual Average 1435.1mm. 109% of Annual Average) and the summary for the entire Wet Season (October 2021 to April 2022) ranked rainfall as High with 1491.2mm recorded during the period equating to 109% of Annual Average. The Recent Climate averages for Gove Airport are shown in Table 1 below and the Rainfall for 2021 and 2022 to date are included in Figures 3a and 3b.

Table 1: Climate Averages for Recent years at Gove Airport

Years	Maximum temperatures (°C)		Minimum temperatures (°C)		Rainfall (millimetres)			
	Mean	Diff from Average	Mean	Diff from Average	Total	Annual Average Total	Rank	Fraction of Average
2018	31.6	+0.8	23.0	+0.6	1257.4	1446.4	low	87%
2019	31.2	+0.4	22.7	+0.2	1373.8	1444.5	average	95%
2020	31.7	+0.9	/	/	933.8	1431.8	v low	65%
2021	31.6	+0.8	23.8	+1.3	1566.0	1435.1	average	109%
2022 (Oct 21 – April 22)	33.1	+1.1			1491.2	1290.2	high	116%

Rainfall 2021

During 2021 Gove Airport weather station recorded an average rainfall, as a result of significant rainfall in December 2021. The preceding Wet season was below average however these falls in December raised annual totals for Gove (BOM 2022)

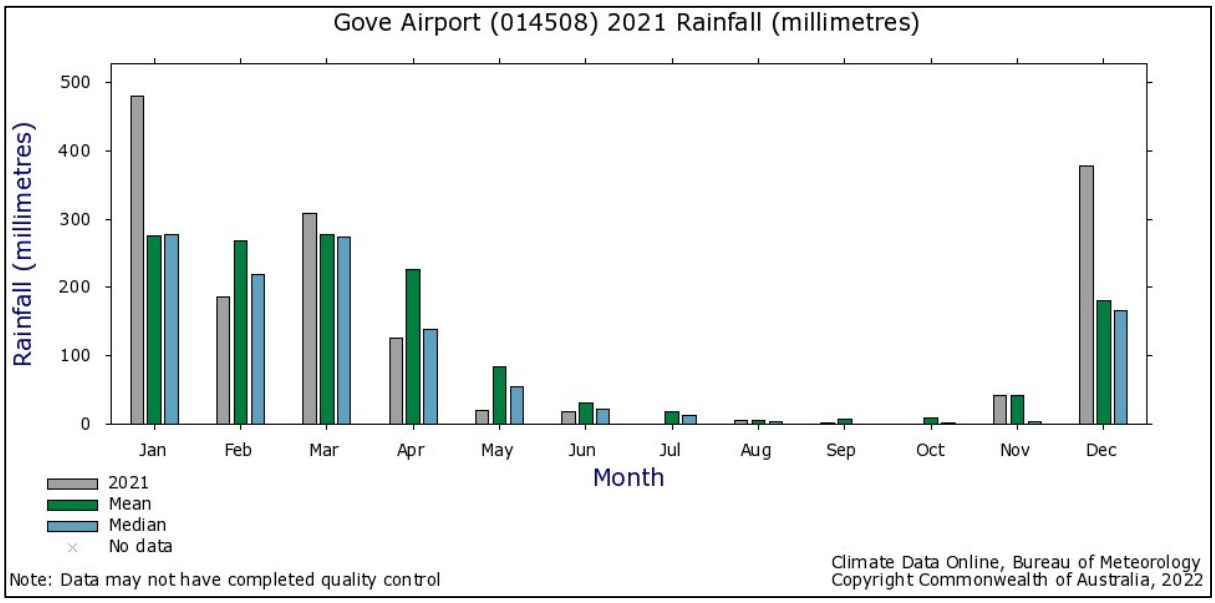

Figure 3a: Rainfall Data 2021 at Gove Airport

Rainfall 2022 (Jan- July 2022)

Rainfall associated with the Monsoonal conditions were generally below average for January and February however rainfall increased in March and, rainfall in April exceeded averages by more than double.

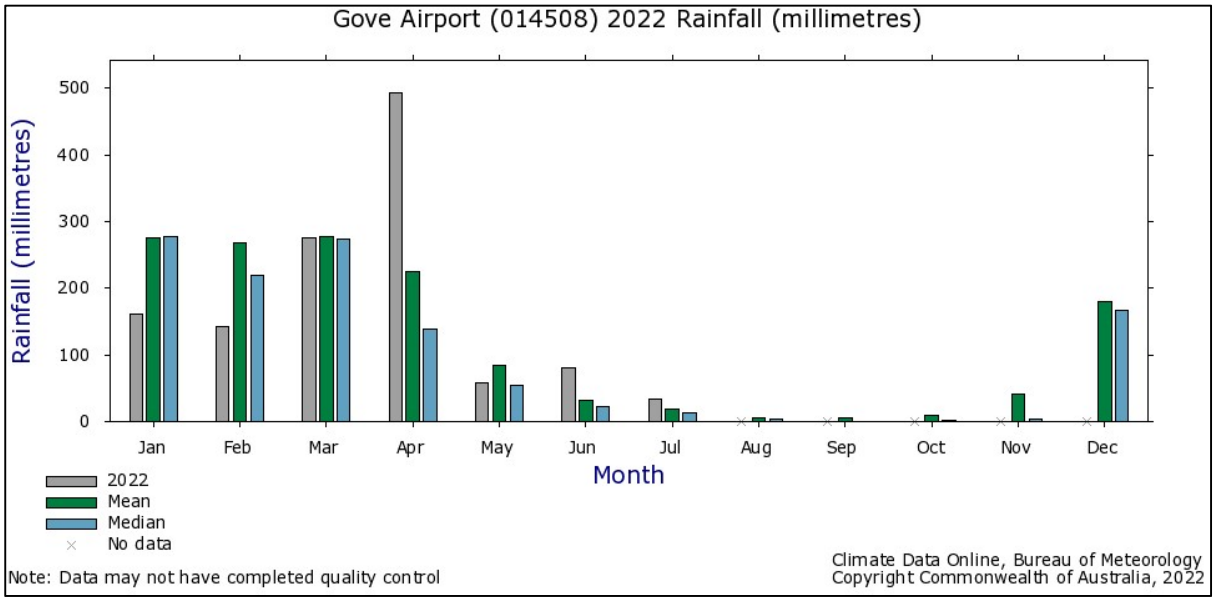

Figure 3b: Rainfall Data 2021 at Gove Airport

Methodology

The 2021 monitoring was undertaken over a two day period on the 9th and 10th September 2020. The following provides the methods employed for Leachate, Surface Water, Groundwater and Landfill Gas Monitoring.

2.1 Landfill Gas Monitoring

The Landfill Gas Monitoring sampling approach was to identify the gas concentrations within the landfill cells and whether any vertical or horizontal LFG migration could be detected. The sampling of the Leachate/LFG monitoring bores was conducted on the two new Landfill Gas boreholes, and three shallow bores (to 5.5m) installed in 2003 at the base of the landfill cells.

The dedicated Landfill Gas Monitoring was conducted at two wells was installed into the centre of each of the two capped landfill cells, to a depth of approximately 6m below ground surface within the waste mass and at 3 shallow Leachate wells to determine if any migration of Landfill gas was occurring.

All bores were fitted with an Ex Cap Vapour extraction 2" Locking Monitoring Well Expansion Plug, with Air Sampling Ports and the insitu gas composition was analysed at all five bores and the two ambient air sampling sites using the Landtec GA5000 Portable Landfill Gas Analyser. The details of each monitoring bore is shown in Table 1 and the location of each bore is provided on Figure 2.

Detailed gas composition sampling was undertaken at the two LFG bores (LFG 01 and LFG02) using soil gas canisters.

Figure 4: Landfill Gas Monitoring Bores installed at Gove Peninsula Waste Management Facility.

Table 1: Details on Leachate and Landfill Gas Monitoring Bores

Monitoring Bore Name	Monitoring Bore Type	Depth	Notes
LL01	Leachate and Landfill Gas Migration Bore	Approximately 5.5m Below ground surface	Within 10 m of landfill, Ex -cap fitted to existing bore installed in 2003
LL02	Leachate and Landfill Gas Migration Bore	Approximately 5.5m Below ground surface	Ex -cap fitted to existing bore installed in 2003
LL03	Leachate and Landfill Gas Migration Bore	Approximately 5.5m Below ground surface	Ex -cap fitted to existing bore installed in 2003
LG01	Landfill Gas Bore	Approximately 6.0m into landfill waste	Installed during 2016 – slotted pipe grouted to surface
LG02	Landfill Gas Bore	Approximately 6.0m into landfill waste	Installed during 2016 – slotted pipe grouted to surface

Figure 5: Landfill Gas Monitoring - Gove Peninsula Waste Management Facility

2.2 Leachate Monitoring

During the August 2022 monitoring only 1 of the leachate bores contained water to enable the collection of samples for leachate monitoring.

2.3 Surface Water Monitoring

The site has only contains ephemeral water channels and no permanent standing water bodies. During the August 2022 surface water monitoring was not undertaken as no surface waters were available for monitoring.

2.4 Groundwater Monitoring

The location of the groundwater boreholes and the relative groundwater heights are shown in **Figure 3**. The heights recorded at each of the groundwater boreholes, and the relative heights are detailed in **Table 2** below. The recent groundwater investigations determined that the groundwater gradient generally follows the terrain as shown in the DSM, in that the flow is generally from east to west.

Table 2: Groundwater Bore information from bore installation program 2016

Groundwater bore No.	Surface elevation (at top of monument)	Depth to groundwater (from monument)	Groundwater elevation (m AHD) #
GW01	17.49	7.21	10.28
GW02	17.22	7.53	9.69
GW03	26.53	10.52	16.01
GW04	28.05	11.83	16.22
GW05	25.08	7.7	17.38
GW06	24.07	11.25	12.82
GW07	17.11	8.18	8.93

Elevation currently approximate and only relative as elevation not rectified from monument.

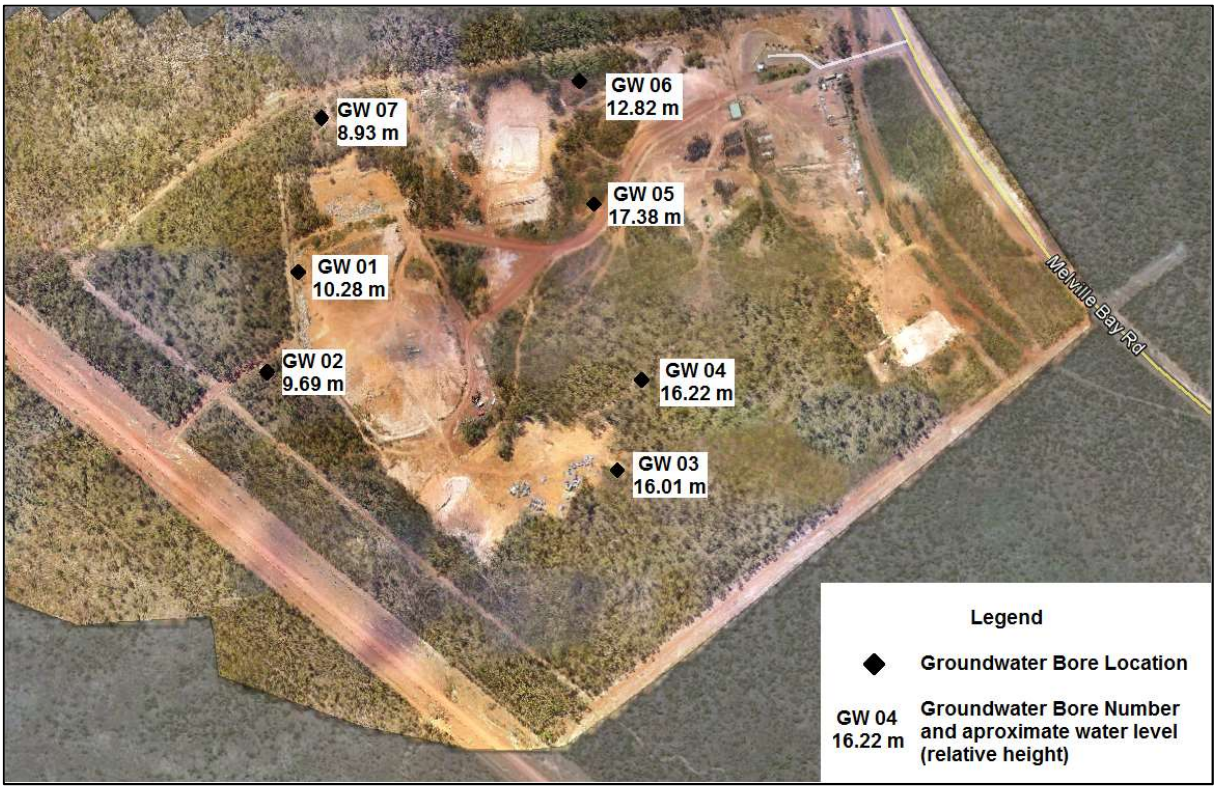

Figure 6: Groundwater boreholes and the relative groundwater heights encountered at Gove Peninsula Waste Management Facility

Results

3.1 Landfill Gas Monitoring results

The results of the insitu field sampling undertaken in 2016 and 2020 are detailed in Tables 3 and 4 (below).

Table 3: Insitu Gas composition sampling results – Field measurements Baseline 2016

Monitoring Bore /Site	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)	Balance Gases (%)
LL01	0.1	3.0	18.2	45	3	78.8
LL02	0.0	4.9	16.8	1	1	78.3
LL03	0.1	6.7	13.9	66	6	79.4
LG01	49.0	15.8	0.0	182	7	35.2
LG02	64.7	31.8	0.1	303	29	3.4

Table 4: Insitu Gas composition sampling results – Field measurements August 2022

Monitoring Bore /Site	CH4 (%)	CO2 (%)	O2 (%)	CO (ppm)	H2S (ppm)	Balance Gases (%)
LL01	0.7	0.5	19.4	1	0	79.4
LL02	0.3	0.3	19.5	1	0	79.9
LL03	0.1	6.0	15.0	1	0	79.0
LG01	38.4	8.1	5.7	8	1	47.5
LG02	53.2	25.0	0.9	10	1	21.5

The results demonstrate that the landfill continues to generate significant percentages of Methane in the closed and capped landfill cells. The gas composition recorded in LG01 has observed a decrease in Methane levels between 2016 and 2022 from 49.0% (previously 62.6% in 2021) to 38.4% in 2022. The older of the two cells (LFG 02) shows methane concentrations of approximately 64.7% in 2016, and similar levels in 2021 to 64.5% but slightly lower in 2022 at 53.2%

The three Leachate/Landfill gas bores (LL01/LL02/LL03) situated on the edge of the landfill recorded extremely low Methane (0.1 -0.7%) and extremely low levels of Hydrogen Sulphide (1ppm). Neither of these correlate to typical Landfill gas concentrations.

3.2 Groundwater Monitoring

3.2.1 Groundwater heights

Table 5: Insitu sampling results – Field measurements

Groundwater bore No.	Surface elevation (at top of monument)	Depth to groundwater (from monument Baseline 2016)	Depth to groundwater (from monument 2019)	Depth to groundwater (from monument 2020)	Depth to groundwater (from monument 2021)	Depth to groundwater (from monument 2022)	Difference between 2016 to 2022
GW01	17.49	7.21	6.98	11.72	4.23	5.39	+ 1.82
GW02	17.22	7.53	7.40	11.19	5.42	6.39	+ 1.14
GW03	26.53	10.52	11.42	13.75	13.33	11.98	-1.46
GW04	28.05	11.83	12.40	15.08	14.83	14.03	-2.20
GW05	25.08	7.7	7.01	10.27	5.23	6.19	+1.51
GW06	24.07	11.25	7.88	10.80	6.59	7.24	+4..01
GW07	17.11	8.18	5.64	9.39	4.37	5.09	+3.09

The recorded groundwater heights showed a slight variation in water levels in between May 2021 and August 2022 results however are within ranges of fluctuations recorded in 2021. Consistent with last year all piezometers recorded heights above the baseline recorded in 2016 except, two piezometers (GW03 and GW04) with heights generally 2.2 -1.46m lower than the originals heights after installation.

3.2.2 Groundwater Physiochemical Results August 2022

The recorded Groundwater Physiochemical results are shown in Table 6 below.

Table 6: Groundwater Field Physiochemical Results August 2022

Date	Site	pH Value (pH Units)	Electrical Conductivity µS/cm	Redox Potential mV
23/08/2022	GW01	6.11	794	140
24/08/2022	GW02	5.03	313	285
24/08/2022	GW03	5.17	1351	187
24/08/2022	GW04	4.17	539	302
24/08/2022	GW05	4.10	120	359
24/08/2022	GW06	3.9	242	400
24/08/2022	GW07	4.7	148	280

The following graphs demonstrate the laboratory Physiochemical Results for each Piezometer.

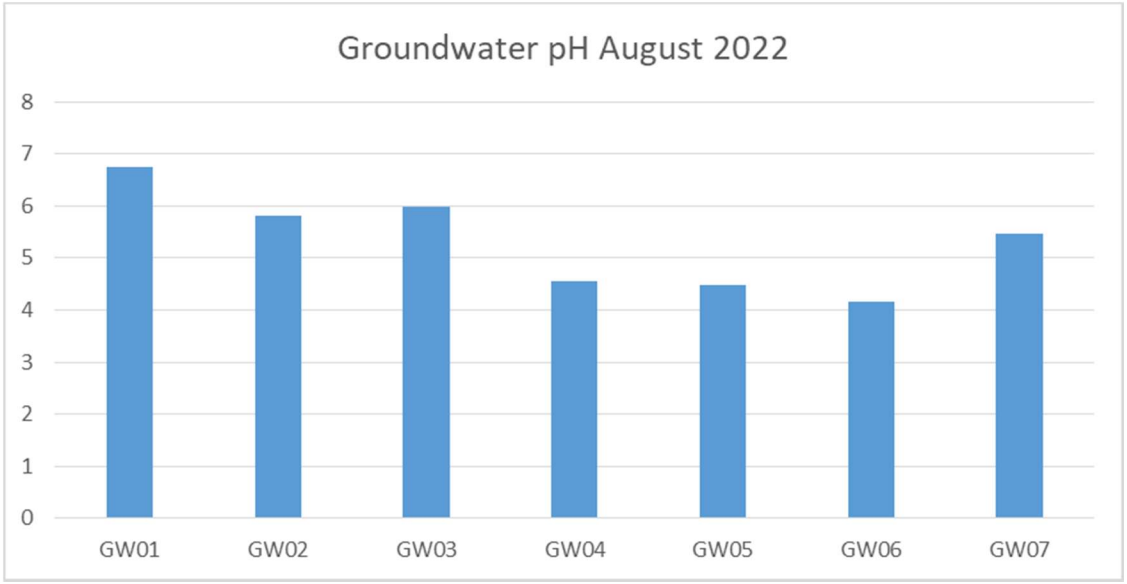

Figure 7: Groundwater pH August 2022

Groundwater pH was relatively consistent across all piezometers apart from GW01 which recorded a near neutral pH level. All other piezometers recorded acidic water ranging from 4.15 to 5.99.

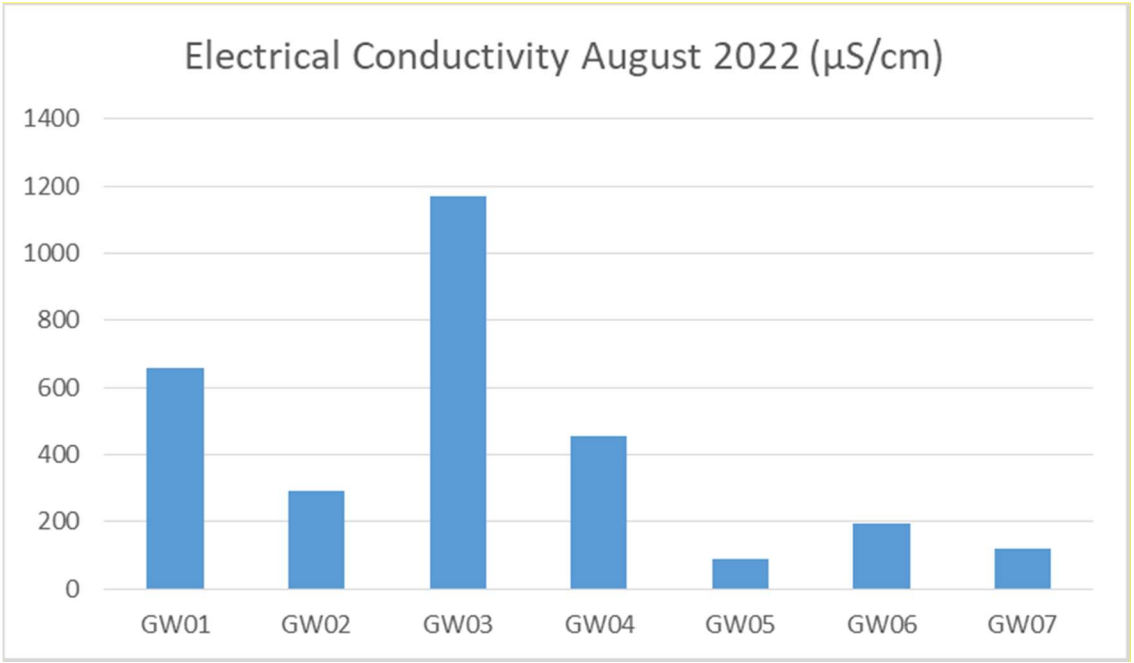

Figure 8: Electrical Conductivity (µS/cm) August 2022

The recorded Electrical Conductivity (EC) varied across piezometers however the piezometers with the highest EC at GW03 which is not located near any current or former landfill cell and similar results between GW01 down gradient to the recent operational cells and the up gradient (control) piezometer at GW04

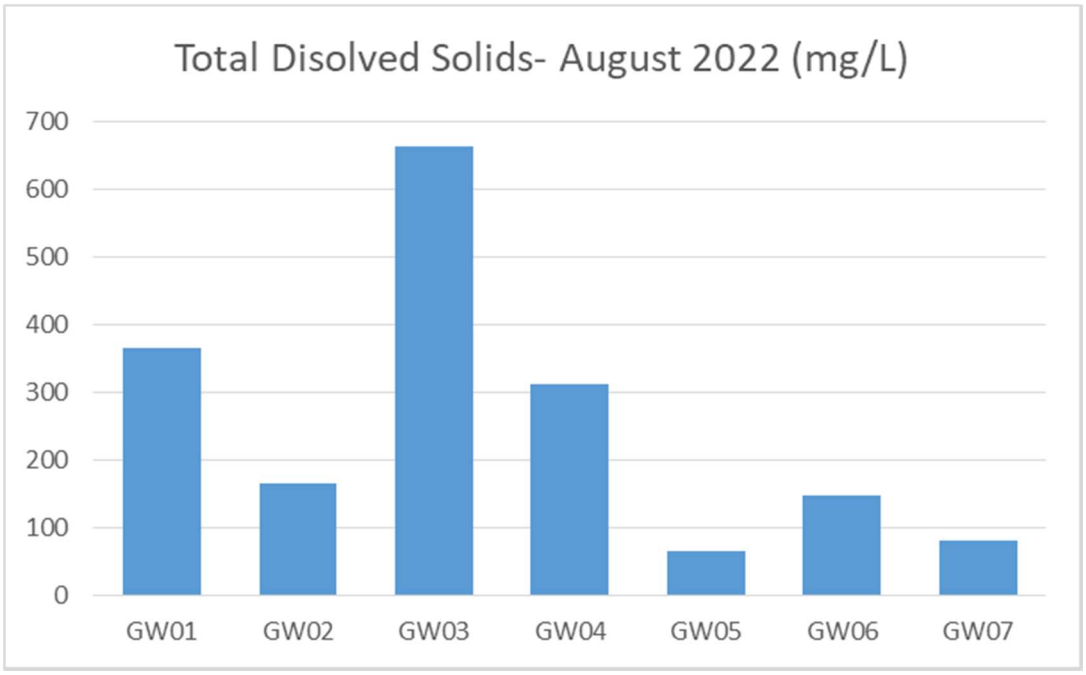

Figure 9: Total Dissolved Solid (TDS) August 2022

Similar to the recorded Electrical Conductivity (EC), TDS varied across piezometers however the piezometers with the greatest variability was GW03 which is not located near any current or former landfill cell. The EC was however consistently lower at the up gradient piezometers GW04, GW05, GW06 and GW07.

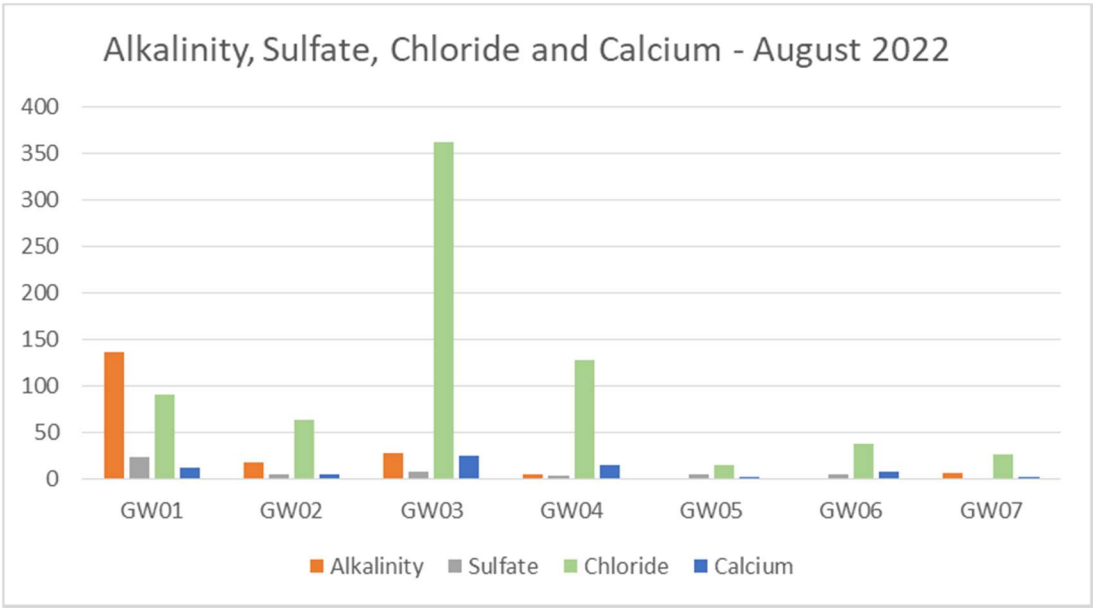

Figure 10: Alkalinity, Sulphate, Chloride and Calcium August 2022

The Alkalinity, Sulphate, Chloride and Calcium also followed the trends of the EC with again GW03 recording highest Chloride levels despite being a significant distance from any cell. GW01 down gradient to the recent operational cells also showed some elevation in Alkalinity, Sulphate, Chloride and Calcium.

3.2.3 Groundwater Metals and Metalloid Results September 2020

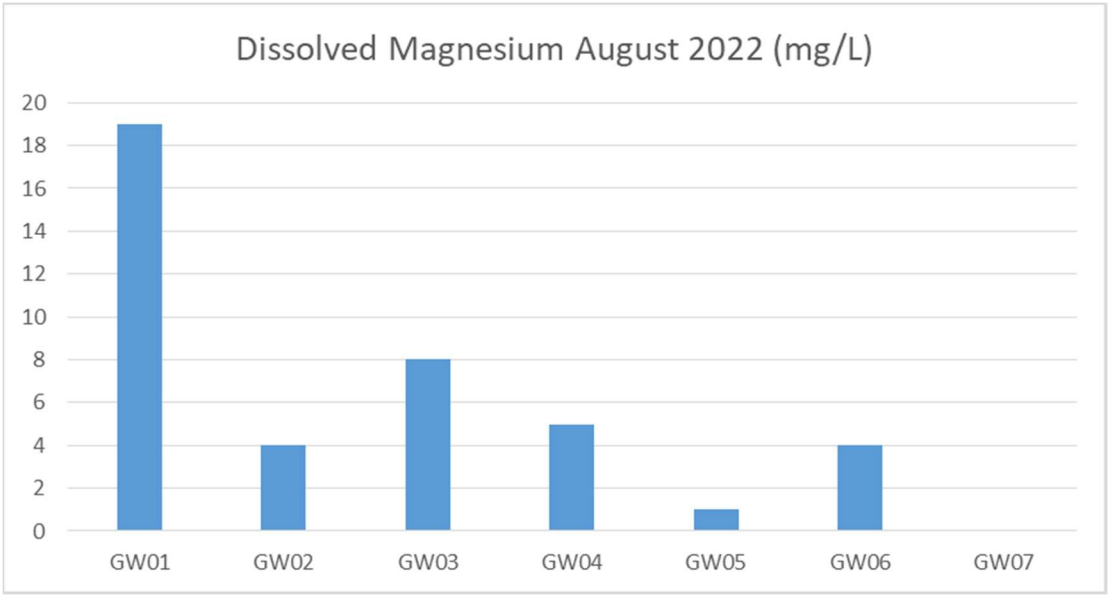

Figure 11: Dissolved Magnesium August 2022

The levels of Dissolved Magnesium were elevated at GW01 down gradient to the recent operational cells while all other piezometers recorded low concentrations.

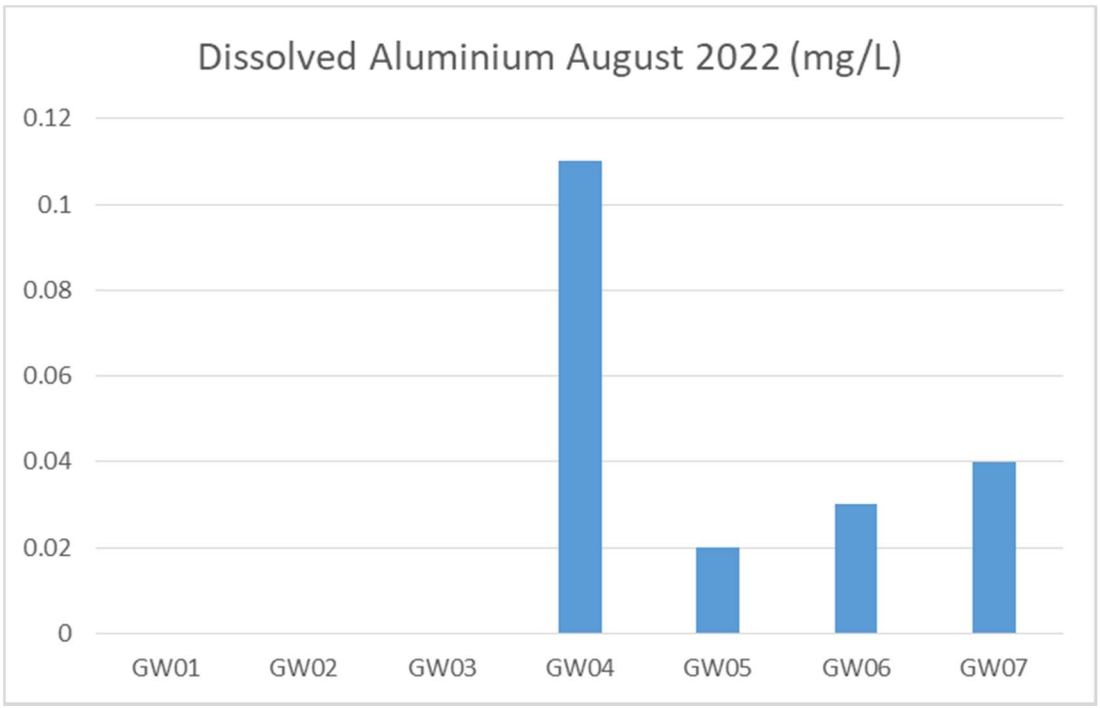

Figure 12: Dissolved Aluminium August 2022

The levels of Dissolved Aluminium were lowest (below LOR) at GW01 down gradient to the recent operational cells and GW02, and GW03 and highest at GW04 a “control piezometer”, while all other piezometers recorded low concentrations.

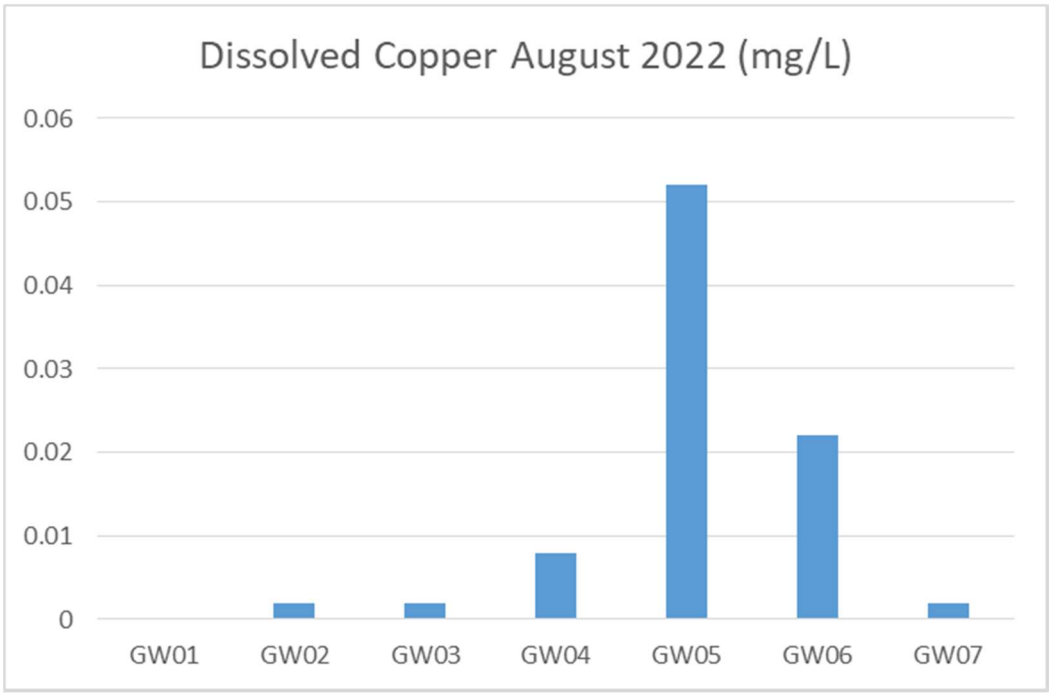

Figure 13: Dissolved Copper August 2022

The levels of Dissolved Copper were only elevated at GW05 which is near operational cells, while all other piezometers recorded low concentrations.

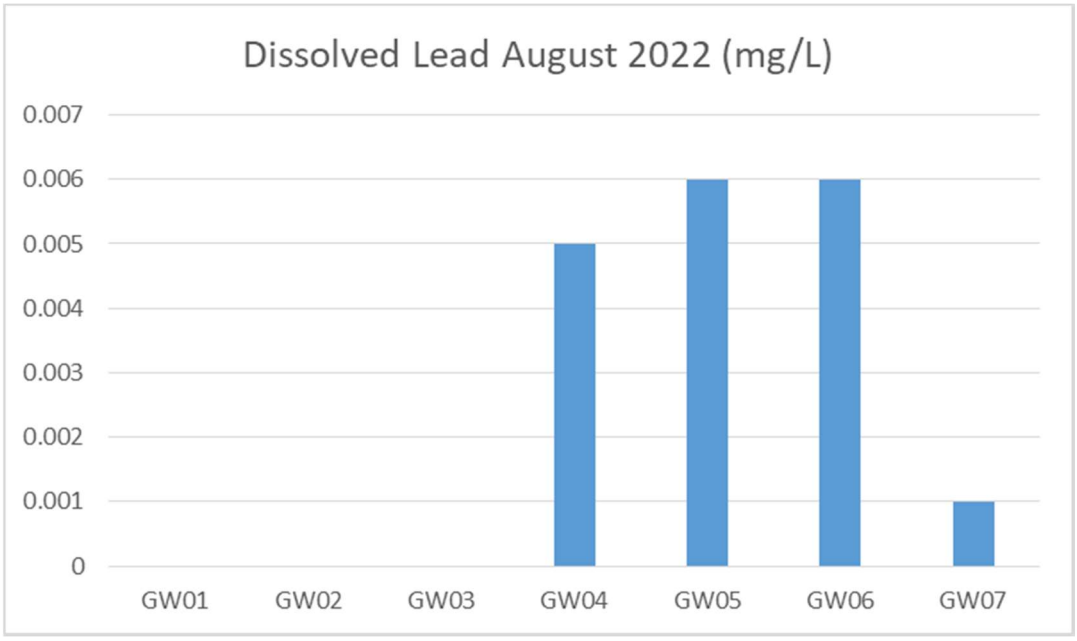

Figure 14: Dissolved Lead August 2022

The levels of Dissolved Lead were detected at GW04, GW05, GW06 and GW07, while all other piezometers recorded "below detect" concentrations.

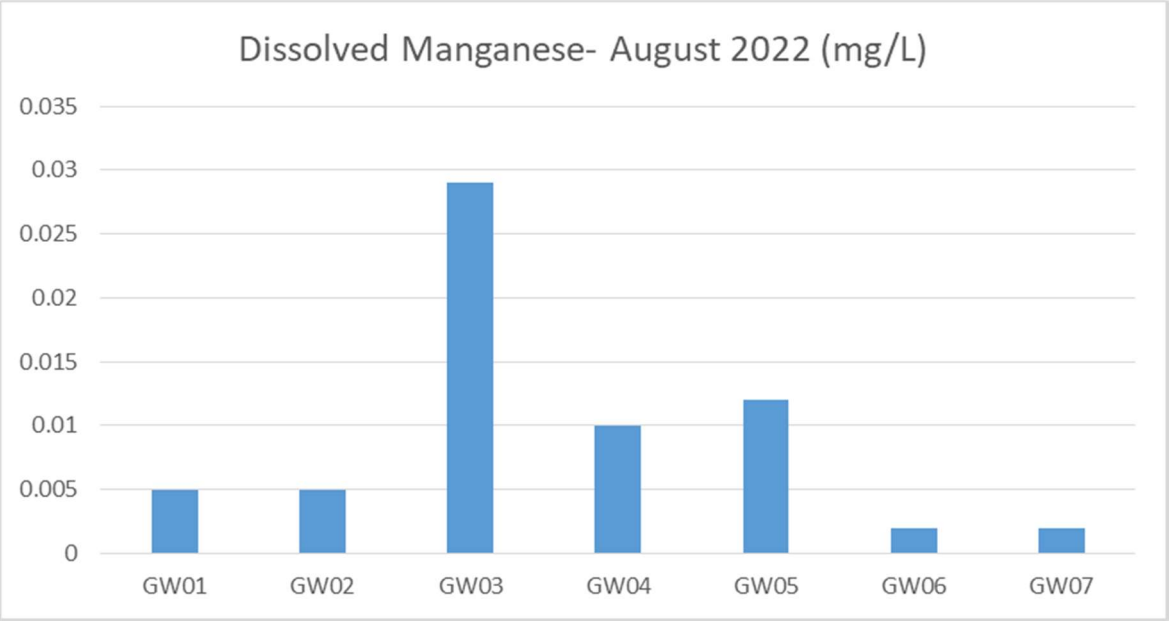

Figure 15: Dissolved Manganese August 2022

The levels of Dissolved Manganese were elevated at GW03 up gradient of operations while all other piezometers recorded low concentrations.

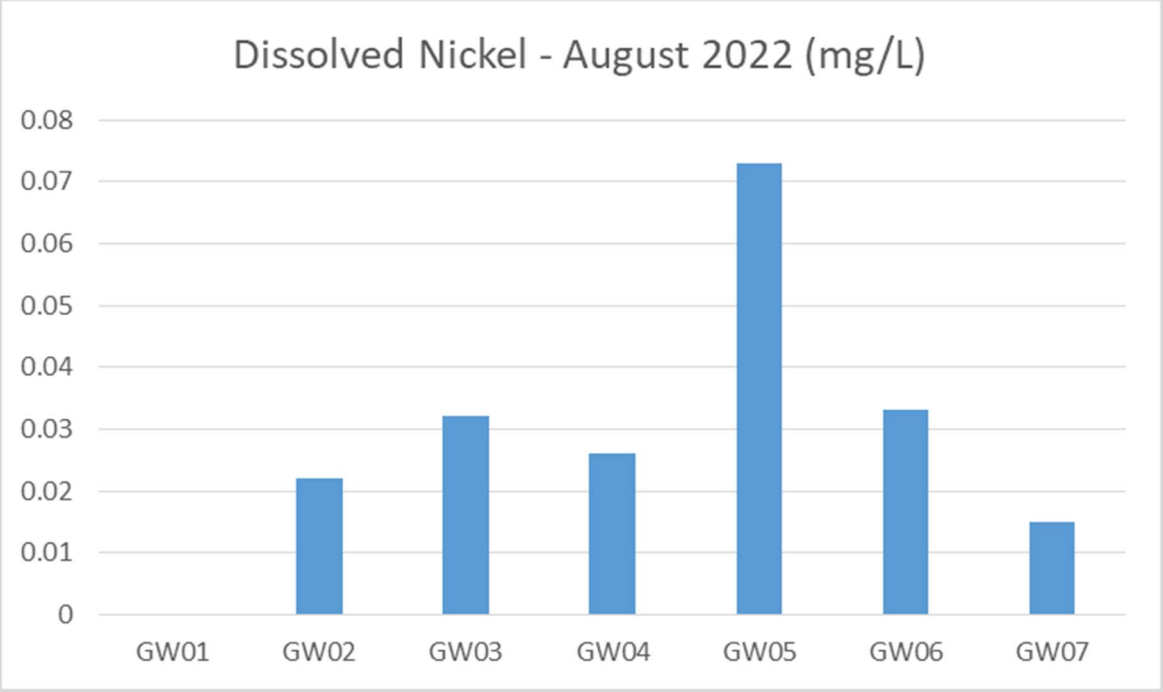

Figure 16: Dissolved Nickel August 2022

The levels of Dissolved Nickel were similar between all piezometers except at GW05 and at GW01 which was below LOR.

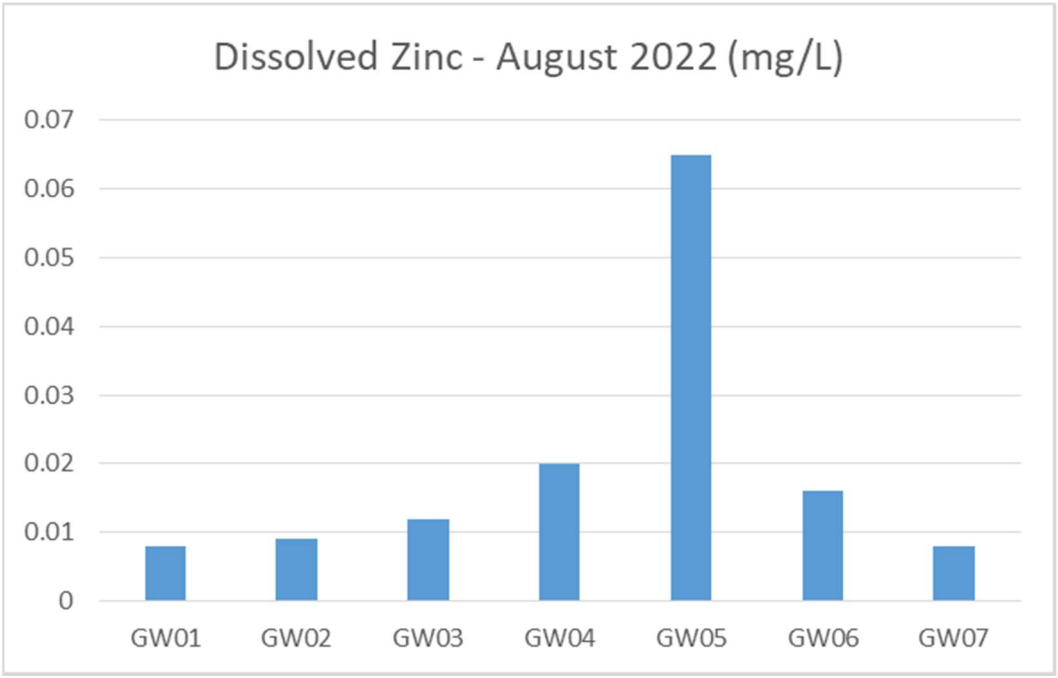

Figure 17: Dissolved Zinc May2021

The levels of Dissolved Zinc were elevated at GW05 near the current operational landfill.

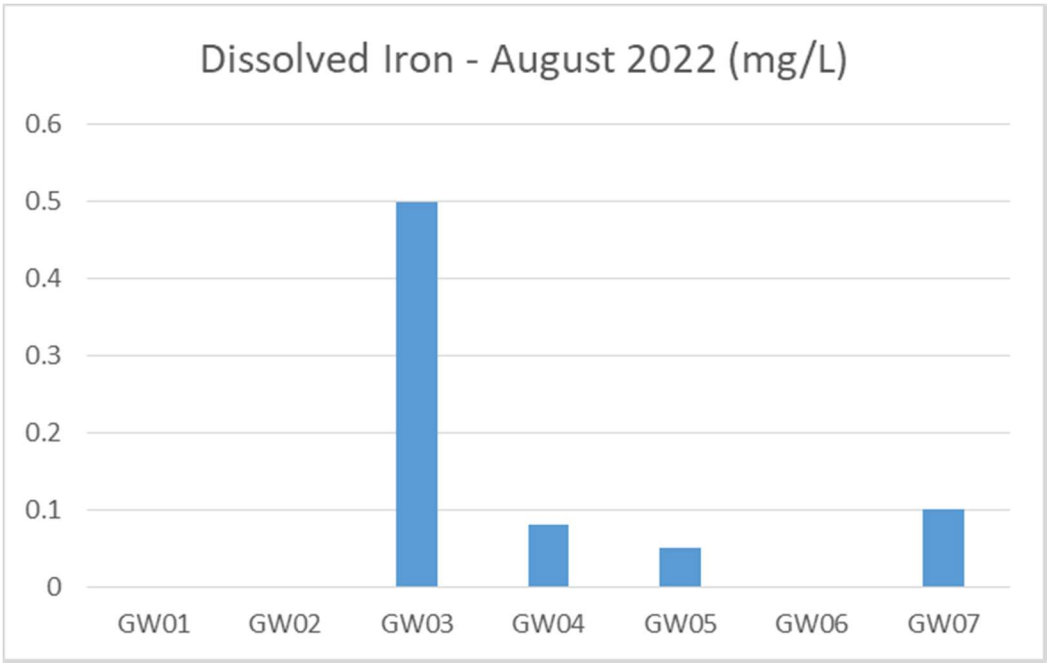

Figure 18: Dissolved Iron May2021

The levels of Dissolved Zinc were elevated GW03 a control site and GW07 on the northern side of the newest cell.

Where a Dissolved metal was recorded below Limit of Recording (LOR) the results were not represented graphically.

Table 7 below details the Metals/Metalloids that were recorded below LOR for each site during the May2021 monitoring period.

Table 7: Groundwater Dissolved Metals below Limit of Recording (LOR) August 2022

Date	Site	Dissolved Arsenic (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Chromium (mg/L)	Dissolved Selenium (mg/L)
25/05/2021	GW01	<0.001	<0.0001	<0.001	<0.01
25/05/2021	GW02	<0.001	<0.0001	<0.001	<0.01
25/05/2021	GW03	<0.001	<0.0001	<0.001	<0.01
25/05/2021	GW04	<0.001	<0.0001	<0.001	<0.01
26/05/2021	GW05	<0.001	<0.0001	<0.001	<0.01
26/05/2021	GW06	<0.001	<0.0001	<0.001	<0.01
26/05/2021	GW07	<0.001	<0.0001	<0.001	<0.01

Arsenic, Cadmium, Chromium and Selenium (Dissolved all recorded levels below the LOR at each of the seven (7) piezometers). Results in Blue designate below LOR.

The results for Metals and metalloids recorded to date (2016 -2021) for each Piezometer are tabulated in Appendix B for comparison.

3.2.4 Groundwater Ammonia, Nitrogen and Phosphorus Results August 2022

Table 8: Groundwater Ammonia, Nitrogen and Phosphorus August 2022

Date	Site	Ammonia as N (mg/L)	Total Nitrogen as N (mg/L)	Total Phosphorus as P (mg/L)
25/05/2021	GW01	5.89	4.72	0.01
25/05/2021	GW02	0.37	0.07	<0.01
25/05/2021	GW03	0.05	0.03	0.01
25/05/2021	GW04	0.31	0.02	0.01
26/05/2021	GW05	0.08	0.33	<0.01
26/05/2021	GW06	0.63	0.36	0.02
26/05/2021	GW07	0.6	0.03	<0.01

3.2.5 Total Petroleum/Total Recoverable /Polynuclear Aromatic Hydrocarbons and BTEXN Results August 2022

Table 9: Groundwater Total Petroleum/Total Recoverable /Polynuclear Aromatic Hydrocarbons and BTEXN Results August 2022

Analyte	Unit	LOR	GW01	GW02	GW03	GW04	GW05	GW06	GW07
Total Petroleum Hydrocarbons									
C6 - C9 Fraction	µg/L	20	<20	<20	<20	<20	<20	<20	<20
C10 - C14 Fraction	µg/L	50	<50	<50	<50	<50	<50	<50	<50
C15 - C28 Fraction	µg/L	100	**200**	<100	<100	<100	<100	<100	<100
C29 - C36 Fraction	µg/L	50	<50	<50	<50	<50	<50	<50	<50
C10 - C36 Fraction (sum)	µg/L	50	**200**	<50	<50	<50	<50	<50	<50
Total Recoverable Hydrocarbons									
C6 - C10 Fraction	µg/L	20	<20	<20	<20	<20	<20	<20	<20
C6 - C10 Fraction minus BTEX (F1)	µg/L	20	<20	<20	<20	<20	<20	<20	<20
>C10 - C16 Fraction	µg/L	100	<100	<100	<100	<100	<100	<100	<100
>C16 - C34 Fraction	µg/L	100	**200**	<100	<100	<100	<100	<100	<100
>C34 - C40 Fraction	µg/L	100	<100	<100	<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	µg/L	100	**200**	<100	<100	<100	<100	<100	<100
>C10 - C16 Fraction minus Naphthalene	µg/L	100	<100	<100	<100	<100	<100	<100	<100

Polynuclear Aromatic Hydrocarbons									
Naphthalene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sum of polycyclic aromatic hydrocarbons	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ (zero)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BTEXN									
Benzene	µg/L	1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	2	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	µg/L	2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	µg/L	2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	µg/L	2	<2	<2	<2	<2	<2	<2	<2
Total Xylenes	µg/L	2	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	µg/L	1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	5	<5	<5	<5	<5	<5	<5	<5

Results in Blue designate below LOR

Table 9 shows that the only Hydrocarbons results were detected at GW01.

Table 10: Groundwater PCBs and Pesticides August 2022

Table 10 shows the Total PCBs and Pesticide Results August 2022

Analyte	Unit	LOR	GW01	GW02	GW03	GW04	GW05	GW06	GW07
Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls	µg/L	1	<1	<1	<1	<1	<1	<1	<1
Organochlorine Pesticides									
alpha-BHC	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
beta-BHC	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
gamma-BHC	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
delta-BHC	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-Chlordane	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
alpha-Endosulfan	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-Chlordane	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dieldrin	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDE	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
beta-Endosulfan	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDD	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulfate	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDT	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Endrin ketone	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methoxychlor	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Chlordane (sum)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sum of DDD + DDE + DDT	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sum of Aldrin + Dieldrin	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Organophosphate Pesticides									
Dichlorvos	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Demeton-S-methyl	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dimethoate	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Analyte	Unit	LOR	GW01	GW02	GW03	GW04	GW05	GW06	GW07
Chlorpyrifos-methyl	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion-methyl	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Malathion	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Pirimphos-ethyl	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorfenvinphos	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromophos-ethyl	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenamiphos	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Prothiofos	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethion	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbophenothion	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Azinphos Methyl	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Discussion and Recommendations

4.1 Landfill Gas Monitoring

The Landfill Gas results demonstrate that the landfill continues to generate significant percentages of Methane in the closed and capped landfill cells. The gas composition of Methane however has seen a reduction potentially due to the age pf the cells.

The three Leachate/Landfill gas bores (LL01/LL02/LL03) situated on the edge of the landfill recorded extremely Methane (0.1 -0.7%) and extremely low levels of Hydrogen Sulphide (1ppm). Neither of these correlate to typical Landfill gas concentrations and therefore indicate that there is little to no horizontal landfill gas migration beyond the sealed landfill gas cells. This is supported by the high concentrations Landfill Gas generated by the landfill is well contained in the capped landfill cells of Methane recorded in the capped Landfill cells and the lack of landfill gases recorded in the Leachate/LFG bores on the edge of the landfill. This containment is presumed to be due to the high percentage of Kaolinite clays in the soils used for the landfill capping.

4.2 Surface Water Monitoring

As detailed in the methodology, the site has only contains ephemeral water channels and no permanent standing water bodies.

4.3 Leachate Monitoring

During the August 2022 monitoring only one leachate bores contained water to enable the collection of samples for leachate monitoring. As the monsoonal weather patterns were above average for the 2021/2022 periods it would be expected that if leachate migration was occurring that it would be detected at all three leachate piezometers.

4.4 Groundwater Monitoring

The recorded groundwater heights in 2022 showed a similar trend in water levels as recorded in May 2021 results in all but two piezometers (GW03 and GW04) with heights generally above the originals heights after installation. The drops in water levels at GW03 and GW04 are unexplained, but as these are generally at higher elevations it could reflect movement since rainfall periods

These results are consistent with the above average rainfall described by BOM during the 2020-2021-2022 Monsoonal periods. Previous years were affected by both the Indian Ocean Dipole and neutral to slightly positive El nino weather patterns experienced at Gove however conditions returned to La nina influences across the NT. As the climate predictions are for a La Nina event the 2022-2022 monsoon is expected to provide a level of rainfall replenishing the groundwater reserves and potentially, depending upon the local rainfall recorded – returning groundwater levels to 2016 equivalences in all piezometers and exceeding previous groundwater heights in 2021.

The results of the Groundwater monitoring did not demonstrate the extreme variability in numerous analytes in previous years due to the increased rainfall in 2020/2021/2022. The variance across the sites did not show clear trends between natural or background levels except at GWO1. This piezometer is an old piezometer installed greater than 10 years ago and purged during the installation program in 2016. This piezometer is located within 5m of a recently completed Landfill Cell and as

such is more likely to represent some very localised leachate migration rather than contamination of the larger groundwater resource as discussed in the following sections.

4.4.1 Physicochemical results

The Groundwater pH was relatively consistent across all piezometers however the recorded Electrical Conductivity (EC) varied across piezometers with the highest results recorded at GW03 which is not located near any current or former landfill cell. This result appears to be anomalous result in localised water chemistry as there is no defined pathway based on hydrological gradients from the landfill impacts. The second highest EC level was however at GW01, directly down gradient to the recent operational cells. Similar to the recorded Electrical Conductivity (EC), TDS varied across piezometers however the piezometers with the highest results were again GW01 and GW03.

The alkalinity Sulphate, Chloride and Calcium also followed the trends of the EC with again GW03 recording highest Chloride levels despite being a significant distance from any cell. GW01 down gradient to the recent operational cells also showed some elevation in Alkalinity, Sulphate, Chloride and Calcium.

4.4.2 Dissolved Metals

The results of dissolved metals does not show a clear trend in metals or metalloids across the piezometers installed at the landfill. Dissolved Magnesium were elevated at GW01 down gradient to the recent operational cells while all other piezometers recorded low concentrations.

The levels of Dissolved Aluminium were lowest (below LOR) at GW01, GW02 both down gradient to the landfill cells and GW03 not impacted by Landfill operations. GW04 a “control piezometer”, recorded the highest levels and all other piezometers recorded low concentrations. The levels of Dissolved Lead were elevated at GW04, GW05, and GW06 and while two of these are potentially impacted by landfill operations, GW04 is not and all other piezometers recorded below detect concentrations. The levels of Dissolved Nickel were elevated at GW03 and slightly elevated at GW05 up-gradient of operations similar to GW01, while all other piezometers recorded low concentrations.

Upon reviewing all data – it is clear that the down gradient piezometer GW01 has a water chemistry influenced by the Landfill as this is showing elevated results in some metals, however as this is extremely close (<10m) to the landfill it does not provide a good indication of contaminants moving off site. the other ‘close’ downgradient piezometer GW02 has not recorded similar elevated results. Also where an analyte is found to be elevated at GW02 the same analyte is elevated at up gradient or “control piezometers” therefor showing natural variation in water chemistry and not significant movement of soluble metalloids as a result of the landfill.

4.4.3 Hydrocarbon, BTEX, PCB and Pesticide contamination.

The results of the 2022 monitoring program demonstrate that the landfill cells are not contributing the contamination of groundwater for Polynuclear Aromatic Hydrocarbons and BTEXN, Polychlorinated Biphenyls (PCB) Organochlorine Pesticides or Organophosphate Pesticides with all results at all piezometers returning results below LORs.

The only recorded Hydrocarbons were the detection of Total Petroleum and Total Recoverable Hydrocarbons at GW01 and as these were not recorded at GW02 it indicates that the contamination is extremely localised and not contributing to local contamination of the groundwater resource. .

Conclusion

The Landfill Gas sampling results determined that the landfill gas is contained within the landfill cells with little migration due to the capping materials used. As such the risks of explosion and other human health or environmental impacts from the site are considered low. Notwithstanding long term passive landfill gas management measures such as Biofilters or Biocover should be investigated once additional landfill gas monitoring has been conducted and that this Landfill Gas assessment be updated based on the additional data.

The Groundwater monitoring results demonstrate that the landfill leachate is not migrating from the site with most down gradient bores recording similar water quality levels for contaminants as those up gradient of the landfill. The monitoring to date has recorded only one piezometer GW01 recording elevated contaminants, this piezometer is within 10 m from the south western corner of a recent Landfill cell, and shows some migration of leachate but is believed to localised and not impacting on the local groundwater resource. Consideration should be made to the installation of an additional piezometer further away from GW01 in future years and as the landfill expands additional piezometers on the boundary of the site.

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Appendix A

Analytical results of Landfill Gas composition

Analyte grouping/Analyte	Units	LOR	LFG01	LFG02
EP101-S: Reduced Sulphur Compounds in Air				
Hydrogen Sulphide	ppbv	10	<10	<10
Carbonyl Sulfide	ppbv	5	15	29
Dimethyl Sulfide	ppbv	0.5	<10.0	188
Carbon disulfide	ppbv	0.5	11.3	34.3
Methanethiol	ppbv	5	<10	<10
Ethanethiol	ppbv	5	<10	<10
EP101-S: Reduced Sulphur Compounds in Air (Calculated Concentration)				
Hydrogen Sulphide	µg/m³	30	<600	<600
Carbonyl Sulfide	µg/m³	10	<200	<200
Dimethyl Sulfide	µg/m³	1	<20	477
Carbon disulfide	µg/m³	1.8	<36	107
Methanethiol	µg/m³	10	<200	<200
Ethanethiol	µg/m³	10	<200	<200
EP101: VOCs by USEPA Method TO15 (Calculated Concentration)				
Freon 12	µg/m³	2.5	<50.0	<250
Chloromethane	µg/m³	1	<20.0	<100
Freon 114	µg/m³	3.5	<70.0	<350
Vinyl chloride	µg/m³	1.3	774	<130
Bromomethane	µg/m³	1.9	<38.0	<190
Chloroethane	µg/m³	1.3	<26.0	<130
Freon 11	µg/m³	2.8	<56.0	<280
1.1-Dichloroethene	µg/m³	2	<40.0	<200
Dichloromethane	µg/m³	1.7	<34.0	<170
Freon 113	µg/m³	3.8	<76.0	<380
1.1-Dichloroethane	µg/m³	2	<40.0	<200
cis-1.2-Dichloroethene	µg/m³	2	4790	693
Chloroform	µg/m³	2.4	<48.0	<240
1.2-Dichloroethane	µg/m³	2	<40.0	255
1.1.1-Trichloroethane	µg/m³	2.7	<54.0	<270
Benzene	µg/m³	1.6	540	1370
Carbon Tetrachloride	µg/m³	3.1	<62.0	<310
1.2-Dichloropropane	µg/m³	2.3	<46.0	<230
Trichloroethene	µg/m³	2.7	55.8	<270
cis-1.3-Dichloropropylene	µg/m³	2.3	<46.0	<230
trans-1.3-Dichloropropene	µg/m³	2.3	<46.0	<230
1.1.2-Trichloroethane	µg/m³	2.7	<54.0	<270
Toluene	µg/m³	1.9	922	10000
1.2-Dibromoethane (EDB)	µg/m³	3.8	<76.0	<380
Tetrachloroethene	µg/m³	3.4	<68.0	<340
Chlorobenzene	µg/m³	2.3	<46.0	<230
Ethylbenzene	µg/m³	2.2	44700	186000

Analyte grouping/Analyte	Units	LOR	LFG01	LFG02
meta- & para-Xylene	µg/m³	4.3	143000	516000
Styrene	µg/m³	2.1	56.6	<210
1.1.2.2-Tetrachloroethane	µg/m³	3.4	<68.0	<340
ortho-Xylene	µg/m³	2.2	58600	187000
4-Ethyltoluene	µg/m³	2.4	<48.0	<240
Total Xylenes	µg/m³	6.5	202000	703000
1.3.5-Trimethylbenzene	µg/m³	2.4	132	265
1.2.4-Trimethylbenzene	µg/m³	2.4	246	405
1.3-Dichlorobenzene	µg/m³	3	<60.0	<300
Benzylchloride	µg/m³	2.6	<52.0	<260
1.4-Dichlorobenzene	µg/m³	3	1690	3000
1.2-Dichlorobenzene	µg/m³	3	<60.0	<300
1.2.4-Trichlorobenzene	µg/m³	3.7	<74.0	<370
Hexachlorobutadiene	µg/m³	5.3	<106	<530
Acetone	µg/m³	1.2	<24.0	<120
Bromodichloromethane	µg/m³	3.4	<68.0	<340
1.3-Butadiene	µg/m³	1.1	<22.0	<110
Carbon disulfide	µg/m³	1.6	33.9	<160
2-Chlorotoluene	µg/m³	2.6	<52.0	<260
1-Chloro-2-propene (Allyl chloride)	µg/m³	1.6	<32.0	<160
Cyclohexane	µg/m³	1.7	1400	1270
Dibromochloromethane	µg/m³	4.3	<86.0	<430
1.4-Dioxane	µg/m³	1.8	<36.0	<180
Ethylacetate	µg/m³	1.8	<36.0	<180
trans-1.2-Dichloroethene	µg/m³	2	46	<200
Heptane	µg/m³	2	1160	2030
Hexane	µg/m³	1.8	490	528
Isooctane	µg/m³	2.3	607	1020
Isopropyl Alcohol	µg/m³	1.2	<24.0	1530
2-Butanone (MEK)	µg/m³	1.5	64.8	395
Methyl iso-Butyl ketone	µg/m³	2	51.6	368
2-Hexanone (MBK)	µg/m³	2	<40.0	<200
Propene	µg/m³	0.9	4680	12100
Methyl tert-Butyl Ether (MTBE)	µg/m³	1.8	<36.0	<180
Tetrahydrofuran	µg/m³	1.5	44.8	<150
Bromoform	µg/m³	5.2	<104	<520
Vinyl Acetate	µg/m³	1.8	<36.0	<180
Vinyl bromide	µg/m³	2.2	<44.0	<220
Ethanol	µg/m³	0.9	66.3	3410
Acetonitrile	µg/m³	0.8	<16.0	<80.0
Acrolein	µg/m³	1.1	<22.0	<110
Acrylonitrile	µg/m³	1.1	<22.0	<110

Analyte grouping/Analyte	Units	LOR	LFG01	LFG02
tert-Butyl alcohol	µg/m³	1.5	<30.0	<150
2-Chloro-1.3-butadiene	µg/m³	1.8	<36.0	<180
Di-isopropyl Ether	µg/m³	2.1	<42.0	<210
Ethyl tert-Butyl Ether (ETBE)	µg/m³	2.1	<42.0	<210
tert-Amyl Methyl Ether (TAME)	µg/m³	2.1	<42.0	<210
Methyl Methacrylate	µg/m³	2.1	<42.0	<210
1.1.1.2-Tetrachloroethane	µg/m³	3.4	<68.0	<340
Isopropylbenzene	µg/m³	2.4	919	3270
n-Propylbenzene	µg/m³	2.4	241	<240
tert-Butylbenzene	µg/m³	2.7	<54.0	<270
sec-Butylbenzene	µg/m³	2.7	<54.0	<270
2-isopropyltoluene	µg/m³	2.7	<54.0	<270
n-Butylbenzene	µg/m³	2.7	<54.0	<270
Naphthalene	µg/m³	2.6	<52.0	<260
EP104: Light Hydrocarbons				
Methane	Mol %	0.05	51.3	62.6
EP104: Light Hydrocarbons (Calc Conc)				
Methane	mg/m³	330	335000	409000
EP104: Permanent Gases				
Carbon Dioxide	Mol %	0.05	16.4	30
Oxygen	Mol %	0.1	<0.20	<0.20
EP104: Permanent Gases (Calc Conc)				
Carbon Dioxide	mg/m³	900	294000	540000
Oxygen	mg/m³	1310	<2620	<2620
Sampling Quality Assurance				
Pressure - As received	kPaa	0.1	95.9	98.2
Pressure - Laboratory Atmosphere	kPaa	0.1	103	103
Temperature as Received	°C	0.1	20	20

Appendix B

Analytical results – Dissolved Metals and Metalloids levels recorded at GW01 2016-2021

Table B1 – Dissolved Metals and Metalloids levels recorded at GW01 2016-2022

Date	Magnesium	Sodium	Potassium	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	1	1	1	0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.05
20/07/2016	-	-	-	-	<0.001	<0.0001	<0.001	0.001	<0.001	-	0.013	-	0.023	-
14/08/2017	18	59	11	<0.01	<0.001	<0.0001	0.002	0.001	<0.001	0.007	0.002	<0.01	0.02	<0.05
26/06/2018	22	68	14	<0.01	<0.001	<0.0001	<0.001	0.002	<0.001	0.009	0.007	<0.01	0.045	0.16
24/09/2019	20	75	14	<0.01	<0.001	<0.0001	<0.001	0.002	<0.001	0.008	0.003	<0.01	0.043	<0.05
9/09/2020	20	75	15	<0.01	<0.001	<0.0001	<0.001	0.001	<0.001	0.008	0.011	<0.01	0.036	<0.05
25/05/2021	22	83	17	<0.01	<0.001	<0.0001	<0.001	0.011	<0.001	0.006	0.009	<0.01	0.089	<0.05
23/08/2022	19	79	14	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	0.005	<0.001	<0.01	0.008	<0.05

Table B2 – Dissolved Metals and Metalloids levels recorded at GW02 2016-2022

Date	Magnesium	Sodium	Potassium	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	1	1	1	0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.05
20/07/2016	-	-	-	-	<0.001	<0.0001	<0.001	<0.001	0.002	-	0.019	-	0.022	-
14/08/2017	3	31	<1	0.06	<0.001	<0.0001	0.001	0.006	0.002	0.005	0.013	<0.01	0.041	<0.05
26/06/2018	3	31	<1	0.05	<0.001	<0.0001	<0.001	0.005	0.002	0.003	0.01	<0.01	0.032	<0.05
24/09/2019	2	14	<1	0.03	<0.001	<0.0001	<0.001	0.01	0.005	0.003	0.023	<0.01	0.067	<0.05
9/09/2020	4	40	<1	0.05	<0.001	<0.0001	<0.001	0.006	0.002	0.002	0.025	<0.01	0.046	<0.05
25/05/2021	2	41	<1	<0.01	<0.001	<0.0001	<0.001	0.005	<0.001	0.002	0.007	<0.01	0.037	<0.05
23/08/2022	4	40	<1	<0.01	<0.001	<0.0001	<0.001	0.002	<0.001	0.005	0.022	<0.01	0.009	<0.05

Table B3 – Dissolved Metals and Metalloids levels recorded at GW03 2016-2022

Date	Magnesium	Sodium	Potassium	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	1	1	1	0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.05
20/07/2016	-	-	-	-	<0.001	<0.0001	<0.001	0.006	0.007	-	0.014	-	0.096	-
14/08/2017	2	188	3	0.02	<0.001	<0.0001	<0.001	0.002	<0.001	0.007	0.018	<0.01	0.015	0.06
26/06/2018	3	180	3	0.06	<0.001	<0.0001	<0.001	0.002	0.002	0.016	0.035	<0.01	0.053	0.1
24/09/2019	5	266	4	0.06	<0.001	<0.0001	<0.001	<0.001	0.001	0.036	0.025	<0.01	0.027	0.18
9/09/2020	3	174	3	0.02	<0.001	<0.0001	<0.001	0.002	<0.001	0.012	0.006	<0.01	0.052	0.26
25/05/2021	2	150	3	0.02	<0.001	<0.0001	<0.001	0.018	0.001	0.01	0.012	<0.01	0.124	0.2
24/08/2022	8	180	4	<0.01	<0.001	<0.0001	<0.001	0.002	<0.001	0.029	0.032	<0.01	0.012	0.5

Table B4 – Dissolved Metals and Metalloids levels recorded at GW04 2016-2022

Date	Magnesium	Sodium	Potassium	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	1	1	1	0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.05
20/07/2016	-	-	-	-	<0.001	<0.0001	0.001	0.004	0.0024	-	0.015	-	0.076	-
14/08/2017	3	15	1	0.01	<0.001	<0.0001	0.003	<0.001	0.001	0.016	0.002	<0.01	0.014	0.55
26/06/2018	3	15	1	0.02	<0.001	<0.0001	<0.001	0.001	<0.001	0.006	0.007	<0.01	0.032	0.09
24/09/2019	4	26	2	0.02	<0.001	<0.0001	<0.001	<0.001	0.002	0.006	0.006	<0.01	0.016	0.06
9/09/2020	4	36	2	0.06	<0.001	<0.0001	<0.001	0.002	0.004	0.009	0.006	<0.01	0.026	<0.05
25/05/2021	4	28	2	0.06	<0.001	<0.0001	<0.001	0.008	0.002	0.006	0.006	<0.01	0.063	<0.05
24/08/2022	5	55	2	0.11	<0.001	<0.0001	<0.001	0.008	0.005	0.01	0.026	<0.01	0.02	0.08

Table B5 – Dissolved Metals and Metalloids levels recorded at GW05 2016-2022

Date	Magnesium	Sodium	Potassium	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	1	1	1	0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.05
20/07/2016	-	-	-	-	<0.001	<0.0001	<0.001	0.001	0.004	-	0.009	-	0.029	-
14/08/2017	1	13	<1	0.03	<0.001	<0.0001	0.006	0.002	0.002	0.004	0.01	<0.01	0.01	<0.05
26/06/2018	1	14	<1	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.002	<0.01	<0.005	<0.05
24/09/2019	1	11	<1	0.02	<0.001	<0.0001	<0.001	0.014	<0.001	0.002	0.002	<0.01	0.03	<0.05
9/09/2020	<1	11	<1	<0.01	<0.001	<0.0001	<0.001	0.001	<0.001	<0.001	0.014	<0.01	0.011	<0.05
26/05/2021	1	10	<1	0.01	<0.001	<0.0001	<0.001	0.01	<0.001	<0.001	0.01	<0.01	0.028	<0.05
24/08/2022	1	10	<1	0.02	<0.001	<0.0001	<0.001	0.052	0.006	0.012	0.073	<0.01	0.065	0.05

Table B6 – Dissolved Metals and Metalloids levels recorded at GW06 2016-2022

Date	Magnesium	Sodium	Potassium	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	1	1	1	0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.05
20/07/2016	-	-	-	-	<0.001	<0.0001	<0.001	<0.001	0.004	-	0.013	-	0.019	-
14/08/2017	3	16	<1	0.02	<0.001	<0.0001	<0.001	0.006	0.004	0.001	0.01	<0.01	0.023	<0.05
26/06/2018	4	16	<1	0.04	<0.001	<0.0001	<0.001	0.036	0.002	0.002	0.009	<0.01	0.12	<0.05
24/09/2019	3	20	<1	0.04	<0.001	<0.0001	0.005	0.005	0.002	0.005	0.02	<0.01	0.01	<0.05
9/09/2020	3	15	<1	0.02	<0.001	<0.0001	<0.001	0.003	<0.001	<0.001	0.004	<0.01	0.009	<0.05
26/05/2021	4	15	<1	0.02	<0.001	<0.0001	<0.001	0.007	<0.001	<0.001	0.005	<0.01	0.03	<0.05
24/08/2022	4	17	<1	0.03	<0.001	<0.0001	<0.001	0.022	0.006	0.002	0.033	<0.01	0.016	<0.05

Table B7 – Dissolved Metals and Metalloids levels recorded at GW07 2016-2022

Date	Magnesium	Sodium	Potassium	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	1	1	1	0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.05
20/07/2016	-	-	-	-	<0.001	<0.0001	<0.001	<0.001	0.002	-	0.014	-	0.024	-
14/08/2017	<1	18	<1	0.04	<0.001	<0.0001	0.005	0.001	0.004	0.004	0.016	<0.01	0.012	0.09
26/06/2018	<1	19	<1	0.03	<0.001	<0.0001	<0.001	0.004	0.002	0.004	0.009	<0.01	0.085	<0.05
24/09/2019	<1	22	<1	0.04	<0.001	<0.0001	<0.001	0.001	<0.001	0.001	0.012	<0.01	0.013	<0.05
9/09/2020	<1	20	<1	0.04	<0.001	<0.0001	<0.001	0.001	<0.001	0.001	0.004	<0.01	0.018	<0.05
26/05/2021	<1	18	<1	0.05	<0.001	<0.0001	<0.001	0.008	<0.001	0.001	0.008	<0.01	0.055	0.07
24/08/2022	<1	19	<1	0.04	<0.001	<0.0001	<0.001	0.002	0.001	0.002	0.015	<0.01	0.008	0.1

Table B8 – Dissolved Metals and Metalloids levels recorded at LL01 2017-2022

Date	Magnesium	Sodium	Potassium	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	1	1	1	0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.05
14/08/2017	21	72	13	0.04	<0.001	<0.0001	0.003	<0.001	<0.001	0.009	<0.001	<0.01	<0.005	0.36
26/06/2018	25	80	14	0.02	<0.001	<0.0001	<0.001	<0.001	<0.001	0.009	0.001	<0.01	<0.005	0.06
24/09/2019	18	71	11	0.03	<0.001	<0.0001	<0.001	<0.001	<0.001	0.004	<0.001	<0.01	<0.005	<0.05
23/08/2022	20	74	14	0.04	<0.001	<0.0001	<0.001	<0.001	<0.001	0.005	<0.001	<0.01	<0.005	<0.05

Table B9 – Dissolved Metals and Metalloids levels recorded at LL02 2017-2022

Date	Magnesium	Sodium	Potassium	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR	1	1	1	0.01	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.05
14/08/2017	24	103	19	0.01	<0.001	<0.0001	<0.001	0.002	<0.001	0.005	0.001	<0.01	0.008	<0.05
26/06/2018	26	104	21	0.01	<0.001	<0.0001	<0.001	0.002	<0.001	0.024	0.002	<0.01	0.007	<0.05