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Cyngor Sir Ynys Môn

Penhesgyn Landfill Site

Landfill Gas Risk Assessment and Management Plan

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Prepared for

Cyngor Sir Ynys Môn

Prepared by

Egniol Environmental Ltd.
Llys Onnen
Ffordd y Llyn
Bangor
Gwynedd
LL57 4DF

Document Review

Revision	Date of Review	Prepared By	Reviewed By	Approved By
-	16/12/2019	Anna Cole	Dave Wolstencroft	
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1.0 INTRODUCTION

This document provides a review of the Landfill Gas Risk Assessment and Management Plan (LFGMP) for Penhesgyn landfill Site. The original Management Plan for the closure and aftercare period was prepared in May 2007. The Plan contained a detailed risk assessment of landfill gas generation and emissions as known at the time of the site closure and set out the requirements for gas control measures for the aftercare period.

Penhesgyn Landfill Site is regulated under two extant environmental permits: EPR/KP3994FG (formerly EAWML/37083 (mod. 2005) for Area 3 Engineered Landfill) and EPR/CP3694FW (formally EAWML/37129 (mod. 2006) Dilute and Disperse Area 2).

The Site accepted non-hazardous waste between 1968 and 1998 in landfill Area 2 followed by disposal of non-hazardous waste in the engineered landfill Area 3 between 1999 and 2007. The Site was 'definitely closed' by the Environment Agency in 2008 and has since been managed in accordance with the Closure Report (Penhesgyn Landfill Site, Closure Report, May 2007).

During the post closure period it continued to maintain an active gas management system with an added gas combustion plant introduced in 2011 and the gas infrastructure system progressively upgraded to ensure adequate gas management provision.

This document reviews and updates the landfill gas management plan (2007). It provides for gas management and monitoring requirements based on the current understanding of environmental risks at the Site, and the best practice guidance for landfill gas management on closed landfill sites.

The scope of the Plan follows the standard framework for a gas management plan, set out in LFGTN 03 Guidance on the management of landfill gas, as follows:

Section 2 – Site Information

Section 3 – Landfill Gas Risk Assessment

Section 4 – Landfill Gas Management System and Control Measures

Section 5 – Landfill Gas Monitoring Plan

Section 6 – Landfill Gas Action Plan

Section 7 – Data Storage and Reporting

Section 8 - Aftercare and Completion Plan.

2.0 SITE

2.1 Site location

Penhesgyn Landfill Site (NGR SH 532 74, Lat. 53.24541, Long. -4.19421) is located 2km northwest of Menai Bridge on Ynys Môn. The site address is:

Penhesgyn Waste Transfer and Recycling Centre
Llansadwrn
Menai Bridge
Ynys Môn
LL59 5RY

Isle of Anglesey County Council is the current operator of the Site.

The landfill site covers an area of approximately 12ha. The Site is adjacent to a Civic Amenity Site, an In-Vessel Composting (IVC) facility, and a Household Waste Recycling Centre (HWRC), also operated by the County Council. Access to the Site is via the weighbridge and through a set of agricultural type galvanized steel double gates. Engineered tracks were constructed in 2017 to provide access across the Site.

The Site is bound to the east, west and north by agricultural grazing land and on the southern side by a low-lying wetland area.

2.2 Overview of construction details

Landfill design of Area 2 is uncertain. It is understood that it has no engineered basal containment and was designed on the principle of 'dilute-and-disperse'.

Area 3 (Cell 1, Cell 2, Cell 3) and the Valley Cell have been designed on the principle of engineered containment. The lining system consists of a composite engineered basal liner comprising a geomembrane (2mm thick HDPE welded liner) underlain by a geosynthetic clay liner (GCL). A 300mm granular drainage layer overlies the geotextile installed to protect the geomembrane.

The capping layer of Area 3 and the Valley Cell comprises a 1mm LLDPE geomembrane overlain by a geosynthetic drainage layer and a1m thick soil layer.

There were proposals to develop landfill Area 4 on land to the south-east from Area 3, but these plans have not been implemented. The land is currently utilized for storing plant and construction materials.

The landfill gas management system comprises a network of gas extraction wells installed in Area 2 and Area 3 and the Valley Cell. The original gas management infrastructure was installed during 2005-2006 and comprises a combination of above and below ground high-density polyethylene (HDPE) pipework of various diameter. Over time the gas collection pipework has undergone various alterations with additional gas wells installed and a small number of gas wells capped/decommissioned.

The gas collection system is shown on drawing 6170.GA.D04.

2.3 Gas Plant

Landfill gas utilisation on site commenced in 2009 when a Jenbacher JGC320GS-LL internal combustion gas engine was installed to supply renewable electricity to the National Grid. The 1065kWe capacity engine operated at a reduced power output of approximately 400kWe due to the fluctuating gas quality and quantity. A decision was made to downsize the gas engine in August 2018.

A set of replacement gas engines (Scania J12 and J13) with individual capacity of 160kW and 180kW, offered a better match to the gas generated in the landfill site. Technical specifications of the gas engines are enclosed in Appendix 2.

In addition, an enclosed high-temperature gas flare provides back-up gas combustion, as required.

The layout of the cells and the current landfill gas management system, are shown on Drawing 6170.GA.D04A.

2.4 Environmental Settings

The environmental receptors of the Site are well understood and documented within the Closure Report. For consistency with other Management Plans, the environmental settings are summarised and updated, below.

Local Receptors

Amenity and human health receptors situated within a 500m radius of the site boundary and which may be sensitive to the effects of landfill gas, are:

- Penhesgyn Hall (220m South)
- Cae Uchaf (320m East)
- Penhesgyn Isaf (340m East)
- Maes Llyn (450m West)
- General public using Penhesgyn Civic Amenity Site
- Proposed travellers site along the south east boundary of the site, some 150m from the landfill at the nearest distance.

Topography

The site lies in an area of gently undulating ground dissected by the shallow valleys of the Afon Braint to the northeast and an unnamed stream to the southwest. The higher ground forms a series of low hills that have a general northeast to southwest orientation. Immediately to the southwest of the site is an area of lower lying wetland. This is fed by drainage from the surrounding area and in turn drains to the west into the Afon Braint.

Geology

The site is underlain by alluvium overlying glacial till, which is embedded with layers of sand and gravel, this in turn overlies Mica Schist of the Penmynydd Zone of

metamorphism, which forms part of the Mona Complex. Prior to the land filling of Cell 3 most of the basal area is reported to have had pockets of peat, overlying the glacial drift deposits, which was subsequently removed prior to construction works taking place. Schist bedrock was not encountered during the construction works.

Hydrogeology

The sand and gravel deposits beneath the Site are classified as a Minor Aquifer. Beneath the western part of the Site the aquifer is confined by the overlying clay. In the east of the site where the clay is absent the aquifer is unconfined.

Hydrology

The groundwater beneath the site discharges into the wetland to the southwest. In turn this wetland is drained by two surface ditches which then flow into the Afon Braint, 800m downstream of the site.

3.0 LANDFILL GAS RISK ASSESSMENT

3.1 Conceptual Site Model

The original Landfill Gas Risk Assessment (LFGRA) was prepared for the landfill permit application in December 2003 (Entec document ref. 00264rr1382i1). The terms of Source, Pathways and Receptors are still valid and well understood at this Site.

LFG Source

The site has two distinct areas, Area 2 and Area 3, with a separate cell known as the Valley Cell. The landfill contains two distinctive areas: an older landfill Area 2, and the engineered landfill Area 3, which is subdivided into hydraulically separated engineered cells (known as Cell 1, Cell 2, Cell 3). The construction details of the above landfill areas are provided in Section 2.2 of this Plan.

Deposition of waste at the site predates 1968; however, there is no documentary information available before this date. Previous site investigations have indicated that both municipal and commercial waste was deposited in Area 2. Historically such waste had high organic content, especially the municipal waste processed using a Dano Rotating Drum Pulveriser, which homogenised the waste before deposit. This process results in waste with high gas production properties. The Area operated until 1999 and was capped in 2000.

Area 3 contains mixed non-hazardous waste including municipal waste with progressively lower organic content than the waste inputs into Area 2, as well as mixed commercial and industrial wastes, waste soil and construction and demolition waste. This Area also accepted many thousands of sheep which were buried as part of the response to the foot and mouth outbreak in 2001-2002. The landfill area was operational between 2000 and 2007.

The total weight of waste deposited on site as reported by the operator is as follows:

- Area 2: 1,213,000 tonnes
- Area 3: 630,000 tonnes
- Valley Cell: 290,000tonnes

Total approximate tonnage deposited = 2,133,000 tonnes.

Receptors

As mentioned in 2.3 above, amenity and Human health receptors situated within a 500m radius of the site boundary and that maybe sensitive to the effects of landfill gas, are:

- Penhesgyn Hall (220m South)
- Cae Uchaf (320m East)
- Penhesgyn Isaf (340m East)
- Maes Llyn (450m West)
- Proposed travellers site along the south east boundary of the site, some 150m from the landfill at the nearest distance.

For all human receptors landfill gas presents potential hazards due to it's properties as an explosive gas. Landfill gas contains methane which is flammable and explosive, and carbon dioxide, which is an asphyxiant. Trace compounds of landfill gas are responsible for malodours.

Pathway

Subsurface lateral migration was modelled as part of the Gas Risk Assessment (2003). The engineered landfill Area 3 and the Valley Cell were assessed to show that landfill gas concentrations at the nearby sensitive receptors will be considerably less than the site trigger levels, during the estimated waste stabilisation period up to 2040. The older part of the site (Area 2) is unlined, thus lateral migration could not be reliably modelled by GasSim. Based on the lateral migration results for CH_4 and CO_2 it was also concluded that the sub-surface pathway for exposure to trace components of landfill gas will be negligible for local sensitive receptors.

3.2 Revision of The Source Term

A conceptual landfill site model for Penhesgyn LFS was initially developed in 2003 at the time of the Permit Application for the Valley Cell. The original LFG RA was a quantitative Tier 2 risk assessment produced using GasSim v1.52. The source term was defined using a combination of the site data and Gassim default values.

The actual data was used for the following parameters:

- Waste input tonnages and composition;
- Landfill geometry;
- Engineering specifications for liner and cap, incl hydraulic conductivity;
- % waste capped;
- Infiltration rate;
- Annual precipitation, mm/year;
- Gas plant properties.

Where site specific data was not available, default values reported in the GasSim model or reasonable estimated values based on data supplied by the site operator, were used.

The original GasSim model was used for the revised LFGRA prepared as part of the Landfill Site Closure Report in 2007.The source term was updated to reflect that the site ceased accepting waste in 2007 and the proposed Cell 4 was removed from the model.

Landfill gas management and monitoring provisions of the LFGMP (2007) are based on understanding of environmental risks at the time of the site closure. The risk assessment predicted that at the time of the site closure the gas yield at the site should be 730m^3/h. The actual gas extraction rate at the time was 650m^3/h which validated well with the predicted gas yield at nearly 90% collection efficiency.

After the landfill was closed for accepting waste for disposal in 2007, the gas yield was predicted to reduce progressively due to declining source of landfill gas.

In the absence of the original GasSim model to update the LFG source term, the current LFGRA used ACUMEN[1] gas estimation tool. It is designed to estimate gas generation rates during the post-closure period of a typical UK landfill site. The outputs for both landfill areas are enclosed in Appendix 1 and summarised in Table 1 below.

Table 1: Estimated total landfill gas generation, Penhesgyn Landfill

ACUMEN Gas Estimation Tool	Area 2	Area 3 (incl. Valley Cell)
2019	104-155-207m^3/h	280-420-560m^3/h

The variability of the ACUMEN estimated scale of gas generation reflects the assumptions used by the model on how the site was designed and operated, and a variability of waste inputs.

In 2019 gas utilisation rates at the Site were between 180m^3/h to 300m^3/h which indicate that gas generation rates are in the region of 225-380m^3/h (at an assumed 80% collection efficiency) or somewhat greater if the collection efficiency is lower. The current gas generation rates accord with the Acumen model lower end performance (-33%), and therefore could be used as a guide for future revisions of the risk assessment.

There are certain site-specific factors which influence the gas generation rate and are responsible for the difference between the predicted and actual gas yields. Shallow waste deposits (8-15m) at the site show a greater influence by the ambient conditions, such as air temperature, atmospheric pressure and rainfall. It has been observed that the methanogenic process at the site is impeded during wet and cold weather conditions. Gas generation in Area 2 in particular is affected by these ambient factors coupled with fluctuating levels of groundwater ingress into this Dilute and Disperse landfill area.

Such sensitivities to the external factors add a degree of uncertainty about the overall waste stabilisation process and the gas generation volumes as compared with the conservative estimates by ACUMEN. The modelling tool estimates that the gas yield would reach the benchmark level of 50-100m^3/hr[2] by 2025-30 in Area 2 and by 2033-2040 in Area 3 (incl. the Valley Cell), at which stage active gas extraction for utilisation is unlikely to be feasible. Afterwards the appropriate management will require gas extraction by flaring in a low calorific value flare.

3.3 Impact Assessment

The original LFG risk assessment (2003) concluded that there would be no significant impacts on human receptors, or the environment as a result of lateral emissions though the liner, fugitive emissions through the cap and stack gas emissions, providing that active gas management measures are in place, that maintenance of gas infrastructure is

[1] The ACUMEN Gas Estimation Tool. https://landss.soton.ac.uk/gas-estimation-tool

[2] In reference to LFTGN 03 Guidance on the Management of Landfill Gas (2004), the indicative lowest benchmark levels of 50-100m^3/hr should be applied when assessing when gas utilisation may not be suitable.

carried out and the design of the extraction plant is closely matched with the gas production rates.

The original Gassim model was not available to review and update for the current risks of landfill gas on the environment and human health. Therefore, the risks were re-appraised by reviewing the long-term gas monitoring data collected during the aftercare period. This section describes the impact of the residual emissions of LFG through the cap and lateral emissions, point source emissions to air from the gas plant, as well as any fugitive emissions as a result of potential accidents and failures of the gas extraction system. The gas management system and control measures are described in Section 4.

3.3.1 Lateral Emissions

To minimise the risk of lateral migration of landfill gas, Landfill Area 3 has been constructed on the principle of containment, using an engineered low permeability perimeter and basal lining system (the older Area 2 has no engineering containment).

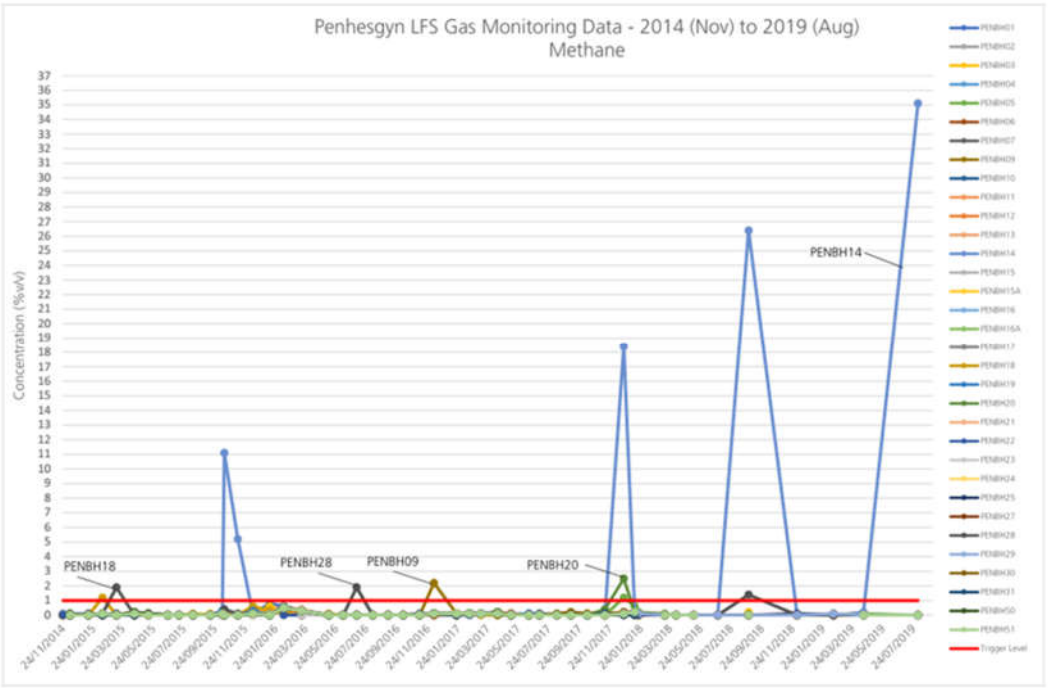
Landfill gas is managed by active extraction and utilisation across the whole site, thus reducing the risk of gas migration off site.

Review of the available monitoring results for landfill gas bulk components methane (CH_4) and carbon dioxide (CO_2) for the period between 2014 (Nov-Dec) and 2019 (Jan-Aug), is summarised below. Monitoring data record is enclosed in Appendix 3.

Methane

Methane (CH_4) readings during the 58-month monitoring period are shown below.

Graph 1 – Methane Monitoring Data 2014 to 2019



There were no trends evident in the readings during the 58-month monitoring period and in general no methane was detected in perimeter gas monitoring boreholes. On occasions CH_4 was detected in concentrations in excess of the trigger level of 1.0%, as summarised in Table 2 below.

Table 2: Methane in Perimeter Boreholes (2014-2019)

BH ID	Landfill Area	Date	CH_4 Value Recorded (%)
PENBH02	3	28/08/2018	1.4
PENBH09	3	06/12/2016	2.2
PENBH14	2	13/10/2015	11.1
PENBH14	2	21/12/2017	18.4
PENBH14	2	28/08/2018	26.4
PENBH14	2	02/08/2019	35.1
PENBH18	2	11/02/2015	1.2
PENBH20	2	21/12/2017	2.2
PENBH28	2	04/07/2016	1.9

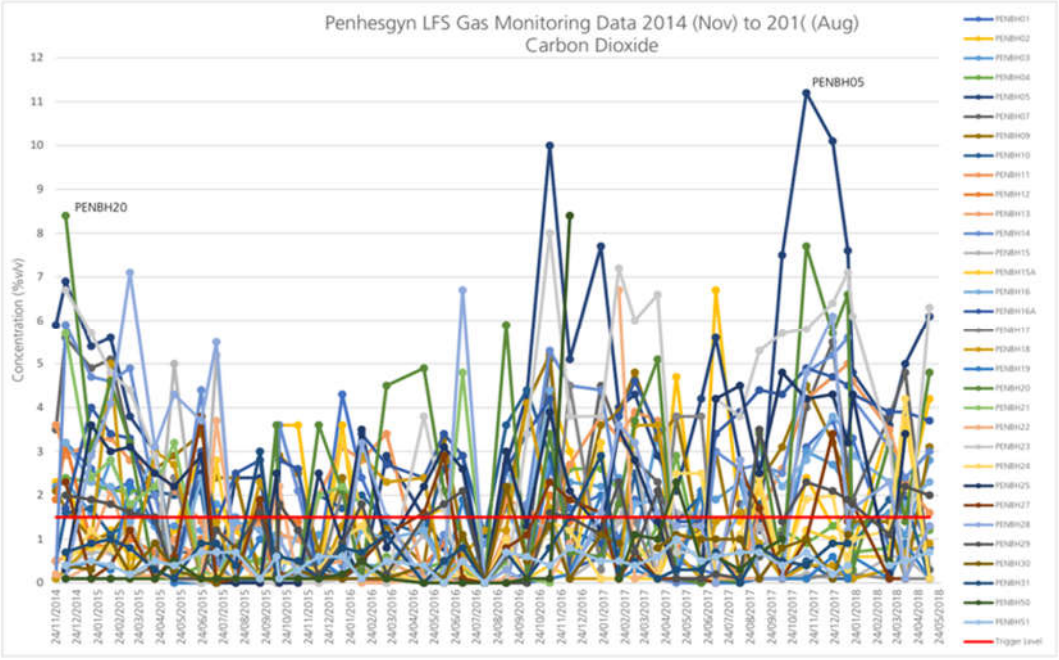
The elevated concentrations of CH_4 were recorded in borehole PENBH14 on several occasions at the time of a failure or temporary shutdown of the former gas utilisation plant suggesting that a build-up of the gas within Area 2 may have caused these spikes. All other readings from this and other boreholes were low, determining that lateral gas migration is unlikely while landfill gas continues to be actively extracted.

Overall the long-term data indicates that there is little to no impact from methane from the waste mass on the areas to the perimeter of the site under normal operational conditions.

Carbon Dioxide

Carbon Dioxide readings during the 58-month monitoring period are shown below.

Graph 2 – Carbon Dioxide Monitoring Data 2014 to 2019



Carbon dioxide levels were subject to greater fluctuations across the monitoring period than methane, with many levels recorded in excess of the trigger level of 1.5%. No long-term trends were evident in any of the boreholes.

Environmental Risks

Subsurface lateral migration was modelled as part of the original LFG Risk Assessment (2003). The engineered landfill Area 3 and Valley Cell showed that landfill gas concentrations at the nearby sensitive receptors would be below the trigger level during the aftercare period up to 2040. Monitoring results for CH_4 and CO_2 in perimeter boreholes for the aftercare period confirmed that the risk of lateral migration of the gas from Area 3 and the Valley Cell is negligible for local sensitive receptors.

The older part of the site (Area 2) is unlined, thus lateral migration could not be reliably modelled by GasSim. At the time of site closure in 2007 it was known that CH_4 was not detected in any perimeter boreholes apart from occasional marginal exceedances in boreholes PENBH14 and PENBH18. The potential risks of gas migration were addressed at the time by installing flammable gas alarms in the nearest receptors (site offices and Penhesgyn Gors an unoccupied building within the site boundary, owned by the County Council), and by installing additional gas monitoring boreholes next to both receptors.

Fluctuating levels of CO_2 in the surrounding strata may be caused by organic matter present in local deposits of alluvial ground materials. The gas is naturally produced in the soil when organic matter is broken down in aerobic conditions. Alternatively, there may be residual levels of CO_2 in the soil from anaerobic decomposition. And finally, adjacent to Area 2, CO_2 concentrations are likely to be from oxidation of CH_4.

In discussions with Natural Resources Wales (NRW) in March 2017 regarding fluctuating

levels of carbon dioxide, the regulator commented that "*NRW is not overly concerned with the elevated CO_2 readings. They are often not associated with LFG but are a product of natural geo-chemical processes".*

The wealth of monitoring data collected on both bulk components of landfill gas since the site closure, demonstrates that the potential risk associated with lateral gas migration remains low and insignificant under the current gas management provisions.

3.3.2 Emissions through the cap

All the landfill cells are capped with a geomembrane cap and fully restored.

Negative pressure is applied to the waste mass by operating active gas extraction for utilisation/flaring. The pressure is regulated to ensure that no build-up of the gas takes place within the fill. The 115 gas extraction wells are individually balanced according to methane concentrations, the gas flow rate and the presence of oxygen in the gas mix. This is to ensure optimal gas suction and to prevent positive pressure build up.

The site operator undertakes regular surveys of the condition of the cap by visual assessment for any signs of breaching, such as cracks, surface erosion, and ground subsidence, as well as any apparent signs of vegetation die back. In addition, gas surveys are carried out at the well heads, drainage trenches and generally across the site to detect any breaches of the cap integrity.

The latest comprehensive gas emissions audit at Penhesgyn landfill site was carried out by the site operator in conjunction with Natural Resources Wales in 2017. NRW instigated the gas audit as part of their overall strategy of works to reduce methane emissions from landfill sites in Wales. The survey area included the gas wells, key points along the gas main, along the surface water drainage trenches and other areas of the cap in Area 2, Area 3 and Valley Cell.

The objectives of the gas emissions survey and the gas audit of the site were to ensure that the Site is being operated and maintained to maximise gas collection efficiency, to minimise fugitive landfill gas emissions, and ensure that treating of the gas is carried out in a manner that minimises point source emissions.

A Flame Ionising Detector (FID) was used to measure the concentration of flammable gases, such as volatile hydrocarbons, inorganics etc. Within the context of landfill monitoring, FIDs are calibrated to methane (CH_4) and have a detection limit of 1ppm.

The gas emissions audit identified the wells which had methane emissions from around their seals and other issues which required remedial works. As a result of the site audit, the site operator carried out a comprehensive set of remedial works during 2017-2018 including the following:

- The wells shown to have leaks around the seals required re-sealing with bentonite.
- The status of the seals on the gas and leachate wells were checked and faults rectified. Seals were replaced (where necessary) and pipe boots upgraded with bentonite surround.

- Existing gas pipework was checked for low spots across the whole extraction system. Where such sections were discovered they were re-laid to the correct falls to ensure appropriate dewatering of gas condensate.
- Regular inspections of the knock-out pots, pipe falls, pressure readings in gas mains and submains and checks for any blockages or deformations in pipework.
- Reconnection of the knock-out pot outside the engine compound for compressed air and condensate lines to ensure they are in working order.
- All dewatering points are regularly checked, and condensate removed as necessary including the newly found and unreferenced dewatering point between BH79 and BH80.
- Areas of the cap which showed fugitive emissions of landfill gas were investigated and all identified faults rectified.
- Sections of the surface water drainage trenches which showed fugitive emissions of landfill gas were investigated and all identified faults rectified.

Following the above remediation works, the current risk of fugitive emissions from the cap are considered low and insignificant under the ongoing provision of active gas management by extraction for utilisation.

3.3.3 Stack gas emissions from gas flare and gas engines

As stated in Section 4 the gas management system at Penhesgyn landfill site includes two internal combustion gas engines (Scania SGI12 and SGI13) and a high temperature flare (HAASA 5, max gas extraction capacity of 750m^3/h) used as a backup gas plant.

3.3.4 Accidents and their Consequences

The main type of incidents that can impact LFG management are categorised in Guidance on the Management of Landfill Gas (LFTGN03), as the following three categories:

- Loss of containment, liner failure, leakage, spillage etc
- Loss of collection and/or treatment capability, i.e. failure of pipework, gas well, gas plant.
- Explosions and fires, e.g. deep-seated landfill fire.

The three categories of accidents were assessed in the LFGMP 2007 based on understanding of the risks at the time of the site closure. The following section reviews and updates the conclusions of that risk assessment.

Loss of Containment

Landfill area 2 has no engineered basal and side wall lining system. The key containment feature in Area 2 is the landfill cap, a LLDPE geomembrane designed to provide low permeability of 10^{-9}m/s. Landfill gas is actively extracted from the Area via a dense network of gas wells connected via the gas main to the gas utilisation plant. Potential loss of containment through the cap in Area 2 is monitored by undertaking regular gas audits and where necessary undertaking remedial measures to the cap and the gas

infrastructure. The gas field is regularly balanced to optimise the gas extraction rate so as to minimise fugitive emissions of LFG through the cap.

Landfill area 3 is engineered to be a fully contained landfill area and therefore loss of containment is a potential gas impact issue. Damage to the engineered basal lining system, side slope lining system or cap could be caused by settlement of waste, physical damage such as caused by excavation, tracking of machinery etc, or through a deep-seated fire in the waste. Should any such incidents occur, LFG would no longer be fully controlled in the gas management system but would have a preferential pathway for emissions in the atmosphere. In addition, any breach of containment would lead to ingress of oxygen into the fill especially if the section of the fill is under a negative pressure. Any such ingress of oxygen could lead to deep seated fires.

The potential for damage to the containment system in landfill Area 3 is managed in a similar way as in Area 2. All in-waste gas wells in this area are monitored on a regular basis as part of the gas field balancing surveys. If oxygen concentrations are recorded at and above 5% v/v the gas well would be disconnected from extraction (valve closed). This would trigger checks on the sealing of the gas well and the cap in the surrounding area.

The gas management measures are described in Section 4.

In terms of potential risks of such accidents resulting in potential LFG environmental impact, the conclusions of the LFGMP (2007) still stand. The Likelihood of a loss of containment has a score of 4 (somewhat unlikely) given the engineering design of the containment system and its construction and maintenance to CQA standards. Regular monitoring of LFG in waste and gas surveys will continue to ensure the continuous integrity of the capping system by identifying any potential problems at an early stage so that any necessary maintenance can be carried out in a time manner.

Occurrence of such incidents is assigned a severity score of 2 (noticeable) given that a potential incident could cause a noticeable nuisance off-site due to odour or an adverse health effect to site operators working in proximity of a breached containment system.

The resultant updated risk score is 8 which is an acceptable level of risk.

Loss /Failure of Active Gas Collection Capacity

The potential loss of collection capacity can occur because of failure of pipework, gas wells or gas utilisation plant. The LFGMP (2007) assessed the risks of failure of gas flare, and failure of gas extraction system. The updated assessment below reflects on modifications to the system carried out during the aftercare period so far.

The LFGMP assessed the likelihood of failure of gas flare as 6 (Probable) to cover regular episodes of no gas extraction when the flare needs to be shut down for maintenance as well as any occasional plant failure. The severity category of such shutdowns/ failures was given category 2 (Noticeable) because of the potential to cause short-term nuisance

(LFG odour) and/or a minor breach in permitted control levels while the failure is dealt with by the flare operator.

The overall risk score of 12 (Acceptable) was assigned in LFGMP 2007. This is due to the high standard of plant design, installation, maintenance, monitoring and servicing. The risk assessment also concluded that once the gas utilisation plant is enhanced with a gas engine, the gas flare will be used as a back-up for the engine. The likelihood of a failure of the gas plant was therefore predicted to reduce to 4 (Somewhat unlikely) with the resultant risk score reduced to 8 (Acceptable).

Since the site closure in 2007 a 1065KWe gas engine (Jenbacher GC320) was installed in 2008 alongside a high temperature ground flare (currently HAASE 5). The engine has been operating between 2008 and 2018. Due to fluctuating gas quality and depleting quantity of the gas in the waste mass, the engine had been de-rated to run at a reduced capacity since January 2009 of 600kW, and again in June 2010 to 400kW, at which level the engine was run until 2018. A 'managed shutdown' was introduced in March 2011 to operate the engine during weekdays (Monday to Friday) only, so to allow the gas field to recover over weekends.

The 1MW gas engine was subsequently replaced in 2018 with two small engines: Scania SG1 13ST (189 Kwh) and SG1 12ST (159kWh)). The engines were installed in September 2018 with an objective to sustain a continuous gas treatment and utilisation.

The gas engines are managed by a telemetry system which provides operational data to the engine operator and alerts on the power failure or technical faults. These are addressed in a timely manner via a coordinated response by the engine operator and the landfill manager. Any failures are addressed as earlier as possibly within the 8-hour response period.

Given the improved performance of gas plant and the telemetry provisions for its operational management, the likelihood of a combined failure of the two engines and the back-up flare, is reduced to 3 (Unlikely). With the severity of such an incident Noticeable (Category 4), the updated risk rating of the gas plant failure is Insignificant (score 6).

The potential failure of the gas collection system can occur as a result of damage caused to gas collection pipework and a blockage caused by LFG condensate build-up in the pipework. These issues were risk assessed in the LFGMP (2007). Such incidents were assigned a likelihood category 5 (Fairly Probable) as such accidents can occur at least once per year and a Severity score 2 (Noticeable) as they could result in a minor non-compliance and/or lead to a temporary loss of amenity. The resultant risk score was assigned as 10 (Acceptable).

Following the site closure in 2008, there remains a potential for failure of gas pipework at Penhesgyn landfill due to damage caused by vehicles and machinery traversing the site. All gas pipework is buried within the cap / restoration layer. Risk assessment of the material damage was carried out in 2015 and concluded that the risk is potentially

significant and should be reduced by adopting a formal Traffic Management Plan. The Plan identified the designated crossing points over the gas main, which were reinforced for protection. The residual risk rating was assigned as High as the risk cannot be further reduced by redesigning the pipework burial deeper underground. The emphasis is on compliance with Traffic Management Plan. The Plan is enclosed in Appendix 6 for completeness.

Overall, the revised risk rating due to loss of LFG collection capacity is considered to be Acceptable given the various management measures put into place to control and monitor the risks.

Explosion and Fire

Ingress of air into the landfill mass which contains combustible waste material, can lead to deep-seated fires. Once ignited, a fire may be self-sustaining. Such conditions can be recognised by the following:

- High temperatures in waste;
- Elevated levels of carbon monoxide in LFG;
- A burning smell or smoke emitting from gas wells or leachate chambers.

At the time of the site closure, the risk assessment assigned a likelihood Category 4 (Somewhat Unlikely) given the uncertainty of the risk during and following landfill capping and aftercare management.

Such an incident is generally considered to have potential significant effects on the environment and human health; assigned Category 3 (Significant). The risk score of such an incident occurring on Site was 12 (in 2007), which is an acceptable level.

During the 13-year period of the landfill aftercare, no deep-seated fires or smaller 'hot spots' occurred at the site. The site regulator continues to carry out periodic inspection and maintenance of the gas infrastructure and landfill cap, and regular monitoring of LFG at in-waste monitoring points including concentrations of oxygen and carbon monoxide, as precursor of exothermic condition developing below the cap. The feedback provided by the gas field monitoring personnel also includes comments on any faults observed on the gas infrastructure.

Furthermore, the site operator carries out leachate recirculation in Landfill Area 3, in order to increase waste moisture content. Landfill Area 2 is operated on Dilute and Disperse principle and thus has a hydrogeological continuity with the surrounding strata. These factors reduce the potential risk of deep-seated fires within the site.

The current (2019) likelihood of a deep-seated fire /'hot-spot' event occurring on site, is assigned Category 3 (Unlikely). The severity of such potential incident remains significant, giving the overall current risk score of 9 (Acceptable).

4.0 LANDFILL GAS MANAGEMENT PLAN

4.1 General Principles of Landfill Gas Management

Landfill gas within the waste moves from areas of high pressure to areas of low pressure. The movement allows the capture and recovery of gas generated within the site. Vertical gas wells create 'artificial' regions of low pressure. The low pressure is applied to the waste via a network of pipes which are connected to the wells.

Gas flow through the waste is not easy to predict and is often affected by a boundary layer. Vertical gas flow can be prevented by soils and perched leachate while lateral gas flow can be blocked by soils and engineering structures. The result can be a localised pressure build-up. The position of the wells within the site is influenced by the waste type, depth, moisture content and density. Well location on the site is critical to gas flow and recovery.

As landfill gas enters the pipe network it expands under the pressure reduction. As the gas expands, it cools down forming a condensate. The condensate must be collected, controlled and removed to prevent blockages and corrosion. An effective system must be incorporated for the disposal of condensate.

4.2 Penhesgyn Landfill Gas Control System – Gas Field

The gas management system comprises of 115 gas extraction wells installed after the completion of waste infilling and connected, via transmission pipework, to the gas plant. During the post closure period, several gas wells have been capped while new gas wells were installed, and the gas pipework has undergone various alterations. At the same time, several leachate wells in Area 3 were retrofitted as gas extraction wells.

There are currently 115 vertical landfill gas extraction wells with a casing diameter of 125mm to 160mm together with a small number of temporary pin wells. The wells were drilled no closer than 2m from the base of the landfill to ensure there is no interference with the basal lining system. They are typically situated with a nominal spacing of approximately 40m with a maximum spacing of 60m. The wells have been spaced with a radius of influence to ensure that the landfill gas is drawn back towards the centre of the site and away from the side perimeter.

The gas collection system pipework consists of high-density polyethylene (HDPE) pipework comprising of 90-125mm diameter spur lines connecting to a 180-315mm diameter main carrier positioned around the perimeters of both landfill areas. The main carrier has dewatering points at low points along its length and at the gas compound.

Wellheads are located above ground while the pipework is buried within the layer of restoration soils. The wells are connected to spur lines via 63mm flow lines if they are positioned above the spur connection or 90mm flow lines if it is positioned below the spur connection. Each 63mm or 90mm flow line is connected to the spur via an electrofusion saddle. A 2" ball valve or angle seat valve connected on the flow line allows

the well to be balanced. Each well has a sample point and flow measuring point fitted to allow individual measurement and balancing.

All gas and leachate extraction wells and the associated pipework were installed to the specification in the agreed CQA Plans. The gas wells and extraction infrastructure are installed according to Construction Quality Assurance (CQA) principles and CQA plans agreed with Natural Resources Wales.

During any change to the landfill gas management system, such as installation of additional gas wells, connection of new gas wells, relocation of spurs and similar, the work will be undertaken in a phased manner. The area of the gas field where work is being undertaken will be isolated from the rest of the gas field, and work will be carefully managed to minimise disruption of the gas extraction and keep the risk for increased emissions of landfill gas and odour to an absolute minimum. Each gas well is inspected during each gas field balancing exercise. If any defects are noticed, repairs are being undertaken immediately if possible, otherwise arranged as soon as possible.

4.3 Penhesgyn Landfill Gas Control System – Condensate Management

The gas field at Penhesgyn landfill has been designed so that condensate removal facilities are located in low points along the gas main carrier. These consist of Knock Out Pots (KOP1-KOP6) and a pumped sump in the gas compound.

Knock-out pots facilitate the removal of any condensate which may accumulate in the pipework. These vessels dewater through barometric lances back into the waste mass. Each pumped sump is a sealed unit situated outside the waste mass and any condensate collected is pumped via air or electric pump back to the waste mass. All condensate flow from in-line KOPs is at a suitable gradient so as to prevent its accumulation in the lines.

The locations of the dewatering points are shown on Drawing 6170.GA.D04.

4.4 Penhesgyn Landfill Gas Control System – Gas Utilisation Plant

Landfill gas extraction for flaring initiated in 2001 when a Biogas 500 m^3/h gas flare was installed. That flare was replaced with a permanent high temperature flare (HAASA 5, with gas extraction capacity of 750 m^3/h), in 2007.

The first gas utilisation plant, a 1065kWe Jenbacher (JG320 GS-L.L) gas engine was commissioned in 2008. The rationale for selecting a large engine was based on the projected gas generation from the Site at the time of the proposed development of Cell 4 which subsequently did not go ahead. Due to insufficient and progressively depleting quantities of the gas in the waste mass, the engine was been regulated to run at a reduced capacity of 600kW since January 2009, and again in June 2010 to 400kW. A 'managed shutdown' approach was introduced in March 2011 to operate the engine during weekdays (Monday to Friday) only, so to allow the gas field to recover over weekends.

In 2018 a decision was made to replace the 1065kWe Jenbacher (JG320 GS-L.L) gas engine with a smaller internal combustion engine which would match the gas generation potential at the site. The replacement set of two gas combustion engines (Scania models SG1 13ST and SG1 12ST) with electrical output of 159kWe and 189kWe, respectively, were installed in September 2018. These engines operate on a 24/7 basis.

The ground flare operates as a back-up gas plant to burn treat any excess gas as and when required during any planned shutdown of the gas engines for maintenance and in case of trips on the electricity grid network.

4.5 Gas Management Responsibilities

Operation of the landfill gas management system is coordinated by IoACC (landfill operator) with a support from NewEnCo (appointed gas engine company), YLEM (appointed gas monitoring contractor) and Egniol Environmental which provides various supporting environmental monitoring and management, and engineering services, in relation to aftercare management of the landfill site.

The scope of gas management and monitoring works is outlined in Table 3 below.

Table 3: Landfill Gas Management Responsibilities at Penhesgyn LFS

What	Who	When
NORMAL OPERATING CONDITIONS		
Gas collection	IoACC	Continuous
Gas extraction	IoACC	Continuous
Gas utilisation (energy production)	Appointed gas engine company	Continuous
Gas flaring	Appointed gas engine company / IoACC	When collected gas cannot be utilised
Gas system inspection	IoACC	Weekly
Gas field balancing and in-waste LFG quality monitoring	Appointed gas monitoring contractor	4-weeky or more frequently if required
Perimeter gas monitoring and reporting to NRW	Appointed gas monitoring contractor	Quarterly or more frequently if trigger levels exceeded Reporting as per Schedule 4 of the Environmental Permit
Perimeter borehole maintenance	IoACC	When required
Engine Emission Testing	IoACC	Annually*
Flare Emission Testing	IoACC	Annually**
ENGINEERING WORKS ON LANDFILL		
Gas system design	IoACC and specialist subcontractor	As required
Gas system installation/alteration	IoACC	As required

What	Who	When
CQA inspection & validation	Egniol	As required during gas system installation/alteration
Gas system commissioning	Egniol	As required
Gas pipework connection/disconnection	Egniol	As required
Gas system maintenance	IoACC and specialist subcontractor	As per maintenance schedule
Condensate removal from gas system	IoACC	As required
ABNORMAL OPERATING CONDITIONS		
Resolving gas system failures/problems	IoACC	Arrive at site within 3 hours and resolve as soon as possible
Resolving gas engine failures	IoACC and appointed gas engine company	Arrive at site within 3 hours and resolve as soon as possible
Resolving gas flare failures	IoACC and specialist subcontractor	Arrive at site within 3 hours and resolve as soon as possible
Resolving gas well failures	IoACC	Arrive at site within 3 hours and resolve as soon as possible
Dealing with in-waste fires/explosions	IoACC and appointed gas monitoring contractor	Immediately
Responding to odour related complaints	IoACC	Immediately upon receipt of complaint
Investigating gas-related complaints	IoACC	Upon receipt of complaint
Unscheduled monitoring	IoACC	As soon as possible

* Annually for gas engine capacity exceeds 250kWe and subject to H1 RA;

**If gas flare operates for more than 10% of the year (LFTGN 05).

4.6 Competence and Training

All personnel involved in the gas management shall have been trained to be able to fulfil their responsibilities.

The site manager is a technically competent manager who holds a Certificate of Technical Competence (CoTC) issued by the Waste Management Industry Training and Advisory Board (WAMITAB) for managing Landfill Hazardous Waste (Level 4) – 4LH along with a continuing competence certificate. The site manager will remain qualified to supervise the landfill operation by undertaking re-testing every two years.

Site operatives are fully trained in operational procedures, undertaking site surveys and reporting non-operational conditions. All site users (including the site operatives) are inducted on their first visit to site. The site training records are kept at the site office. They can be made available for inspection on request.

5 LANDFILL GAS MONITORING PLAN

This Monitoring Plan reviews the monitoring and assessment carried out as part of the Closure Plan and the Site Permit (modified WMLs), and assesses these requirements against the relevant assumptions, parameters and results of the updated LFGRA.

Currently, landfill gas emissions at the site are regulated to control lateral migration of landfill gas and gas plant emissions to air. The monitoring locations are shown on Drawing 5739.SURV.D03.

5.1 Monitoring of LFG in-waste and Balancing of LFG Extraction

The typical composition of LFG (under extraction) from a well-balanced gas collection system would include:

Gas	Typical % LFG
Methane	40-50%
Carbon Dioxide	30-40%
Nitrogen	< 20%
Oxygen	< 5%

Ref: Landfill Gas, Industry Code of Practice, The Management of Landfill Gas (March 2012)

At Penhesgyn landfill site, landfill gas quality continues to decline with methane concentrations currently varying between 0% to approximately 70%. The corresponding concentrations of carbon dioxide vary between 3% and 40%. The presence of balance gas is similarly highly fluctuating between 0% and over 80% though gradually increasing. Oxygen concentrations in waste are regulated to below 5%v/v, and those wells which show O_2 levels above 5% and balance gas levels greater than 20%, are isolated from the gas extraction system.

There are requirements to monitor and balance landfill gas extraction in the site Permit, as detailed below (ref. Penhesgyn Gors Landfill EAWL/37129, 2006).

Table 3.10 Standards for balancing and monitoring of extraction system

Landfill gas monitoring determinands at each well or manifold (unless stated)	Monitoring frequencies	Units and accuracies	Trigger levels
Methane	Fortnightly from commissioning the extraction system	% ± 0.3%	< 40% v/v or a change in concentration of more than 20% v/v from previous results
Carbon dioxide	Fortnightly from commissioning the extraction system	% ± 0.3%	Ratio of methane: carbon dioxide should be > 1.1
Oxygen	Fortnightly from commissioning the extraction system	% ± 0.1%	>5% at each well
Nitrogen	Fortnightly from commissioning the extraction system	% calculated as balance of total other gases	> 20% v/v at each well
Flow rate or suction	Fortnightly from commissioning the extraction system	m^3/h or(±) mbar	No trigger level – information enabling balancing of landfill gas extraction
Openness of valve aperture (for use on manifold systems)	Fortnightly from commissioning the extraction system	% open	No trigger level – information enabling balancing of landfill gas extraction
Composition [including trace components] of raw landfill gas from the extraction line, prior to the disposal system	Annually	$\mu g/m^3$	No trigger level – information supporting analysis of landfill gas generation and emissions from the site
Carbon Monoxide	Monthly	ppmv	>25 May indicate possible hotspot or fire. Confirm readings by Gas Chromatography

The site operator continues to collect monitoring for landfill gas conditions in waste as part of the regular balancing of the gas collection system (gas wells, manifolds etc strategic points on the gas system). A network of 115 in-waste gas wells has been installed in both landfill Areas 2 and 3 as shown on the updated Drawing 6170.GA.D04.

A qualified gas technician is responsible for carrying out in-waste gas monitoring and balancing of the gas extraction system. Gas wells are currently monitored on a fortnightly as part of a regular gas field balancing exercise. The presence and concentrations of

landfill gas and gas flow rates are measured to ensure optimal gas extraction for utilisation. If necessary, a position of a gas extraction valve on a well is adjusted to minimise negative pressure (suction) applied to non-productive wells. Any maintenance issues identified during the monitoring, are reported to the site operator. The site operator also undertakes regular reviews of the gas management system and carries out remedial measures as required (Section 4).

It is proposed to reduce the current fortnightly gas monitoring of the gas extraction system to four-weekly monitoring. The landfill site is closed and therefor there is no upward trend in landfill gas generation. The existing gas field is regularly balanced to ensure the risks of gas migration offsite remain low. The proposed revised monitoring schedule is summarised in Table 4.

Table 4: LFG Extraction System - Proposed Monitoring Schedule

Monitoring point	Parameter	Monitoring Frequency	Monitoring Standard
LFG collection system at well control valve, and at the input to the LFG Utilisation Compound, as shown on Drawing 6170.GA.D04	Methane, % Carbon Dioxide, % Oxygen, % Carbon Monoxide, ppm Atmospheric Pressure, mb Gas Flow rate or Suction Balance Gas, %v/v Hydrogen Sulphide, ppm	4-weekly	As per LFTGN03 or subsequent guidance. Record of the ground condition. Calibrated handheld Gas Analyser capable of detecting the target gases at the required limits of detection.

5.2 Lateral LFG Emissions Monitoring

At Penhesgyn landfill site, perimeter monitoring boreholes have been installed adjacent to both Landfill Areas 2 and 3. A total of 38 perimeter boreholes have been installed at intervals of 25-70m along the site boundary. Of the originally installed monitoring points 33 gas monitoring boreholes remain operational and are utilised for collecting monitoring data.

On the basis of the updated risk assessment which demonstrates low risks of landfill gas migration off site, the current monitoring strategy should remain focused on the existing monitoring boreholes. Considering the existing confidence in the long-term monitoring results, the landfill monitoring schedule can be reduced in line with the provisions of the Landfill Directive (1999/31/EC).

A1.1.2 The monitoring regime may reduce during the aftercare period and this will be reflected in the cost profile. For estimating costs for monitoring (unless specified to the contrary in the permit), we assume that; a. The operational monitoring regime persists for 10 years after closure, b. Between 11 and 30 years after closure, the monitoring regime is 50% of the operational frequency, or LFD, Annex 3 minimum

whichever is higher, and c. From year 31 onwards Landfill Directive, Annex 3 minimum requirements apply.[3]

At Penhesgyn landfill which is in its 13th year of post-closure management, the monitoring frequency can therefore be reduced from monthly to quarterly.

5.2.1 Assessment Criteria – Perimeter Boreholes

Methane

The Environment Agency's Technical Guidance Note on the Management of Landfill Gas (LFTGN03) specifies that the assessment level should be set at 1% above background concentrations for CH_4. The current site permits for Landfill Area 2 and Area 3 (incl. the Valley Cell) specify the trigger level for CH_4 at 1%v/v, i.e. not based on background concentrations.

As discussed in Section 3, long-term monitoring data was used to update the understanding of potential risks from lateral migration of LFG. The assessment results show that during the five-year review period methane was detected in perimeter boreholes at concentrations in excess of the site current trigger level of 1%v/v on nine occasions (Table 2). These elevated results were triggered by abnormal operational conditions on site. Overall, the background concentrations of methane are negligible and below 0%v/v, therefore it is considered appropriate to continue using the current trigger level for methane of 1%v/v.

Carbon Dioxide

As with the assessment level for methane, the current site permits set the trigger level for CO_2 at 1.5% which is not based on background concentrations. The wealth of monitoring data collected for CO_2 during the aftercare period shows that the gas is present in the surrounding strata and continues to be detected in perimeter boreholes. This situation was flagged in the Site Closure Report (Entec 2008) which proposed a set of borehole specific trigger levels for CO_2 for gas monitoring during the aftercare period. These proposed trigger levels were based on the 90%ile for plus 1.5%v/v.

Having reviewed the monitoring data for 2014-2019, it is considered that the compliance levels for CO_2 should be adopted based on background concentrations of the gas.

The Industry Code of Practice (ICoP): Perimeter Soil Gas Emissions Criteria and Associated Management[4] advised that carbon dioxide is not an appropriate choice of gas to use to regulate emissions from landfills because there are alternative sources in the subsurface environment. The ICoP recommends that compliance limits should not be set, but instead the monitoring data should be used to set borehole specific Action Levels for landfill operator's management purposes to confirm the conceptual site model and inform a need for further investigation and remediation actions.

[3] EPR 5.02.2 Guidance on Financial Provision for Landfill. Environment Agency (21 April 2011)
[4] Industry Code of Practice (ICoP): Perimeter Soil Gas Emissions Criteria and Associated Management. January 2011

The ICoP follows an approach based on a methodology detailed in the Environment Agency Guidance P1-471 to establish the maximum background level of CH_4 and CO_2. The P1-471 multiple outlier test is a screening tool which 'cleans up' data to estimate baseline statistics. The method standardises and ranks the data (No. - Mean / Standard Deviation) and compares the maximum value (Tmax) to a critical value at P = 1%. If the Tmax is not greater than the critical value (specific to the size of the dataset), then the Tmax is not an outlier and should be used for setting background level. Otherwise the highest point value should be removed from the dataset and the Tmax value becomes the second highest value of the standardised dataset, and the second highest Tmax should be used setting background levels.

The Action Levels were augmented where applicable by a Factor of Safety (FoS) to make a clear distinction between background and other sources of gas. The application of a FoS is dependent on the stability of the ground gas data set. An unstable data set is suggested to occur when "…*the range in concentration values (between high and low data) is >8% v/v, but this will be decided on a site-by-site basis*. *A stable data set can be presumed when for example the majority of data points are located within the range 0 – 5 % v/v, 5 – 10 % v/v and so on."*

The multiple outlier test identifies and 'removes' data points assumed to be erroneous to the wider data set (be they high or low) leaving a statistically significant distribution of data.

An unstable data set will be reflected by the majority of values appearing to be randomly distributed between the maximum and minimum values which may be at least > 8 % v/v apart. An objective assessment of the data set is therefore required (informed by the statistical analysis) to justify whether a Tmax / FoS based Action Level is appropriate. Tables 5a and 5b summarise the approach for setting up CO_2 Action Levels.

Table 5a: CO_2 Action Levels (stable concentrations)

CO_2 Background Concentration	**CO_2 Action Level (incl. FoS)**
Tmax CO_2 concentration in range 0 - 5%	Tmax + 1%
Tmax CO_2 concentration in range 5 – 10%	Tmax + 2%
Tmax CO_2 concentration in range 10 – 20%	Tmax + 3%
Tmax CO_2 concentration in range 20 – 25%	Tmax + 4%
Tmax CO_2 concentration in range >25%	None*

* If background CO_2 concentrations are routinely greater than 25 % v/v, then setting Action Levels is unlikely to be appropriate when trying to assess migration from landfills.

Table 5b: CO_2 Action Levels (unstable concentrations)

CO_2 Background Concentration	CO_2 Action Level
Non applicable	Tmax

Using the above statistical approach, the current compliance level for CO_2 of 1.5%v/v has been revised taking into account the background concentrations of the gas. A 49-month monitoring data set (2014-2019) for CO_2 has been screened for anomalies using the appropriate statistical method. The results are summarised below.

Table 6: Proposed CO_2 Action Levels in perimeter boreholes (based on a 48-month data set between 2014 and 2019)

Monitoring Point	CH_4 Tmax (%v/v)	CO_2 Tmax (%v/v)	Action Level CO_2(%v/v)	CO_2 Data Stability	Risk Level and Justification
PENBH01	0.8	4.3	5.3	Stable	LFG source term is well defined. Significant quantity of LFG. Active gas management by extraction and utilisation. Low risk of gas migration off site: engineered landfill. Clay based geology. CH_4 not detected in perimeter BHs part from occasional spikes which coincide with the downtime of the gas management system.
PENBH02	0.5	4.7	5.7	Stable	
PENBH03	0.2	3.4	4.4	Stable	
PENBH04	0.2	2.9	3.9	Stable	
PENBH05	1.2	11.2	14.2	Stable	
PENBH06	0.1	1.8	2.8	Stable	
PENBH07	0.5	5.6	7.6	Stable	
PENBH09	2.2	5.2	7.2	Stable	
PENBH10	0.2	4.4	5.4	Stable	
PENBH11	0.5	4.7	5.7	Stable	
PENBH12	0.5	3.2	4.2	Stable	
PENBH13	0.3	2.1	3.1	Stable	
PENBH14	35.1	6.3	8.3	Stable	
PENBH15	0.5	5.2	7.2	Stable	
PENBH15a	0.5	3.8	4.8	Stable	
PENBH16	0.5	4.4	5.4	Stable	
PENBH16a	0.5	4.9	5.9	Stable	
PENBH17	0.6	3.8	4.8	Stable	
PENBH18	1.2	5.0	7.0	Stable	
PENBH19	0.3	3.3	4.3	Stable	
PENBH20	2.5	8.4	10.4	Stable	

Monitoring Point	CH_4 Tmax (%v/v)	CO_2 Tmax (%v/v)	Action Level CO_2(%v/v)	CO_2 Data Stability	Risk Level and Justification
PENBH21	0.5	5.7	7.7	Stable	
PENBH22	0.1	2.2	3.2	Stable	
PENBH23	0.2	8.0	8.0	Unstable	
PENBH24	0.5	2.5	3.5	Stable	
PENBH25	0.5	4.8	5.8	Stable	
PENBH27	0.5	3.8	4.8	Stable	
PENBH28	1.9	9.4	9.4	Unstable	
PENBH29	0.5	3.5	4.5	Stable	
PENBH30	0.5	2.2	3.2	Stable	
PENBH31	0.5	1.1	2.10	Stable	
PENBH50	0.5	2.2	2.2	Unstable	
PENBH51	0.2	1.0	3.0	Stable	
PENBH52	0.5	2.6	3.6	Stable	
PENBH53	2.0	2.3	3.3	Stable	
PENBH54	0.6	3.4	4.4	Stable	

5.2.2 Monitoring Frequency – Perimeter Boreholes

The results of this monitoring review confirm that the risks of lateral migration of landfill gas remain negligible as a result of on-going active management of landfill gas.

On this basis, the future monitoring strategy should remain focused on the existing monitoring boreholes and the same monitoring parameters. Considering there is sufficient confidence in the monitoring data collected in the last five years, the monitoring frequency could be reduced from monthly to quarterly. The proposed landfill gas monitoring schedule is summarised in Table 7 below.

Table 7: Landfill gas in perimeter boreholes – proposed monitoring schedule

Monitoring Point	Parameter	Compliance Level	Monitoring Frequency	Monitoring Standard
LFG monitoring points as shown on Drawing 5739.SURV.D03	Methane	1%v/v	Quarterly	As per LFTGN03 or subsequent guidance. Record of the ground condition.
	Carbon Dioxide	As per Table 6.	Quarterly	
	Oxygen	None	Quarterly	
	Atm. Pressure	None	Quarterly	
	Differ. Pressure	None	Quarterly	

5.3 Point Source Emissions Monitoring

The current site permits (modified WMLs) set out the following monitoring requirements for emissions from the gas flare and the engine(s), as detailed below (ref. Penhesgyn Gors Landfill EAWL/37129, 2006).

5.3.1 Gas Flare

Table 4.2 Landfill gas flare monitoring programme – determinands and standards

monitoring determinand	Monitoring frequencies	Units and accuracies	Trigger levels at NTP and 3% O_2, unless otherwise agreed in writing by the Agency
Oxides of nitrogen (NO_x)	Annually from commissioning system	mg/Nm^3± 1 mg/Nm^3	≥150 mg/Nm^3
Total VOC's	Annually	mg/Nm^3± 1 mg/Nm^3	≥10mg/ Nm^3
NMVOC's	Annually	mg/Nm^3± 1 mg/Nm^3	≥5mg/ Nm^3
Carbon monoxide (CO)	Annually from commissioning system	mg/Nm^3± 1 mg/Nm^3	≥50 mg/Nm^3
Gas Flow Rate in combustion chamber	Annually from commissioning system	Cubic metres of landfill gas per hour ±1%	Minimum level recommended in the relevant design specification

Note: NTP = Normal Temperature and Pressure at 0ºC and 1013 mbar.

This condition was fulfilled during the post-closure site management when the main form of gas treatment was by oxidation of the gas in a high temperature flare. This approach was replaced with the main treatment of the gas by combustion (for utilisation) while the flare is retained as a back-up gas plant only.

The future monitoring requirements of the gas flare will be based on provisions of Guidance for Monitoring Enclosed Landfill Gas Flares LFTGN05 v2 2010, as detailed in Table 8 below.

Table 8: Monitoring requirements – Fixed Gas Flare

Emission Point Reference	Parameter	Source	Limit	Reference Period	Monitoring Frequency
Fixed gas flare	Oxides of Nitrogen	Landfill Gas Flares	150 mg/m^3	Hourly mean	Annually*
	CO		50 mg/m^3		
	Total VOCs		10 mg/m^3		
Mobile gas flare	Oxides of Nitrogen	Landfill Gas Flares	150 mg/m^3	Hourly mean	Annually*
	CO		50 mg/m^3		
	Total VOCs		10 mg/m^3		

*Monitoring of the flare is unnecessary where the flare is active for <10% of the year.

5.3.2 Gas Engine(s)

The current monitoring requirements for gas utilisation system are set in the site permit (WML).

Table 5.2 Standards for emission monitoring and sampling programme of utilisation plant.

Emission monitoring determinands	Monitoring frequencies	Units and accuracies referenced to NTP at 0°C + 1013mbar + 5%O_2
Total VOC's	Annually	mg/Nm^3±1 mg/Nm^3
Total NMVOC's	Annually	mg/Nm^3±1 mg/Nm^3
Oxides of nitrogen (NO_x)	Annually	mg/Nm^3±1 mg/Nm^3
Carbon monoxide (CO)	Annually	Mg/Nm^3±1 mg/Nm^3

This condition was fulfilled during the post-closure site management while the 1065kWe gas engine was providing the bulk of gas utilisation on site. As described in Section 4, this gas engine was downsized due to depleting gas resource at the site. The replacement set of smaller Scania SGI12 and SGI13 combustion engines have electrical output of 159kWe and 189kWe, respectively.

For such engines with capacity less than 250kWe, there are provisions in the Guidance for Monitoring Landfill Gas Engine Emissions LFTGN08 v2 (2010), Section 2.6 which states that the Environment Agency Wales (now NRW) "*do not intend to impose specific emission limits on these engines other than the mass release of pollutants from these engines should not exceed the comparative mass release from an engine meeting the emission standards in Table 2.4".* And *"The impact of small engines should be assessed on a site-specific basis in accordance with Horizontal Guidance Note EPR H1".*

The H1 risk assessment of emissions from current gas utilisation plant has been carried out and is enclosed in Appendix 4.

The locations of the gas flare and utilisation plant (as point sources of emissions to air) are shown on Drawing 6170.GA.D04.

5.4 LFG emissions from the cap

There is no permit requirement to undertake landfill gas surface emissions monitoring at Penhesgyn landfill site. The site is fully capped and restored.

The site operator takes proactive steps to assess potential fugitive emissions of the gas from the cap and the protruding gas wells/pipework, by undertaking regular gas emissions surveys and carries out any necessary remediation works, as discussed in Section 4.

5.5 Monitoring Protocols

5.5.1 Lateral Emissions of LFG

A real-time landfill gas analyser GA5000 will be used for the monitoring of landfill gas concentrations in perimeter boreholes. The analyser is maintained in good working order and is calibrated in-line with the manufacturer's recommendations.

An ATEX certified dip meter for measuring water/leachate levels on the landfill site, will be used. All monitoring works will be carried out by a competent monitoring technician and in accordance with relevant H&S risk assessment and method statement.

5.5.2 Borehole Access and Maintenance

Maintenance of borehole headworks, locks, signs/identification labels and sampling ports will be the responsibility of the Site Manager.

Any faults will be repaired promptly following detection of the faults. Details of faults should be noted during the routine gas monitoring by the monitoring personnel and reported to the Site Manager. Any identified need for maintenance of a particular installation should not reasonably prevent routine sampling and monitoring data being obtained.

A safe access to all gas monitoring boreholes shall be provided at all time. Vegetation should be cut as necessary from around both flush and raised headworks. The boreholes shall be clearly visible and clearly identified on the ground.

5.5.3 Monitoring and Balancing of LFG Extraction

The gas collection system will be monitored regularly to assist the balancing of the gas extraction system. A real-time landfill gas analyser GA2000 Plus or GA5000 will be used in monitoring of landfill gas concentrations in gas wells and at key points in the gas extraction system. The analysers are maintained in good working order and are calibrated in-line with the manufacturer's recommendations.

The appointed gas technician follows operational procedures for monitoring, logging, assessment and reporting landfill gas data. The Landfill Gas Balancing Protocol is in line with the recommendations of the EA's Guidance LFTGN03 Management of Landfill Gas (2004). Monitoring of hydrogen sulphide (H_2S) is carried out in accordance with Safe System of Work for Working in the Presence of Hydrogen Sulphide and Methane. The relevant documents are enclosed in Appendix 5.

Where the oxygen concentration exceeds 5%, or 20% of balance gas then an assessment of air ingress into the system will be undertaken. Where the concentration of carbon monoxide exceeds 100ppm then further investigation will be undertaken. Concentrations of hydrogen sulphide will be assessed in accordance with the Gas and Odour Management Plans for the site.

Where the oxygen concentration in the input to the LFG Utilisation Compound exceeds 5% or the %age of balance gas is greater than 20% an assessment of air ingress into the system shall be undertaken.

5.5.4 Stack Gas Emissions

When required to undertake point source emission monitoring for the gas plant, the monitoring will be carried out in accordance with the Environment Agency's technical document M2, v.10 (2013) or such other subsequent guidance as may be agreed in writing with the Environment Agency.

A designated sampling port on the gas engine and flare(s) will be used for stack gas monitoring and gas sampling. A temporary platform will be erected to allow access to the sampling port. Sampling will be carried out when the engine/flare is operating normally.

Sampling will be carried out by a specialist company which is endorsed by the Source Testing Association (STA) and have UKAS accreditation covering on-site testing. All analysis will be undertaken by a UKAS accredited environmental laboratory.

A two-man sampling team will carry out monitoring works to comply with Health and Safety requirements for working at height and hot surfaces.

6 GAS ACTION PLAN

This action plan establishes the steps required to be taken in the event of four key events relating to the control and monitoring of landfill gas at Penhesgyn Landfill Site. These are:

a) Failure of the gas extraction system;

b) Breach of the compliance levels for methane or carbon dioxide in perimeter monitoring boreholes;

c) Exceedances of hydrogen sulphide in landfill gas;

d) Exceedances of carbon monoxide in landfill gas / suspected in-waste fire.

6.1 Failure of Gas Extraction System

Landfill gas is currently managed by placing suction to the completed landfill and burning it in two engines and a flare. Gas extracted has condensate removed via knock-out pots, gravity drain legs and a pumped sump. Condensate is returned to the waste mass.

The gas extraction system will be inspected during each monitoring visit to ensure the ongoing operation of various components. The gas technician will undertake checks on the gas collection system for any of the following:

- Failed sampling ports and valves;
- Cracks in any over-ground pipework;
- Leaks at flange connection points on the gas infrastructure;
- Liquid build up in the over-ground pipework;
- Signs of deep-seated fire.

Any identified minor faults will be repaired immediately. In the event of any major defects identified in the system when repairs could not be carried out immediately then a temporary fix will be carried out immediately, and the permanent repair/remediation undertaken as soon as practically possible.

A failure of the extraction system to exert suction to the field will trigger the implementation of section **A** of this Action Plan.

6.2 Breach of Compliance Levels in Perimeter Boreholes

Landfill gas will be monitored at all boreholes located around the perimeter of the site. All monitoring data will be entered directly onto an electronic database system and checked against compliance levels for the regulated parameters.

In the events that methane and/or carbon dioxide concentrations in perimeter boreholes exceed the compliance levels, these events will trigger the implementation of section **B** of this Action Plan.

6.3 Exceedances of Hydrogen Sulphide in Landfill Gas

The main gaseous hazards on landfill sites are Hydrogen Sulphide (H_2S), which is an extremely hazardous and toxic compound. At concentrations of above 100 parts per million (ppm), a person's ability to detect H_2S is affected. This loss of the sense of smell means the gas can be present in high concentrations with no perceivable odour so a person will continue to breathe in the gas without realising causing possible respiratory failure.

Hydrogen Sulphide can settle in low areas, and employees working on landfill sites are issued with personal Gas Detectors which detect concentration levels of this gas. The Site operator and the appointed gas technician must operate a safe system of work necessary to protect site personnel in relation to working in the presence of hydrogen sulphide on landfill sites. The Safe System of Working in the Presence of Hydrogen Sulphide (and Methane) is enclosed in Appendix 5.

The control of H_2S emissions is also required for prevention of odour events at the site.

Control measures for prevention of H_2S emissions are listed in section **C** of this Action Plan.

6.4 Exceedances of Carbon Monoxide / Suspected In-Waste Fire

Presence of Carbon Monoxide (CO) in landfill gas is a precursor of a potential in-waste fire. A limit for CO in gas wells of 100ppm is used by the site monitoring contractor YLEM to investigate the potential hotspot in accordance with their procedure OP-W1-001A. If an abnormal condition in waste has been identified the site operator and the gas monitoring contractor will adopt the approach to contain and control this occurrence, and the approach will be agreed with Natural Resources Wales.

The Control measures for prevention of subsurface fires are listed in section **D** of this Action Plan.

A FAILURE OF GAS EXTRACTION SYSTEM

A.1 Identify cause of failure – gas technician on site within 24 hours. Minor faults will be resolved by the site operator as soon as possible. Any faults that require more extensive remedial measures will be scheduled and a suitable contractor(s) appointed to design and carry out the works.

A.2 If power cut off detected leading to interruption in gas extraction, the site operator will contact Scottish Power on tel: 0800092 9290 to investigate. Resolve as soon as possible.

A.3 If the flare unit has broken down – the gas management contractor/site manager on site within 3 hours. Resolve as soon as possible. The contractor will coordinate the response with the site operator to enable a prompt resolution of the fault.

A.4 If gas engine unit has broken down, the gas management contractor / site manager on site within 3 hours. Resolve as soon as possible. The contractor will coordinate the response with the site operator to enable continuous gas treatment by flaring.

A.5 If the gas blower unit has broken down, the gas management contractor / site manager on site within 3 hours. Resolve as soon as possible. Spare blower is available at a short notice and will be brought to site within 24 hours if required.

A.6 If condensate blockage of the gas collection system detected, the site operator will investigate the location and the extent of blockage. The site operator will attempt to remove the blockage by using a vacuum tanker to clear the blockage and will plan and carry out maintenance of the damaged area.

A.7 If there is a suspected deep-seated fire on site - instigate YLEM's Procedure OP-W1-001A (Appendix 5).

A.8 The site operator to notify Natural Resources Wales in accordance with relevant condition(s) of the Environmental Permit.

A.9 If the failure results in increased odour release – the site operator will investigate the potential cause and if the odour release is confirmed to be related to landfill gas, the cause of the release will be investigated and resolved as per above Actions.

B CONTROL LEVEL BREACH IN PERIMETER MONITORING BOREHOLES

B.1 The Site Manager will notify Natural Resources Wales (NRW) in accordance with relevant conditions of the Environmental Permit.

B.2 Review landfill gas conditions in-waste and performance of the gas management system. Instigate immediate measures to remediate any problems identified. If gas control system has failed instigate Section A of this Action Plan. Assess if any sudden changes in leachate levels in Area 3 and groundwater levels in Area 2, have occurred. Instigate increased leachate pumping if required.

B.3 Review the risk associated with the breach e.g. proximity of properties.

B.4 Repeat gas monitoring within 7 days to confirm whether the concentrations of methane or carbon dioxide remain outside normal ranges. All results will be forwarded to NRW.

B.5 If gas migration is persistently observed in a specific borehole or a reason for gas migration is not evident, inform NRW. If the borehole is close to sensitive receptor(s) then monitoring frequency in that borehole and the surrounding area will be increased to weekly. The local area will be checked for signs of gas or leachate escaping, and vegetation die back. If elevated levels continue, the area of gas migration will be audited to establish potential remediation measures required to minimise the risks to human health and the environment.

B.6 A review of off-site monitoring measures should also be undertaken. In addition, a bulk sample of gas will be collected as soon as practicable to carry out landfill gas chromatography analysis for bulk and trace components.

C H_2S EXCEEDANCE IN LANDFILL GAS

C.1 The Gas Detector is issued to the gas technician and all site operatives; this safety device warns when H_2S exceeds factory set alarm set-points - 5 ppm (low) to 10 ppm (high).

C.2 On discovering the presence of hydrogen sulphide above 75ppm on a Manifold or at the Gas Compound, the Site Manager will be informed as soon as possible.

C.3 H_2S data will be logged and added to LFG Monitoring Locations Drawing 5739.SURF.D03 indicating high H_2S areas. This drawing will be reviewed and updated as required; each 'high' well has signage attached and that level dictates the method of operation around it. Once the H_2S concentrations dropped below safe levels the 'high' wells are removed from the drawing.

C.4 The gas monitoring contractor will notify the Site Manager of H_2S hotspots when undertaking gas field balancing and when noticed in ambient air. The site operator will investigate and remediate H_2S odours in line with procedures listed in Section **A.**

D HOT SPOTS / DEEP-SEATED FIRES

D.1 If a subsurface fire is suspected by the appointed gas monitoring contractor, the Site Manager will be informed as soon as possible to agree the control and contain process;

D.2 The site operator will instigate procedures in the Hot Spot Containment Plan.

D.3 The site operator will notify Natural Resources Wales in accordance with relevant conditions of the Environmental Permit.

7 DATA STORAGE AND REPORTING

Routine gas monitoring data uploaded from the gas analyser will be collated by the site operator, as provided by the gas technician and the appointed monitoring contractor, and any non-compliance issues highlighted.

All data will be reviewed by the Site Manager and reported to NRW in line with the relevant conditions of the Environmental Permit.

It is proposed that landfill gas monitoring data will be reported to NRW in line with the proposed amended monitoring schedules, as listed in Table 9 below.

Table 9: Reporting of Landfill Gas Monitoring Data

Parameter	Reporting Period	Period ends
Point source emissions to air	Annually	31st December
LFG in external monitoring boreholes	Quarterly	31st March 30th June 30th September 31st December
Landfill Gas Production: • Combustion in flare • Combustion in gas engines • Average methane concentration entering the gas plant • Methane generation rate (50%ile from a representative model)	Annually	31st December

8 SITE COMPLETION PLAN

This section outlines the current regulatory approach towards landfill site completion in terms of the permit surrender. The overarching goal of landfill site completion is to reach the conditions of waste stabilisation, low gas generation potential and certain leachate quality which won't require active management measures to control the potential risks to local receptors.

In terms of landfill gas, the Landfill Sector (EPR 5.02)[5] guidance states that the environmental regulator will not accept an application for the permit surrender if and where:

- gas concentrations measured in perimeter boreholes show gas migration and a breach of compliance limits;
- gas is causing harm to flora on or around the site;
- there is visual evidence of impact from the gas on the surrounding environment, and if this is a result of a previous escape of gas there is a need to demonstrate that that pollution is no longer occurring.

8.1 Completion Criteria

Document EPR 5.02 outlines the approach for surrender by undertaking aftercare monitoring of the landfill gas stabilisation process which would demonstrate compliance with gas completion criteria without a need to apply active gas management measures. It is estimated that a typical UK landfill site which contains biodegradable waste can achieve the currently used completion criteria within 60 years following cessation of landfilling.

The Environment Agency Guidance on Financial Provision for landfill (EPR 5.02 v.2 2012) identifies a need to provide contingency planning for aftercare management of landfill sites for a period of 60 years post closure, however the document recognises opportunities for enhanced waste stabilisation, by for example in-waste leachate recirculation, in order to reduce the overall duration of aftercare management.

The site completion plan will be based on one of the following scenarios to demonstrate landfill gas stabilisation.

Scenario 1 Completion criteria
Gas concentration:
Maximum CH_4 concentration is less than 1.5%v/v
Maximum CO_2 concentration is less than 5%v/v
Standard of evidence:
A minimum of 12 datasets over two consecutive years.

Note: You must ensure that these limits have been met throughout the entire waste body and that the gas concentrations have not been exceeded at any time during the 2-year period. Alternatively, if you can show that the concentration of methane and carbon dioxide within the waste is similar to background concentrations (either natural sources or because of non-landfill activities) in the surrounding environment we will accept that the gas completion criteria have been met.

The Guidance recognises that the gas concentration alone does not reflect the true risk associated with its emissions and that there may be circumstances when the gas

[5] The Landfill Sector (EPR 5.02) and other permanent deposits of waste. Additional Guidance. How to surrender your environmental permit. Environment Agency V2. 13/12/2012

concentrations are greater than the criteria set in Scenario 1. The Guidance provides further completion criteria on landfill gas which are based on a combination of both the concentration and flow rate of the gas.

Scenario 2 is where the observed methane concentration is less than 5%v/v Lower Explosive Limit (LEL) and there is therefore little risk that gas migration off site will present an explosion hazard.

Scenario 2 Completion criteria
Gas concentration
Maximum methane concentration is less than 5%v/v and
Maximum carbon dioxide concentration is less than 10%v/v
Flow rate
Qhgs in on-site monitoring boreholes is less than 0.7l/h
Maximum gas flow rate in any borehole is less than 70l/hr
Standard of evidence
A minimum of 12 datasets over two consecutive years.
This must include gas concentrations in external boreholes between the site and nearby receptors if this is not already required by your permit.
Where continuous monitoring is used this must be for a minimum of 2 months.

Scenario 3 covers situations where the methane concentration is greater than the LEL. The sites that fall into Scenario 3 are required to collect extended monitoring data to provide evidence to support a surrender of the permit. The derived Qhgs (hazardous gas flow rates as defined by BS 8485) should include the worst-case scenarios for landfill gas migration.

Scenario 3 Completion criteria
Measured gas concentration
Maximum methane concentration is greater than 5%v/v or
Maximum carbon dioxide concentration is greater than 10%v/v
Flow rate
Qhgs in on-site monitoring boreholes is less than 0.7l/h
Maximum flow in any borehole is less than 70l/hr
Standard of evidence
A minimum of 24 datasets over two consecutive years.
This must include gas concentrations in external boreholes around the site perimeter if this is not already required by your permit.
Where continuous monitoring is used this must be for a minimum period of six months.

The site characteristic hazardous gas flow rates (l/h) (Qhgs) are defined in British Standard BS 8485:2007 (updated in 2015).

8.2 Landfill gas monitoring requirements for landfill completion

Once on-site active gas management measures have been removed or replaced with passive gas controls, landfill gas monitoring data should be collected to provide evidence of landfill stabilisation.

For the purpose of demonstrating the site meets the completion criteria on gas, the monitoring data can be gathered by either (i) regular monitoring for over a minimum period of two years with a minimum of 12 data sets during that period, or (ii) continuously monitoring over a shorter period.

The regular monitoring data should comprise the following parameters:

- CH_4 (%v/v)
- CO_2 (%v/v)

- O_2 (%v/v)
- atmospheric pressure (mbar)
- differential pressure (mbar)
- flow (l/hr).

The monitoring data should include the ambient conditions when:

- when the site surface may be sealed, for example following periods of heavy rain when the ground is saturated or when the ground is frozen;
- when atmospheric pressure is less than 1000mbar and falling;
- during or immediately following a rapid fall in atmospheric pressure (as a guide this would be a drop of at least 6mbar within a 3-hour period).

Landfill gas monitoring must represent the full depth of the waste that has a potential to produce gas. Monitoring must be undertaken from permanent monitoring points installed within the waste at a frequency of no less than two boreholes per hectare, with a minimum of four boreholes per site.

When considering continuous gas monitoring it should be carried out in representative monitoring boreholes within the waste. The monitoring data should comprise of:

- concentrations of bulk landfill gases;
- differential and atmospheric pressure incl. meteorological events outlined above;
- periodic flow rate measurements. Additional flow monitoring would be required I there are variation in differential pressure under different climatic conditions or gas concentrations.

This landfill gas management plan will be implemented and regularly reviewed in the context of the above completion criteria and requirements.

Area 3 Cell 1
Area 3 Cell 2
Area 3 Cell 3
Valley Cell
Area 2
BH 1
BH 2
BH 3
BH 4
BH 5
BH 6
BH 7
BH 8
BH 9
BH 10
BH 11
BH 12
BH 13
BH 14
BH DW3
BH 15
BH L4
BH 16
BH 17
BH 18
BH 19
BH 20
BH DW4
BH 21
BH 22
BH 23
DW5
BH 24
BH 25
BH 26
BH 27
BH 28
BH 29
BH 30
DW9
SUMP
BH 31
BH 32
DW6
BH 33
VALVE
BH 34
BH L14
BH (no num)
BH 35
BH L15
BH 36
BH 37
BH 38
BH 39
BH L13
BH 40
BH CELL 2 DIP
BH DW7
BH 41
BH L12
BH 42
BH 43
BH 44
BH 45
BH L10
BH 46
DW8
BH L9
BH 47
BH 48
BH 52
BH 53
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BH 128
BH L3
BH L11
BH MH 3A
BH MH 3B
BH MH V
BH L7
BH 129
VALVE
MP
LINE 1
LINE 2
MIX
SUMP
Notes
1. Survey information provided by Egniol Environmental Ltd.
2. All dimensions in milimetres and all levels in metres Above Ordnance Datumn Newlyn.
3. Do not scale from this drawing.
4. Any anomalies on this drawing should be brought to the attention of Egniol Environmental Ltd. prior to construction works.
Key
90mm diameter pipe
125mm diameter pipe
180mm diameter pipe
250mm diameter pipe
315mm diameter pipe
BH** Existing Gas Well
BH DW** Dewatering point
Gas Landfill Compund
Area 3
Area 2
Rev | Modification | By | Chk | App | Date
Penhesgyn Closed Landfill Site
Gas System Layout
Drawn by: JCR
Checked by: AC
Approved by: AC
Date: 01.02.2017
Scale @ A1: 1:1000
Revision:
Status: Draft
Drawing Number: 6170.GA.D04
ENGINEERING ENVIRONMENTAL HEALTH & SAFETY
egniol
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CAD File Ref:M:\CAD Projects\6170 Penhesgyn Leachate Recirc\Drawings\Current Working Drawings\6170.GA.D04.A.dwg

NOTES

1. All Survey information provided by Egniol Environmental Ltd.
2. All dimensions in millimetres and all levels in metres above ordnance datum.
3. Do not scale from this drawing.
4. Any anomalies on this drawing should be brought to the attention of Egniol Environmental Ltd.

Key

- 6.0 — Topographical Contours
- BH9 — Borehole Monitoring Point
- BH9 — Water Monitoring Point
- Fence Line
- Top of Batter
- Bottom of Batter

PLEASE NOTE
Water Monitoring Locations BH96B SW9 and SW10 are located to the south of the site and the As-built co-ordinates can be found in the adjacent table.

All Monitoring Borehole and Water Sample Locations are to Local Grid Co-ordinates.

Monitoring Borehole Locations

Borehole I.D.'s	Easting	Northing
BH1	5157.906	5303.375
BH2	5228.768	5380.112
BH3	5279.349	5439.864
BH4	5318.808	5492.211
BH5	5407.673	5432.536
BH6	5485.657	5388.465
BH7	5578.167	5358.108
BH9	5792.651	5357.339
BH10	5750.574	5276.982
BH11	5716.254	5201.142
BH12	5680.675	5136.870
BH13	5666.004	5085.401
BH14	5621.109	5053.065
BH15	5594.390	5032.218
BH15A	5581.081	5027.513
BH16	5577.030	5040.875
BH16A	5571.972	5031.738
BH17	5547.380	5047.918
BH18	5549.903	5033.564
BH19	5527.912	5028.782
BH20	5516.558	5018.116
BH21	5507.075	5007.594
BH22	5383.099	4955.481
BH23	5553.714	5024.058
BH24	5577.413	5012.530
BH25	5588.479	5018.988
BH27	5580.989	5042.940
BH28	5605.268	5035.938
BH29	5576.516	5001.116
BH30	5564.091	5000.899
BH31	5560.940	5001.924
BH50	5175.062	5601.238
BH51	5087.428	5486.804
BH52	5051.609	5392.980
BH53	5860.992	5197.072
BH54	5839.241	5142.462
BHHOUSE	5568.490	5009.009

Water Sample Locations

Water Sample I.D.'s	Easting	Northing
SW1	5041.936	5388.239
SW2	4963.347	5304.715
SW3	4996.475	5055.871
SW4	5007.627	5060.869
SW5	5214.581	5041.517
SW6	5630.914	5331.117
SW7	5540.404	5191.359
SW8	5457.929	5022.281
SW9	5063.947	4707.944
SW10	4730.794	4396.464
BH1	4984.649	5292.405
BH2	5018.043	5071.678
BH96B	5118.544	4875.527
L1	5050.756	5296.104
L4	5080.621	5071.335
L5	5285.330	5049.782
L6	5370.160	5025.942
L7	5457.527	5079.782
LV	5593.760	5189.176

REV	MODIFICATIONS	BY	CH	AP	DATE

CYNGOR SIR YNYS MÔN ISLE OF ANGLESEY COUNTY COUNCIL

Penhesgyn Landfill Site

Monitoring Locations

DRAWN BY	CHECKED BY	APPROVED BY
DMD	GOJR	IR
DATE	SCALE @ A1	REVISION
07.01.2015	1:1250	-

ISSUE: Information

DRAWING NUMBER: 5379.SURV.D03

ENGINEERING ENVIRONMENTAL HEALTH & SAFETY — egniol

CAD FILE REF: M:\CAD Projects\5379 Penhesgyn Landfill Site\5379\Drawings\Current Working Drawings\5379.SURV.D03.dwg

APPENDICES

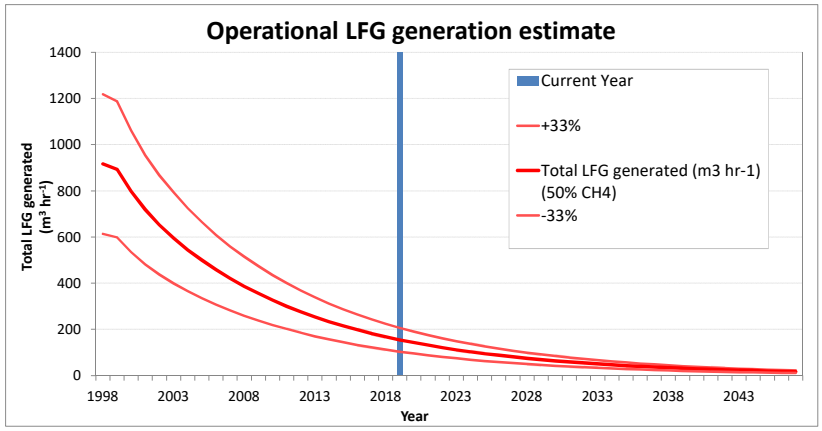
APPENDIX 1. LANDFILL GAS GENERATION ASSESSMENT

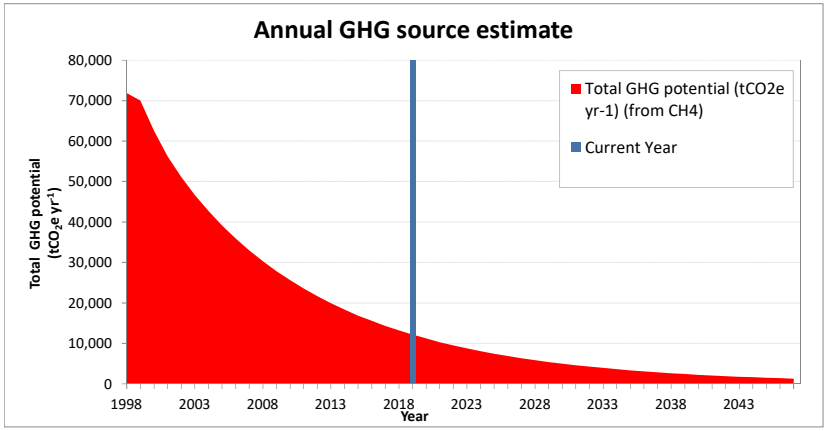
ACUMEN Gas Estimation Tool

Penhesgyn Landfill Site Area 2

	Current year	2019	Year	= Result Cell
Step 1 - Enter the year in which your site first accepted waste	Year of site opening	1969	Year	= Text Entry Cell
Step 2 - Enter the year in which your site ceased accepting waste	Year of site closure	1998	Year	
Step 3 - Enter the total amount of waste deposited in kilotonnes (1 kt = 1,000 tonnes)	Total waste emplaced	1213	kt	

Graphical results





Operational results

Result 1 - This is the operational period of your landfill	Operational period	29	Years
Result 2 - This is the current estimated gas generation rate at your site	Current estimated gas generation	155	$m^3\ hr^{-1}$ (@ STP, @ **50%** CH_4)

Greenhouse gas results

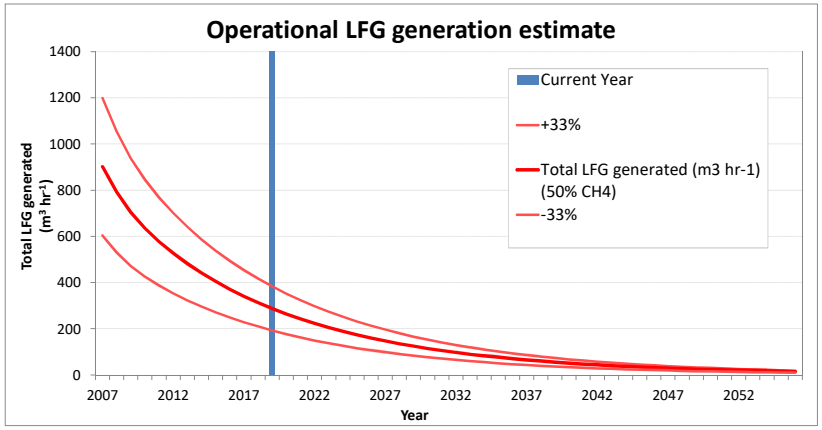
Result 3 - This is the current estimated greenhouse gas source at your site, expressed in tCO_2e	Estimated GHG potential this year	12,175	tCO_2e
Result 4 - This is the estimated remaining greenhouse gas source term for the fifty years following site closure, e	Estimated potential GHG remaining up to **2047**	142,154	tCO_2e

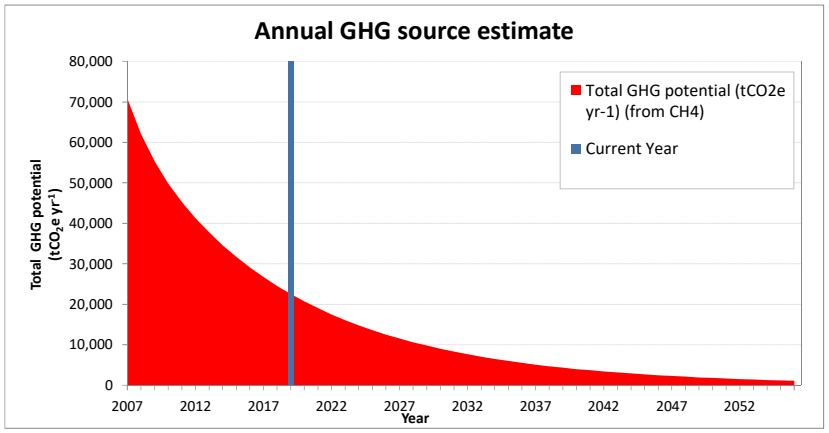
ACUMEN Gas Estimation Tool

Penhesgyn Landfill Site Area 3 &Valley Cell

	Current year	2019	Year	= Result Cell
Step 1 - Enter the year in which your site first accepted waste	Year of site opening	1999	Year	= Text Entry Cell
Step 2 - Enter the year in which your site ceased accepting waste	Year of site closure	2007	Year	
Step 3 - Enter the total amount of waste deposited in kilotonnes (1 kt = 1,000 tonnes)	Total waste emplaced	920	kt	

Graphical results





Operational results

Result 1 - This is the operational period of your landfill	Operational period	8	Years
Result 2 - This is the current estimated gas generation rate at your site	Current estimated gas generation	420	$m^3\ hr^{-1}$ (@ STP, @ **50%** CH_4)

Greenhouse gas results

Result 3 - This is the current estimated greenhouse gas source at your site, expressed in tCO_2e	Estimated GHG potential this year	32,955	tCO_2e
Result 4 - This is the estimated remaining greenhouse gas source term for the fifty years following site closure, e	Estimated potential GHG remaining up to **2056**	397,484	tCO_2e

APPENDIX 2. TECHNICAL DATA: GAS GENERATORS (SCANIA SGI12 AND SGI13)

APPENDIX 2

GENERATOR TECHNICAL DATA – SCANIA SGI13

Consumption on Landfill Gas: at 100% load

% CH_4	KW_e @ alternator	KW_e @transformer	Gas Demand kW (HHV)	Gas Consumption (Nm^3/hr)	Efficiency (% HHV)
60	215	190	520	87	36.6%
55	215	190	520	95	36.6%
50	215	190	520	104	36.6%
45	215	190	520	116	36.6%
40	215	190	520	130	36.6%
35	215	190	520	149	36.6%

Consumption on Landfill Gas: at 75% load

% CH_4	KW_e @ alternator	KW_e @transformer	Gas Demand kW (HHV)	Gas Consumption (Nm^3/hr)	Efficiency (% HHV)
60	161	140	432	72	32.3%
55	161	140	432	79	32.3%
50	161	140	432	86	32.3%
45	161	140	432	96	32.3%
40	161	140	432	108	32.3%
35	161	140	432	123	32.3%

Consumption on Landfill Gas: at 50% load

% CH_4	KW_e @ alternator	KW_e @transformer	Gas Demand kW (HHV)	Gas Consumption (Nm^3/hr)	Efficiency (% HHV)
60	108	89	318	53	28.0%
55	108	89	318	58	28.0%
50	108	89	318	64	28.0%
45	108	89	318	71	28.0%
40	108	89	318	80	28.0%
35	108	89	318	91	28.0%

Design tolerance on values above to be not less than 5%

Notes:

(1) Gross output taken as output at the alternator terminals.

(2) Parasitic loads to include all continuous loads associated with the generator within this scope of supply.

(3) Net export to be the Gross Output less Parasitic Loads.

(4) Gas consumption to be given using gross calorific value assuming gas at 25°C with a dew point of 10°C.

Parasitic Loads:

(a) Continuous			(b) Intermittent		
Radiator fans	0*	kW	Lighting	<1	kW
Crank Case Vent Fan	<1	kW	Battery Charger	<1	kW
Intercooler water pump	<1	kW	Container Heaters	0	kW
Panel supply and Engine Vent Fan	<1	kW	Cool down oil pump	<1	kW
			Alternator Heaters	<1	kW
TOTAL	**1.5**	**kW**	**TOTAL**	**<1**	**kW**

*Vent fan mechanical

Gas Pressures:

Minimum gas supply pressure at inlet to container: mbar 100

Maximum gas supply pressure at inlet to container: 250 mbar

Emissions:

The supplied generator(s) will be required to comply with limits as given below:

Parameter	**EA Emission Limits***	**Stated Emissions**
Nitrogen Oxides	500 mg/Nm3	500 mg/Nm3
Carbon Monoxide	1400 mg/Nm3	1400 mg/Nm3
Total Volatile Organic Compounds (VOCs)	1000 mg/Nm3	1000 mg/Nm3
Total Non-Methane Volatile Organic Compounds (NMVOCs)	75 mg/Nm3	75 mg/Nm3

All limits at reference conditions of 273 °K, 1013 mBar, 5% oxygen and dry gas.

* Emission limits from Guidance for monitoring landfill gas engine emissions LFTGN08 v2 2010

Noise Levels:

The sound pressure levels for the generator(s) measured at a distance of 10 metres:

dB at 10m	31.5Hz	63 Hz	125 Hz	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz	Sum dBA
										65

Oil & Oil Consumption:

Oil consumption at full load	<0.3	g/kwh
Recommended standard intervals for changes	1000	operating hours
Recommended Oil Manufacturer and Type	Fuchs Ganymet Ultra	

Maintenance:

Generator Down Time Through Planned Maintenance:

Year 1	30	Hours	Year 6	38	Hours
Year 2	38	Hours	Year 7	33	Hours
Year 3	46	Hours	Year 8	70	Hours
Year 4	57	Hours	Year 9	38	Hours
Year 5	214	Hours	Year 10	206	Hours

GENERATOR TECHNICAL DATA – SCANIA SGI12

Consumption on Landfill Gas: at 100% load

% CH_4	KW_e @ alternator	KW_e @transformer	Gas Demand kW (HHV)	Gas Consumption (Nm^3/hr)	Efficiency (% HHV)
60	180	160	435	73	36.8%
55	180	160	435	79	36.8%
50	180	160	435	87	36.8%
45	180	160	435	97	36.8%
40	180	160	435	109	36.8%
35	180	160	435	124	36.8%

Consumption on Landfill Gas: at 75% load

% CH_4	KW_e @ alternator	KW_e @transformer	Gas Demand kW (HHV)	Gas Consumption (Nm^3/hr)	Efficiency (% HHV)
60	135	118	362	60	32.6%
55	135	118	362	66	32.6%
50	135	118	362	72	32.6%
45	135	118	362	80	32.6%
40	135	118	362	90	32.6%
35	135	118	362	103	32.6%

Consumption on Landfill Gas: at 50% load

% CH_4	KW_e @ alternator	KW_e @transformer	Gas Demand kW (HHV)	Gas Consumption (Nm^3/hr)	Efficiency (% HHV)
60	90	76	266	44	28.4%
55	90	76	266	48	28.4%
50	90	76	266	53	28.4%
45	90	76	266	59	28.4%
40	90	76	266	67	28.4%
35	90	76	266	76	28.4%

Design tolerance on values above to be not less than 5%

Notes:

(1) Gross output taken as output at the alternator terminals.

(2) Parasitic loads to include all continuous loads associated with the generator within this scope of supply.

(3) Net export to be the Gross Output less Parasitic Loads.

(4) Gas consumption to be given using gross calorific value assuming gas at 25°C with a dew point of 10°C.

Parasitic Loads:

(a) Continuous			(b) Intermittent		
Radiator fans	0*	kW	Lighting	<1	kW
Crank Case Vent Fan	<1	kW	Battery Charger	<1	kW
Intercooler water pump	<1	kW	Container Heaters	0	kW
Panel supply and Engine Vent Fan	<1	kW	Cool down oil pump	<1	kW
			Alternator Heaters	<1	kW
TOTAL	**1.5**	**kW**	**TOTAL**	**<1**	**kW**

*Vent fan mechanical

Gas Pressures:

Minimum gas supply pressure at inlet to container: mbar 100

Maximum gas supply pressure at inlet to container: 250 mbar

Emissions:

The supplied generator(s) will be required to comply with limits as given below:

Parameter	**EA Emission Limits***	**Stated Emissions**
Nitrogen Oxides	500 mg/Nm3	500 mg/Nm3
Carbon Monoxide	1400 mg/Nm3	1400 mg/Nm3
Total Volatile Organic Compounds (VOCs)	1000 mg/Nm3	1000 mg/Nm3
Total Non-Methane Volatile Organic Compounds (NMVOCs)	75 mg/Nm3	75 mg/Nm3

All limits at reference conditions of 273 °K, 1013 mBar, 5% oxygen and dry gas.

* Emission limits from Guidance for monitoring landfill gas engine emissions LFTGN08 v2 2010

Noise Levels:

The sound pressure levels for the generator(s) measured at a distance of 10 metres:

dB at 10m	31.5Hz	63 Hz	125 Hz	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz	Sum dBA
										65

Oil & Oil Consumption:

Oil consumption at full load	<0.3	g/kwh
Recommended standard intervals for changes	1000	operating hours
Recommended Oil Manufacturer and Type	Fuchs Ganymet Ultra	

Maintenance:

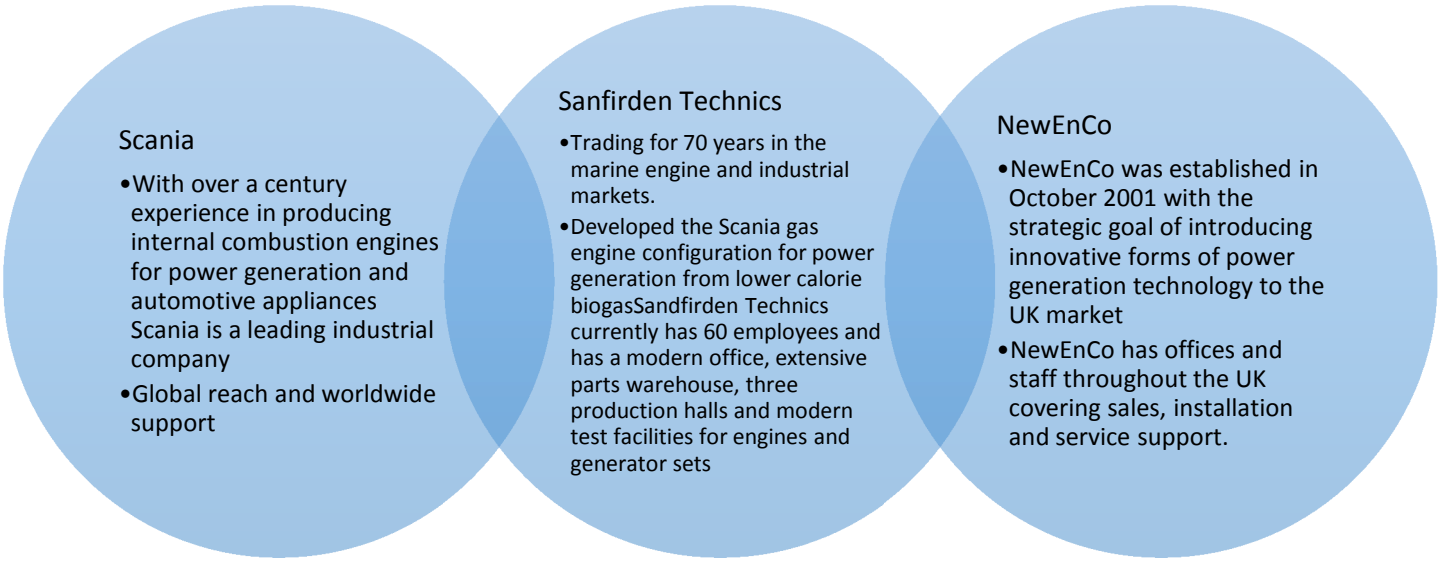
Generator Down Time Through Planned Maintenance:

Year 1	30	Hours	Year 6	38	Hours
Year 2	38	Hours	Year 7	33	Hours
Year 3	46	Hours	Year 8	70	Hours
Year 4	57	Hours	Year 9	38	Hours
Year 5	214	Hours	Year 10	206	Hours

NewEnCo
The New Energy Company

SCANIA SGI GAS GENERATION

COST EFFECTIVE GAS FUELLED ELECTRICTY GENERATION



LANDFILL GAS

Developed for duty on landfill gas applications. Able to cope with contaminated gas with excellent reliability and availability.

AD AND BIOGAS

Suitable for duty on AD biogas with H_2S removal. High efficiency maximises electrical output.

NATURAL GAS

Cost effective on site generation with natural gas or LPG.

COMBINED HEAT AND POWER

Options include for jacket water heat recovery or full CHP spec with exhaust heat recovery as well.

CONTAINERISED

Available in easily installed fully packaged container or generator to be installed in a plant room

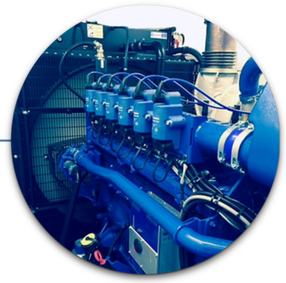
GRID CONNECTED

Supplied with synchronising breaker and G59 protection relays for operation in parallel with the grid.

ISLAND MODE

Able to operate in island mode supplying base load power to off grid applications. Options include load bank package for full off grid power supply to replace diesel generation

HIGH OUTPUT WITH LOW OPERATING COSTS



OUTSTANDING EFFICIENCY

- Up to 44% mechanical efficiency
- Up to 86% overall efficiency with CHP

EXCELLENT RELIABILITY

- Remote access using mobile app and Air Gate makes for easy remote starting.
- Text alerts provide instant notification of faults.
- Spares available next day from a nationwide network of Scania dealers

LOW MAINTENANCE COSTS

- Reliable and Strong
- Long head life
- Plug life up to 5,000 hours
- Long oil life

PROVEN TRACK RECORD

- 60,000+ running hours on lead units
- Units installed world wide

NewEnCo
The New Energy Company

PRODUCT DATA

OUTPUT

Unit	Engine Output	Heat Output	Efficiency
Biogas	215 kW 189 kWe 237 kVA	HT Circuit 80 kWt LT Circuit 24 kWt Exhaust 139 kWt*	41% Mechanical 39% Electrical** 83% Thermal
Natural Gas	215 kW 189 kWe 237 KVA	HT Circuit 61 kWt LT Circuit 32 kWt Exhaust 138 kWt*	44% Mechanical 42% Electrical** 86% Thermal

*Based upon reducing exhaust temperature to 150 °C
**Equivalent without parasitic fan losses

EMISSIONS

Lean Burn gives excellent emission levels. Easily meets all relevant legislation and EA emission standards.

Biogas	Complies with LFTGN08 Environment Agency guidance	<500 mg/Nm^3 NOx, <1400 mg/Nm^3 CO, <1000 mg/Nm^3 VOC at 5% O_2 reference conditions
Natural Gas	Complies with limits proposed under Medium Combustion Plant Directive	<190 mg/Nm^3 NOx at 15% O_2 reference conditions

NOISE

106 dB(A) at 1 m for the bare engine
65 dB(A) at 10 m as standard for containerised unit.
Alternative Silencer and container arrangements are available if lower noise spec is required.

INSTALLATION

With a proven track record of over 100 power generation projects installed and commissioned NewEnCo can offer a range of options including supply and installation, fully comprehensive operation and maintenance services, and project finance.

MAINTENANCE AND SUPPORT

NewEnCo has offices and service personnel throughout the UK and we are able to offer a first class maintenance and support service.

We offer fully comprehensive Maintenance Contracts for any equipment which we install and/or supply, tailored to the customer's individual requirements.

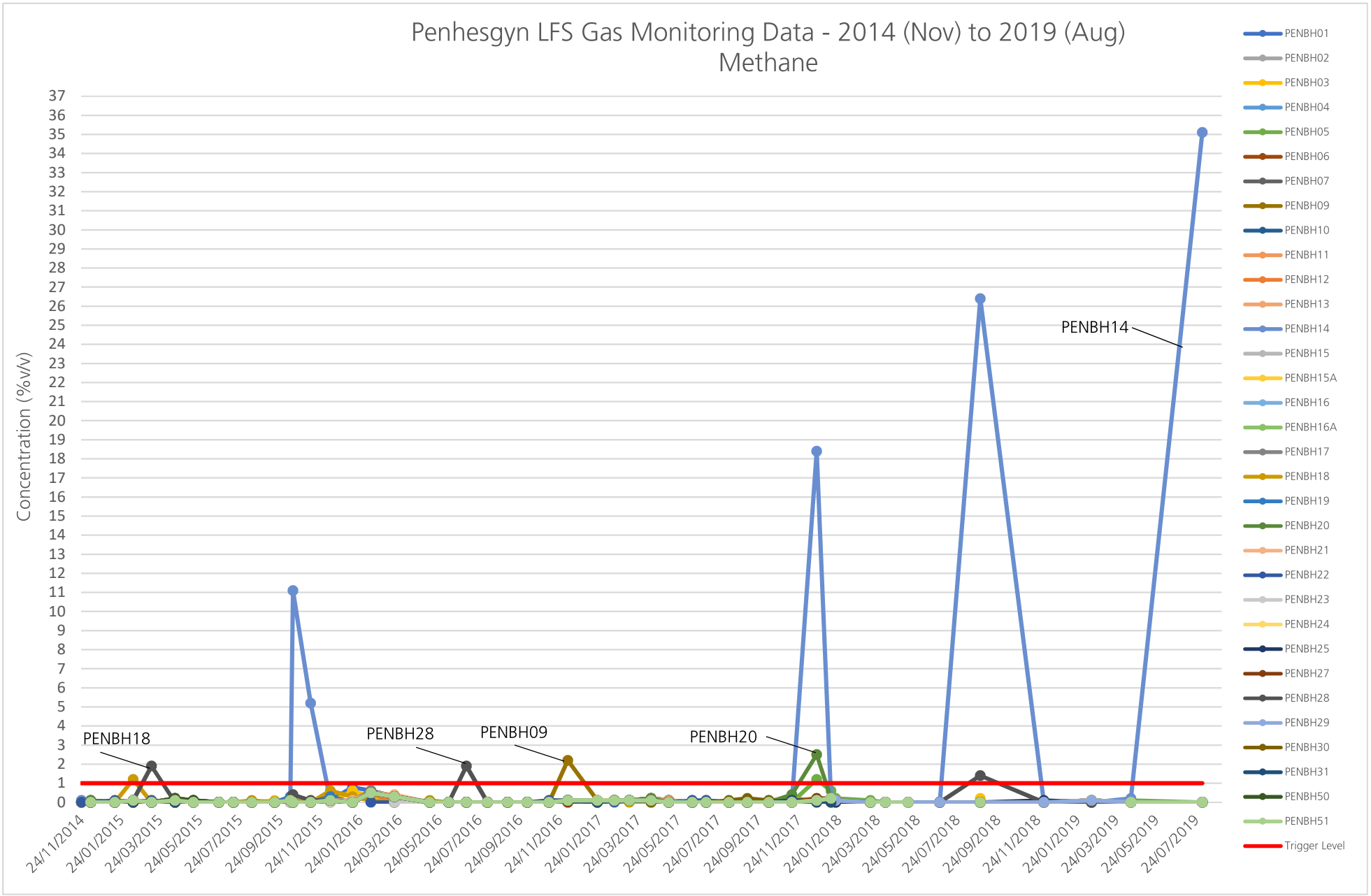
Our service offering is outstanding, so our many satisfied customers tell us.

We can also provide a remote monitoring service for supplied equipment which allows performance to be monitored on a daily basis, providing early warning of potential problems and, where appropriate, faults to be reset.

QUTOTATIONS

For all product enquiries call NewEnCo on 01270 768040

APPENDIX 3. SUMMARY OF GAS MONITORING DATA IN PERIMETER BOREHOLES (2014-2019)


Penhesgyn LFS Gas Monitoring Data - 2014 (Nov) to 2019 (Aug)
Methane
Concentration (%v/v)
PENBH18
PENBH28
PENBH09
PENBH20
PENBH14
PENBH01
PENBH02
PENBH03
PENBH04
PENBH05
PENBH06
PENBH07
PENBH09
PENBH10
PENBH11
PENBH12
PENBH13
PENBH14
PENBH15
PENBH15A
PENBH16
PENBH16A
PENBH17
PENBH18
PENBH19
PENBH20
PENBH21
PENBH22
PENBH23
PENBH24
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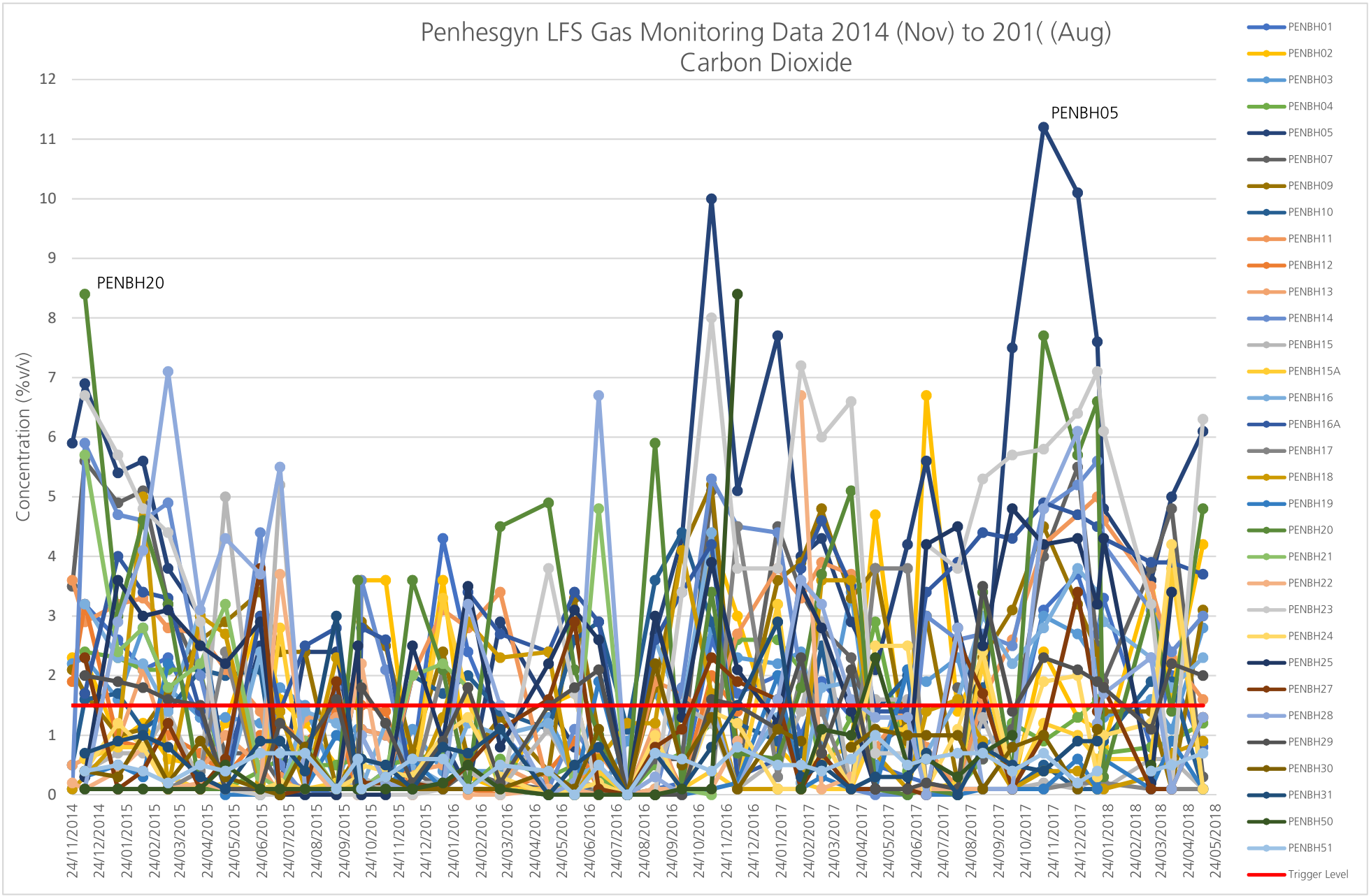
PENBH27
PENBH28
PENBH29
PENBH30
PENBH31
PENBH50
PENBH51
Trigger Level


Penhesgyn LFS Gas Monitoring Data 2014 (Nov) to 201((Aug)
Carbon Dioxide
Concentration (%v/v)
PENBH20
PENBH05
PENBH01
PENBH02
PENBH03
PENBH04
PENBH05
PENBH07
PENBH09
PENBH10
PENBH11
PENBH12
PENBH13
PENBH14
PENBH15
PENBH15A
PENBH16
PENBH16A
PENBH17
PENBH18
PENBH19
PENBH20
PENBH21
PENBH22
PENBH23
PENBH24
PENBH25
PENBH27
PENBH28
PENBH29
PENBH30
PENBH31
PENBH50
PENBH51
Trigger Level

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH01	24/11/2014							Data set Max value:	4.3	
PENBH01	08/12/2014	0.0	3.2	18.8	1017	0	1.7	Data set Min value:	0.0	
PENBH01	14/01/2015	0.0	2.6	15.7	996	0	1.1	Mean:	1.3	
PENBH01	11/02/2015	0.1	2.1	19.6	1017	0	0.7	SD:	1.14	
PENBH01	11/03/2015	0.0	2.3	18.3	1013	0	0.9	No. Readings:	47	
PENBH01	16/04/2015	0.1	1.3	20.1	1012		0.0	Critical Value:	3.34	
PENBH01	14/05/2015	0.0	0.1	21.7	1005	1	-1.1	No. Outliner Values:	0	
PENBH01	22/06/2015	0.0	0.1	21.1	1007	1	-1.1	Stat. Max(tmax)	4.3	
PENBH01	14/07/2015	0.0	0.1	20.9	1010	1	-1.1	Action Level	5.3	
PENBH01	11/08/2015	0.0	0.1	21.1	1016	0	-1.1	(tmax+FoS)		
PENBH01	15/09/2015	0.0								
PENBH01	09/10/2015	0.1	0.5	21.6	1018	0	-0.7			
PENBH01	13/10/2015	0.0	1.1	20.8	1022	0	-0.2			
PENBH01	09/11/2015	0.0	1.0	21.8	1022	0	-0.3			
PENBH01	09/12/2015	0.1	0.5	21.6	1018	0	-0.7			
PENBH01	12/01/2016	0.8	4.3	14.2	993	0	2.6			
PENBH01	09/02/2016	0.6	2.4	20.0	977	0	1.0			
PENBH01	16/03/2016	0.3	1.1	20.4	1026	0	-0.2			
PENBH01	09/05/2016	0.0	0.1	21.1	1005	0	-1.1			
PENBH01	07/06/2016	0.0	0.1	21.7	1020	0	-1.1			
PENBH01	04/07/2016	0.0	0.1	21.6	1011	0	-1.1			
PENBH01	05/08/2016	0.0	0.0	21.7	1026	0	-1.1			
PENBH01	05/09/2016	0.0	0.1	21.1	1010	0	-1.1			
PENBH01	05/10/2016	0.0	0.2	21.3	1023	0	-1.0			
PENBH01	07/11/2016	0.0	2.6	20.6	1005	0	1.1			
PENBH01	06/12/2016	0.1	1.7	20.3	1017	0	0.4			
PENBH01	20/01/2017	0.1	2.0	19.9	1027		0.6			
PENBH01	15/02/2017	0.1	1.0	21.6	1019	0	-0.3			
PENBH01	10/03/2017	0.1	1.9	19.7	1018	0	0.5			
PENBH01	12/04/2017	0.1	1.3	20.7	1014	0	0.0			
PENBH01	09/05/2017	0.0	0.5	18.2	1020	0	-0.7			
PENBH01	14/06/2017	0.0	0.3	20.9	1020	0	-0.9			
PENBH01	05/07/2017	0.0	0.2	21.1	1014	0	-1.0			
PENBH01	09/08/2017	0.0	0.1	16.4	1017	0	-1.1			
PENBH01	06/09/2017	0.0	0.1	21.5	1014	0	-1.1			
PENBH01	09/10/2017	0.0	0.8	21.1	1022	0	-0.4			
PENBH01	13/11/2017	0.0	3.1	19.8	1019	0	1.6			
PENBH01	21/12/2017	0.1	3.7	17.9	1030	0	2.1			
PENBH01	12/01/2018	0.2	2.7	20.5	1017	0	1.2			
PENBH01	19/01/2018	0.1	3.3	17.1	1013	0	1.8			
PENBH01	13/03/2018	0.0	0.8	19.8	1001	0	-0.4			
PENBH01	05/04/2018	0.0	2.0	19.6	1011	0	0.6			
PENBH01	10/05/2018	0	0.8	21	1010		-0.4			
PENBH01	27/06/2018	0	1.2	20.3	1020	0	-0.1			
PENBH01	28/08/2018	0	1.3	20.3	1020	0	0.0			
PENBH01	03/12/2018	0	2.4	19.8	995	0	1.0			
PENBH01	14/02/2019	0.1	2.2	19.6	1024	0	0.8			
PENBH01	15/04/2019	0	1.8	19.6	1010	0	0.4			
PENBH01	02/08/2019	0	0.1	21	1016	0	-1.1			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH02	24/11/2014	0.0	2.3	20.3	1018	0	0.42	Data set Max value:	6.7	
PENBH02	08/12/2014	0.0	2.3	20.0	1016	0	0.4	Data set Min value:	0.0	
PENBH02	14/01/2015	0.0	0.9	21.9	995	0	-0.6	Mean:	1.7	
PENBH02	11/02/2015	0.1	1.2	21.6	1017	0	-0.3	SD:	1.44	
PENBH02	11/03/2015	0.0	0.6	21.5	1012	0	-0.8	No. Readings:	49	
PENBH02	16/04/2015	0.1	0.5	20.7	1012		-0.8	Critical Value:	3.34	
PENBH02	14/05/2015	0.0	1.2	19.8	1005	1	-0.3	No. Outliner Values:	1	6.7
PENBH02	22/06/2015	0.0	3.0	16.9	1006	1	0.9	Stat. Max(tmax)	4.7	
PENBH02	14/07/2015	0.0	1.6	18.5	1010	1	-0.1	Action Level	5.7	
PENBH02	11/08/2015	0.0	1.2	19.3	1014	1	-0.3	(tmax+FoS)		
PENBH02	15/09/2015	0.0	0.5	20.4	989	1	-0.8			
PENBH02	09/10/2015	0.1	0.2	21.9	1017	0	-1.0			
PENBH02	13/10/2015	0.0	3.6	16.9	1022	0	1.3			
PENBH02	09/11/2015	0.0	3.6	16.4	1022	0	1.3			
PENBH02	09/12/2015	0.1	0.2	21.9	1017	0	-1.0			
PENBH02	12/01/2016	0.0	3.6	16.9	1022	0	1.3			
PENBH02	09/02/2016	0.5	0.3	22.4	976	0	-1.0			
PENBH02	16/03/2016	0.3	0.1	22.1	1025	0	-1.1			
PENBH02	09/05/2016	0.0	1.5	16.6	1003	0	-0.1			
PENBH02	07/06/2016	0.0	1.7	18.6	1018	0	0.0			
PENBH02	04/07/2016	0.0	0.0	21.3	1011	0	-1.2			
PENBH02	05/08/2016	0.0	0.0	21.2	1025	0	-1.2			
PENBH02	05/09/2016	0.0	0.6	19.4	1009	0	-0.8			
PENBH02	05/10/2016	0.0	1.3	19.7	1022	0	-0.3			
PENBH02	07/11/2016	0.0	4.3	15.5	1010	0	1.8			
PENBH02	06/12/2016	0.1	3.0	18.8	1017	0	0.9			
PENBH02	20/01/2017	0.1	0.8	21.4	1027	0	-0.6			
PENBH02	15/02/2017	0.1	0.4	21.3	1017	0	-0.9			
PENBH02	10/03/2017	0.1	0.6	21.6	1017	0	-0.8			
PENBH02	12/04/2017	0.2	0.8	21.1	1013	0	-0.6			
PENBH02	09/05/2017	0.1	4.7	16.1	1020	0	2.1			
PENBH02	14/06/2017	0.0	0.3	20.6	1020	0	-1.0			
PENBH02	05/07/2017	0.0	6.7	10.7	1013	0	3.5			
PENBH02	09/08/2017	0.0	1.4	19.1	1015	0	-0.2			
PENBH02	06/09/2017	0.0	2.3	18.7	1010	0	0.4			
PENBH02	09/10/2017	0.0	0.1	21.5	1020	0	-1.1			
PENBH02	13/11/2017	0.1	2.4	21.5	1018	0	0.5			
PENBH02	21/12/2017	0.1	1.3	20.9	1029	0	-0.3			
PENBH02	12/01/2018	0.2	1.1	21.3	1016	0	-0.4			
PENBH02	19/02/2018	0.1	0.8	21.0	1014	0	-0.6			
PENBH02	13/03/2018	0.0	3.6	16.8	1003	0	1.3			
PENBH02	05/04/2018	0.0	1.7	20.7	1010	0	0.0			
PENBH02	10/05/2018	0	4.2	14.7	1009		1.7			
PENBH02	27/06/2018	0	2.5	18.1	1020	0	0.6			
PENBH02	28/08/2018	0	1.8	19.6	1009	0	0.1			
PENBH02	03/12/2018	0	2.2	18.1	993	0	0.3			
PENBH02	14/02/2019	0.1	0.6	21.2	1023	0	-0.8			
PENBH02	15/04/2019	0	2.4	16.7	1009	0	0.5			
PENBH02	02/08/2019	0	1.9	17.9	1015	0	0.1			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH03	24/11/2014							Data set Max value:	3.4	
PENBH03	08/12/2014	0.0	2.2	21.1	1016	0	0.81	Data set Min value:	0.0	
PENBH03	14/01/2015	0.0	2.3	20.9	995	0	0.9	Mean:	1.5	
PENBH03	11/02/2015	0.1	1.6	21.4	1017	0	0.1	SD:	0.86	
PENBH03	11/03/2015	0.0	2.8	20.2	1012	0	1.5	No. Readings:	44	
PENBH03	16/04/2015	0.1	1.8	19.4	1012		0.3	Critical Value:	3.24	
PENBH03	14/05/2015	0.0	1.3	20.8	1005	0	-0.2	No. Outliner Values:	0	
PENBH03	22/06/2015	0.0	1.3	19.6	1006	0	-0.2	Stat. Max(tmax)	3.4	
PENBH03	14/07/2015	0.0	1.2	19.9	1010	0	-0.3	Action Level	4.4	
PENBH03	11/08/2015	0.0	1.8	19.6	1015	1	0.3	(tmax+FoS)		
PENBH03	15/09/2015	0.0	1.5	20.0	989	1	0.0			
PENBH03	09/10/2015	0.1	0.2	21.8	1009	0	-1.5			
PENBH03	13/10/2015	0.0	1.1	20.7	1022	0	-0.5			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH03	09/11/2015	0.0	1.0	18.7	1022	0	-0.6			
PENBH03	09/12/2015	0.1	0.2	21.8	1009	0	-1.5			
PENBH03	12/01/2016	0.0	1.1	20.7	1022	0	-0.5			
PENBH03	09/02/2016	0.6	0.4	22.4	976	0	-1.3			
PENBH03	16/03/2016	0.3	0.4	21.9	1025	0	-1.3			
PENBH03	09/05/2016	0.0	0.4	20.4	1004	0	-1.3			
PENBH03	07/06/2016	0.0	1.3	19.9	1019	0	-0.2			
PENBH03	04/07/2016	0.0	0.4	20.9	1011	0	-1.3			
PENBH03	05/08/2016	0.0	0.0	21.1	1026	0	-1.7			
PENBH03	05/09/2016	0.0	0.9	20.0	1009	0	-0.7			
PENBH03	05/10/2016	0.0	1.7	20.1	1023	0	0.2			
PENBH03	07/11/2016	0.0	0.7	21.7	1011	0	-0.9			
PENBH03	06/12/2016	0.1	2.8	18.3	1017	0	1.5			
PENBH03	20/01/2017	0.1	2.3	20.9	1027	0	0.9			
PENBH03	15/02/2017	0.1	2.2	20.2	1018	0	0.8			
PENBH03	10/03/2017	0.1	2.4	19.2	1017	0	1.0			
PENBH03	12/04/2017	0.1	0.9	20.9	1012	0	-0.7			
PENBH03	09/05/2017	0.1	3.4	16.7	1020	0	2.2			
PENBH03	14/06/2017	0.0	0.4	20.4	1020	0	-1.3			
PENBH03	05/07/2017	0.0	2.1	19.2	1014	0	0.7			
PENBH03	09/08/2017	0.0	1.9	19.8	1016	0	0.5			
PENBH03	06/09/2017	0.0	2.3	19.1	1013	0	0.9			
PENBH03	09/10/2017	0.0	0.8	21.1	1021	0	-0.8			
PENBH03	13/11/2017	0.0	1.2	21.6	1019	0	-0.3			
PENBH03	21/12/2017	0.1	3.0	20.1	1029	0	1.7			
PENBH03	12/01/2018	0.2	2.7	20.5	1016	0	1.4			
PENBH03	19/02/2018	0.1	2.2	20.1	1013	0	0.8			
PENBH03	13/03/2018	0.0	1.3	21.1	1003	0	-0.2			
PENBH03	05/04/2018	0.0	1.6	20.8	1010	0	0.1			
PENBH03	10/05/2018	0	1.1	20.4	1009		-0.5			
PENBH03	27/06/2018	0	2.8	17.8	1021	0	1.5			
PENBH03	28/08/2018						-1.7			
PENBH03	03/12/2018	0.2	0.7	20.8	994		-0.9			
PENBH03	14/02/2019						-1.7			
PENBH03	15/04/2019						-1.7			
PENBH03	02/08/2019						-1.7			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH04	24/11/2014							Data set Max value:	2.9	
PENBH04	08/12/2014	0.0	2.4	20.6	1016	0	1.82	Data set Min value:	0.0	
PENBH04	14/01/2015	0.0	2.3	20.4	995	0	1.7	Mean:	1.0	
PENBH04	11/02/2015	0.1	2.1	20.5	1017	0	1.4	SD:	0.77	
PENBH04	11/03/2015	0.0	2.1	20.1	1012	0	1.4	No. Readings:	48	
PENBH04	16/04/2015	0.1	2.1	19.5	1012		1.4	Critical Value:	3.34	
PENBH04	14/05/2015	0.0	0.1	21.7	1005	0	-1.2	No. Outliner Values:	0	
PENBH04	22/06/2015	0.0	0.4	21.0	1006	0	-0.8	Stat. Max(tmax)	2.9	
PENBH04	14/07/2015	0.0	0.6	20.7	1010	0	-0.5	Action Level	3.9	
PENBH04	11/08/2015	0.0	0.5	20.6	1015	1	-0.6	(tmax+FoS)		
PENBH04	15/09/2015	0.0	0.5	20.6	989	0	-0.6			
PENBH04	09/10/2015	0.1	0.6	21.6	1017	0	-0.5			
PENBH04	13/10/2015	0.0	0.6	20.2	1022	0	-0.5			
PENBH04	09/11/2015	0.0	0.5	21.2	1022	0	-0.6			
PENBH04	09/12/2015	0.1	0.6	21.6	1017	0	-0.5			
PENBH04	12/01/2016	0.0	0.7	22.2	991	0	-0.4			
PENBH04	09/02/2016	0.5	0.1	22.6	976	0	-1.2			
PENBH04	16/03/2016	0.3	0.6	22.0	1025	0	-0.5			
PENBH04	09/05/2016	0.0	0.3	21.0	1004	0	-0.9			
PENBH04	07/06/2016	0.0	0.5	21.1	1018	0	-0.6			
PENBH04	04/07/2016	0.0	0.3	20.9	1011	0	-0.9			
PENBH04	05/08/2016	0.0	0.0	21.3	1025	0	-1.3			
PENBH04	05/09/2016	0.0	0.5	20.5	1009	0	-0.6			
PENBH04	05/10/2016	0.0	0.7	20.9	1022	0	-0.4			
PENBH04	07/11/2016	0.0	1.2	21.2	1011	0	0.3			
PENBH04	06/12/2016	0.1	2.6	20.5	1017	0	2.1			
PENBH04	20/01/2017	0.1	2.6	19.4	1027	0	2.1			
PENBH04	15/02/2017	0.1	2.1	19.8	1018	0	1.4			
PENBH04	10/03/2017	0.1	0.4	21.6	1017	0	-0.8			
PENBH04	12/04/2017	0.1	1.3	19.6	1012	0	0.4			
PENBH04	09/05/2017	0.0	2.9	17.2	1020	0	2.5			
PENBH04	14/06/2017	0.0	0.4	20.5	1020	0	-0.8			
PENBH04	05/07/2017	0.0	0.7	20.7	1013	0	-0.4			
PENBH04	09/08/2017	0.0	0.1	21.4	1016	0	-1.2			
PENBH04	06/09/2017	0.0	0.6	21.5	1012	0	-0.5			
PENBH04	09/10/2017	0.0	1.2	20.6	1020	0	0.3			
PENBH04	13/11/2017	0.0	0.9	21.8	1018	0	-0.1			
PENBH04	21/12/2017	0.1	1.3	20.6	1029	0	0.4			
PENBH04	12/01/2018	0.2	1.6	20.0	1016	0	0.8			
PENBH04	19/02/2018	0.1	0.7	20.8	1013	0	-0.4			
PENBH04	13/03/2018	0.0	0.8	21.2	1002	0	-0.3			
PENBH04	05/04/2018	0.0	0.9	20.4	1009	0	-0.1			
PENBH04	10/05/2018	0	1.2	20.2	1009		0.3			
PENBH04	27/06/2018	0	1.4	19.8	1020	0	0.5			
PENBH04	28/08/2018	0	1.5	20.2	1010	0	0.6			
PENBH04	03/12/2018	0	0.4	20.9	994	0	-0.8			
PENBH04	14/02/2019	0.1	0.4	21.2	1023	0	-0.8			
PENBH04	15/04/2019	0	0.7	20.9	1010	0	-0.4			
PENBH04	02/08/2019	0	2.1	17.8	1015	0	1.4			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH05	24/11/2014	0.0	5.9	4.0	1020	0	0.81	Data set Max value:	11.2	
PENBH05	08/12/2014	0.0	6.9	2.7	1010	0	1.2	Data set Min value:	0.0	
PENBH05	14/01/2015	0.0	5.4	2.8	994	0	0.6	Mean:	3.7	
PENBH05	11/02/2015	0.1	5.6	2.0	1017	0	0.7	SD:	2.72	
PENBH05	11/03/2015	0.0	3.8	11.0	1012	0	0.0	No. Readings:	49	
PENBH05	16/04/2015	0.1	3.0	12.5	1012		-0.3	Critical Value:	3.34	
PENBH05	14/05/2015	0.1	0.4	21.2	1005	1	-1.2	No. Outliner Values:	0	
PENBH05	22/06/2015	0.0	2.5	17.4	1005	1	-0.4	Stat. Max(tmax)	11.2	
PENBH05	14/07/2015	0.0	0.1	20.9	1010	1	-1.3	Action Level	14.2	
PENBH05	11/08/2015	0.0	2.4	19.2	1014	1	-0.5	(tmax+FoS)		
PENBH05	15/09/2015	0.0	2.4	19.5	989	1	-0.5			
PENBH05	09/10/2015	0.1	0.4	21.0	1018	0	-1.2			
PENBH05	13/10/2015	0.0	0.1	21.1	1022	0	-1.3			
PENBH05	09/11/2015	0.0	0.4	21.8	1022	0	-1.2			
PENBH05	09/12/2015	0.1	0.4	21.0	1018	0	-1.2			
PENBH05	12/01/2016	0.1	0.9	22.1	990	0	-1.0			
PENBH05	09/02/2016	0.5	0.1	22.3	976	0	-1.3			
PENBH05	16/03/2016	0.3	2.9	14.6	1025	0	-0.3			
PENBH05	09/05/2016	0.0	1.5	18.8	1004	0	-0.8			
PENBH05	07/06/2016	0.0	0.8	20.1	1019	0	-1.1			
PENBH05	04/07/2016	0.0	0.4	20.8	1011	0	-1.2			
PENBH05	05/08/2016	0.0	0.0	21.0	1025	0	-1.4			
PENBH05	05/09/2016	0.0	2.7	15.9	1009	0	-0.4			
PENBH05	05/10/2016	0.0	4.3	15.1	1023	0	0.2			
PENBH05	07/11/2016	0.0	10.0	5.1	1011	0	2.3			
PENBH05	06/12/2016	0.1	5.1	11.1	1017	0	0.5			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH05	20/01/2017	0.1	7.7	16.9	1027	0	1.5			
PENBH05	15/02/2017	0.1	4.0	11.2	1018	0	0.1			
PENBH05	10/03/2017	0.1	4.3	10.2	1017	0	0.2			
PENBH05	12/04/2017	0.2	2.9	15.0	1013	0	-0.3			
PENBH05	09/05/2017	0.1	2.1	19.1	1020	0	-0.6			
PENBH05	14/06/2017	0.0	4.2	11.8	1020	0	0.2			
PENBH05	05/07/2017	0.0	5.6	12.3	1014	0	0.7			
PENBH05	05/07/2017	0.0	2.8	15.6	1014	0	-0.3			
PENBH05	09/08/2017	0.0	1.2	20.5	1016	0	-0.9			
PENBH05	06/09/2017	0.0	7.5	1.3	1013	0	1.4			
PENBH05	09/10/2017	0.0	11.2	0.8	1021	0	2.8			
PENBH05	13/11/2017	1.2	10.1	0.2	1019	0	2.4			
PENBH05	19/12/2017	0.6	7.6	0.2	1028	0	1.4			
PENBH05	12/01/2018	0.2	4.8	11.4	1017	0	0.4			
PENBH05	19/02/2018	0.1	3.6	11.2	1014	0	0.0			
PENBH05	13/03/2018	0.0	5.0	4.1	1003	0	0.5			
PENBH05	05/04/2018	0.0	6.1	1.0	1011	0	0.9			
PENBH05	10/05/2018	0	4.4	9.5	1009		0.3			
PENBH05	27/06/2018	0	4.6	13.5	1021	0	0.3			
PENBH05	28/08/2018	0	4.2	17.6	1008	0	0.2			
PENBH05	03/12/2018	0	3	6	994	0	-0.3			
PENBH05	14/02/2019	0.1	3.7	4.8	1023	0	0.0			
PENBH05	15/04/2019	0	5	3.8	1010	0	0.5			
PENBH05	02/08/2019	0	3.9	17.1	1015	0	0.1			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH06	24/11/2014	0.0	0.4	21.9	1020	1	-0.98	Data set Max value:	1.8	
PENBH06	08/12/2014	0.1	0.2	22.2	1014	0	-1.31	Data set Min value:	0.1	
PENBH06	14/01/2015	0.0	0.1	22.3	995	0	-1.48	Mean:	1.0	
PENBH06	11/02/2015	0.1	0.1	22.3	1017	0	-1.48	SD:	0.61	
PENBH06	11/03/2015	0.0	0.1	21.7	1013	0	-1.48	No. Readings:	16	
PENBH06	16/04/2015	0.1	0.1	21.1	1012		-1.48	Critical Value:	2.75	
PENBH06	14/05/2015							No. Outliner Values:	0	
PENBH06	22/06/2015							Stat. Max(tmax)	1.8	
PENBH06	14/07/2015							Action Level	2.8	
PENBH06	11/08/2015							(tmax+FoS)		
PENBH06	15/09/2015		0.1	20.8	989	1	-1.48			
PENBH06	09/10/2015	0.1	0.1	21.8	1019	0	-1.48			
PENBH06	13/10/2015	0.0	1.6	18.1	1022	0	0.98			
PENBH06	09/11/2015	0.0	1.6	18.3	1022	0	0.98			
PENBH06	09/12/2015	0.1	0.1	21.8	1019	0	-1.48			
PENBH06	12/01/2016						-1.64			
PENBH06	09/02/2016	0.5	0.1	22.3	977	0	-1.48			
PENBH06	16/03/2016									
PENBH06	09/05/2016	0.0	1.8	17.3	1004	0	1.31			
PENBH06	07/06/2016	0.0	0.1	21.1	1018	0	-1.48			
PENBH06	04/07/2016	0.0	0.1	21.0	1012	0	-1.48			
PENBH06	05/08/2016									
PENBH06	05/09/2016	0.0	0.1	20.6	1009	0	-1.48			
PENBH06	05/10/2016									
PENBH06	07/11/2016									
PENBH06	06/12/2016						-1.64			
PENBH06	20/01/2017						-1.64			
PENBH06	15/02/2017						-1.64			
PENBH06	10/03/2017						-1.64			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH07	24/11/2014	0.0	3.5	19.7	1021	0	0.95	Data set Max value:	5.6	
PENBH07	08/12/2014	0.0	5.6	19.1	1008	0	2.1	Data set Min value:	0.0	
PENBH07	14/01/2015	0.0	4.9	18.9	996	0	1.7	Mean:	1.8	
PENBH07	11/02/2015	0.1	5.1	19.3	1017	0	1.8	SD:	1.79	
PENBH07	11/03/2015	0.0	3.2	20.0	1012	0	0.8	No. Readings:	48	
PENBH07	16/04/2015	0.2	2.0	20.4	1012		0.1	Critical Value:	3.34	
PENBH07	14/05/2015	0.1	0.7	21.6	1005	1	-0.6	No. Outliner Values:	0	
PENBH07	22/06/2015	0.0	0.7	21.0	1006	1	-0.6	Stat. Max(tmax)	5.6	
PENBH07	14/07/2015	0.0	0.2	20.8	1010	1	-0.9	Action Level	7.6	
PENBH07	11/08/2015	0.0	0.1	20.5	1014	1	-0.9	(tmax+FoS)		
PENBH07	15/09/2015	0.0	0.1	20.8	989	1	-0.9			
PENBH07	09/10/2015	0.1	0.4	21.7	1018	0	-0.8			
PENBH07	13/10/2015	0.0	0.2	21.4	1022	0	-0.9			
PENBH07	09/11/2015	0.0	0.1	21.1	1022	0	-0.9			
PENBH07	09/12/2015	0.1	0.4	21.7	1018	0	-0.8			
PENBH07	12/01/2016	0.0	0.1	22.5	992	0	-0.9			
PENBH07	09/02/2016	0.5	0.4	22.3	976	0	-0.8			
PENBH07	16/03/2016	0.3	0.2	22.2	1025	0	-0.9			
PENBH07	09/05/2016	0.0	0.1	20.8	1003	0	-0.9			
PENBH07	07/06/2016	0.0	0.2	21.1	1018	0	-0.9			
PENBH07	04/07/2016	0.0	0.1	20.8	1011	0	-0.9			
PENBH07	05/08/2016	0.0	0.0	20.8	1026	0	-1.0			
PENBH07	05/09/2016	0.0	0.6	20.2	1008	0	-0.7			
PENBH07	05/10/2016	0.0	0.6	20.8	1022	0	-0.7			
PENBH07	07/11/2016	0.0	5.1	19.4	1010	0	1.8			
PENBH07	06/12/2016	0.1	0.3	18.9	1017	0	-0.8			
PENBH07	20/01/2017	0.1	4.5	19.2	1027	0	1.5			
PENBH07	15/02/2017	0.1	3.4	19.3	1018	0	0.9			
PENBH07	10/03/2017	0.1	2.8	20.0	1017	0	0.6			
PENBH07	12/04/2017	0.2	2.3	20.1	1013	0.2	0.3			
PENBH07	09/05/2017	0.1	0.8	19.0	1019	0	-0.6			
PENBH07	14/06/2017	0.0	1.2	19.9	1019	0	-0.3			
PENBH07	05/07/2017						-1.0			
PENBH07	09/08/2017	0.0	1.8	19.9	1016	0	0.0			
PENBH07	06/09/2017	0.0	0.6	20.9	1012	0	-0.7			
PENBH07	09/10/2017	0.0	1.1	21.0	1020	0	-0.4			
PENBH07	13/11/2017	0.0	4.0	20.6	1019	0	1.2			
PENBH07	19/12/2017	0.1	5.5	19.3	1028	0	2.1			
PENBH07	12/01/2018	0.2	2.5	20.8	1016	0	0.4			
PENBH07	19/02/2018	0.1	1.9	20.7	1014	0	0.1			
PENBH07	13/03/2018	0.0	3.8	20.4	1003	0	1.1			
PENBH07	05/04/2018	0.0	4.8	19.8	1011	0	1.7			
PENBH07	10/05/2018	0	0.3	21.6	1009		-0.8			
PENBH07	27/06/2018	0	0.9	19.8	1020	0	-0.5			
PENBH07	28/08/2018	0	0.9	20.2	1009	0	-0.5			
PENBH07	03/12/2018	0	3.7	19.1	994	0	1.1			
PENBH07	14/02/2019	0.1	2.4	20.1	1023	0	0.3			
PENBH07	15/04/2019	0	2.9	20	1010	0	0.6			
PENBH07	02/08/2019	0	0.2	19.8	1014	0	-0.9			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH09	24/11/2014	0.0	2.1	16.8	1020	0	0.00	Data set Max value:	5.2	
PENBH09	08/12/2014	0.0	1.7	16.3	1013	0	-0.3	Data set Min value:	0.1	
PENBH09	14/01/2015	0.0	1.0	20.3	995	0	-0.8	Mean:	2.1	
PENBH09	11/02/2015	0.1	1.1	14.1	1017	0	-0.8	SD:	1.33	
PENBH09	11/03/2015	0.0	1.7	13.9	1011	0	-0.3	No. Readings:	49	

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH09	16/04/2015	0.2	2.6	10.9	1008		0.4	Critical Value:	3.34	
PENBH09	14/05/2015	0.1	2.9	15.8	1005	1	0.6	No. Outliner Values:	0	
PENBH09	22/06/2015	0.0	3.4	16.2	1004	1	1.0	Stat. Max(tmax)	5.2	
PENBH09	14/07/2015	0.0	2.4	18.8	1008	1	0.2	Action Level	7.2	
PENBH09	11/08/2015	0.0	2.4	18.4	1014	1	0.2	(tmax+FoS)		
PENBH09	15/09/2015	0.0	0.1	20.6	987	1	-1.5			
PENBH09	09/10/2015	0.1	0.7	20.5	1016	0	-1.1			
PENBH09	13/10/2015	0.1	2.9	19.4	1021	0	0.6			
PENBH09	09/11/2015	0.0	2.5	18.4	1022	0	0.3			
PENBH09	09/12/2015	0.1	0.7	20.5	1016	0	-1.1			
PENBH09	12/01/2016	0.0	2.4	18.4	1014	1	0.2			
PENBH09	09/02/2016	0.6	0.6	21.2	975	0	-1.1			
PENBH09	16/03/2016	0.3	1.3	17.4	1025	0	-0.6			
PENBH09	09/05/2016	0.0	0.4	20.3	1001	0	-1.3			
PENBH09	07/06/2016	0.0	3.3	17.9	1016	0	0.9			
PENBH09	04/07/2016	0.0	1.0	18.7	1009	0	-0.8			
PENBH09	05/08/2016	0.0	0.1	20.8	1023	0	-1.5			
PENBH09	05/09/2016	0.0	1.8	18.0	1007	0	-0.2			
PENBH09	05/10/2016	0.0	4.1	18.6	1021	0	1.5			
PENBH09	07/11/2016	0.0	5.2	11.8	1009	0	2.3			
PENBH09	06/12/2016	2.2	0.7	5.7	1017	1	-1.1			
PENBH09	20/01/2017	0.1	3.6	16.9	1027	0	1.1			
PENBH09	15/02/2017	0.1	3.9	12.0	1017	0	1.4			
PENBH09	10/03/2017	0.1	4.8	14.5	1015	0	2.0			
PENBH09	12/04/2017	0.2	3.3	13.7	1012	0.2	0.9			
PENBH09	09/05/2017	0.1	3.8	16.1	1018	0	1.3			
PENBH09	14/06/2017	0.0	0.9	19.2	1018	0	-0.9			
PENBH09	05/07/2017	0.1	3.0	16.8	1012	0	0.7			
PENBH09	09/08/2017	0.0	0.2	19.3	1014	0	-1.4			
PENBH09	06/09/2017	0.0	2.3	18.4	1011	0	0.2			
PENBH09	09/10/2017	0.0	3.1	16.7	1018	0	0.8			
PENBH09	13/11/2017	0.0	4.5	14.9	1017	0	1.8			
PENBH09	19/12/2017	0.1	3.2	14.4	1027	0	0.8			
PENBH09	12/01/2018	0.2	2.4	16.4	1015	0	0.2			
PENBH09	19/02/2018	0.1	1.4	18.7	1012	0	-0.5			
PENBH09	13/03/2018	0.0	1.4	18.9	1001	0	-0.5			
PENBH09	05/04/2018	0.0	0.1	21.3	1009	0	-1.5			
PENBH09	10/05/2018	0	3.1	10.1	1008		0.8			
PENBH09	27/06/2018	0	2.5	17.4	1019	0	0.3			
PENBH09	28/08/2018	0	0.8	20.1	1008	0	-1.0			
PENBH09	03/12/2018	0	0.1	20.7	993	0	-1.5			
PENBH09	14/02/2019	0.1	1.1	17.7	1021	0	-0.8			
PENBH09	15/04/2019	0	1.4	16.5	1008	0	-0.5			
PENBH09	02/08/2019	0	2.8	17.6	1013	0	0.5			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH10	24/11/2014	0.0	0.5	20.4	1020	0	-0.87	Data set Max value:	4.4	
PENBH10	08/12/2014	0.1	1.6	15.9	1013	0	0.2	Data set Min value:	0.0	
PENBH10	14/01/2015	0.0	1.7	11.6	995	0	0.3	Mean:	1.4	
PENBH10	11/02/2015	0.1	1.1	19.9	1017	0	-0.3	SD:	1.03	
PENBH10	11/03/2015	0.0	1.4	7.0	1013	0	0.0	No. Readings:	44	
PENBH10	16/04/2015	0.2	2.1	8.4	1008		0.7	Critical Value:	3.34	
PENBH10	14/05/2015	0.0	2.0	9.6	1005	1	0.6	No. Outliner Values:	0	
PENBH10	22/06/2015	0.0	2.1	19.0	1005	1	0.7	Stat. Max(tmax)	4.4	
PENBH10	14/07/2015							Action Level	5.4	
PENBH10	11/08/2015							(tmax+FoS)		
PENBH10	15/09/2015									
PENBH10	09/10/2015	0.1	2.0	11.4	1018		0.6			
PENBH10	13/10/2015									
PENBH10	09/11/2015									
PENBH10	09/12/2015	0.1	2.0	11.4	1018		0.6			
PENBH10	12/01/2016	0.0	1.7	11.5	991	0	0.3			
PENBH10	09/02/2016	0.6	2.0	9.7	977	0	0.6			
PENBH10	16/03/2016	0.3	1.4	14.8	1025	0	0.0			
PENBH10	09/05/2016	0.0	1.1	19.1	1002	0	-0.3			
PENBH10	07/06/2016	0.0	2.6	18.8	1018	0	1.2			
PENBH10	04/07/2016	0.0	2.9	7.9	1010	0	1.5			
PENBH10	05/08/2016	0.0	1.1	20.6	1024	0	-0.3			
PENBH10	05/09/2016	0.0	3.6	7.8	1008	0	2.1			
PENBH10	05/10/2016	0.0	4.4	14.4	1022	0	2.9			
PENBH10	07/11/2016	0.0	2.9	17.5	1011	0	1.5			
PENBH10	06/12/2016	0.1	1.2	20.0	1017	0	-0.2			
PENBH10	20/01/2017	0.1	0.9	20.6	1027	0	-0.5			
PENBH10	15/02/2017	0.1	0.7	20.1	1018	0	-0.7			
PENBH10	10/03/2017	0.1	2.5	8.9	1017	0	1.1			
PENBH10	12/04/2017	0.2	0.1	21.1	1013	0.2	-1.3			
PENBH10	09/05/2017	0.1	1.4	19.4	1019	0	0.0			
PENBH10	14/06/2017	0.0	2.0	10.8	1019	0	0.6			
PENBH10	05/07/2017	0.0	0.1	21.1	1013	0	-1.3			
PENBH10	09/08/2017	0.0	0.0	21.2	1016	0	-1.4			
PENBH10	06/09/2017	0.0	1.8	11.9	1012	0	0.4			
PENBH10	09/10/2017	0.0	0.1	21.3	1020	0	-1.3			
PENBH10	13/11/2017	0.0	0.5	21.4	1019	0	-0.9			
PENBH10	19/12/2017	0.1	0.1	21.6	1028	0	-1.3			
PENBH10	12/01/2018	0.2	0.1	21.1	1016	0	-1.3			
PENBH10	19/02/2018	0.1	0.9	14.3	1013	0	-0.5			
PENBH10	13/03/2018	0.0	1.9	10.3	1002	0	0.5			
PENBH10	05/04/2018	0.0	1.9	10.9	1010	0	0.5			
PENBH10	10/05/2018	0	0.1	21.5	1009		-1.3			
PENBH10	27/06/2018	0	0.2	20	1020	0	-1.2			
PENBH10	28/08/2018	0	0.2	20.4	1009	0	-1.2			
PENBH10	03/12/2018	0	2.1	10.9	993	0	0.7			
PENBH10	14/02/2019	0.1	0.1	21.2	1023	0	-1.3			
PENBH10	15/04/2019	0	0.1	21	1010	0	-1.3			
PENBH10	02/08/2019	0	0.8	19.3	1014	0	-0.6			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH11	24/11/2014	0.0	3.6	15.7	1020	0	2.1	Data set Max value:	5.0	
PENBH11	08/12/2014	0.0	2.9	18.6	1013	0	1.5	Data set Min value:	0.1	
PENBH11	14/01/2015	0.0	3.2	16.4	995	0	1.7	Mean:	2.0	
PENBH11	11/02/2015	0.1	3.3	15.9	1017	1	1.8	SD:	1.425994761	
PENBH11	11/03/2015	0.0	2.8	16.7	1012	0	1.4	No. Readings:	49	
PENBH11	16/04/2015	0.2	2.7	17.0	1011		1.3	Critical Value:	3.34	
PENBH11	14/05/2015	0.1	2.1	17.6	1005	1	0.7	No. Outliner Values:	1	5
PENBH11	22/06/2015	0.0	1.4	16.2	1005	1	0.0	Stat. Max(tmax)	4.7	
PENBH11	14/07/2015	0.0	0.3	20.3	1010	1	-1.1	Action Level	5.7	
PENBH11	11/08/2015	0.0	0.1	20.2	1014	1	-1.3	(tmax+FoS)		
PENBH11	15/09/2015	0.0	0.1	20.7	988	1	-1.3			
PENBH11	09/10/2015	0.1	2.0	17.5	1018	0	0.6			
PENBH11	13/10/2015	0.1	0.1	21.3	1021	0	-1.3			
PENBH11	09/11/2015	0.0	0.1	21.5	1022	0	-1.3			
PENBH11	09/12/2015	0.1	2.0	17.5	1018	0	0.6			
PENBH11	12/01/2016	0.0	3.1	15.0	991	0	1.7			
PENBH11	09/02/2016	0.5	2.8	15.7	977	0	1.4			
PENBH11	16/03/2016	0.3	3.4	12.2	1025	0	1.9			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH11	09/05/2016	0.0	0.1	20.9	1003	0	-1.3			
PENBH11	07/06/2016	0.0	0.1	21.1	1018	0	-1.3			
PENBH11	04/07/2016	0.0	0.7	19.4	1010	0	-0.7			
PENBH11	05/08/2016	0.0	0.1	20.7	1026	0	-1.3			
PENBH11	05/09/2016	0.0	1.9	17.3	1008	0	0.5			
PENBH11	05/10/2016	0.0	1.7	18.2	1022	0	0.3			
PENBH11	07/11/2016	0.0	1.3	20.6	1011	0	-0.1			
PENBH11	06/12/2016	0.1	2.7	19.4	1017	0	1.3			
PENBH11	20/01/2017	0.1	3.8	14.9	1027	0	2.3			
PENBH11	15/02/2017	0.1	3.3	15.9	1017	0	1.8			
PENBH11	10/03/2017	0.1	3.9	12.2	1017	0	2.4			
PENBH11	12/04/2017	0.2	3.7	13.4	1013	0.2	2.2			
PENBH11	09/05/2017	0.1	0.8	19.1	1019	0	-0.6			
PENBH11	14/06/2017	0.0	1.5	18.5	1019	0	0.1			
PENBH11	05/07/2017	0.0	0.8	20.1	1014	0	-0.6			
PENBH11	09/08/2017	0.0	0.1	21.1	1015	0	-1.3			
PENBH11	06/09/2017	0.0	1.6	19.2	1012	0	0.2			
PENBH11	09/10/2017	0.0	2.6	17.6	1019	0	1.2			
PENBH11	13/11/2017	0.0	4.2	14.6	1019	0	2.7			
PENBH11	19/12/2017	0.1	4.7	9.3	1028	0	3.2			
PENBH11	12/01/2018	0.2	5.0	8.4	1016	0	3.5			
PENBH11	19/02/2018	0.1	4.6	9.7	1013	0	3.1			
PENBH11	13/03/2018	0.0	3.5	12.0	1002	0	2.0			
PENBH11	05/04/2018	0.0	2.3	16.5	1010	0	0.9			
PENBH11	10/05/2018	0	1.6	19	1009		0.2			
PENBH11	27/06/2018	0	0.7	19.2	1020	0	-0.7			
PENBH11	28/08/2018	0	0.9	19	1009	0	-0.5			
PENBH11	03/12/2018	0	0.5	20.1	993	0	-0.9			
PENBH11	14/02/2019	0.1	2.2	17.8	1023	0	0.8			
PENBH11	15/04/2019	0	1.7	18.9	1010	0	0.3			
PENBH11	02/08/2019	0	0.4	19.5	1014	0	-1.0			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH12	24/11/2014	0.0	1.9	17.4	1020	0	0.5	Data set Max value:	3.2	
PENBH12	08/12/2014	0.0	3.2	14.9	1015	0	1.7	Data set Min value:	0.0	
PENBH12	14/01/2015	0.0	0.9	16.2	991	0	-0.5	Mean:	1.1	
PENBH12	11/02/2015	0.0	0.8	12.2	1015	0	-0.6	SD:	0.76	
PENBH12	11/03/2015	0.0	1.0	19.3	1013	0	-0.4	No. Readings:	45	
PENBH12	16/04/2015	0.0	0.7	14.2	1010		-0.7	Critical Value:	3.34	
PENBH12	14/05/2015	0.0	0.3	21.6	1005	0	-1.1	No. Outliner Values:	0	
PENBH12	22/06/2015	0.0	1.0	12.4	1007	0	-0.4	Stat. Max(tmax)	3.2	
PENBH12	14/07/2015	0.0	1.2	12.4	16.5	0	-0.2	Action Level	4.2	
PENBH12	11/08/2015	0.0	0.9	17.8	1015	1	-0.5	(tmax+FoS)		
PENBH12	15/09/2015	0.0	1.4	16.8	990	1	0.0			
PENBH12	09/10/2015									
PENBH12	13/10/2015	0.0	1.5	17.4	1022	0	0.1			
PENBH12	09/11/2015	0.0	1.4	15.4	1022	0	0.0			
PENBH12	09/12/2015									
PENBH12	12/01/2016									
PENBH12	09/02/2016	0.5	0.1	20.4	976	0	-1.3			
PENBH12	16/03/2016			21.7	1024	0				
PENBH12	09/05/2016	0.0	0.4	20.7	1005	0	-1.0			
PENBH12	07/06/2016	0.0	0.9	18.6	1019	0	-0.5			
PENBH12	04/07/2016	0.0	0.1	21.7	1009	0	-1.3			
PENBH12	05/08/2016	0.0	0.0	21.9	1042	0	-1.4			
PENBH12	05/09/2016	0.0	1.0	19.5	1010	0	-0.4			
PENBH12	05/10/2016	0.0	0.1	21.1	1022	0	-1.3			
PENBH12	07/11/2016	0.0	2.0	16.8	1010	0	0.6			
PENBH12	06/12/2016	0.0	1.4	19.7	1017	0	0.0			
PENBH12	20/01/2017	0.0	1.4	19.6	1027	0	0.0			
PENBH12	15/02/2017	0.1	0.9	21.2	1018	0	-0.5			
PENBH12	10/03/2017	0.1	0.6	21.6	1016	0	-0.8			
PENBH12	12/04/2017	0.1	0.3	21.1	1013	0	-1.1			
PENBH12	09/05/2017	0.0	2.9	8.9	1020	0	1.5			
PENBH12	14/06/2017	0.0	2.9	8.9	1020	0	1.5			
PENBH12	05/07/2017	0.0	0.1	20.7	1014	0	-1.3			
PENBH12	09/08/2017	0.0	0.4	7.1	1017	0	-1.0			
PENBH12	06/09/2017	0.0	1.8	16.6	1013	0	0.4			
PENBH12	09/10/2017	0.0	2.6	13.5	1021	0	1.2			
PENBH12	13/11/2017	0.0	1.2	21.1	1017	0	-0.2			
PENBH12	21/12/2017	0.1	0.8	21.5	1029	0	-0.6			
PENBH12	12/01/2018	0.2	1.0	20.4	1015	0	-0.4			
PENBH12	19/02/2018	0.0	1.1	19.5	1013	0	-0.3			
PENBH12	13/03/2018	0.0	1.1	20.6	1003	0	-0.3			
PENBH12	05/04/2018	0.0	1.4	18.4	1010	0	0.0			
PENBH12	10/05/2018	0	1.5	16	1010		0.1			
PENBH12	27/06/2018	0	2.1	13.1	1020	0	0.7			
PENBH12	28/08/2018	0	1.1	16.7	1010	0	-0.3			
PENBH12	03/12/2018	0	1	20.3	994	0	-0.4			
PENBH12	14/02/2019	0	0.7	21	1023	0	-0.7			
PENBH12	15/04/2019	0	1.1	19.8	1009	0	-0.3			
PENBH12	02/08/2019	0	0.3	20.2	1015	0	-1.1			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH13	24/11/2014	0.1	0.5	17.5	1020	0	-1.70	Data set Max value:	2.1	
PENBH13	08/12/2014	0.0	0.6	17.2	1015	0	-1.51	Data set Min value:	0.0	
PENBH13	14/01/2015	0.0	0.9	21.7	992	0	-0.94	Mean:	1.4	
PENBH13	11/02/2015	0.0	2.1	18.9	1015	0	1.32	SD:	0.53	
PENBH13	11/03/2015	0.0	0.8	10.3	1015	0	-1.13	No. Readings:	28	
PENBH13	16/04/2015	0.0	0.4	20.9	1010		-1.89	Critical Value:	3.1	
PENBH13	14/05/2015	0.0	1.0	12.3	1005	0	-0.75	No. Outliner Values:	0	
PENBH13	22/06/2015	0.0	0.5	19.6	1007	0	-1.70	Stat. Max(tmax)	2.1	
PENBH13	14/07/2015	0.0	0.0	19.6	21	0	-2.64	Action Level	3.1	
PENBH13	11/08/2015	0.0	1.3	16.4	1015	1	-0.19	(tmax+FoS)		
PENBH13	15/09/2015	0.0	1.3	9.5	990	1	-0.19			
PENBH13	09/10/2015	0.1	0.4	21.6	1015	0	-1.89			
PENBH13	13/10/2015	0.0	1.1	10.4	1022	0	-0.57			
PENBH13	09/11/2015	0.0	1.0	10.6	1022	0	-0.75			
PENBH13	09/12/2015	0.1	0.4	21.6	1015	0	-1.89			
PENBH13	12/01/2016	0.0	0.5	21.8	994	0	-1.70			
PENBH13	09/02/2016									
PENBH13	16/03/2016	0.3	0.5	21.1	1024	0	-1.70			
PENBH13	09/05/2016	0.0	0.1	21.7	1004	0	-2.45			
PENBH13	07/06/2016									
PENBH13	04/07/2016									
PENBH13	05/08/2016	0.0	0.0	21.9	1026	0	-2.64			
PENBH13	05/09/2016	0.0	1.2	12.9	1010	0	-0.38			
PENBH13	05/10/2016									
PENBH13	07/11/2016	0.0	1.7	8.9	1011	0	0.57			
PENBH13	06/12/2016									
PENBH13	20/01/2017									
PENBH13	15/02/2017									
PENBH13	10/03/2017									
PENBH13	12/04/2017									
PENBH13	09/05/2017									

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH13	14/06/2017									
PENBH13	05/07/2017									
PENBH13	09/08/2017									
PENBH13	06/09/2017									
PENBH13	09/10/2017									
PENBH13	13/11/2017									
PENBH13	21/12/2017									
PENBH13	12/01/2018									
PENBH13	19/02/2018									
PENBH13	13/03/2018									
PENBH13	05/04/2018									
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH14	24/11/2014	0.1	0.1	22.2	1020	0	-1.15	Data set Max value:	6.3	
PENBH14	08/12/2014	0.0	5.9	10.7	1015	0	1.63	Data set Min value:	0.0	
PENBH14	14/01/2015	0.0	4.7	7.7	993	0	1.1	Mean:	2.5	
PENBH14	11/02/2015	0.0	4.6	8.1	1015	0	1.0	SD:	2.08	
PENBH14	11/03/2015	0.0	4.9	2.5	1015	0	1.2	No. Readings:	48	
PENBH14	16/04/2015	0.0	2.0	15.9	1010		-0.2	Critical Value:	3.34	
PENBH14	14/05/2015	0.0	0.3	21.2	1004	0	-1.1	No. Outliner Values:	0	
PENBH14	22/06/2015	0.0	4.4	6.2	1007	0	0.9	Stat. Max(tmax)	6.3	
PENBH14	14/07/2015	0.0	0.5	6.2	20	0	-1.0	Action Level	8.3	
PENBH14	11/08/2015	0.0	0.0	20.9	1015	1	-1.2	(tmax+FoS)		
PENBH14	15/09/2015	0.0	1.8	8.4	990	2	-0.3			
PENBH14	09/10/2015	0.1	0.1	21.6	1015	0	-1.2			
PENBH14	13/10/2015	11.1	3.6	11.1	1022	0	0.5			
PENBH14	09/11/2015	5.2	2.1	15.1	1022	0	-0.2			
PENBH14	09/12/2015	0.1	0.1	21.6	1015	0	-1.2			
PENBH14	12/01/2016	0.0	0.2	19.5	995	0	-1.1			
PENBH14	09/02/2016	0.5	0.5	17.7	975	0	-1.0			
PENBH14	16/03/2016	0.3	0.1	21.7	1024	0	-1.2			
PENBH14	09/05/2016	0.0	0.1	21.4	1004	0	-1.2			
PENBH14	07/06/2016	0.0	1.1	17.1	1019	0	-0.7			
PENBH14	04/07/2016	0.0	0.5	20.1	1009	0	-1.0			
PENBH14	05/08/2016	0.0	0.0	21.1	1025	0	-1.2			
PENBH14	05/09/2016	0.0	0.0	21.1	1010	0	-1.2			
PENBH14	05/10/2016	0.0	1.8	18.7	1022	0	-0.3			
PENBH14	07/11/2016	0.0	5.3	16.8	1011	0	1.3			
PENBH14	06/12/2016	0.0	4.5	17.3	1017	0	1.0			
PENBH14	20/01/2017	0.0	4.4	16.1	1027	1	0.9			
PENBH14	15/02/2017	0.1	2.0	16.4	1018	0	-0.2			
PENBH14	10/03/2017	0.1	0.7	20.5	1017	0	-0.9			
PENBH14	12/04/2017	0.1	0.1	21.5	1013	0	-1.2			
PENBH14	09/05/2017	0.0	0.0	20.9	1020	0	-1.2			
PENBH14	14/06/2017	0.0	0.0	20.9	1020	0	-1.2			
PENBH14	05/07/2017	0.0	3.0	15.5	1014	0	0.2			
PENBH14	09/08/2017	0.0	2.6	15.6	1017	0	0.0			
PENBH14	06/09/2017	0.0	2.7	17.6	1013	0	0.1			
PENBH14	09/10/2017	0.0	2.5	18.9	1021	0	0.0			
PENBH14	13/11/2017	0.0	4.8	7.5	1017	0	1.1			
PENBH14	21/12/2017	18.4	5.2	0.3	1029	0	1.3			
PENBH14	12/01/2018	0.2	5.6	4.3	1015	0	1.5			
PENBH14	19/02/2018	0.1	4.2	10.6	1013	0	0.8			
PENBH14	13/03/2018	0.0	3.1	10.7	1003	0	0.3			
PENBH14	05/04/2018	0.0	2.4	13.1	1010	0	0.0			
PENBH14	10/05/2018	0	3	17	1010		0.2			
PENBH14	27/06/2018	0	0	21.5	1020	0	-1.2			
PENBH14	28/08/2018	26.4	6.1	0.2	1010	1	1.7			
PENBH14	03/12/2018	0	3.6	8.7	994	0	0.5			
PENBH14	14/02/2019	0	3.9	8.6	1023	0	0.7			
PENBH14	15/04/2019	0.2	5.3	2.1	1009	0	1.3			
PENBH14	02/08/2019	35.1	6.3	0.7	1015	0	1.8			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH15	24/11/2014							Data set Max value:	5.2	
PENBH15	08/12/2014	0.0	0.4	21.7	1015	0	-1.0	Data set Min value:	0.0	
PENBH15	14/01/2015	0.0	0.7	20.4	993	0	-0.9	Mean:	0.7	
PENBH15	11/02/2015	0.0	0.7	21.0	1016	0	-0.9	SD:	1.098338183	
PENBH15	11/03/2015	0.0	1.4	19.0	1015	0	-0.5	No. Readings:	47	
PENBH15	16/04/2015	0.0	0.2	21.4	1010		-1.1	Critical Value:	3.34	
PENBH15	14/05/2015	0.0	5.0	11.3	1005	0	1.2	No. Outliner Values:	0	
PENBH15	22/06/2015	0.0	0.1	21.0	1007	0	-1.2	Stat. Max(tmax)	5.2	
PENBH15	14/07/2015	0.0	5.2	23.0	13.3	0	1.3	Action Level	7.2	
PENBH15	11/08/2015	0.0	0.1	20.8	1016	1	-1.2	(tmax+FoS)		
PENBH15	15/09/2015	0.0	0.1	20.7	991	1	-1.2			
PENBH15	09/10/2015	0.1	0.2	21.5	1015	0	-1.1			
PENBH15	13/10/2015	0.0	0.3	21.5	1022	0	-1.1			
PENBH15	09/11/2015	0.0	0.1	21.3	1023	0	-1.2			
PENBH15	09/12/2015	0.1	0.2	21.5	1015	0	-1.1			
PENBH15	12/01/2016	0.0	0.2	21.8	994	0	-1.1			
PENBH15	09/02/2016	0.5	0.4	21.5	975	0	-1.0			
PENBH15	16/03/2016	0.3	0.1	21.7	1024	0	-1.2			
PENBH15	09/05/2016	0.0	1.1	18.7	1005	0	-0.7			
PENBH15	07/06/2016	0.0	0.3	20.7	1019	0	-1.1			
PENBH15	04/07/2016	0.0	0.1	21.6	1009	0	-1.2			
PENBH15	05/08/2016	0.0	0.0	21.4	1028	0	-1.2			
PENBH15	05/09/2016	0.0	0.3	20.3	1010	0	-1.1			
PENBH15	05/10/2016	0.0	1.5	20.2	1023	0	-0.5			
PENBH15	07/11/2016	0.0	1.2	19.4	1011	0	-0.6			
PENBH15	06/12/2016	0.1	0.1	21.7	1017	0	-1.2			
PENBH15	20/01/2017	0.0	0.6	20.4	1027	0	-0.9			
PENBH15	15/02/2017	0.1	1.4	20.9	1018	0	-0.5			
PENBH15	10/03/2017	0.1	2.9	16.4	1017	0	0.2			
PENBH15	12/04/2017	0.1	0.1	21.6	1013	0	-1.2			
PENBH15	09/05/2017	0.0	1.6	19.5	1020	0	-0.4			
PENBH15	14/06/2017	0.0	1.6	19.5	1020	0	-0.4			
PENBH15	05/07/2017	0.0	0.0	20.8	1014	0	-1.2			
PENBH15	09/08/2017	0.0	0.0	21.5	1017	0	-1.2			
PENBH15	06/09/2017	0.0	1.3	18.1	1013	0	-0.6			
PENBH15	09/10/2017	0.0	0.1	21.2	1022	0	-1.2			
PENBH15	13/11/2017	0.0	0.2	22.1	1018	0	-1.1			
PENBH15	21/12/2017	0.1	0.1	21.8	1029	0	-1.2			
PENBH15	12/01/2018	0.2	0.3	21.3	1016	0	-1.1			
PENBH15	19/02/2018	0.1	0.1	21.5	1014	0	-1.2			
PENBH15	13/03/2018	0.0	0.6	20.7	1003	0	-0.9			
PENBH15	05/04/2018	0.0	0.6	20.0	1010	0	-0.9			
PENBH15	10/05/2018	0	0.1	21.6	1010		-1.2			
PENBH15	27/06/2018	0	0.1	21.2	1021	0	-1.2			
PENBH15	28/08/2018	0	1.4	9.4	1010	0	-0.5			
PENBH15	03/12/2018									
PENBH15	14/02/2019	0	0.1	21.6	1024	0	-1.2			
PENBH15	15/04/2019	0	0.5	20.7	1009	0	-1.0			
PENBH15	02/08/2019	0	0.6	20.2	1016	0	-0.9			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH15A	24/11/2014							Data set Max value:	3.8	
PENBH15A	08/12/2014	0.0	0.6	21.8	1015	0	-0.11	Data set Min value:	0.0	
PENBH15A	14/01/2015	0.0	0.8	21.7	994	0	0.1	Mean:	0.7	
PENBH15A	11/02/2015	0.0	0.8	21.3	1016	0	0.1	SD:	0.93	
PENBH15A	11/03/2015	0.0	0.3	21.6	1014	0	-0.4	No. Readings:	47	
PENBH15A	16/04/2015	0.0	0.1	21.8	1013		-0.6	Critical Value:	3.34	
PENBH15A	14/05/2015	0.0	0.2	21.7	1004	0	-0.5	No. Outliner Values:	0	
PENBH15A	22/06/2015					0		Stat. Max(tmax)	3.8	
PENBH15A	14/07/2015	0.0	2.8	20.6	17.5	0	2.3	Action Level	4.8	
PENBH15A	11/08/2015	0.0	0.1	20.9	1016	1	-0.6	(tmax+FoS)		
PENBH15A	15/09/2015	0.0	0.2	20.6	990	1	-0.5			
PENBH15A	09/10/2015	0.1	0.1	21.5	1016	0	-0.6			
PENBH15A	13/10/2015	0.0	0.1	21.6	1023	0	-0.6			
PENBH15A	09/11/2015	0.0	0.1	21.5	1022	0	-0.6			
PENBH15A	09/12/2015	0.1	0.1	21.5	1016	0	-0.6			
PENBH15A	12/01/2016	0.0	3.3	17.4	994	0	2.8			
PENBH15A	09/02/2016	0.5	1.6	7.9	976	0	1.0			
PENBH15A	16/03/2016	0.3	0.1	21.6	1024	0	-0.6			
PENBH15A	09/05/2016	0.0	0.1	21.5	1005	0	-0.6			
PENBH15A	07/06/2016	0.0	0.1	21.2	1019	0	-0.6			
PENBH15A	04/07/2016	0.0	0.4	21.0	1010	0	-0.3			
PENBH15A	05/08/2016	0.0	0.0	21.1	1026	0	-0.8			
PENBH15A	05/09/2016	0.0	0.1	20.7	1010	0	-0.6			
PENBH15A	05/10/2016	0.0	0.1	21.4	1022	0	-0.6			
PENBH15A	07/11/2016	0.0	0.4	21.6	1011	0	-0.3			
PENBH15A	06/12/2016	0.0	0.1	21.8	1017	0	-0.6			
PENBH15A	20/01/2017	0.0	3.2	12.0	1027	0	2.7			
PENBH15A	15/02/2017	0.1	0.2	21.8	1018	0	-0.5			
PENBH15A	10/03/2017	0.1	0.1	21.7	1017	0	-0.6			
PENBH15A	12/04/2017	0.1	0.1	21.6	1013	0	-0.6			
PENBH15A	09/05/2017	0.0	1.1	20.1	1020	0	0.4			
PENBH15A	14/06/2017	0.0	1.1	20.1	1020	0	0.4			
PENBH15A	05/07/2017	0.0	0.1	21.1	1014	0	-0.6			
PENBH15A	09/08/2017	0.0	0.2	11.2	1017	0	-0.5			
PENBH15A	06/09/2017	0.0	2.2	16.5	1013	0	1.6			
PENBH15A	09/10/2017	0.0	0.1	21.2	1021	0	-0.6			
PENBH15A	13/11/2017	0.0	1.2	20.6	1018	0	0.5			
PENBH15A	21/12/2017	0.1	1.0	20.7	1029	0	0.3			
PENBH15A	12/01/2018	0.2	0.6	21.4	1016	0	-0.1			
PENBH15A	19/02/2018	0.1	0.6	20.7	1014	0	-0.1			
PENBH15A	13/03/2018	0.0	0.6	21.3	1003	0	-0.1			
PENBH15A	05/04/2018	0.0	3.8	16.0	1010	0	3.3			
PENBH15A	10/05/2018	0	0.1	21.4	1010		-0.6			
PENBH15A	27/06/2018	0	0.8	20.1	1020	0	0.1			
PENBH15A	28/08/2018	0	0.1	21.1	1010	0	-0.6			
PENBH15A	03/12/2018	0	1.7	19.7	996	0	1.1			
PENBH15A	14/02/2019	0.1	0.6	21.2	1024	0	-0.1			
PENBH15A	15/04/2019	0	0.5	20.8	1009	0	-0.2			
PENBH15A	02/08/2019	0	0.4	20.7	1016	0	-0.3			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH16	24/11/2014							Data set Max value:	4.4	
PENBH16	08/12/2014	0.0	3.2	16.6	1015	0	1.38	Data set Min value:	0.0	
PENBH16	14/01/2015	0.0	2.3	17.8	994	0	0.6	Mean:	1.7	
PENBH16	11/02/2015	0.0	2.2	17.1	1016	0	0.5	SD:	1.09	
PENBH16	11/03/2015	0.0	1.4	16.8	1015	0	-0.3	No. Readings:	47	
PENBH16	16/04/2015	0.0	3.1	8.0	1010		1.3	Critical Value:	3.34	
PENBH16	14/05/2015	0.0	0.1	21.7	1005	0	-1.5	No. Outliner Values:	0	
PENBH16	22/06/2015	0.0	2.4	16.1	1008	0	0.6	Stat. Max(tmax)	4.4	
PENBH16	14/07/2015	0.0	0.0	16.1	20.9	0	-1.6	Action Level	5.4	
PENBH16	11/08/2015	0.0	1.4	19.3	1016	1	-0.3	(tmax+FoS)		
PENBH16	15/09/2015	0.0	1.2	20.1	991	1	-0.5			
PENBH16	09/10/2015	0.1	0.5	20.2	1016	0	-1.1			
PENBH16	13/10/2015	0.0	0.1	22.0	1023	0	-1.5			
PENBH16	09/11/2015	0.0	1.2	21.0	1022	0	-0.5			
PENBH16	09/12/2015	0.1	0.5	20.2	1016	0	-1.1			
PENBH16	12/01/2016	0.0	0.2	21.6	995	0	-1.4			
PENBH16	09/02/2016	0.5	1.2	20.5	975	0	-0.5			
PENBH16	16/03/2016	0.3	1.0	19.8	1025	0	-0.6			
PENBH16	09/05/2016	0.0	1.2	17.4	1005	0	-0.5			
PENBH16	07/06/2016	0.0	0.3	20.8	1020	0	-1.3			
PENBH16	04/07/2016	0.0	0.5	20.1	1010	0	-1.1			
PENBH16	05/08/2016									
PENBH16	05/09/2016		2.6	15.4	1011	0	0.8			
PENBH16	05/10/2016	0.0	1.4	19.6	1023	0	-0.3			
PENBH16	07/11/2016	0.0	4.4	16.5	1012	0	2.5			
PENBH16	06/12/2016	0.1	0.3	21.5	1017	0	-1.3			
PENBH16	20/01/2017	0.1	1.3	20.5	1027	0	-0.4			
PENBH16	15/02/2017	0.1	0.2	21.9	1019	0	-1.4			
PENBH16	10/03/2017	0.1	1.8	20.3	1017	0	0.1			
PENBH16	12/04/2017	0.1	1.9	18.2	1013	0	0.2			
PENBH16	09/05/2017	0.0	1.3	18.8	1020	0	-0.4			
PENBH16	14/06/2017	0.0	1.3	18.8	1020	0	-0.4			
PENBH16	05/07/2017	0.0	0.7	20.1	1014	0	-0.9			
PENBH16	09/08/2017	0.0	1.6	19.1	1017	0	-0.1			
PENBH16	06/09/2017	0.0	3.0	17.7	1013	0	1.2			
PENBH16	09/10/2017	0.0	2.2	18.1	1022	0	0.5			
PENBH16	13/11/2017	0.0	2.8	17.8	1019	0	1.0			
PENBH16	21/12/2017	0.1	3.8	15.6	1029	0	1.9			
PENBH16	12/01/2018	0.2	3.4	16.5	1016	0	1.6			
PENBH16	19/02/2018	0.1	2.9	17.0	1014	0	1.1			
PENBH16	13/03/2018	0.0	2.3	18.8	1003	0	0.6			
PENBH16	05/04/2018	0.0	1.8	18.9	1010	0	0.1			
PENBH16	10/05/2018	0	2.3	17.7	1011		0.6			
PENBH16	27/06/2018	0	2	18	1021	0	0.3			
PENBH16	28/08/2018	0	2.4	17.7	1010	0	0.6			
PENBH16	03/12/2018	0	0.2	21.5	991	0	-1.4			
PENBH16	14/02/2019	0	2.6	17.8	1024	0	0.8			
PENBH16	15/04/2019	0	2.4	18.5	1010	0	0.6			
PENBH16	02/08/2019	0	3.1	10.2	1016	0	1.3			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH16A	24/11/2014							Data set Max value:	4.9	
PENBH16A	08/12/2014	0.0	1.7	20.7	1015	0	-0.7	Data set Min value:	0.0	
PENBH16A	14/01/2015	0.0	4.0	17.1	994	0	0.9	Mean:	2.7	
PENBH16A	11/02/2015	0.0	3.4	17.0	1016	0	0.5	SD:	1.40	
PENBH16A	11/03/2015	0.0	3.3	17.4	1014	0	0.4	No. Readings:	47	
PENBH16A	16/04/2015	0.0	1.4	20.6	1013		-0.9	Critical Value:	3.34	
PENBH16A	14/05/2015	0.0	0.1	21.6	1005	0	-1.9	No. Outliner Values:	0	
PENBH16A	22/06/2015	0.0	3.0	16.2	1008	0	0.2	Stat. Max(tmax)	4.9	
PENBH16A	14/07/2015	0.0	1.4	16.2	18.2	0	-0.9	Action Level	5.9	
PENBH16A	11/08/2015	0.0	2.5	17.6	1016	1	-0.1	(tmax+FoS)		

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH16A	15/09/2015	0.0	2.8	16.9	990	1	0.1			
PENBH16A	09/10/2015	0.1	0.1	21.6	1016	0	-1.9			
PENBH16A	13/10/2015	0.0	2.8	16.7	1023	0	0.1			
PENBH16A	09/11/2015	0.0	2.6	16.5	1022	0	-0.1			
PENBH16A	09/12/2015	0.1	0.1	21.6	1016	0	-1.9			
PENBH16A	12/01/2016	0.0	0.2	19.5	994	0	-1.8			
PENBH16A	09/02/2016	0.5	3.4	21.9	976	0	0.5			
PENBH16A	16/03/2016	0.3	2.7	16.7	1025	0	0.0			
PENBH16A	09/05/2016	0.0	2.4	16.5	1004	0	-0.2			
PENBH16A	07/06/2016	0.0	3.4	13.6	1019	0	0.5			
PENBH16A	04/07/2016	0.0	2.9	16.5	1009	0	0.1			
PENBH16A	05/08/2016	0.0	0.0	21.4	1027	0	-1.9			
PENBH16A	05/09/2016	0.0	2.6	16.0	1010	0	-0.1			
PENBH16A	05/10/2016	0.0	3.4	15.2	1023	0	0.5			
PENBH16A	07/11/2016	0.0	4.2	14.2	1011	0	1.1			
PENBH16A	06/12/2016	0.1	0.3	21.2	1017	0	-1.7			
PENBH16A	20/01/2017	0.0	0.6	20.9	1027	0	-1.5			
PENBH16A	15/02/2017	0.1	3.8	15.2	1018	0	0.8			
PENBH16A	10/03/2017	0.1	4.6	15.5	1017	0	1.4			
PENBH16A	12/04/2017	0.0	3.5	15.7	1013	0	0.6			
PENBH16A	09/05/2017	0.0	1.4	18.5	1020	0	-0.9			
PENBH16A	14/06/2017	0.0	1.4	18.5	1020	0	-0.9			
PENBH16A	05/07/2017	0.0	3.4	17.1	1015	1	0.5			
PENBH16A	09/08/2017	0.0	3.9	6.5	1017	0	0.9			
PENBH16A	06/09/2017	0.0	4.4	16.8	1013	0	1.2			
PENBH16A	09/10/2017	0.0	4.3	15.8	1021	0	1.1			
PENBH16A	13/11/2017	0.0	4.9	15.2	1018	0	1.6			
PENBH16A	21/12/2017	0.1	4.7	14.5	1027	0	1.4			
PENBH16A	12/01/2018	0.2	4.5	14.9	1016	0	1.3			
PENBH16A	19/02/2018	0.0	4.3	15.6	1014	0	1.1			
PENBH16A	13/03/2018	0.0	3.9	16.2	1003	0	0.9			
PENBH16A	05/04/2018	0.0	3.9	17.8	1010	0	0.9			
PENBH16A	10/05/2018	0	3.7	15.8	1010		0.7			
PENBH16A	27/06/2018						-1.9			
PENBH16A	28/08/2018	0	3.4	17.9	1011	0	0.5			
PENBH16A	03/12/2018	0	3.3	7.9	996	0	0.4			
PENBH16A	14/02/2019	0	1.8	19.5	1024	0	-0.6			
PENBH16A	15/04/2019	0	1.9	18.8	1010	0	-0.6			
PENBH16A	02/08/2019	0	2.7	16.4	1016	0	0.0			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH17	24/11/2014							Data set Max value:	4.5	
PENBH17	08/12/2014	0.0	0.1	22.4	1016	0	-0.38	Data set Min value:	0.0	
PENBH17	14/01/2015	0.0	0.1	22.1	994	0	-0.4	Mean:	0.5	
PENBH17	11/02/2015	0.0	0.1	22.0	1016	0	-0.4	SD:	1.06	
PENBH17	11/03/2015	0.0	0.1	22.1	1015	0	-0.4	No. Readings:	48	
PENBH17	16/04/2015	0.0	0.4	21.1	1013		-0.1	Critical Value:	3.34	
PENBH17	14/05/2015	0.0	2.4	16.3	1005	0	1.8	No. Outliner Values:	1	4.5
PENBH17	22/06/2015	0.0	0.1	21.2	1008	0	-0.4	Stat. Max(tmax)	3.8	
PENBH17	14/07/2015	0.0	0.0	21.2	20.9	0	-0.5	Action Level	4.8	
PENBH17	11/08/2015	0.0	0.1	20.9	1016	1	-0.4	(tmax+FoS)		
PENBH17	15/09/2015	0.0	0.1	20.8	991	1	-0.4			
PENBH17	09/10/2015	0.1	0.1	21.6	1015	0	-0.4			
PENBH17	13/10/2015	0.0	0.1	21.9	1023	0	-0.4			
PENBH17	09/11/2015	0.0	0.1	21.5	1022	0	-0.4			
PENBH17	09/12/2015	0.1	0.1	21.6	1015	0	-0.4			
PENBH17	12/01/2016	0.1	2.1	13.0	994	0	1.5			
PENBH17	09/02/2016	0.6	0.1	8.4	975	0	-0.4			
PENBH17	16/03/2016	0.3	0.1	21.8	1025	0	-0.4			
PENBH17	09/05/2016	0.0	0.0	21.6	1005	0	-0.5			
PENBH17	07/06/2016	0.0	0.0	21.3	1020	0	-0.5			
PENBH17	04/07/2016	0.0	0.1	21.5	1010	0	-0.4			
PENBH17	05/08/2016	0.0	0.0	21.3	1027	0	-0.5			
PENBH17	05/09/2016	0.0	0.0	20.9	1011	0	-0.5			
PENBH17	05/10/2016	0.0	0.1	21.6	1022	0	-0.4			
PENBH17	07/11/2016	0.0	0.1	21.6	1012	0	-0.4			
PENBH17	06/12/2016	0.0	4.5	15.7	1017	0	3.8			
PENBH17	20/01/2017	0.1	0.3	21.5	1027	0	-0.2			
PENBH17	15/02/2017	0.1	2.0	20.2	1018	0	1.4			
PENBH17	10/03/2017	0.1	1.4	19.3	1017	0	0.8			
PENBH17	12/04/2017	0.1	0.1	21.5	1014	0	-0.4			
PENBH17	09/05/2017	0.0	3.8	17.0	1020	0	3.1			
PENBH17	14/06/2017	0.0	3.8	17.0	1020	0	3.1			
PENBH17	05/07/2017	0.0	0.1	21.1	1015	0	-0.4			
PENBH17	09/08/2017	0.0	0.1	19.1	1018	0	-0.4			
PENBH17	06/09/2017	0.0	0.1	21.4	1014	0	-0.4			
PENBH17	09/10/2017	0.0	0.1	21.1	1021	0	-0.4			
PENBH17	13/11/2017	0.0	0.1	22.0	1019	0	-0.4			
PENBH17	21/12/2017	0.1	0.2	21.6	1029	0	-0.3			
PENBH17	12/01/2018	0.2	0.2	21.6	1016	0	-0.3			
PENBH17	19/02/2018	0.1	0.2	21.3	1014	0	-0.3			
PENBH17	13/03/2018	0.0	0.1	22.2	1003	0	-0.4			
PENBH17	05/04/2018	0.0	0.1	21.8	1010	0	-0.4			
PENBH17	10/05/2018	0	0.1	21.6	1011		-0.4			
PENBH17	27/06/2018	0	0.1	21.1	1021	0	-0.4			
PENBH17	28/08/2018	0	0.1	21.1	1011	0	-0.4			
PENBH17	03/12/2018	0	0.1	21.6	991	0	-0.4			
PENBH17	14/02/2019	0.1	0.1	21.5	1024	0	-0.4			
PENBH17	15/04/2019	0	0.1	21.6	1010	0	-0.4			
PENBH17	02/08/2019	0	0.2	20.9	1016	0	-0.3			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH18	24/11/2014							Data set Max value:	5.0	
PENBH18	08/12/2014	0.0	0.7	21.5	1016	0	-0.37	Data set Min value:	0.0	
PENBH18	14/01/2015	0.0	0.1	22.1	994	0	-0.8	Mean:	1.2	
PENBH18	11/02/2015	0.0	0.3	21.7	1016	0	-0.7	SD:	1.34	
PENBH18	11/03/2015	0.0	0.9	19.9	1015	0	-0.2	No. Readings:	48	
PENBH18	16/04/2015	1.2	5.0	0.3	1013		2.8	Critical Value:	3.34	
PENBH18	14/05/2015	0.0	0.1	21.8	1005	0	-0.8	No. Outliner Values:	0	
PENBH18	22/06/2015	0.0	3.0	15.3	1008	0	1.3	Stat. Max(tmax)	5.0	
PENBH18	14/07/2015	0.0	2.7	15.3	15.7	0	1.1	Action Level	7.0	
PENBH18	11/08/2015	0.0	0.2	20.8	1016	1	-0.7	(tmax+FoS)		
PENBH18	15/09/2015	0.0	1.4	18.7	991	1	0.1			
PENBH18	09/10/2015	0.1	0.1	21.6	1016	0	-0.8			
PENBH18	13/10/2015	0.0	2.3	18.3	1023	0	0.8			
PENBH18	09/11/2015	0.0	1.5	17.9	1022	0	0.2			
PENBH18	09/12/2015	0.1	0.1	21.6	1016	0	-0.8			
PENBH18	12/01/2016	0.0	0.1	21.8	994	0	-0.8			
PENBH18	09/02/2016	0.6	0.1	20.2	975	0	-0.8			
PENBH18	16/03/2016	0.3	1.3	19.5	1025	0	0.1			
PENBH18	09/05/2016	0.1	2.9	15.8	1005	0	1.3			
PENBH18	07/06/2016	0.0	2.3	16.4	1020	0	0.8			
PENBH18	04/07/2016	0.1	2.4	16.5	1010	0	0.9			
PENBH18	05/08/2016	0.0	0.0	21.4	1025	0	-0.9			
PENBH18	05/09/2016	0.0	0.6	19.9	1010	0	-0.4			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH18	05/10/2016	0.0	1.2	18.9	1023	0	0.0			
PENBH18	07/11/2016	0.0	1.2	20.2	1011	0	0.0			
PENBH18	06/12/2016	0.0	4.1	14.2	1017	0	2.2			
PENBH18	20/01/2017	0.0	1.7	20.0	1027	0	0.4			
PENBH18	15/02/2017	0.1	0.1	21.9	1019	0	-0.8			
PENBH18	10/03/2017	0.1	0.1	21.8	1017	0	-0.8			
PENBH18	12/04/2017	0.1	0.1	21.5	1013	0	-0.8			
PENBH18	09/05/2017	0.0	3.6	14.1	1020	0	1.8			
PENBH18	14/06/2017	0.0	3.6	14.1	1020	0	1.8			
PENBH18	05/07/2017	0.0	0.7	20.0	1014	0	-0.4			
PENBH18	09/08/2017	0.0	0.1	21.1	1017	0	-0.8			
PENBH18	06/09/2017	0.0	1.4	18.9	1013	0	0.1			
PENBH18	09/10/2017	0.0	1.6	19.1	1021	0	0.3			
PENBH18	13/11/2017	0.0	0.9	21.4	1018	0	-0.2			
PENBH18	21/12/2017	0.1	0.1	21.7	1029	0	-0.8			
PENBH18	12/01/2018	0.2	0.4	21.4	1016	0	-0.6			
PENBH18	19/02/2018	0.1	0.4	21.2	1014	0	-0.6			
PENBH18	13/03/2018	0.0	0.1	22.1	1003	0	-0.8			
PENBH18	05/04/2018	0.0	0.1	21.8	1010	0	-0.8			
PENBH18	10/05/2018	0	0.3	21.4	1011		-0.7			
PENBH18	27/06/2018	0	0.7	20.2	1021	0	-0.4			
PENBH18	28/08/2018	0	0.9	20	1011	0	-0.2			
PENBH18	03/12/2018	0	5	17.5	996	0	2.8			
PENBH18	14/02/2019	0	1	18.7	1024	0	-0.1			
PENBH18	15/04/2019	0	1.6	18.3	1010	0	0.3			
PENBH18	02/08/2019	0	0	21	1016	0	-0.9			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH19	24/11/2014							Data set Max value:	3.3	
PENBH19	08/12/2014	0.0	0.3	21.8	1015	0	-0.67	Data set Min value:	0.0	
PENBH19	14/01/2015	0.0	0.5	21.6	995	0	-0.52	Mean:	0.5	
PENBH19	11/02/2015	0.1	0.3	21.8	1017	0	-0.67	SD:	0.74	
PENBH19	11/03/2015	0.0	2.2	17.1	1013	0	0.75	No. Readings:	41	
PENBH19	16/04/2015						-0.90	Critical Value:	3.24	
PENBH19	14/05/2015							No. Outliner Values:	0	
PENBH19	22/06/2015							Stat. Max(tmax)	3.3	
PENBH19	14/07/2015							Action Level	4.3	
PENBH19	11/08/2015	0.0	0.1	20.8	1016	1	-0.82	(tmax+FoS)		
PENBH19	15/09/2015	0.0	1.0	19.0	990	0	-0.15			
PENBH19	09/10/2015	0.3	0.6	20.9	1016	0	-0.45			
PENBH19	13/10/2015	0.0	0.1	22.1	1023	0	-0.82			
PENBH19	09/11/2015	0.0	0.1	21.1	1024	0	-0.82			
PENBH19	09/12/2015	0.3	0.6	20.9	1016	0	-0.45			
PENBH19	12/01/2016	0.0	0.1	21.5	994	0	-0.82			
PENBH19	09/02/2016	0.5	0.1	9.7	976	0	-0.82			
PENBH19	16/03/2016	0.3	0.1	21.5	1025	0	-0.82			
PENBH19	09/05/2016	0.0	0.0	21.3	1005	0	-0.90			
PENBH19	07/06/2016	0.0	0.1	21.1	1019	0	-0.82			
PENBH19	04/07/2016	0.0	1.9	17.4	1011	0	0.52			
PENBH19	05/08/2016	0.0	0.1	21.7	1028	0	-0.82			
PENBH19	05/09/2016									
PENBH19	05/10/2016									
PENBH19	07/11/2016	0.0	0.1	21.9	1012		-0.82			
PENBH19	06/12/2016	0.1	0.2	21.6	1017		-0.75			
PENBH19	20/01/2017	0.1	2.0	19.9	1027	0	0.60			
PENBH19	15/02/2017	0.1	0.1	22.1	1019	0	-0.82			
PENBH19	10/03/2017	0.1	0.3	21.3	1018	0	-0.67			
PENBH19	12/04/2017	0.1	0.1	21.6	1013	0	-0.82			
PENBH19	09/05/2017	0.0	0.1	20.9	1021	0	-0.82			
PENBH19	14/06/2017	0.1	2.1	19.4	1021	0	0.67			
PENBH19	05/07/2017	0.0	0.0	21.2	1014	0	-0.90			
PENBH19	09/08/2017	0.0	0.0	21.5	1017	0	-0.90			
PENBH19	06/09/2017	0.0	0.1	21.7	1013	0	-0.82			
PENBH19	09/10/2017	0.0	0.1	21.5	1021	0	-0.82			
PENBH19	13/11/2017	0.0	0.1	22.2	1019	0	-0.82			
PENBH19	21/12/2017	0.1	0.6	20.7	1030	0	-0.45			
PENBH19	12/01/2018	0.2	0.1	21.9	1017	0	-0.82			
PENBH19	19/02/2018	0.1	0.6	19.3	1014	0	-0.45			
PENBH19	13/03/2018	0.0	0.1	22.0	1003	0	-0.82			
PENBH19	05/04/2018	0.0	0.9	20.7	1010	0	-0.22			
PENBH19	10/05/2018	0	0.1	21.7	1010		-0.82			
PENBH19	27/06/2018	0	0.2	21.2	1021	0	-0.75			
PENBH19	28/08/2018	0	0.1	21.1	1021	0	-0.82			
PENBH19	03/12/2018						-0.90			
PENBH19	14/02/2019	0.1	0.1	21.7	1024	0	-0.82			
PENBH19	15/04/2019	0	3.3	9.3	1010	0	1.57			
PENBH19	02/08/2019	0	0	21.3	1016	0	-0.90			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH20	24/11/2014							Data set Max value:	8.4	
PENBH20	08/12/2014	0.1	8.4	0.3	1015	0	2.65	Data set Min value:	0.0	
PENBH20	14/01/2015	0.0	3.0	18.2	995	0	0.3	Mean:	2.3	
PENBH20	11/02/2015	0.1	4.6	15.3	1017	0	1.0	SD:	2.30	
PENBH20	11/03/2015	0.0	3.2	14.9	1013	0	0.4	No. Readings:	47	
PENBH20	16/04/2015	0.1	0.1	21.5	1013		-1.0	Critical Value:	3.34	
PENBH20	14/05/2015	0.0	0.1	21.8	1005	1	-1.0	No. Outliner Values:	0	
PENBH20	22/06/2015	0.0	0.1	21.1	1007	1	-1.0	Stat. Max(tmax)	8.4	
PENBH20	14/07/2015	0.0	0.1	21.0	1013	1	-1.0	Action Level	10.4	
PENBH20	11/08/2015	0.0	0.8	19.8	1016	1	-0.7	(tmax+FoS)		
PENBH20	15/09/2015	0.0								
PENBH20	09/10/2015	0.1	3.6	11.7	1016	0	0.6			
PENBH20	13/10/2015	0.0	0.1	21.8	1023	0	-1.0			
PENBH20	09/11/2015	0.0	0.1	22.2	1024	0	-1.0			
PENBH20	09/12/2015	0.1	3.6	11.7	1016	0	0.6			
PENBH20	12/01/2016	0.0	2.1	15.7	994	0	-0.1			
PENBH20	09/02/2016	0.5	0.1	21.2	976	0	-1.0			
PENBH20	16/03/2016	0.3	4.5	4.6	1025	0	1.0			
PENBH20	09/05/2016	0.0	4.9	8.1	1005	0	1.1			
PENBH20	07/06/2016	0.0	2.1	16.1	1019	0	-0.1			
PENBH20	04/07/2016	0.0	1.0	18.8	1011	0	-0.6			
PENBH20	05/08/2016	0.0	0.0	21.3	1028	0	-1.0			
PENBH20	05/09/2016	0.0	5.9	9.7	1010	0	1.6			
PENBH20	05/10/2016	0.0	0.1	21.2	1023	0	-1.0			
PENBH20	07/11/2016	0.0	3.4	15.1	1012	0	0.5			
PENBH20	06/12/2016	0.1	0.7	19.3	1017	0	-0.7			
PENBH20	20/01/2017	0.1	0.6	20.0	1027	0	-0.7			
PENBH20	15/02/2017	0.1	1.8	16.4	1019	0	-0.2			
PENBH20	10/03/2017	0.1	3.7	10.4	1017	0	0.6			
PENBH20	12/04/2017	0.2	5.1	13.0	1014	0	1.2			
PENBH20	09/05/2017	0.0	0.1	20.7	1021	0	-1.0			
PENBH20	14/06/2017	0.0	0.0	21.0	1021	0	-1.0			
PENBH20	05/07/2017	0.0	0.1	21.2	1014	0	-1.0			
PENBH20	09/08/2017	0.0	0.0	21.5	1017	0	-1.0			
PENBH20	06/09/2017	0.0	3.4	13.0	1014	0	0.5			
PENBH20	09/10/2017	0.0	0.3	21.2	1022	0	-0.9			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH20	13/11/2017	0.4	7.7	0.3	1019	0	2.3			
PENBH20	21/12/2017	2.5	5.7	0.3	1024	0	1.5			
PENBH20	12/01/2018	0.2	6.6	0.8	1017	0	1.9			
PENBH20	19/02/2018	0.1	0.3	20.5	1014	0	-0.9			
PENBH20	13/03/2018	0.0	3.2	13.4	1004	0	0.4			
PENBH20	05/04/2018	0.0	1.4	16.5	1011	0	-0.4			
PENBH20	10/05/2018	0	4.8	11.7	1011		1.1			
PENBH20	27/06/2018	0	0	21.6	1021	0	-1.0			
PENBH20	28/08/2018	0	3.3	16	1021	0	0.4			
PENBH20	03/12/2018	0	0.4	20.8	995	0	-0.8			
PENBH20	14/02/2019	0.1	1.7	20.5	1024	0	-0.3			
PENBH20	15/04/2019	0	3	14	1011	1	0.3			
PENBH20	02/08/2019	0	0.1	20.9	1015	0	-1.0			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH21	24/11/2014							Data set Max value:	5.7	
PENBH21	08/12/2014	0.0	5.7	10.2	1015	0	2.80	Data set Min value:	0.0	
PENBH21	14/01/2015	0.0	2.4	20.9	995	0	0.70	Mean:	1.3	
PENBH21	11/02/2015	0.1	2.8	15.4	1017	0	0.96	SD:	1.57	
PENBH21	11/03/2015	0.0	1.8	19.2	1013	0	0.32	No. Readings:	36	
PENBH21	16/04/2015	0.0	2.2	19.2	1013		0.57	Critical Value:	3.1	
PENBH21	14/05/2015	0.0	3.2	15.3	1005	0	1.21	No. Outliner Values:	0	
PENBH21	22/06/2015	0.0	0.3	20.8	1008	0	-0.64	Stat. Max(tmax)	5.7	
PENBH21	14/07/2015	0.0	0.1	20.9	1013	0	-0.76	Action Level	7.7	
PENBH21	11/08/2015	0.0	0.9	19.6	1016	1	-0.25	(tmax+FoS)		
PENBH21	15/09/2015	0.0	0.1	20.5	990	1	-0.76			
PENBH21	09/10/2015	0.1	2.0	20.1	1014	0	0.45			
PENBH21	13/10/2015	0.0	0.1	22.2	1023	0	-0.76			
PENBH21	09/11/2015	0.0	0.4	21.8	1024	0	-0.57			
PENBH21	09/12/2015	0.1	2.0	20.1	1014	0	0.45			
PENBH21	12/01/2016	0.1	2.2	16.2	993	0	0.57			
PENBH21	09/02/2016	0.5	1.8	21.6	975	0	0.32			
PENBH21	16/03/2016	0.4	0.1	21.4	1023	0	-0.76			
PENBH21	09/05/2016	0.0	0.0	21.1	1003	0	-0.83			
PENBH21	07/06/2016	0.0	0.3	18.0	1019	0	-0.64			
PENBH21	04/07/2016	0.0	4.8	16.3	1011	0	2.23			
PENBH21	05/08/2016									
PENBH21	05/09/2016	0.0	0.0	21.1	1010	0	-0.83			
PENBH21	05/10/2016	0.0	0.1	21.1	1023	0	-0.76			
PENBH21	07/11/2016									
PENBH21	06/12/2016									
PENBH21	20/01/2017									
PENBH21	15/02/2017									
PENBH21	10/03/2017									
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH22	24/11/2014							Data set Max value:	6.7	
PENBH22	08/12/2014	0.0	0.2	22.1	1015	0	-0.34	Data set Min value:	0.0	
PENBH22	14/01/2015	0.0	0.1	22.2	996	0	-0.41	Mean:	0.7	
PENBH22	11/02/2015	0.1	0.4	22.0	1017	0	-0.21	SD:	1.46	
PENBH22	11/03/2015	0.0	0.8	21.7	1013	0	0.07	No. Readings:	26	
PENBH22	16/04/2015	0.1	0.1	21.5	1013		-0.41	Critical Value:	3.1	
PENBH22	14/05/2015	0.0	0.2	21.8	1005	0	-0.34	No. Outliner Values:	1	6.7
PENBH22	22/06/2015	0.0	0.1	21.0	1007	0	-0.41	Stat. Max(tmax)	2.2	
PENBH22	14/07/2015	0.0	0.1	21.0	1013	0	-0.41	Action Level	3.2	
PENBH22	11/08/2015	0.0	3.7	17.1	1015	1	2.05	(tmax+FoS)		
PENBH22	15/09/2015	0.0	0.6	19.6	990	1	-0.07			
PENBH22	09/10/2015									
PENBH22	13/10/2015	0.0	2.0	19.3	1022	0	0.89			
PENBH22	09/11/2015	0.0	2.2	18.2	1022	0	1.03			
PENBH22	09/12/2015									
PENBH22	12/01/2016						-0.48			
PENBH22	09/02/2016						-0.48			
PENBH22	16/03/2016									
PENBH22	09/05/2016									
PENBH22	07/06/2016	0.0	0.1	21.2	1018	0	-0.41			
PENBH22	04/07/2016	0.0	0.1	21.8	1011	0	-0.41			
PENBH22	05/08/2016	0.0	0.0	21.3	1027	0	-0.48			
PENBH22	05/09/2016									
PENBH22	05/10/2016	0.0	0.1	21.5	1024	0	-0.41			
PENBH22	07/11/2016	0.0	0.1	21.7	1012	0	-0.41			
PENBH22	06/12/2016	0.1	0.1	21.8	1017	0	-0.41			
PENBH22	06/12/2016	0.1	0.9	20.7	1017		0.14			
PENBH22	20/01/2017									
PENBH22	20/01/2017	0.0	6.7	16.0	1027	1	4.11			
PENBH22	15/02/2017	0.1	0.1	22.1	1019	0	-0.41			
PENBH22	15/02/2017	0.1	0.3	21.7	1018	0	-0.27			
PENBH22	10/03/2017									
PENBH22	10/03/2017	0.1	0.1	21.8	1017	0	-0.41			
PENBH22	12/04/2017	0.1	0.1	21.7	1012	1	-0.41			
PENBH22	09/05/2017	0.0	0.1	20.1	1020	0	-0.41			
PENBH22	14/06/2017	0.0	0.1	21.0	1020	0	-0.41			
PENBH22	05/07/2017									
PENBH22	09/08/2017									
PENBH22	06/09/2017									
PENBH22	09/10/2017									
PENBH22	13/11/2017									
PENBH22	21/12/2017									
PENBH22	12/01/2018									
PENBH22	19/02/2018									
PENBH22	13/03/2018									
PENBH22	05/04/2018									
PENBH22	10/05/2018									
PENBH22	27/06/2018									
PENBH22	28/08/2018									
PENBH22	03/12/2018									
PENBH22	14/02/2019									
PENBH22	15/04/2019									
PENBH22	02/08/2019									
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH23	24/11/2014									
PENBH23	08/12/2014	0.0	6.7	13.9	1015	0	1.14	Data set Max value:	8.0	
PENBH23	14/01/2015	0.0	5.7	19.0	994	0	0.70	Data set Min value:	0.0	
PENBH23	11/02/2015	0.0	4.8	17.4	1016	0	0.31	Mean:	4.1	
PENBH23	11/03/2015	0.0	4.4	19.9	1015	0	0.13	SD:	2.28	
PENBH23	16/04/2015	0.0	2.9	18.9	1013		-0.53	No. Readings:	33	
PENBH23	14/05/2015	0.0	0.1	21.8	1005	0	-1.75	Critical Value:	3.1	
PENBH23	22/06/2015					0		No. Outliner Values:	0	
PENBH23	14/07/2015							Stat. Max(tmax)	8.0	
PENBH23	11/08/2015							Action Level	8.0	
PENBH23	15/09/2015							tmax, as unstabel data set		
PENBH23	09/10/2015									

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH23	13/10/2015									
PENBH23	09/11/2015									
PENBH23	09/12/2015									
PENBH23	12/01/2016	0.0	0.1	22.0	994	0	-1.75			
PENBH23	09/02/2016						-1.80			
PENBH23	16/03/2016									
PENBH23	09/05/2016	0.0	3.8	16.7	1005	0	-0.13			
PENBH23	07/06/2016	0.0	1.7	19.1	1020	0	-1.05			
PENBH23	04/07/2016	0.0	0.0	21.6	1009	0	-1.80			
PENBH23	05/08/2016									
PENBH23	05/09/2016									
PENBH23	05/10/2016	0.0	3.4	17.3	1023	0	-0.31			
PENBH23	07/11/2016	0.0	8.0	12.3	1011	0	1.71			
PENBH23	06/12/2016	0.0	3.8	15.0	1017	0	-0.13			
PENBH23	20/01/2017	0.0	3.8	15.3	1027	0	-0.13			
PENBH23	15/02/2017	0.1	7.2	15.2	1018	0	1.36			
PENBH23	10/03/2017	0.1	6.0	17.4	1017	0	0.83			
PENBH23	12/04/2017	0.1	6.6	14.1	1013	0	1.10			
PENBH23	09/05/2017	0.0	0.7	19.1	1020	0	-1.49			
PENBH23	14/06/2017	0.0	0.7	19.1	1020	0	-1.49			
PENBH23	05/07/2017	0.0	4.2	17.3	1014	0	0.04			
PENBH23	09/08/2017	0.0	3.8	14.3	1017	0	-0.13			
PENBH23	06/09/2017	0.0	5.3	16.0	1013	0	0.53			
PENBH23	09/10/2017	0.0	5.7	14.6	1021	0	0.70			
PENBH23	13/11/2017	0.0	5.8	16.6	1018	0	0.75			
PENBH23	21/12/2017	0.1	6.4	16.2	1029	0	1.01			
PENBH23	12/01/2018	0.2	7.1	15.4	1016	0	1.32			
PENBH23	19/02/2018	0.1	6.1	17.1	1014	0	0.88			
PENBH23	13/03/2018	0.0	3.2	18.9	1003	0	-0.39			
PENBH23	05/04/2018	0.0	0.1	21.9	1010	0	-1.75			
PENBH23	10/05/2018	0	6.3	14.9	1011		0.96			
PENBH23	27/06/2018									
PENBH23	28/08/2018									
PENBH23	03/12/2018	0	3.9	17.9	996	0	-0.09			
PENBH23	14/02/2019	0	4.2	18.8	1024	0	0.04			
PENBH23	15/04/2019	0	4.3	15	1010	0	0.09			
PENBH23	02/08/2019									
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH24	24/11/2014							Data set Max value:	4.2	
PENBH24	08/12/2014	0.0	0.4	21.6	1015	0	-0.45	Data set Min value:	0.0	
PENBH24	14/01/2015	0.0	1.2	20.4	994	0	0.5	Mean:	0.8	
PENBH24	11/02/2015	0.0	0.8	21.4	1016	0	0.0	SD:	0.88	
PENBH24	11/03/2015	0.0	0.1	21.8	1014	0	-0.8	No. Readings:	48	
PENBH24	16/04/2015	0.0	0.1	21.4	1013		-0.8	Critical Value:	3.24	
PENBH24	14/05/2015	0.0	0.5	19.9	1004	0	-0.3	No. Outliner Values:	1	4.2
PENBH24	22/06/2015	0.0	0.1	21.1	1007	0	-0.8	Stat. Max(tmax)	2.5	
PENBH24	14/07/2015	0.0	0.2	21.1	20.3	0	-0.7	Action Level	3.5	
PENBH24	11/08/2015	0.0	0.1	20.9	1016	1	-0.8	(tmax+FoS)		
PENBH24	15/09/2015	0.0	0.1	20.7	990	1	-0.8			
PENBH24	09/10/2015	0.1	0.3	20.7	1015	0	-0.6			
PENBH24	13/10/2015	0.0	0.5	20.7	1022	0	-0.3			
PENBH24	09/11/2015	0.0	0.4	21.1	1023	0	-0.5			
PENBH24	09/12/2015	0.1	0.3	20.7	1015	0	-0.6			
PENBH24	12/01/2016	0.0	1.0	18.7	994	0	0.2			
PENBH24	09/02/2016	0.5	1.3	21.5	976	0	0.6			
PENBH24	16/03/2016	0.3	0.3	21.1	1025	0	-0.6			
PENBH24	09/05/2016	0.0	0.0	21.4	1005	0	-0.9			
PENBH24	07/06/2016	0.0	0.1	21.2	1019	0	-0.8			
PENBH24	04/07/2016	0.0	0.2	21.1	1010	0	-0.7			
PENBH24	05/08/2016	0.0	0.0	21.4	1026	0	-0.9			
PENBH24	05/09/2016	0.0	1.0	17.0	1010	0	0.2			
PENBH24	05/10/2016	0.0	0.0	21.3	1023	0	-0.9			
PENBH24	07/11/2016	0.0	1.4	20.0	1011	0	0.7			
PENBH24	06/12/2016	0.0	1.2	19.8	1017	0	0.5			
PENBH24	20/01/2017	0.1	0.1	21.5	1027	1	-0.8			
PENBH24	15/02/2017	0.1	0.1	22.0	1018	0	-0.8			
PENBH24	10/03/2017	0.1	1.0	19.8	1017	0	0.2			
PENBH24	12/04/2017	0.1	0.1	21.6	1013	0	-0.8			
PENBH24	09/05/2017	0.0	2.5	14.8	1020	0	1.9			
PENBH24	14/06/2017	0.0	2.5	14.8	1020	0	1.9			
PENBH24	05/07/2017	0.0	0.1	21.2	1014	0	-0.8			
PENBH24	09/08/2017	0.0	1.1	12.1	1017	0	0.3			
PENBH24	06/09/2017	0.0	2.4	11.8	1013	0	1.8			
PENBH24	09/10/2017	0.0	0.3	21.2	1021	0	-0.6			
PENBH24	13/11/2017	0.0	1.9	17.2	1018	0	1.3			
PENBH24	21/12/2017	0.1	2.0	17.8	1029	0	1.4			
PENBH24	12/01/2018	0.2	0.3	21.6	1016	0	-0.6			
PENBH24	19/02/2018	0.1	1.0	20.0	1014	0	0.2			
PENBH24	13/03/2018	0.0	1.2	17.7	1003	0	0.5			
PENBH24	05/04/2018	0.0	4.2	6.7	1010	0	3.9			
PENBH24	10/05/2018	0	0.1	21.4	1010		-0.8			
PENBH24	27/06/2018	0	2.3	15.4	1021	0	1.7			
PENBH24	28/08/2018	0	0.1	21.1	1021	0	-0.8			
PENBH24	03/12/2018	0	0.1	21.1	996	0	-0.8			
PENBH24	14/02/2019	0.1	0.9	20.4	1023	0	0.1			
PENBH24	15/04/2019	0	0.2	21.5	1010	1	-0.7			
PENBH24	02/08/2019	0	0.8	23.1	1016	0	0.0			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH25	24/11/2014							Data set Max value:	4.8	
PENBH25	08/12/2014	0.0	0.3	21.7	1015	0	-1.72	Data set Min value:	0.1	
PENBH25	14/01/2015	0.0	3.6	5.2	994	0	0.7	Mean:	2.6	
PENBH25	11/02/2015	0.0	3.0	8.1	1016	0	0.3	SD:	1.34	
PENBH25	11/03/2015	0.0	3.1	8.4	1014	0	0.4	No. Readings:	39	
PENBH25	16/04/2015	0.0	2.5	17.5	1013		-0.1	Critical Value:	3.24	
PENBH25	14/05/2015	0.0	2.2	11.9	1005	0	-0.3	No. Outliner Values:	0	
PENBH25	22/06/2015	0.0	2.9	13.9	1007	0	0.2	Stat. Max(tmax)	4.8	
PENBH25	14/07/2015							Action Level	5.8	
PENBH25	11/08/2015							(tmax+FoS)		
PENBH25	15/09/2015									
PENBH25	09/10/2015	0.1	2.5	13.3	1015	0	-0.1			
PENBH25	13/10/2015									
PENBH25	09/11/2015									
PENBH25	09/12/2015	0.1	2.5	13.3	1015	0	-0.1			
PENBH25	12/01/2016	0.0	0.9	20.9	994	0	-1.3			
PENBH25	09/02/2016	0.5	3.5	22.1	976	0	0.7			
PENBH25	16/03/2016	0.3	0.8	20.7	1024	0	-1.3			
PENBH25	09/05/2016	0.0	2.2	14.8	1004	0	-0.3			
PENBH25	07/06/2016	0.0	3.1	13.3	1020	0	0.4			
PENBH25	04/07/2016	0.0	2.6	10.7	1010	0	0.0			
PENBH25	05/08/2016									
PENBH25	05/09/2016	0.0	3.0	13.2	1010	0	0.3			
PENBH25	05/10/2016	0.0	1.3	16.9	1023	0	-1.0			
PENBH25	07/11/2016	0.0	3.9	9.8	1011	0	1.0			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH25	06/12/2016	0.1	2.1	18.3	1017	0	-0.4			
PENBH25	20/01/2017	0.0	1.2	20.7	1027	1	-1.0			
PENBH25	15/02/2017	0.1	3.5	8.7	1018	0	0.7			
PENBH25	10/03/2017	0.1	2.8	10.7	1017	0	0.1			
PENBH25	12/04/2017	0.1	1.4	19.0	1013	0	-0.9			
PENBH25	09/05/2017	0.0	0.1	20.8	1020	0	-1.9			
PENBH25	14/06/2017	0.0	0.1	20.8	1020	0	-1.9			
PENBH25	09/08/2017	0.0	4.2	6.9	1017	0	1.2			
PENBH25	06/09/2017	0.0	4.5	8.7	1013	0	1.4			
PENBH25	09/10/2017	0.0	2.5	17.7	1021	0	-0.1			
PENBH25	13/11/2017	0.0	4.8	5.4	1018	0	1.6			
PENBH25	21/12/2017	0.1	4.2	6.8	1029	0	1.2			
PENBH25	12/01/2018	0.1	4.3	14.9	1016	0	1.3			
PENBH25	19/02/2018	0.1	3.2	10.6	1014	0	0.4			
PENBH25	13/03/2018	0.0	4.3	6.1	1003	0	1.3			
PENBH25	05/04/2018	0.0	0.2	21.7	1010	0	-1.8			
PENBH25	10/05/2018	0	3.4	13.5	1010		0.6			
PENBH25	27/06/2018						-1.9			
PENBH25	28/08/2018	0	4.2	5.4	1011	0	1.2			
PENBH25	03/12/2018	0	4.2	5.4	996	0	1.2			
PENBH25	14/02/2019	0.1	0.6	19.1	1024	0	-1.5			
PENBH25	15/04/2019	0	3.2	16.6	1009	0	0.4			
PENBH25	02/08/2019						-1.9			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH27	24/11/2014									
PENBH27	08/12/2014	0.0	2.3	19.6	1015	0	0.66	Data set Max value:	6.7	
PENBH27	14/01/2015	0.0	0.1	22.1	988	0	-0.8	Data set Min value:	0.0	
PENBH27	11/02/2015	0.0	0.4	21.6	1016	0	-0.6	Mean:	1.3	
PENBH27	11/03/2015	0.0	1.2	18.1	1015	0	-0.1	SD:	1.52	
PENBH27	16/04/2015	0.0	0.1	21.8	1010		-0.8	No. Readings:	47	
PENBH27	14/05/2015	0.0	0.6	20.2	1005	0	-0.5	Critical Value:	3.24	
PENBH27	22/06/2015	0.0	3.8	15.9	1008	0	1.6	No. Outliner Values:	2	6.7, 6.6
PENBH27	14/07/2015	0.0	0.0	15.9	20.8	0	-0.9	Stat. Max(tmax)	3.8	
PENBH27	11/08/2015	0.0	0.1	20.9	1016	1	-0.8	Action Level	4.8	
PENBH27	15/09/2015	0.0	1.9	17.7	991	1	0.4	(tmax+FoS)		
PENBH27	09/10/2015	0.1	0.2	21.2	1016	0	-0.7			
PENBH27	13/10/2015	0.0	0.2	21.6	1022	0	-0.7			
PENBH27	09/11/2015	0.0	0.2	21.4	1022	0	-0.7			
PENBH27	09/12/2015	0.1	0.2	21.2	1016	0	-0.7			
PENBH27	12/01/2016	0.0	0.1	21.8	995	0	-0.8			
PENBH27	09/02/2016	0.5	0.5	17.1	975	0	-0.5			
PENBH27	16/03/2016	0.3	1.1	19.9	1025	0	-0.1			
PENBH27	09/05/2016	0.0	1.6	18.0	1004	0	0.2			
PENBH27	07/06/2016	0.0	2.9	16.2	1019	0	1.1			
PENBH27	04/07/2016	0.0	0.1	21.6	1010	0	-0.8			
PENBH27	05/08/2016	0.0	0.0	21.3	1024	0	-0.9			
PENBH27	05/09/2016	0.0	0.8	20.0	1010	0	-0.3			
PENBH27	05/10/2016	0.0	1.1	20.7	1023	0	-0.1			
PENBH27	07/11/2016	0.0	2.3	19.4	1011	0	0.7			
PENBH27	06/12/2016	0.0	1.9	19.8	1017	0	0.4			
PENBH27	20/01/2017	0.0	1.6	19.9	1027	0	0.2			
PENBH27	15/02/2017	0.1	0.1	22.0	1018	0	-0.8			
PENBH27	10/03/2017	0.1	0.7	19.9	1017	0	-0.4			
PENBH27	12/04/2017	0.1	0.1	21.6	1013	0	-0.8			
PENBH27	09/05/2017	0.0	0.1	20.6	1020	0	-0.8			
PENBH27	14/06/2017	0.0	0.1	20.6	1020	0	-0.8			
PENBH27	05/07/2017	0.0	0.0	20.9	1015	0	-0.9			
PENBH27	09/08/2017	0.0	2.6	17.9	1017	0	0.9			
PENBH27	06/09/2017	0.0	1.7	20.4	1013	0	0.3			
PENBH27	09/10/2017	0.0	0.1	21.2	1021	0	-0.8			
PENBH27	13/11/2017	0.0	1.0	20.4	1018	0	-0.2			
PENBH27	21/12/2017	0.2	3.4	15.0	1029	0	1.4			
PENBH27	12/01/2018	0.2	1.4	20.1	1016	0	0.1			
PENBH27	19/02/2018	0.1	1.8	19.1	1014	0	0.3			
PENBH27	13/03/2018	0.0	0.1	22.1	1003	0	-0.8			
PENBH27	05/04/2018	0.0	0.1	21.9	1010	0	-0.8			
PENBH27	10/05/2018	0	1.3	20.4	1010		0.0			
PENBH27	27/06/2018	0	2.7	17.4	1021	0	0.9			
PENBH27	28/08/2018	0	6.6	11	1011	0	3.5			
PENBH27	03/12/2018	0	2.6	18.7	993	0	0.9			
PENBH27	14/02/2019	0	1.9	19.2	1024	0	0.4			
PENBH27	15/04/2019	0	2.2	17.2	1010	0	0.6			
PENBH27	02/08/2019	0	6.7	9.2	1016	0	3.6			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH28	24/11/2014							Data set Max value:	9.4	
PENBH28	08/12/2014	0.0	0.1	22.3	1015	0	-0.88	Data set Min value:	0.0	
PENBH28	14/01/2015	0.0	2.9	19.1	993	0	0.4	Mean:	2.1	
PENBH28	11/02/2015	0.1	4.1	15.1	1016	0	0.9	SD:	2.26	
PENBH28	11/03/2015	1.9	7.1	8.1	1015	38	2.2	No. Readings:	48	
PENBH28	16/04/2015	0.0	3.1	16.9	1010		0.4	Critical Value:	3.24	
PENBH28	14/05/2015	0.0	4.3	10.4	1004	0	1.0	No. Outliner Values:	0	
PENBH28	22/06/2015	0.0	3.7	14.0	1008	0	0.7	Stat. Max(tmax)	9.4	
PENBH28	14/07/2015	0.0	5.5	14.0	13.1	0	1.5	Action Level	11.4	
PENBH28	11/08/2015	0.0	0.1	20.9	1016	1	-0.9	(tmax+FoS)		
PENBH28	15/09/2015	0.0	0.1	20.5	990	1	-0.9			
PENBH28	09/10/2015	0.1	0.1	21.6	1015	0	-0.9			
PENBH28	13/10/2015	0.4	1.0	19.5	1022	0	-0.5			
PENBH28	09/11/2015	0.1	0.2	19.2	1023	0	-0.8			
PENBH28	09/12/2015	0.1	0.1	21.6	1015	0	-0.9			
PENBH28	12/01/2016	0.0	0.1	21.9	995	0	-0.9			
PENBH28	09/02/2016	0.5	3.2	21.5	974	0	0.5			
PENBH28	16/03/2016	0.3	1.5	20.0	1024	0	-0.3			
PENBH28	09/05/2016	0.0	0.0	21.7	1004	0	-0.9			
PENBH28	07/06/2016	0.0	0.2	20.1	1019	0	-0.8			
PENBH28	04/07/2016	1.9	6.7	6.4	1009	0	2.0			
PENBH28	05/08/2016	0.0	0.0	21.2	1026	0	-0.9			
PENBH28	05/09/2016	0.0	0.3	20.8	1010	0	-0.8			
PENBH28	05/10/2016	0.0	0.0	21.8	1022	0	-0.9			
PENBH28	07/11/2016	0.0	1.5	19.8	1011	0	-0.3			
PENBH28	06/12/2016	0.1	0.1	21.7	1017	0	-0.9			
PENBH28	20/01/2017	0.0	1.6	19.9	1027	0	-0.2			
PENBH28	15/02/2017	0.1	3.6	18.7	1018	0	0.7			
PENBH28	10/03/2017	0.1	3.2	13.2	1017	0	0.5			
PENBH28	12/04/2017	0.1	1.6	19.9	1013	0	-0.2			
PENBH28	09/05/2017	0.0	1.3	19.7	1020	0	-0.4			
PENBH28	14/06/2017	0.0	1.3	19.7	1020	0	-0.4			
PENBH28	05/07/2017	0.0	0.0	20.8	1014	0	-0.9			
PENBH28	09/08/2017	0.0	2.8	15.1	1017	0	0.3			
PENBH28	06/09/2017	0.0	0.1	21.6	1013	0	-0.9			
PENBH28	09/10/2017	0.0	0.1	21.2	1021	0	-0.9			
PENBH28	13/11/2017	0.0	4.8	7.9	1018	0	1.2			
PENBH28	21/12/2017	0.1	6.1	3.2	1029	0	1.8			
PENBH28	12/01/2018	0.2	1.2	20.0	1015	0	-0.4			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH28	19/02/2018	0.1	1.7	19.8	1014	0	-0.2			
PENBH28	13/03/2018	0.0	2.3	19.2	1003	0	0.1			
PENBH28	05/04/2018	0.0	0.1	22.0	1010	0	-0.9			
PENBH28	10/05/2018	0	1.3	20.2	1010		-0.4			
PENBH28	27/06/2018	0	0	21.7	1021	0	-0.9			
PENBH28	28/08/2018	1.4	9.4	0.4	1010	0	3.2			
PENBH28	03/12/2018	0	2.8	17.1	993	0	0.3			
PENBH28	14/02/2019	0	4.6	13.5	1023	0	1.1			
PENBH28	15/04/2019	0	4.2	14.2	1009	1	0.9			
PENBH28	02/08/2019	0	0.2	>>>>	1016	0	-0.8			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH29	24/11/2014							Data set Max value:	3.5	
PENBH29	08/12/2014	0.0	2.0	12.6	1014	1	0.88	Data set Min value:	0.0	
PENBH29	14/01/2015	0.0	1.9	15.7	995	0	0.75	Mean:	1.3	
PENBH29	11/02/2015	0.0	1.8	17.9	1016	0	0.63	SD:	0.80	
PENBH29	11/03/2015	0.0	1.6	15.0	1014	0	0.38	No. Readings:	46	
PENBH29	16/04/2015	0.0	1.5	16.1	1013		0.25	Critical Value:	3.24	
PENBH29	14/05/2015	0.0	0.1	21.9	1005	0	-1.50	No. Outliner Values:	0	
PENBH29	22/06/2015	0.0	0.1	21.2	1007	0	-1.50	Stat. Max(tmax)	3.5	
PENBH29	14/07/2015	0.0	1.2	21.2	16.5	0	-0.13	Action Level	4.5	
PENBH29	11/08/2015	0.0	0.8	20.0	1016	1	-0.63	(tmax+FoS)		
PENBH29	15/09/2015	0.0	1.6	15.6	990	1	0.38			
PENBH29	09/10/2015	0.1	0.2	21.4	1015	0	-1.38			
PENBH29	13/10/2015	0.0	1.8	14.9	1022	0	0.63			
PENBH29	09/11/2015	0.0	1.2	19.8	1023	0	-0.13			
PENBH29	09/12/2015	0.1	0.2	21.4	1015	0	-1.38			
PENBH29	12/01/2016	0.0	0.9	19.3	994	0	-0.50			
PENBH29	09/02/2016	0.5	1.8	22.2	976	0	0.63			
PENBH29	16/03/2016	0.3	0.2	21.5	1024	0	-1.38			
PENBH29	09/05/2016	0.0	1.5	17.3	1005	0	0.25			
PENBH29	07/06/2016	0.0	1.8	17.2	1019	0	0.63			
PENBH29	04/07/2016	0.0	2.1	13.2	1010	0	1.00			
PENBH29	05/08/2016									
PENBH29	05/09/2016	0.0	0.0	20.9	1010	0	-1.63			
PENBH29	05/10/2016									
PENBH29	07/11/2016	0.0	1.6	18.7	1011	0	0.38			
PENBH29	06/12/2016	0.1	1.5	18.9	1017	0	0.25			
PENBH29	20/01/2017	0.0	1.1	20.3	1027	0	-0.25			
PENBH29	15/02/2017	0.1	2.3	17.4	1018	0	1.25			
PENBH29	10/03/2017	0.1	0.7	20.5	1017	0	-0.75			
PENBH29	12/04/2017	0.1	2.1	18.3	1013	0	1.00			
PENBH29	09/05/2017	0.0	0.1	21.0	1021	0	-1.50			
PENBH29	14/06/2017	0.0	0.1	21.0	1021	0	-1.50			
PENBH29	05/07/2017	0.0	0.2	20.7	1014	0	-1.38			
PENBH29	09/08/2017	0.0	0.1	12.0	1017	0	-1.50			
PENBH29	06/09/2017	0.0	3.5	10.1	1013	0	2.75			
PENBH29	09/10/2017	0.0	1.4	18.6	1021	0	0.13			
PENBH29	13/11/2017	0.0	2.3	14.3	1018	0	1.25			
PENBH29	21/12/2017	0.1	2.1	14.8	1029	0	1.00			
PENBH29	12/01/2018	0.2	1.9	19.3	1016	0	0.75			
PENBH29	19/02/2018	0.1	1.8	17.8	1014	0	0.63			
PENBH29	13/03/2018	0.0	1.1	18.4	1003	0	-0.25			
PENBH29	05/04/2018	0.0	2.2	16.7	1010	0	1.13			
PENBH29	10/05/2018	0	2	17.5	1010		0.875			
PENBH29	27/06/2018	0	1	20.5	1021	1	-0.375			
PENBH29	28/08/2018	0	1.7	19.2	1021	1	0.5			
PENBH29	03/12/2018	0	1.4	13.8	996	0	0.125			
PENBH29	14/02/2019	0.1	0.6	20.9	1023	0	-0.875			
PENBH29	15/04/2019	0	0.9	19.5	1010	1	-0.5			
PENBH29	02/08/2019	0	2.4	18.3	1016	0	1.375			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH30	24/11/2014							Data set Max value:	2.2	
PENBH30	08/12/2014	0.0	0.4	22.0	1015	0	-0.40	Data set Min value:	0.0	
PENBH30	14/01/2015	0.0	0.3	21.9	995	0	-0.60	Mean:	0.6	
PENBH30	11/02/2015	0.0	1.0	20.9	1016	0	0.80	SD:	0.50	
PENBH30	11/03/2015	0.0	0.2	21.7	1013	0	-0.80	No. Readings:	46	
PENBH30	16/04/2015	0.0	0.9	20.8	1013		0.60	Critical Value:	3.24	
PENBH30	14/05/2015	0.0	0.3	21.6	1005	0	-0.60	No. Outliner Values:		
PENBH30	22/06/2015	0.0	0.1	21.1	1007	0	-1.00	Stat. Max(tmax)	2.2	
PENBH30	14/07/2015	0.0	0.0	21.1	21	0	-1.20	Action Level	3.2	
PENBH30	11/08/2015	0.0	0.8	19.9	1016	1	0.40	(tmax+FoS)		
PENBH30	15/09/2015	0.0	0.1	20.6	990	1	-1.00			
PENBH30	09/10/2015	0.1	0.1	21.6	1016	0	-1.00			
PENBH30	13/10/2015	0.0	0.1	21.6	1022	0	-1.00			
PENBH30	09/11/2015	0.0	0.3	20.5	1023	0	-0.60			
PENBH30	09/12/2015	0.1	0.1	21.6	1016	0	-1.00			
PENBH30	12/01/2016	0.0	0.1	21.7	993	0	-1.00			
PENBH30	09/02/2016	0.5	0.1	20.8	976	0	-1.00			
PENBH30	16/03/2016	0.3	0.1	21.7	1024	0	-1.00			
PENBH30	09/05/2016	0.0	0.4	20.7	1005	0	-0.40			
PENBH30	07/06/2016	0.0	0.1	21.2	1019	0	-1.00			
PENBH30	04/07/2016	0.0	1.1	20.1	1011	0	1.00			
PENBH30	05/08/2016	0.0	0.0	21.4	1027	0	-1.20			
PENBH30	05/09/2016	0.0	2.2	16.6	1010	0	3.20			
PENBH30	05/10/2016	0.0	0.5	20.4	1023	0	-0.20			
PENBH30	07/11/2016	0.0	1.3	20.9	1011	0	1.40			
PENBH30	06/12/2016	0.1	0.1	21.8	1017	0	-1.00			
PENBH30	20/01/2017	0.0	1.1	18.9	1027	0	1.00			
PENBH30	15/02/2017	0.1	0.9	21.2	1018	0	0.60			
PENBH30	10/03/2017						-1.20			
PENBH30	09/08/2017	0.0	0.8	19.3	1017	0	0.40			
PENBH30	06/09/2017	0.0	1.1	20.5	1013	0	1.00			
PENBH30	09/10/2017	0.0	1.0	20.7	1022	0	0.80			
PENBH30	13/11/2017	0.0	1.0	21.4	1019	0	0.80			
PENBH30	21/12/2017	0.1	1.0	20.7	1030	0	0.80			
PENBH30	12/01/2018	0.2	0.1	21.8	1017	0	-1.00			
PENBH30	19/02/2018	0.1	0.8	20.5	1014	0	0.40			
PENBH30	13/03/2018	0.0	1.0	20.9	1003	0	0.80			
PENBH30	05/04/2018	0.0	0.1	21.8	1010	0	-1.00			
PENBH30	10/05/2018	0	1.1	20.4	1010		1			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH31	24/11/2014						-1.2	Data set Max value:	3.0	
PENBH31	08/12/2014	0.0	0.7	21.6	1015	0	0.20	Data set Min value:	0.0	
PENBH31	14/01/2015	0.0	0.9	21.2	995	0	0.60	Mean:	0.6	
PENBH31	11/02/2015	0.0	1.0	20.8	1017	0	0.80	SD:	0.639018682	
PENBH31	11/03/2015	0.0	0.8	21.1	1013	0	0.40	No. Readings:	47	
PENBH31	16/04/2015	0.0	0.3	21.3	1013		-0.60	Critical Value:	3.24	
PENBH31	14/05/2015	0.1	0.1	18.9	1005	1	-1.00	No. Outliner Values:	2	3.0, 2.8
PENBH31	22/06/2015	0.0	0.9	20.4	1007	1	0.60	Stat. Max(tmax)	1.1	
PENBH31	14/07/2015	0.0	0.9	20.1	1013	1	0.60	Action Level	2.1	

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH31	11/08/2015	0.0	0.4	20.4	1016	1	-0.40	(tmax+FoS)		
PENBH31	15/09/2015	0.0	3.0	17.6	987	0	4.80			
PENBH31	09/10/2015	0.1	0.1	21.6	1016	0	-1.00			
PENBH31	13/10/2015	0.0	0.6	21.2	1022	0	0.00			
PENBH31	09/11/2015	0.0	0.5	21.3	1023	0	-0.20			
PENBH31	09/12/2015	0.1	0.1	21.6	1016	0	-1.00			
PENBH31	12/01/2016	0.0	0.8	20.5	994	0	0.40			
PENBH31	09/02/2016	0.5	0.7	15.7	976	0	0.20			
PENBH31	16/03/2016	0.3	1.1	19.9	1025	0	1.00			
PENBH31	09/05/2016	0.0	0.0	21.5	1005	0	-1.20			
PENBH31	07/06/2016	0.0	0.5	20.2	1019	0	-0.20			
PENBH31	04/07/2016	0.0	0.8	20.7	1011	0	0.40			
PENBH31	05/08/2016	0.0	0.0	21.4	1027	0	-1.20			
PENBH31	05/09/2016	0.0	0.7	20.0	1010	0	0.20			
PENBH31	05/10/2016	0.0	0.1	21.4	1023	0	-1.00			
PENBH31	07/11/2016	0.0	0.8	21.4	1012	0	0.40			
PENBH31	06/12/2016	0.1	1.5	20.9	1017	0	1.80			
PENBH31	20/01/2017	0.0	2.9	13.5	1027	0	4.60			
PENBH31	15/02/2017	0.1	0.3	21.9	1019	0	-0.60			
PENBH31	10/03/2017	0.1	0.5	21.3	1018	0	-0.20			
PENBH31	12/04/2017	0.1	0.1	21.6	1014	0	-1.00			
PENBH31	09/05/2017	0.0	0.3	20.4	1020	1	-0.60			
PENBH31	14/06/2017	0.0	0.3	20.4	1020	1	-0.60			
PENBH31	05/07/2017	0.0	0.7	20.4	1014	0	0.20			
PENBH31	27/06/2018	0	0	21.6	1021	0	-1.2			
PENBH31	28/08/2018	0	0.8	20.4	1021	0	0.4			
PENBH31	03/12/2018	0	0.5	21	996	0	-0.2			
PENBH31	14/02/2019	0.1	0.4	21.6	1024	0	-0.4			
PENBH31	15/04/2019	0	0.9	20.2	1010	0	0.6			
PENBH31	02/08/2019	0	0.9	19.9	1016	0	0.6			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH50	24/11/2014							Data set Max value:	8.4	
PENBH50	08/12/2014	0.0	0.1	22.2	1017	0	-0.35	Data set Min value:	0.0	
PENBH50	14/01/2015	0.0	0.1	22.2	995	0	-0.4	Mean:	0.6	
PENBH50	11/02/2015	0.1	0.1	22.2	1017	0	-0.4	SD:	1.42	
PENBH50	11/03/2015	0.0	0.1	21.9	1013	0	-0.4	No. Readings:	35	
PENBH50	16/04/2015	0.2	0.1	21.5	1012		-0.4	Critical Value:	3.24	
PENBH50	14/05/2015	0.1	0.5	20.6	1005	0	-0.1	No. Outliner Values:	1	8.2
PENBH50	22/06/2015	0.0	0.1	21.1	1006	0	-0.4	Stat. Max(tmax)	2.2	
PENBH50	14/07/2015	0.0	0.1	21.0	1010	0	-0.4	Action Level	2.2	
PENBH50	11/08/2015	0.0	0.1	20.9	1015	1	-0.4	, due to unstable dataset		
PENBH50	15/09/2015	0.0	0.1	20.9	990	1	-0.4			
PENBH50	09/10/2015	0.1	0.1	21.7	1017	0	-0.4			
PENBH50	13/10/2015	0.0	0.1	21.5	1022	1	-0.4			
PENBH50	09/11/2015	0.0	0.1	20.5	1022	0	-0.4			
PENBH50	09/12/2015	0.1	0.1	21.7	1017	0	-0.4			
PENBH50	12/01/2016	0.0	0.2	22.0	991	0	-0.3			
PENBH50	09/02/2016	0.5	0.5	20.0	976	0	-0.1			
PENBH50	16/03/2016	0.3	0.1	22.1	1024	0	-0.4			
PENBH50	09/05/2016	0.0	0.0	21.4	1003	0	-0.4			
PENBH50	07/06/2016	0.0	0.0	21.5	1019	0	-0.4			
PENBH50	04/07/2016	0.0	0.0	21.3	1010	0	-0.4			
PENBH50	05/08/2016	0.0	0.0	21.3	1025	0	-0.4			
PENBH50	05/09/2016	0.0	0.0	21.0	1009	0	-0.4			
PENBH50	05/10/2016	0.0	0.1	21.5	1022	0	-0.4			
PENBH50	07/11/2016	0.0	0.1	21.9	1010	0	-0.4			
PENBH50	06/12/2016	0.1	8.4	2.1	1017	1	5.5			
PENBH50	20/01/2017				1027		-0.4			
PENBH50	15/02/2017	0.1	0.1	21.7	1018	0	-0.4			
PENBH50	10/03/2017	0.1	1.1	20.0	1016	0	0.4			
PENBH50	12/04/2017	0.1	1.0	20.2	1013	0	0.3			
PENBH50	09/05/2017	0.0	2.3	16.9	1020	0	1.2			
PENBH50	14/06/2017	0.0	0.5	20.4	1020	0	-0.1			
PENBH50	05/07/2017	0.0	0.6	20.6	1013	0	0.0			
PENBH50	09/08/2017	0.0	0.3	21.1	1016	0	-0.2			
PENBH50	06/09/2017	0.0	0.7	20.9	1012	0	0.1			
PENBH50	09/10/2017	0.0	1.0	20.6	1020	0	0.3			
PENBH50	13/11/2017						-0.4			
PENBH50	21/12/2017						-0.4			
PENBH50	12/01/2018						-0.4			
PENBH50	19/02/2018						-0.4			
PENBH50	13/03/2018	0.0	0.5	13.3	1003		-0.1			
PENBH50	05/04/2018						-0.4			
PENBH50	10/05/2018						-0.4			
PENBH50	27/06/2018						-0.4			
PENBH50	28/08/2018	0	2.2	14.4	1009	0	1.1			
PENBH50	03/12/2018						-0.4			
PENBH50	14/02/2019						-0.4			
PENBH50	15/04/2019						-0.4			
PENBH50	02/08/2019						-0.4			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH51	24/11/2014							Data set Max value:	1.0	
PENBH51	08/12/2014	0.0	0.4	21.3	1017	0	-0.48	Data set Min value:	0.0	
PENBH51	14/01/2015	0.0	0.5	18.8	996	0	0.0	Mean:	0.5	
PENBH51	11/02/2015	0.1	0.4	18.7	1017	0	-0.5	SD:	0.21	
PENBH51	11/03/2015	0.0	0.2	21.0	1013	0	-1.4	No. Readings:	43	
PENBH51	16/04/2015	0.1	0.5	19.3	1012		0.0	Critical Value:	3.24	
PENBH51	14/05/2015	0.0	0.4	20.5	1005	0	-0.5	No. Outliner Values:	0	
PENBH51	22/06/2015	0.0	0.7	20.1	1006	0	1.0	Stat. Max(tmax)	1.0	
PENBH51	14/07/2015	0.0	0.7	19.9	1010	0	1.0	Action Level	3.0	
PENBH51	11/08/2015	0.0	0.7	19.6	1015	1	1.0	(tmax+FoS)		
PENBH51	15/09/2015	0.0	0.1	20.8	989	1	-1.9			
PENBH51	09/10/2015	0.1	0.6	20.2	1018	0	0.5			
PENBH51	13/10/2015	0.0	0.1	21.5	1022	0	-1.9			
PENBH51	09/11/2015	0.0	0.3	19.5	1022	0	-1.0			
PENBH51	09/12/2015	0.1	0.6	20.2	1018	0	0.5			
PENBH51	12/01/2016	0.0	0.6	21.0	992	0	0.5			
PENBH51	09/02/2016	0.5	0.1	22.5	977	0	-1.9			
PENBH51	16/03/2016	0.3	0.5	19.1	1025	0	0.0			
PENBH51	09/05/2016	0.0	0.4	19.2	1005	0	-0.5			
PENBH51	07/06/2016					0				
PENBH51	04/07/2016	0.0	0.5	20.6	1010	0	0.0			
PENBH51	05/08/2016	0.0	0.0	21.5	1027	0	-2.4			
PENBH51	05/09/2016	0.0	0.7	20.0	1010	0	1.0			
PENBH51	05/10/2016	0.0	0.6	20.3	1023	0	0.5			
PENBH51	07/11/2016	0.0	0.4	21.1	1011	0	-0.5			
PENBH51	06/12/2016	0.1	0.8	21.3	1017	0	1.4			
PENBH51	20/01/2017	0.1	0.5	17.5	1027	1	0.0			
PENBH51	15/02/2017	0.1	0.5	17.8	1018	0	0.0			
PENBH51	10/03/2017	0.1	0.4	18.1	1017	0	-0.5			
PENBH51	12/04/2017	0.1	0.6	16.1	1014	0	0.5			
PENBH51	09/05/2017	0.0	1.0	19.5	1019	0	2.4			
PENBH51	14/06/2017	0.0	0.5	19.1	1019	0	0.0			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH51	05/07/2017	0.0	0.6	19.7	1014	0	0.5			
PENBH51	09/08/2017	0.0	0.7	19.6	1016	0	1.0			
PENBH51	06/09/2017	0.0	0.7	20.2	1013	0	1.0			
PENBH51	09/10/2017	0.0	0.4	21.1	1021	0	-0.5			
PENBH51	13/11/2017	0.0	0.7	20.3	1018	0	1.0			
PENBH51	21/12/2017	0.1	0.2	20.8	1029	0	-1.4			
PENBH51	12/01/2018	0.2	0.4	18.2	1016	0	-0.5			
PENBH51	19/02/2018						-2.4			
PENBH51	13/03/2018	0.0	0.4	21.1	1003		-0.5			
PENBH51	05/04/2018	0.0	0.5	15.0	1010	0	0.0			
PENBH51	10/05/2018	0	0.7	16.2	1010		1.0			
PENBH51	27/06/2018						-2.4			
PENBH51	28/08/2018	0	0.8	17.6	1010	0	1.4			
PENBH51	03/12/2018						-2.4			
PENBH51	14/02/2019						-2.4			
PENBH51	15/04/2019	0	0.5	14.3	1010	0	0.0			
PENBH51	02/08/2019	0	0.7	16.8	1015	0	1.0			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH52	24/11/2014							Data set Max value:	2.9	
PENBH52	08/12/2014	0.0	0.6	20.5	1017	0	0.15	Data set Min value:	0.0	
PENBH52	14/01/2015	0.0	0.2	21.8	996	0	-0.4	Mean:	0.5	
PENBH52	11/02/2015	0.1	0.4	21.2	1017	0	-0.1	SD:	0.67	
PENBH52	11/03/2015	0.0	0.3	21.6	1013	0	-0.3	No. Readings:	44	
PENBH52	16/04/2015	0.1	0.1	21.2	1012		-0.6	Critical Value:	3.24	
PENBH52	14/05/2015	0.0	1.1	21.0	1005	1	0.9	No. Outliner Values:	1	2.9
PENBH52	22/06/2015	0.0	0.2	20.9	1007	1	-0.4	Stat. Max(tmax)	2.6	
PENBH52	14/07/2015	0.0	0.3	20.6	1010	1	-0.3	Action Level	3.6	
PENBH52	11/08/2015	0.0	0.1	20.9	1016	1	-0.6	(tmax+FoS)		
PENBH52	15/09/2015	0.0	0.6	19.9	990	1	0.1			
PENBH52	09/10/2015	0.1	0.2	21.5	1018	1	-0.4			
PENBH52	13/10/2015	0.0	0.2	20.7	1022	1	-0.4			
PENBH52	09/11/2015	0.0	0.2	20.5	1022	1	-0.4			
PENBH52	09/12/2015	0.1	0.2	21.5	1018	1	-0.4			
PENBH52	12/01/2016	0.0	0.6	20.3	992	0	0.1			
PENBH52	09/02/2016	0.5	0.1	17.7	977		-0.6			
PENBH52	16/03/2016	0.3	0.4	21.1	1026	0	-0.1			
PENBH52	09/05/2016	0.0	0.1	21.0	1005	0	-0.6			
PENBH52	07/06/2016	0.0	0.2	21.5	1018	0	-0.4			
PENBH52	04/07/2016	0.0	0.1	21.5	1010	0	-0.6			
PENBH52	05/08/2016	0.0	0.0	21.5	1028	0	-0.7			
PENBH52	05/09/2016	0.0	0.4	20.7	1010	0	-0.1			
PENBH52	05/10/2016	0.0	0.1	21.3	1023	0	-0.6			
PENBH52	07/11/2016	0.0	0.2	21.7	1012	0	-0.4			
PENBH52	06/12/2016	0.1	2.6	20.6	1017	0	3.1			
PENBH52	20/01/2017	0.1	2.6	19.3	1027	0	3.1			
PENBH52	15/02/2017	0.1	0.3	21.3	1019	1	-0.3			
PENBH52	10/03/2017	0.1	0.4	21.1	1017	1	-0.1			
PENBH52	12/04/2017	0.1	0.2	21.4	1014	0	-0.4			
PENBH52	09/05/2017	0.0	0.9	19.3	1019	1	0.6			
PENBH52	14/06/2017	0.0	0.1	21.0	1019	1	-0.6			
PENBH52	05/07/2017	0.0	0.1	21.2	1014	0	-0.6			
PENBH52	09/08/2017	0.0	0.2	21.2	1017	0	-0.4			
PENBH52	06/09/2017	0.0	0.3	21.3	1013	0	-0.3			
PENBH52	09/10/2017	0.0	0.3	21.4	1021	0	-0.3			
PENBH52	13/11/2017	0.0	0.2	22.1	1019	0	-0.4			
PENBH52	21/12/2017	0.1	0.6	20.0	1030	0	0.1			
PENBH52	12/01/2018	0.2	0.3	21.2	1016	0	-0.3			
PENBH52	19/02/2018						-0.7			
PENBH52	13/03/2018	0.0	1.7	20.5	1003		1.8			
PENBH52	05/04/2018	0.0	0.4	21.3	1011	0	-0.1			
PENBH52	10/05/2018	0	0.2	21.5	1010		-0.4			
PENBH52	27/06/2018						-0.7			
PENBH52	28/08/2018	0	0.5	20.6	1011	0	0.0			
PENBH52	03/12/2018						-0.7			
PENBH52	14/02/2019						-0.7			
PENBH52	15/04/2019	0	0.2	21.3	1011	0	-0.4			
PENBH52	02/08/2019	0	2.9	18.6	1015	0	3.6			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH53	24/11/2014	0.0	0.1	21.6	1019	1	-0.42	Data set Max value:	5.3	
PENBH53	08/12/2014	0.1	0.1	21.3	1011	0	-0.4	Data set Min value:	0.1	
PENBH53	14/01/2015	0.0	0.1	17.2	994	0	-0.4	Mean:	0.5	
PENBH53	11/02/2015	0.1	0.1	16.9	1015	0	-0.4	SD:	0.96	
PENBH53	11/03/2015	0.0	0.1	18.6	1011	0	-0.4	No. Readings:	47	
PENBH53	16/04/2015	0.2	0.1	18.5	1008		-0.4	Critical Value:	3.24	
PENBH53	14/05/2015	0.1	0.1	18.9	1005	1	-0.4	No. Outliner Values:	2	5.3, 4.6
PENBH53	22/06/2015	0.0	0.1	18.6	1004	1	-0.4	Stat. Max(tmax)	2.3	
PENBH53	14/07/2015	0.0	0.1	19.1	1008	1	-0.4	Action Level	3.3	
PENBH53	11/08/2015	0.0	0.1	20.2	1012	1	-0.4	(tmax+FoS)		
PENBH53	15/09/2015	0.0	0.2	19.2	987	1	-0.3			
PENBH53	09/10/2015	0.1	0.8	2.5	1016	0	0.3			
PENBH53	13/10/2015	0.1	0.2	20.2	1019	0	-0.3			
PENBH53	09/11/2015	0.0	0.2	20.3	1018	0	-0.3			
PENBH53	09/12/2015	0.1	0.8	2.5	1016	0	0.3			
PENBH53	12/01/2016	0.0	0.1	22.3	990	0	-0.4			
PENBH53	09/02/2016	0.6	0.1	21.6	975	0	-0.4			
PENBH53	16/03/2016	0.4	0.1	17.4	1023	0	-0.4			
PENBH53	09/05/2016	0.0	0.1	20.7	1001	0	-0.4			
PENBH53	07/06/2016	0.0	0.1	19.2	1016	0	-0.4			
PENBH53	04/07/2016	0.0	1.2	14.6	1009	0	0.7			
PENBH53	05/08/2016	0.0	0.1	20.8	1023	0	-0.4			
PENBH53	05/09/2016	0.0	0.3	17.8	1007	0	-0.2			
PENBH53	05/10/2016	0.0	0.3	19.3	1020	0	-0.2			
PENBH53	07/11/2016	0.0	0.1	21.4	1009	0	-0.4			
PENBH53	06/12/2016	2.0	4.6	5.5	1017	0	4.3			
PENBH53	20/01/2017	0.2	5.3	17.2	1027	0	5.0			
PENBH53	15/02/2017	0.1	0.3	18.5	1016	0	-0.2			
PENBH53	10/03/2017	0.1	0.4	16.5	1015	0	-0.1			
PENBH53	12/04/2017	0.2	0.3	18.3	1011	0.2	-0.2			
PENBH53	09/05/2017	0.2	0.2	19.1	1017	0	-0.3			
PENBH53	14/06/2017	0.0	0.3	18.4	1017	0	-0.2			
PENBH53	05/07/2017	0.1	0.3	18.7	1011	0	-0.2			
PENBH53	09/08/2017	0.0	0.3	20.8	1013	0	-0.2			
PENBH53	06/09/2017	0.0	0.4	19.2	1010	0	-0.1			
PENBH53	09/10/2017	0.0	0.4	19.0	1018	0	-0.1			
PENBH53	13/11/2017	0.0	0.4	18.7	1017	0	-0.1			
PENBH53	19/12/2017	0.1	0.6	6.4	1026	0	0.1			
PENBH53	12/01/2018	0.2	0.4	12.7	1015	0	-0.1			
PENBH53	19/02/2018	0.1	0.3	15.7	1012	0	-0.2			
PENBH53	13/03/2018	0.0	0.3	15.6	1001	0	-0.2			
PENBH53	05/04/2018	0.0	0.2	17.8	1008	0	-0.3			
PENBH53	10/05/2018	0	0.3	17.2	1007		-0.2			
PENBH53	27/06/2018	0	0.1	19.1	1018	0	-0.4			
PENBH53	28/08/2018	0	0.1	20.5	1007	0	-0.4			

ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH53	03/12/2018	0	0.6	14.1	991	0	0.1			
PENBH53	14/02/2019	0.2	0.4	14.1	1020	0	-0.1			
PENBH53	15/04/2019	0	0.5	19	1008	0	0.0			
PENBH53	02/08/2019						-0.5			
ID	DATE	CH4 (%)	CO2 (%)	O2 (%)	BAROMETRIC PRESSURE (mb)	CO (ppm)	(No.-Mean)/SD			
PENBH54	24/11/2014	0.0	0.2	21.6	1019	0	-0.81	Data set Max value:	6.3	
PENBH54	08/12/2014	0.0	0.8	21.0	1011	0	-0.3	Data set Min value:	0.1	
PENBH54	14/01/2015	0.0	1.0	19.2	993	0	-0.2	Mean:	1.2	
PENBH54	11/02/2015	0.1	0.6	19.7	1015	0	-0.5	SD:	1.23	
PENBH54	11/03/2015	0.0	0.5	19.9	1012	0	-0.6	No. Readings:	48	
PENBH54	16/04/2015	0.2	0.5	20.0	1008		-0.6	Critical Value:	3.24	
PENBH54	14/05/2015	0.1	0.5	19.5	1005	1	-0.6	No. Outliner Values:	1	6.3
PENBH54	22/06/2015	0.0	0.6	19.2	1003	1	-0.5	Stat. Max(tmax)	3.4	
PENBH54	14/07/2015	0.0	0.2	20.5	1008	1	-0.8	Action Level	4.4	
PENBH54	11/08/2015	0.0	0.2	18.9	1012	1	-0.8	(tmax+FoS)		
PENBH54	15/09/2015	0.0	3.0	17.6	987	0	1.5			
PENBH54	09/10/2015	0.1	0.7	18.7	1016	0	-0.4			
PENBH54	13/10/2015	0.1	0.1	21.2	1019	0	-0.9			
PENBH54	09/11/2015	0.0	0.1	21.2	1018	0	-0.9			
PENBH54	09/12/2015	0.1	0.7	18.7	1016	0	-0.4			
PENBH54	12/01/2016	0.0	0.3	21.0	989	0	-0.7			
PENBH54	09/02/2016	0.6	0.7	20.0	975	0	-0.4			
PENBH54	16/03/2016	0.4	0.2	21.3	1024	0	-0.8			
PENBH54	09/05/2016	0.1	0.5	19.2	1000	0	-0.6			
PENBH54	07/06/2016	0.1	0.4	19.5	1017	0	-0.7			
PENBH54	04/07/2016	0.0	1.8	19.8	1009	0	0.5			
PENBH54	05/08/2016	0.0	0.1	20.7	1023	0	-0.9			
PENBH54	05/09/2016	0.0	3.3	17.9	1007	0	1.7			
PENBH54	05/10/2016	0.0	2.5	17.7	1020	0	1.1			
PENBH54	07/11/2016	0.1	1.3	19.9	1009	0	0.1			
PENBH54	06/12/2016	0.1	0.4	20.7	1017	0	-0.7			
PENBH54	20/01/2017	0.1	0.4	17.4	1027	0	-0.7			
PENBH54	15/02/2017	0.1	3.3	18.3	1016	0	1.7			
PENBH54	10/03/2017	0.1	6.3	15.2	1015	0	4.1			
PENBH54	12/04/2017	0.2	3.1	18.2	1011	0.3	1.5			
PENBH54	09/05/2017	0.2	3.4	18.0	1017	0	1.8			
PENBH54	14/06/2017	0.1	2.1	19.4	1017	0	0.7			
PENBH54	05/07/2017	0.1	1.5	19.8	1011	0	0.2			
PENBH54	09/08/2017	0.0	0.1	21.1	1013	0	-0.9			
PENBH54	06/09/2017	0.0	2.9	19.2	1010	0	1.4			
PENBH54	09/10/2017	0.1	2.1	19.3	1018	0	0.7			
PENBH54	13/11/2017	0.0	1.4	19.7	1017	0	0.2			
PENBH54	19/12/2017	0.1	1.3	18.9	1026	0	0.1			
PENBH54	12/01/2018	0.2	0.7	19.5	1015	0	-0.4			
PENBH54	19/02/2018	0.2	0.9	19.0	1012	0	-0.2			
PENBH54	13/03/2018	0.0	0.8	19.8	1001	0	-0.3			
PENBH54	05/04/2018	0.1	0.4	20.2	1009	0	-0.7			
PENBH54	10/05/2018	0	0.9	19.3	1007		-0.2			
PENBH54	27/06/2018	0	0.1	20.1	1018	0	-0.9			
PENBH54	28/08/2018	0	0.2	19.4	1007	0	-0.8			
PENBH54	03/12/2018	0	0.8	15.5	991	0	-0.3			
PENBH54	14/02/2019	0.2	1.1	16.3	1020	0	-0.1			
PENBH54	15/04/2019	0	0.4	13.6	1008	0	-0.7			
PENBH54	02/08/2019	0	0.1	20.7	1013	0	-0.9			

APPENDIX 4. POINT SOURCE EMISSIONS RISK ASSESSMENT

APPENDIX 4 Point Source Emissions to Air Risk Assessment

This emissions risk assessment has been carried out to for the two small engines which replaced the previous gas treatment plant (a 1065kWh) on site in 2018. The assessment was carried out in accordance with Horizontal Guidance Note EPR H1.

Gas engines

	Electrical Output, kWhe	Stack Height, m	Gas Flow Rate, Nm3/hr	Min distance to site boundary, m
Scania SGI13	189	3.5	833	70
Scania SGQ12	159	3.5	640	70

Risk Assessment Assumptions

Process Contributions are calculated based on technical specifications of Scania SGI12 and SGI13 gas engines which are designed to comply with the emissions limits set out in LFTGN08 for emissions from gas engines. The relevant emission limits for Nitrogen Dioxide and Carbon Monoxide (NO_x 500mg/Nm^3, CO 1400mg/Nm^3) were applied as a conservative assumption for assessment of Process Contributions from the two landfill gas engines.

This risk assessment is based on the two engines operating simultaneously and continuously (24/7). This is a worst-case assessment scenario and is expected to account for a small percentage of time. Based on 2019 engine performance information, Scania SGI13 was operating for 95% of time (taking accounts maintenance shutdowns), while Scania SGI12 was switched on /added when required and was running for an estimated 7% of time.

The release parameters which are relevant to this emissions risk assessment, are summarised below.

Scania SGI13	Long-term effects		Short-term effects	
	Concentration mg/Nm3	Release Rate*, g/s	Concentration mg/Nm3	Release Rate, g/s
Nitrogen Dioxide	500	0.116	500	0.116
Carbon Monoxide	1400	0.322	1400	0.322

Scania SGI12	Long-term effects		Short-term effects	
	Concentration mg/Nm3	Release Rate*, g/s	Concentration mg/Nm3	Release Rate, g/s
Nitrogen Dioxide	500	0.089	500	0.089
Carbon Monoxide	1400	0.249	1400	0.249

* Release Rate (RR) is calculated by taking the substance's actual Gas Flow Rate (m3/s) and multiplying this number by the substance's Concentration (mg/m3) divided by 1000.

Air emissions risk assessment guidance provides screening methods for emissions to air from landfill sites (engines, flares and capped areas). The staged assessment approach allows to calculate environmental concentrations of emitted substances from each release point (known as a Process Contribution PC).

Emissions from the gas engine and flare stack are considered separately because they are not expected to operate simultaneously.

Stage 1 emissions assessment

Process Contribution (PC) to air is calculated as follows:

PC = DF x RR, where

Dispersion Factors (DF) were applied for landfill gas engines based on effective release height of 2.5m and minimum distance to the site boundary (70m). The hourly DF is 175µg/m3 per g/s, and the annual DF is 15.5µg/m3 per g/s. These DFs will be used for calculating short-term PCs and long-term PC, respectively. (DFs are listed in the Air emissions risk assessment method).

	max PC (Long-term)		Max PC (Short-term)*	
	Scania SGI13	**Scania SGI12**	**Scania SGI13**	**Scania SGI12**
Nitrogen Dioxide	1.78	1.40	10.15	7.87
Carbon Monoxide	4.99	3.86	56.35	43.58

*For assessment against the short-term standard we assume that only 50% of the nitrogen oxides are oxidised to NO2.

The cumulative PCs of nitrogen dioxide emissions from both engines are:

PC_{NO2} (long-term) =3.18µg/m3

PC_{NO2} (short-term) =18.02µg/m3

The cumulative PCs of carbon monoxide emissions from both engines are:

PC_{CO} (long-term) =8.85µg/m3

PC_{CO} (short-term) =99.93µg/m3.

The initial criteria for screening out insignificant emissions to air, which do not warrant further assessment, are:

- PC (long-term) ≤ 1% of the long-term EAL, and
- PC (short-term) ≤ 10% of the short-term EAL, where

Environmental Assessment Level (long–term) for nitrogen dioxide (NO2) = 40 µg/m3

Environmental Assessment Level (short–term) for nitrogen dioxide (NO2) = 200 µg/m3

Short-term EAL for carbon monoxide (CO) is 10,000µg/m3 (8-hour running average across a 24-hour period). There is no long-term EAL for CO.

	LT EAL, µg/m3	ST EAL, µg/m3	Long-term effects			Short-term effects		
			PC, µg/m3	%PC pf EAL	>1% of EAL	PC, µg/m3	%PC pf EAL	>10% of EAL
NO2	40	200	3.18	7.95	**Yes**	18.02	9.01	No
CO	-	10,000	8.85	-	-	99.93	1	No

For NO2, the maximum PC (short-term) < 10% of the short-term EAL, the maximum PC (long-term) > 1% of the long-term EAL, so the air emission from the gas engine may be significant.

For CO, the maximum predicted PC (short-term) < 10% of the short-term EAL so the air emission from the gas engine can be screened out as insignificant. These results show that carbon

monoxide emissions are low and can be screened out from further assessment. Emissions of nitrogen dioxide should be further assessed using Stage 2 emissions assessment method.

Stage 2 emissions assessment

In the second stage of air emissions risk assessment calculates environmental concentration (PEC) with PEC for each substance is a sum of the PC and the background concentration of the substance. For assessment of short-term air quality effects, twice the background annual mean is used to calculate PEC (short-term).

The Stage 2 assessment criteria is that emissions should meet both of the following requirements:

- PEC (short-term) < 20% of the short-term EAL, and
- PEC (long-term) < 70% of the long-term EAL.

		Long-term effects				Short-term effects			
	Air Bkgrnd Conc*, µg/m3	PC, µg/m3	PEC, µg/m3	%PEC of EAL	%PEC of EAL ≥70%	PC, µg/m3	PEC, µg/m3	%PEC of EAL	%PEC of EAL ≥20%
NO2	4.82	3.18	8.00	20	No	18.02	27.66	13.8	no

*DEFRA Air Quality Background maps (2019) for NO2 at 253500 374500 https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

The above assessment results demonstrate emissions of nitrogen dioxide from the two gas engines while operating concurrently and continuously, are low and insignificant in terms of short-term and long-term environmental risks. These levels of risks will not require any further assessment.

APPENDIX 5. LANDFILL GAS MONITORING AND ACTION PROCEDURES

Monitor Gas Field Wells and Boreholes	Doc Code: OP-WI-001
	Issue: 7
	Date: February 2018
	Page 1 of 6

1.0 Objectives and Scope

Regular monitoring and balancing of the Site Gas Field Wells and Boreholes is required to provide gas control, a stable fuel supply and maximisation of generation when a generator is utilised. Site licences may dictate a minimum time requirement for Monitoring. Unless otherwise authorised, weekly Monitoring and Balancing should take place using the csv file format with copies forwarded to Monitor Pro and Head Office Compliance Department. Following if required, Compliance will then forward onto appropriate parties. Any gas or condensate leaks should be repaired immediately. Monthly H_2S surveys are recommended where specific H_2S Risk assessments are in place for levels above 75ppm on a Manifold or at the Compound. This is to monitor any specific risk and to update the site Risk Assessment Plan. For surveys, the H_2S filter must be removed.

NOTE: Ensure a serviceable H_2S filter is fitted for the full suite of gas readings including balancing; failure to do this will compromise the accuracy of CO and at times CH_4 reads. For Perimeter Boreholes, the H_2S filter must be removed as routine or it may corrupt lower CH_4 reads

2.0 Supporting Documentation and Key Environmental, Health and Safety Information

Ref docs	Work Instruction OP – WI – 002 Work Instruction OP – WI – 002A Work Instruction OP – WI – 002B Work Instruction OP – WI – 003 Work Instruction OP – WI – 011 Work Instruction OP – WI – 015 Work Instruction OP – WI – 016 Work Instruction OP – WI – 017 Work Instruction OP – WI – 019 Work Instruction OP – WI – 032 Work Instruction OP – WI – 044
Health & Safety	**Before any work is carried out you must read and comply**

Impacts	**with the safety information sheet at the front of this manual.**
Environmental Impacts	Please refer to work instruction IMS-WI-01.
PPE Required	Please refer to the task-specific risk assessment for PPE requirements.
Tools and consumables required	Gas Meter PTFE Tape Repair Tape Note Pad Spare Sample Valve Suitable spanners

3.0 Work Instruction detail

3.1 Review the site Risk Assessment. As control measures dictate, ensure the correct PPE is worn to minimise Hazards. A mobile

phone must be taken when working on a gas field in case of emergencies.

3.2 The Gas Balancing Protocol is used as back ground detail on Monitoring and Balancing.

3.3 Ensure the gas meter calibration is checked. As required a Field Calibration check should be carried out to check ambient reads; namely 20.9% O_2, 0% CO_2 and 0%CH_4. As required restore factory settings or Span Gas monthly or as required from a suspect read.

3.4 Check the meter battery life, o rings, hoses, x2 water traps and the H_2S filter (gas well and system monitoring only) are all serviceable prior to use. *Work Instruction 016 refers.*

3.5 Ensure all surface laid collector pipes are drained of any condensate before any reads are taken. *Work Instruction 019 refers.*

3.6 If using GAM's, download the site sample point identifications from the csv file and pre arrange the file for the route normally to be followed.

3.7 Wearing appropriate PPE, inspect equipment including the Compressor, Blower and Compound Sump for correct operation. Work instructions 11, 32, 44 refers.

3.8 To start Monitoring of Gas Wells, select sample point ID and take the compound mix gas readings on the appropriate sample points for both vacuum and pressure. Allow a minimum of 30 seconds or as long as required to record a stable representative sample of gas monitored. Answer and record site questions to include your name, generated kW, flow, KOP reads, flare operation and weather conditions.

3.9 To start Monitoring for Boreholes, remove H_2S filter.

3.10 If leaving the compound unattended, secure the premises.

3.11 Inspect the Gas Collection System (GCS) and remediate any basic faults (leaks, dips in lines, well head seals, sample valves etc). Record all gas field works on Monitor Pro. Report any major works not completed noting all in the site diary and on any site Exception Forms as appropriate.

3.12 On route record all air pump counter readings as under the unique KOP ID to ascertain if the pump has stalled.

3.13 Follow the normal route for the site.

3.14 **Manifold Monitoring:**

a. At the next monitoring point e.g. first manifold on the gas route, always take a manifold mix reading before and after any balancing actions.

b. Briefly open the sample valve to clear any moisture from rain fall so it cannot be sucked into the gas meter.

c. Select Manifold ID.
d. Connect the Gas Meter and record relative pressure noting any cross suction or pressure build up for any fault reporting.
e. Allow a minimum of 30 seconds or as long as required to record a stable representative sample of gas monitored.
f. Record the valve position at Closed – C, Partly Open – P or Fully Open – F. Answer any other site CSV questions.

3.15 **Collector Line Monitoring – Open Well:**

a. Briefly open the sample valve to clear any moisture from rain fall so it cannot be sucked into the gas meter.
b. Select collector ID. Connect the Gas Meter and review relative pressure noting any cross suction or pressure build up for any fault reporting.
c. On the GA5000 meter store relative pressure read. On the GA2000 meter it will automatically record the relative pressure read at the point of selecting 'pump'.
d. Allow a minimum of 30 seconds or as long as required to record a stable representative sample of gas monitored.
e. Record the collector valve position at Partly Open – P or Fully Open – F.
f. Record any fault conditions on that collector.
g. Answer any other CSV well questions.

3.16 **Collector Line Monitoring – Closed Well**

a. Briefly open the sample valve to clear any moisture from rain fall so it cannot be sucked into the gas meter.
b. Select collector ID. Connect the Gas Meter and review relative pressure noting any cross suction or pressure build up for any fault reporting.
c. On the GA5000 meter store relative pressure. On the GA2000 meter it will automatically record the relative pressure read at the point of selecting 'pump'.
d. Open the closed well only sufficient enough to obtain a flow from the well head. Depending on the collector length, when you believe stale gas has been cleared, peak and stabilise and a representative sample is now available, select store or return to record the gas quality.
e. Record the valve position at Closed – C.
f. Record any fault conditions on that collector. Specifically if you believe that the closed well is subject to cross suction.
g. Answer any other csv well questions.

h. Review the Summarised Result from at least the previous two gas balances and following trend analysis determine if any adjustment is to be made.
i. Close the well off again if no adjustment is to be made or make any adjustment and record on the gas meter as a second read.
j. Answer any other CSV well questions again.

3.17 Move on to the next sampling point in the route. Repeat procedure 3.15 or 3.16 above as required.

3.18 Following adjustments on individual collectors take the mix after read on the manifold. Record the mix quality, vacuum and answer csv manifold questions.

3.19 Ideally the quality on the manifold should have improved and the vacuum reduced (at the same engine load). If the mix is not improved, review adjustments made and consider reverting back to pre-adjustment settings.

SCOPE: Minimal adjustments to individual wells and maximum wells open within site parameters.

NOTE: Consideration must be given for any site odour or migration. Aerobic activity must be controlled (Any well that has a CO_2 read within 2% of the CH_4 ,aerobic activity is in progress meaning that well must have a reduced suction applied. If level or above with the CH_4 read, the well must be turned off. Reducing air ingress will minimise the risk of a potential site 'Hot Spot' occurring. This must be avoided at all costs as any underground fires within the waste are not only environmentally disagreeable but are difficult to extinguish and can be very costly.
Any well that has an O_2 value of 2% to 5% should be investigated at the time and remediated if possible. Any well of 5% or over must not be opened, even if CH_4 value is well above CO_2 value. If applicable, report exceptions on local report, note in the site diary and inform your Supervisor.
CO levels must be closely monitored. Any with increased trends or above 100ppm should be sampled again using a clean H_2S filter. If the read remains elevated, another meter should be used to sample. If still high a bag sample should be taken for laboratory analysis. Request a test for both CO and H_2 (elevated levels of H_2 will affect the CO read on the gas meter).

3.20 Complete the above for all manifolds or individual collector lines connected to the gas collection system.

3.21 On return to the compound, record the post compound gas quality, vacuum, pressure and flow and answer any csv compound questions.

3.22 Adjust the engine/s Tecjet/Heinzman position as required.

3.23 Down Load the csv file.

3.24 Edit the csv for any mistakes or duplicate reads.

3.25 The csv file is then uploaded to Monitor Pro and a copy sent to Head Office Compliance for record.

LOAD ADJUSTMENT/GAS FLOW:

Often following Monitoring and Balancing, the gas mix can change prompting change to the site load/flow. To maintain gas control, consideration needs to be given to balancing compound load/flow to gas being produced. The following actions should be taken:

a. Site vacuum up, decrease load to match previous site vacuum or known site parameter to not over draw gas field.
b. Site vacuum decreases, wait 24hrs for balance to take affect and re-monitor before increasing load/flow in small increments at a time. Wait for that adjustment to take effect on site vacuum and flow before making any further adjustment.

4.0 Records & Retention

4.1 Retain copies of the gas field balance for site records.

4.2 Record the completion of the gas balance in the site diary and KOP reads. Check KOP reads have moved on as expected.

4.3 Ensure the CSV file is uploaded to Monitor Pro and forwarded to Head Office. They will then distribute to named addresses.

1.0 Objectives and Scope

A 'Hot Spot' or Under Ground Fire can occur in the Waste Mass. Extreme care must always be taken to control site suction and aerobic activity. If a path is open that allows air ingress into the site, the risks of this occurrence increase. Extinguishing fires and cooling hot spots can be extremely difficult. Preventative measures and early detection are the best options to control the risk. Early detection can be achieved through either routine monitoring of carbon monoxide (CO) within the landfill gas collection system or visual signs to include smoke, melted GCS and odour of burning at well heads. Temperature monitoring can be under taken as part of further investigations. The presence of hydrogen gas and hydrogen sulphide gas can cause interference to readings when using the gas meter. The Site Gas Management Plan will confirm details of the frequency and assessment levels for CO monitoring, together with actions required should the assessment level be exceeded.

2.0 Supporting documentation and Key Environmental, Health and safety information

Ref docs	Work Instruction OP – WI - 016
Health & Safety Impacts	**Before any work is carried out you must read and comply with the safety information sheet at the front of this manual.**
Environmental Impacts	Please refer to work instruction IMS-WI-01
PPE Required	Please refer to the task-specific risk assessment for PPE requirements
Tools and consumables required	

3.0 Work Instruction detail

In the event of elevated CO levels during a routine balance, the following procedure is to be carried out:

3.1 Ensure the gas meter has sufficient charge to complete the checks and the H2S filter is serviceable *(Work Instruction 016 refers)*.
3.2 Ensure that all the correct PPE is worn and that you take your mobile phone with you in case of emergency.
3.3 Monitor the CO level at the normal point of balancing, record the reading.
3.4 If the well head is exposed, check the well head reading for comparison.
3.5 If a reading of 100ppm or more is recorded, isolate the well or leachate tower using the control valve. Isolate all surrounding wells/towers also within a 40M grid.
3.6 Turn off the compressed air supply to any leachate pump (this could feed the Hot Spot Oxygen).
3.7 If appropriate, reduce load/vacuum on remaining wells.
3.8 Inform the site operator of the readings and actions taken.
3.9 Arrange for a bag sample to be taken for laboratory analysis to confirm the CO level.

In the event of visual/odorous signs of a Hot Spot being reported, the following procedure is to be carried out:

3.10 Confirm visual or odorous signs that could include:
a. Smoke or a heat haze rising from the waste mass, a leachate tower or gas extraction well.
b. Signs of burning or melted GCS.
3.11 Where possible, measure the temperature using a calibrated thermometer.
3.12 Check for presence of CO using the gas meter as above.
3.13 Follow steps 3.5 to 3.9 as above.

When the Hot Spot/Under Ground Fire has been extinguished and the site operator has confirmed that they now require the gas wells or leachate towers to be re-commissioned for gas extraction, the following procedure is to be followed:

1. Introduce vacuums at 5% of the average vacuum of affected wells for a period of 6 months prior to the Hot Spot.
2. Gas well monitoring to recommence.
3. Bag samples to be taken to confirm CO levels.
4. Temperatures to be monitored at 2M intervals.

4.0 Records & Retention

All events and findings are to be recorded in the site diary and the site operator updated on a weekly basis unless CO or temperature results exceed limits set.

APPENDIX 6. TRAFFIC MANAGEMENT PLAN

5494

ANGLESEY COUNTY COUNCIL

PENHESGYN LANDFILL SITE

TRAFFIC MANAGEMENT PLAN

JUNE 2015

Prepared by

Egniol Environmental Ltd.
Tre Felin
Bangor
Gwynedd
LL57 4LH

1.0 INTRODUCTION

2.0 LOCATION AND DESCRIPTION OF THE SITE

3.0 VEHICLE MOVEMENTS

4.0 RISK ASSESSMENT (HEALTH AND SAFETY, MATERIAL DAMAGE)

5.0 TRAFFIC MANAGEMENT PLAN

6.0 FURTHER RECOMMENDATIONS

APPENDICES

1. **Design Risk Assessment**
2. **Traffic Management Plan (Dwg)**

Document Review

Version No.	Date of Review	Prepared By	Reviewed By	Approved By
1.0	30/06/15	Ian Roberts	Richard Furniss	Ian Roberts

1.0 INTRODUCTION

1.1 Purpose of this Plan

- This Traffic Management Plan has been developed for the Penhesgyn Landfill site to address potential construction traffic impacts on the landfill area including the safety of operatives and potential damage to the existing gas and leachate infrastructure both above and below ground. In producing this plan, consideration has been given to the maintenance required to existing landfill infrastructure, the existing traffic routes and vehicles used.

1.2 Limitations

- The Traffic Management Plan is limited to the landfill area and does not include the site office car park, civic amenity centre and weighbridge areas.

- Information of underground pipe-work has been taken from previous 'as-built' surveys and indicative location drawings and cannot be relied upon for accuracy.

2.0 LOCATION AND DESCRIPTION OF THE SITE

2.1 Penhesgyn Landfill is located approximately 2km northwest of Menai Bridge. Access to the main site is off an unclassified road which connects the B5420 and the A5025.

2.1 Access to the landfill area is via the weighbridge and through a set of double agricultural type galvanised steel gates. The landfill area is generally flat with sloped side areas around the perimeter and a valley (low point) which dissects the site into two distinct areas. This valley forms one of the two access roads. The existing landfill site access roads are unmade and have gradients in parts. The existing roads become muddy in wet weather and are suitable only for four wheel drive vehicles with good ground clearance i.e. not suitable for cars/vans etc.

2.2 Gas and leachate infrastructure on site comprises a combination of above and underground high-density polyethylene (HDPE) pipework. Above ground infrastructure has been surveyed and, generally, are clearly visible to drivers. However, the accurate locations and depths of the underground pipework are unknown.

3.0 VEHICLE MOVEMENTS

3.1 The principal vehicle movements on the landfill area are:

- Site tractor to transport materials, fuels to water pumps (heavy)
- Excavator to maintain existing road (heavy)
- Contractor vehicles (inc. construction plant excavators, dumpers etc.) when required (infrastructure repairs, new gas wells etc.).
- Farmer's tractor (heavy)/quad bike (light)

4.0 RISK ASSESSMENT (HEALTH AND SAFETY, MATERIAL DAMAGE)

4.1 In producing this Traffic Management Plan and designated traffic routes, a risk assessment has been carried taking in account the health and safety aspects of vehicle movements on site.

4.2 Consideration has also been given to the risks of damage to the existing infrastructure arising from vehicles traversing the site and below ground infrastructure. A copy of the risk assessment is located in Appendix 1

5.0 TRAFFIC MANGEMENT PLAN

5.1 Traffic Routes

- Designated traffic routes for all vehicles have been highlighted on the Penhesgyn Landfill Site Traffic Management Plan (dwg) 5494.GA.D01in Appendix 2.

- All vehicles must follow the designated traffic route as detailed on the Traffic Management Plan (dwg) and should not deviate from the authorised routes.

- All other areas should be classified as 'No-Go' areas for vehicles unless authorised by the Site Manager following an assessment of the terrain (slopes, gradients, obstructions etc.) and the landfill infrastructure in the area.

- To access areas on the landfill site to carry out repairs, dewatering, re-drills etc. the Traffic Management Plan (dwg) should be reviewed and specific secondary traffic route(s) to the Works area(s) determined to avoid traversing underground landfill pipework.

- It is recommended that when secondary routes are required (i.e. off the designated traffic routes) they should be physically demarcated on site to ensure vehicles avoid traversing underground pipework to reach works area(s). Demarcation should be limited to above ground markers (e.g. traffic cones at change of direction points or similar). Under no circumstances should a post/spike be driven into the ground.

5.2 Training

- All staff driving on site should receive appropriate training in the requirements of this Traffic Management Plan and specific detail of any secondary traffic routes (as assessed and demarcated) which must be followed to access Works area(s).

- Contractors carrying out works on the landfill site should undergo a site induction which should include the requirements of the Traffic Management Plan and specific detail of any secondary traffic routes (as assessed and demarcated) which must be followed to access Works area(s).

6.0 FURTHER RECOMMENDATIONS

6.1 Road Maintenance

- The designated landfill site access roads should be regularly inspected and maintained as required. The access roads are 'unmade' and maintenance is limited to civilizing the surface with an excavator to remove ruts.

- Consideration should be given to weather conditions when maintaining roads – i.e. wet weather (mud) and dry summer months (dust).

6.2 Crossing Points

- There are 2nr points identified as crossing underground pipe-work (as highlighted on the Traffic Management Plan (dwg). There is a high risk of damage to below ground pipe-work and, where it exists, geo-synthetic capping material at these crossing points as heavy vehicles continue to traverse. It is recommended that a designed crossing point should be constructed to protect the underground infrastructure and geo-synthetic capping material.

- As a temporary protection, steel road plates or similar placed over the area should be considered until a permanent design solution is constructed.

- Underground pipe-work should be positively identified to ensure exact location and to inspect for damage prior to any Works at the crossing points.

6.3 Permit to Work

- A Permit for Work system should be considered for Works which require vehicle access to carry out infrastructure repairs, dewatering etc. following an assessment of the Works, the vehicles/plant involved and required access routes.

6.4 Third party users (farmer)

- Third party users (farmer) of the site should be informed of traffic management requirements including 'No-Go' areas with heavy vehicles (tractor).

End

APPENDIX 1

Project (inc Job Nº): (5494) PENHESGYN LANDFILL SITE TRAFFIC MANAGEMENT PLAN	**Dwg Ref: 5494.GA.D01**	**Date: 30/06/15**

Likelihood		Severity					
		L	M	H	Severity	Likelihood	Risk Rating
	L	**1**	**1**	**2**	H – Fatality, major injury causing long term disability/ Significant Material damage	H – Certain or near certain	3 – High risk - action required
	M	**1**	**2**	**3**	M – Injury or illness causing short term disability/ Material damage	M – Reasonably likely	2 – Medium risk – action required unless good reason
	H	**2**	**3**	**3**	L – Minor injury or illness/Material damage	L – Very seldom or never	1 – Low risk – no further action required

Note: A 'SIGNIFICANT' RESIDUAL RISK IS A RISK WHICH IS NOT LIKELY TO BE OBVIOUS TO A COMPETENT CONTRACTOR OR OTHER DESIGNERS; UNUSUAL; OR LIKELY TO BE DIFFICULT TO MANAGE EFFECTIVELY.

Activity, Design, Element, Material (Describe activity or element)	**Hazard** (Outline what has the potential to cause harm as a result of the activity or element)	**Initial Risk Rating** (Severity x Likelihood)See matrix above	**Action by designer to eliminate or reduce risk:** Is the initial risk rating>1. If yes consider as a priority need to avoid or reduce risks a) Can the risk be reasonably avoided by changing the design or specification? If yes, explain how and change it. b) Can the risk be reasonably reduced by changing the design or specification? If yes, explain how and change it. c) If the final risk rating is >1, explain why and what others need to do to minimize the risk.	**Residual Risk Rating** (See matrix. above)	**Is there a 'significant' residual risk? (Yes/No)** If 'yes', highlight on drawing (label or drwg notes)
Driving vehicles on rough terrain/ sloped areas	Tractor lateral instability/ vehicle overturning on steep slopes (perimeter) - leading to personal injury/vehicle damage	3 (HxM)	a) No - existing designed closed landfill profile b) No - existing designed closed landfill profile c) Traffic routes follow low contours/areas of landfill site away from perimeter slopes to prevent overturning and minimise traversing pipe-work. Ensure compliance with Traffic Management Plan Designated vehicle access roads/routes to access areas to be regularly serviced Regular access road maintenance	2 (HxL)	No
Driving vehicles over underground landfill pipework	Damage to underground landfill infrastructure	3 (HxH)	a) No - existing designed closed landfill infrastructure and cover materials b) No - existing designed closed landfill infrastructure and cover materials c) Ensure compliance with Traffic Management Plan Protect U/G pipe-work at identified crossing points	3 (HxM)	Yes

APPENDIX 2

NOTES

1. Boreholes and surface laid pipework survey information provided by Egniol Environmental Ltd.
2. Egniol Environmental Ltd. do not take responsibility for the accuracy of the buried pipework shown. Buried pipework locations have been supplied by Caulmert Ltd. (Drawing reference: 1907.GEX.01) these are included for information purposes and should be considered as indicative locations only.
3. Do not scale from this drawing.
4. Any anomalies on this drawing should be brought to the attention of Egniol Environmental Ltd.

Key

- Gas well□KOP and Leachate well Location
- Existing Valve
- KOP — Knock-Out Pot
- Buried gas pipework location (Indicative)
- Surface laid gas pipework location
- Fence Line
- Top of Batter
- Bottom of Batter
- Designated Traffic Route
- Crossing Point (Underground Pipework)

BH16 BH17 DW10 BH18 BH19 BHDW4 BH20 BHL4 BH15 NO REF(MANHOLE COVER) NO REF BH21 BHDW3 BH14 CAPPED BH29 BH107 BH28 BH22 BH13 BH66 NO REF BH62 BHDW5 BH23 BH12 BH104 BH67 BH65 BH29 BH63 BH61 NO REF NO REF BH27 BH11 BH30 BH64 CAPPED BH31 BH100 BHDW2 BHL5 BH75 BH10 BH69 BH15 BH68 BH36 BH101 CAPPED BH32 NO REF CAPPED BH83 BH82 BH26 BH70 BH16 BH52 BH9 BH76 BH121 BH35 BHL14 CAPPED BH33 DW6 NO REF BH85 BH53 BH84 BH37 BH102 BH71 BH34 BH25 BH106 NO REF BH120 NO REF BH8 BHL6 BH77 BH54 BH86 BH38 NO REF CAPPED BH87 BH72 BH122 NO REF CAPPED NO REF BH129 BH42 BH39 BH105 NO REF CAPPED BH78 BH123 BH7 BH90 BHL13 CAPPED BH89 BH55 BH41 BH73 BHL17 BHL12 BH125 BH6 BH74 BH57 BH92 BH127 BH93 BHDW7 BH91 BH40 BHL7 BH79 BHMHV L11 CAPPED BH124 BH96 BH58 BH5 BHDW(NO REF) BH128 BH43 BH97 BH98 BHMH3B BH94 NO REF BH44 BHL11 CAPPED WATER PUMP CONNECT BH60 BH45 BH59 BH95 BH126 BHL10 CAPPED BHMH3A NO REF(KOP) BH50 BHL8 BH4 NO REF BH80 BH48 NO REF BH47 BH46 BHL9 BHDW8 BH3 HOUSE NO REF BH81 NO REF NO REF NO REF NO REF NO REF NO REF NO REF NO REF BH2 NO REF BH1 LINE 1 LINE 2 NO REF(KOP) OLD WEIGHBRIDGE

Turning Area (Not marked on site)

REV	MODIFICATIONS	BY	CH	AP	DATE

CYNGOR SIR YNYS MÔN ISLE OF ANGLESEY COUNTY COUNCIL

Penhesgyn Landfill Site

Landfill Site Traffic Management Plan

DRAWN BY	CHECKED BY	APPROVED BY
DMD	GOJR	IR
DATE	**SCALE @ A1**	**REVISION**
29.06.2015	1:1000	-

ISSUE: Final

DRAWING NUMBER: 5494.GA.D01

ENGINEERING ENVIRONMENTAL HEALTH & SAFETY egniol