Hartland Landfill – Landfill Gas Monitoring 2025 Report

Capital Regional District | Parks, Recreation & Environmental Services, Environmental Protection



Biogas Upgrading Facility at Hartland Landfill

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HARTLAND LANDFILL − LANDFILL GAS MONITORING
2025 REPORT

EXECUTIVE SUMMARY

Hartland Landfill provides solid waste disposal services for the Capital Regional District (CRD). The landfill is a multi-purpose facility providing collection services for recyclable materials, household hazardous waste, items covered by product stewardship, as well as disposal of municipal solid waste (MSW) and controlled waste. The site operates pursuant to an operational certificate under the *Environmental Management Act*, issued by the BC Ministry of Environment and Parks (ENV); and follows a Design, Operations and Closure Plan required under the operational certificate.

The landfill footprint (Phase 1 + Phase 2) occupies 42.9 hectares with an estimated 8.6 million tonnes of MSW in place in 2025. When the landfill reaches planned final filling elevations in Phase 2, it is estimated to contain approximately 18 million tonnes of MSW. This report fulfills annual reporting requirements set out in the BC *Operational Certificate 12659* and the BC *Landfill Gas Management Regulation*. Landfill gas (LFG) collection/management at Hartland (described below) includes collection and utilization infrastructure, generation modelling and monitoring (utilization, perimeter gas probes and hotspot monitoring).

LFG collection and/or management at Hartland Landfill in 2025 included the following components:

- **Gas collection infrastructure** including cover systems, collection pipes, wells, and blowers to facilitate gas collection and utilization.
- **Biogas Upgrading Facility (BUF)** for upgrading landfill gas to renewable natural gas (RNG).
- **Flaring system including** enclosed flare and candle stick flares.
- **LFG monitoring system** including collection system, hotspot and subsurface monitoring programs.
- **Methane production and gas generation modelling** rates given landfill waste volumes and decomposition rates.

GAS GENERATION, COLLECTION AND UTILIZATION

The Biogas Upgrading Facility (BUF) was commissioned in May 2025, representing a significant milestone for landfill gas management at the Hartland Landfill. The facility upgrades landfill gas to renewable natural gas (RNG), allowing beneficial use of the captured methane as a low-carbon energy source.

In 2025, the gas collection system consisted of 58 vertical wells and 131 horizontal wells, for a total of 227 wells that captured an average of 1,672 Nm^3/hour of LFG. The well field was balanced monthly in 2025, as recommended by the BC *Landfill Gas Management Facilities Design Guidelines*.

From 2020 to 2024, the CRD used the UBC Integrated Gas Generation Model © (UBCi Model), supported by a comprehensive study that demonstrated close alignment between modelled generation rates and measured landfill gas recovery at Hartland Landfill. In 2025, following the release of Environment and Climate Change Canada's (ECCC) Landfill Methane Regulations and associated gas generation model, the ECCC model was adopted as an additional estimation tool. Because its results closely align with the UBCi model and it is required for future federal regulatory reporting, the UBCi model was discontinued for 2025 modelling. Going forward, landfill gas generation estimates will be generated using both the ENV and ECCC models.

At the end of 2025, landfill gas collection efficiency was estimated at 61% using the ENV model and 71% using the ECCC model. According to the ENV model, collection efficiency increased significantly from 43% in 2024 to 61% and similarly from 50% to 71% according to ECCC model in 2025. The primary factor contributing to this improvement was the connection of multiple gas extraction wells on the south slope of Phase 2, Cell 3 in early 2025, which enhanced gas capture across the landfill.

Gas collection optimization is expected to remain challenging throughout 2026 due to the ongoing transition to Cells 4 and 5, which has affected the installation and expansion of landfill gas collection infrastructure. Technical design constraints associated with the transition have delayed the connection of new gas extraction wells, while the absence of extraction wells in the upper two lifts of Cell 3 continues to limit gas recovery from newly placed waste. Consequently, landfill gas collection efficiency is anticipated to remain below desired levels until additional collection infrastructure is installed and commissioned within active disposal areas.

Table ES1 Modelled Methane Generation and Collection Efficiency 2025

Year	Modelled Annual Methane Generated ENV (tonnes/year)	Modelled Annual Methane Generated ECCC (tonnes/year)	Measured Annual Gas Capture (tonnes/year)	Collection Efficiency (%) ENV Model	Collection Efficiency (%) ECCC Model
2025	8,574	7,407	5,247	61%	71%

MONITORING

Hartland Landfill has several monitoring programs to assess the effectiveness of the LFG collection infrastructure. The following summarizes the components of the program:

1. **Collection and flaring system monitoring** to evaluate changes in gas quality over time and to document data for gas collection and gas flaring to assess collection efficiency and total emissions from the landfill.
2. **Monitoring of subsurface perimeter and building foundation probes** to assess the potential for subsurface LFG migration at the eastern landfill boundary and at on-site buildings for compliance with BC *Landfill Criteria*, and for worker and public health and safety.
3. **Surface emissions and hotspot monitoring** to verify the effectiveness of cover and the LFG collection system in order to identify health and safety risks associated with fugitive LFG emissions.

COMPLIANCE SUMMARY

Table ES2 has been prepared to summarize the results of LFG monitoring programs, whether the results comply with requirements, actions taken to address non-compliance, and recommendations.

Table ES2 LFG Compliance Summary

Program	Compliance Location	Criteria	Findings	Mitigation/Actions	Recommendations
Perimeter Probe Monitoring	Probes GP-1A, 1B, 2A, 2B, 3A, 3B, 11A, 11B, 12A and 12B	Methane must not exceed 5% in subsurface soils (BC *Landfill Criteria for Municipal Solid Waste* & BC *Landfill Gas Management Facilities Design Guidelines*)	No exceedances Low risk of sub-surface gas migration to adjacent properties	None	Continue quarterly monitoring.
Building Foundation Probe Monitoring	Probes GP-4A, 5A, 6A, 6B, 7A, 7B, 8A, 9A, 13A, 17A and 18A	Maximum 1% methane in any on-site facility (BC *Landfill Criteria for Municipal Solid Waste* & BC *Landfill Gas Management Facilities Design Guidelines*)	No exceedances Low risk of subsurface gas migration to adjacent building	None	Continue quarterly monitoring.
Ambient Grid Monitoring	N/A	100 ppm total hydrocarbon (THC), as methane (CRD internal guideline)	13 grid locations >100 ppm mainly due to potential gas accumulation. No cover system failures suspected in the closed area of Phase 1	Investigated hotspots and mitigated, where possible.	Continue annual monitoring.
Hotspot Monitoring	N/A	1,000 ppm THC (CRD internal guideline)	Four new hotspots (Z-points) >1,000 ppm were identified. Currently 11 locations for hotspot investigation	Added new locations of hotspots to the monitoring program.	Continue annual monitoring. Investigate mitigation options.
Well Field Monitoring and Balancing	N/A	Monitor monthly. Oxygen 2.5% - gas optimization and reduction of fire potential *(BC Landfill Gas Management Facilities Design Guidelines)*	Monitoring completed monthly; Oxygen did not exceed 2.5%	None	Continue monthly monitoring at minimum.
Gas Collection	N/A	75% gas collection efficiency target by the end of 2016, as per *Landfill Gas Management Plan*	ENV model estimated collection efficiency at 61%. ECCC model estimated the collection efficiency at 71%.	*Landfill Gas Management Plan* submitted to ENV.	Continue to implement the gas management plan and optimize gas concentrations in the well field.

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List of Acronyms and Units of Measurement

%	Percent
<	Less than
≤	Less than or equal to
=	Equal to
>	Greater than
BC	British Columbia
BUF	Biogas Upgrading Facility
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CRD	Capital Regional District
ECCC	Environment and Climate Change Canada
ECCC Model	Environment and Climate Change Canada Landfill Gas Generation Model
ENV	Ministry of Environment and Parks
ENV Model	Ministry of Environment and Parks Landfill Gas Generation Model
EPro	Environmental Protection
GHG	Greenhouse gas
H_2S	Hydrogen sulfide
LEL	Lower explosive limit
LFG	Landfill gas
m	Meter
m^3	Cubic meter
mm	Millimeters
MSW	Municipal solid waste
Nm^3/hour	Normal cubic meters per hour
O_2	Oxygen
ppm	Parts per million
Q1-4	Four quarters of the year
RNG	Renewable natural gas
scfm	Standard cubic feet per minute
THC	Total hydrocarbon
UBCi Model	UBC Integrated Gas Generation Model ©
US EPA	United States Environmental Protection Agency
VOC	Volatile organic content
WAGABOX	Waga Energy's patented landfill gas upgrading technology ©
Z-points	Ambient survey locations with over 1,000 ppm methane

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1.0 INTRODUCTION

Hartland Landfill provides solid waste disposal services for the Capital Regional District (CRD). The landfill is a multi-purpose facility providing collection services for recyclable materials, household hazardous waste, extended producer responsibility products, salvageable items, as well as disposal services for municipal solid waste and controlled waste. Landfill operations are guided by the *Hartland Landfill Design, Operations and Closure Plan (updated 2023),* the BC *Operational Certificate 12659* issued by the BC Ministry of Environment and Parks (ENV), and the CRD's *Solid Waste Management Plan (approved in 2022)*.

Landfill gas (LFG) is primarily composed of methane, carbon dioxide and nitrogen, with small amounts of water vapour, oxygen and trace gases. Trace gases include hydrogen sulphide, ammonia, nitrous oxide, volatile organic compounds and chlorofluorocarbons. Risks associated with LFG include asphyxiation, flammability (between 5% and 15% methane by volume), toxicity, odour, and greenhouse gas (GHG) emissions.

The objective of an LFG collection system is to reduce GHGs through the destruction of collected methane, mitigate fugitive emissions, and reduce the potential for subsurface, lateral gas migration. Ongoing monitoring is conducted at the landfill to assess the effectiveness of these controls, and includes gas generation modelling, gas capture assessment, and ambient and subsurface monitoring.

This report is prepared to assess operational needs and performance, meet regulatory reporting requirements and to inform the public regarding LFG management at Hartland Landfill. This report meets the reporting requirements specified in the BC *Operational Certificate 12659* and the BC *Landfill Gas Management Regulation* for annual reporting of gas collection and management.

2.0 SITE DESCRIPTION

The Hartland Landfill is situated on 320 hectares within the District of Saanich. Mount Work Regional Park is located to the west, parkland and the Heal's Rifle Range lies to the north, residential properties lie to the east, and undeveloped CRD property is located to the south.

The climate in the area is classified as "cool mediterranean" due to warm, dry summers and cool, wet winters. Annual precipitation is around 800-1,000 mm per year. The site is surrounded by bedrock; discontinuous bedrock fractures have been identified.

The CRD took over operation of the landfill site in 1985. Prior to that, it was privately owned and operated. The landfill footprint (Phase 1 + Phase 2) occupies 42.9 hectares with an estimated 8.6 million tonnes of municipal solid waste (MSW) in place. The average annual disposal rate for the last five years is approximately 186,986 tonnes which comprises residential, commercial and industrial waste as well as controlled waste and asbestos containing material.

The landfill has two operational areas: Phase 1 was operational between the 1950s and 1997 and has final cover. Phase 2 comprises the current active area of the landfill, which began in 1997. Phase 1 is unlined and covered with a combination geomembrane/clay cap. Phase 2 was constructed within a former lake basin (now referred to as the Phase 2 basin); it is partially lined and also relies on hydraulic gradients to contain leachate. Development of the Hartland Landfill gas collection system is guided conceptually by the cell development and filling plan, updated annually or per the Landfill Gas Management Regulatory Framework.

There are a number of provincial and federal regulations that apply to LFG management, emissions management and reporting. Key regulations are listed below.

2.1 LFG Management Regulation

The BC *Landfill Gas Management Regulation* requires landfills that produce 1,000 tonnes of methane per year to have a qualified professional prepare an LFG management plan. According to the regulation, the *Landfill Gas Management Plan* must be prepared in accordance with the BC *Landfill Gas Management Facilities Design Guidelines*, 2010 ('*the Guidelines*') and include:

- a description of existing or planned methods or maintenance practices and processes for LFG management on the site;
- a plan for installation, operation and maintenance of LFG management facilities (including contingencies for planned or emergency shutdowns); and
- recommendations for optimizing LFG collection to meet a 75% collection efficiency target four years after implementation.

The Guidelines specify a set of design and performance objectives/standards regarding LFG management and operations including gas collection and composition, extraction and destruction infrastructure, and gas migration and assessment.

2.2 WorkSafeBC

Many of the compounds in LFG, particularly methane, hydrogen sulphide and individual volatile organic compounds, have worker exposure limits set out within WorkSafeBC regulations. The Hartland Landfill must comply with these limits.

2.3 BC Landfill Criteria for Municipal Solid Waste

The BC *Landfill Criteria for Municipal Solid Waste* (2016) stipulates compliance with the *Landfill Gas Management Regulation* and the Guidelines described above. Also, the landfill must be managed to ensure there is no public threat or nuisance/odour. Annual reporting and compliance review is a requirement under Hartland Landfill's *Operational Certificate 12659.* A full compliance report for all Operational Certificate requirements is provided in the 2025 Hartland Landfill Annual Operations Report.

3.0 HEALTH AND SAFETY

LFG is flammable, toxic and poses an asphyxiation risk to landfill employees and contractors on-site. Specifically:

- LFG can accumulate in confined spaces or low-lying areas with poor air circulation, which can pose an asphyxiation risk due to the displacement of oxygen.
- Both trace gases and major gas constituents can result in acute toxicity if exposure occurs at high enough concentrations.
- Trace gases, usually associated with sulphur compounds, can create odours.
- Methane is explosive at concentrations between 5 and 15%. It is also a GHG with 28 times the global warming potential of carbon dioxide.

There is also potential for gas to laterally migrate off-site. When gas pressure builds up in a landfill, gas migrates via cracks, soil pores, and/or fractures to equalize with the surrounding atmosphere. This includes migrating through permeable cover systems or subsurface migration toward adjacent properties. The main objective of an LFG collection system is to mitigate the above risks and reduce the potential for subsurface, lateral gas migration. However, while lateral movement can be mitigated with LFG collection and control, there will still be fugitive LFG emissions on-site. A number of factors influence this, such as atmospheric pressure, groundwater level, gas pressure in the refuse mass, and permeability of cover systems.

4.0 LFG GENERATION

Decomposition of refuse creates LFG; the composition and amount of gas generated varies based on factors such as amount, type and age of waste, as well as environmental conditions, such as temperature and moisture content.

Peak gas generation occurs during the first one to three years after disposal. Initially, decomposition of waste is an aerobic process and produces mainly carbon dioxide. As oxygen is depleted, the decomposition occurs under anaerobic conditions. The total waste input and waste composition affects overall gas generation rates. For clarity, it is important to note that gas production is the total amount of gas predicted to be produced by the landfill given waste composition, volume of existing waste in place and site-specific, meteorological conditions.

4.1 Waste Quantity

The quantity of LFG production is dependent on the amount and type of waste received. In 2025, the Hartland Landfill received 173,828 tonnes of waste, which included 150,527 tonnes of general refuse, 20,540 tonnes of controlled waste and 2,761 tonnes of asbestos. This total does not include the material tonnage beneficially used at Hartland Landfill. Historical waste tonnages received or estimated at Hartland Landfill are indicated in Figure 1.

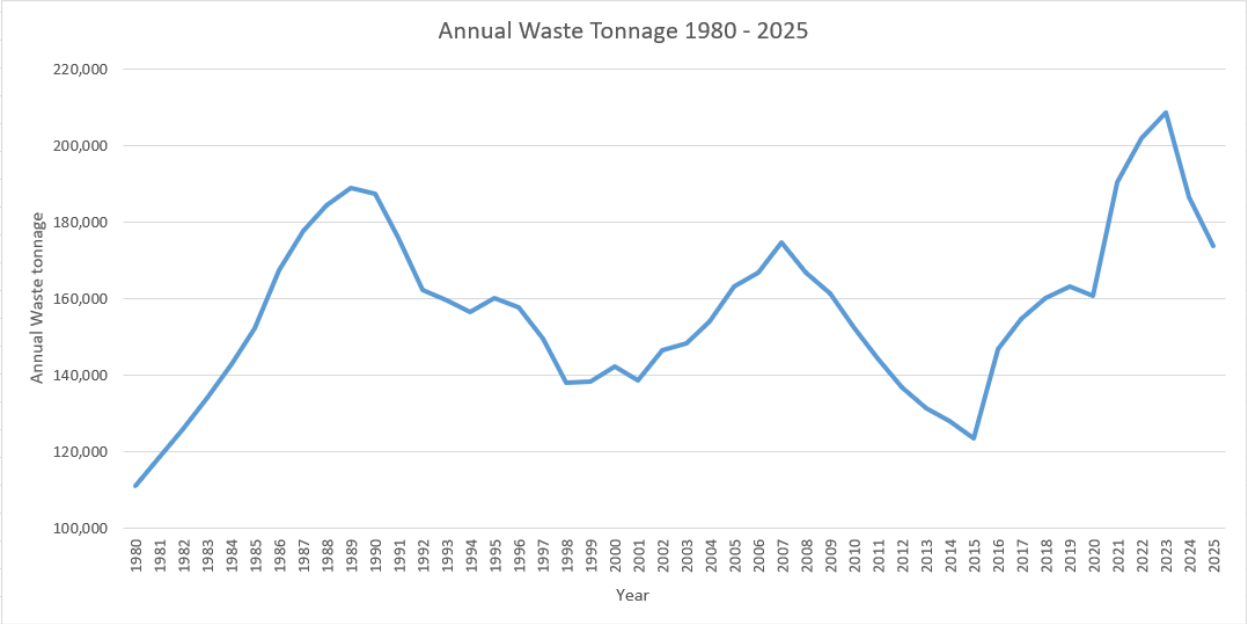


Figure 1 Annual Waste Tonnages Received or Estimated for Hartland Landfill from 1980-2025

4.2 Waste Composition

Waste composition is used to calculate methane generation rates in order to estimate overall LFG generation. Waste composition study results are included in Table 1.

Controlled waste composition is attributed to each of the waste composition categories (relatively inert, moderately decomposable and decomposable waste) in the models. The Waste Composition Study conducted by Tetratech (2022) does not quantify controlled waste. Controlled waste is classified by the CRD as wastes that, due to environmental or health and safety considerations, require special handling. Controlled waste deposited at the site is measured by scale and classified by type. For the modelling purposes by using ECCC model, controlled waste data is categorized as described below. Based on the consultant's recommendation, the following assumptions were applied to categorize controlled waste decomposability:

- All asbestos and demolition wastes are relatively inert.
- Anything with unknown composition is categorized as Miscellaneous (50% moderately decomposable and 50% relatively inert).
- Waste sludge and pumpings from sewage treatment are decomposable.

The waste compositions used in the models were developed using Municipal Solid Waste (MSW) and Controlled Waste tonnage and waste composition data from 2022. A weighted average composition was then calculated and applied consistently across all models. The details of the waste composition categories since 1981 are included in Table 1. The waste compositions used for both ENV and ECCC model in 2025, are included in Appendix A1 and A2.

In 2025, the general refuse total tonnage did not include any biosolids.

Table 1 indicates the waste composition used since 1981.

Table 1 Waste Composition 1981 to Present Used in ENV Model

Year	Relatively Inert	Moderately Decomposable	Decomposable
1981 - 2013	35.1%	37.2%	27.7%
2014	35.3%	40.9%	23.9%
2015	35.1%	41.3%	23.6%
2016	36.0%	43.4%	20.6%
2017	36.0%	43.4%	20.6%
2018	36.0%	43.4%	20.6%
2019	35.9%	43.5%	20.6%
2020	35.2%	45.6%	19.1%
2021	34.5%	46.9%	18.6%
2022	39.6%	45.4%	15.0%
2023	38.9%	46.2%	14.9%
2024	38.8%	46.6%	14.6%
2025	38.8%	46.6%	14.6%

4.3 Gas Generation Modelling

LFG generation rates are estimated using the ENV model stipulated by the BC *Landfill Gas Management Regulation*. Between 2020 and 2024, the CRD employed the UBCi landfill gas generation model. The transition to UBCi was supported by a comprehensive landfill gas quantification study, which empirically demonstrated that modelled gas generation rates aligned closely with measured landfill gas recovery data at Hartland Landfill. In 2025, following the release of Environment and Climate Change Canada's (ECCC) Landfill Methane Regulations and associated landfill gas generation model, the ECCC model was adopted as an additional tool for estimating landfill gas generation. The results of the landfill gas generation estimates using both ENV and ECCC models are included in Appendix A1 and A2. The ECCC model results align closely with those of the UBCi model. As the ECCC model is required for regulatory reporting under the new federal regulations, the UBCi model was discontinued for 2025 gas generation modelling. Going forward, landfill gas generation estimates will be generated using both the ENV and ECCC models. The estimated methane generation by year is included in Table 2.

Table 2 Estimated Methane Generation by Year at Hartland Landfill

Year	Annual Methane Generation (tonnes/year) UBCi model	Annual Methane Generation (tonnes/year) ENV model	Annual Methane Generation (tonnes/year) ECCC model
2021	7,167	8,192	6,992
2022	7,283	8,325	7,140
2023	7,307	8,418	7,233
2024	7,363	8,532	7,350
2025	n/a	8,574	7,407

LFG Collection and Monitoring Infrastructure Systems to control and monitor fugitive LFG emissions have been implemented at Hartland Landfill. The objective of these controls is to:

- protect employee and public health and safety
- prevent migration of gas off-property or into on-site buildings
- reduce GHG
- capture gas for energy recovery
- control odour

The original LFG management system was installed in 1990 and upgraded in 1996. Under this early LFG system, collected methane was destroyed via candlestick flare. Beginning in 2004, LFG was been used to generate electricity. The electricity generation function of the gas plant ceased on December 31, 2023. A new enclosed flare and blowers were installed in 2024 during construction of a new Biogas Upgrading Facility (BUF). The BUF was under construction from 2024 to May 2025 that upgrades landfill gas to Renewable Natural Gas (RNG) for sale to FortisBC.

The current LFG management system consists of:

- An extraction well network, including vertical and horizontal wells
- A collection system incorporating branch, lateral and header pipes to convey the collected LFG from the extraction network to the LFG utilization facility or flares.
- The Biogas Upgrading Facility (commissioned May 2025) which includes:
  - WAGABOX upgrading technologies that remove hydrogen sulphide, carbon monoxide, carbon dioxide, nitrogen, etc.
  - A flare system consisting of two blowers, an enclosed flare, flame arrestor, condensate knock-out, analyzers, valves, controls, interconnected piping and electrical system. A candlestick flare was installed and integrated into the system in December 2025.
  - A thermal oxidizer to treat tail gas generated during the biogas upgrading process
- A subsurface gas migration monitoring network that includes gas monitoring probes located adjacent to the eastern property boundary and the perimeter of on-site building foundations
- An LFG monitoring program

4.4 Gas Extraction Wells

In 2025, the gas collection system consisted of 58 vertical wells and 131 horizontal wells, for a total of 227 wells. Table 3 shows the number and type of gas wells installed and operating over the last six years.

Table 3 Number and Type of Gas Wells Installed or Operating

Type of Gas Well	2021	2022	2023	2024	2025
Vertical gas wells operating	58	58	58	58	58
Horizontal gas wells operating	84	86	94	97	131
Wells installed, but not connected[1]	7	25	33	33	38
Totals	**148**	**145**	**152**	**155**	**227**

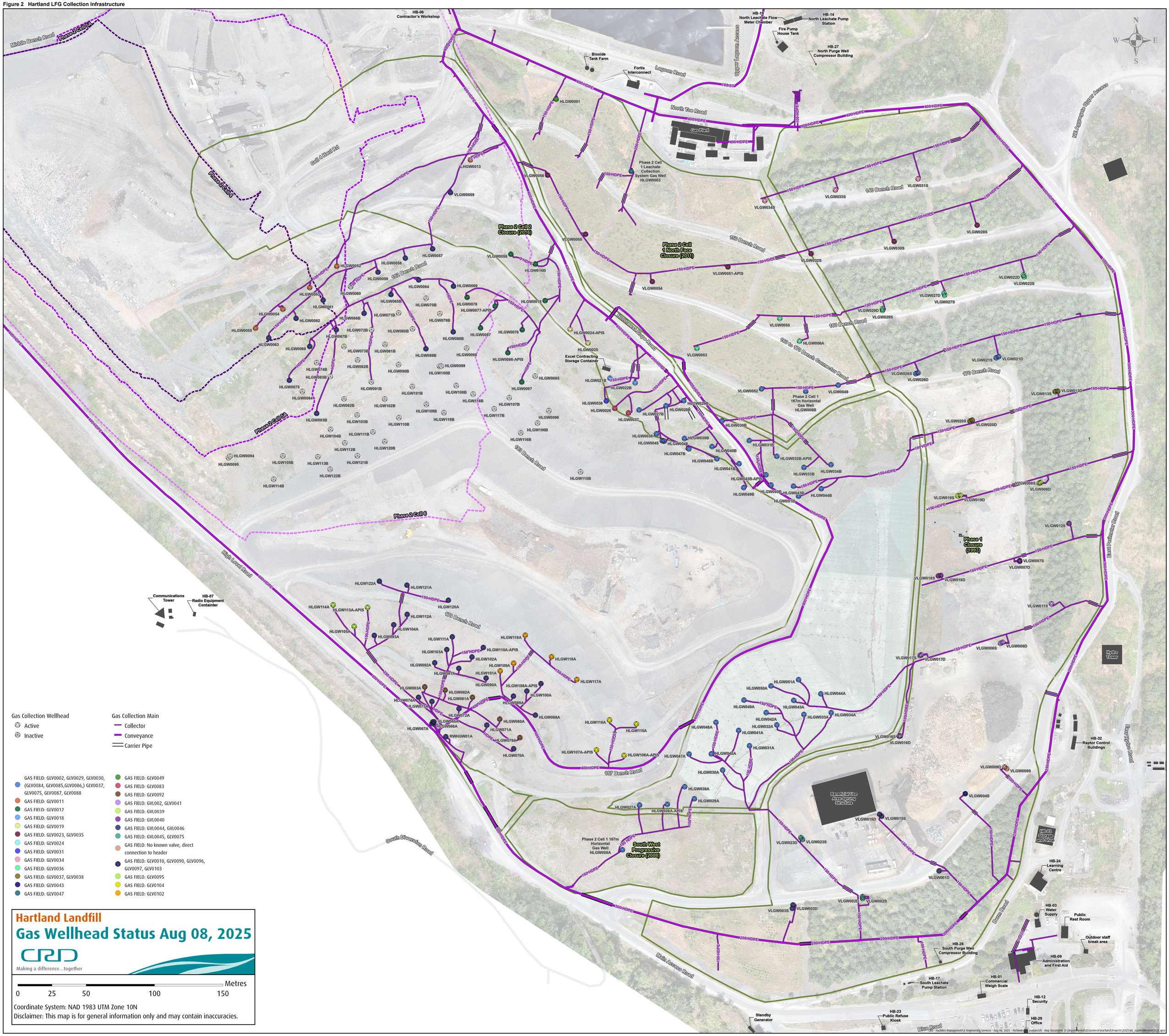
[1]The total number of wells does count wells currently installed, but not connected the gas collection system yet

See Figure 2 for the general location and layout of the LFG infrastructure.

Since 2011, the density of horizontal wells has increased from 45-50 m to 20 m on center. In 2024, horizontal well spacing in Cells 4 & 5 was increased to 25 m, on consultant recommendation. Wells are placed on each vertical lift, approximately every 4 m, with each offset from the lower trench alignment. Landfill gas collection infrastructure for Cells 4 and 5 will be installed and connected in accordance with the Landfill Gas Management Design Plan, the Landfill Master Plan, and subsequent detailed design plans.

Current vertical well design includes dual zone shallow and deep wells extending approximately 16 m and 30 m into the waste, respectively. Vertical well saturation with leachate has complicated gas extraction and, as a result, no further vertical wells have been installed since the 2012 implementation of the *Landfill Gas Management Plan*.

Figure 2 Hartland LFG Collection Infrastructure



4.5 Gas Well Field Operation and Monitoring

CRD staff monitor gas wells for methane, carbon dioxide, carbon monoxide, oxygen, balance gas, static pressure, differential pressure, temperature and flow on a monthly basis. The well field must be measured and balanced at least once per month and more often if there are changes in gas composition, or if there are fluctuations in the system vacuum. There are many factors that impact gas generation, so frequent well adjustments are critical to minimize oxygen, and optimize flow and methane content. Ideally, constant vacuum is applied at a well so that gas is drawn at approximately the same rate that it is being generated (a target of approximately 50% methane and <3% oxygen is desirable).

The well field was balanced 12 times in 2025 on a monthly basis (specific wells are checked more often to optimize gas extraction), as recommended by the BC *Landfill Gas Management Facilities Design Guidelines.*

5.0 LFG UTILIZATION AND COLLECTION EFFICIENCY

Following the commissioning of WAGABOX in May 2025, total landfill gas collected in 2025 was quantified using dedicated flow meters installed on both the flare system and the WAGABOX system. Measurements from these systems were combined to determine the total LFG received by the facility.

Table 4 and Table 5 show a summary of gas collection, utilization and overall collection efficiency based on ENV and ECCC models, respectively. Figures in the following section illustrate the collection efficiency for the last several years (2021-2025) and the monthly collected data in 2025 is provided in Appendix B.

Table 4 LFG System Collection Efficiency (ENV Model)

Year	LFG Flow (Nm^3/hour @ 50% CH_4)	CH_4 Captured (tonnes/year)	CH_4 Generation Estimate (tonnes/year)	Collection Efficiency	GHG Emissions with 25% Oxidation (tonnes CO_2e/year)
2021	1,954	6,128	8,192	75%	43,347
2022	2,042	5,864	8,325	70%	51,689
2023	1,888	5,422	8,418	64%	62,915
2024	1,271	3,650	8,532	43%	102,516
2025	1,673	5,247	8,574	61%	69,949

[1] Assuming 25% biological oxidation

Table 5 LFG Collection System Efficiency (ECCC Model)

Year	LFG Flow (Nm^3/hour @ 50% CH_4)	CH_4 Captured (tonnes/year)	CH_4 Generation Estimate (tonnes/year)	Collection Efficiency	GHG Emissions with 25% Oxidation (tonnes CO_2e/year)
2021	1,954	6,128	6,992	88%	18,147
2022	2,042	5,864	7,140	82%	26,801
2023	1,888	5,422	7,233	75%	38,031
2024	1,271	3,650	7,350	50%	77,703
2025	1,673	5,247	7,407	71%	45,433

[1] Assuming 25% biological oxidation

In 2025, collection efficiency was estimated at 61% using the ENV model and 71% using the ECCC model, with total uncollected (fugitive) GHG emissions, after accounting for 25% biological oxidation, estimated at 69,949 and 45,433 tonnes CO_2e, respectively. Landfill gas generation projections for future years are included in Appendix C. The estimated GHG emissions and corresponding collection efficiencies for both

models are presented in Figures 3 and 4. For the 2025 reporting year, a 25% biological oxidation factor through the landfill cover was applied based on the United States Environmental Protection Agency (US EPA) reference provided in Appendix A3.

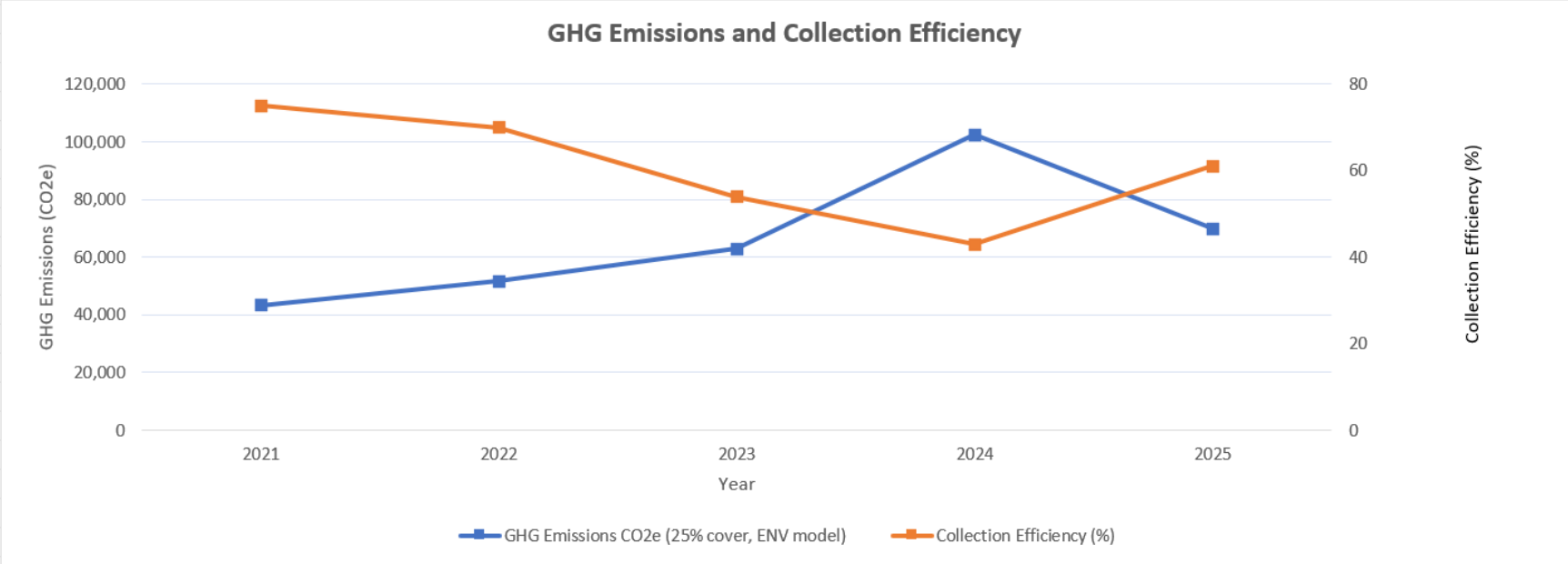
In 2025, collection efficiency increased significantly compared with 2024. According to the ENV model, collection efficiency increased from 43% to 61%, while according to the ECCC model it increased from 50% to 71%. The primary factor contributing to this improvement was the connection of multiple gas extraction wells on the south slope of Phase 2, Cell 3 in early 2025, following completion of the loop header expansion in 2024.

The increase in calculated collection efficiency can also be attributed to improvements in flow measurement with the new BUF, as well as improved conversion methodologies. Conversion factors and assumptions used to calculate the mass of recovered gas were updated to ensure consistency with standard temperature and pressure conditions and gas density parameters.

Overall, the following general observations can be made regarding gas production and collection for 2025:

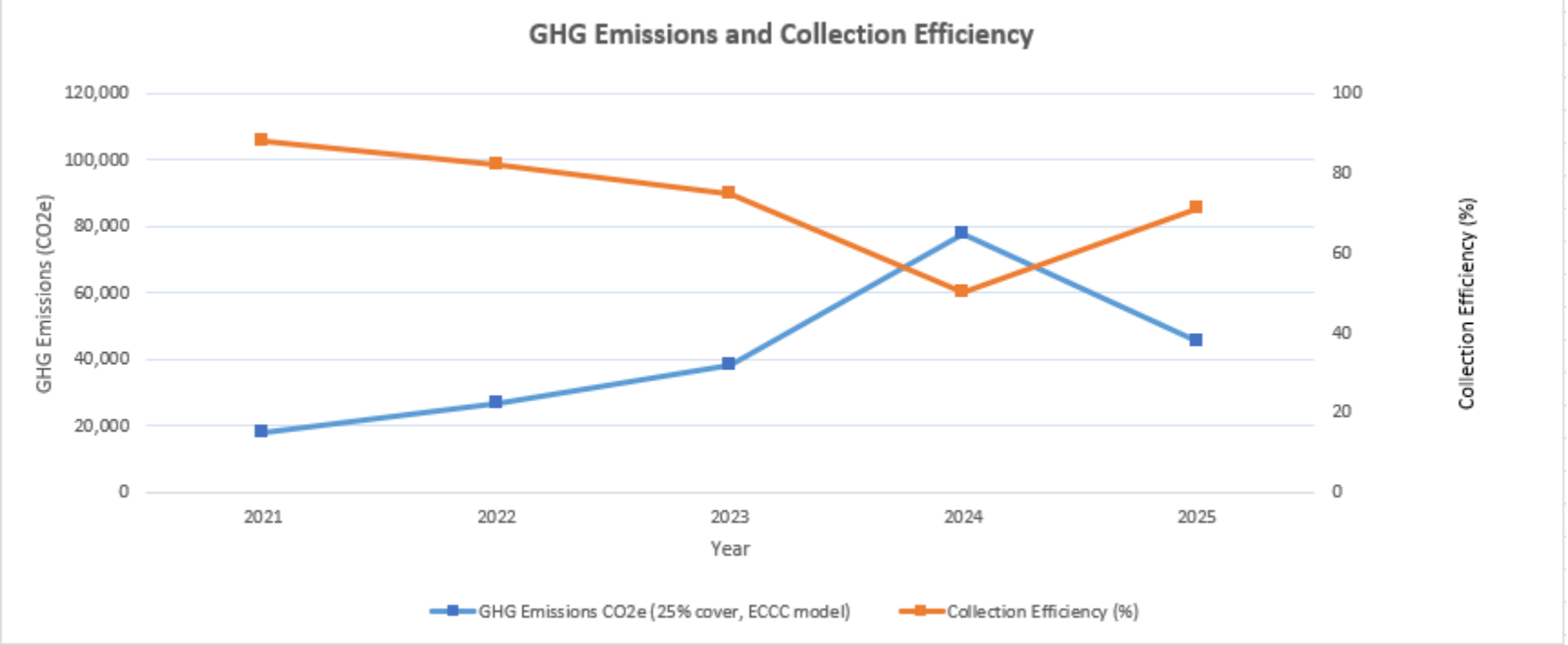
- Phase 1 gas production continues to decline. Waste in this area of the landfill has been in place for more than 30 years and gas production has declined significantly.
- There is decreased gas production in some high producing wells in Phase 2, Cell 2 which is expected due to age of refuse and advanced methanogenic processes.
- Much of the gas production is now in Phase 2, Cell 3 due to the age of the refuse (landfill began in 2016).

Figure 3 Fugitive GHG Emission and the Corresponding Collection Efficiency Using ENV model



Note: The GHG emissions are estimated based on 25% oxidation through cover according to US EPA recommendation included in Appendix A3.

Figure 4 Fugitive GHG Emission and the Corresponding Collection Efficiency Using ECCC model



Note: The GHG emissions are estimated based on 25% oxidation through cover according to US EPA recommendation included in Appendix A3.

5.1 Destruction Devices and Usage

Landfill gas destruction infrastructure was maintained throughout the reporting period. Following decommissioning of the original landfill gas plant in December 2023, landfill gas was continuously destroyed via the existing enclosed flare. Now, any excess gas or tail gas is destroyed by thermal oxidizer, enclosed flare or candlestick flare. These systems ensured continued landfill gas destruction capacity and supported compliance with regulatory requirements for destruction of landfill gas through approved destruction devices. Since commissioning the BUF in May 2025, landfill gas was beneficially utilized for RNG production approximately 95.4% of the time between June and December 2025.

5.2 LFG Management Plan Implementation Status

The CRD has implemented the conceptual design in the *Landfill Gas Management Plan*. However, since the plan was prepared, some operational changes have occurred, which are summarized below:

2012	Per the *Landfill Gas Management Plan*, alignment of horizontal wells changed from east-west to north-south due to the master fill plan cell phasing and progression.
2012/2013	Relocation and reconfiguration of controlled waste disposal areas. Controlled waste, initially landfilled in clay-lined cells, is now trenched into refuse. Landfilling was conducted over the controlled waste area expanding the available footprint for Cell 2. This benefits overall collection in that it allows gas wells to be installed in controlled waste areas that would otherwise be inappropriate due to clay.
2014	Installation of vertical gas wells has been delayed pending further review of efficacy due to leachate inundation or minimal gas production. Vertical gas wells installed in recent closed areas (2012) were not productive due to density of horizontal wells and overlapping areas-of-influence.
2014	Since implementation of the *Landfill Gas Management Plan*, horizontal well installation depths have been reduced (made shallower). The proposed deeper wells were intended to accelerate activation; however, this was not actualized, and the deeper wells triggered odour and safety issues during installation. As a result, this part of the *Landfill Gas Management Plan* was revised to allow for shallow wells. The shallow wells have fewer health and safety considerations, are less expensive to install, and can be activated in the same timeframe as deeper wells specified in the plan.
2015/2016	Filling plan sequencing has changed since the plan was prepared. These changes represent schedule variations rather than whole scale deviations from *the Landfill Gas Management Plan*. Changes include: • Phase 2, Cell 2 vertical extension by two lifts to allow time for completion of the cliff quarry and construction of Cell 3.
2017	A bypass line valve was opened at the gas plant to reduce backpressure on the well field and increase gas flows to the plant. As a result, flows increased by 50-100 scfm.
2018	No significant changes to the system were made in 2018.
2019	No significant changes to the system were made, but additional Cell 3 wells are now coming online, which is consistent with the *Landfill Gas Management Plan* prediction that Cell 3 well activation may take up to five years.
2020	No significant changes to the system were made. LFG generation and emissions study was completed to confirm the effectiveness of the current collection infrastructure and well field balancing programs. Additional well field optimization projects are planned for 2021.
2021	CRD staff continue the well balancing efforts several times a month to optimize the methane generation in each well and subsequently improve the well field gas production (i.e., reducing nitrogen and oxygen content and increasing the methane production).

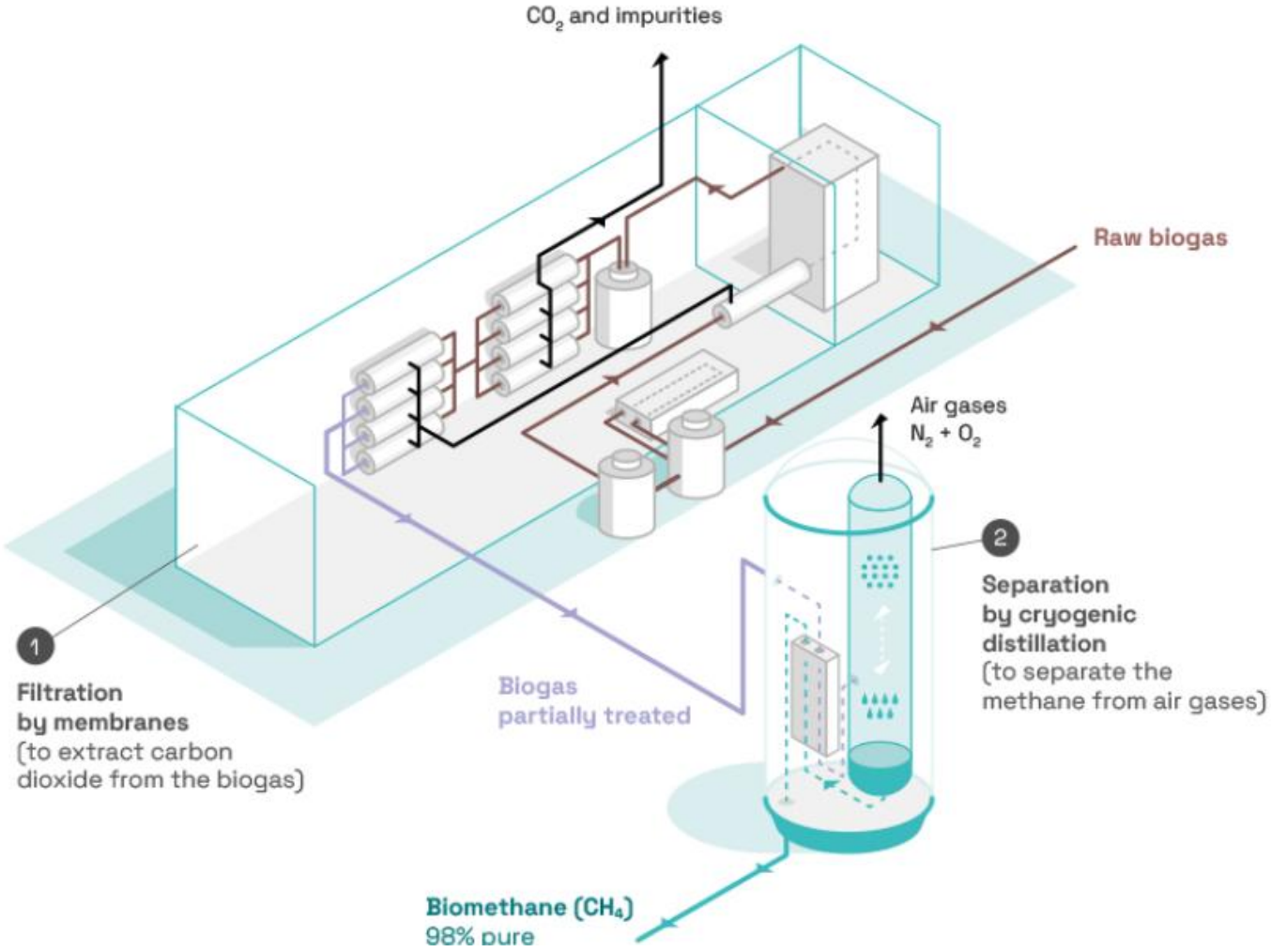
2022	No significant changes to the system were made. Additional well field optimization and biocover projects are planned for 2023. CRD staff will continue the well balancing efforts several times a month to optimize the methane generation in each well and subsequently improve the well field gas production (i.e., reducing nitrogen and oxygen content and increasing the methane production). Due to the current design and development of Cells 4, 5 and 6 in Phase 2, connection has been delayed for a number of collection wells already installed on the north slope of Cell 3.
2023	Approximately 2 hectares of fabricated biocover was installed on both the south and north slopes of the Cell 3 disposal area and a follow-up field measurement on the biocover areas is planned for 2024. While the biocover is not an approved LFG mitigation/destruction method under the regulation, it is expected to reduce localized fugitive methane emissions in areas without tarps or permanent closures. Results of the follow-up monitoring will be presented in a future annual report. In 2023, the construction of Cell 4 in Phase 2 was initiated, resulting in delayed connection of 33 collection wells already installed in the upper lifts of Cell 3. These wells will be connected to a collection system at both ends (north and south) but south connections require the extension of a main gas header on top of Cell 3, which is scheduled for construction in the third and fourth quarters (Q3/Q4) of 2024. The final north connection will not be completed until Cell 4 construction and subsequent LFG collection design is completed (2025). Gas collection is expected to decline in 2024 until the wells are connected. CRD staff will continue wellfield balancing each month to optimize LFG collection in each well and improve the quality of collected gas (i.e., reduce nitrogen and oxygen content and increase methane production). To reduce staff workload and improve data collection and wellfield balancing efforts, the CRD plans to install and pilot automated gas well tuning devices in 2024 at key collection wells. The existing gas-to-energy facility (generator) was formally decommissioned to enable construction of the Biogas Upgrading Facility on December 31, 2023.
2024	The final Cell 3 split header design in the CRD's 2011 LFG Management Plan was reconfigured to a loop header to improve vacuum and collection efficiency needed to facilitate the connection of new wells. Additionally, loop headers have historically been the norm at Hartland. As a result, the CRD altered the Cell 3 header design in 2024 to increase capacity and, in partnership with a consultant, to a loop configuration. This header was completed in Q4 of 2024 and will enable the south side connection of 33 gas wells in the upper lifts of Cell 3 in early 2025. Final redundant north-side connection of these wells is anticipated after final closure of Cell 2 & 3 (anticipated 2027-2028). While gas collection continued to decline in 2024, a significant increase is expected in 2025 once these wells are connected to the new LFG loop-header collection system. CRD staff will continue wellfield balancing each month to optimize LFG collection in each well and improve the quality of collected gas (i.e., reduce nitrogen and oxygen content and increase methane production). To reduce staff workload and improve data collection and wellfield balancing efforts, the CRD plans to install and pilot automated gas well tuning devices in 2025 at key collection wells. The construction of the Biogas Upgrading Facility continued throughout 2024. Landfill gas was continuously flared during this time.

2025	The Biogas Upgrading Facility (BUF) was commissioned in May 2025, representing a significant milestone for landfill gas management at the Hartland Landfill. The facility upgrades landfill gas to renewable natural gas (RNG), allowing beneficial use of the captured methane as a low-carbon energy source. The loop header that was completed in Q4 of 2024 enabled the connection of multiple gas wells in the upper lifts of south slope Cell 3 in early 2025 which ultimately led to an increase in the collection efficiency. Twelve autotuning devices were installed to reduce staff workload and improve data collection and well field balancing efforts. CRD staff will continue wellfield balancing each month to optimize LFG collection in each well and improve the quality of collected gas (i.e., reduce nitrogen and oxygen content and increase methane production). The final Cell 4 landfill gas collection system design was completed in 2025 and the design is included in Appendix D.

5.3 Renewable Natural Gas (RNG)

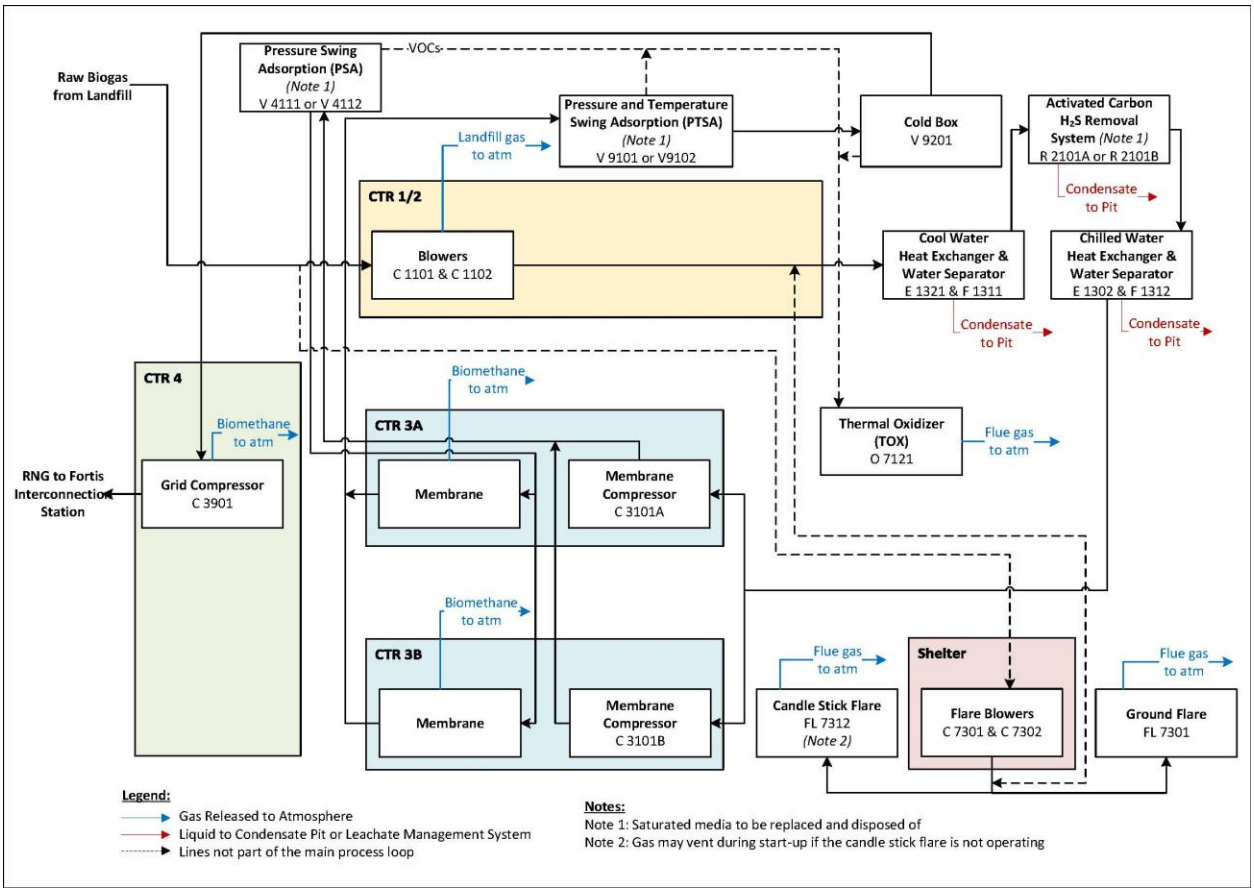
The BUF started producing RNG for sale to FortisBC in 2025. This facility uses proprietary technologies and has a complex design. A high-level process is indicated in Figure 5; and a detailed process flow diagram is included in Figure 6. As the raw biogas enters the system it is directed to the WAGABOX where the carbon dioxide and other impurities are filtered out by membranes followed by secondary treatment where the methane is separated from other gases like oxygen and nitrogen through cryogenic distillation. The BUF maximum design capacity is approximately 2,000 scfm (3,398 Nm^3/hour) and the output is delivered to the Fortis Injection Station for distribution as RNG into the Fortis Intermediate Pressure piping network.

Figure 5 Overview of process design for the Biogas Upgrading Facility



Note: The complete details of this technology are proprietary information and can be provided to the regulator upon request.
Figure Source: Renewable natural gas for all - Waga Energy (waga-energy.com)

Figure 6 Process Flow Diagram for Biogas Upgrading Facility at Hartland Landfill



6.0 LANDFILL GAS DESIGN AND OPTIMIZATION PROJECTS

6.1 Well Auto Tuning Devices

In 2025, the CRD initiated a pilot project testing the feasibility of automated well head tuning devices at Hartland Landfill. Automated well tuning devices monitor and adjust gas well extraction rate at a higher frequency than a field technician (e.g., multiple times a day, depending on the device and the design). These devices measure vacuum, gas concentrations and flow rate at each well, and then adjust the extraction rate of each well to achieve optimal performance. The devices are anticipated to improve LFG collection efficiency and reduced overall fugitive emissions, and the efficacy of these devices will be reviewed in 2026 following the completion of one year of data collection and use.

6.2 Continuous Surface Emission Monitoring

In 2025, the CRD completed the installation of continuous methane surface emission monitoring devices at multiple locations across Hartland Landfill. This pilot project was undertaken to evaluate an alternative approach for surface emissions monitoring and methane leak detection. Each device is equipped with methane sensors and capabilities for monitoring meteorological conditions including wind speed, temperature, pressure and humidity. The initiative is carried out in partnership with Qube Technologies and was partially funded through a federal grant administered by the vendor. As part of the collaboration, the CRD provided in-kind support, including staff time, technical feedback, and access to site data. The project represents an opportunity to assess the technology as a potential tool for supporting compliance with upcoming federal landfill methane regulations and for identifying and mitigating health and safety risks

associated with fugitive emissions in operational areas. The efficacy of the monitoring system and overall project outcomes will be evaluated in 2026 following completion of one full year of data collection.

6.3 Future Projects

The following projects are planned for 2026 and beyond, to continue to improve the gas capture and decrease the fugitive emissions:

- Reassessing landfill gas extraction strategy to optimize the balance between gas flow and methane concentration.
- Connection of approximately 15-16 new wells on the north slope.
- Dewatering activities for Cell 3 wells prone to flooding
- Connection of wells in Cell 4.
- Progressive connection of wells in Cells 4, 5, and 6 as landfill development progresses.
- Incorporation of Cell 3 final closure planning into gas collection system development.

Despite the mentioned plans, landfill gas collection is expected to face significant challenges in 2026 due to the ongoing transition to Cells 4 and 5, which has complicated the installation and expansion of landfill gas collection infrastructure. In addition, the absence of gas extraction wells in the upper lift of Cell 3 will continue to limit the capture of landfill gas from recently placed waste. As a result, landfill gas collection efficiency is anticipated to remain below desired levels throughout 2026 until additional collection infrastructure can be installed and commissioned in the active disposal areas.

The CRD is planning to undertake the development of a comprehensive Hartland Landfill Gas (LFG) Management Facilities Master Design Plan (Design Plan) to supplement the existing LFG Design Plan. It is intended to guide landfill gas collection infrastructure through the continued development of Cells 4, 5A, 5B and 6, and the closure of Phase 2 Cell 3.

The Design Plan is intended to provide a long-term roadmap for maintaining regulatory compliance, maximizing landfill gas collection efficiency, and ensuring uninterrupted renewable natural gas (RNG) production at Hartland Landfill.

The plan will identify and phase future landfill gas infrastructure requirements, including horizontal gas wells, collection trenches, subheaders, headers, condensate management systems, and leachate collection system connections. It will also establish annual capital work packages, schedules, and budget forecasts to support future landfill development and closure activities.

Key objectives of the Design Plan include:

- Supporting the final closure of Phase 2 Cell 3 while maintaining effective landfill gas capture and RNG production.
- Developing lift-by-lift landfill gas collection systems for Cells 4, 5A, 5B and 6.
- Relocating existing landfill gas header infrastructure that conflicts with future filling activities, including sections along High Level Road and Mid-Bench Road.
- Addressing known deficiencies in the existing collection system.
- Optimizing landfill gas collection efficiency through wellfield evaluation, balancing, condensate management, and reduction of air intrusion.
- Planning for future integration of biogas flows from the Residuals Treatment Facility (RTF) into the RNG facility.
- Ensuring continued compliance with BC Landfill Gas Management Regulations and minimizing disruption to landfill gas recovery and RNG generation during future construction and closure activities.

The Design Plan is anticipated to be completed in 2026, after which the identified landfill gas infrastructure upgrades, relocations, and optimization measures will be implemented in phases over the coming years in coordination with landfill filling, development, and closure activities. These works are expected to support

the long-term performance, reliability, and efficiency of the Hartland Landfill gas collection and RNG systems.

7.0 OPERATIONAL PERFORMANCE

The gas system operates continuously, except when there are power failures, and planned or unplanned shutdowns for maintenance. System downtime is defined as the period of time when no vacuum is applied to the field. Total system downtime in 2025 was approximately six days. The highest downtime occurred in February, March, and December, primarily due to scheduled shutdowns associated with WAGABOX commissioning activities in February and March, and scheduled maintenance and a power outage in December. The downtimes associated with these shutdowns were communicated to the BC Ministry of Environment and Parks, where applicable.

Table 6 summarizes collection system downtime for 2025.

Table 6 Summary of 2025 Blower Downtime by Month

Month	Shutdown Duration (minutes)
January	755
February	3,070
March	2,325
April	357
May	40
June	220
July	160
August	209
September	107
October	455
November	196
December	1,093
Total (minutes)	**8,987**
Total (hours)	**6.2**

8.0 MONITORING PROGRAMS

Annual monitoring is conducted to evaluate LFG collection and control system performance. Monitoring includes both operational monitoring, generator performance monitoring and environmental monitoring (e.g., gas quality in surface probes). This section and Table 7 summarize the LFG monitoring activities.

Table 7 Summary of LFG Monitoring Programs

Task & Objectives	Frequency	Primary Parameters	Criteria	Action if Criteria Exceeded	Monitoring By
1. Perimeter subsurface probe monitoring					
To detect potential subsurface LFG migrating off-site	Quarterly at perimeter probes	CH_4, CO_2, O_2, pressure and/or vacuum	LEL for methane (5.0%)	Increase sampling frequency. Initiate off-site sampling (see Task 7 below). Evaluate effectiveness of remedial measures.	EPro staff
2. Building foundation probes					
To detect potential subsurface LFG migration into on-site building foundations	Quarterly at foundation probes	CH_4, CO_2, O_2, pressure and/or vacuum	20% of LEL 10% of LEL – CRD internal standard	Initiate appropriate remedial action.	EPro staff
3. On-site ambient grid sampling					
To assess on-site LFG concentrations at known grid locations across the landfill surface	Once per year	THC as methane and H_2S	100 ppm as THC (methane)	Initiate investigation of remedial measures. Identify locations >100 ppm THC for Task 4.	EPro staff
4. On-site ambient hotspot monitoring					
To identify localized sources of LFG, or releases that could create potential health, safety, environmental or operational problems	Once per year	THC as methane and H_2S	12,500 ppm/1.25% THC (25% of the LEL) 5 ppm H_2S	Initiate investigation of remedial measures. Identify locations with THC >1,000 ppm or H_2S >5 ppm as Z points (hotspots). Personal gas detectors required in high-risk areas.	EPro staff

Task & Objectives	Frequency	Primary Parameters	Criteria	Action if Criteria Exceeded	Monitoring By
5. Gas well field monitoring					
Monitor the concentrations and gas flows from all the wells connected to the gas collection system	Minimum of monthly	Temperature, vacuum, flow rate, CH_4, CO_2, O_2	Maintain gas flow and methane content, control oxygen intake	Adjust wellhead vacuum.	Hartland staff
6. Blower, flare					
Monitor the performance of the moisture separators, blowers and flare and/or generation station	Continuous	Temperature, pressure, gas flow rate, CH_4, O_2	Operational	Adjust well field if outside operational criteria.	Hartland staff
7. Off-site properties					
To measure concentrations of gases in the event of LFG migrating off-site	Task 1 exceedance	THC and H_2S	Detectable above air quality guidelines and WorkSafeBC criteria	Initiate appropriate remedial action.	Hartland staff
8. On-site building gas monitoring					
To monitor methane and H_2S levels to protect workers in on-site buildings	Task 2 exceedance	Methane and H_2S	20% of the LEL (1% CH_4) – the Guidelines 10 ppm H_2S – WorkSafeBC	Initiate appropriate remedial action.	Hartland staff
9. LFG speciation					
To measure concentrations of compounds in the LFG at the inlet to the gas conditioning skid and power generation station	Once every two years	VOC and H_2S	WorkSafeBC criteria for individual compounds in ambient air	Initiate Task 10 if calculated ambient concentrations exceed WorkSafeBC limits.	EPro staff
10. On-site ambient air quality measurement					
Measure ambient VOC	Task 9 exceedance	VOC and H_2S	WorkSafeBC criteria for individual compounds in ambient air	Initiate remedial action.	EPro staff

Notes:
EPro staff = Environmental Protection staff
LEL = lower explosive limit
THC = total hydrocarbons
VOC = volatile organic content

8.1 Subsurface Gas Monitoring − Perimeter and Foundation Probes

Perimeter probes and foundation/trench probes have been used at Hartland Landfill to monitor for subsurface gas migration since 1996. Perimeter and foundation probes are required in the BC *Landfill Criteria for Municipal Solid Waste* (2016). Quarterly monitoring is conducted in five eastern perimeter monitoring probes and 12 foundation monitoring probes (Figure 7). Through long-term improvements to the LFG collection system, LFG migration potential has been mitigated and there is no indication of gas migration off-site. Although the risk is minimal, ongoing monitoring is required to meet regulatory requirements and to confirm worker and public health and safety. A complete monitoring methodology, probe locations, details, and data from the perimeter and building foundation probes are provided in Appendix E.

All probes were monitored according to the standard operating procedures four times in 2025; data is presented in Table 8 and Table 9. There was no detectable methane recorded in 2025. Consistent with historical data, CO_2 levels are slightly higher in the shallower 'B' probes than the deeper 'A' probes. Elevated CO_2 levels may give an early indication of the presence of LFG; however, no unusually high CO_2 levels were observed. Ongoing monitoring will continue to determine if any trends develop.

Foundation probes were monitored four times in 2025, which meets ENV requirements (see Table 10 and Table 11). Carbon dioxide levels were similar to previous years. There were no recorded exceedances of the ENV limit of 1.0% methane during the reporting period. Monitoring will continue to satisfy regulatory requirements and to determine if any trends develop.

Perimeter and foundation probe monitoring results for 2025 meet ENV requirements. Methane was not detected. The data indicates minimal risk of subsurface methane migration to adjacent properties or buildings. Quarterly monitoring should continue, to meet regulatory requirements and to evaluate health and safety risks.

Table 8 Average Gas Concentrations in Subsurface Perimeter Probes

Probe	CH_4 (%)					Probe	CO_2 (%)					Probe	O_2 (%)				
	2021	2022	2023	2024	2025		2021	2022	2023	2024	2025		2021	2022	2023	2024	2025
GP-01A	0.00	0.00	0.00	0.00	0.00	**GP-01A**	0.05	0.20	0.10	0.08	0.10	**GP-01A**	21.5	20.2	21.1	20.8	21.0
GP-01B	0.00	0.00	0.00	0.00	0.00	**GP-01B**	2.98	3.05	1.90	2.90	1.55	**GP-01B**	16.1	15.4	17.7	15.9	18.3
GP-02A	0.00	0.00	0.00	0.00	0.00	**GP-02A**	0.05	0.20	0.13	0.10	0.10	**GP-02A**	21.6	20.1	21.2	21.1	21.1
GP-02B	0.00	0.00	0.00	0.00	0.00	**GP-02B**	2.23	4.70	2.73	5.20	3.43	**GP-02B**	16.8	9.7	16.6	9.6	15.2
GP-03A	0.00	0.00	0.00	0.00	0.00	**GP-03A**	1.88	1.75	0.70	0.85	0.33	**GP-03A**	18.5	13.0	18.5	17.8	20.0
GP-03B	0.00	0.00	0.00	0.00	0.00	**GP-03B**	4.98	3.75	0.77	6.48	4.07	**GP-03B**	14.9	15.4	20.5	14.8	15.7
GP-11A	0.00	0.00	0.00	0.00	0.30	**GP-11A**	0.13	0.20	0.13	0.20	0.17	**GP-11A**	21.5	20.4	21.2	21.1	21.1
GP-11B	0.00	0.00	0.00	0.00	0.00	**GP-11B**	1.98	11.00	1.83	2.05	1.33	**GP-11B**	19.5	18.4	19.3	18.9	19.7
GP-12A	0.00	0.00	0.00	0.00	0.00	**GP-12A**	1.80	11.70	1.63	4.08	0.23	**GP-12A**	15.3	14.2	16.6	12.7	20.9
GP-12B	0.00	0.00	0.00	0.00	0.00	**GP-12B**	5.23	8.25	4.63	3.73	2.90	**GP-12B**	12.9	8.2	14.6	15.5	18.5

Table 9 Historical Maximum Gas Concentrations in Perimeter Probes (2015 – 2025)

Probe	CH_4 (%)	CO_2 (%)
GP-01A	0.20	0.30
GP-01B	0.20	4.90
GP-02A	0.00	0.30
GP-02B	0.10	6.30
GP-03A	0.10	5.00
GP-03B	0.10	10.00
GP-11A	0.90	0.30
GP-11B	0.00	19.00
GP-12A	0.00	20.80
GP-12B	0.00	10.40

Figure 7 Location of Gas Probes

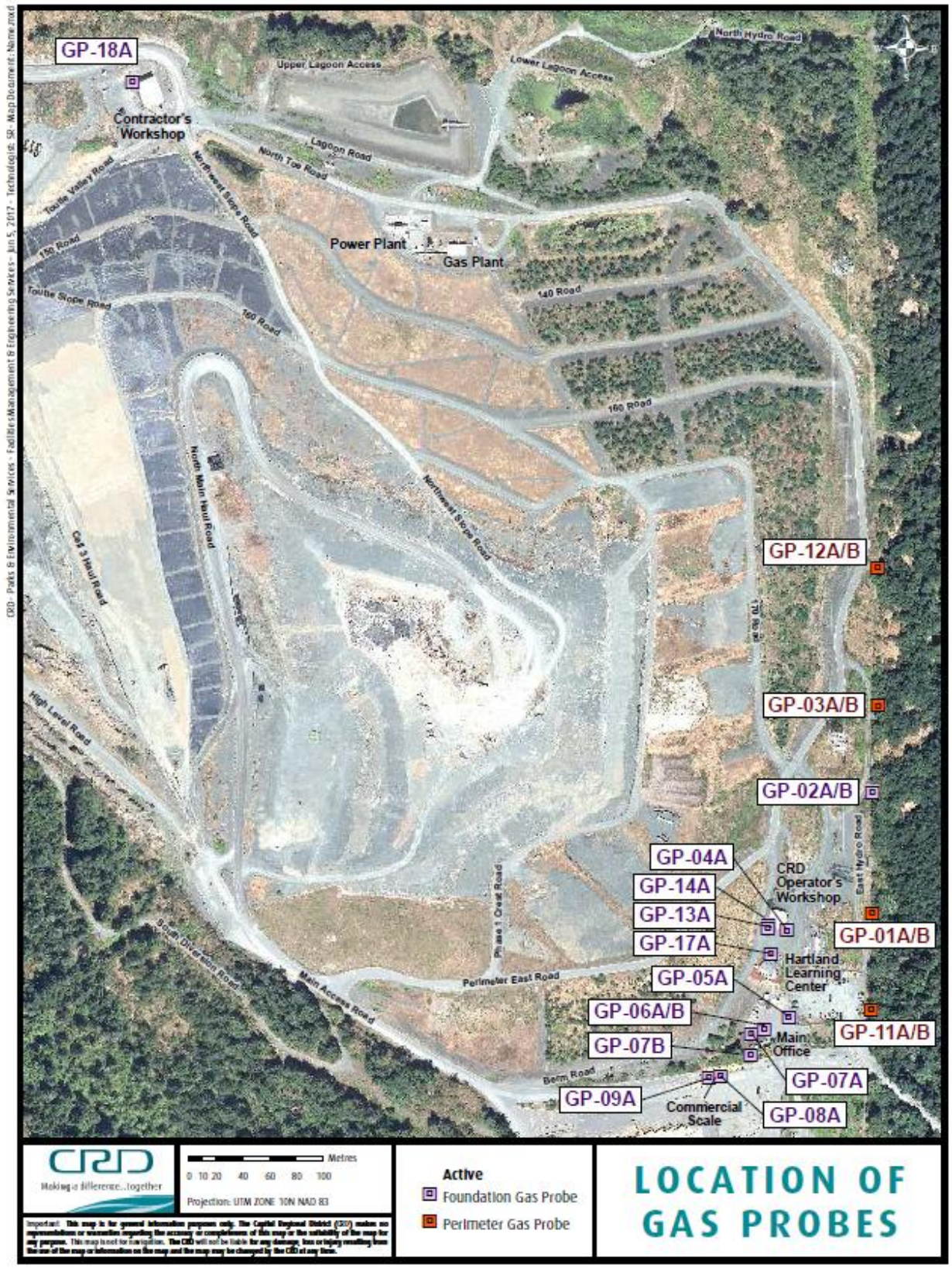


Table 10 Average Gas Concentrations in Subsurface Foundation Probes

Probe	CH_4 (%)					Probe	CO_2 (%)					Probe	O_2 (%)				
	2021	2022	2023	2024	2025		2021	2022	2023	2024	2025		2021	2022	2023	2024	2025
GP-04A	0.00	0.00	0.00	0.00	0.00	**GP-04A**	1.08	2.10	1.50	2.43	1.63	**GP-04A**	20.8	18.4	18.8	18.2	19.5
GP-05A	0.00	0.00	0.00	0.00	0.00	**GP-05A**	0.80	0.60	0.87	0.73	0.77	**GP-05A**	21.0	20.0	20.2	20.4	20.2
GP-06A	0.00	0.00	0.00	0.00	0.00	**GP-06A**	1.33	0.40	1.17	2.03	1.47	**GP-06A**	20.3	20.1	19.6	18.8	19.8
GP-06B	0.00	0.00	0.00	0.00	0.00	**GP-06B**	1.50	0.75	1.07	1.98	1.63	**GP-06B**	20.2	19.8	19.9	18.8	19.6
GP-07A	0.00	0.00	0.00	0.00	0.00	**GP-07A**	0.53	0.25	0.37	0.58	0.57	**GP-07A**	16.8	20.6	20.8	20.3	20.5
GP-07B	0.00	0.00	0.00	0.00	0.00	**GP-07B**	0.33	0.15	0.23	0.25	0.23	**GP-07B**	21.6	20.7	20.9	20.7	20.7
GP-08A	0.00	0.00	0.00	0.00	0.00	**GP-08A**	0.25	0.20	0.20	0.28	0.23	**GP-08A**	21.7	20.7	21.1	20.8	20.6
GP-09A	0.00	0.00	0.00	0.00	0.00	**GP-09A**	0.20	0.20	0.27	0.25	0.23	**GP-09A**	21.7	20.6	21.0	20.5	20.7
GP-13A	0.00	0.00	0.00	0.00	0.00	**GP-13A**	2.35	11.80	2.63	4.10	2.67	**GP-13A**	19.0	16.0	18.3	17.1	18.5
GP-17A	0.00	0.00	0.00	0.00	0.00	**GP-17A**	0.15	10.90	0.13	0.18	0.13	**GP-17A**	21.7	20.0	21.1	21.1	20.9
GP-18A	0.00	0.00	0.00	0.00	0.03	**GP-18A**	0.18	10.65	0.20	0.30	0.43	**GP-18A**	21.0	20.5	20.8	20.9	19.7

Notes:
GP-17A: probe for Hartland Learning Centre (constructed in 2011)
GP-18A: probe for new contractors workshop (constructed in 2011)

Table 11 Historical Maximum Gas Concentrations in Foundation Probes (2015-2025)

Probe	CH_4 (%)	CO_2 (%)
GP-04A	0.10	6.80
GP-05A	0.10	1.30
GP-06A	0.20	2.40
GP-06B	0.20	2.90
GP-07A	0.20	0.80
GP-07B	0.20	0.40
GP-08A	0.20	0.60
GP-09A	0.20	0.60
GP-13A	0.10	17.90
GP-17A	0.10	21.10
GP-18A	0.10	21.00

8.2 Surface Emissions and Hotspot Monitoring

Fugitive emissions can occur from advection and/or diffusion via soil pores, gaps and defective cover materials and are monitored routinely through surface monitoring. This monitoring assesses landfill closure integrity, supports worker health and safety, informs operational or capital planning, and supports optimal LFG collection. This monitoring is a simple and low cost means to assess methane and non-methane emissions.

Grid points are recorded as any location with a methane concentration over 100 ppm, while Z-Points (hotspots) are any location with a methane concentration over 1,000 ppm. Although hotspot locations over time, they are usually located at breaks or seams of cover systems and near side slopes in Phase 2, where gas collection is a challenge. The locations of all grid points and hotspots are shown in Figure 8 and historical hotspots at Hartland Landfill are included in Figure 9. A summary of the results is shown in Table 12 and Table 13 and more details are included in Appendix F.

In 2025, a total of 11 Z-points were identified. This included four new locations compared to previous years. Four hotspot locations were also discontinued as there were no elevated hydrogen sulphide concentrations. The absence of hotspots in Phase 1 indicates that the cover and gas collection system in the permanent closure is functioning. Annual monitoring should continue. Hotspots have decreased significantly since the implementation of the *Landfill Gas Management Plan* in 2012.

Table 12 Summary of Grid Sampling Results

Survey date	June
Grid points monitored	189
# Grid points >100 ppm THC	13

Note: Does not include discontinued locations and grid points located in Active Face or Controlled Waste areas as they can't be safely accessed.

Table 13 Summary of Hotspot Results

Survey date	August
Total # hotspots[1]	11
New hotspots at end of survey	4
Hotspots discontinued[2]	0
Maximum CH_4 (ppm)	>50,000

[1] Total number of hotspots at the end of the survey date
[2] Hotspots discontinued at the end of the survey date

Figure 8 Hartland Landfill Ambient Air Monitoring Results

GIO - Parks & Environmental Services - Facilities Management & Engineering Services - Aug 18, 2025 - Technologist: sviljanich - Map Document: HartlandAmbientAirJun2025-Ortho.aprx

	June 4-5, 2025	
WAYPOINT	Methane	H2S
	ppm	ppm
Z100	6,500	0
Z106	---	---
Z122	670	0
Z123	---	---
Z124	1,000,000	0
Z125	1,000,000	0
Z126	430,000	0
Z127	5,000	0
Z128	1,000,000	0
Z129	---	---
Z130	---	---
Z131	---	---
Z132	---	---
Z133	Too strong	0
Z134	Too strong	0
Z135	---	---
Z136	---	---
(New) Z137	540	0
(New) Z138	4,600	0
(New) Z139	1,000,000	0
(New) Z140	12,000	0

CRD
Making a difference...together

Metres
0 20 40 60 80 100

Projection: UTM ZONE 10N NAD 83

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

Combustible Gas Result
(parts per million)
- 0-99 ppm
- 100-999 ppm
- 1,000-12,499 ppm
- >12,500 ppm

Final Closure Areas
Progressive Closure Areas

HARTLAND LANDFILL AMBIENT AIR MONITORING RESULTS - JUNE 2025

Figure 9 Historical Hotspot Locations

CCRDS Geomatics Services - Jul 17, 2026 - svuljancich - Hartland\Ambient\Al2025.aprx\HartlandHistoric2_2025



CRD
Making a difference...together

Metres
0 20 40 60 80 100

Projection: UTM ZONE 10N NAD 83

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

Historical Z-Spot Locations
- Active
- Inactive

Closure Areas
- Active Filling Area
- Final Closure Areas
- Progressive Closure Areas

HISTORICAL Z-POINT LOCATIONS (2025)

Table 14 summarizes LFG monitoring results, compliance, mitigation actions and recommendations.

Table 14 LFG Compliance Summary

Program	Compliance Location	Criteria	Findings	Mitigation/Actions	Recommendations
Perimeter Probe Monitoring	Probes GP-1A, 1B, 2A, 2B, 3A, 3B, 11A, 11B, 12A and 12B	Methane must not exceed 5% in subsurface soils (BC *Landfill Criteria for Municipal Solid Waste* & BC *Landfill Gas Management Facilities Design Guidelines*)	No exceedances Low risk of sub-surface gas migration to adjacent properties	None	Continue quarterly monitoring.
Building Foundation Probe Monitoring	Probes GP-4A, 5A, 6A, 6B, 7A, 7B, 8A, 9A, 13A, 17A and 18A	Maximum 1% methane in any on-site facility (BC *Landfill Criteria for Municipal Solid Waste* & BC *Landfill Gas Management Facilities Design Guidelines*)	No exceedances Low risk of subsurface gas migration to adjacent building	None	Continue quarterly monitoring.
Ambient Grid Monitoring	N/A	100 ppm total hydrocarbon (THC), as methane (CRD internal guideline)	13 grid locations >100 ppm mainly due to potential gas accumulation. No cover system failures suspected in the closed area of Phase 1	Investigated hotspots and mitigated, where possible.	Continue annual monitoring.
Hotspot Monitoring	N/A	1,000 ppm THC (CRD internal guideline)	Four new hotspots (Z-points) >1,000 ppm were identified. Currently 11 locations for hotspot investigation	Added new locations of hotspots to the monitoring program.	Continue annual monitoring. Investigate mitigation options.
Well Field Monitoring and Balancing	N/A	Monitor monthly. Oxygen 2.5% - gas optimization and reduction of fire potential *(BC Landfill Gas Management Facilities Design Guidelines)*	Monitoring completed monthly; Oxygen did not exceed 2.5%	None	Continue monthly monitoring at minimum.
Gas Collection	N/A	75% gas collection efficiency target by the end of 2016, as per *Landfill Gas Management Plan*	ENV model estimated collection efficiency at 61%. ECCC model estimated the collection efficiency at 71%.	*Landfill Gas Management Plan* submitted to ENV.	Continue to implement the gas management plan and optimize gas concentrations in the well field.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The following section presents the key findings and recommendations developed from the 2025 LFG monitoring program at Hartland Landfill.

GAS GENERATION

In 2025, the ENV and ECCC models estimated methane generation at Hartland Landfill to be 8,574 and 7,407 tonnes CH_4 per year, respectively. Based on a measured methane collection rate of 5,247 tonnes CH_4 per year, estimated methane capture efficiencies were 61% for the ENV model and 71% for the ECCC model. After accounting for landfill cover oxidation (25%), fugitive emissions were estimated at 69,949 tonnes CO_2e using the ENV model and 45,433 tonnes CO_2e using the ECCC model. The ECCC model therefore predicts lower methane generation and fugitive emissions than the ENV model.

GAS GENERATION, COLLECTION AND UTILIZATION

In 2025, the gas extraction network consisted of 155 wells that captured an average of 1,672 Nm^3/hour of LFG. Well field balancing was completed at least monthly to optimize collection. Well field monitoring and balancing should continue at least monthly, as recommended by the BC *Landfill Gas Management Facilities Design Guidelines*.

At the end of 2025, landfill gas collection efficiency was estimated at 61% using the ENV model and 71% using the ECCC model. According to the ENV model, collection efficiency increased significantly from 43% in 2024 to 61% in 2025. The primary factor contributing to this improvement was the connection of multiple gas extraction wells on the south slope of Phase 2, Cell 3 in early 2025, as well as some refinements to internal to calculation methodologies.

The CRD continues to follow the *Landfill Gas Management Plan* design specifications for reaching 75% collection efficiency using the ENV model. Staff continue to monitor and adjust the well field to maximize collection and optimize key gas constituents (methane and nitrogen) in accordance with the Guidelines.

OPERATIONAL PERFORMANCE

The gas collection system largely remained in continuous operation throughout the year, except during power outages or unplanned maintenance shutdowns required for the commissioning and maintenance of the BUF. The total time period during which gas was not being flared amounted to approximately six days which was mainly associated with scheduled activities for the BUF commissioning, shutdowns for maintenance activities and power outages.

MONITORING

No methane concentrations were observed during foundation and perimeter probe monitoring and, as a result, there is little risk of lateral LFG migration. This monitoring is a regulatory requirement and should continue on a quarterly schedule.

During the 2025 surface emissions grid monitoring, 13 grid locations with methane concentrations >100 ppm, and 11 locations with methane concentrations above 1,000 ppm (Z-points) were identified.

10.0 REFERENCES

British Columbia Ministry of Environment. 2010. *Landfill Gas Management Facilities Design Guidelines*. Prepared by Conestoga-Rovers & Associates.

British Columbia Ministry of Environment and Climate Change Strategy. 2022. *Landfill Gas Management Regulation*, B.C. Reg. 391/2008.

British Columbia Ministry of Environment. 2016. *Landfill Criteria for Municipal Solid Waste* (2nd Edition).

British Columbia Ministry of Environment. 2009. *Landfill Gas Generation Assessment Procedure Guidelines*. Prepared by Conestoga-Rovers & Associates.

Capital Regional District, 2000 to 2026. Environmental Resource Management Annual Reports.

Capital Regional District. 2011. *Hartland Landfill Long Term Landfill Gas Management Plan*. Prepared by Conestoga-Rovers & Associates. Ref. No. 011624(10).

Environment and Climate Change Canada (ECCC). 2025. Landfill Methane Regulations, SOR/2025-279, under the Canadian Environmental Protection Act, 1999. Government of Canada, Ottawa, ON.

Environment and Climate Change Canada (ECCC). 2025. *Technical Guidance Document on Estimating, Measuring and Monitoring Landfill Methane*. Government of Canada, Gatineau, QC.

Sperling Hansen Associates. 2020. *Hartland Landfill Greenhouse Gas Emissions Quantification (Second Draft)*. Prepared for Capital Regional District, Victoria, BC. PRJ20007.

Tetra Tech EBA Inc, 2022 Solid Waste Stream Composition Study.

Statement of Limitations

This report has been prepared for the purpose of documenting and interpreting information related to landfill gas management at the Hartland Landfill in accordance with the requirements of the BC Environmental Management Act, the Landfill Gas Management Regulation, the Hartland Landfill Operational Certificate, and related guidelines.

This report is based on data and information collected during field monitoring programs, investigations and operational information, and projects completed in accordance with the CRD's Landfill Gas Management Design Plan and previous annual report updates to the plan. The data and information were provided by CRD staff and consultants. This report does not include independent verification of engineering design or modeling results generated by others, except where specifically noted.

Use of this report or any part thereof is subject to the understanding that professional judgment has been applied within the limits of the available information, applicable regulations, and accepted practice standards at the time of writing.

Statement of Qualifications

Kelly Tradewell, P.Ag., is a registrant in good standing with the British Columbia Institute of Agrologists (BCIA) and this report has been prepared in accordance with the Professional Governance Act (PGA) and the Agrologists Regulation.

Kelly has over 20 years of professional experience in environmental monitoring, assessment, and interpretation of soil, water, and air quality data at waste management facilities. For the past 17 years, she has worked extensively at the Hartland Landfill, providing professional oversight and assessment of operational compliance with the facility's authorization, the Environmental Management Act, and applicable regulations and guidelines, including the Landfill Gas Management Regulation and the Landfill Criteria for Municipal Solid Waste.

Kelly provided report oversight and senior review of the data analysis/interpretation and regulatory compliance review for this report.

Arma Attar, MSc., P.Geo, holds a Master of Science degree in Earth Sciences. She is a registrant in good standing with Engineering and Geoscientists BC (EGBC) with over ten years of professional experience in environmental monitoring, data interpretation, and regulatory reporting. Her work has focused on evaluating environmental datasets to assess compliance with provincial and federal regulations, including the Environmental Management Act and associated guidelines. Arma has contributed to numerous projects at Hartland Landfill involving groundwater, surface water, and air quality, and landfill gas monitoring.

Arma was responsible for the preparation and interpretation of environmental monitoring data and the assessment of regulatory compliance for this report.

BRITISH COLUMBIA

Ministry of
Environment and
Climate Change Strategy

Declaration of Competency

The Ministry of Environment and Climate Change Strategy relies on the work, advice, recommendations and in some cases decision making of qualified professionals[1], under government's professional reliance regime. With this comes an assumption that professionals who undertake work in relation to ministry legislation, regulations and codes of practice have the knowledge, experience and objectivity necessary to fulfill this role.

1. Name of Qualified Professional Kelly Tradewell

   Title Supervisor, GeoEnvironmental Programs

2. Are you a registered member of a professional association in B.C.? ☒ Yes ☐ No

   Name of Association: BC Institute of Agrologists Registration # 4409

3. Brief description of professional services:
   Oversight and senior review of the data analysis, interpretation and compliance summary of the 2025 Hartland Landfill Gas Annual Report

This declaration of competency is collected under section 26(c) of the *Freedom of Information and Protection of Privacy Act* for the purposes of increasing government transparency and ensuring professional ethics and accountability. By signing and submitting this statement you consent to its publication and its disclosure outside of Canada. This consent is valid from the date submitted and cannot be revoked. If you have any questions about the collection, use or disclosure of your personal information please contact the Ministry of Environment and Climate Change Strategy Headquarters Office at 1-800-663-7867.

Declaration

I am a qualified professional with the knowledge, skills and experience to provide expert information, advice and/or recommendations in relation to the specific work described above.

Signature:

X

Print Name: Kelly Tradewell

Witnessed by:

X

Print Name: Avrael Perreault

Date signed: November 6, 2026

[1] *Qualified Professional, in relation to a duty or function under ministry legislation, means an individual who*

a) *is registered in British Columbia with a professional association, is acting under that organization's code of ethics, and is subject to disciplinary action by that association, and*

b) *through suitable education, experience, accreditation and knowledge, may reasonably be relied on to provide advice within his or her area of expertise, which area of expertise is applicable to the duty or function.*

11.0 REPORT SIGNOFF

Prepared by:

Arma Attar, M.Sc.
Environmental Contaminants Officer

Approved by:

Kelly Tradewell, P.Ag
Supervisor, GeoEnvironmental Programs

BRITISH COLUMBIA INSTITUTE OF AGROLOGISTS 4409 Kelly Tradewell 23 Oct 2025 PAg

Approved by:

Ian Wiebenga, P.Eng.
Manager, Project Engineering

APPENDIX A

Landfill Gas (LFG) Generation Estimates

A1 **Ministry of Environment and Parks (ENV) Model Results 2025**

A2 **Environment and Climate Change Canada (ECCC) Model Results 2025**

A3 **United States Environmental Protection Agency (US EPA) oxidation table reference for cover system capture**

Appendix A1 Ministry of Environment and Parks (ENV) Model Results 2025

Table 1: Waste Tonnage Inputs

Year of Report	2026	
Annual Tonnage in Preceding Year	173,828	(tonnes/year)
Total waste in Place in the Preceding Year	7,210,746	(tonnes/year)
Methane generation in the Preceding Year	8,574	(tonnes CH4/year)

Next Five Years	Waste Tonnage (tonnes)	Methane Generation (tonnes CH4/year)
2026	175,740	8,582
2027	177,673	8,599
2028	179,627	8,625
2029	181,603	8,658
2030	183,601	8,700

Table 2: Methane Generation Input Parameters

	Relatively Inert	Moderately Decomposable	Decomposable	
Gas Production potential, Lo =	20	120	160	m^3 CH4/tonne
lag time before start of gas production, lag =	1	years		
Historical Data Used (years)	46			
1st Year of Historical Data Used	1980			
4 Years after Reporting Year	2030			
methane (by volume)	50%			
carbon dioxide (by volume)	50%			
methane (density) - 1atm, 25C	0.6557	kg/m^3	(25C,SP)	
carbon dioxide (density)	1.7988	kg/m^3	(25C,SP)	

Appendix A1 Ministry of Environment and Parks (ENV) Model Results 2025

Table 3: Historical Waste Inputs and Methane Generation Estimates

Year	Year Number	Annual Tonnage (tonnes)	Cumulative Waste-in-place (tonnes)	Waste Tonnage			Methane Generation Rate, k			Annual Methane Production (tonnes/yr)	Annual Landfill Gas Production (m^3/hr)
				Relatively Inert (tonnes)	Moderately Decomposable (tonnes)	Decomposable (tonnes)	Relatively Inert ($year^{-1}$)	Moderately Decomposable ($year^{-1}$)	Decomposable ($year^{-1}$)		
1980	1	111,037	111,037	38,974	41,306	30,757	0.02	0.04	0.09	0	-
1981	2	118,254	229,291	41,507	43,990	32,756	0.02	0.04	0.09	431	150
1982	3	125,941	355,232	44,205	46,850	34,886	0.02	0.04	0.09	859	299
1983	4	134,127	489,359	47,079	49,895	37,153	0.02	0.04	0.09	1,287	448
1984	5	142,845	632,204	50,139	53,138	39,568	0.02	0.04	0.09	1,718	598
1985	6	152,130	784,334	53,398	56,592	42,140	0.02	0.04	0.09	2,152	749
1986	7	167,472	951,806	58,783	62,300	46,390	0.02	0.04	0.09	2,593	903
1987	8	177,686	1,129,492	62,368	66,099	49,219	0.02	0.04	0.09	3,063	1,067
1988	9	184,193	1,313,685	64,652	68,520	51,021	0.02	0.04	0.09	3,541	1,233
1989	10	188,750	1,502,435	66,251	70,215	52,284	0.02	0.04	0.09	4,012	1,397
1990	11	187,476	1,689,911	65,804	69,741	51,931	0.02	0.04	0.09	4,469	1,556
1991	12	175,956	1,865,867	61,761	65,456	48,740	0.02	0.04	0.09	4,891	1,703
1992	13	162,329	2,028,196	56,977	60,386	44,965	0.02	0.04	0.09	5,240	1,824
1993	14	159,431	2,187,627	55,960	59,308	44,162	0.02	0.04	0.09	5,513	1,920
1994	15	156,285	2,343,912	54,856	58,138	43,291	0.02	0.04	0.09	5,759	2,005
1995	16	159,993	2,503,905	56,158	59,517	44,318	0.02	0.04	0.09	5,977	2,081
1996	17	157,528	2,661,433	55,292	58,600	43,635	0.02	0.04	0.09	6,196	2,157
1997	18	149,429	2,810,862	52,450	55,588	41,392	0.02	0.04	0.09	6,392	2,226
1998	19	138,081	2,948,943	48,466	51,366	38,248	0.02	0.04	0.09	6,545	2,279
1999	20	138,174	3,087,117	48,499	51,401	38,274	0.02	0.04	0.09	6,646	2,314
2000	21	142,239	3,229,356	49,926	52,913	39,400	0.02	0.04	0.09	6,742	2,347
2001	22	138,533	3,367,889	48,625	51,534	38,374	0.02	0.04	0.09	6,849	2,385
2002	23	146,324	3,514,213	51,360	54,433	40,532	0.02	0.04	0.09	6,936	2,415
2003	24	148,225	3,662,438	52,027	55,140	41,058	0.02	0.04	0.09	7,049	2,454
2004	25	154,113	3,816,551	54,094	57,330	42,689	0.02	0.04	0.09	7,163	2,494
2005	26	163,040	3,979,591	57,227	60,651	45,162	0.02	0.04	0.09	7,294	2,540
2006	27	166,820	4,146,411	58,554	62,057	46,209	0.02	0.04	0.09	7,452	2,595

Appendix A1 Ministry of Environment and Parks (ENV) Model Results 2025 - continued

Year	Year Number	Annual Tonnage (tonnes)	Cumulative Waste-in-place (tonnes)	Waste Tonnage			Methane Generation Rate, k			Annual Methane Production (tonnes/yr)	Annual Landfill Gas Production (m^3/hr)
				Relatively Inert (tonnes)	Moderately Decomposable (tonnes)	Decomposable (tonnes)	Relatively Inert ($year^{-1}$)	Moderately Decomposable ($year^{-1}$)	Decomposable ($year^{-1}$)		
2007	28	174,537	4,320,948	61,262	64,928	48,347	0.02	0.04	0.09	7,616	2,652
2008	29	166,722	4,487,670	58,519	62,021	46,182	0.02	0.04	0.09	7,799	2,716
2009	30	161,194	4,648,864	56,579	59,964	44,651	0.02	0.04	0.09	7,942	2,765
2010	31	152,062	4,800,926	53,374	56,567	42,121	0.02	0.04	0.09	8,054	2,804
2011	32	144,179	4,945,105	50,607	53,635	39,938	0.02	0.04	0.09	8,125	2,829
2012	33	136,763	5,081,868	48,004	50,876	37,883	0.02	0.04	0.09	8,163	2,842
2013	34	131,418	5,213,286	46,128	48,887	36,403	0.02	0.04	0.09	8,170	2,845
2014	35	128,045	5,341,331	45,177	52,311	30,557	0.02	0.04	0.09	8,158	2,841
2015	36	123,381	5,464,712	43,252	50,976	29,153	0.02	0.04	0.09	8,103	2,822
2016	37	146,704	5,611,416	52,809	63,618	30,278	0.02	0.04	0.09	8,038	2,799
2017	38	154,472	5,765,888	55,592	67,007	31,873	0.02	0.04	0.09	8,032	2,797
2018	39	159,942	5,925,830	57,589	69,335	33,018	0.02	0.04	0.09	8,056	2,805
2019	40	163,001	6,088,831	58,544	70,892	33,566	0.02	0.04	0.09	8,101	2,821
2020	41	160,727	6,249,558	56,654	73,371	30,702	0.02	0.04	0.09	8,157	2,840
2021	42	190,209	6,439,767	65,578	89,299	35,332	0.02	0.04	0.09	8,192	2,852
2022	43	201,980	6,641,747	79,887	91,698	30,395	0.02	0.04	0.09	8,325	2,899
2023	44	208,646	6,850,393	81,203	96,341	31,103	0.02	0.04	0.09	8,418	2,931
2024	45	186,525	7,036,918	72,306	87,011	27,208	0.02	0.04	0.09	8,532	2,971
2025	46	173,828	7,210,746	67,596	80,809	25,423	0.02	0.04	0.09	8,574	2,986
2026	47	175,740	7,386,486	68,379	81,619	25,742	0.02	0.04	0.09	8,582	2,988
2027	48	177,673	7,564,159	69,171	82,437	26,065	0.02	0.04	0.09	8,599	2,994
2028	49	179,627	7,743,786	69,971	83,265	26,391	0.02	0.04	0.09	8,625	3,003
2029	50	181,603	7,925,390	70,780	84,102	26,721	0.02	0.04	0.09	8,658	3,015
2030	51	183,601	8,108,991	71,598	84,948	27,055	0.02	0.04	0.09	8,700	3,029

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

Landfill Methane Modelling Tool: User Inputs and Model Parameters

Landfill Information

Landfill name:	Hartland Landfill	GHGRP ID: (if applicable)
Province:	BC	*The landfill location determines which provincial or territorial time-series waste composition will be used in the model.*
Landfill opening year:	1955	*The first year the landfill began receiving waste (the earliest possible year in the model is 1941)*
Landfill closing year:	2036	*The last year in which the landfill received waste (either a known year for closed landfills, or estimated for active landfills)*
Current year:	2025	*The last year for which waste disposal data is entered.*

Model Parameters

Select the basis for determining decay rates (k): Average annual precipitation

Enter annual precipitation: 932 mm

Annual Precipitation: In order to obtain the average annual precipitation, please use the link provided below to access the Canadian Climate Normals data. Under the tab "1991-2020", select the nearest weather station. On the next screen, select the "Normals Data" tab and scroll to the "Precipitation" table. The annual precipitation (in mm) is provided in the column titled "Year". Enter this number in the cell to the left.

Canadian Climate Normals

Decay rate precipitation category: >500 to 1000mm

Model parameters, Defaults and Constants

Waste Type	Decay Rate (k) (User-selected)	DOC (Default)	DOC_f (Default)
	Average annual precipitation		
	>500 to 1000mm		
Food	0.09	0.15	0.7
Paper	0.04	0.4	0.5
Yard and Garden	0.09	0.2	0.7
Soiled Paper	0.09	0.4	0.5
Wood	0.02	0.43	0.1
Textiles	0.04	0.24	0.5
Pet Waste	0.09	0.24	0.5
Diapers and Sanitary	0.09	0.24	0.5
Rubber and Leather	0.02	0.39	0.1
Other - Residential	0.09	0.1	0.5
Other - ICI	0.09	0.05	0.5
Other - Unknown	0.09	0.05	0.5
Sludge	0.09	0.05	0.7
Soil	0.02	0.03	0.1

Defaults	
Methane Correction Factor (MCF)	1
CH_4 content in LFG (%CH_4)	50%
Constants	
Molar ratio of CH_4:C	1.33
CH_4 density (kg/m^3) (at 25 °C and 1 atm)	0.656

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

Annual Waste Disposal

Will annual waste disposed be entered as bulk MSW or by sector of origin (Residential, ICI, C&D)?	Bulk MSW	
Do you want to enter user-defined waste composition percentages?	Yes	Note: If you have selected "yes", please provide additional input in the "WASTE COMPOSITION" sheet
Do you want to model the impact of future diversion of biodegradable waste?	No	Note: If you have selected "yes", please provide additional input in the "DIVERSION" sheet.

Year	Annual Waste Disposed						
	Bulk Municipal Solid Waste	Residential Waste	ICI Waste	C&D Waste	Wastewater sludge or biosolids (wet weight)	Soil (Contaminated or other soils - does not include landfill cover)	Total Waste Disposed
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1955	23,000						23,000
1956	24,495						24,495
1957	26,087						26,087
1958	27,783						27,783
1959	29,589						29,589
1960	31,512						31,512
1961	33,560						33,560
1962	35,742						35,742
1963	38,065						38,065
1964	40,539						40,539
1965	43,174						43,174
1966	45,980						45,980
1967	48,969						48,969
1968	52,152						52,152
1969	55,542						55,542
1970	59,152						59,152
1971	62,997						62,997
1972	67,092						67,092
1973	71,453						71,453
1974	76,097						76,097
1975	81,044						81,044
1976	86,312						86,312
1977	91,922						91,922
1978	97,897						97,897
1979	104,260						104,260
1980	111,037						111,037

Annual Waste Disposal - Missing Data

For years where detailed disposal data is not available (for example, prior to the installation of weigh scales at the landfill), the annual waste tonnage disposed should be estimated considering the following recommended approaches.

1. Multiply the estimated population served by the landfill in each year by an appropriate per capita waste disposal rate. The per capita disposal rate may be based on existing landfill-specific waste disposal and population data (for a year where this data is available). Provincial/territorial per capita waste disposal rates may also be used, if available.

2. Use any available estimates of total waste disposed ("waste-in-place") for specific years in the landfill's history (for example, based on a topographic or aerial survey). The difference between any two waste-in-place values can be distributed across the intervening years evenly (or based on other assumptions). If the waste-in-place data is in volumetric units (e.g., cubic metres), an appropriate waste density value (based on the procedures employed at the landfill including compaction, cover material, cover frequency, etc.) should be used to estimate the waste mass in tonnes.

3. Extrapolate the waste quantity for the first year for which waste quantities are available backwards in time to the landfill's opening year.

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

Year	Annual Waste Disposed						
	Bulk Municipal Solid Waste	Residential Waste	ICI Waste	C&D Waste	Wastewater sludge or biosolids (wet weight)	Soil (Contaminated or other soils - does not include landfill cover)	Total Waste Disposed
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1981	118,254						118,254
1982	125,941						125,941
1983	134,127						134,127
1984	142,845						142,845
1985	152,130						152,130
1986	167,472						167,472
1987	177,686						177,686
1988	184,193						184,193
1989	188,750						188,750
1990	187,476						187,476
1991	175,956						175,956
1992	162,329						162,329
1993	159,431						159,431
1994	156,285						156,285
1995	159,993						159,993
1996	157,528						157,528
1997	149,429						149,429
1998	138,081						138,081
1999	138,174						138,174
2000	142,239						142,239
2001	138,533						138,533
2002	146,324						146,324
2003	148,225						148,225
2004	154,113						154,113
2005	163,040						163,040
2006	166,820						166,820
2007	174,537						174,537
2008	166,722						166,722
2009	161,194						161,194
2010	152,062						152,062
2011	144,179						144,179
2012	136,763						136,763
2013	131,418						131,418
2014	128,045						128,045
2015	123,381						123,381
2016	146,704						146,704
2017	154,472						154,472
2018	159,942						159,942
2019	163,001						163,001
2020	160,727						160,727

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

Year	Annual Waste Disposed						
	Bulk Municipal Solid Waste	Residential Waste	ICI Waste	C&D Waste	Wastewater sludge or biosolids (wet weight)	Soil (Contaminated or other soils - does not include landfill cover)	Total Waste Disposed
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
2021	190,210						190,210
2022	201,981						201,981
2023	208,647						208,647
2024	186,525						186,525
2025	173,828						173,828
2026	175,740						175,740
2027	177,673						177,673
2028	179,627						179,627
2029	181,603						181,603
2030	183,601						183,601
2031	185,621						185,621
2032	187,662						187,662
2033	189,727						189,727
2034	191,814						191,814
2035	193,924						193,924
2036	196,057						FALSE

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

Landfill Methane Modelling Tool: Waste Composition (Optional)

Instructions
1. Enter site-specific waste composition values in the green cells below.
2. Ensure that the percentages by waste type add to 100% in column AB named "Check" on a yearly basis.
3. For years where site-specific values are not available, copy default values into green cells.

Year	P/T	Food		Paper		Soiled Paper		Wood		Yard and Garden		Diapers and Sanitary		Pet Waste		Rubber and Leather		Textiles		Other - Unknown		Inert	
		Edible and inedible food, including leftovers, spoiled food, peels, and kitchen scraps		Paper-based materials such as newspapers, office paper, magazines, and cardboard		Paper products contaminated by food, grease, or other substances, such as napkins and food-soiled paper containers		Treated and untreated wood, including lumber scraps and pallets		Organic material from outdoor maintenance, including grass clippings, leaves, branches, and plant debris		Disposable hygiene products, including diapers, sanitary and incontinence items		Animal excrement and associated materials such as cat litter and disposal bags		Mixed materials made from rubber and leather (e.g., belts, upholstery, footwear) (excludes pure rubber materials such as tires)		Clothing and fabric materials made from natural or synthetic fibers		Other mixed material miscellaneous or non-classifiable items		Includes plastics, glass, metal, electronics, household hazardous waste, bulky items (e.g., furniture, mattresses), and inert construction debris (concrete, asphalt).	
		Default	User-Definec	Default	User-Definec	Default	User-Defined	Default	User-Definec	Default	User-Definec	Default	User-Definec	Default	User-Definec	Default	User-Definec	Default	User-Define	Default	User-Definec	Default	User Defined
1955	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1956	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1957	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1958	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1959	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1960	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1961	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1962	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1963	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1964	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1965	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1966	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1967	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1968	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1969	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1970	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1971	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1972	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1973	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1974	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1975	BC	12%	22%	43%	16%	0%	0%	2%	12%	11%	6%	0%	4%	0%	0%	0.3%	0%	1%	6%	0%	0%	27%	35%
1976	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1977	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1978	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1979	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1980	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1981	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1982	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1983	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1984	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1985	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1986	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1987	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1988	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1989	BC	13%	22%	24%	16%	0%	0%	8%	12%	13%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	32%	35%
1990	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
1991	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
1992	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
1993	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
1994	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
1995	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
1996	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
1997	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
1998	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
1999	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
2000	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
2001	BC	15%	22%	16%	16%	0%	0%	11%	12%	14%	6%	0%	4%	0%	0%	0.0%	0%	2%	6%	0%	0%	35%	35%
2002	BC	28%	22%	13%	16%	0%	0%	14%	12%	5%	6%	2%	4%	0%	0%	1.5%	0%	4%	6%	0%	0%	32%	35%
2003	BC	28%	22%	13%	16%	0%	0%	14%	12%	5%	6%	2%	4%	0%	0%	1.5%	0%	4%	6%	0%	0%	32%	35%
2004	BC	28%	22%	13%	16%	0%	0%	14%	12%	5%	6%	2%	4%	0%	0%	1.5%	0%	4%	6%	0%	0%	32%	35%
2005	BC	28%	22%	13%	16%	0%	0%	14%	12%	5%	6%	2%	4%	0%	0%	1.5%	0%	4%	6%	0%	0%	32%	35%
2006	BC	28%	22%	13%	16%	0%	0%	14%	12%	5%	6%	2%	4%	0%	0%	1.5%	0%	4%	6%	0%	0%	32%	35%
2007	BC	28%	22%	13%	16%	0%	0%	14%	12%	5%	6%	2%	4%	0%	0%	1.5%	0%	4%	6%	0%	0%	32%	35%
2008	BC	20%	22%	9%	16%	6%	0%	12%	12%	4%	6%	4%	4%	2%	0%	0.6%	0%	4%	6%	0%	0%	34%	35%

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Year	P/T	Food		Paper		Soiled Paper		Wood		Yard and Garden		Diapers and Sanitary		Pet Waste		Rubber and Leather		Textiles		Other – Unknown		Inert	
		Edible and inedible food, including leftovers, spoiled food, peels, and kitchen scraps		Paper-based materials such as newspapers, office paper, magazines, and cardboard		Paper products contaminated by food, grease, or other substances, such as napkins and food-soiled paper containers		Treated and untreated wood, including lumber scraps and pallets		Organic material from outdoor maintenance, including grass clippings, leaves, branches, and plant debris		Disposable hygiene products, including diapers, sanitary and incontinence items		Animal excrement and associated materials such as cat litter and disposal bags		Mixed materials made from rubber and leather (e.g., belts, upholstery, footwear) (excludes pure rubber materials such as tires)		Clothing and fabric materials made from natural or synthetic fibers		Other mixed material miscellaneous or non-classifiable items		Includes plastics, glass, metal, electronics, household hazardous waste, bulky items (e.g., furniture, mattresses), and inert construction debris (concrete, asphalt).	
		Default	User-Definec	Default	User-Definec	Default	User-Defined	Default	User-Definec	Default	User-Definec	Default	User-Definec	Default	User-Definec	Default	User-Definec	Default	User-Define	Default	User-Definec	Default	User Defined
2009	BC	20%	22%	9%	16%	6%	0%	12%	12%	4%	6%	4%	4%	2%	0%	0.6%	0%	4%	6%	0%	0%	34%	35%
2010	BC	20%	22%	9%	16%	6%	0%	12%	12%	4%	6%	4%	4%	2%	0%	0.6%	0%	4%	6%	0%	0%	34%	35%
2011	BC	20%	22%	9%	16%	6%	0%	12%	12%	4%	6%	4%	4%	2%	0%	0.6%	0%	4%	6%	0%	0%	34%	35%
2012	BC	20%	22%	9%	16%	6%	0%	12%	12%	4%	6%	4%	4%	2%	0%	0.6%	0%	4%	6%	0%	0%	34%	35%
2013	BC	20%	22%	9%	16%	6%	0%	12%	12%	4%	6%	4%	4%	2%	0%	0.6%	0%	4%	6%	0%	0%	34%	35%
2014	BC	20%	20%	9%	14%	6%	0%	12%	14%	4%	4%	4%	7%	2%	0%	0.6%	0%	4%	6%	0%	0%	34%	35%
2015	BC	20%	20%	9%	14%	6%	0%	12%	14%	4%	3%	4%	8%	2%	0%	0.6%	0%	4%	5%	0%	0%	34%	35%
2016	BC	20%	19%	9%	14%	6%	0%	12%	16%	4%	1%	4%	8%	2%	0%	0.6%	0%	4%	6%	0%	0%	34%	35%
2017	BC	22%	19%	9%	14%	6%	0%	13%	16%	3%	1%	3%	8%	2%	0%	1.1%	0%	3%	6%	0%	0%	35%	35%
2018	BC	22%	19%	9%	14%	6%	0%	13%	16%	3%	1%	3%	8%	2%	0%	1.1%	0%	3%	6%	0%	0%	35%	35%
2019	BC	22%	19%	9%	14%	6%	0%	13%	16%	3%	1%	3%	9%	2%	0%	1.1%	0%	3%	6%	0%	0%	35%	35%
2020	BC	22%	18%	9%	14%	6%	0%	13%	16%	3%	1%	3%	11%	2%	0%	1.1%	0%	3%	6%	0%	0%	35%	35%
2021	BC	16%	17%	9%	13%	5%	0%	15%	15%	3%	1%	4%	13%	3%	0%	0.7%	0%	4%	6%	0%	0%	37%	34%
2022	BC	16%	12%	9%	13%	5%	0%	15%	17%	3%	3%	4%	11%	3%	0%	0.7%	0%	4%	5%	0%	0%	37%	39%
2023	BC	16%	12%	9%	13%	5%	0%	15%	17%	3%	3%	4%	12%	3%	0%	0.7%	0%	4%	5%	0%	0%	37%	39%
2024	BC	16%	12%	9%	12%	5%	0%	15%	17%	3%	3%	4%	13%	3%	0%	0.7%	0%	4%	5%	0%	0%	37%	38%
2025	BC	16%	12%	9%	12%	5%	0%	15%	17%	3%	3%	4%	13%	3%	0%	0.7%	0%	4%	5%	0%	0%	37%	39%

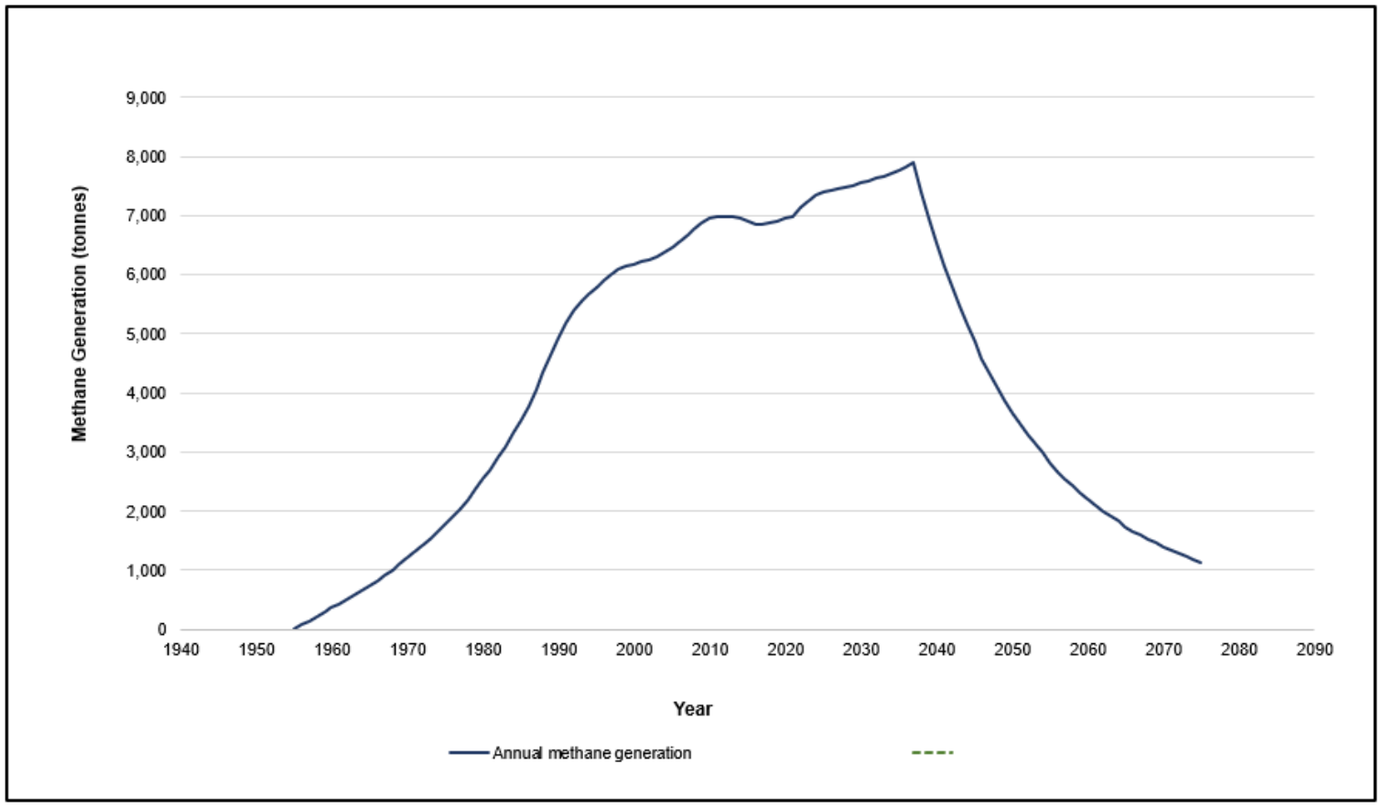
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Landfill Methane Modelling Tool: Results

Landfill Name: Hartland Landfill

Year opened: 1955 **Province :** BC

Closure year: 2036



Waste modelled	Bulk MSW
User-specified waste composition?	Yes
Diversion?	No

User-selected and Default Model parameters

The following material parameters were used in the methane generation calculations, based on user selections and inputs:

Waste Type	Decay Rate (k) (User-selected)	DOC (Default)	DOC_f (Default)
	Average annual precipitation		
	>500 to 1000mm		
Food	0.09	0.15	0.7
Paper	0.04	0.4	0.5
Yard and Garden	0.09	0.2	0.7
Soiled Paper	0.09	0.4	0.5
Wood	0.02	0.43	0.1
Textiles	0.04	0.24	0.5
Pet Waste	0.09	0.24	0.5
Diapers and Sanitary	0.09	0.24	0.5
Rubber and Leather	0.02	0.39	0.1
Other - Residential	0.09	0.1	0.5
Other - ICI	0.09	0.05	0.5
Other - Unknown	0.09	0.05	0.5
Sludge	0.09	0.05	0.7
Soil	0.02	0.03	0.1

Other Parameters and Defaults		Constants	
Methane Correction Factor (MCF)	1	Molar ratio of CH_4:C	1.33
CH_4 content in LFG (%CH_4)	50%	CH_4 density (at 25 °C and 1 atm) (kg/m^3)	0.656

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Year	Total Annual Waste Disposed	Total Waste in Place	Methane generation (no diversion)		
	tonnes/year	tonnes	tonnes/year	m^3 methane/year	scfm methane (standard cubic feet per minute)
1955	23,000	23,000	0	0	0
1956	24,495	47,495	72	109,199	22,382
1957	26,087	73,582	143	217,879	44,658
1958	27,783	101,365	214	326,595	66,941
1959	29,589	130,954	286	435,893	89,344
1960	31,512	162,466	358	546,305	111,975
1961	33,560	196,026	432	658,358	134,942
1962	35,742	231,768	507	772,579	158,353
1963	38,065	269,833	584	889,498	182,318
1964	40,539	310,372	662	1,009,640	206,943
1965	43,174	353,546	744	1,133,541	232,339
1966	45,980	399,526	828	1,261,746	258,616
1967	48,969	448,495	915	1,394,808	285,890
1968	52,152	500,647	1,006	1,533,301	314,276
1969	55,542	556,189	1,101	1,677,810	343,896
1970	59,152	615,341	1,200	1,828,942	374,873
1971	62,997	678,338	1,304	1,987,323	407,336
1972	67,092	745,430	1,413	2,153,609	441,419
1973	71,453	816,883	1,527	2,328,483	477,263
1974	76,097	892,980	1,648	2,512,658	515,012
1975	81,044	974,024	1,776	2,706,879	554,821

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1976	86,312	1,060,336	1,910	2,911,938	596,852
1977	91,922	1,152,258	2,052	3,128,657	641,272
1978	97,897	1,250,155	2,203	3,357,906	688,261
1979	104,260	1,354,415	2,362	3,600,606	738,006
1980	111,037	1,465,452	2,531	3,857,725	790,707
1981	118,254	1,583,706	2,709	4,130,292	846,574
1982	125,941	1,709,647	2,899	4,419,391	905,830
1983	134,127	1,843,774	3,100	4,726,178	968,711
1984	142,845	1,986,619	3,314	5,051,870	1,035,468
1985	152,130	2,138,749	3,541	5,397,760	1,106,364
1986	167,472	2,306,221	3,782	5,765,226	1,181,682
1987	177,686	2,483,907	4,055	6,181,616	1,267,029
1988	184,193	2,668,100	4,342	6,619,278	1,356,735
1989	188,750	2,856,850	4,631	7,059,251	1,446,915
1990	187,476	3,044,326	4,915	7,492,246	1,535,665
1991	175,956	3,220,282	5,177	7,891,190	1,617,435
1992	162,329	3,382,611	5,386	8,209,926	1,682,766
1993	159,431	3,542,042	5,539	8,444,135	1,730,771
1994	156,285	3,698,327	5,675	8,650,694	1,773,109

Year	Total Annual Waste Disposed	Total Waste in Place	Methane generation (no diversion)		
	tonnes/year	tonnes	tonnes/year	m^3 methane/year	scfm methane (standard cubic feet per minute)

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

1994	156,285	3,698,327	5,675	8,650,694	1,773,109
1995	159,993	3,858,320	5,793	8,830,351	1,809,932
1996	157,528	4,015,848	5,915	9,017,505	1,848,293
1997	149,429	4,165,277	6,024	9,182,295	1,882,069
1998	138,081	4,303,358	6,100	9,299,505	1,906,094
1999	138,174	4,441,532	6,138	9,356,994	1,917,877
2000	142,239	4,583,771	6,175	9,413,187	1,929,395
2001	138,533	4,722,304	6,223	9,486,945	1,944,513
2002	146,324	4,868,628	6,258	9,540,066	1,955,401
2003	148,225	5,016,853	6,316	9,628,504	1,973,527
2004	154,113	5,170,966	6,377	9,721,755	1,992,641
2005	163,040	5,334,006	6,454	9,838,359	2,016,541
2006	166,820	5,500,826	6,554	9,991,068	2,047,841
2007	174,537	5,675,363	6,660	10,152,892	2,081,010
2008	166,722	5,842,085	6,784	10,341,875	2,119,745
2009	161,194	6,003,279	6,876	10,482,374	2,148,543
2010	152,062	6,155,341	6,946	10,588,635	2,170,323
2011	144,179	6,299,520	6,984	10,645,919	2,182,064
2012	136,763	6,436,283	6,995	10,663,535	2,185,675
2013	131,418	6,567,701	6,984	10,646,408	2,182,164
2014	128,045	6,695,746	6,958	10,606,717	2,174,029
2015	123,381	6,819,127	6,911	10,534,438	2,159,214
2016	146,704	6,965,831	6,860	10,457,286	2,143,401
2017	154,472	7,120,303	6,853	10,447,010	2,141,294
2018	159,942	7,280,245	6,871	10,473,427	2,146,709

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

2019	163,001	7,443,246	6,903	10,522,462	2,156,760
2020	160,727	7,603,973	6,946	10,588,295	2,170,253
2021	190,210	7,794,183	6,992	10,658,224	2,184,586
2022	201,981	7,996,164	7,140	10,883,918	2,230,846
2023	208,647	8,204,811	7,233	11,025,714	2,259,910
2024	186,525	8,391,336	7,350	11,203,570	2,296,364
2025	173,828	8,565,164	7,407	11,291,803	2,314,449
2026	175,740	8,740,904	7,427	11,321,905	2,320,619
2027	177,673	8,918,577	7,451	11,358,745	2,328,170
2028	179,627	9,098,204	7,480	11,401,922	2,337,020
2029	181,603	9,279,807	7,512	11,451,064	2,347,093
2030	183,601	9,463,408	7,548	11,505,835	2,358,319
2031	185,621	9,649,029	7,587	11,565,924	2,370,635
2032	187,662	9,836,691	7,630	11,631,045	2,383,983

Year	Total Annual Waste Disposed	Total Waste in Place	Methane generation (no diversion)		
	tonnes/year	tonnes	tonnes/year	m^3 methane/year	scfm methane (standard cubic feet per minute)

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

2033	189,727	10,026,418	7,676	11,700,940	2,398,309
2034	191,814	10,218,231	7,725	11,775,368	2,413,564
2035	193,924	10,412,155	7,776	11,854,111	2,429,704
2036	196,057	10,608,211	7,831	11,936,969	2,446,687
2037	0	10,608,211	7,888	12,023,758	2,464,476
2038	0	10,608,211	7,406	11,289,709	2,314,020
2039	0	10,608,211	6,959	10,608,034	2,174,299
2040	0	10,608,211	6,543	9,974,629	2,044,472
2041	0	10,608,211	6,157	9,385,728	1,923,766
2042	0	10,608,211	5,798	8,837,874	1,811,474
2043	0	10,608,211	5,463	8,327,894	1,706,945
2044	0	10,608,211	5,151	7,852,875	1,609,582
2045	0	10,608,211	4,861	7,410,139	1,518,835
2046	0	10,608,211	4,590	6,997,228	1,434,202
2047	0	10,608,211	4,337	6,611,882	1,355,219
2048	0	10,608,211	4,101	6,252,025	1,281,460
2049	0	10,608,211	3,881	5,915,748	1,212,534
2050	0	10,608,211	3,674	5,601,295	1,148,082
2051	0	10,608,211	3,481	5,307,050	1,087,771
2052	0	10,608,211	3,301	5,031,530	1,031,299
2053	0	10,608,211	3,131	4,773,364	978,383
2054	0	10,608,211	2,973	4,531,294	928,767
2055	0	10,608,211	2,824	4,304,161	882,212
2056	0	10,608,211	2,684	4,090,896	838,499
2057	0	10,608,211	2,552	3,890,513	797,428
2058	0	10,608,211	2,429	3,702,106	758,810

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

2059	0	10,608,211	2,312	3,524,837	722,476
2060	0	10,608,211	2,203	3,357,932	688,266
2061	0	10,608,211	2,100	3,200,680	656,034
2062	0	10,608,211	2,002	3,052,421	625,646
2063	0	10,608,211	1,911	2,912,546	596,976
2064	0	10,608,211	1,824	2,780,495	569,910
2065	0	10,608,211	1,742	2,655,746	544,341
2066	0	10,608,211	1,665	2,537,820	520,170
2067	0	10,608,211	1,592	2,426,270	497,306
2068	0	10,608,211	1,522	2,320,685	475,664
2069	0	10,608,211	1,457	2,220,683	455,167
2070	0	10,608,211	1,395	2,125,910	435,742
2071	0	10,608,211	1,336	2,036,038	417,321
2072	0	10,608,211	1,280	1,950,763	399,842
2073	0	10,608,211	1,227	1,869,801	383,248
2074	0	10,608,211	1,176	1,792,891	367,484
2075	0	10,608,211	1,128	1,719,787	352,500

Appendix A2 Environment and Climate Change Canada (ECCC) Model Results 2025

Landfill Methane Modelling Tool: Model Parameters

The following table provides the model parameters included in the modelling tool:

Material		Precipitation-based Methane Generation Rate (yr^{-1})						Climate Zone-based Decay Rate (yr^{-1})			Degradable Organic Carbon		Fraction of Degradable Organic Carbon that Decomposes	
		<250mm	>250 to <500mm	>500 to <1000mm	>1000 to <2000mm	>2000mm	Decay rate Reference	Dry	Wet	Reference	DOC	Reference	DOC_f	Reference
Food	bulk, sector-specific	0.03	0.05	0.09	0.185	0.185	BC LFG Generation Estimation Tool, 2009; IPCC 2006 Guidelines, Food Waste, Boreal/Temperate (Wet)	0.06	0.185	IPCC 2006 Guidelines, Food Waste, Boreal/Temperate (Wet/Dry)	0.15	IPCC 2006 Guidelines	0.7	IPCC 2019 Refinement (Highly decomposable wastes)
Paper	bulk, sector-specific	0.01	0.02	0.04	0.06	0.07	BC LFG Generation Estimation Tool, 2009	0.04	0.06	IPCC 2006 Guidelines, Paper/Textiles, Boreal/Temperate (Wet/Dry)	0.4	IPCC 2006 Guidelines	0.5	IPCC 2019 Refinement (moderately decomposable waste)
Yard and Garden	bulk, sector-specific	0.03	0.05	0.09	0.11	0.12	BC LFG Generation Estimation Tool, 2009	0.05	0.1	IPCC 2006 Guidelines, Moderately Degrading Waste (Garden and park waste), Boreal/Temperate (Wet/Dry)	0.2	IPCC 2006 (garden and park waste)	0.7	IPCC 2019 Refinement (Highly decomposable wastes)
Soiled Paper	bulk, sector-specific	0.03	0.05	0.09	0.11	0.12	BC LFG Generation Estimation Tool, 2009 (assumed to be moderately decaying)	0.05	0.1	IPCC 2006 Guidelines, Moderately Degrading Waste (Other, non-food, organic putrescible), Boreal/Temperate	0.4	IPCC 2006 Guidelines, assumed to be same as paper	0.5	IPCC 2019 Refinement (moderately decomposable waste)
Wood	bulk, sector-specific	0.01	0.01	0.02	0.02	0.03	BC LFG Generation Estimation Tool, 2009 (assumed to be very slowly decaying)	0.02	0.03	IPCC 2006 Guidelines, Wood/Straw, Boreal/Temperate (Wet/Dry)	0.43	IPCC 2006 Guidelines	0.1	IPCC 2019 Refinement (less decomposable waste)
Textiles	bulk, sector-specific	0.01	0.02	0.04	0.06	0.07	BC LFG Generation Estimation Tool, 2009	0.04	0.06	IPCC 2006 Guidelines, Paper/Textiles, Boreal/Temperate (Wet/Dry)	0.24	IPCC 2006 Guidelines (60% assumed to be natural fiber)	0.5	IPCC 2019 Refinement (moderately decomposable waste)
Pet Waste	bulk, sector-specific	0.03	0.05	0.09	0.185	0.185	BC LFG Generation Estimation Tool, 2009 (Rapidly Decaying Waste); IPCC 2006 Guidelines, Boreal/Temperate (Wet)	0.06	0.185	IPCC 2006 Guidelines, Boreal/Temperate (Wet/Dry), Assumed to be rapidly degrading waste, same as sewage sludge)	0.24	ECCC Estimate	0.5	IPCC 2019 Refinement, ECCC estimate (assumed to be moderately decomposable waste)
Diapers and Sanitary	bulk, sector-specific	0.03	0.05	0.09	0.11	0.12	BC LFG Generation Estimation Tool, 2009 (assumed to be moderately decaying)	0.05	0.1	IPCC 2019 Guidelines, Excel model workbook	0.24	IPCC 2006 Guidelines	0.5	IPCC 2019 Refinement (moderately decomposable waste)
Rubber and Leather	bulk, sector-specific	0.01	0.01	0.02	0.02	0.03	BC LFG Generation Estimation Tool, 2009 (assumed to be very slowly decaying)	0.02	0.03	Assumed to be very slowly decaying waste	0.39	IPCC 2006 Guidelines	0.1	ECCC estimate (assumed to be less decomposable waste)
Other - Residential	sector-specific	0.03	0.05	0.09	0.11	0.12	BC LFG Generation Estimation Tool, 2009 (assumed to be moderately decaying)	0.05	0.09	IPCC 2019 refinement (Boreal/Temperate) (assumed to be similar to bulk waste/moderately degrading waste)	0.1	ECCC Estimate	0.5	IPCC 2006 guidelines (bulk waste, moderately decomposable waste)
Other - ICI	sector-specific	0.03	0.05	0.09	0.11	0.12	BC LFG Generation Estimation Tool, 2009 (assumed to be moderately decaying)	0.05	0.09	IPCC 2019 refinement (Boreal/Temperate) (assumed to be similar to bulk waste/moderately degrading waste)	0.05	ECCC Estimate	0.5	IPCC 2006 guidelines (bulk waste, moderately decomposable waste)
Other - Unknown	bulk	0.03	0.05	0.09	0.11	0.12	BC LFG Generation Estimation Tool, 2009 (assumed to be moderately decaying)	0.05	0.09	IPCC 2019 refinement (Boreal/Temperate) (assumed to be similar to bulk waste/moderately degrading waste)	0.05	ECCC Estimate	0.5	IPCC 2006 guidelines (bulk waste, moderately decomposable waste)
Sludge	bulk, sector-specific	0.03	0.05	0.09	0.185	0.185	BC LFG Generation Estimation Tool, 2009; IPCC 2006 Guidelines, Sewage Sludge, Boreal/Temperate (Wet)	0.06	0.185	IPCC 2006 Guidelines, Sewage Sludge, Boreal/Temperate (Wet/Dry)	0.05	IPCC 2019 refinement (untreated sludge with 10% solids, wet weight)	0.7	IPCC 2019 refinement, ECCC estimate (assumed to be highly decomposable waste)
Soil	bulk, sector-specific	0.01	0.01	0.02	0.02	0.03	BC LFG Generation Estimation Tool, 2009	0.02	0.03	Assumed to be very slowly decaying waste	0.03	ECCC estimate (estimated 3% carbon)	0.1	IPCC 2019 refinement, assumed to be less decomposable waste

Appendix A3 United States Environmental Protection Agency (US EPA) oxidation table reference for cover system capture

Conditions (C1 to C7)	CH_4 Oxidation Fraction
I. For all reporting years prior to 2013 reporting year	
C1. For all landfills regardless of cover type or methane flux	0.10
II. For 2013 reporting year and all subsequent years	
C2. For landfills that have a geomembrane (synthetic) cover or other non-soil barrier meeting the definition of final cover with less than 300 mm of cover soil for greater than 50% of the landfill area containing waste	0.0
C3. For landfills that do not meet the conditions in C2 above and for which you elect not to determine CH_4 flux	0.10
C4. For landfills that do not meet the conditions in C2 or C3 above and that do not have final cover, or intermediate or interim cover[a] for greater than 50% of the landfill area containing waste	0.10
C5. For landfills that do not meet the conditions in C2 or C3 above and that have final cover, or intermediate or interim cover[a] for greater than 50% of the landfill area containing waste and for which the CH_4 flux rate[b] is less than 10 grams per square meter per day ($g/m^2/d$)	0.35
C6. For landfills that do not meet the conditions in C2 or C3 above and that have final cover or intermediate or interim cover[a] for greater than 50% of the landfill area containing waste and for which the CH_4 flux rate[b] is 10 to 70 $g/m^2/d$	0.25
C7: For landfills that do not meet the conditions in C2 or C3 above and that have final cover or intermediate or interim cover[a] for greater than 50% of the landfill area containing waste and for which the CH_4 flux rate[b] is greater than 70 $g/m^2/d$	0.1

[a] Where a landfill is located in a state that does not have an intermediate or interim cover requirement, the landfill must have soil cover of 12 inches (300 mm) or greater in order to use an oxidation fraction of 0.25 or 0.35.

[b] Methane flux rate (in grams per square meter per day; $g/m^2/d$) is the mass flow rate of methane per unit area at the bottom of the surface soil prior to any oxidation and is calculated as follows:

For Equation HH-5 of this subpart, or for Equation TT-6 of subpart TT of this part,

$$\mathrm{MF} = K \times G_{\mathrm{CH\,4}} / \mathrm{SArea}$$

For Equation HH-6 of this subpart,

$$\mathrm{MF} = K \times \left(G_{\mathrm{CH\,4}} - \sum_{n-1}^{N} R_n\right) / \mathrm{SArea}$$

For Equations HH-7 pf this subpart,

$$\mathrm{MF} = K \times \left(\frac{1}{\mathrm{CE}} \sum_{n-1}^{N} \left[\frac{R_n}{f_{\mathrm{Rec},n}}\right]\right) / \mathrm{SArea}$$

For Equation HH-8 of this subpart,

$$\mathrm{MF} = K \times \left(\frac{1}{\mathrm{CE}} \left\{\sum_{n-1}^{N} \left[\frac{R_n}{f_{\mathrm{Rec},n}}\right]\right\} - \sum_{n-1}^{N} R_n\right) / \mathrm{SArea}$$

Where:

MF = Methane flux rate from the landfill in the reporting year ($g/m^2/d$).

K = unit conversion factor = $10^6/365$ (g/metric ton per days/year) or $10^6/366$ for a leap year.

SArea = The surface area of the landfill containing waste at the beginning of the reporting year (m^2).

G_{CH4} = Modeled methane generation rate in reporting year from Equation HH-1 of this subpart or Equation TT-1 of subpart TT of this part, as applicable, except for application with Equation HH-6 of this subpart (metric tons CH_4). For application with Equation HH-6 of this subpart, the greater of the modeled methane generation rate in reporting year from Equation HH-1 of this subpart or Equation TT-1 of this part, as applicable, and the quantity of recovered CH_4 from Equation HH-4 of this subpart (metric tons CH4).

CE = Collection efficiency estimated at landfill, taking into account system coverage, operation, and cover system materials from Table HH-3 of this subpart. If area by soil cover type information is not available, use default value of 0.75 (CE4 in table HH-3 of this subpart) for all areas under active influence of the collection system.

N = Number of landfill gas measurement locations (associated with a destruction device or gas sent off-site). If a single monitoring location is used to monitor volumetric flow and CH_4 concentration of the recovered gas sent to one or multiple destruction devices, then N = 1.

R^n = Quantity of recovered CH_4 from Equation HH-4 of this subpart for the nth measurement location (metric tons).

$f^{Rec,n}$ = Fraction of hours the recovery system associated with the nth measurement location was operating (annual operating hours/8760 hours per year or annual operating hours/8784 hours per year for a leap year).

APPENDIX B

Landfill Gas (LFG) Collection Data

Appendix B Landfill Gas (LFG) Collection Data

Year	Month	Average methane (CH4)	Wagabox			Flare			Total (Nm3) [Waga+Flare]		
			Wagabox (Nm3)	Avg Wagabox Flow (Nm3/hr)	Wagabox Operating Hours	Flare (Nm3)	Avg Flare Flow (Nm3/hr)	Flare Operating Hours	Total (Nm3)	Avg Total Flow (Nm3/hr)	Normalized Flow (Nm^3/hr @ 50% CH_4)
2025	January*	46.3				990,325	1376	744	990,325	1376	1275
2025	February*	49.2				1,132,704	1573	672	1,132,704	1573	1548
2025	March*	45.5				1,256,140	1745	744	1,256,140	1745	1588
2025	April+	45.5							1,024,112	1422	1294
2025	May+	45.9							1,353,250	1819	1670
2025	June	46.2	1532837	2149	713	5,060	1797	3	1,537,897	2136	1973
2025	July	46.3	1585783	2139	741	0	-	0	1,585,782	2131	1974
2025	August	45.2	1448834	2088	694	90,031	1963	46	1,538,865	2068	1870
2025	September	45.3	1479566	2063	717	2,012	1979	1	1,481,578	2058	1864
2025	October	45.0	1435483	1951	736	191	1910	0	1,435,674	1930	1735
2025	November	45.0	1311409	1838	713	379	1420	0	1,311,788	1822	1639
2025	December	44.5	1339671	1901	705	28,453	1882	15	1,368,124	1839	1636
AVERAGE		**45.8**	**1,447,655**	**2018**		**350,530**	**1738**		**1,334,687**	**1827**	**1672**
TOTAL			**10,133,583**		**5,019**	**3,505,295**		**2,225**	**16,016,239**		

* LFG was flared during the months of January to March 2025 prior to commissioning Wagabox

+ April and May are commissioning months with partial data available

APPENDIX C

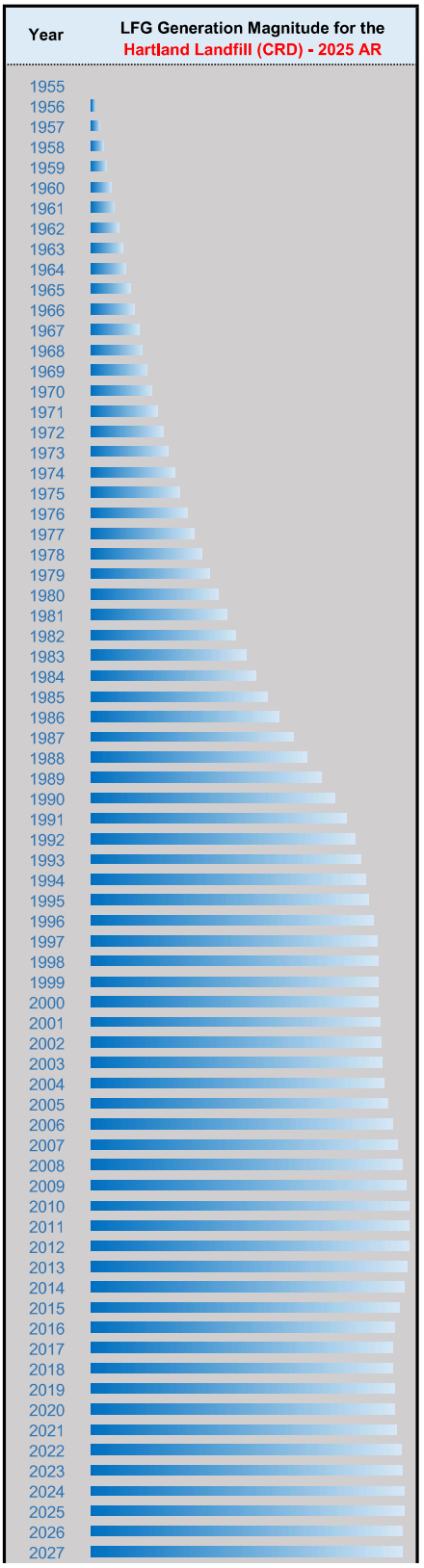
Projected Methane Generation Estimates

Methane Generation Estimates from the Hartland Landfill (CRD) - 2025 AR

Actual CH_4 Yields

L_o (m^3/tonne)	131	163	147	70	117	105	76.9

Year	Methane generation estimates for the Hartland Landfill (CRD) - 2025 AR							Methane Generation Potential	Total LFG Flow Rate Estimated
	Food (tonnes)	Garden (tonnes)	Paper (tonnes)	Wood (tonnes)	Textile (tonnes)	Nappies (tonnes)	Total (tonnes)	(L_o, m^3/tonne)	(scfm)
1955	5	1	1	0	0	0	9	81.3	2
1956	65	12	18	5	5	3	109	81.3	22
1957	120	23	36	9	10	6	204	81.3	42
1958	172	35	53	13	15	10	297	81.3	61
1959	221	46	71	18	20	13	388	81.3	80
1960	267	57	89	23	26	16	478	81.3	98
1961	313	68	108	28	31	20	568	81.3	116
1962	357	79	128	33	37	23	657	81.3	135
1963	401	91	148	39	42	27	748	81.3	153
1964	445	103	169	45	48	31	840	81.3	172
1965	489	115	191	51	54	35	934	81.3	191
1966	534	128	213	57	61	39	1,031	81.3	211
1967	580	141	237	64	68	43	1,132	81.3	232
1968	628	154	261	71	75	47	1,236	81.3	253
1969	677	168	287	78	82	52	1,344	81.3	275
1970	728	183	314	86	90	57	1,457	81.3	299
1971	782	198	342	94	98	62	1,576	81.3	323
1972	838	214	372	103	106	67	1,701	81.3	349
1973	897	231	404	112	115	73	1,832	81.3	375
1974	959	248	437	122	125	79	1,970	81.3	404
1975	1,025	267	472	132	135	85	2,116	81.3	434
1976	1,095	286	509	143	145	92	2,270	81.3	465
1977	1,168	307	547	154	156	99	2,433	81.3	499
1978	1,246	329	589	167	168	107	2,605	81.3	534
1979	1,329	352	632	179	181	115	2,788	81.3	571
1980	1,417	377	678	193	194	123	2,982	81.3	611
1981	1,511	403	727	208	208	132	3,188	81.3	653
1982	1,610	430	779	223	223	141	3,407	81.3	698
1983	1,716	460	834	239	238	151	3,639	81.3	746
1984	1,828	491	893	257	255	162	3,885	81.3	796
1985	1,948	524	954	275	273	173	4,147	81.3	850
1986	2,076	559	1,021	295	292	185	4,427	81.3	907
1987	2,226	599	1,094	317	313	198	4,747	81.3	973
1988	2,380	641	1,172	340	335	212	5,080	81.3	1,041
1989	2,530	682	1,250	363	357	227	5,409	81.3	1,109
1990	2,669	723	1,328	386	380	241	5,726	81.3	1,173
1991	2,783	759	1,400	409	400	254	6,004	81.3	1,231
1992	2,850	787	1,460	428	417	265	6,207	81.3	1,272
1993	2,875	806	1,508	445	431	273	6,339	81.3	1,299
1994	2,889	822	1,551	461	443	281	6,448	81.3	1,322
1995	2,895	836	1,591	476	455	288	6,540	81.3	1,340
1996	2,908	851	1,631	490	466	295	6,641	81.3	1,361
1997	2,911	862	1,666	504	476	302	6,722	81.3	1,378
1998	2,892	869	1,694	516	484	307	6,763	81.3	1,386
1999	2,849	870	1,713	526	489	310	6,758	81.3	1,385
2000	2,813	872	1,731	536	495	314	6,760	81.3	1,385
2001	2,791	874	1,751	546	500	317	6,779	81.3	1,389
2002	2,765	876	1,768	555	505	320	6,788	81.3	1,391
2003	2,761	881	1,789	565	511	324	6,831	81.3	1,400
2004	2,764	886	1,811	575	518	328	6,882	81.3	1,410
2005	2,783	894	1,836	586	525	333	6,957	81.3	1,426
2006	2,821	906	1,867	598	533	338	7,064	81.3	1,448
2007	2,864	919	1,899	611	543	344	7,179	81.3	1,471
2008	2,918	934	1,934	624	553	350	7,313	81.3	1,499
2009	2,945	944	1,962	636	561	355	7,402	81.3	1,517
2010	2,952	950	1,984	646	567	359	7,459	81.3	1,529
2011	2,935	952	1,998	655	571	362	7,473	81.3	1,532
2012	2,900	949	2,006	661	573	363	7,454	81.3	1,528
2013	2,851	943	2,008	667	574	364	7,407	81.3	1,518
2014	2,794	933	2,006	671	574	365	7,342	78.6	1,505
2015	2,716	899	1,996	677	572	378	7,237	78.6	1,483
2016	2,639	863	1,982	682	570	396	7,133	75.9	1,462
2017	2,611	814	1,984	696	575	417	7,098	75.9	1,455
2018	2,604	770	1,990	711	580	440	7,097	75.9	1,454
2019	2,610	730	2,000	728	587	464	7,119	76.0	1,459
2020	2,618	694	2,010	743	594	490	7,149	76.3	1,465
2021	2,599	659	2,019	758	599	529	7,164	76.9	1,468
2022	2,621	633	2,042	779	610	588	7,272	69.8	1,490
2023	2,554	630	2,064	807	618	636	7,308	70.4	1,498
2024	2,500	628	2,086	834	626	690	7,363	70.5	1,509
2025	2,416	620	2,092	855	629	739	7,351	70.4	1,507
2026	2,329	611	2,091	872	630	780	7,313	70.4	1,499
2027	2,257	603	2,092	889	631	820	7,291	70.4	1,494



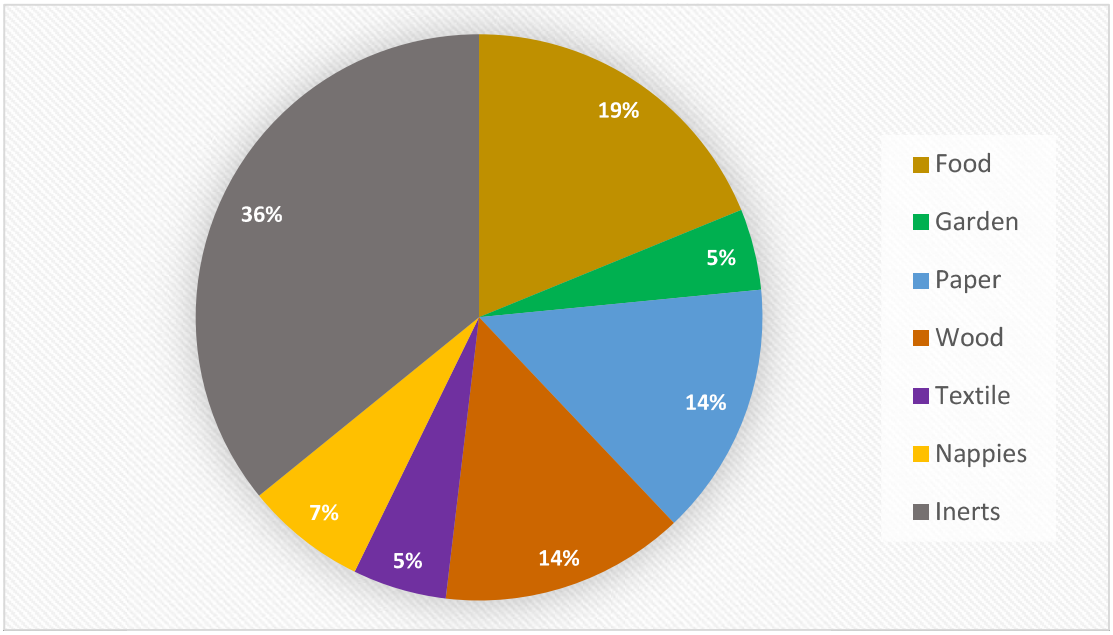
Year	Methane generation estimates for the Hartland Landfill (CRD) - 2025 AR							Methane Generation Potential	Total LFG Flow Rate Estimated
	Food (tonnes)	Garden (tonnes)	Paper (tonnes)	Wood (tonnes)	Textile (tonnes)	Nappies (tonnes)	Total (tonnes)	(L_o, m^3/tonne)	(scfm)
2028	2,198	596	2,093	906	632	859	7,283	70.4	1,493
2029	2,149	589	2,096	923	634	896	7,288	70.4	1,494
2030	2,110	584	2,100	940	636	933	7,303	70.4	1,497
2031	2,080	580	2,104	957	638	969	7,328	70.4	1,502
2032	2,057	576	2,110	974	641	1,004	7,361	70.4	1,509
2033	2,039	573	2,117	991	644	1,038	7,401	70.4	1,517
2034	2,027	571	2,124	1,008	647	1,071	7,448	70.4	1,526
2035	2,020	569	2,132	1,025	650	1,104	7,501	70.4	1,537
2036	2,017	568	2,141	1,042	653	1,136	7,558	70.4	1,549
2037	1,992	564	2,141	1,055	654	1,160	7,566		1,551
2038	1,715	521	2,037	1,023	622	1,104	7,021		1,439
2039	1,476	481	1,938	993	592	1,050	6,529		1,338
2040	1,270	444	1,843	964	563	999	6,082		1,247
2041	1,093	410	1,753	935	535	950	5,677		1,163
2042	941	378	1,668	908	509	904	5,307		1,088
2043	810	349	1,586	881	484	859	4,970		1,019
2044	697	322	1,509	855	461	818	4,662		955
2045	600	297	1,435	830	438	778	4,378		897
2046	516	275	1,365	805	417	740	4,118		844
2047	445	253	1,299	781	397	704	3,878		795
2048	383	234	1,236	758	377	669	3,657		749
2049	329	216	1,175	736	359	637	3,452		707
2050	283	199	1,118	714	341	606	3,262		668
2051	244	184	1,063	693	325	576	3,085		632
2052	210	170	1,012	672	309	548	2,921		599
2053	181	157	962	653	294	521	2,767		567
2054	156	145	915	633	279	496	2,624		538
2055	134	134	871	615	266	472	2,490		510
2056	115	123	828	596	253	449	2,365		485
2057	99	114	788	579	241	427	2,247		460
2058	85	105	749	562	229	406	2,136		438
2059	73	97	713	545	218	386	2,032		416
2060	63	90	678	529	207	367	1,934		396
2061	54	83	645	513	197	349	1,842		377
2062	47	76	614	498	187	332	1,755		360
2063	40	70	584	483	178	316	1,672		343
2064	35	65	555	469	170	301	1,594		327
2065	30	60	528	455	161	286	1,521		312
2066	26	55	502	442	153	272	1,451		297
2067	22	51	478	429	146	259	1,385		284
2068	19	47	455	416	139	246	1,322		271
2069	16	44	432	404	132	234	1,262		259
2070	14	40	411	392	126	223	1,206		247
2071	12	37	391	380	119	212	1,152		236
2072	10	34	372	369	114	202	1,101		226
2073	9	32	354	358	108	192	1,053		216
2074	8	29	337	348	103	182	1,006		206
2075	7	27	320	337	98	174	963		197
2076	6	25	305	327	93	165	921		189
2077	5	23	290	318	88	157	881		181
2078	4	21	276	308	84	149	843		173
2079	4	20	262	299	80	142	807		165
2080	3	18	249	290	76	135	772		158
2081	3	17	237	282	72	129	739		152
2082	2	15	226	273	69	122	708		145
2083	2	14	215	265	66	116	678		139
2084	2	13	204	257	62	111	650		133
2085	1	12	194	250	59	105	622		128
2086	1	11	185	242	56	100	596		122
2087	1	10	176	235	54	95	571		117
2088	1	10	167	228	51	91	548		112
2089	1	9	159	222	49	86	525		108
2090	1	8	151	215	46	82	503		103
2091	1	8	144	209	44	78	483		99
2092	1	7	137	203	42	74	463		95
2093	0	6	130	197	40	71	444		91
2094	0	6	124	191	38	67	426		87
2095	0	5	118	185	36	64	409		84
2096	0	5	112	180	34	61	392		80
2097	0	5	107	174	33	58	376		77
2098	0	4	101	169	31	55	361		74
2099	0	4	96	164	29	52	346		71
2100	0	4	92	159	28	50	333		68
2101	0	3	87	155	27	47	319		65
2102	0	3	83	150	25	45	307		63
2103	0	3	79	146	24	43	294		60
2104	0	3	75	141	23	41	283		58
2105	0	2	71	137	22	39	272		56

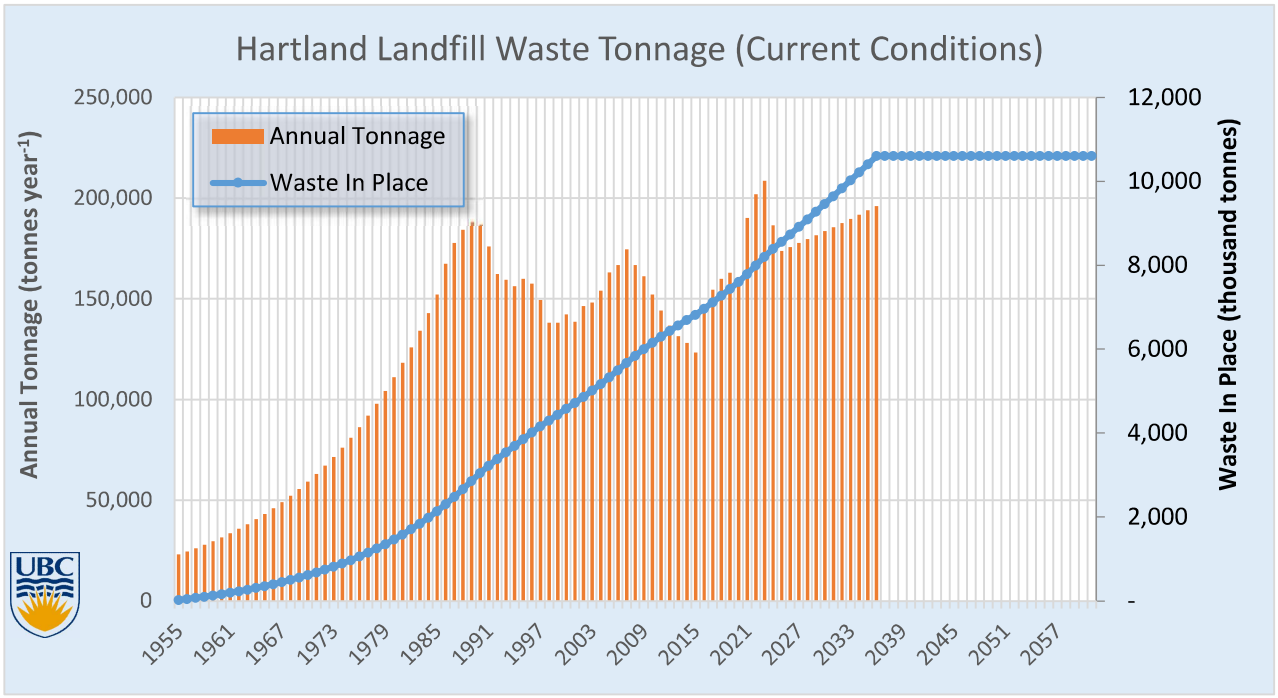
Year	LFG Generation Magnitude for the Hartland Landfill (CRD) - 2025 AR
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Hartland Landfill (CRD) - 2025 AR

Landfill Gas Generation Analysis **GRAPHICAL RESULTS**

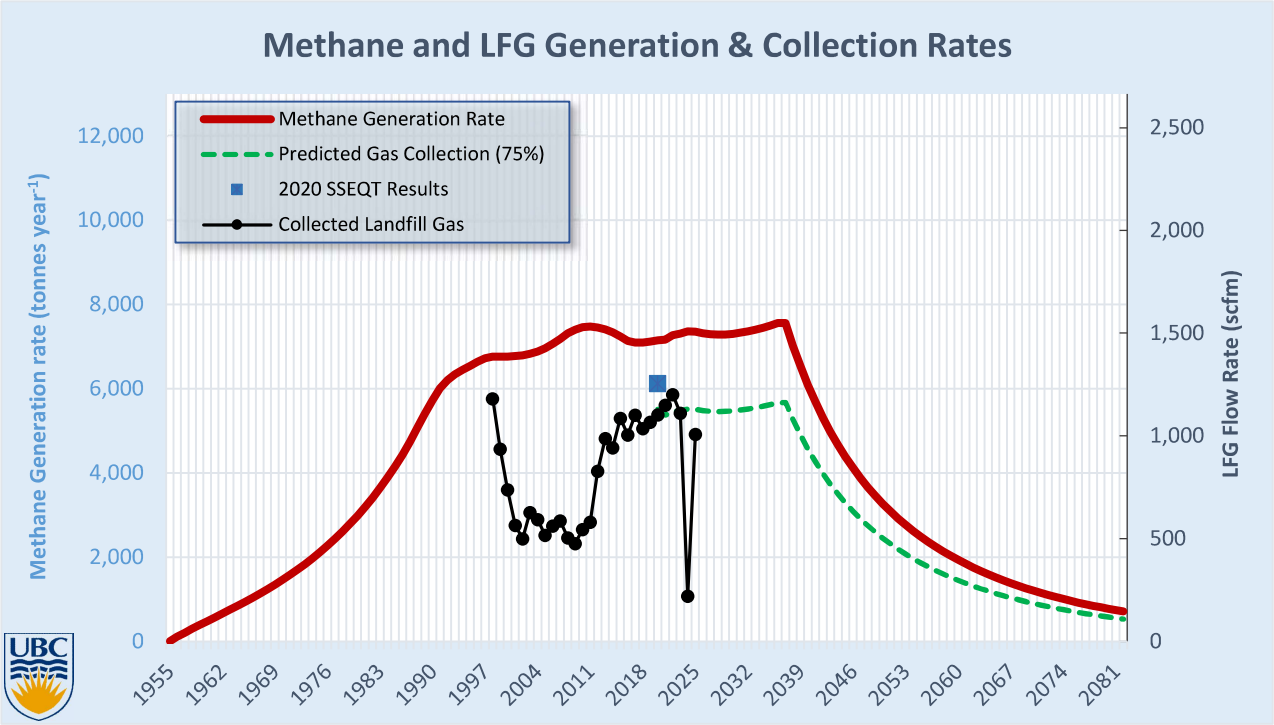
Average (Lifespan) Waste Composition

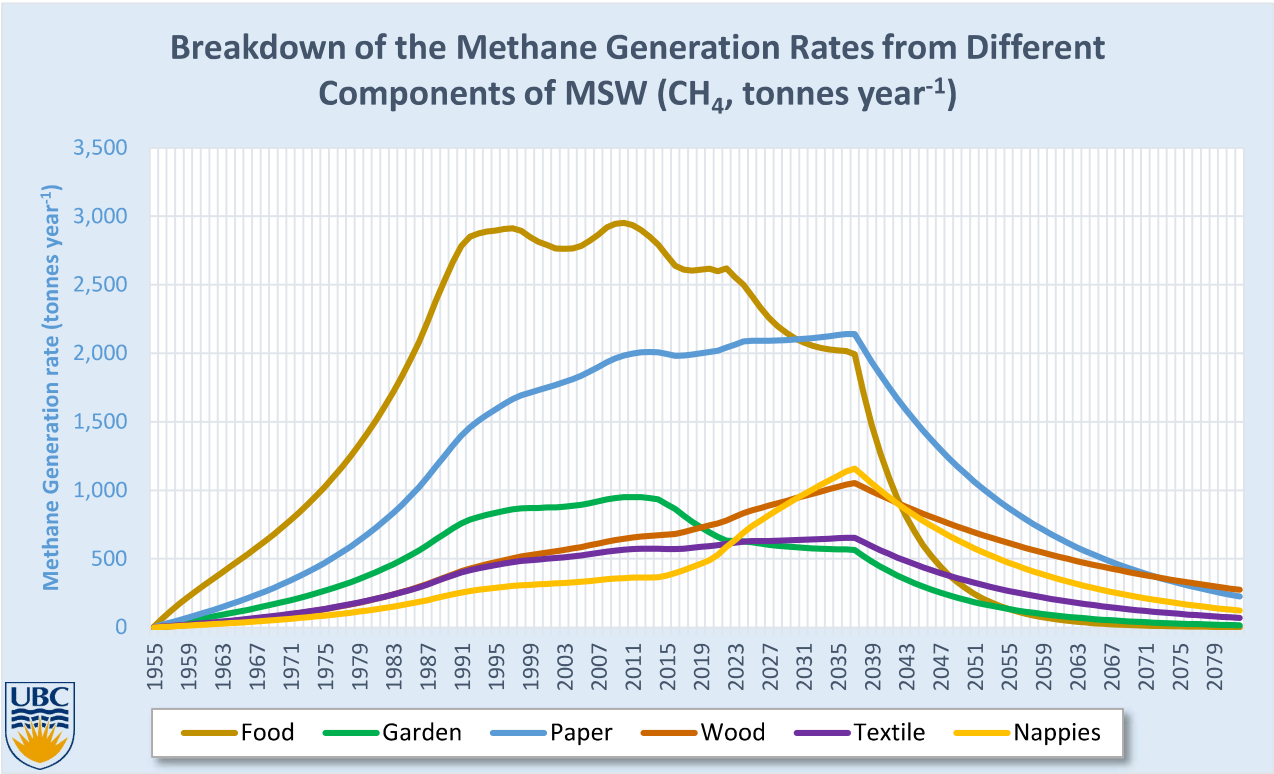




Hartland Landfill (CRD) - 2025 AR

Landfill Gas Generation Analysis **GRAPHICAL RESULTS**





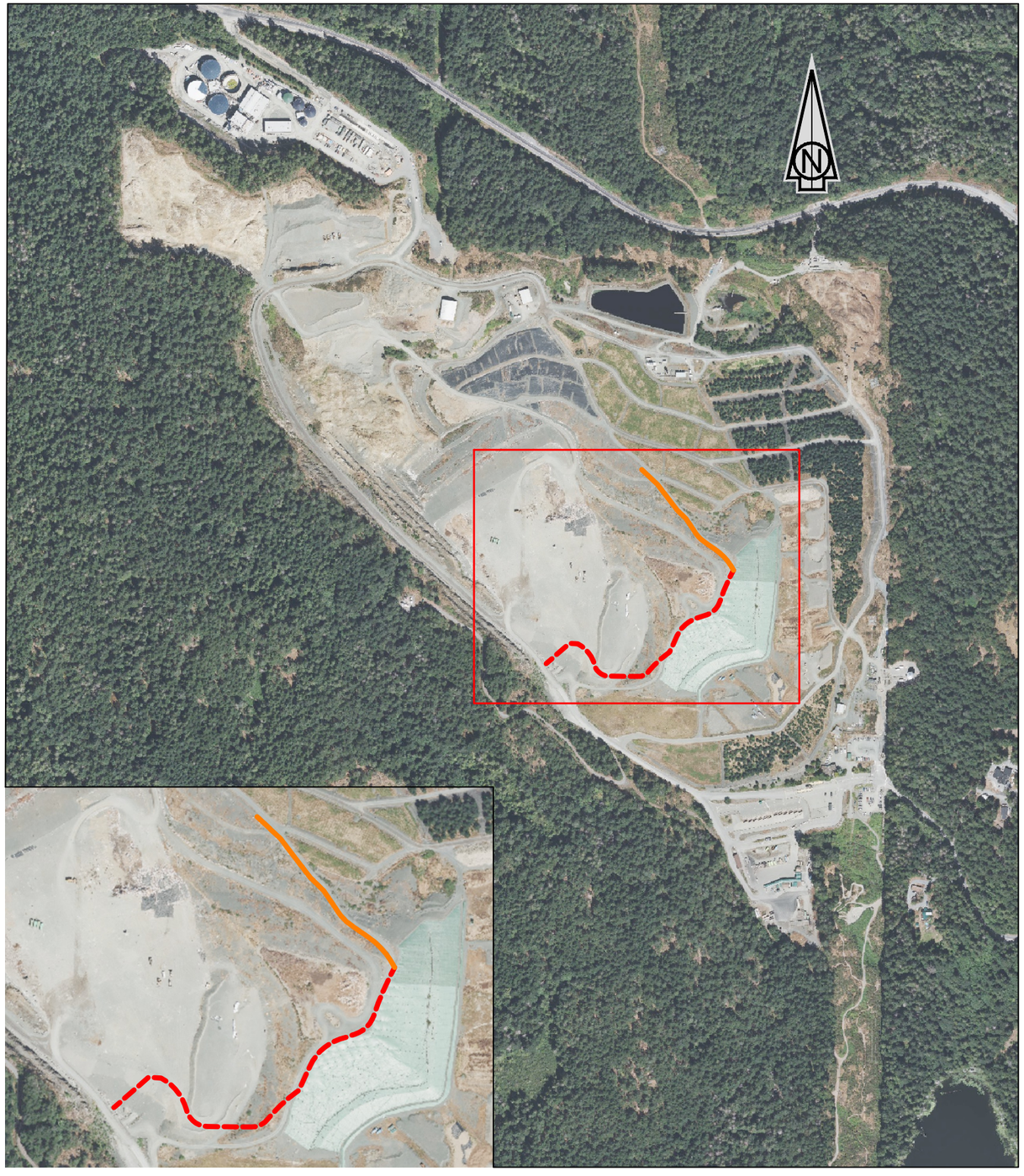
APPENDIX D

Draft Landfill Gas Engineering Designs

D1 Draft Landfill Gas Design Cell 3 New Header

D2 Draft Landfill Gas Design for Cell 4

Appendix D1 Draft Landfill Gas Design Cell 3 New Header



HARTLAND LANDFILL - CELL 3 LFG HEADER UPGRADE

Sheet No.	DWG No.	Rev. No.	Sheet Title
00	PRJ23001-00	0	COVER SHEET
01	PRJ23001-01	0	PLAN VIEW
02	PRJ23001-02	0	PROFILE VIEW
03	PRJ23001-03	0	DETAILS
04	PRJ23001-04	0	DETAILS
05	PRJ23001-05	0	DETAILS
06	PRJ23001-06	0	DETAILS
07	PRJ23001-07	0	DETAILS

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55509
2024-08-06

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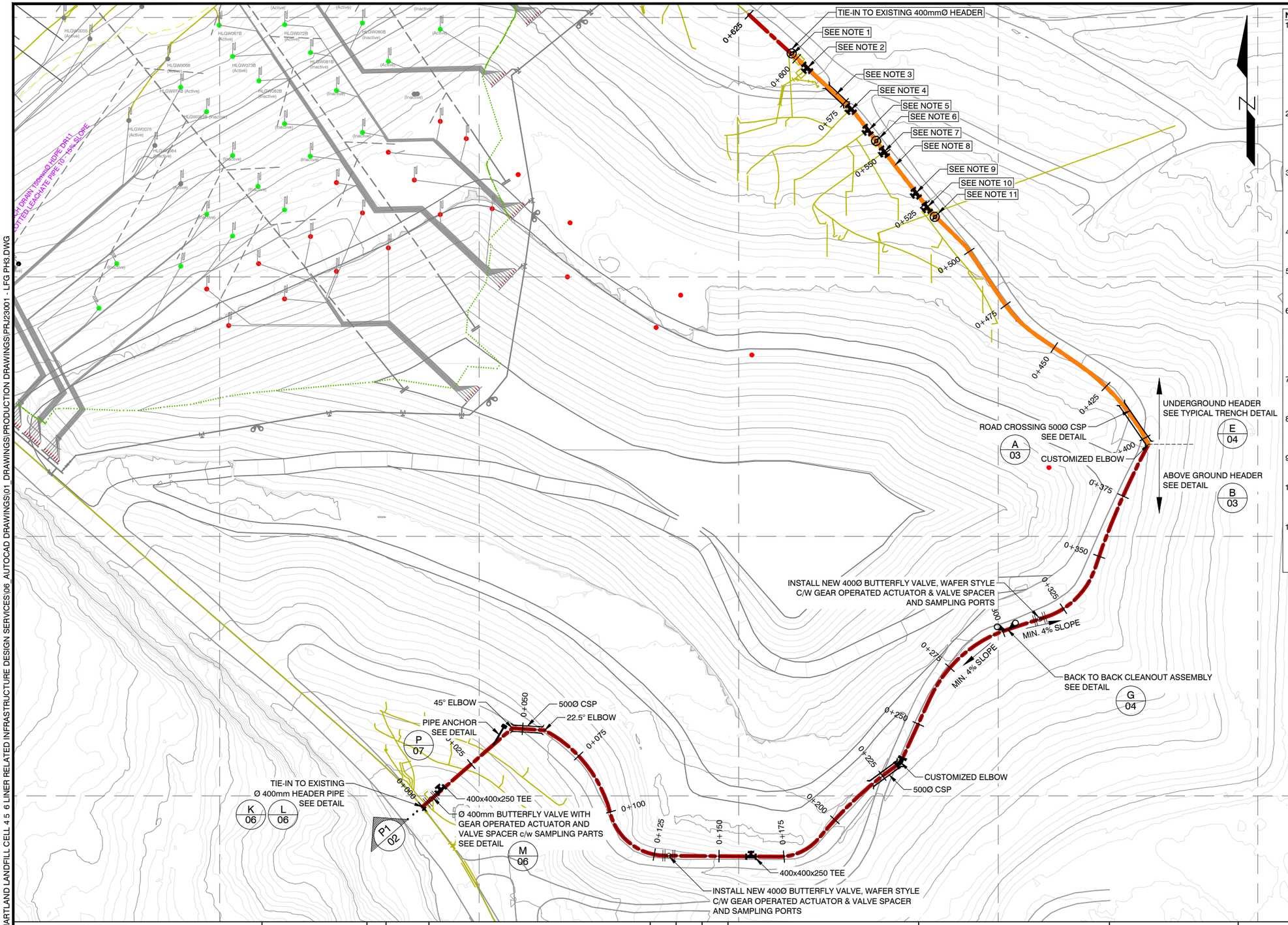
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DESIGN BY:	A.ABEDINI	SHA PROJECT # PRJ 23001	CELL 3 LANDFILL GAS HEADER UPGRADE
DRAWN BY:	L.BOBARIU	VERTICAL SCALE: NTS	**COVER SHEET**
CHECKED BY:	T.SPERLING	HORIZONTAL SCALE: NTS	
APPROVED BY:	A.ABEDINI	C.R.D. CONTRACT# 30.22.06-03	

ADJUST SCALE 50% FOR 34"x22" SHEET

DRAWING NO:	REV	SHEET
PRJ23001-00	0	00

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NOTES:

1. REMOVE 400ØF x 300ØF HDPE REDUCER ASSEMBLY. RELOCATE EXISTING VALVE CHAMBER AS SHOWN. INSTALL NEW 400Ø BUTTERFLY VALVE, WAFER STYLE C/W GEAR OPERATED ACTUATOR & VALVE SPACER AND SAMPLING PORTS (EACH SIDE OF VALVE). CONNECT NEW 400Ø DR17 HDPE GAS HEADER AS REQUIRED.
   SEE DETAIL H 05
2. REMOVE 300ØPE x 300ØPE x 150ØF TEE. INSTALL NEW 400ØPE x 400ØPE x 150ØF TEE
   ADJUST INVERT FOR 150Ø TEE CONNECTION.
   SEE DETAIL C 04 D 04
3. REMOVE EXISTING 400Ø CSP. INSTALL NEW 500Ø CSP FOR NEW 400Ø HDPE GAS HEADER. LENGTH TO SUIT. MAINTAIN INVERT ELEVATION TO MATCH EXISTING. BUILD UP ROAD SURFACE MATERIAL TO ENSURE 300mm MIN. COVER ABOVE NEW CSP. COMPACTION AS REQUIRED.
4. REMOVE 300ØPE x 300ØPE x 150ØF TEE. INSTALL NEW 400ØPE x 400ØPE x 150ØF TEE
   ADJUST INVERT FOR 150Ø TEE CONNECTION
5. REMOVE 300ØPE x 300ØPE x 150ØF TEE. INSTALL NEW 400ØPE x 400ØPE x 150ØF TEE
   ADJUST INVERT FOR 150Ø TEE CONNECTION
6. REMOVE EXIST. 300Ø BUTTERFLY VALVE. INSTALL NEW 400Ø BUTTERFLY VALVE, WAFER STYLE C/W GEAR OPERATED ACTUATOR & VALVE SPACER AND SAMPLING PORTS (EACH SIDE OF VALVE).
   SEE DETAIL H 05
7. REMOVE 300ØPE x 300ØPE x 150ØF TEE. INSTALL NEW 400ØPE x 400ØPE x 150ØF TEE
   ADJUST INVERT FOR 150Ø TEE CONNECTION
8. REMOVE EXISTING G-300Ø HDPE. REPLACE WITH G-400Ø DR17 HDPE. MAINTAIN INVERT ELEVATION OF OUTGOING EXISTING PIPE AND MINIMUM COVER WHERE REQUIRED
9. INSTALL NEW 400Ø x 400Ø x 250Ø HDPE TEE c/w 250Ø FLANGE ADAPTER AND BLIND FLANGE
10. REMOVE 300ØPE x 300ØPE x 150ØF TEE. INSTALL NEW 400ØPE x 400ØPE x 150ØF TEE
    ADJUST INVERT FOR 150Ø TEE CONNECTION
11. REMOVE EXISTING BLIND FLANGE AND 300Ø VALVE IN CHAMBER. INSTALL NEW 400Ø BUTTERFLY VALVE, WAFER STYLE C/W GEAR OPERATED ACTUATOR & VALVE SPACER AND SAMPLING PORTS (EACH SIDE OF VALVE). CONNECT NEW 400Ø HDPE DR17 GAS PIPE

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- Environmental Monitoring

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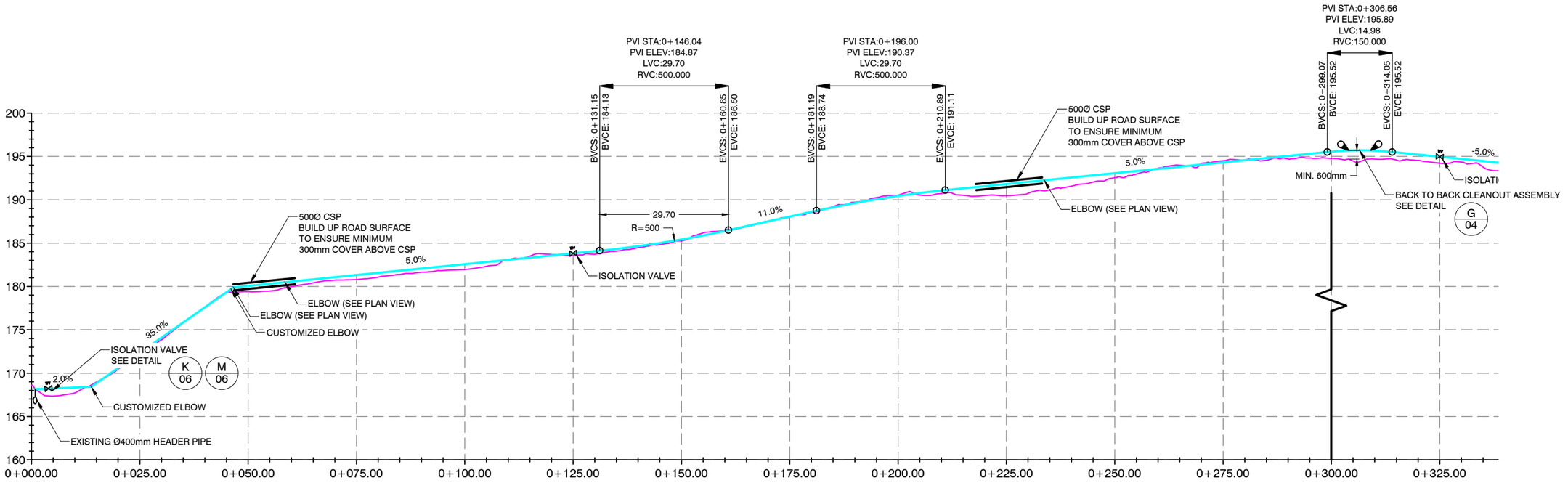
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DRAWN BY:	L.BOBARIU	VERTICAL SCALE:	1:1500
CHECKED BY:	T.SPERLING	HORIZONTAL SCALE:	1:1500
APPROVED BY:	A.ABEDINI	C.R.D. CONTRACT#	30.22.06-03

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CELL 3 LANDFILL GAS HEADER UPGRADE

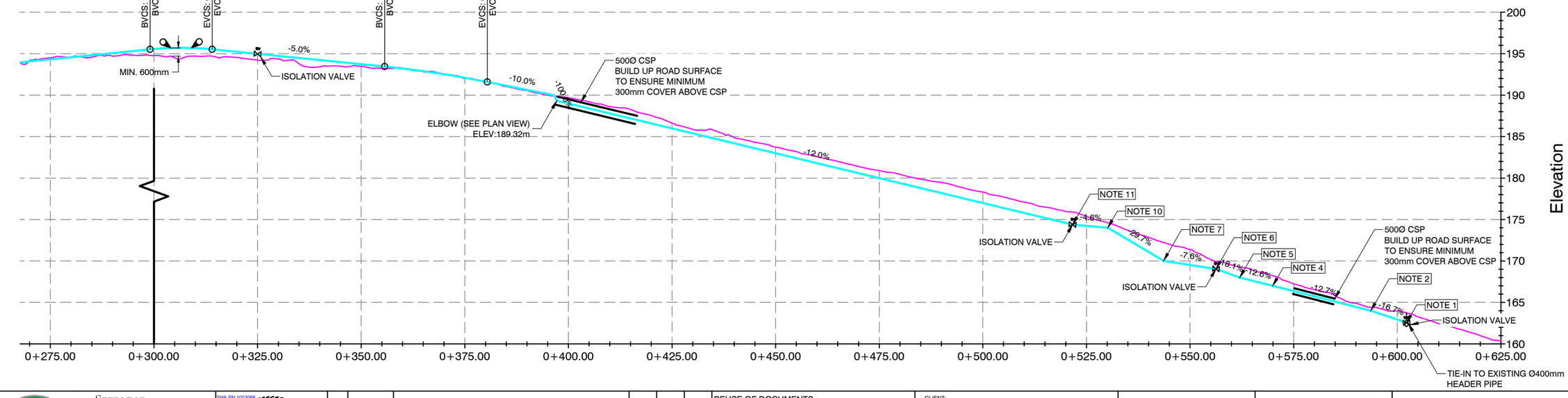
PLAN VIEW

DRAWING NO:	REV	SHEET
PRJ23001-01	0	01



PROFILE
H - 1:1000
V - 1:500

P1
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55509
2024-08-05

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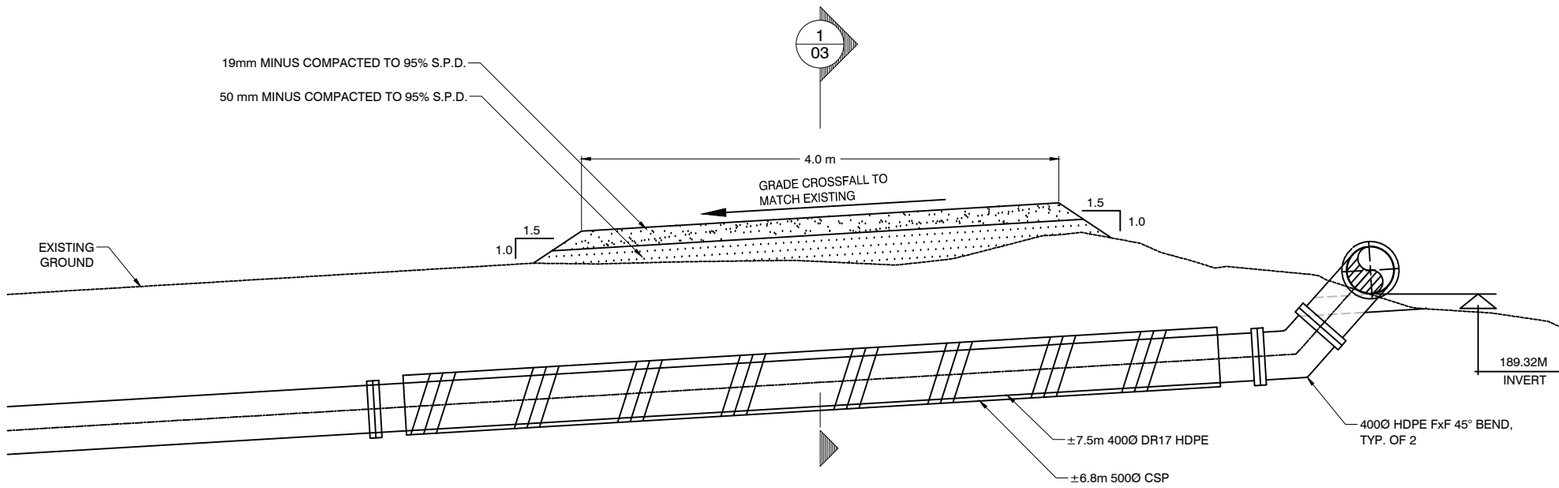
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DRAWN BY:	L.BOBARIU	HORIZONTAL SCALE: 1:500	**PROFILE VIEW**
CHECKED BY:	T.SPERLING	HORIZONTAL SCALE: 1:1000	
APPROVED BY:	A.ABEDINI	C.R.D. CONTRACT# 30.22.06-03	DRAWING NO: PRJ23001-02 / REV: 0 / SHEET: 02

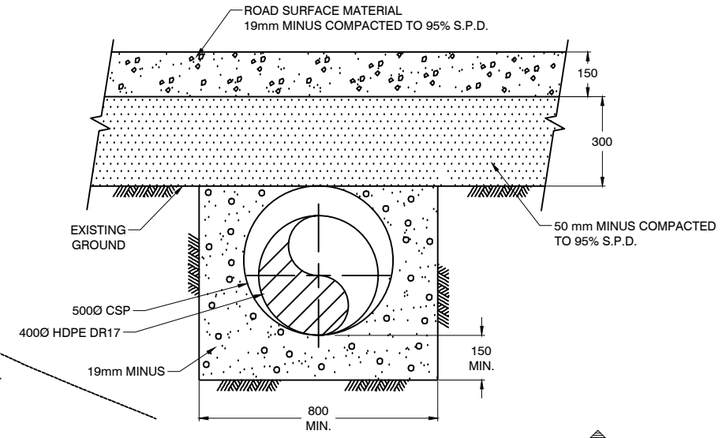
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GAS PIPE ROAD CROSSING DETAIL

SCALE 1:50

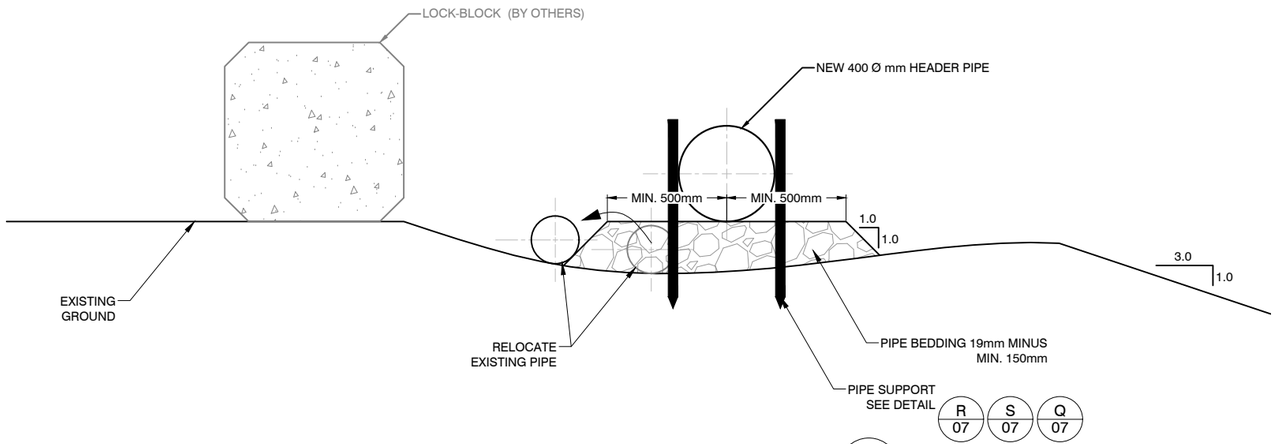
A
01



CULVERT CROSSING ROAD SECTION

SCALE 1:20

1
03



ABOVE GROUND GAS PIPE BEDDING DETAIL

SCALE 1:25

B
01

NOTES:

1. ALL PVC PIPE SHALL BE SCHEDULE 80 UNLESS NOTED OTHERWISE.
2. ALL HDPE PIPE SHALL BE SDR 17.0 UNLESS NOTED OTHERWISE.
3. HDPE PIPE JOINT SHALL BE THERMAL BUTT FUSION WELDED UNLESS NOTED OTHERWISE. ELECTRO-FUSION FITTINGS & FLANGES ARE NOT ALLOWED UNLESS NOTED OTHERWISE OR AUTHORIZED BY OWNER.
4. DEPTH OF PIPE VARIES, SEE PROFILE DRAWINGS. MINIMUM SOIL COVER OVER TOP OF PIPE 600 mm.
5. NEW HEADER PIPE TO BE SLOPED MINIMUM 5%, IF NEEDED, SOIL BERM TO BE ESTABLISHED FOR THE ABOVEGROUND SECTION OF THE HEADER.

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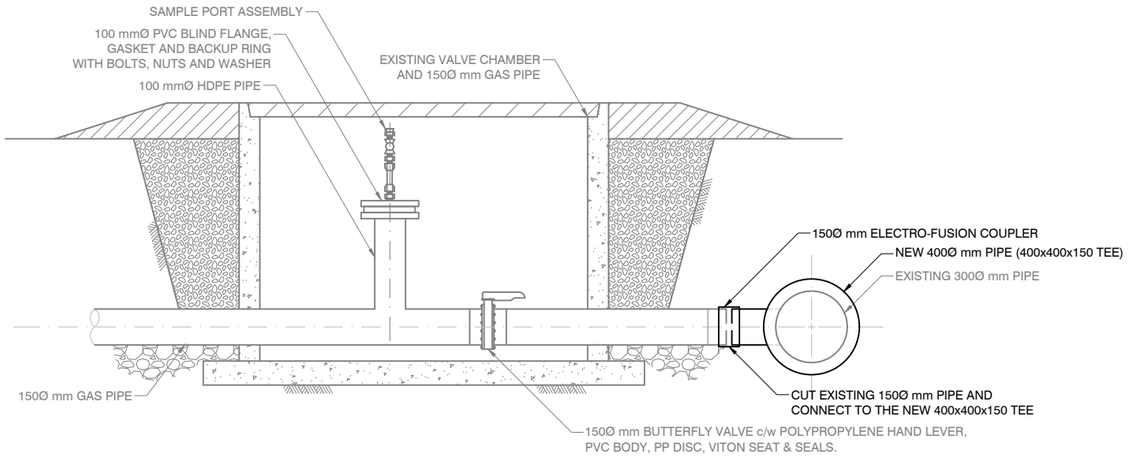
Capital Regional District | Parks & Environmental Services

DESIGN BY:	AA	SHA PROJECT # PRJ 23001	CELL 3 LANDFILL GAS HEADER UPGRADE
DRAWN BY:	NL		DETAILS
CHECKED BY:	AA	HORIZONTAL SCALE: AS SHOWN	
APPROVED BY:	TS	C.R.D. CONTRACT# 30.22.06-03	

ADJUST SCALE 50% FOR 34"x22" SHEET

DRAWING NO:	REV	SHEET
PRJ23001-03	0	03

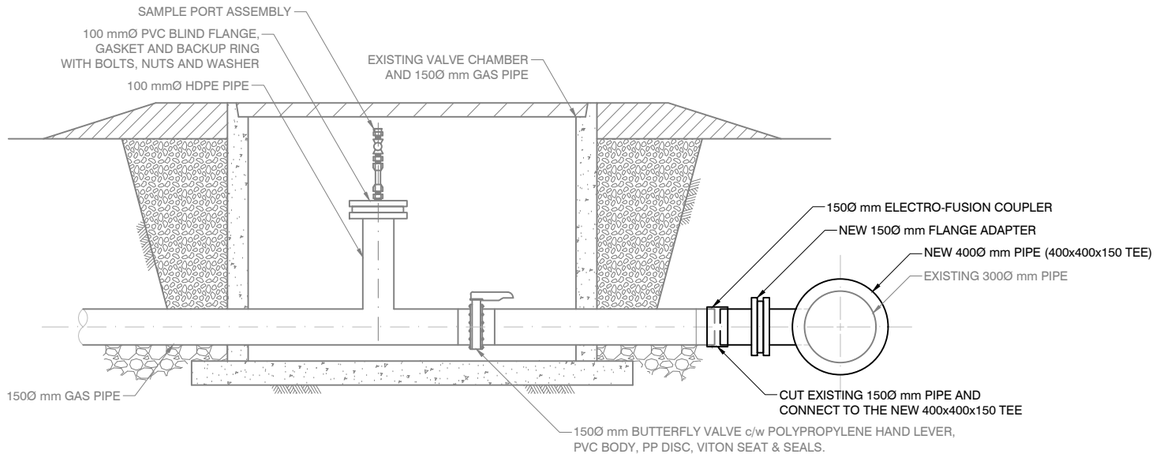
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NEW UNDER GROUND HEADER TIE-IN TO EXISTING 150Ø GAS PIPES - OPTION 1

C / 01

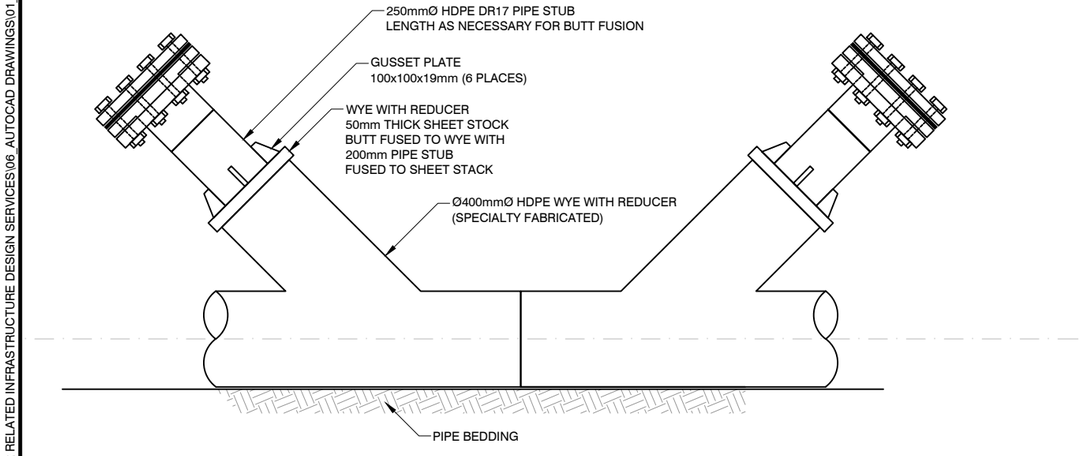
SCALE 1:25



NEW UNDER GROUND HEADER TIE-IN TO EXISTING 150Ø GAS PIPES - OPTION 2

D / 01

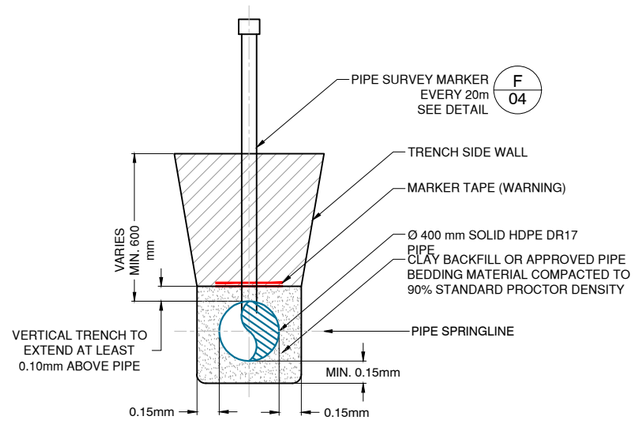
SCALE 1:25



ABOVE GROUND BACK TO BACK CLEAN OUT DETAIL

G / 01 G / 02

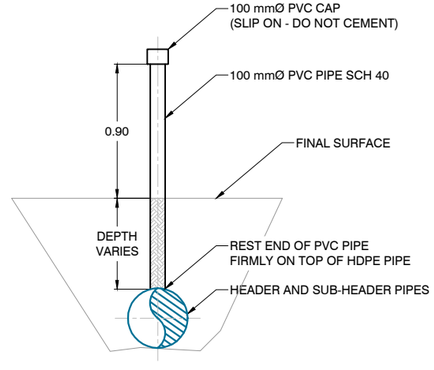
SCALE 1:40



TYPICAL LFG SUBHEADER PIPE TRENCH

E / 01

SCALE 1:40



PIPE SURVEY MARKER

F / 04

SCALE 1:40

NOTES:

1. ALL PVC PIPE SHALL BE SCHEDULE 80 UNLESS NOTED OTHERWISE.
2. ALL HDPE PIPE SHALL BE SDR 17.0 UNLESS NOTED OTHERWISE.
3. HDPE PIPE JOINT SHALL BE THERMAL BUTT FUSION WELDED UNLESS NOTED OTHERWISE. ELECTRO-FUSION FITTINGS & FLANGES ARE NOT ALLOWED UNLESS NOTED OTHERWISE OR AUTHORIZED BY OWNER.
4. DEPTH OF PIPE VARIES, SEE PROFILE DRAWINGS. MINIMUM SOIL COVER OVER TOP OF PIPE 600 mm.
5. NEW HEADER PIPE TO BE SLOPED MINIMUM 5%, IF NEEDED, SOIL BERM TO BE ESTABLISHED FOR THE ABOVEGROUND SECTION OF THE HEADER.

SPERLING HANSEN ASSOCIATES
Landfill Services Group
- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

SHA PN:100306

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — Dr. A. R. ABEDINI # 55509 — 2024-08-06

No.	DATE yr/m/day	REVISIONS	DRAWN	CHK'D	APP'D
0	2024/08/06	ISSUED FOR CONSTRUCTION	LB	TS	AA

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CLIENT:

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DESIGN BY:	A.ABEDINI	SHA PROJECT # PRJ 23001	CELL 3 LANDFILL GAS HEADER UPGRADE
DRAWN BY:	L.BOBARIU		DETAILS
CHECKED BY:	T.SPERLING	HORIZONTAL SCALE: AS SHOWN	
APPROVED BY:	A.ABEDINI	C.R.D. CONTRACT# 30.22.06-03	

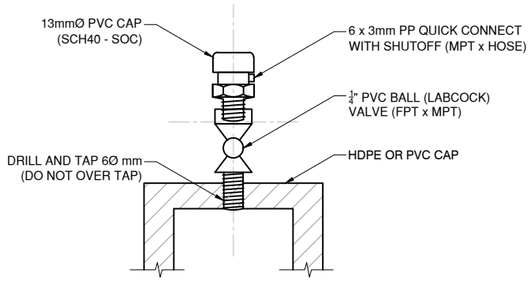
ADJUST SCALE 50% FOR 34"x22" SHEET

DRAWING NO:	REV	SHEET
PRJ23001-04	0	04

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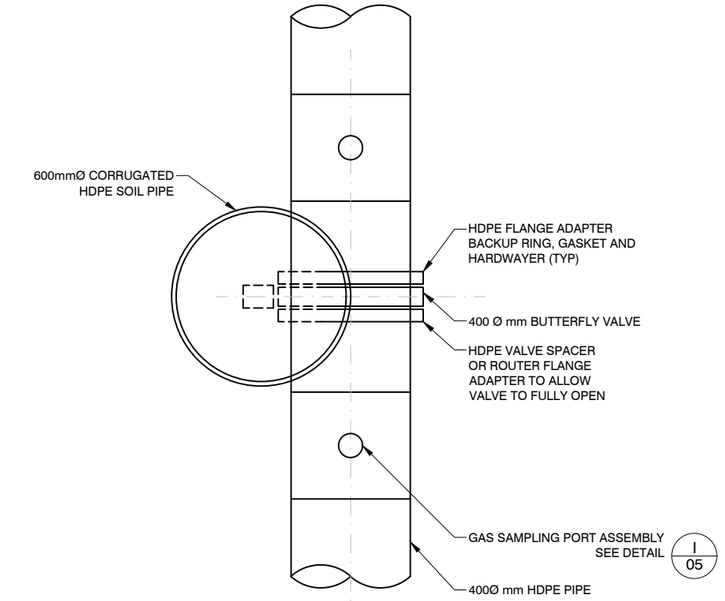
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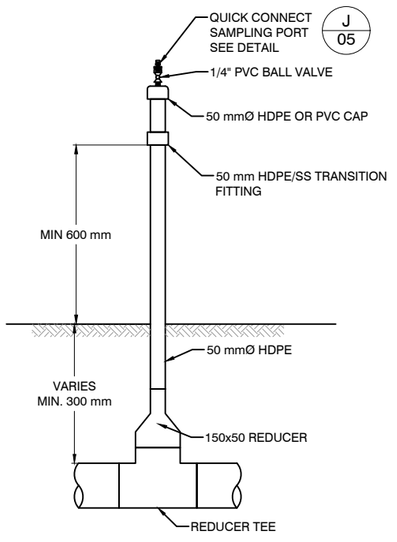
1. ALL PVC PIPE SHALL BE SCHEDULE 80 UNLESS NOTED OTHERWISE.
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4. DEPTH OF PIPE VARIES, SEE PROFILE DRAWINGS. MINIMUM SOIL COVER OVER TOP OF PIPE 600 mm.
5. NEW HEADER PIPE TO BE SLOPED MINIMUM 5%, IF NEEDED, SOIL BERM TO BE ESTABLISHED FOR THE ABOVEGROUND SECTION OF THE HEADER.



QUICK CONNECT SAMPLING PORT DETAILS - TYPE 1 (J/05)

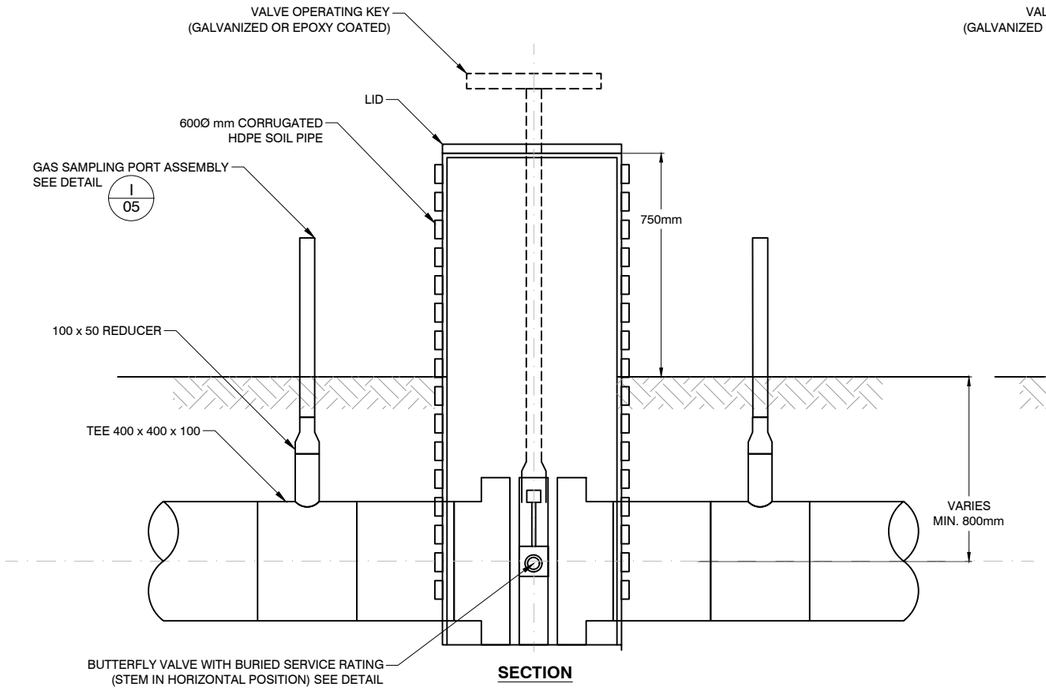
SCALE 1:20



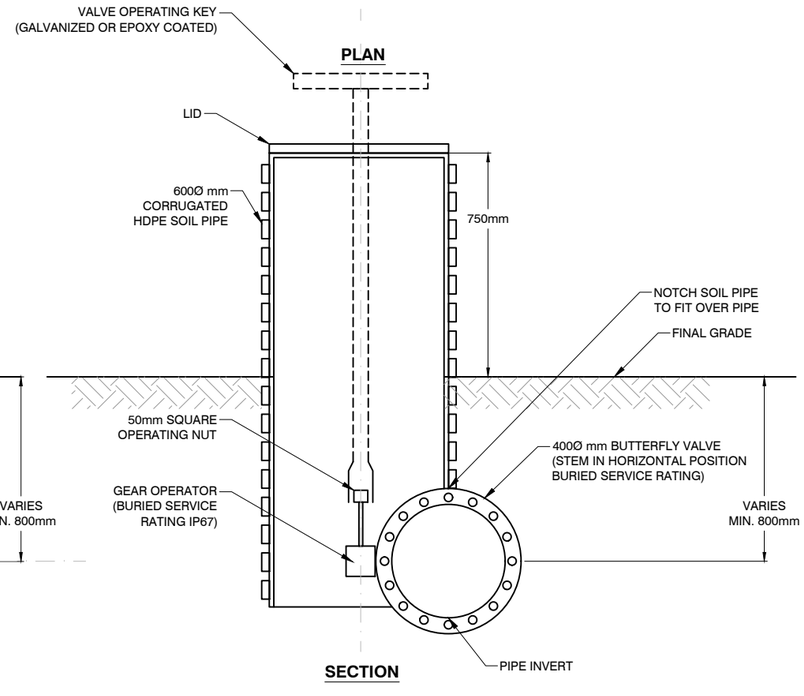


GAS SAMPLING PORT ASSEMBLY (I/05)

SCALE 1:20



SECTION



SECTION

BURIED VALVE SOIL PIPE DETAILS (H/01)

SCALE 1:20

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- Landfill Closure
- Environmental Monitoring

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Phone: (604) 986-7723

SHA PN:100306

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — Dr. A. R. ABEDINI # 55509 — 2024-08-06

No.	DATE yr/m/day	REVISIONS	DRAWN	CHK'D	APP'D
0	2024/08/06	ISSUED FOR CONSTRUCTION	LB	TS	AA

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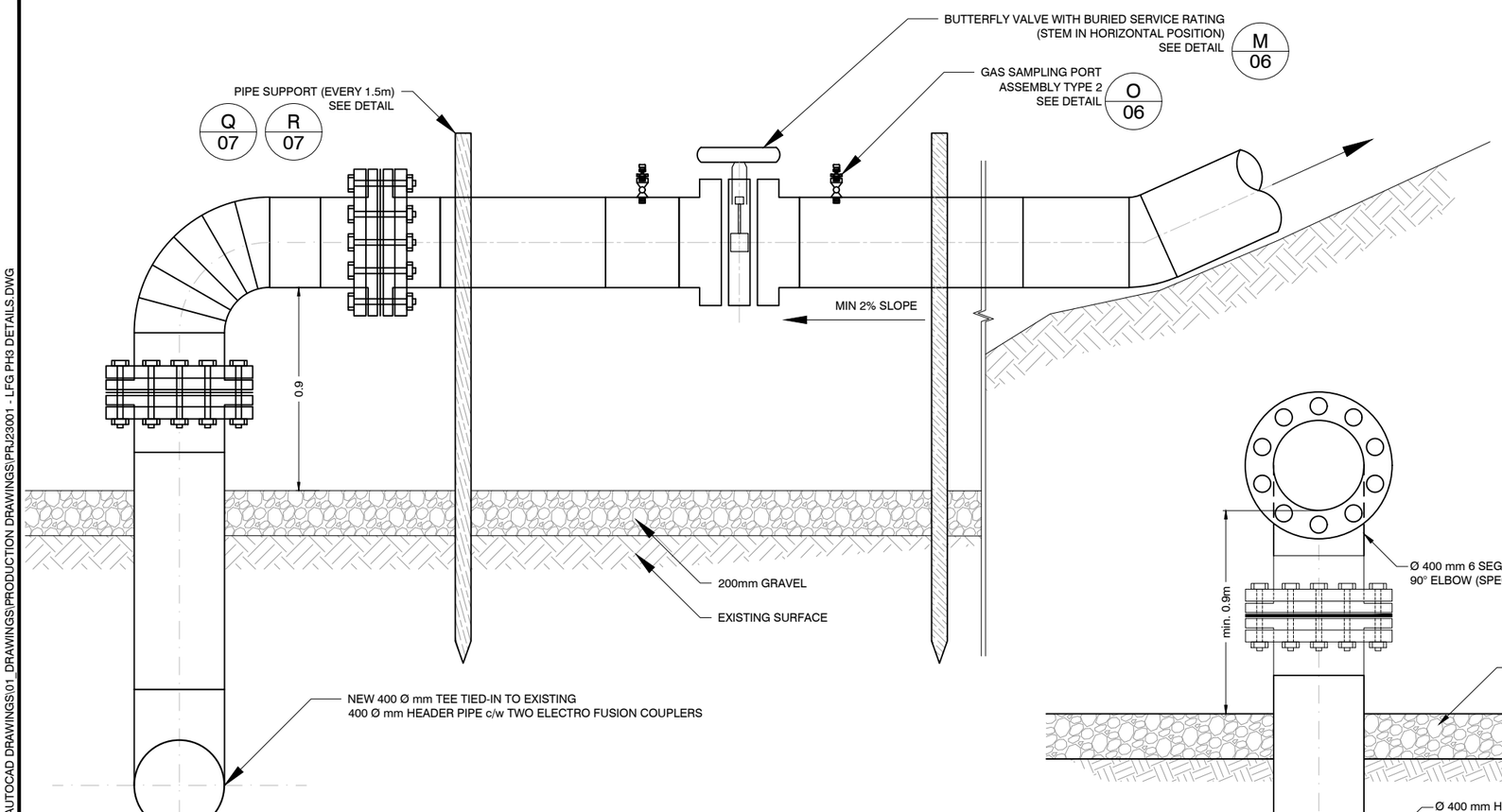
CLIENT: Capital Regional District | Parks & Environmental Services — Making a difference...together

DESIGN BY:	A.ABEDINI	SHA PROJECT # PRJ 23001	CELL 3 LANDFILL GAS HEADER UPGRADE
DRAWN BY:	L.BOBARIU		**DETAILS**
CHECKED BY:	T.SPERLING	HORIZONTAL SCALE: AS SHOWN	
APPROVED BY:	A.ABEDINI	C.R.D. CONTRACT# 30.22.06-03	

ADJUST SCALE 50% FOR 34"x22" SHEET

DRAWING NO:	REV	SHEET
PRJ23001-05	0	05

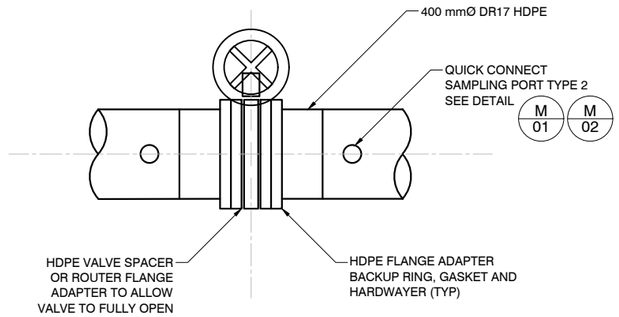
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TIE-IN TO EXISTING 400Ø mm HEADER PIPE DETAILS

K 01 K 02

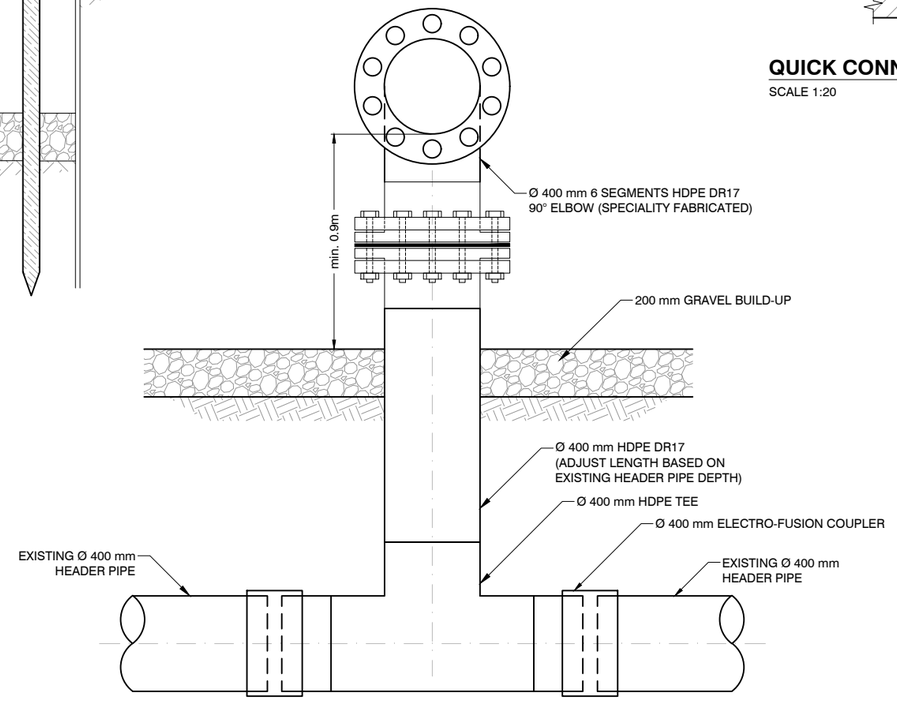
SCALE 1:25



ABOVE GROUND BUTTERFLY VALVE

M 02

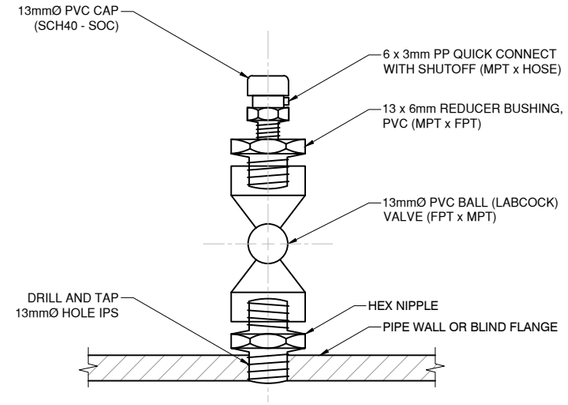
SCALE 1:10



TEE-OFF OF EXISTING 400Ø mm HEADER PIPE

L 01

SCALE 1:25



QUICK CONNECT SAMPLING PORT DETAILS - TYPE 2

O 06

SCALE 1:20

NOTES:

1. ALL PVC PIPE SHALL BE SCHEDULE 80 UNLESS NOTED OTHERWISE.
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SPERLING HANSEN ASSOCIATES

Landfill Services Group

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- Landfill Closure
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North Vancouver, B.C. V7J 1J3

Phone: (604) 986-7723

SHA PN:100309

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — Dr. A. R. ABEDINI # 55509

2024-08-06

No.	DATE yr/m/day	REVISIONS	DRAWN	CHK'D	APP'D
0	2024/08/06	ISSUED FOR CONSTRUCTION	LB	TS	AA

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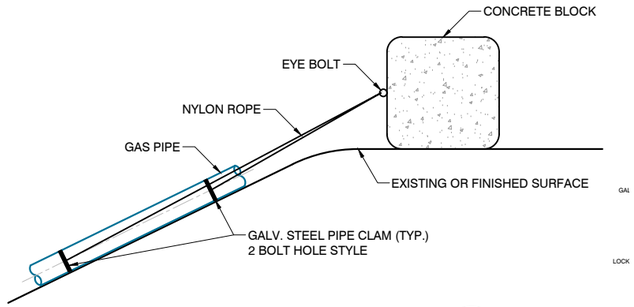
Capital Regional District | Parks & Environmental Services

DESIGN BY:	A.ABEDINI	SHA PROJECT # PRJ 23001	CELL 3 LANDFILL GAS HEADER UPGRADE
DRAWN BY:	L.BOBARIU		**DETAILS**
CHECKED BY:	T.SPERLING	HORIZONTAL SCALE: AS SHOWN	
APPROVED BY:	A.ABEDINI	C.R.D. CONTRACT# 30.22.06-03	

ADJUST SCALE 50% FOR 34"x22" SHEET

DRAWING NO:	REV	SHEET
PRJ23001-06	0	06

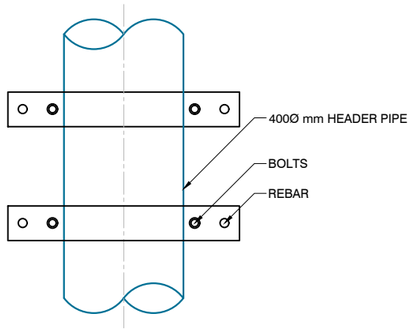
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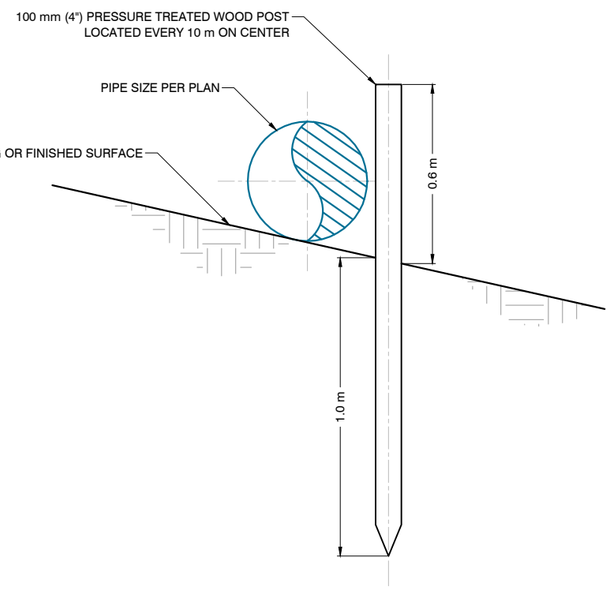
PIPE ANCHOR DETAIL

SCALE 1:40

P 01



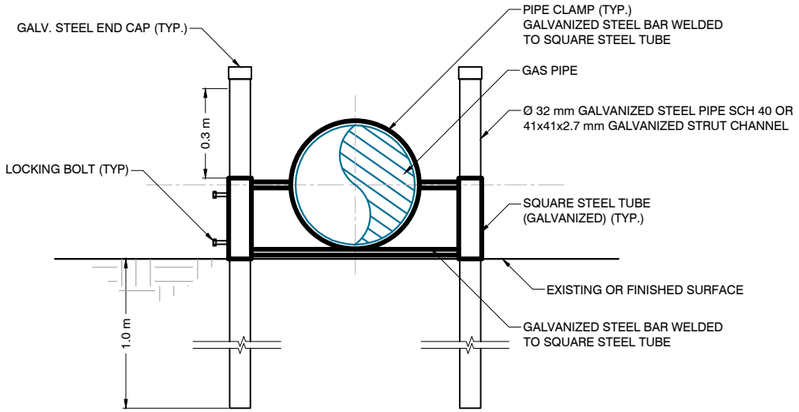
PLAN VIEW - TYPE 2



PIPE SUPPORT - TYPE 1

SCALE 1:20

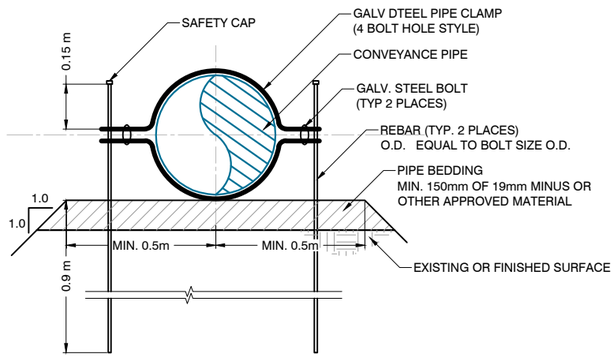
S 03



PIPE SUPPORT - TYPE 3

SCALE 1:20

R 03 R 06



PIPE SUPPORT - TYPE 2

SCALE 1:20

Q 03 Q 06

NOTES:

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SPERLING HANSEN ASSOCIATES

Landfill Services Group
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- Landfill Closure
- Environmental Monitoring

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Phone: (604) 986-7723

SHA PN:100309

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
Dr. A. R. ABEDINI
55509
2024-08-06

No.	DATE yr/m/day	REVISIONS	DRAWN	CHK'D	APP'D
0	2024/08/06	ISSUED FOR CONSTRUCTION	LB	TS	AA

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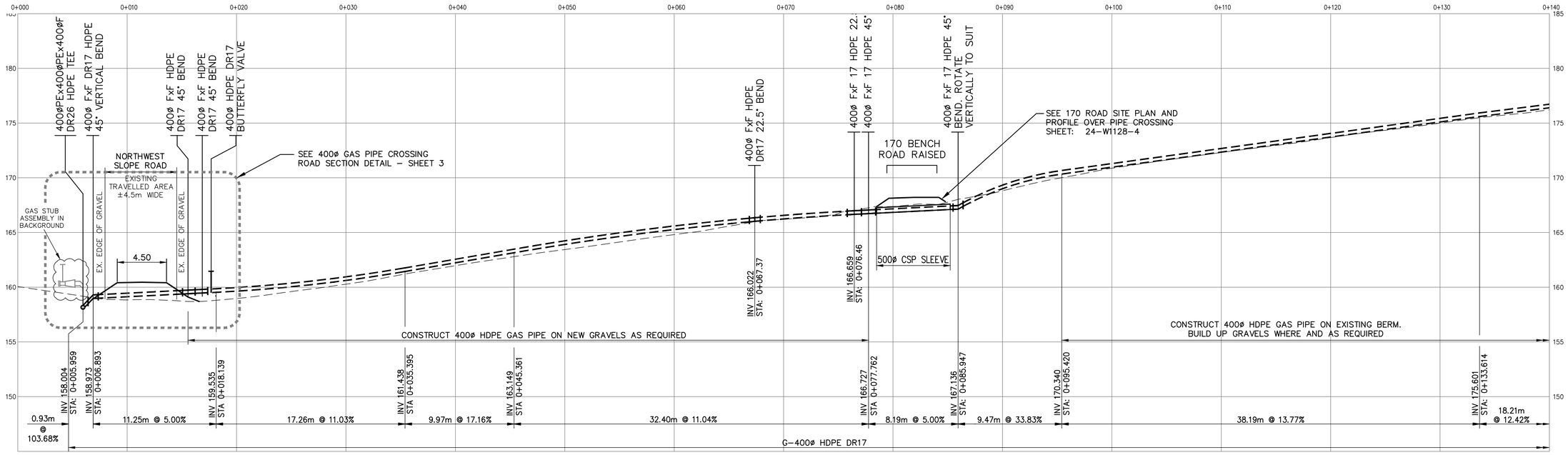
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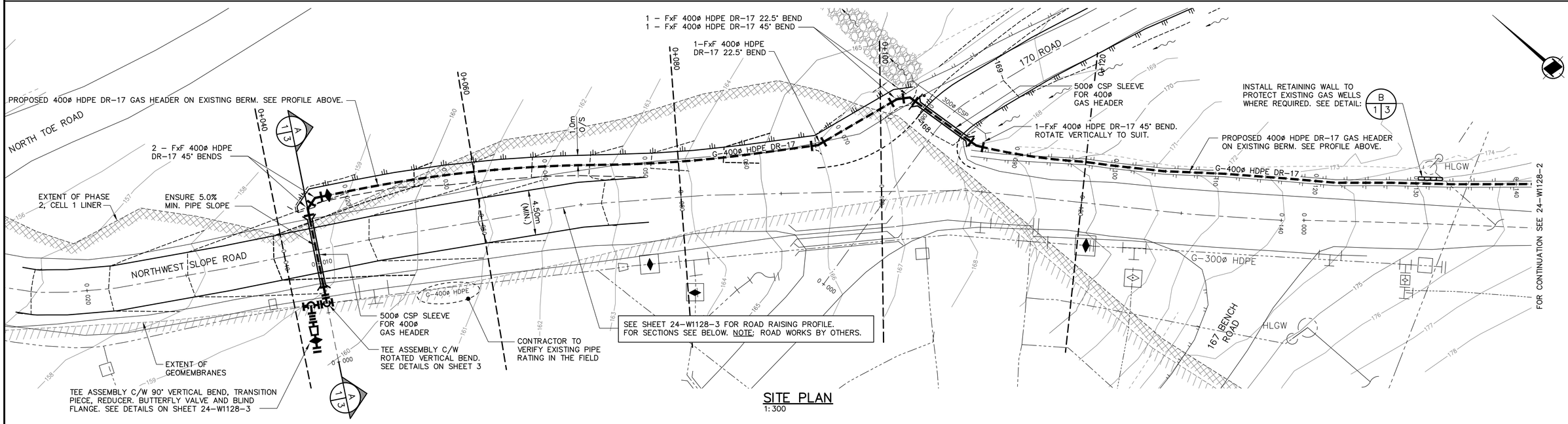
DESIGN BY:	A.ABEDINI	SHA PROJECT # PRJ 23001	CELL 3 LANDFILL GAS HEADER UPGRADE
DRAWN BY:	L.BOBARIU		DETAILS
CHECKED BY:	T.SPERLING	HORIZONTAL SCALE: AS SHOWN	
APPROVED BY:	A.ABEDINI	C.R.D. CONTRACT# 30.22.06-03	DRAWING NO: PRJ23001-07 / REV: 0 / SHEET: 07

ADJUST SCALE 50% FOR 34"x22" SHEET

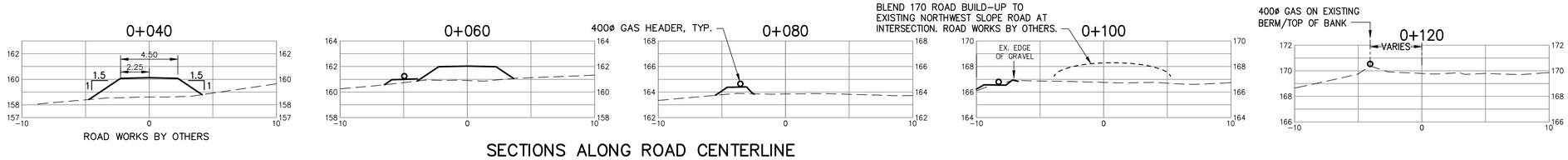
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PROFILE ALONG PROPOSED 400ø GAS LINE
1:300



SITE PLAN
1:300



SECTIONS ALONG ROAD CENTERLINE
1:200 H&V NOTE: ROAD DESIGN AND CONSTRUCTION BY OTHERS

1:200 0 4 12m

Sperling Hansen Associates
Landfill Services Group
• Landfill Siting
• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring
#8 – 1225 Keith Road East, North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723
EGBC Permit No. 1003066

DESIGNED
DRAWN HL
CHECKED
APPROVED AA

SHA PIN 100000
Professional Engineer of British Columbia
Dr. A. R. ABEDINI
55509
PROFESSIONAL OF RECORD

ISSUE	DATE	BY	REVISION DESCRIPTION	ENG.
3	07/02/25	HL	ISSUED FOR CONSTRUCTION PER SPERLING HANSEN COMMENTS	AA
2	30/01/25	HL	SPERLING HANSEN COMMENTS ADDRESSED. GAS HEADER DESIGN FOR CONSTRUCTION.	AA

No.	DATE	ISSUE
3	07/02/25	ISSUED FOR CONSTRUCTION
2	30/01/25	ISSUED FOR REVIEW – REV 2
1	08/01/25	FOR REVIEW

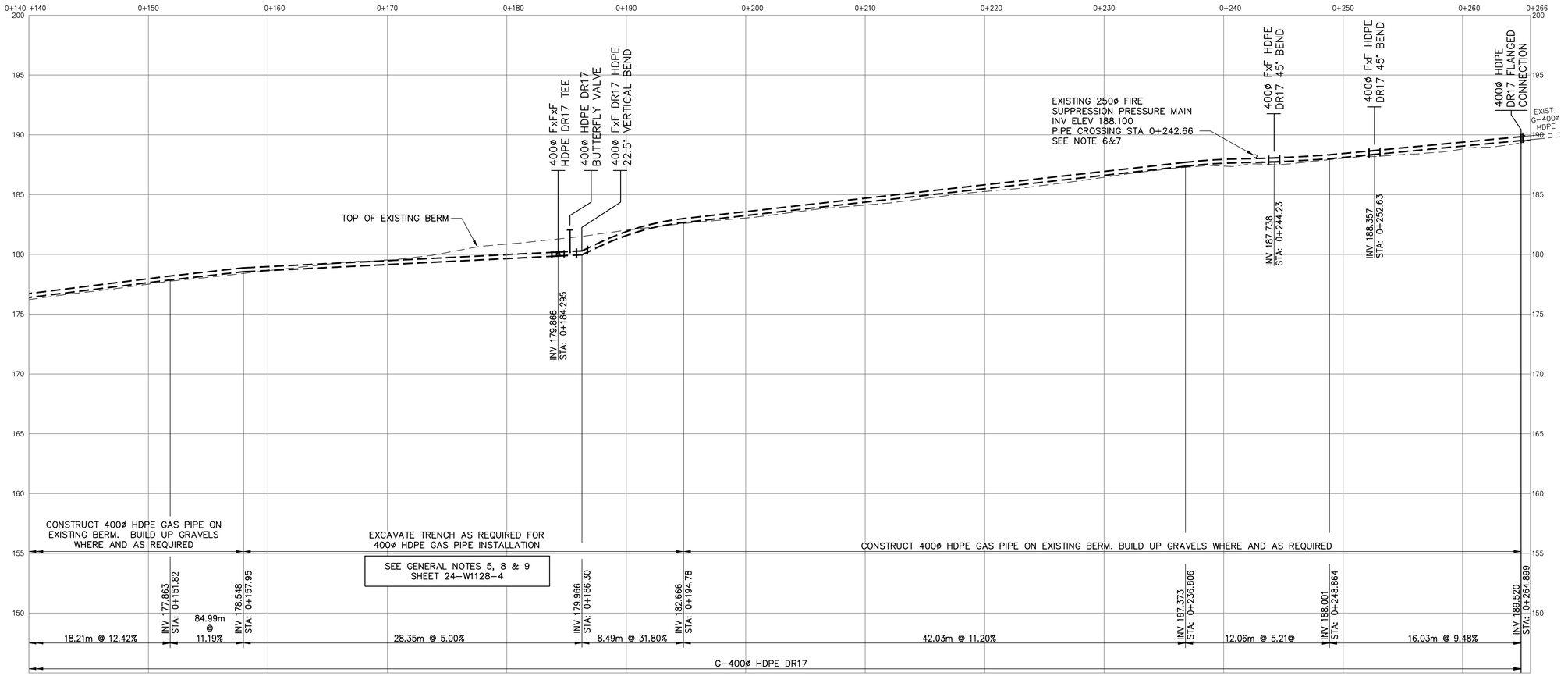
CRD
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EGBC PERMIT No. 1003385

HARTLAND LANDFILL

PROPOSED 400 DIAMETER GAS HEADER REVISION
GAS HEADER STA: 0+000.000 ~ 0+141.500
SITE PLAN, PROFILE AND SECTIONS

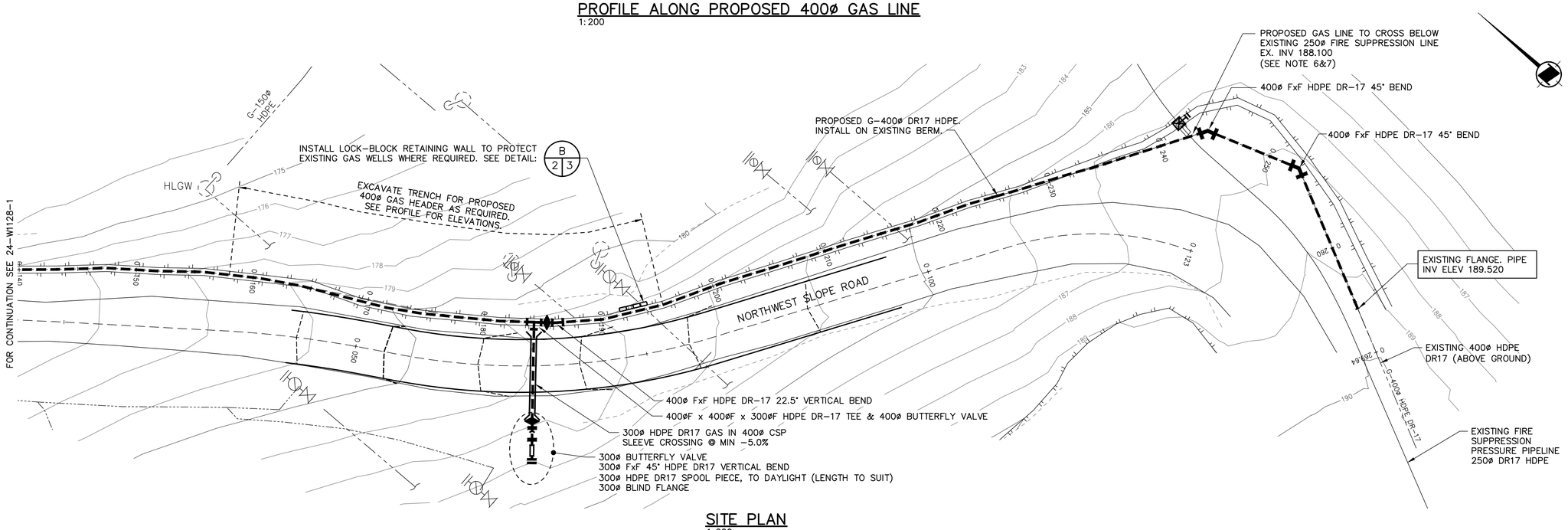
PROJECT REFERENCE 30.22.07–01 | DRAWING NUMBER 24–W1128–1 | ISSUE 3 | SHT. No. 1 OF 4

Filename: J:\ARCHIVE\CENTRAL\24W\24W1128\24-W1128-1.DWG
Last saved by: HLOCKE(2025-02-07) Last Plotted: 2025-02-07



PROFILE ALONG PROPOSED 400ø GAS LINE

1:200



SITE PLAN

1:200

1:200 0 4 12m

						3	07/02/25	ISSUED FOR CONSTRUCTION
3	07/02/25	HL	ISSUED FOR CONSTRUCTION PER SPERLING HANSEN COMMENTS	AA	2	30/01/25	ISSUED FOR REVIEW – REV 2
2	30/01/25	HL	SPERLING HANSEN COMMENTS ADDRESSED. GAS HEADER DESIGN FOR CONSTRUCTION.	AA	1	08/01/25	FOR REVIEW
ISSUE	DATE	BY	REVISION DESCRIPTION	ENG.	No.	DATE	ISSUE

DESIGNED
DRAWN HL
CHECKED
APPROVED AA

PROFESSIONAL OF RECORD

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• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring
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Phone: (604) 986-7723
EGBC Permit No. 1003066

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EGBC PERMIT No. 1003385

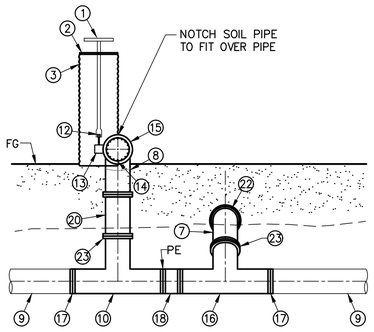
HARTLAND LANDFILL

PROPOSED 400 DIAMETER GAS HEADER REVISION
GAS HEADER STA: 0+141.500 ~ 0+266.000
SITE PLAN AND PROFILE

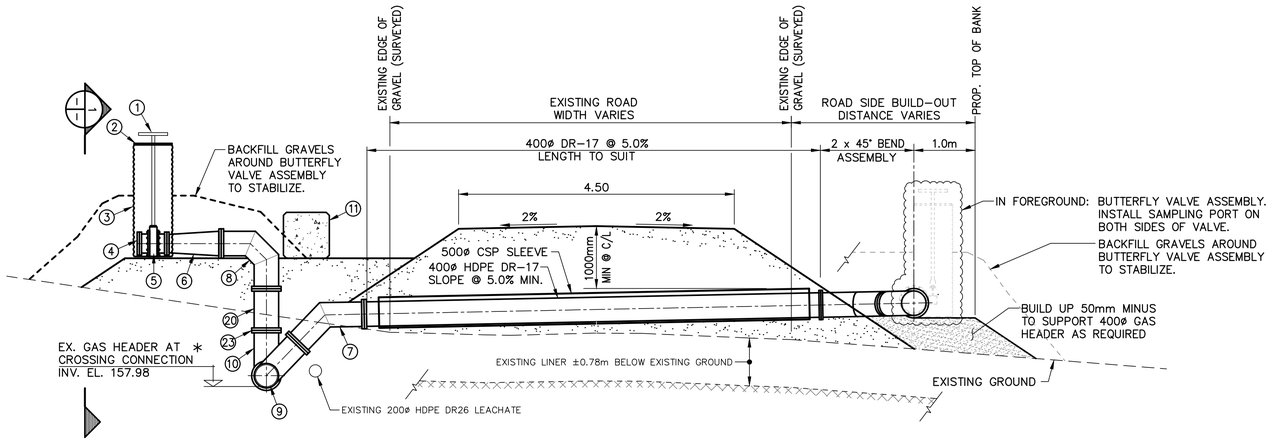
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DRAWING NUMBER 24-W1128-2
ISSUE 3
SHT. No. 2 OF 4

Filename: J:\ARCHIVE\CENTRAL\24W\24W1128\24-W1128-1.DWG
Last saved by: HLOCKE(2025-02-07) Last Plotted: 2025-02-07

MATERIAL LIST	
ITEM	DESCRIPTION
1	VALVE OPERATING KEY (GALVANIZED OR EPOXY COATED)
2	LID
3	600ømm CORRUGATED HDPE SOIL PIPE
4	BLIND FLANGE
5	300ø BUTTERFLY VALVE WITH BURIED SERVICE RATING (STEM IN HORIZONTAL POSITION)
6	400øF x 300øF HDPE DR17 REDUCER
7	400øF x 400øF HDPE DR17 45° ELBOW
8	400°øF x 400øF 90° DR17 ELBOW
9	EXISTING 400ø HDPE–DR26 GAS HEADER (CONTRACTOR TO VERIFY RATING)
10	400øPE x 400øPE x 400øPE HDPE DR26 TEE (FLANGE END ON VERTICAL SIDE)
11	PLACE LOCK BLOCK AS NEEDED TO PROTECT ABOVEGROUND PIPE
12	50mm SQUARE OPERATING NUT
13	GEAR OPERATOR (BURIED SERVICE RATING IP67)
14	PIPE INVERT
15	400ø mm BUTTERFLY VALVE (STEM IN HORIZONTAL POSITION BURIED SERVICE RATING)
16	400øPE x 400øPE x 400øF HDPE DR26 TEE (BEFORE FUSING ROTATE TO ALIGN WITH 7)
17	DR26 EF COUPLING
18	400ø DR26 SPOOL PIECE – FIELD FIT
20	DR17 400ø SPOOL PIECE (LENGTH TO SUIT) c/w FLANGED ENDS
22	ROAD CROSSING C/W CULVERT SLEEVE
23	FLANGED END FOR DR26 TEE

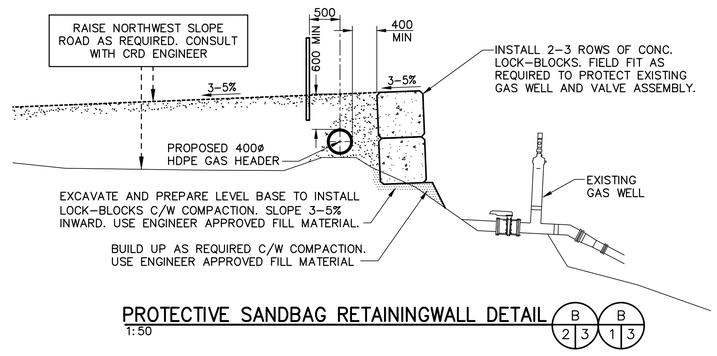


SECTION 1 / 1
1:50

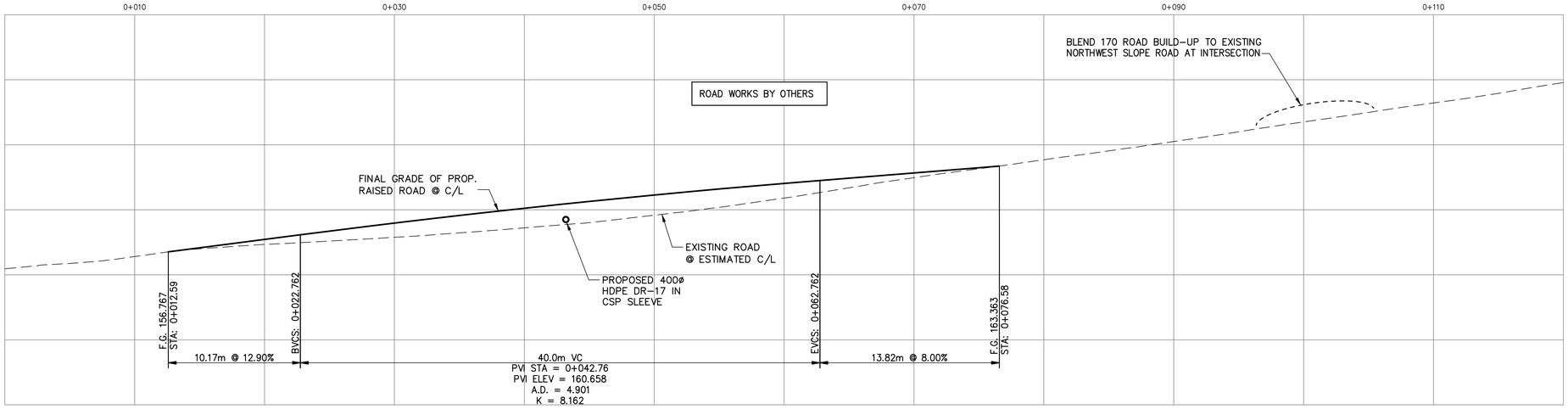


* DERIVED FROM PROFILE SEE C.R.D. RECORD DRAWING 24–W696–5

400ø GAS PIPE CROSSING ROAD SECTION DETAIL A / 1 3
1:50



PROTECTIVE SANDBAG RETAININGWALL DETAIL B / 2 3 — B / 1 3
1:50



PROFILE OF NORTHWEST SLOPE ROAD (LOWER) RAISING AT C/L OF PROPOSED ROAD
1:200

1:200 0 4 12m

SPERLING HANSEN ASSOCIATES
Landfill Services Group
• Landfill Siting
• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring
#9 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723
EGBC Permit No. 1003066

DESIGNED
DRAWN HL
CHECKED
APPROVED AA

SHA PN 1003066
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA
Dr. A. R. ABEDINI
55509
PROFESSIONAL OF RECORD

ISSUE	DATE	BY	REVISION DESCRIPTION	ENG.
3	07/02/25	HL	ISSUED FOR CONSTRUCTION PER SPERLING HANSEN COMMENTS	AA
2	30/01/25	HL	SPERLING HANSEN COMMENTS ADDRESSED. GAS HEADER DESIGN FOR CONSTRUCTION.	AA

No.	DATE	ISSUE
3	07/02/25	ISSUED FOR CONSTRUCTION
2	30/01/25	ISSUED FOR REVIEW – REV 2
1	08/01/25	FOR REVIEW

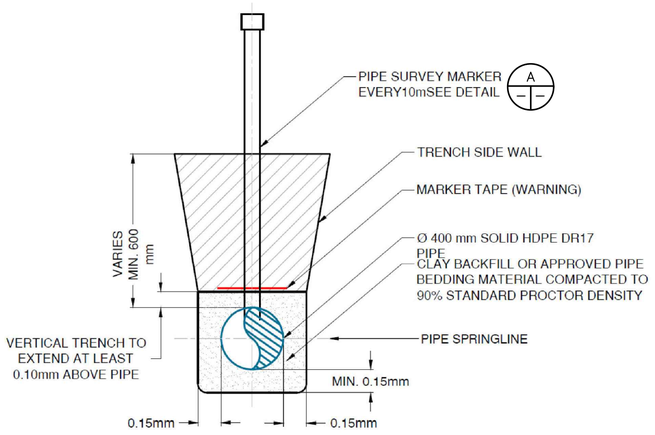
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HARTLAND LANDFILL

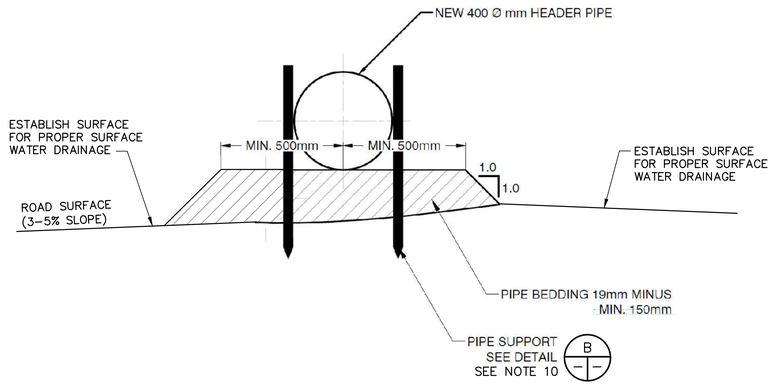
PROPOSED 400 DIAMETER GAS HEADER REVISION
LOWER NORTHWEST SLOPE ROAD
ROAD RAISING PROFILE AND DETAILS

PROJECT REFERENCE 30.22.07–01
DRAWING NUMBER 24–W1128–3
ISSUE 3
SHT. No. 3 OF 4

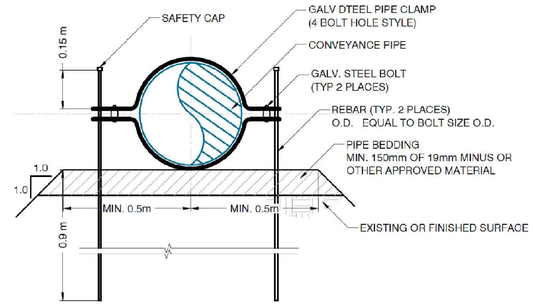
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Last saved by: HLOCKE(2025–02–07) Last Plotted: 2025–02–07



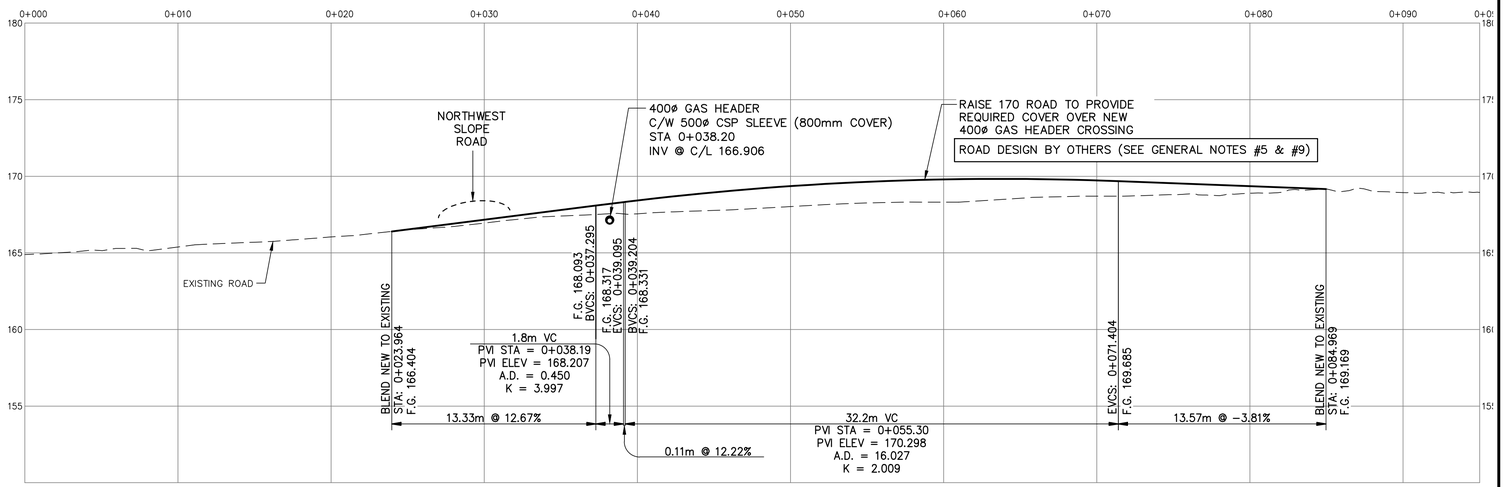
TYPICAL LFG HEADER PIPE TRENCH
NOT TO SCALE



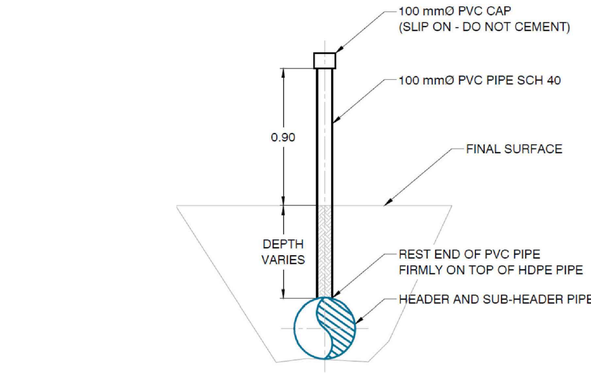
ABOVE GROUND GAS PIPE BEDDING DETAIL
NOT TO SCALE



PIPE SUPPORT
NOT TO SCALE
B



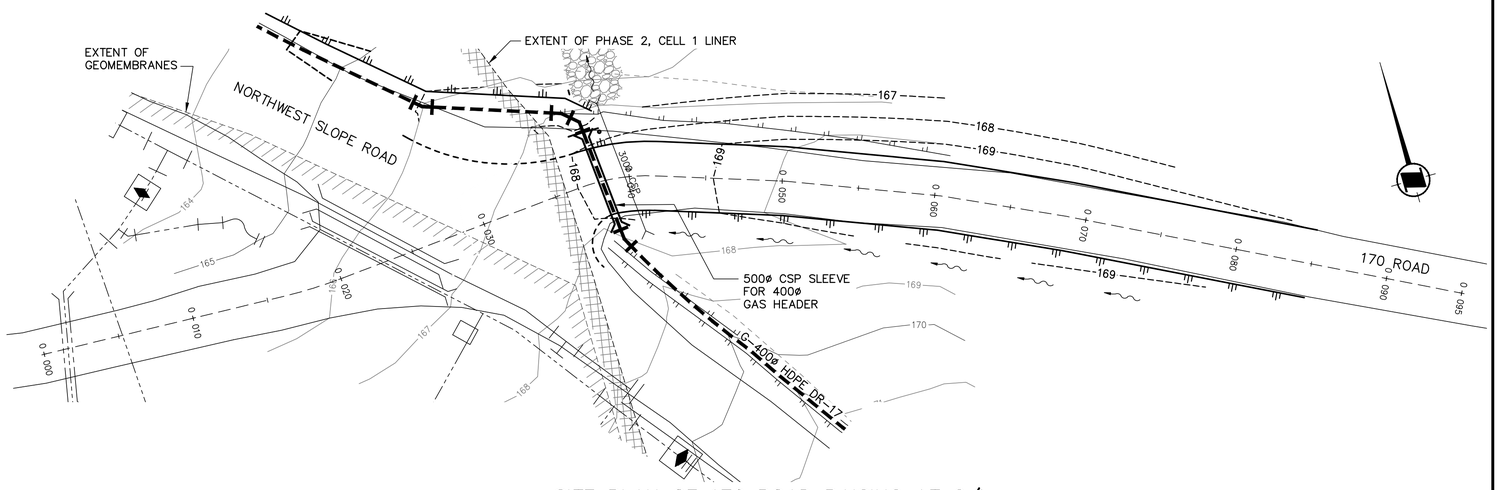
PROFILE OF 170 ROAD RAISING AT C/L
1: 200



PIPE SURVEY MARKER
NOT TO SCALE
A

GENERAL NOTES:

1– ALL HDPE PIPE SHALL BE SDR 17.0 UNLESS NOTED OTHERWISE
2– HDPE PIPE JOINT SHALL BE THERMAL BUTT FUSION WELDED UNLESS NOTED OTHERWISE. ELECTRO–FUSION FITTINGS & FLANGES ARE NOT ALLOWED UNLESS NOTED OTHERWISE
3– ALL ELASTOMETRIC SEALS (E.G. GASKETS AND O–RINGS) SHALL BE NITRILE OR VITON
4– PIPE BEDDING THINKNESS MAY VARY TO ACCOMMODATE MINIMUM 5% SLOPE ON THE HEADER PIPE
5– MINIMUM SOIL COVER OVER ROAD CROSSING AND UNDERGROUND HEADER PIPE SHALL BE 600MM
6– VERTICAL DISTANCE BETWEEN TWO CROSSING PIPES SHALL BE MORE THAN 150MM
7– FIRE SUPPRESSION PRESSURE MAIN TO BE DEPRESSURIZED BEFORE CONSTRUCTION OF THE 400Ø PIPE COMMENCES.
8– NEW HEADER PIPE TO BE SLOPED MINIMUM 5%,. WHERE NEEDED, PLACE PIPE IN TRENCH (SEE TRENCH DETAILS (E)) OR INCREASE PIPE BEDDING THICKNESS FOR THE ABOVEGROUND SECTION OF THE HEADER TO ACHIVE THE MINIMUM 5% SLOPE.
9– HEADER SURVEY MARKER REQUIRED EVERY 10M FOR THE BURRIED SECTIONS OF THE HEADER (SEE DETAILS E & F).
10–PIPE SUPPORT TO BE INSTALLED FOR THE ABOVE GROUND HEADER EVERY 10M (SEE DETAILS)
11– WHERE REQUIRED, ROAD SURFACE SHALL BE ELEVATED AND RESLOPED FOR PROPER DRAINAGE AND AVOIDING RUNOFF BLOCKAGE BY ABOVEGROUND PIPE AND PIPE BEDDING MATERIAL.



SITE PLAN OF 170 ROAD RAISING AT C/L
1: 200

1:200 0 4 12m

						3	07/02/25	ISSUED FOR CONSTRUCTION
3	07/02/25	HL	ISSUED FOR CONSTRUCTION PER SPERLING HANSEN COMMENTS	AA		2	30/01/25	ISSUED FOR REVIEW – REV 2
2	30/01/25	HL	SPERLING HANSEN COMMENTS ADDRESSED. GAS HEADER DESIGN FOR CONSTRUCTION.	AA		1	08/01/25	FOR REVIEW
ISSUE	DATE	BY	REVISION DESCRIPTION	ENG.		No.	DATE	ISSUE

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• Environmental Monitoring
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APPROVED AA

SHA PIN 100894
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA
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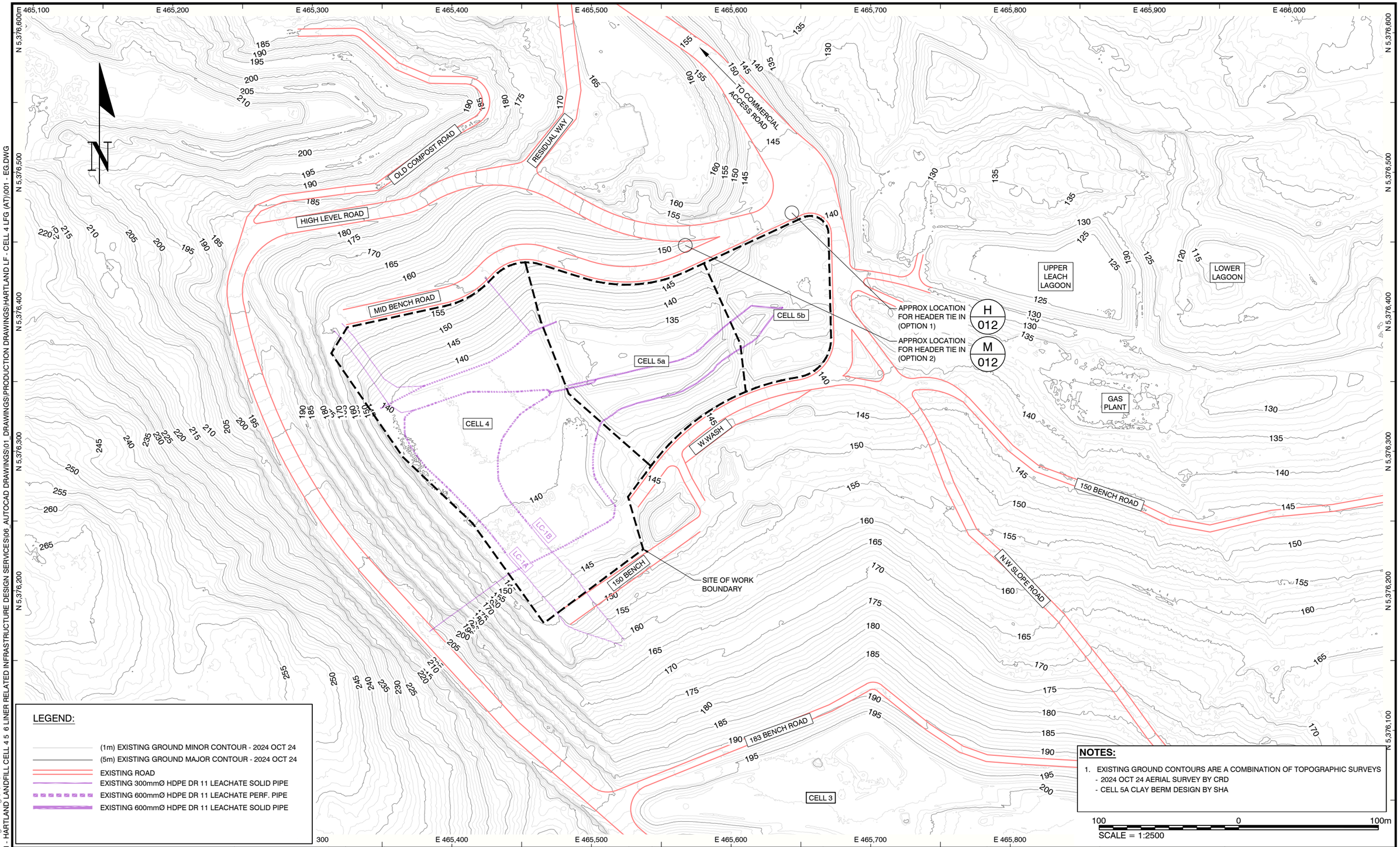
HARTLAND LANDFILL

PROPOSED 400 DIAMETER GAS HEADER REVISION
170 ROAD RAISING
SITE PLAN, PROFILE, DETAILS AND GENERAL NOTES

PROJECT REFERENCE 30.22.07–01 | DRAWING NUMBER 24–W1128–4 | ISSUE 3 | SHT. No. 4 OF 4

Filename: J:\ARCHIVE\CENTRAL\24W\24W1128\24–W1128–1.DWG
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Appendix D2 Draft Landfill Gas Design for Cell 4



LEGEND:

- (1m) EXISTING GROUND MINOR CONTOUR - 2024 OCT 24
- (5m) EXISTING GROUND MAJOR CONTOUR - 2024 OCT 24
- EXISTING ROAD
- EXISTING 300mmØ HDPE DR 11 LEACHATE SOLID PIPE
- EXISTING 600mmØ HDPE DR 11 LEACHATE PERF. PIPE
- EXISTING 600mmØ HDPE DR 11 LEACHATE SOLID PIPE

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

100 0 100m

SCALE = 1:2500

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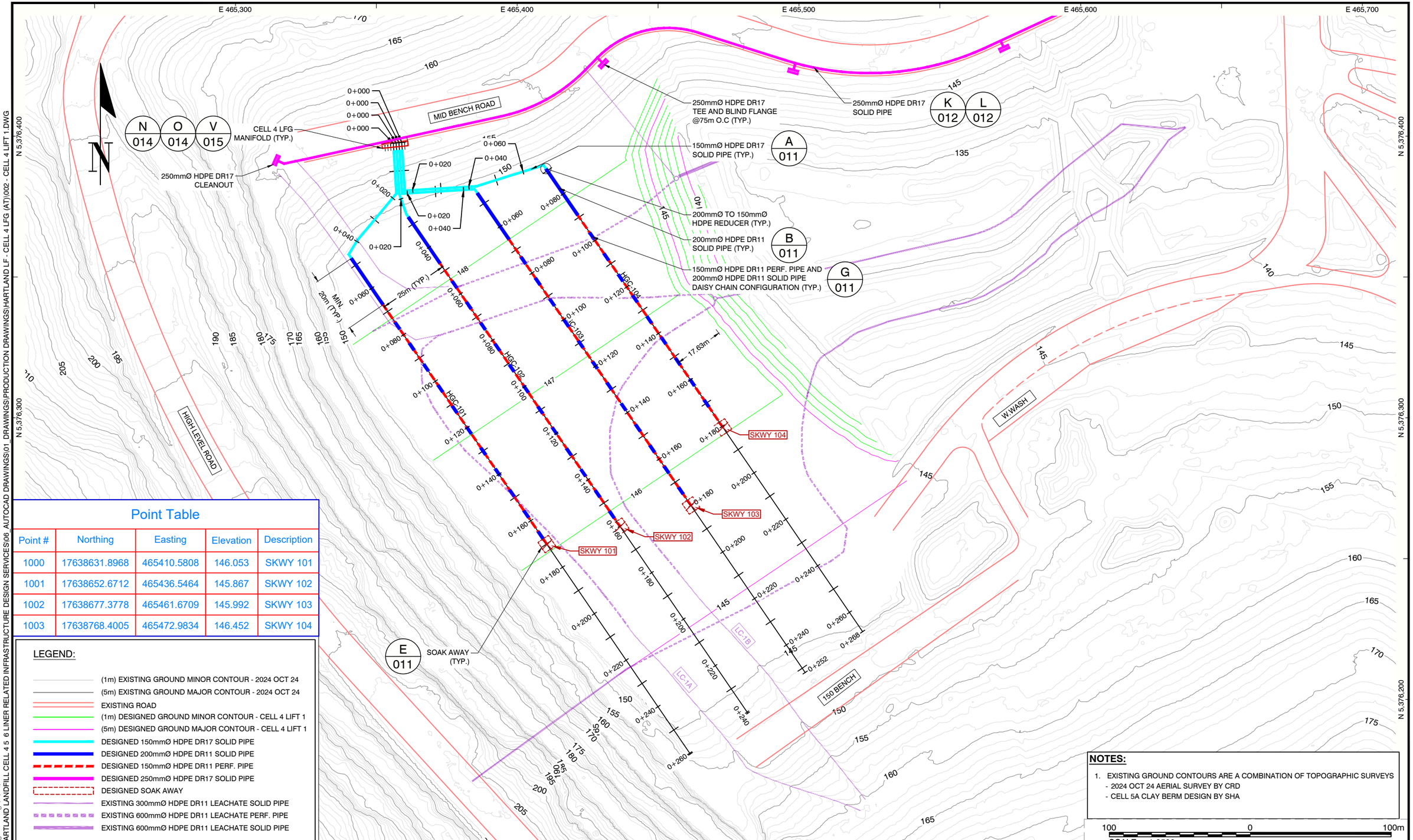
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APPROVED BY:	AA	VERTICAL SCALE:	1:2500

ADJUST SCALE 50% FOR 34"x22" SHEET

HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

EXISTING TOPOGRAPHY

DRAWING NO:	REV	SHEET
23001-001	A	001



Point Table

Point #	Northing	Easting	Elevation	Description
1000	17638631.8968	465410.5808	146.053	SKWY 101
1001	17638652.6712	465436.5464	145.867	SKWY 102
1002	17638677.3778	465461.6709	145.992	SKWY 103
1003	17638768.4005	465472.9834	146.452	SKWY 104

LEGEND:

- (1m) EXISTING GROUND MINOR CONTOUR - 2024 OCT 24
- (5m) EXISTING GROUND MAJOR CONTOUR - 2024 OCT 24
- EXISTING ROAD
- (1m) DESIGNED GROUND MINOR CONTOUR - CELL 4 LIFT 1
- (5m) DESIGNED GROUND MAJOR CONTOUR - CELL 4 LIFT 1
- DESIGNED 150mmØ HDPE DR17 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE
- DESIGNED 150mmØ HDPE DR11 PERF. PIPE
- DESIGNED 250mmØ HDPE DR17 SOLID PIPE
- DESIGNED SOAK AWAY
- EXISTING 300mmØ HDPE DR11 LEACHATE SOLID PIPE
- EXISTING 600mmØ HDPE DR11 LEACHATE PERF. PIPE
- EXISTING 600mmØ HDPE DR11 LEACHATE SOLID PIPE

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

100 0 100m

SCALE = 1:2500

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APPROVED BY:	AA	VERTICAL SCALE:	1:1250

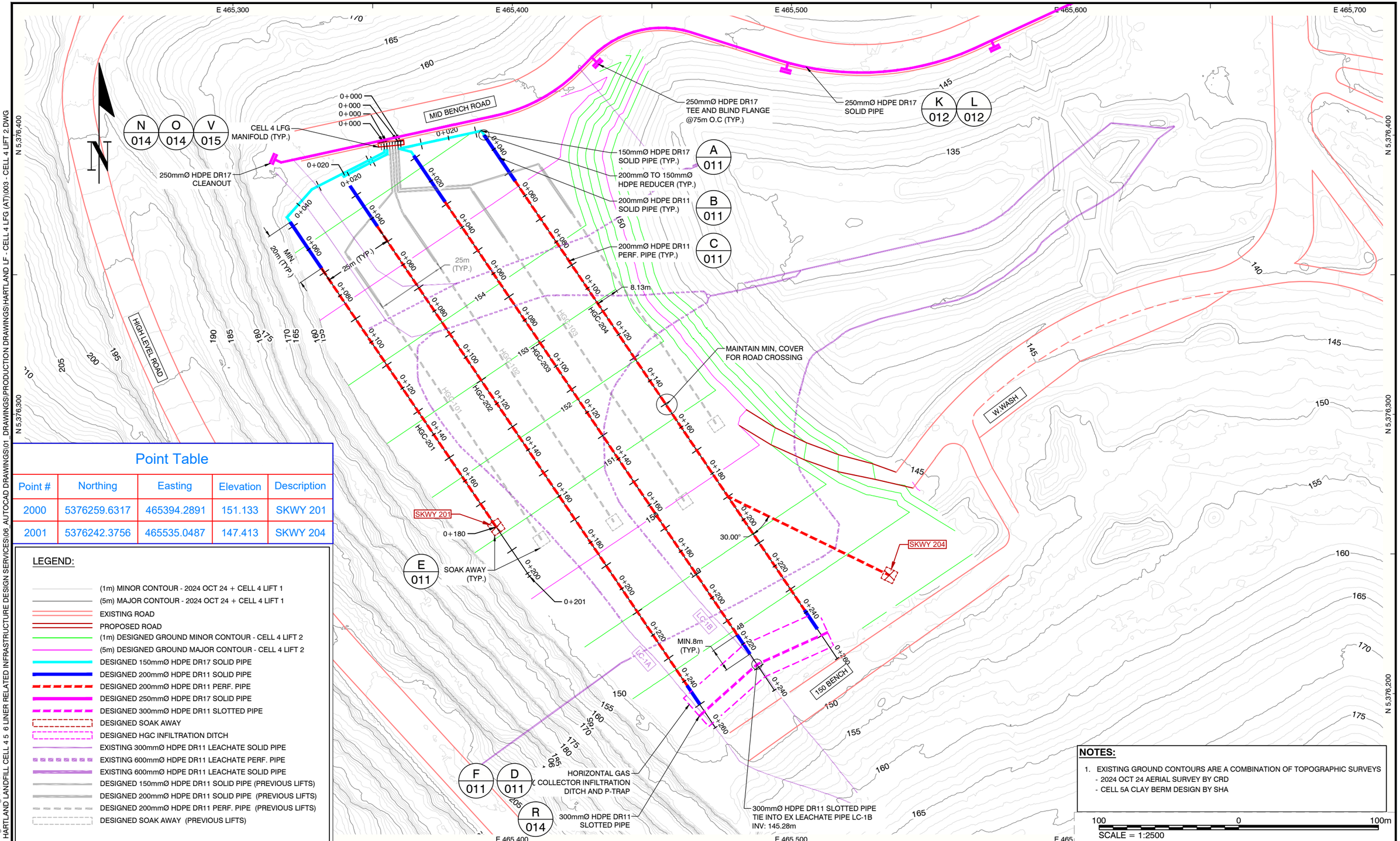
ADJUST SCALE 50% FOR 34"x22" SHEET

HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

CELL 4 LIFT 1 LFG MANAGEMENT PLAN

DRAWING NO:	REV	SHEET
23001-002	A	002

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Point Table

Point #	Northing	Easting	Elevation	Description
2000	5376259.6317	465394.2891	151.133	SKWY 201
2001	5376242.3756	465535.0487	147.413	SKWY 204

LEGEND:

- (1m) MINOR CONTOUR - 2024 OCT 24 + CELL 4 LIFT 1
- (5m) MAJOR CONTOUR - 2024 OCT 24 + CELL 4 LIFT 1
- EXISTING ROAD
- PROPOSED ROAD
- (1m) DESIGNED GROUND MINOR CONTOUR - CELL 4 LIFT 2
- (5m) DESIGNED GROUND MAJOR CONTOUR - CELL 4 LIFT 2
- DESIGNED 150mmØ HDPE DR17 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE
- DESIGNED 250mmØ HDPE DR17 SOLID PIPE
- DESIGNED 300mmØ HDPE DR11 SLOTTED PIPE
- DESIGNED SOAK AWAY
- DESIGNED HGC INFILTRATION DITCH
- EXISTING 300mmØ HDPE DR11 LEACHATE SOLID PIPE
- EXISTING 600mmØ HDPE DR11 LEACHATE PERF. PIPE
- EXISTING 600mmØ HDPE DR11 LEACHATE SOLID PIPE
- DESIGNED 150mmØ HDPE DR11 SOLID PIPE (PREVIOUS LIFTS)
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE (PREVIOUS LIFTS)
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE (PREVIOUS LIFTS)
- DESIGNED SOAK AWAY (PREVIOUS LIFTS)

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

100 0 100m
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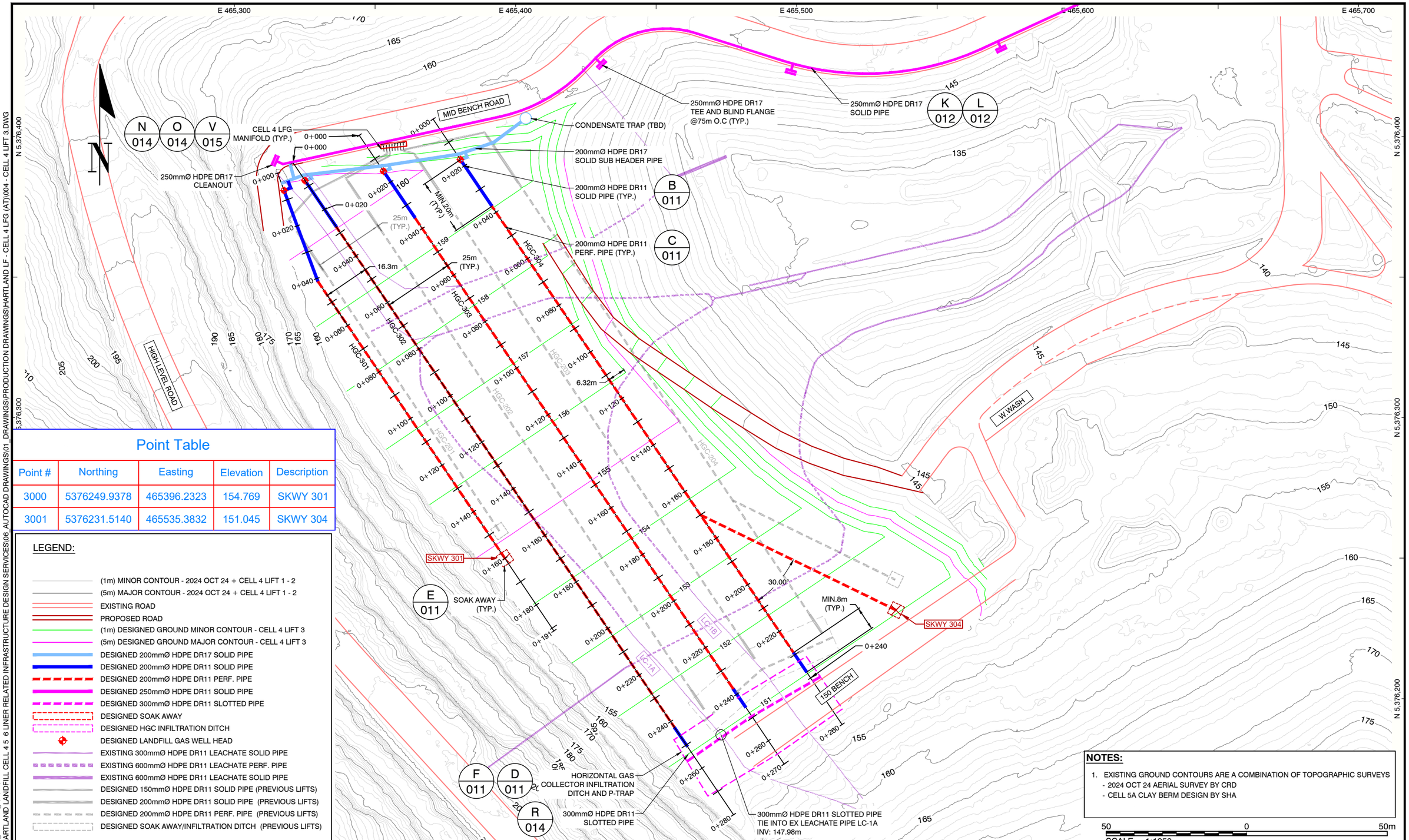
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HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

CELL 4 LIFT 2 LFG MANAGEMENT PLAN

DRAWING NO:	REV	SHEET
23001-003	A	003



Point Table

Point #	Northing	Easting	Elevation	Description
3000	5376249.9378	465396.2323	154.769	SKWY 301
3001	5376231.5140	465535.3832	151.045	SKWY 304

LEGEND:

- (1m) MINOR CONTOUR - 2024 OCT 24 + CELL 4 LIFT 1 - 2
- (5m) MAJOR CONTOUR - 2024 OCT 24 + CELL 4 LIFT 1 - 2
- EXISTING ROAD
- PROPOSED ROAD
- (1m) DESIGNED GROUND MINOR CONTOUR - CELL 4 LIFT 3
- (5m) DESIGNED GROUND MAJOR CONTOUR - CELL 4 LIFT 3
- DESIGNED 200mmØ HDPE DR17 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE
- DESIGNED 250mmØ HDPE DR11 SOLID PIPE
- DESIGNED 300mmØ HDPE DR11 SLOTTED PIPE
- DESIGNED SOAK AWAY
- DESIGNED HGC INFILTRATION DITCH
- DESIGNED LANDFILL GAS WELL HEAD
- EXISTING 300mmØ HDPE DR11 LEACHATE SOLID PIPE
- EXISTING 600mmØ HDPE DR11 LEACHATE PERF. PIPE
- EXISTING 600mmØ HDPE DR11 LEACHATE SOLID PIPE
- DESIGNED 150mmØ HDPE DR11 SOLID PIPE (PREVIOUS LIFTS)
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE (PREVIOUS LIFTS)
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE (PREVIOUS LIFTS)
- DESIGNED SOAK AWAY/INFILTRATION DITCH (PREVIOUS LIFTS)

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

50 0 50m
SCALE = 1:1250

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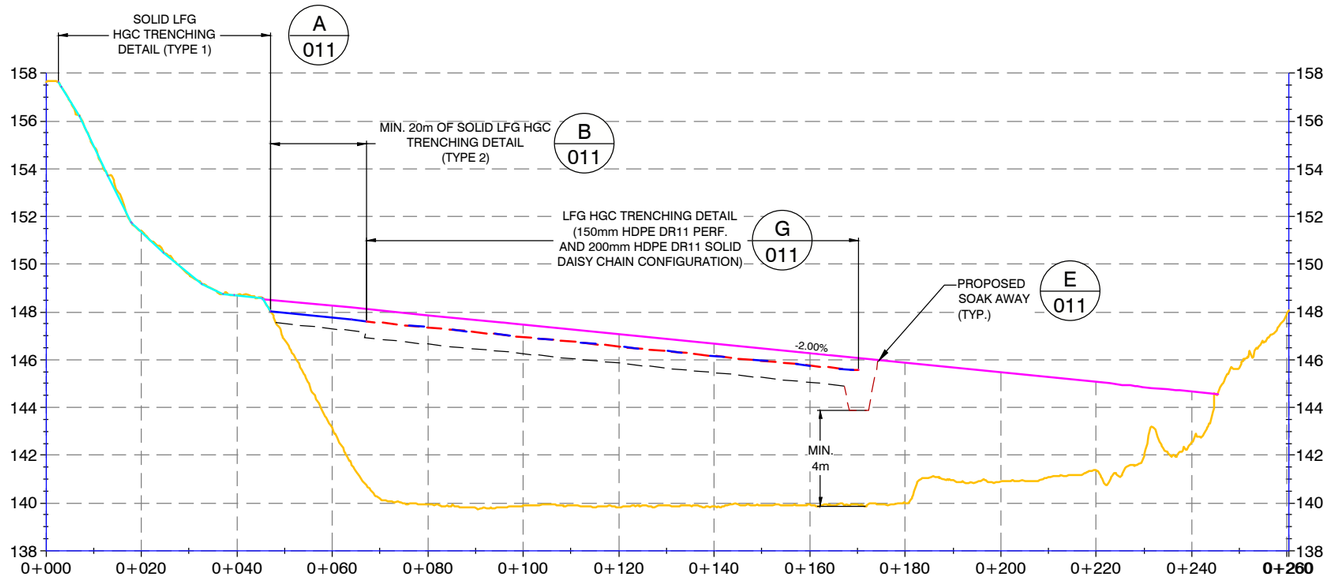
ADJUST SCALE 50% FOR 34"x22" SHEET

HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

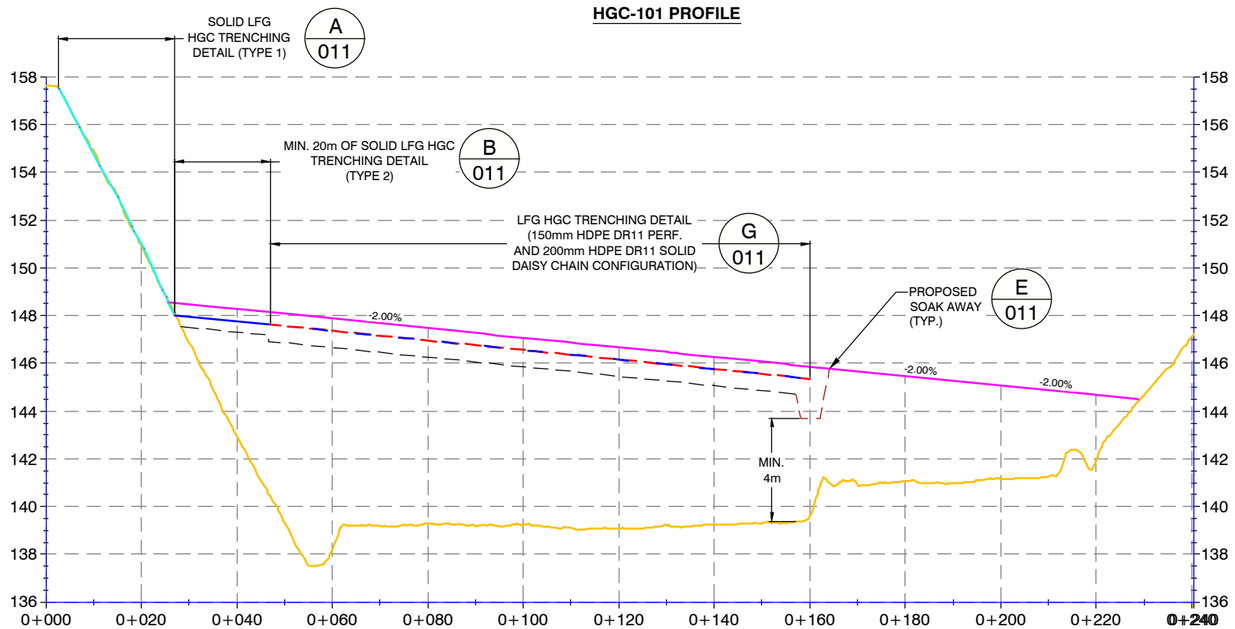
CELL 4 LIFT 3 LFG MANAGEMENT PLAN

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23001-004	A	004

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HGC-101 PROFILE



HGC-102 PROFILE

LEGEND:

- EXISTING GROUND PROFILE - 2024 OCT 24
- DESIGNED FILL PROFILE - CELL 4 LIFT 1
- DESIGNED PIPE TRENCHING PROFILE
- DESIGNED 150mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE
- DESIGNED SOAK AWAY

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

50 0 50m

SCALE = 1:1250

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APPROVED BY:	AA	VERTICAL SCALE:	1:250

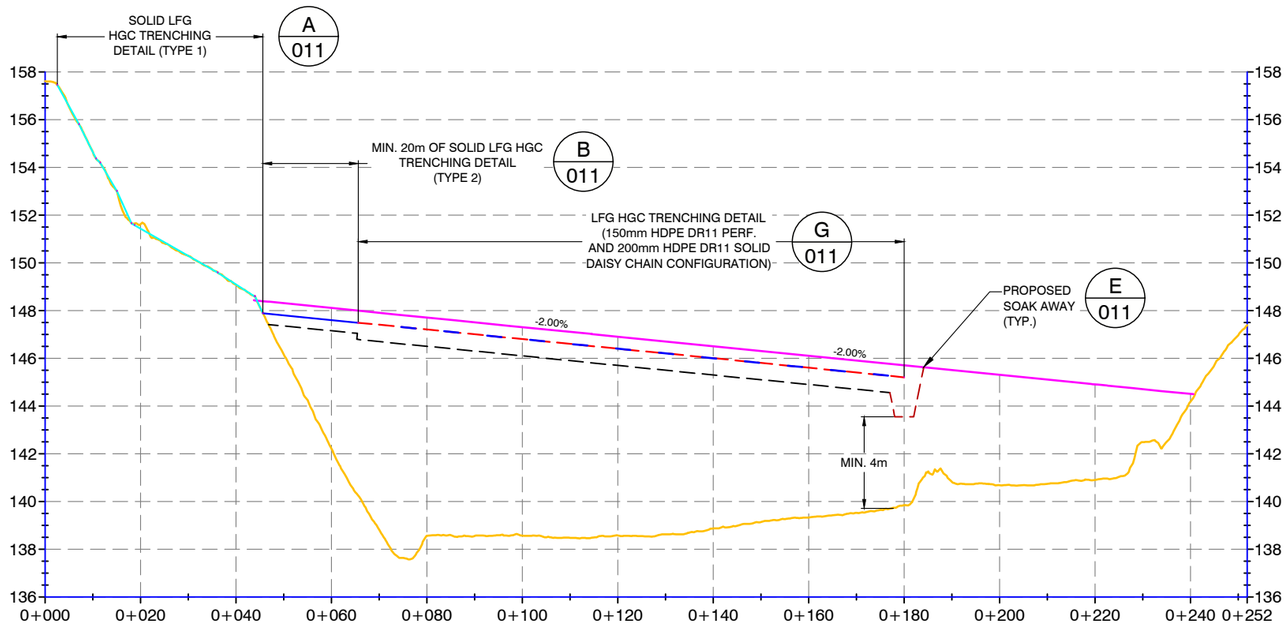
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HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

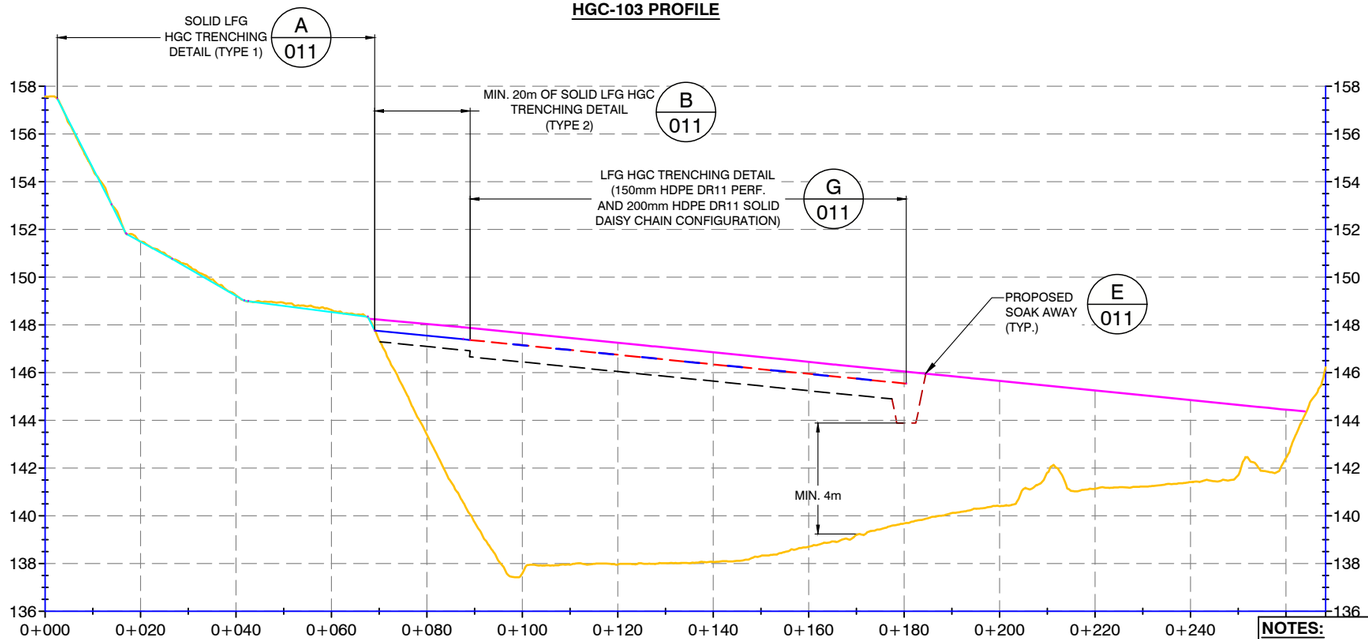
PROFILE (HGC-101 & HGC-102)

DRAWING NO:	REV	SHEET
23001-005	A	005

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HGC-103 PROFILE



HGC-104 PROFILE

LEGEND:

- EXISTING GROUND PROFILE - 2024 OCT 24
- DESIGNED FILL PROFILE - CELL 4 LIFT 1
- DESIGNED PIPE TRENCHING PROFILE
- DESIGNED 150mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE
- DESIGNED SOAK AWAY

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

50 0 50m

SCALE = 1:1250

SPERLING HANSEN ASSOCIATES

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

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APPROVED BY:	AA	VERTICAL SCALE:	1:250

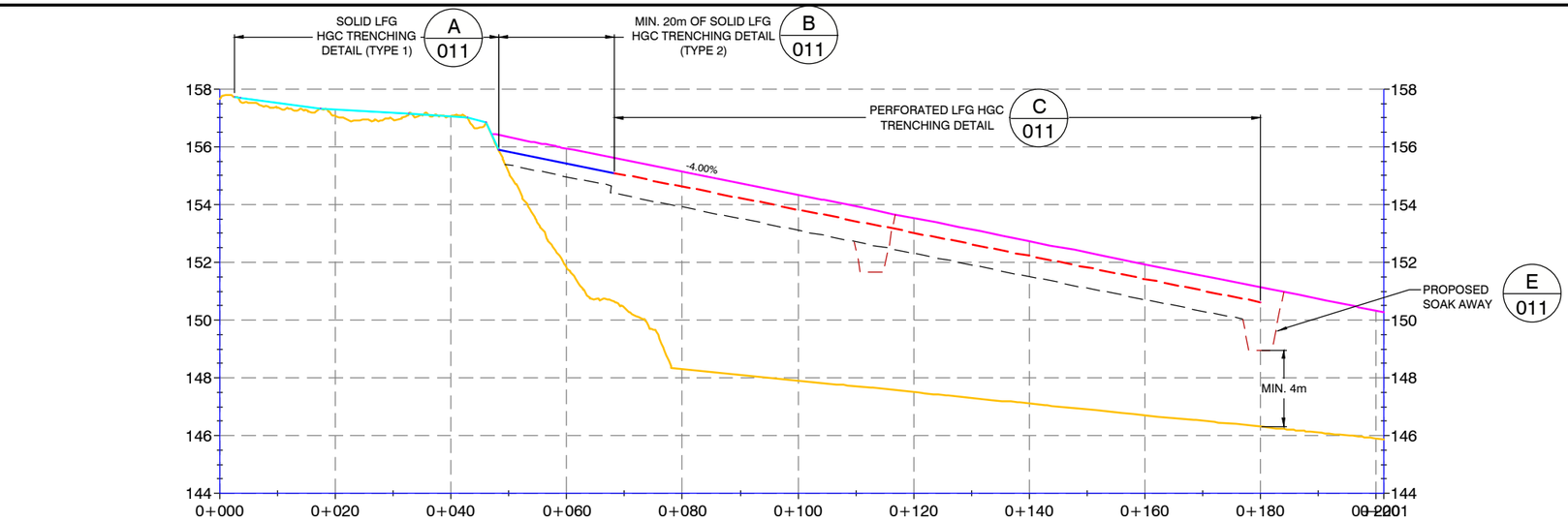
ADJUST SCALE 50% FOR 34"x22" SHEET

HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

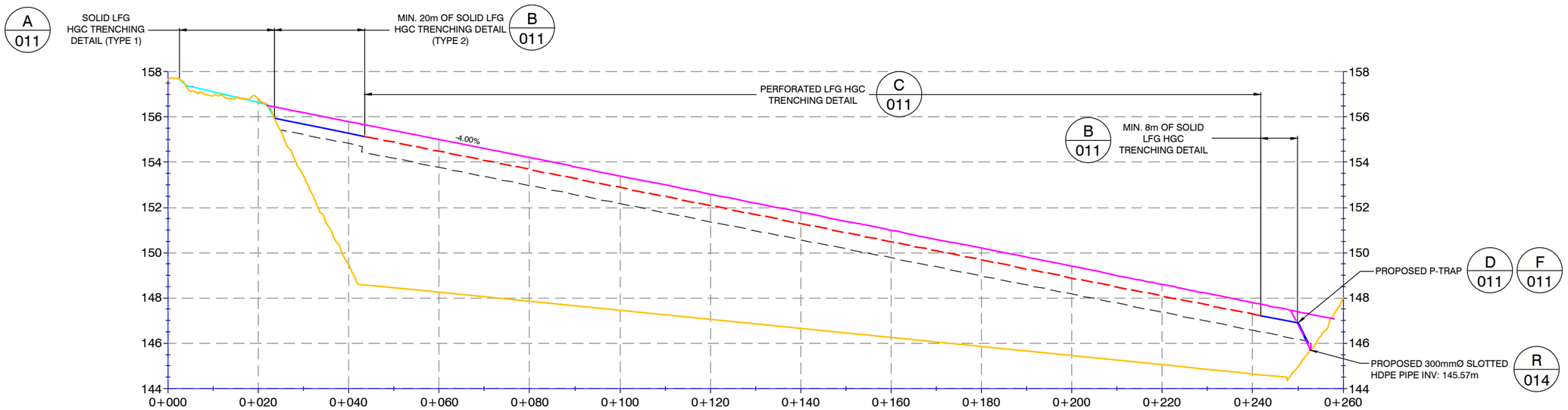
PROFILE (HGC-103 & HGC-104)

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23001-006	A	006

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HGC-201 PROFILE



HGC-202 PROFILE

LEGEND:

- EXISTING GROUND PROFILE - EG + CELL 4 LIFT 1
- DESIGNED FILL PROFILE - CELL 4 LIFT 2
- DESIGNED PIPE TRENCHING PROFILE
- DESIGNED 150mmØ HDPE DR17 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE
- DESIGNED SOAK AWAY
- DESIGNED HGC INFILTRATION DITCH
- EXISTING 300mmØ HDPE DR11 SOLID PIPE

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

10 0 10 20 30 40 50 60 70 80 90 100m

SCALE = 1:1000

SPERLING HANSEN ASSOCIATES

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- Environmental Monitoring

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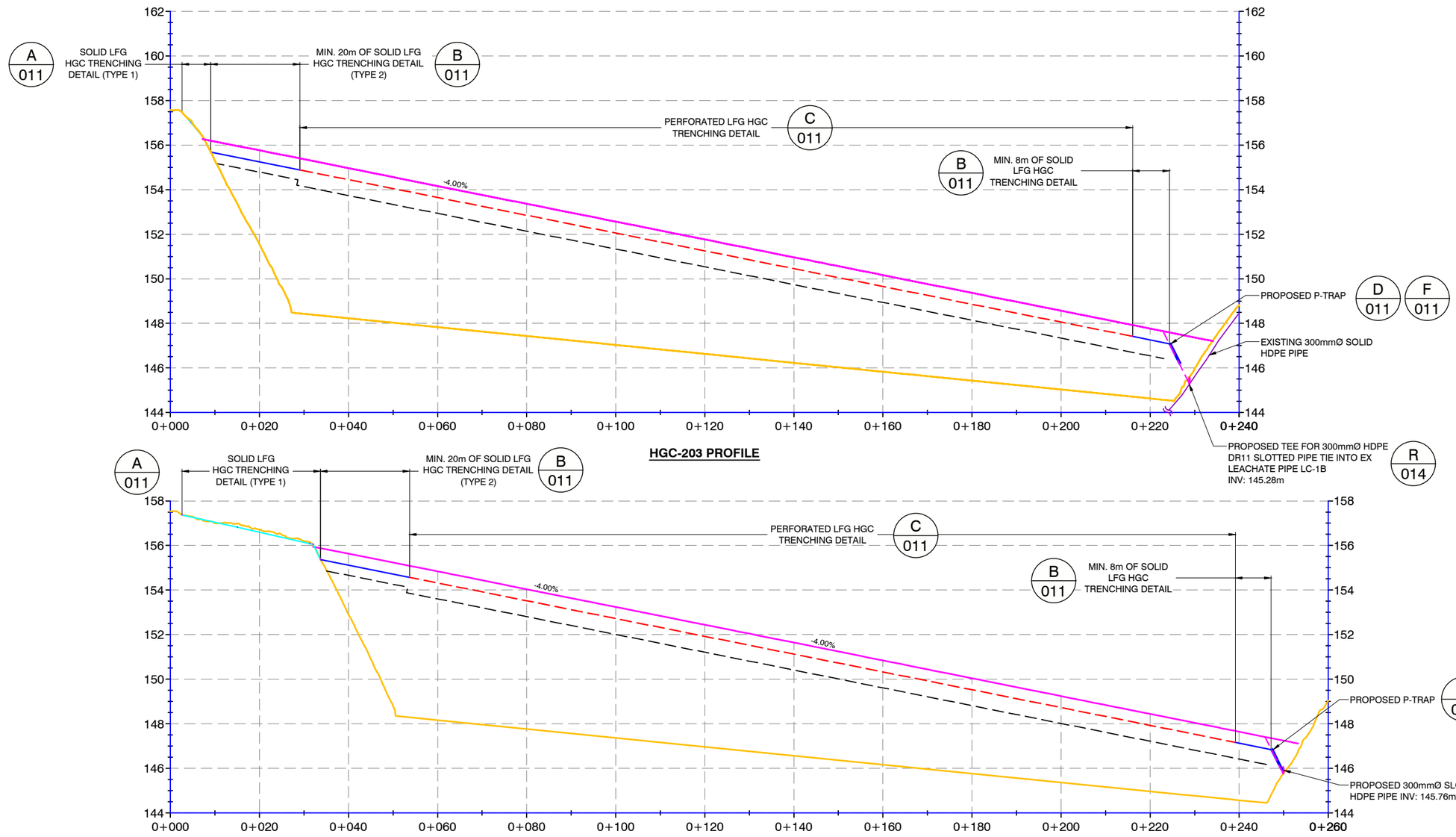
ADJUST SCALE 50% FOR 34"x22" SHEET

HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

PROFILE (HGC-201 & HGC-202)

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23001-007	A	007

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HGC-203 PROFILE

HGC-204 PROFILE

LEGEND:

- EXISTING GROUND PROFILE - EG + CELL 4 LIFT 1
- DESIGNED FILL PROFILE - CELL 4 LIFT 2
- DESIGNED PIPE TRENCHING PROFILE
- DESIGNED 150mmØ HDPE DR17 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE
- DESIGNED SOAK AWAY
- DESIGNED HGC INFILTRATION DITCH
- EXISTING 300mmØ HDPE DR11 SOLID PIPE

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

10 0 10 20 30 40 50 60 70 80 90 100m
SCALE = 1:1000

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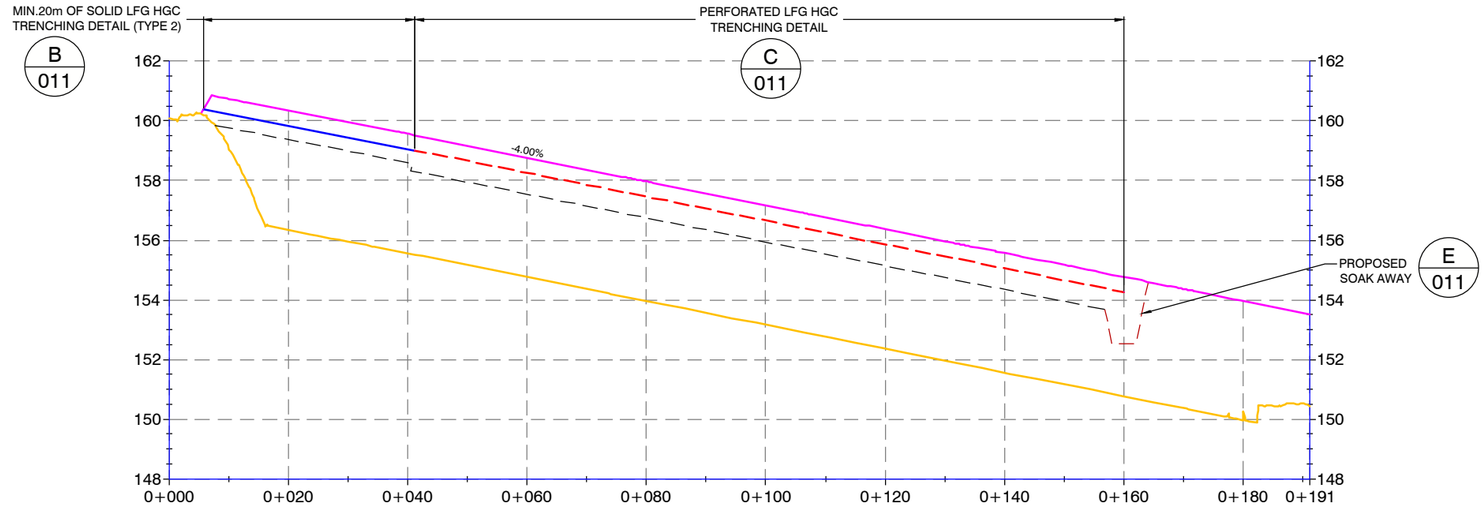
ADJUST SCALE 50% FOR 34"x22" SHEET

HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

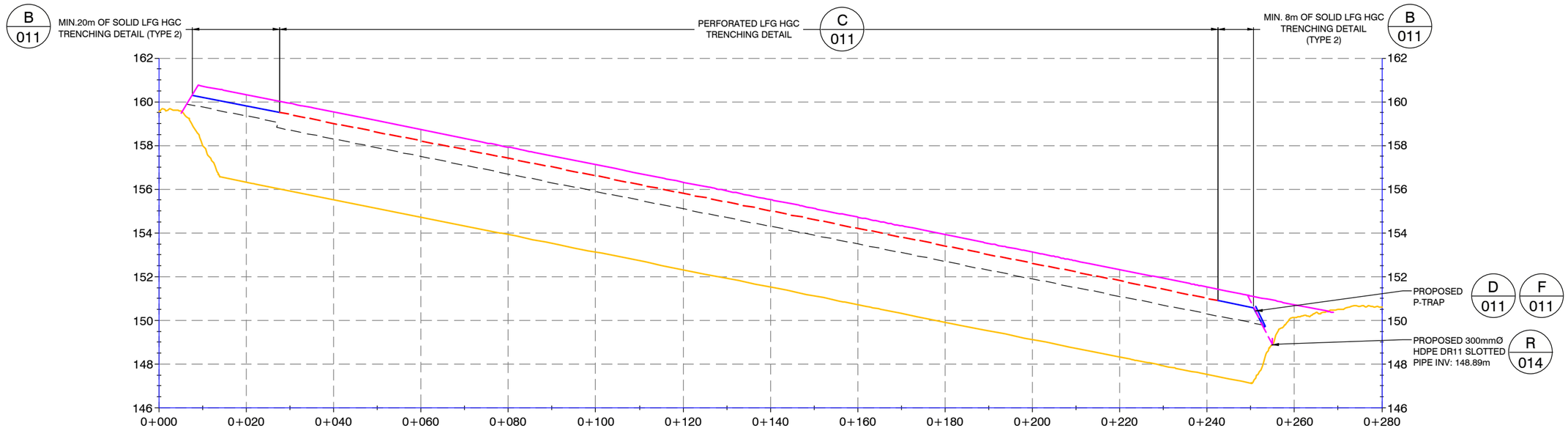
PROFILE (HGC-203 & HGC-204)

DRAWING NO:	REV	SHEET
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HGC-301 PROFILE



HGC-302 PROFILE

LEGEND:

- EXISTING GROUND PROFILE - EG + CELL 4 LIFT 1 - 2
- DESIGNED FILL PROFILE - CELL 4 LIFT 3
- DESIGNED PIPE TRENCHING PROFILE
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE
- DESIGNED SOAK AWAY
- DESIGNED HGC INFILTRATION DITCH
- EXISTING 300mmØ HDPE DR11 SOLID PIPE

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

10 0 10 20 30 40 50 60 70 80 90 100m

SCALE = 1:1000

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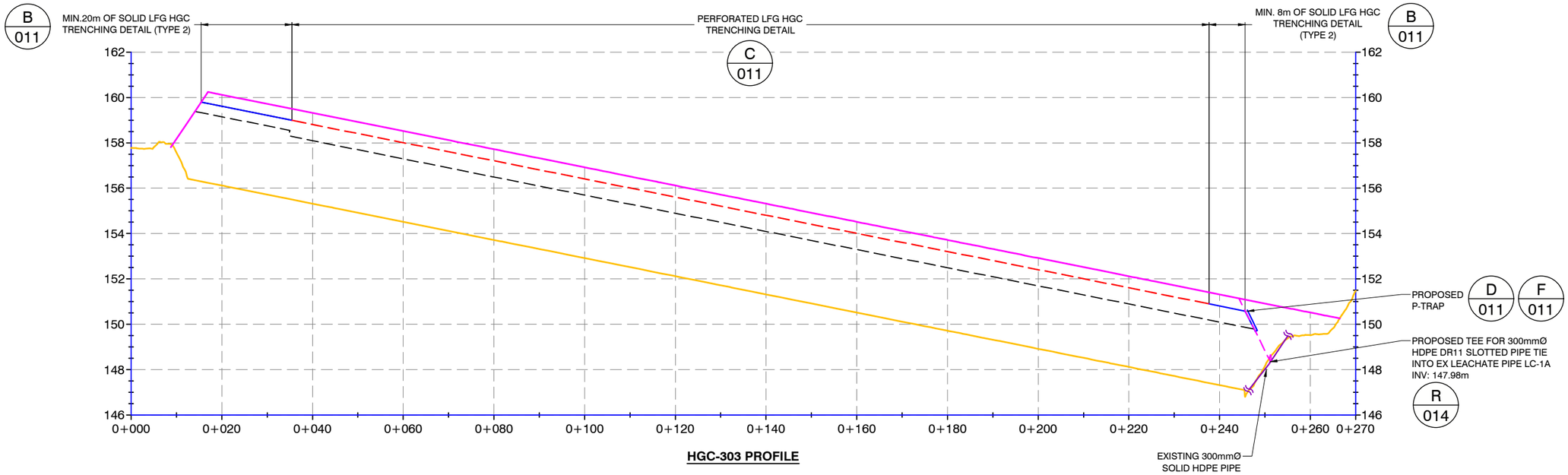
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HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

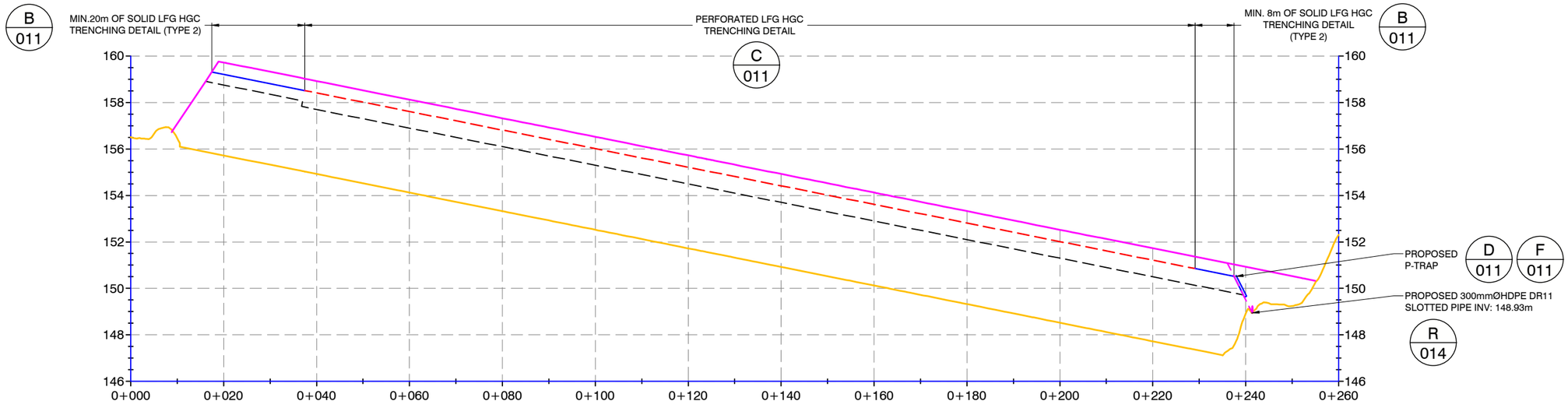
PROFILE (HGC-301 & HGC-302)

DRAWING NO:	REV	SHEET
23001-009	A	009

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HGC-303 PROFILE



HGC-304 PROFILE

LEGEND:

- EXISTING GROUND PROFILE - EG + CELL 4 LIFT 1 - 2
- DESIGNED FILL PROFILE - CELL 4 LIFT 3
- DESIGNED PIPE TRENCHING PROFILE
- DESIGNED 150mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 SOLID PIPE
- DESIGNED 200mmØ HDPE DR11 PERF. PIPE
- DESIGNED SOAK AWAY
- DESIGNED HGC INFILTRATION DITCH
- EXISTING 300mmØ HDPE DR11 SOLID PIPE

NOTES:

1. EXISTING GROUND CONTOURS ARE A COMBINATION OF TOPOGRAPHIC SURVEYS
   - 2024 OCT 24 AERIAL SURVEY BY CRD
   - CELL 5A CLAY BERM DESIGN BY SHA

10 0 10 20 30 40 50 60 70 80 90 100m

SCALE = 1:1000

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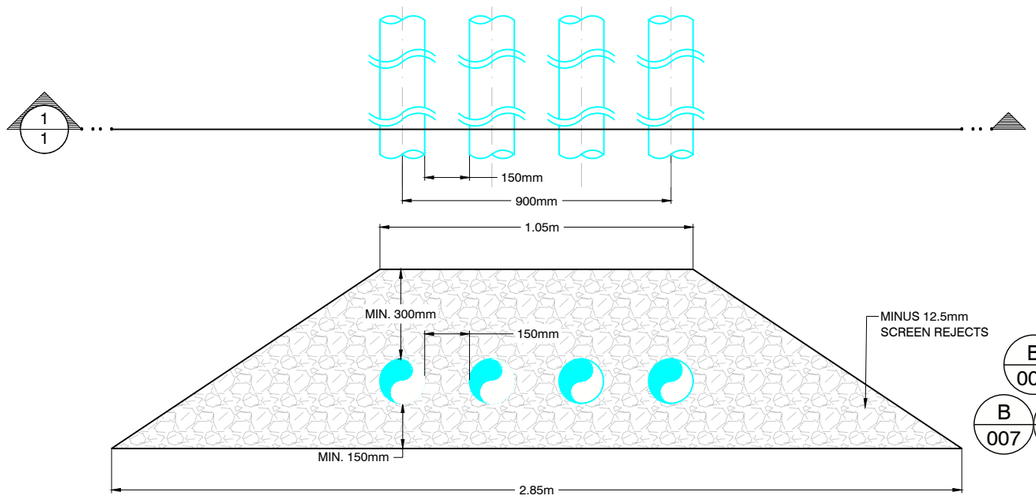
ADJUST SCALE 50% FOR 34"x22" SHEET

HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

PROFILE (HGC-303 & HGC-304)

DRAWING NO:	REV	SHEET
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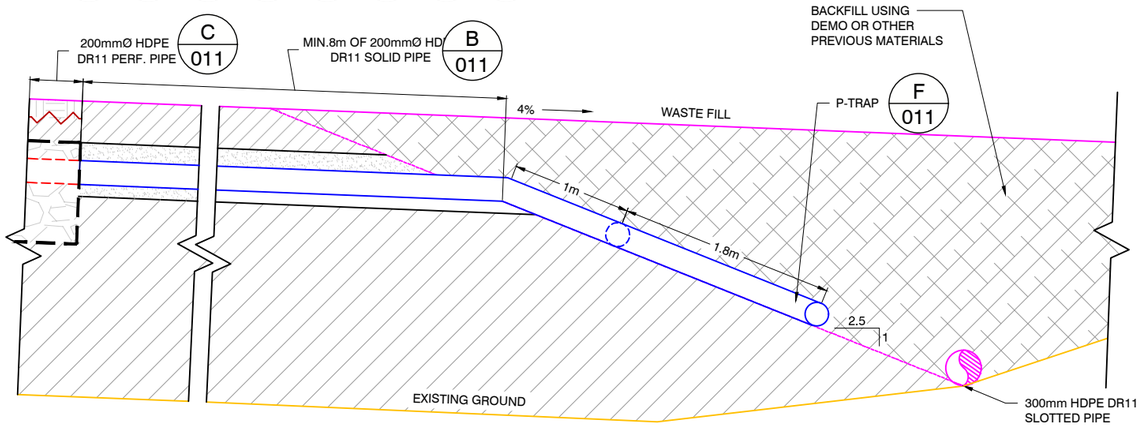


SECTION 1

A 002 | A 003 | A 005 | A 006 | A 007 | A 008 | A 014 | A 015

REMOTE WELL LFG PIPE COMMON BERM (TYPE 1)

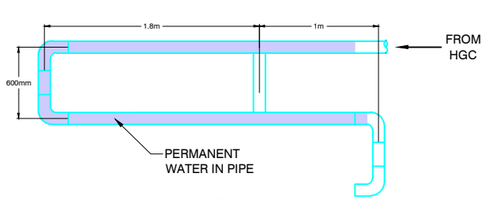
SCALE NTS



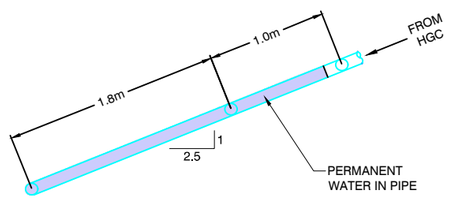
B 003 | B 004 | B 007 | B 008 | B 009 | D 010

TYPICAL HORIZONTAL GAS COLLECTOR INFILTRATION DITCH AND P-TRAP DETAIL

SCALE 1:50



PLAN VIEW

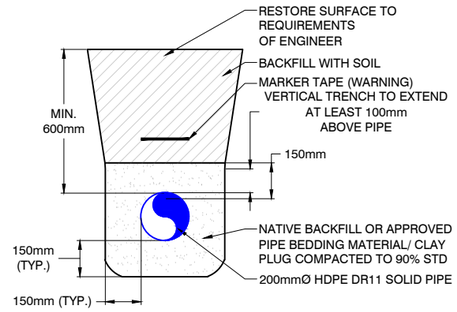


PROFILE VIEW

F 003 | F 004 | F 007 | F 008 | F 009 | F 011

HORIZONTAL COLLECTOR P-TRAP DETAIL

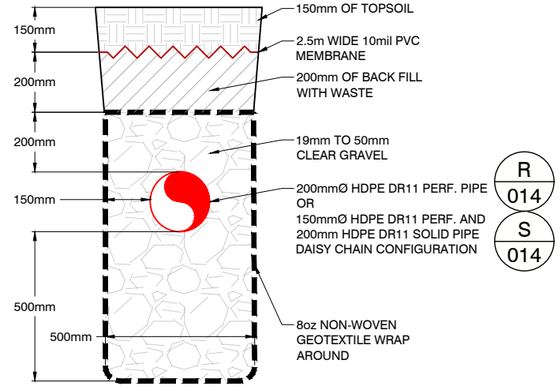
SCALE 1:50



B 002 | B 003 | B 004 | B 005 | B 006 | B 007 | B 008 | B 009 | B 010 | B 011 | B 015

HORIZONTAL LFG SOLID COLLECTOR TRENCH DETAIL (TYPE 2)

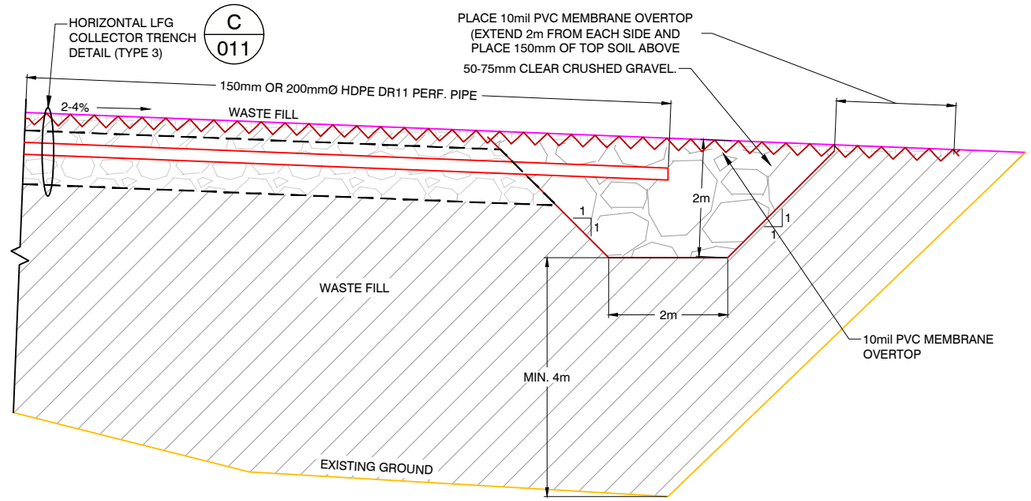
SCALE 1:20



C 003 | C 004 | C 007 | C 008 | C 009 | C 010 | C 011 | C 015

HORIZONTAL LFG PERF. COLLECTOR TRENCH DETAIL (TYPE 3)

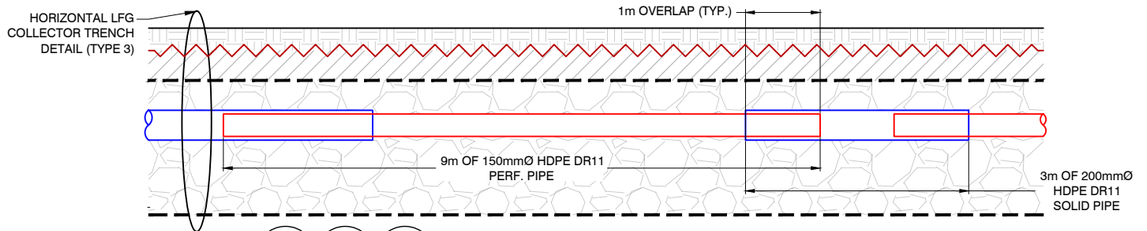
SCALE 1:20



E 002 | E 003 | E 004 | E 005 | E 006 | E 007 | E 009

TYPICAL SOAK AWAY DETAIL

SCALE 1:100



G 002 | G 005 | G 006

DAISY CHAIN CONFIGURATION DETAIL (LIFT 1 ONLY)

SCALE NTS

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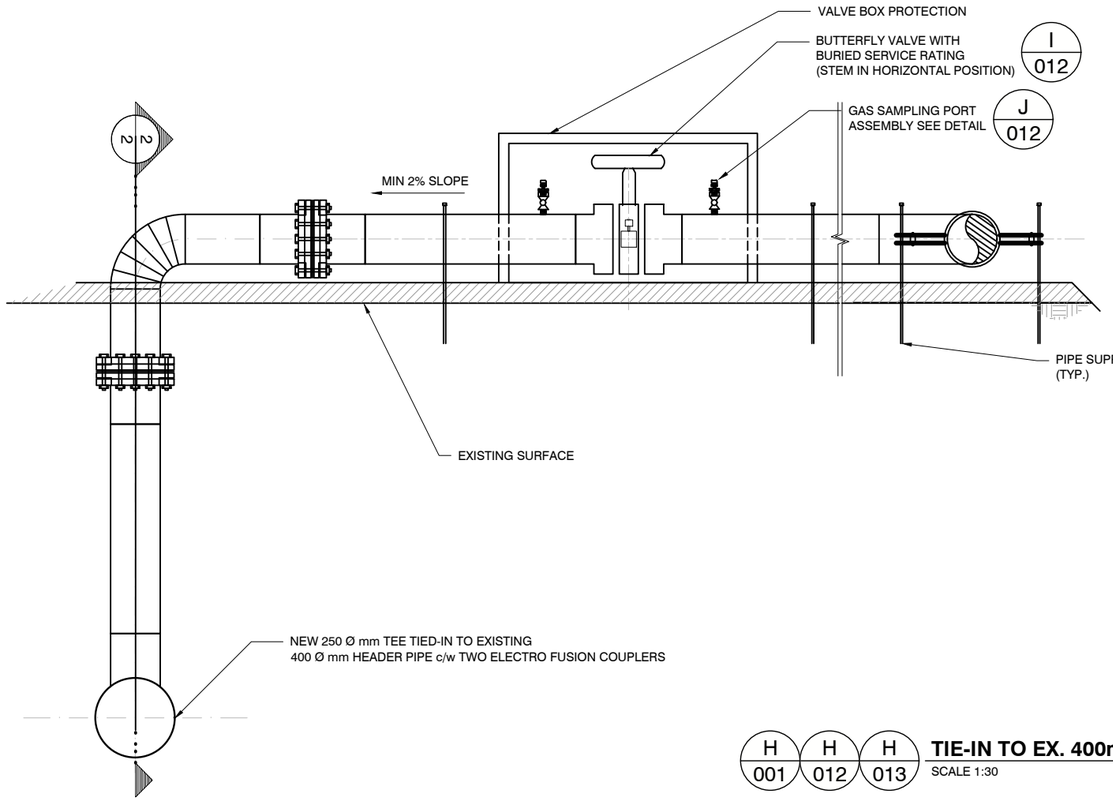
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DRAWN BY:	AT	DATE CREATED:	2025/07/16
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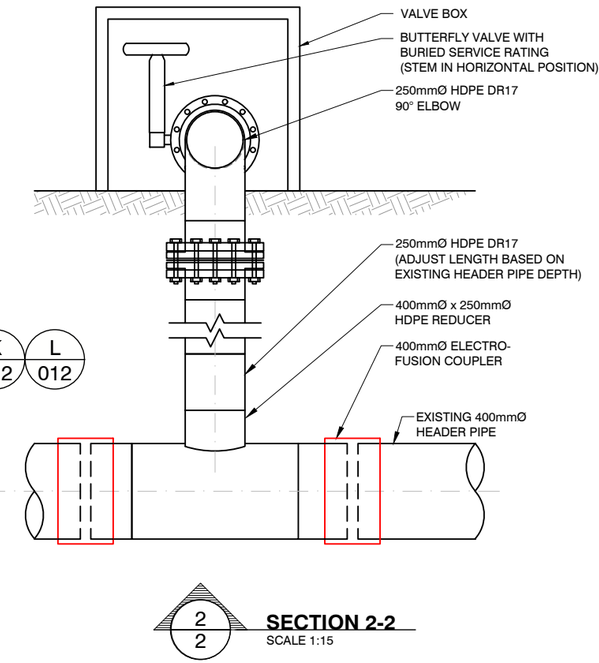
HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

DETAILS 1

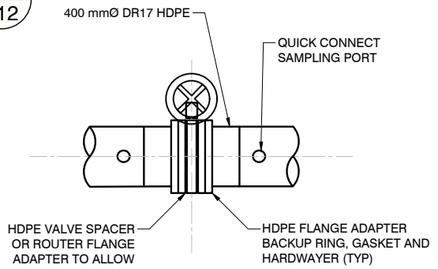
DRAWING NO:	REV	SHEET
23001-011	A	011



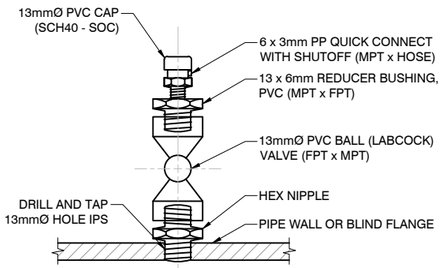
H 001 H 012 H 013 **TIE-IN TO EX. 400mmØ HEADER PIPE DETAIL (OPTION 1)**
SCALE 1:30



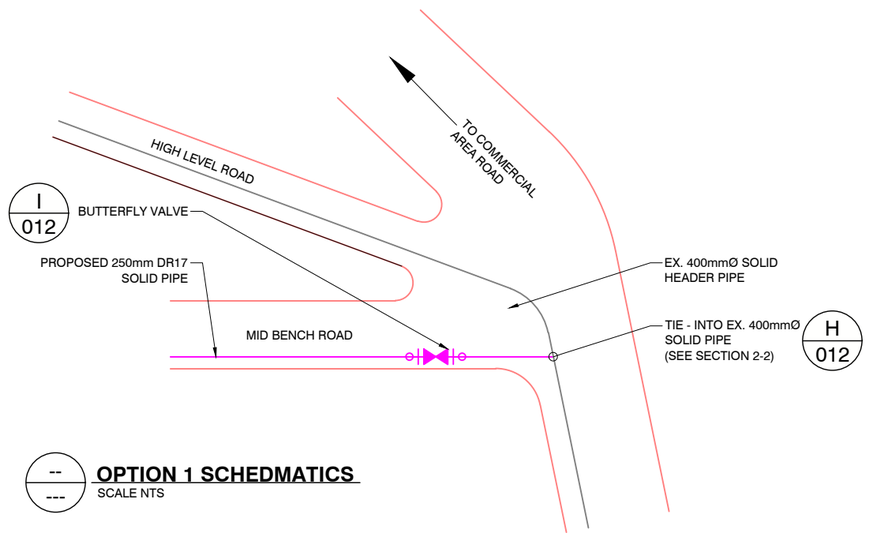
2 2 **SECTION 2-2**
SCALE 1:15



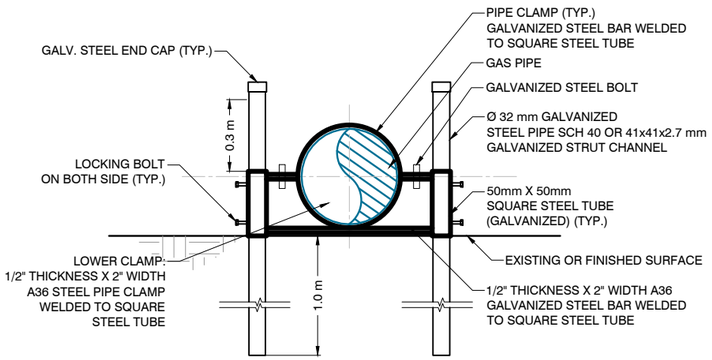
I 012 I 013 **BUTTERFLY VALVE DETAIL (TOP VIEW)**
SCALE 1:15



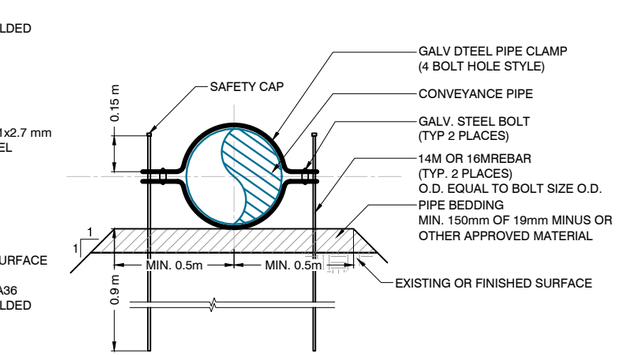
J 012 **QUICK CONNECT SAMPLING PORT DETAILS -**
SCALE 1:30



-- --- **OPTION 1 SCHEDMATICS**
SCALE NTS



K 002 K 003 K 004 K 012 K 013 **PIPE SUPPORT - TYPE 2**
SCALE 1:20



L 002 L 003 L 004 L 012 L 012 **PIPE SUPPORT - TYPE 1**
SCALE 1:20

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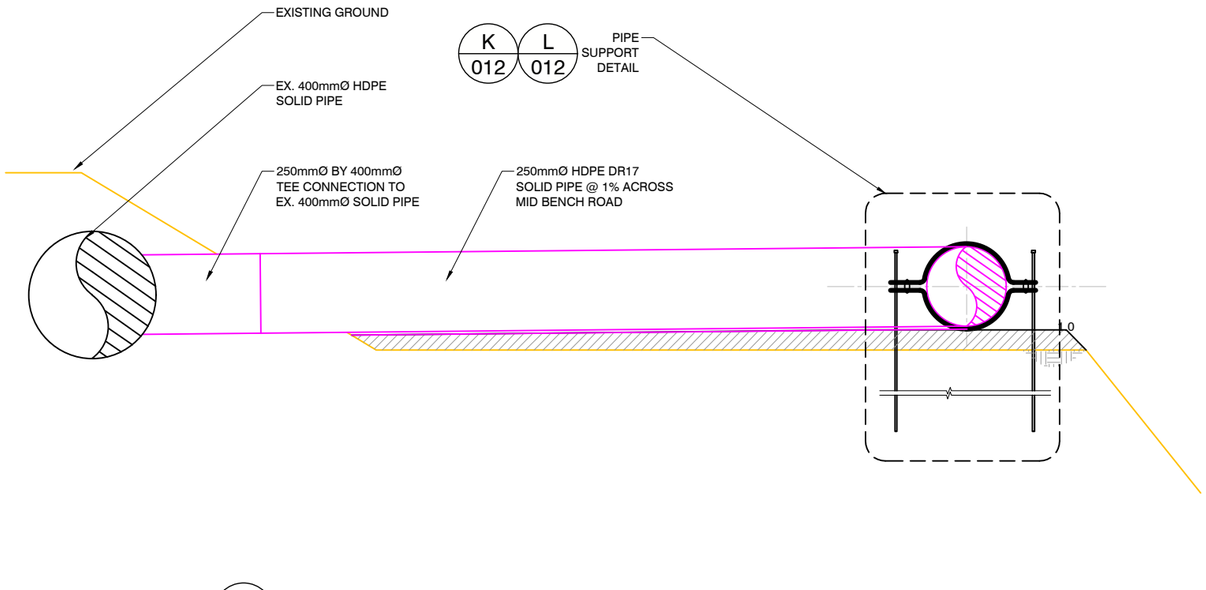
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DRAWN BY:	AT	DATE CREATED:	2025/07/16
CHECKED BY:	TS	HORIZONTAL SCALE:	AS SHOWN
APPROVED BY:	AA	VERTICAL SCALE:	AS SHOWN

ADJUST SCALE 50% FOR 34"x22" SHEET

HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

DETAILS 2

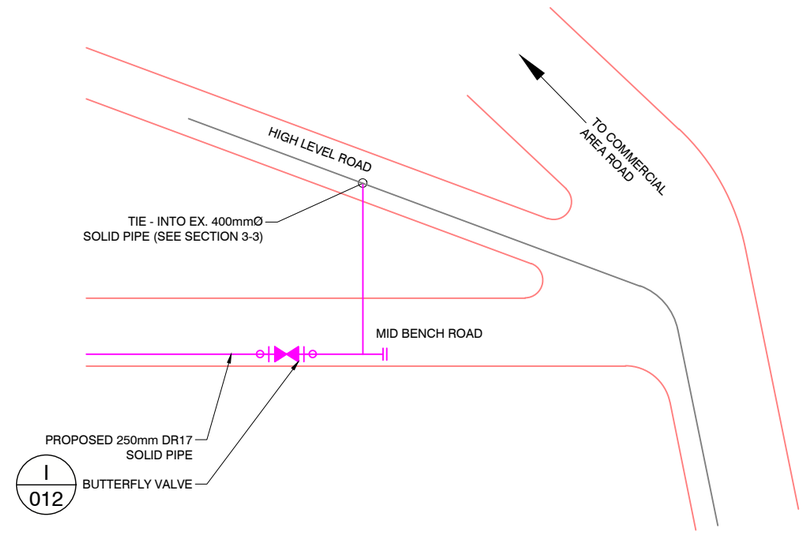
DRAWING NO:	REV	SHEET
23001-012	A	012



M
001

TIE-IN TO EX. 400mmØ HEADER PIPE DETAIL (SECTION 3-3) (OPTION 2)

SCALE 1:30



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OPTION 2 SCHEDMATICS

SCALE NTS

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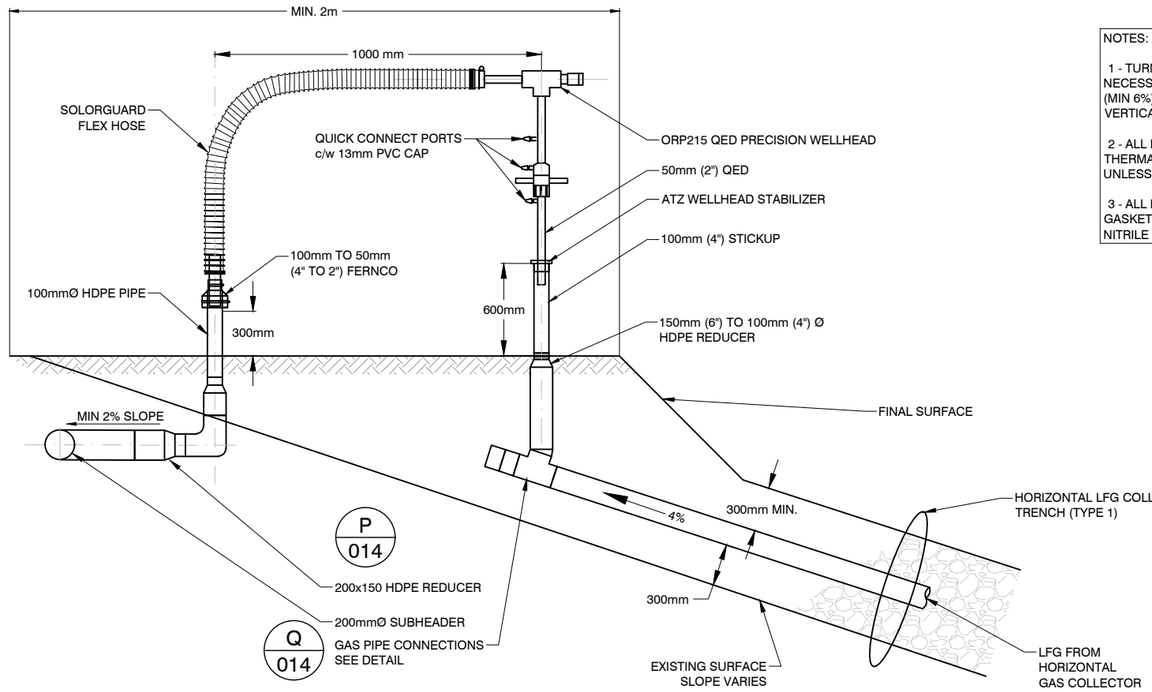
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ADJUST SCALE 50% FOR 34"X22" SHEET

HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

DETAILS 3

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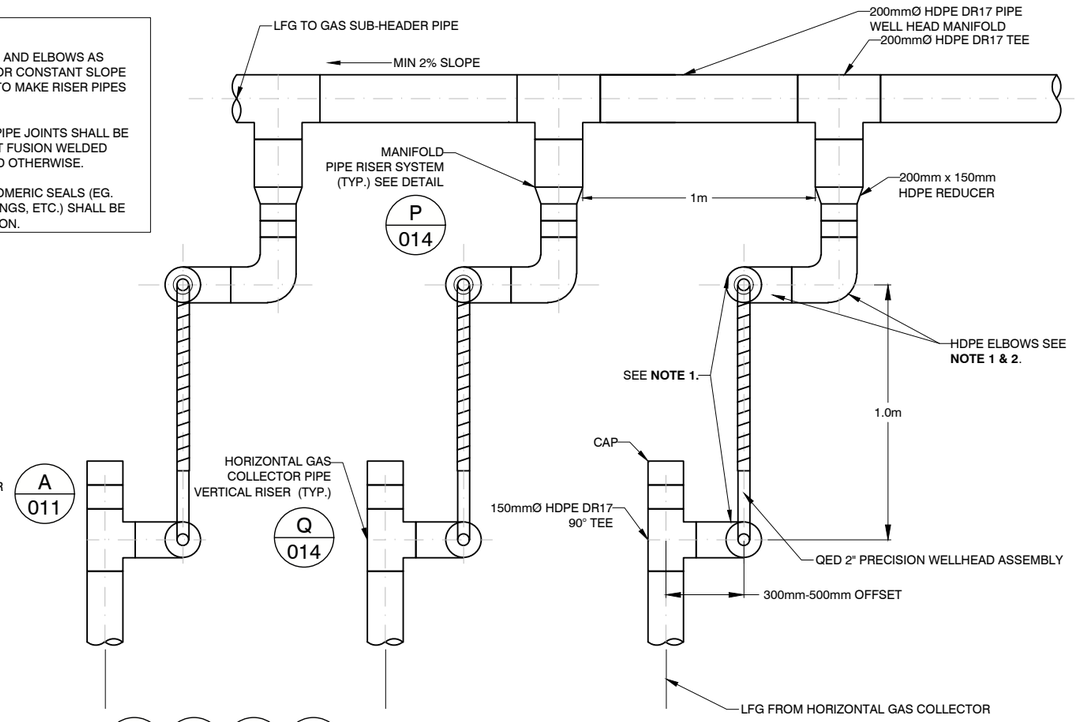
N 002 / N 003 / N 004 / N 015 **RISER PIPE (WELLHEAD) CONNECTION TO MANIFOLD DETAIL**
SCALE 1:40

NOTES:

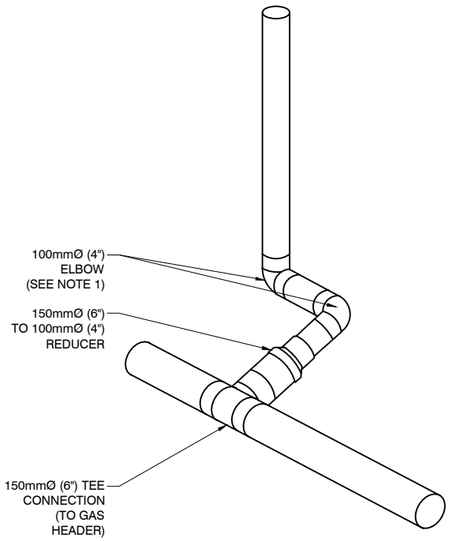
1 - TURN TEES AND ELBOWS AS NECESSARY FOR CONSTANT SLOPE (MIN 6%) AND TO MAKE RISER PIPES VERTICAL.

2 - ALL HDPE PIPE JOINTS SHALL BE THERMAL BUTT FUSION WELDED UNLESS NOTED OTHERWISE.

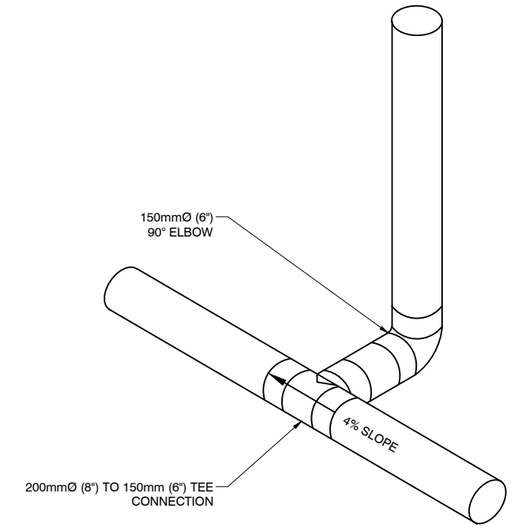
3 - ALL ELASTOMERIC SEALS (EG. GASKETS, O-RINGS, ETC.) SHALL BE NITRILE OR VITON.



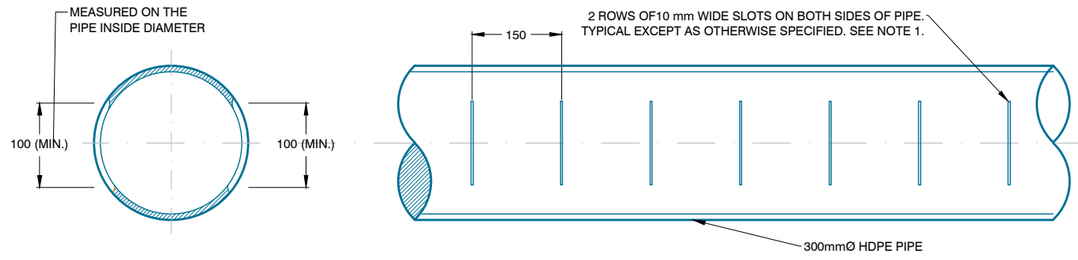
O 002 / O 003 / O 004 / O 015 **RISER PIPE (WELLHEAD) CONNECITON TO MANIFOLD PLAN VIEW**
SCALE 1:25



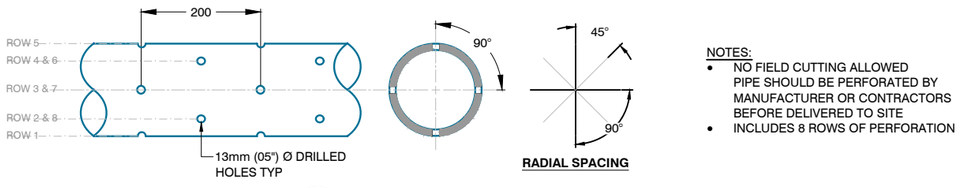
P 014 / P 015 **MANIFOLD PIPE RISER SYSTEM**
SCALE NTS



Q 014 / Q 015 **HORIZONTAL GAS COLLECTOR VERTICAL RISER**
SCALE NTS



R 003 / R 004 / R 007 / R 008 / R 009 / R 010 / R 011 **SLOTTED HDPE PIPE DETAIL (300mm)**
SCALE 1:25



NOTES:
- NO FIELD CUTTING ALLOWED PIPE SHOULD BE PERFORATED BY MANUFACTURER OR CONTRACTORS BEFORE DELIVERED TO SITE
- INCLUDES 8 ROWS OF PERFORATION

S 011 **PERFORATED HDPE PIPE DETAIL (200mm)**
SCALE 1:25

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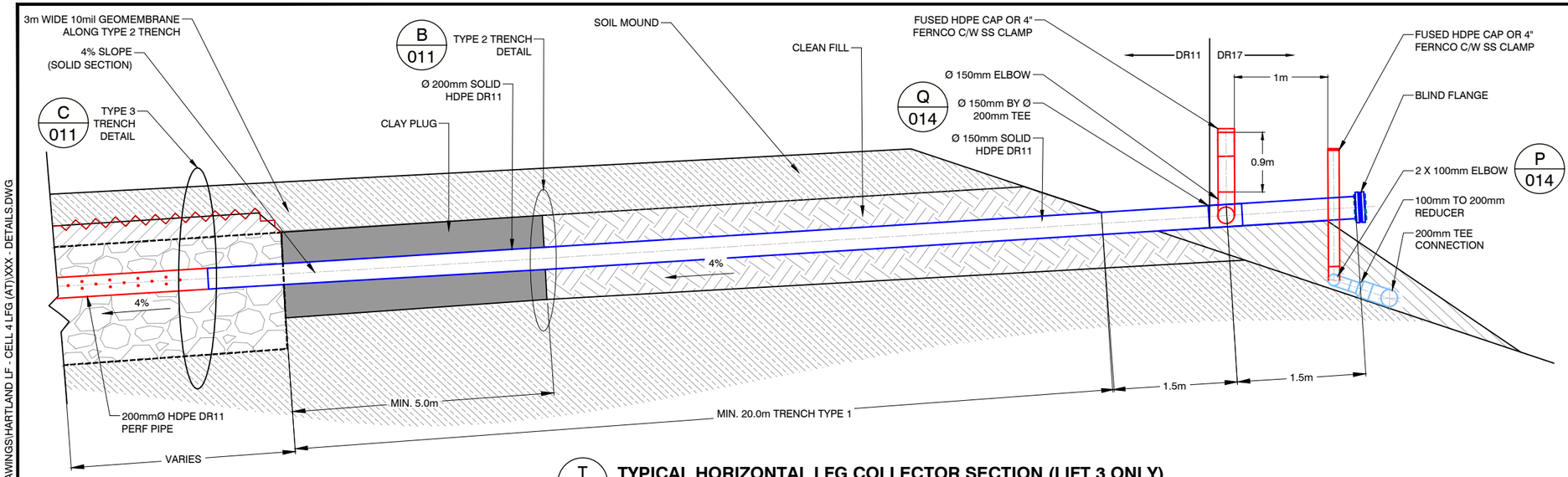
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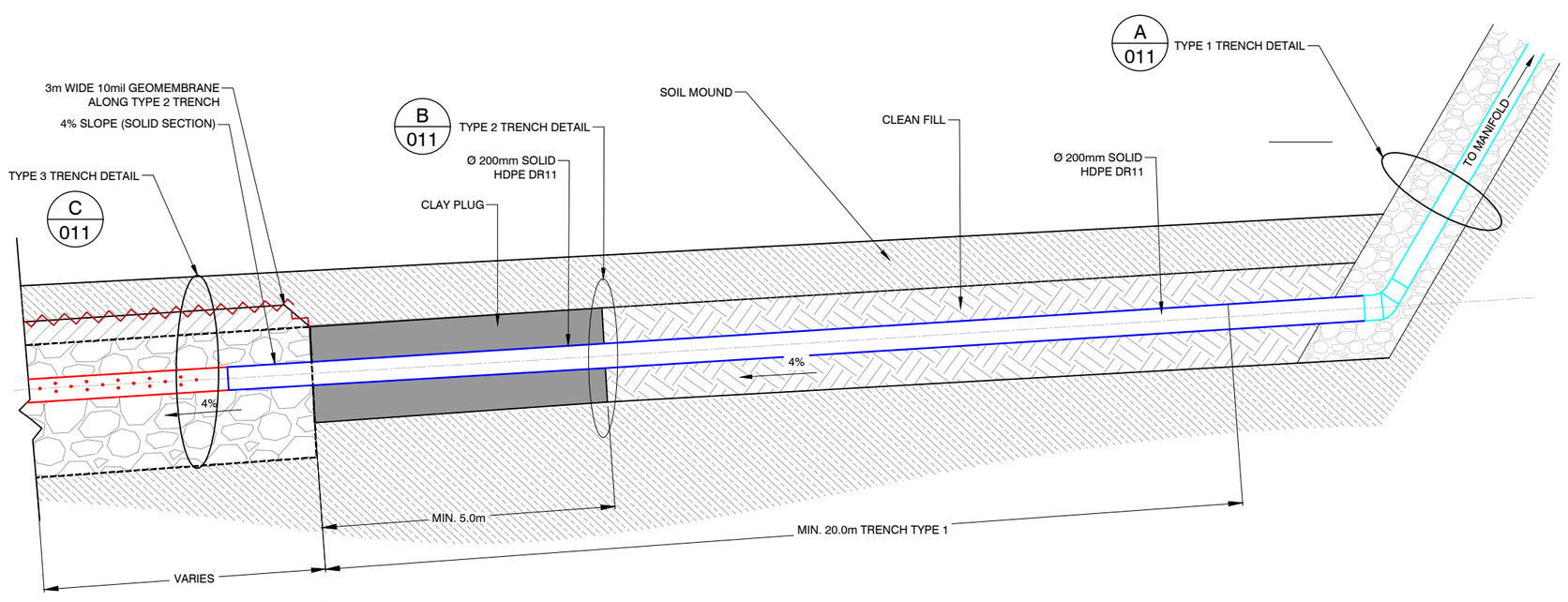
DETAILS 4

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23001-014	A	014

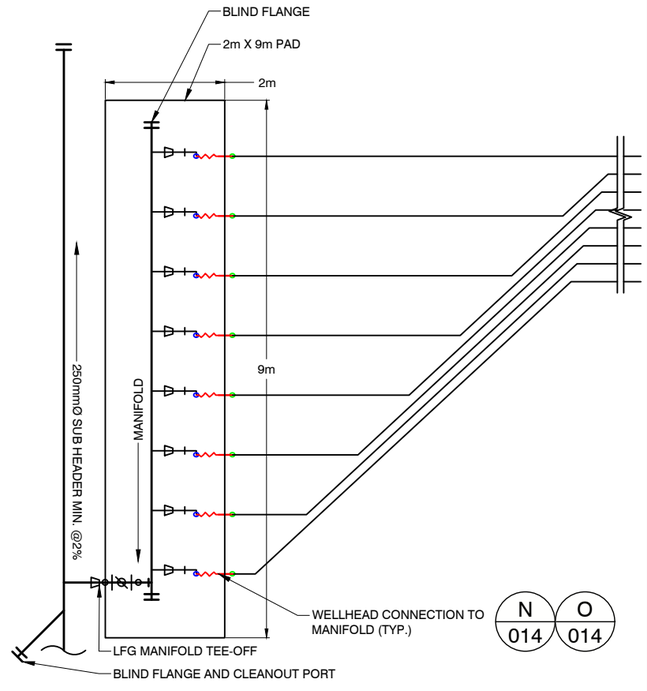
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T --- **TYPICAL HORIZONTAL LFG COLLECTOR SECTION (LIFT 3 ONLY)**
SCALE NTS



U --- **TYPICAL HORIZONTAL LFG COLLECTOR SECTION (LIFT 2 ONLY)**
SCALE NTS



V 002 V 003 V 004 **MANIFOLD CONNECTION TO LFG SUBHEADER AND HEADER**
SCALE NTS

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HARTLAND LANDFILL - LFG CELL 4 DETAILED DESIGN

DETAILS 5

DRAWING NO:	REV	SHEET
23001-015	A	015

APPENDIX E

Landfill Gas (LFG) Monitoring Program

E1 Grid and Hot Spot Monitoring Methodology

E2 LFG Monitoring Program - Gas Probe Data

Appendix E1 Grid and Hot Spot Monitoring Methodology

The following is the grid sampling field methodology, as outlined in *Hartland Landfill Standard Operating Procedures* (2012).

Monitoring usually takes two full days, beginning at 0730 hours and ending between 1600 and 1630. Prior to each monitoring day, the gas analyzer must be calibrated using the calibration gases at Hartland. At the beginning of each field day, the fuel cell for the Flame Ionization Detector (FID) is filled with hydrogen gas and the unit is warmed up for at least 30 minutes before calibration. Calibration is conducted with two methane span gases (currently 500 ppm and 14,990 ppm methane), and a zero gas to generate a proper calibration slope. After successful calibration, as span check is completed and recorded on the calibration sheet. In addition, the Jerome sensor is regenerated at the beginning and end of each day to remove any residual hydrogen sulphide on the gold sensor.

The Jerome analyzer is factory calibrated and, therefore, does not require field calibration. After regeneration, the instrument is turned on for 30 minutes before zeroing. Once it is zeroed, the zero filter is attached to the unit and a sample is taken.

MONITORING

There is an established walking pattern over the grid points, and it denotes two distinct monitoring areas (Phase 1 and Phase 2/Active Face). These areas are monitored separately, due to the distinct differences in gas concentrations, level of landfilling activity, and placement of litter fences. This results in acquisition of data from a similar area under similar environmental conditions, as monitoring typically takes two days. In each area, the grid points are traversed alphabetically (e.g., B1, B2, B3, B4, etc.) where physically possible. In some cases, litter fences, controlled waste trenches or active filling areas limit or restrict access resulting in deviation from the standard protocol. These deviations should be recorded on the field sheet.

Weather conditions dictate when this monitoring can be completed. The FID cannot operate in rainy conditions and monitoring should be delayed until two consecutive days of dry weather are predicted. In addition, high to moderate winds blow gases away from their origin and dilute gas concentrations. These conditions are not representative of typical landfill conditions and monitoring does not take place on these days.

The following procedure is used to collect methane and H_2S readings at each grid point:

1. Place the hydrogen sulphide (H_2S) analyzer on the ground then press the “Sample” button.
2. The second staff person should place the FID intake controller 4 inches from the ground surface for 30 seconds.
3. Once the H_2S analyzer has reported a value (approximately 30 seconds), the methane value should be read from the FID and both values recorded on the field sheet.
4. The FID is programmed to alarm if methane levels exceed 100 ppm. If the alarm sounds while walking a traverse, staff must investigate the area for the source of elevated methane by means of a detailed 10-by-10 meter (m) grid. The 10-by-10 m grid should be traversed between all adjacent grid points. Obvious sources of methane include bird poles or a seam/edge of a temporary closure lining.
5. Once the source has been identified, record the source description, methane and H_2S values, as well as the location coordinates. This data represents a “hot spot” (>1,000 ppm of methane) or “Z-spot” (>12,500 ppm of methane), identified on figures 5 and 6 as a red, or purple, ‘X’, respectively.
6. If an obvious source cannot be identified, the location and data/observations from the highest localized reading should be recorded.
7. Continue with this method until all grid points, background stations, and pre-existing Z-spots have been monitored. Pre-existing Z-spots can be removed from the monitoring list if methane levels are below 1,000 ppm for three consecutive monitoring events.
8. At the end of each field day, a span check is completed on the FID and recorded on the field sheet.

Appendix E2 LFG Monitoring Program - Gas Probe Data

Table 1. Maximum Value Gas Concentrations in Perimeter Probes (Yellow) and Foundation Probes (Orange)

Well ID #	CH4 (%)	CO2 (%)
GP-01A	0.20	1.60
GP-01B	0.30	4.90
GP-02A	0.20	20.70
GP-02B	0.30	53.00
GP-03A	9.90	6.00
GP-03B	24.70	19.70
GP-04A	49.90	44.90
GP-05A	13.30	14.70
GP-06A	0.50	3.70
GP-06B	0.40	6.50
GP-07A	0.40	4.50
GP-07B	0.30	2.20
GP-08A	0.40	1.00
GP-09A	0.30	1.00
GP-11A	0.90	0.80
GP-11B	0.20	19.00
GP-12A	0.20	20.80
GP-12B	0.20	13.00
GP-13A	20.70	22.70
GP-17A	0.10	21.10
GP-18A	0.10	21.00

APPENDIX F

Grid and Hotspot Monitoring

Table 1. Hartland Landfill VOC & TRS Grid Data

Summer 2025		
WAYPOINT	Methane (ppm)	H2S (ppm)
BACK-1	0.0	0.000
BACK-10	0.0	0.000
BACK-11	0.0	0.000
BACK-12	0.0	0.000
BACK-13	0.0	0.000
BACK-20	0.0	0.000
BACK-21	0.0	0.000
BACK-6	0.0	0.000
BACK-7	0.0	0.000
B1	0.0	0.000
B2	0.1	0.000
B3	0.0	0.000
B4	0.0	0.000
B5	0.0	0.000
B6	0.4	0.000
B7	0.5	0.000
B8	0.5	0.000
B9	0.6	0.000
B10	0.0	0.000
C1	0.0	0.000
C2	0.0	0.000
C3	0.0	0.000
C4	0.8	0.000
C5	0.0	0.000
C6	0.0	0.000
C7	0.0	0.000
C8	0.0	0.000
C9	0.0	0.000
C10	0.0	0.000
C11	0.0	0.000
D1	0.0	0.000
D2	0.0	0.000
D3	0.0	0.000
D4	0.0	0.000
D5	0.0	0.000
D6	0.0	0.000
D7	0.0	0.000
D8	0.0	0.000
D9	15.0	0.000
D10	11.0	0.000
D11	12.0	0.000
E1	0.0	0.000
E2	0.0	0.000
E3	0.0	0.000
E4	0.0	0.000
E5	0.0	0.000
E6	0.0	0.000
E7	0.0	0.000
E8	14.0	0.000

Appendix F
Table 1, continued

Summer 2025		
WAYPOINT	**Methane (ppm)**	**H2S (ppm)**
E9	15.0	0.000
E10	15.0	0.000
E11	20.0	0.000
F1	0.0	0.000
F2	0.0	0.000
F3	0.0	0.000
F4	0.0	0.000
F5	0.0	0.000
F6	0.0	0.000
F7	4.0	0.002
F8	4.0	0.005
F9	12.0	0.003
F10	52.0	0.095
F11	30.0	0.007
F12	12.0	0.000
G1	0.0	0.000
G2	0.0	0.000
G3	0.0	0.000
G4	0.0	0.000
G5	0.0	0.000
G6	0.0	0.000
G7	0.0	0.000
G8	15.0	0.000
G9	10.0	0.000
G10	30.0	0.000
G11	21.0	---
G12	25.0	0.000
G13	34.0	0.000
G14	10.0	0.000
G15	11.0	0.000
H1	0.0	0.000
H2	0.0	0.000
H3	0.0	0.000
H4	0.0	0.000
H5	0.0	0.000
H6	0.0	0.000
H7	15.0	0.000
H8	5.0	0.000
H9	4.0	0.000
H10	22.0	0.000
H11	16.0	0.000
H12	Too high	0.000
H13	Too high	0.000
I1	0.0	0.000
I2	0.0	0.000
I3	0.0	0.000
I4	0.0	0.000
I5	0.0	0.000
I6	0.0	0.000
I7	2.0	0.000
I8	2.0	0.000

Appendix F
Table 1, continued

Summer 2025		
WAYPOINT	**Methane (ppm)**	**H2S (ppm)**
I9	4.0	0.000
I10	0.0	0.000
I11	0.0	0.000
I12	11000.0	17.330
I13	10000.0	0.000
I14	9000.0	0.000
I15	4000.0	0.000
J1	0.0	0.000
J2	0.0	0.000
J3	0.0	0.000
J4	0.0	0.000
J5	0.0	0.000
J6	0.0	0.000
J7	0.0	0.000
J8	0.0	0.000
J9	0.0	0.000
K1	0.0	0.000
K2	0.0	0.000
K3	0.0	0.000
K4	0.0	0.000
K5	0.0	0.000
K6	0.0	0.000
K7	0.0	0.000
K8	0.0	0.000
K9	0.0	0.000
K10	0.0	0.000
K11	180.0	0.000
K12	Too high	0.000
K13	Too high	0.000
K14	Too high	0.000
K15	Too high	0.003
L1	0.0	0.000
L2	0.0	0.000
L3	0.0	0.000
L4	0.0	0.000
L5	0.0	0.000
L6	0.0	0.000
L7	0.0	0.000
L8	0.0	0.000
L9	0.0	0.000
L10	0.0	0.000
L11	0.0	0.000
L12	0.0	0.000
L13	17000.0	0.000
L14	0.0	0.000
M1	0.0	0.000
M2	0.0	0.000
M3	0.0	0.000
M4	0.0	0.000
M5	0.0	0.000
M6	0.0	0.000

Appendix F
Table 1, continued

Summer 2025		
WAYPOINT	**Methane (ppm)**	**H2S (ppm)**
M7	0.0	0.000
M8	0.0	0.000
M9	0.0	0.000
M10	0.0	0.000
M11	0.0	0.000
M12	0.0	---
M13	0.0	---
M14	0.0	---
N1	0.0	0.000
N2	0.0	0.000
N3	0.0	0.000
N4	0.0	0.000
N5	0.0	0.000
N6	0.0	0.000
N7	0.0	0.000
N8	0.0	0.000
N9	0.0	0.000
N10	0.0	0.000
N11	0.0	---
N12	0.0	---
N13	0.0	---
P1	0.0	0.000
P2	0.0	0.000
P3	0.0	0.000
P4	0.0	0.000
Z100	6500.0	---
Z122	670.0	---
Z124	1000000.0	0.000
Z125	1000000.0	---
Z126	1000000.0	---
Z127	5000.0	0.00732
Z128	1000000.0	---
Z133	Too high	0.00369
Z134	Too high	0.000
(New) Z135	540.0	0
(New) Z136	4600.0	0.000
(New) Z137	1000000.0	0.04443
(New) Z138	12000.0	---
Z130	---	---
Z131	---	---
Z132	---	---
Z133	0.3	0.000
Z134	0.2	0
Z135	---	---
Z136	---	---

Table 2. Hartland Landfill VOC from Walkabout

Waypoint	Methane %	Comments
Z122	670	Concrete box infrastructure with black lid, across and up the road from wheel wash
Z124	100%	Concrete box with metal hatch by road
Z125	100%	Concrete box with metal hatch by road, adjacent to Z124, slightly south/uphill of 124
Z126	100%	Concrete box with metal hatch by road, uphill of Z125
Z128	100%	Inside casing of Gw well 90-2-1 (90-1-1 reading: 1.3ppm methane, 0.150ppm H2S in 2023)
Z133	too high	Buried 2023, did not access in 2025 due to high methane in the area
Z134	too high	Flange on black pipe at top of slope, did not access in 2025 due to high methane in the area (started to feel lightheaded)
Z137	100%	Hatch by intersection North/downslope of Z124
Z138	1.2%	LFG end cap/pipe closed red valve