Hendy Quarry Landfill: Permit Variation Application (EPR/BT1088ID)

For the addition of waste types and increase in the maximum water discharge volume

21 November 2018

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1 Introduction

1.1 Background

Tarmac Trading Ltd (Tarmac) instructed ESI Ltd (ESI) (now Stantec UK Ltd (Stantec)) to prepare and submit an Environmental Permit variation application to facilitate: the inclusion of additional inert waste types; and an increase in the maximum volume limit of the existing water discharge consent. The existing Permit (EPR/ BT1088ID/V006, issued 11 November 2015) allows the operation of an inert landfill accepting 450,000 tonnes per annum (tpa) of waste and a water discharge consent to soakaway 750 m^3/day at Hendy Quarry Landfill, School Road, Miskin, Pontyclun, Mid Glamorgan (the Site).

The Site (Figure 1.1) is currently permitted to accept a limited number of inert waste types; those acceptable without testing at an inert landfill. Following the testing of an existing stockpile of material within the recycling area on the Site, intended for deposit within the landfill, it was determined that it did not comply with inert waste acceptance criteria (WAC) due to elevated concentrations of some hydrocarbons. It was decided that this waste would be treated by the deployment of a mobile treatment plant by a third party, with the aim of producing material suitable for deposit in the inert landfill.

The purpose of this variation is to broaden the waste types which can be accepted to include those acceptable at inert landfill with testing, consistent with other inert landfills that Tarmac operates.

Following the preparation of a Run-off Assessment in 2014 (ESI, 2014), it was determined that the actual discharge to soakaway of rainfall run-off from the Site, was likely to regularly exceed the consented volume (750 m^3/day). Indeed, some measured volumes had already exceeded the permitted water discharge limit. As such, this variation application seeks to increase the maximum permitted volume, though the actual volume of water discharged from the Site will remain unchanged.

1.2 Variation

This Environmental Permit variation application was prepared by Stantec in September 2018, on behalf of Tarmac and serves to add the waste codes in Table 2.2 and increase the permitted discharge volume for the Site to 5,000 m^3/day to more accurately reflect existing conditions.

It was agreed with National Resource Wales (NRW) that the variation would constitute a *normal variation* application (NRW pre-application correspondence, Appendix A).

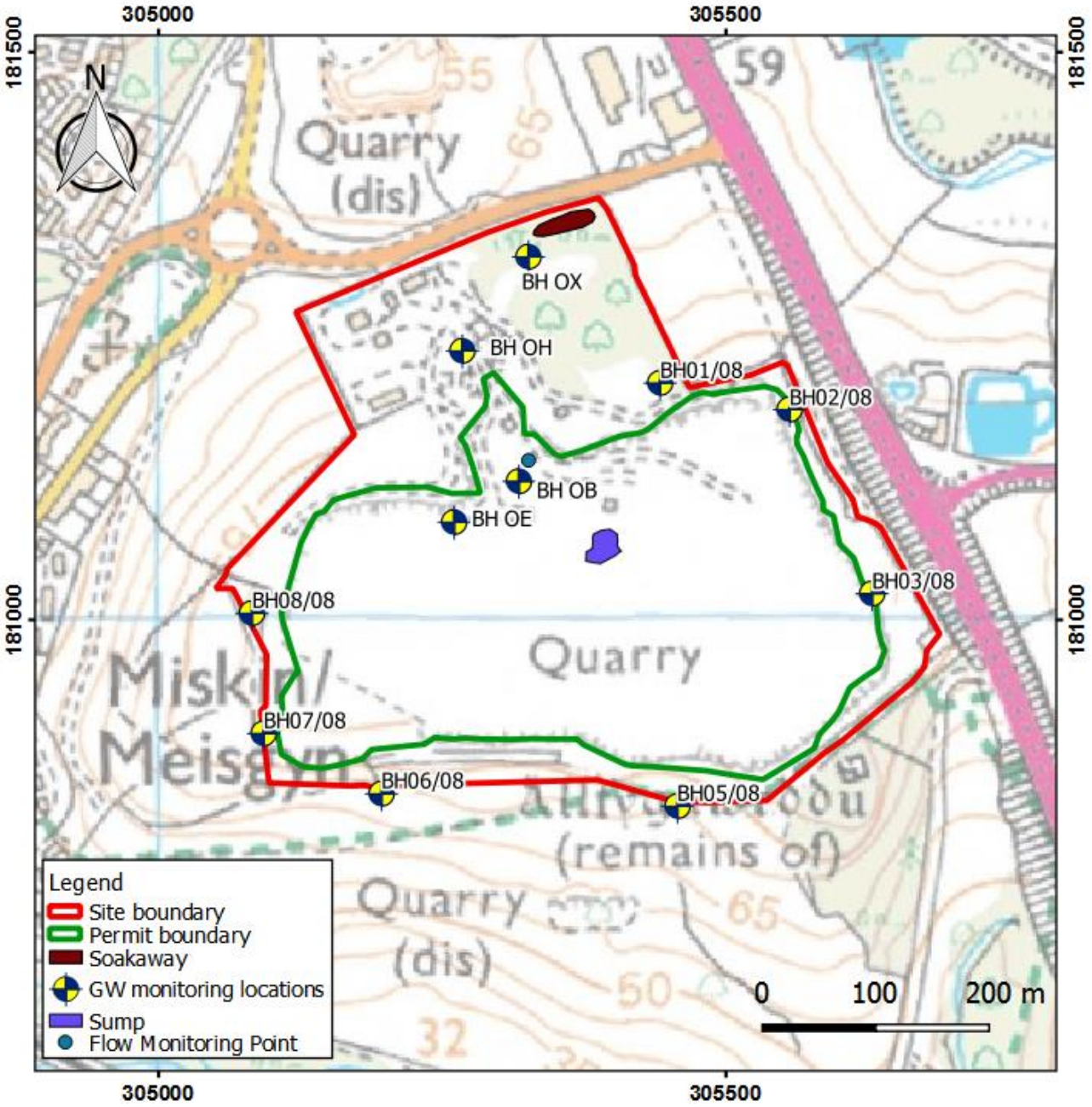
A revision to this report was prepared in November 2018 to include consideration of an Environmental Risk Assessment (ERA) in relation to the proposed additional waste types and the increase in water discharge volume, in accordance with appropriate guidance (Environment Agency, 2006, 2017 and 2018).

The application is accompanied by the appropriate application forms;

- Part A: About you;
- Part C2: General: Varying a bespoke permit;
- Part C4: Varying a bespoke waste operation permit;
- Part C6: Variation to a bespoke water discharge activity and groundwater (point source) activity;
- Part F1: Opra, charges and declarations; and
- Part F2: Charging for discharges charges and declarations.

The normal variation application fee has been determined from the Operational Risk Appraisal (Opra) for the Site, which is presented as Appendix B (electronic). The Opra submitted with the original application had an Opra score of 54. Following inclusion of some NRW requested amendments, the Opra score is now 55. Payment of the additional fee (£139) has been processed electronically.

Figure 1.1 Site plan and monitoring locations



1.3 Site Setting

The Site occupies approximately 13.5 ha of the wider Hendy Quarry site located in Miskin, Pontyclun centred approximately at National Grid Reference (NGR) ST 05425 80991. It is situated c.0.5 km to the east of Miskin and c.2 km south of Llantrisant, Mid Glamorgan.

This Site is surrounded by predominately agricultural land to the east, former quarries to the north and south (now agricultural land or woodland) and residential development associated with the towns of Miskin and Hendy to the west and north west. The A4119 bounds the quarry to the east and the M4 runs broadly east-west c.700 m to the south.

The Ely Valley Site of Special Scientific Interest (SSSI) runs broadly north west to south east c.260 m south of the Site, at its closest approach. There are also a number of issues and brooks to the east and south of the Site. These are discussed in more detail in the Surface Water Feature Survey technical note (ESI, 2018a).

1.4 Conceptual site model

The Conceptual Site Model (CSM) remains unchanged from those presented in the series of HRA's produced and submitted to NRW for approval (Caulmert, 2018; BCL,2009). Table 1.1 provides a summary of the CSM.

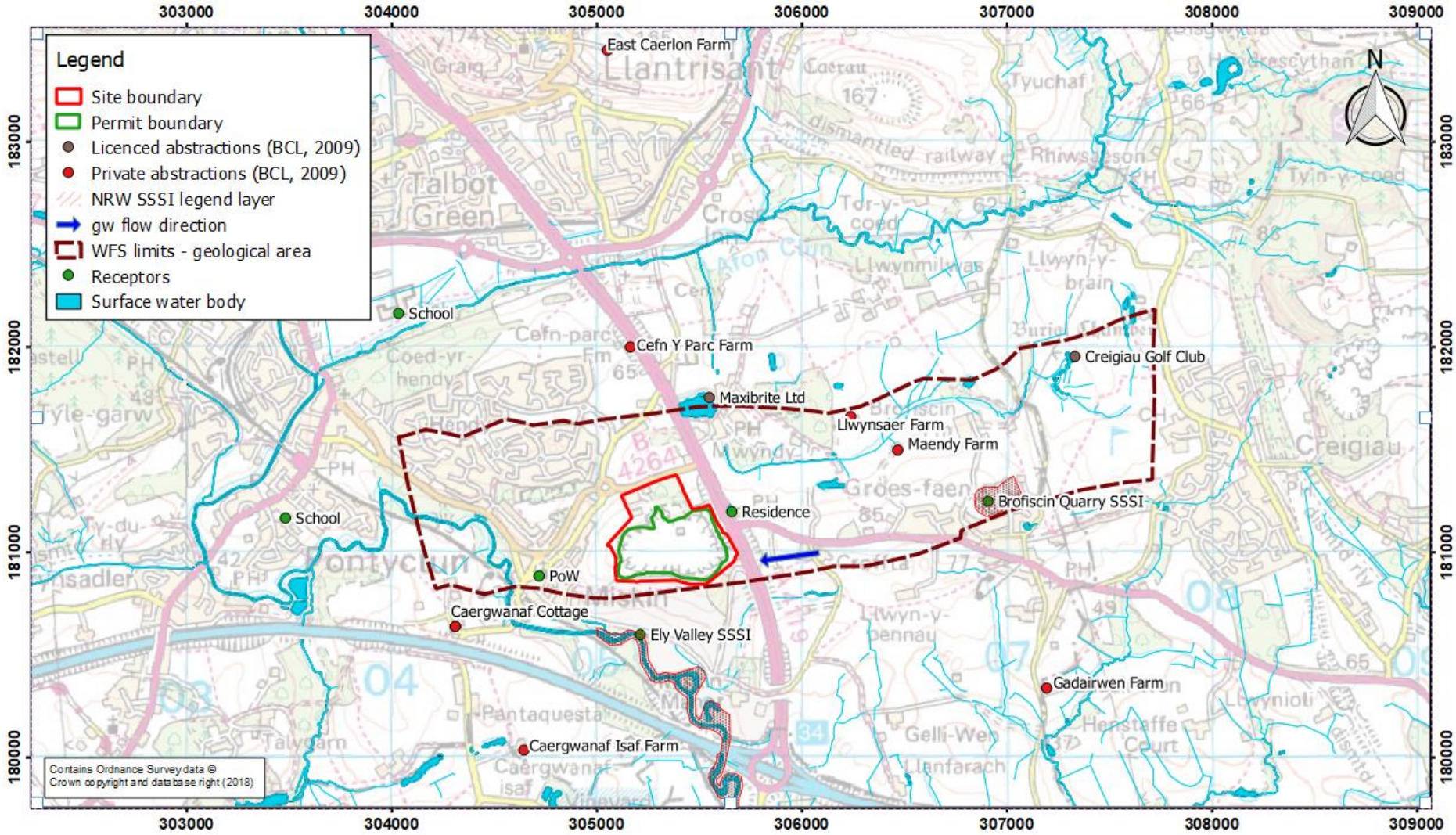
Table 1.1 Summary conceptual site model

Topography	The Site and local topography comprise an area of low hills with summit elevations ranging from 80-91 mAOD (metres Above Ordnance Datum). The quarry has been excavated at the summit of one of these hills. Ground elevation at the quarry boundary is c.80 mAOD. To the south and west of the Site, land slopes steeply to the valley of the River Ely to c.32 mAOD.
Geology	Superficial deposits, (now excavated within the quarry void) comprise glacial sands and gravels, boulder clay and recent alluvium (Diametcon) and cover much of the surrounding area. Bedrock deposits comprise; • Upper Old Red Sandstone Group; • Overlying Lower Carboniferous Limestone Series; • The Lower Limestone Shale Group; • The Black Limestone Group (into which the quarry is excavated); and • The Hunts Bay Oolite Group.
Hydrology	The Site lies within the catchment of the River Ely. At its closest approach, the river flows towards the south east, passing some 300 m to the south west of the Site. Tributaries of the River Ely drain the area of hills within which the quarry is situated. 'Croffta Stream' arises c. 550 m east of the quarry boundary (in the vicinity of Croffta Farm) and flows westwards under the A4119 before veering south towards the River Ely some 250 m southeast of the Site at its closest approach. Its confluence with the River Ely is at Miskin Manor, 750 m south of the Site. 'Brofiscin Quarry/Farm Stream' arises in the vicinity of Creigiau Golf Course and joins a stream coming from Brofiscin Quarry, the confluence being 1.5 km to the east of the Site. It flows westwards towards the quarry (coming within 200 m of the north east boundary of the Site) then heads northwards to its confluence with Afon Clun, some 1.1 km north of the Site. The Afon Clun flows from east to west and, 1.7 km north west of the Site, discharges into the River Ely. The Site is not in an area at risk of fluvial flooding.
Hydrogeology	The Black Rock Limestone Group, into which the quarry is excavated, is part of the Carboniferous Limestone Series, a Principal Aquifer. Based on groundwater level data, groundwater flow is determined to be broadly from east to west in the Carboniferous Limestone. The Avon Group (Lower Limestone Shale) is classified as Secondary A. It is noted that this strata was previously classified as a non-aquifer. Although the change in classification reflects a greater understanding of the potential for this strata to transmit groundwater, site investigation and monitoring data collected over the development of the site confirm that the original CSM remains valid where there is no groundwater migration towards the south. This is confirmed by

	the presence of two boreholes along the southern boundary (installed within the Avon Group) which have significantly higher groundwater levels in comparison to those installed within the permeable fractured limestone. Therefore, notwithstanding the permeability contrast between the limestone and Avon group, the hydraulic gradient is such that there is no possible groundwater flow towards the south. The water levels within the Avon Group boreholes are considered to represent water in the superficial deposits and weathered zone. Therefore, it is considered that these strata effectively form a barrier to flow in a southern direction at the site. The orientation and dip of this strata is considered to constrain the groundwater flow to the south and therefore the principal groundwater flow is along the strike of the beds towards the west.
Abstractions	Environment Agency data indicate that the only licensed groundwater abstraction within 3 km radius of the Site is the on-Site abstraction (Licence Number 21/57/31/0010) borehole at NGR 30532 18111, taking groundwater from the Carboniferous Limestone. The permitted rate of abstraction is 56,825 m^3/yr for mineral washing. Two licenced surface water abstractions are present within 3 km radius of the Site (see Figure 1.2). Maxibrite Limited (Licence Number 21/57/31/0043) is authorised to abstract from Mwyndy Pool (NGR 30555 18175), some 300 m to the NNE of the Site. Mwyndy Pool exhibits a surface water level of some 55 mAOD (based upon topographic detail shown on the OS map). It is considered that the Pool lies hydraulically up-gradient from the Site, given that groundwater levels in the Permit Area declines from 50/51 mAOD (eastern boundary) down to 44 mAOD (western limit). Creigiau Golf Club Limited (Licence Number 21/57/31/0034) is authorised to abstract from a spring-fed pond at NGR 30733 18195 (67.5 mAOD), which is some 1.85 km to the ENE (hydraulically up-gradient) of Hendy Quarry. The permitted rate of abstraction is 7,000 m^3/yr (spray irrigation) and 8,052 m^3/yr (topping up a series of conservation ponds). A total of eight private water abstractions are recorded within the vicinity of the Site, see Figure 1.2. It is unknown if they are from surface or groundwater, so have conservatively been assumed to be groundwater. The abstractions are listed against farm locations, so it is assumed that they are for irrigation purposes.
Designated habitat and protected species	The closest water-related Site of Special Scientific Interest (SSSI) is a stretch of the Ely Valley, some 2 km south/downstream from the Site, between NGR 3061 1789 and NGR 3097 1767. The SSSI, which occupies some 87 ha, is the best location in Wales for *Aconitum anglicum*. This rare plant has a population alongside several miles of the River Ely. Brofiscin Quarry SSSI at Groes Faen (NGR 3070 1813) is located some 1.3 km to the east of the Site. This site shows an important section through the Lower Carboniferous Limestone Black Rock Group, including the Brofiscin Oolite. The SSSI comprising Llantrisant/Cymdda Common and Pastures (113.2 ha) lies immediately to the north of the hill-top town of Llantrisant, approximately 2.6 km north of Hendy Quarry. It is of special interest for its extensive area of predominantly acidic marshy grassland in a lowland setting and for smaller areas of species-rich neutral and acidic grassland and soligenous flush. The site lies over Coal Measures and drains via ditches towards tributaries of the River Ely. Nant Myddlyn (a woodland alongside a tributary of the Afon Clun) is centred upon NGR 3073 1835, this being 2.75 km to the northeast of the Site. The local nature reserve at Coed Llwyn Rhyddid comprises wet woodland,

	supporting the third largest heronry in Wales. It is centred upon NGR 3041 1778, some 3.25 km to the SSW of the quarry. There are no other protected sites within 4 km radius of Hendy Quarry. The search not only included SSSI and National Nature Reserves (NNRs) but also sites of international importance (e.g. Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar Sites) and Landscape Protected Areas (e.g. Areas of Outstanding Natural Beauty (AONBs) and National Parks).

Figure 1.2 Receptors plan



2 Proposed variation

2.1 Additional Waste Types

The Site is currently permitted to accept the waste types as listed in Schedule 3 of the permit (EPR/BT1088ID/V003), which are reproduced in Table 2.1. These wastes are consistent with wastes acceptable without waste acceptance testing (EC, 2003).

Table 2.1 Permitted waste types

EWC code	Description	Restrictions
10	**Thermal Processes**	
10 11	Manufacture of glass and glass products	
10 11 03	Waste glass based fibrous materials	Only without organic binders
15	Packaging, absorbents, wiping cloths and filters	
15 01	Packaging (including separately collected municipal packaging waste)	
15 01 07	Glass packaging	
17	**Construction and demolition waste**	
17 01	Concrete, bricks tiles and ceramics	
17 01 01	Concrete	Selected C&D waste only
17 01 02	Bricks	Selected C&D waste only
17 01 03	Tiles and ceramics	Selected C&D waste only
17 01 07	Mixtures of concrete, bricks, tiles and ceramics	Selected C&D waste only
17 02	Wood, glass and plastic	
17 02 02	Glass	
17 05	Soil (including excavated soil from contaminated sites) stones and dredging spoil	
17 05 04	Soil and stones	Excluding topsoil, peat; excluding soil and stones from contaminated sites
19	**Materials from waste and water treatment**	
19 12	Mechanical treatment of waste (for example sorting, crushing, pelletising) not otherwise specified	
19 12 05	Glass	
20	**Municipal waste and similar materials from commerce industry**	
20 01	Separately collected fractions	
20 01 02	Glass	Separately collected glass only
20 02	Garden and park wastes (including cemetery waste)	
20 02 02	Soil and stones	Only from garden and parks waste; Excluding topsoil, peat

It is proposed that the waste types are increased to include the wastes in Table 2.2 which will comply with inert Waste Acceptance Criteria (WAC) as defined in EC, 2003.

Table 2.2 Proposed additional waste types

EWC code	Description	Restrictions
01	**Mining, quarrying, mineral treatment**	
01 01	Mineral excavation	
01 01 02	Wastes from mineral non-metalliferous excavation	
01 04	Physical and chemical processing of non-metalliferous minerals	
01 04 08	Waste gravel and crushed rock other than those mentioned in 01 04 07	
01 04 09	Waste sand and clays	
10	**Thermal processes**	
10 12	Manufacture of ceramic goods, brick, tiles and construction products	
10 12 08	Waste ceramics, bricks, tiles and construction products (after thermal processing)	
17	**Construction and demolition waste**	
17 05	Soil (including excavated soil from contaminated sites) stones and dredging spoil	
17 05 08	Track ballast (other than those mentioned in 17 05 05	
17 09	Other construction and demolition wastes	
17 09 04	Mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	
19	**Materials from waste and water treatment**	
19 12	Mechanical treatment of waste (for example sorting, crushing, pelletising) not otherwise specified	
19 12 09	Minerals (except for sand, stones)	
19 12 12	other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11	
19 13	Soil and groundwater remediation	
19 13 02	solid wastes from soil remediation other than those mentioned in 19 13 01	

Wastes having any of the following characteristics shall not be accepted:

- Consisting solely or mainly of dusts, powders or loose fibres
- Wastes that are in a form which is either sludge or liquid.

2.2 Waste Acceptance

Waste acceptance at the Site will be strictly controlled in accordance with Tarmac's existing Waste Acceptance Procedure (WAP), which is presented as Appendix C and includes provision for acceptance, checking and rejection.

Basic characterisation and compliance testing will be carried out by the waste producer and will be checked in accordance with the WAP.

Verification testing will be carried out on each load of waste arriving at the weighbridge by visual and olfactory assessment, to confirm it accords with the Basic Characterisation and Compliance testing provided by the waste producer.

For wastes requiring testing which are imported to the Site, verification testing will also include Waste Acceptance Criteria testing to verify that the waste is inert as defined in EC (2003). The verification testing will be in accordance with BS EN 12457-2:2002, or BS EN 12457-4:2002 leaching test (L:S 10 l/kg) which will be compared to the WAC results provided by the waste producer, to ensure it is consistent.

The rate of this leachate verification testing for imported waste will vary based on the waste type and source but will be at least 1 test per 100 loads (or 1 test per 4,000 tonnes) and 1 test per source. If a waste source is considered to be heterogeneous, this frequency may be increased.

For waste which is already on Site, and which will be extensively characterised, verification testing is not proposed.

2.3 Water Discharge Volume Increase

The Site is currently consented to discharge 750 m^3/day of water to soakaway under the existing permit (EPR/BT1088ID).

Following some exceedances of this limit, a technical assessment (ESI, 2014) was commissioned, which found that the rainfall contribution was greater than that originally calculated. ESI (2014) determined that in order to cope with the potential rainfall run-off at the Site, a water discharge volume rate of 2,500 m^3/day was more appropriate.

A Drainage Assessment (ESI, 2018b), was prepared to assess the relative rainfall / groundwater contribution to the water discharged from Site. The assessment concludes that the discharge is predominately rainwater. A copy of this assessment is included as Appendix G. This assessment also considered the maximum water discharge rates based on measured discharge (flow rate) data between 2014 and 2018. As such, it was considered that a water discharge limit of **5,000 m^3/day** was deemed to be more appropriate. This is based on monitored water discharge flow data (2014-2018) and simulated maximum rainfall run-off calculations, which were calculated to be 5,281 m^3/day, see Section 3 of ESI (2014).

2.3.1 Data limitations

The water discharge flow rate is measured on a continual basis by a flow monitor. The flow rate data collection is manual and as such, may not be at regular (e.g. 24 hr) intervals. It is possible that inconsistencies in data collection, may cause some 'spike' results in the flow rate measurements. However, it is acknowledged that the discharge rate is rainfall dependant and therefore likely to produce 'spikes' following rainfall events.

The pump operates on a continuous (24 hour) basis, when required. The maximum pump rate is not known.

It is important to note that the request to increase the water discharge limit is simply an administrative correction for actual discharge of incident rainfall at the Site, which has been ongoing since 1998. The rate of water discharge is limited by the pumping rate to the soakaway, discharge point. The pump has operated at maximum pumping capacity over 24 hr periods during rainfall events without problem.

To answer the questions in application form Part C6, Q4, ESI (2014) was used to answer each question in Table 2.3.

Table 2.3 Discharge calculations

Application reference Part C6	Question	Answer	Justification
Q4a	Daily dry weather flow (m^3/day)	100	Discharge is predominately for the removal of rainfall ingress to the quarry void. Estimate is based on measured flow rates during dry weather conditions (2014 – 2018).
Q4b	Maximum discharge (m^3/day)	5000	Based on measured discharge flow rates 2014-2018 (Figure 2.2 of ESI, 2018b)
Q4c	Maximum discharge (l/s)	58	As above
Q4d	Maximum non-rainfall dependant discharge (m^3/day)	100	Section 3 of ESI 2018b discusses dry weather flow rates of <100m^3 day
Q4e	Maximum rate of rainfall dependant discharge (l/s)	58	As for Q4c, based on the majority of discharge comprising of rainfall

2.3.2 Soakaway design

The soakaway has not been formally designed. However, during its operation, it has demonstrated that it can adequately convey the water discharge flow rates related to the incident rainfall at the Site, without adverse (e.g. flooding) impacts.

As the water discharge is clean, rainfall runoff only, no treatment is required. The water discharge quality must meet the limits specified in the Permit (Table S4.1).

2.3.3 Discharges to groundwater – risk assessment

Application form Part C6 Q10 requires that water discharges to groundwater are accompanied by a quantitative risk assessment in accordance with "'H1 Risk Assessment Horizontal Guidance Note H1 – Groundwater sections". It is acknowledged that this guidance is now withdrawn and is replaced with the guidance at Environment Agency (2018).

Environment Agency (2018) provides that a qualitative assessment is appropriate where;

- *"the discharge has acceptably low concentrations of hazardous substances, or in concentrations that are the same as the natural background levels in the groundwater (whichever is the higher concentration);*
- *the discharge has concentrations of non-hazardous pollutants that are within the relevant environmental standards, or in concentrations that are the same as the natural background levels in the groundwater;*
- *there's a very low risk to groundwater-fed receptors due to the presence of unproductive drift or unproductive bedrock strata (and there are no aquifers present or near your activity) and remoteness from surface waters; or*
- *the volume or hydraulic loading rate of the discharge is so small such that only minimal dilution in underlying groundwater will be needed to avoid pollution by non-hazardous pollutants."*

It is considered by ESI (2018b), that the discharge comprises predominately rainwater collected from the quarry sump with a minor contribution from groundwater, which is returned to the aquifer within close proximity from where it is removed. Quality limits imposed on the water discharge by the Permit (Table S4.1) will still serve to monitor the quality of the discharge.

In addition, there is no change proposed to those activities over and above those already occurring at the Site. No adverse impacts have been recorded.

As such, it is considered that, given the nature of the discharge, a qualitative risk assessment is appropriate. The risk assessment is detailed in Section 3.5.

3 Operating techniques

In accordance with the respective form guidance (NRW, 2016 and 2017) this section sets out the operating techniques and how the Site will be managed in order to ensure there is no risk to the environment.

3.1 Technical Competence Management

In accordance with Part C2, Question 3b1, the Tarmac will continue to provide Technically Competent Management (TCM) at the Site. TCM will continue to be provided by Andrew Bevan who is certified under the WAMITAB scheme. Copies of Andrew's up-to-date certificates are included in Appendix D.

3.2 Financial Provision

Due to the nature of the changes, the existing financial provision remains appropriate and there is no change.

3.3 Environmental Management System

The Site will continue to be managed in accordance with Tarmac's Environmental Management System (EMS) which is accredited to ISO 14001. A summary of the EMS together with the current ISO 14001 certification, is provided in Appendix E.

3.4 Hydrogeological Risk Assessment

A review of the Site's Hydrogeological Risk Assessment (HRA) was produced in 2017 by Caulmert (2018) and was submitted to NRW. A copy of the HRA is included as Appendix F for completeness.

The HRA concluded;

> *"The review has indicated that there has been no significant change in the conceptual model over the review period. The waste material permitted at the site remains inert waste as defined by the LFD and appropriate waste acceptance procedures are employed at the site.*
>
> *Therefore, under the LFD there is no requirement to collect leachate from the site, install an artificial sealing layer nor provide a low permeability cap to the site.*
>
> *Future areas for disposal will meet the requirements for a geological barrier with a minimum of 1 m at 1 x 10^{-7}m/s or equivalent placed in all new areas in accordance with the a CQA plan.*
>
> *This report has demonstrated that the site remains in a high sensitivity setting with respect to the groundwater environment and that the assessment of accidents and consequences has indicated that there would be no discernible impact on the receptor.*
>
> *Requisite surveillance has been detailed to monitor the performance of the site and enable its compliance with the Environmental Permitting Regulations. The current groundwater monitoring regime is considered to be adequate based on the site's environmental setting.*
>
> *Recommendations include the instatement or refurbishment of PZ07/08 to comply with the minimum requirement of 2 down gradient monitoring boreholes."*

Caulmert (2018) considered the acceptance of inert waste only and allowed provision for the acceptance of a rouge load at a conservative rate of 1 in 100 loads.

The waste types to be accepted at the Site will remain inert and the provision of 1 in 100 rogue loads is considered conservative enough to apply to inert waste which requires testing. As such, the conclusions of Caulmert (2018) remain appropriate for this variation.

3.5 Environmental Risk Assessment

An Environmental Risk Assessment (ERA) (Crestwood, 2000) was submitted with the original Permit application in accordance with H1 guidance, which assessed the risk associated with the currently permitted waste types (Table 2.1) and the risk associated with the consented water discharge at 750 m^3/day.

The risks associated with the water discharge has been assessed in line with the relevant guidance (Environment Agency, 2018).

As the risks associated with the water discharge has been previously assessed, it is considered that this assessment considers the potential risks associated with;

- discharging 5,000 m^3/day (of predominately rainfall) compared to the permitted 750 m^3/day; and
- the additional proposed inert waste types.

The process of risk assessment is an evaluation of the probability of harm, and comprises the identification of sources of contamination, receptors that may be affected by the contamination and pathways by which the receptors may be harmed. This is consistent with the approach advocated by Environment Agency (2017 and 2018).

Table 3.1, Table 3.2 and Table 3.3 are derived from CIRIA C552 (2001) and have been used to define the risk rating presented in the Preliminary Risk Assessment (Table 3.4). It is appreciated that the risk assessment approach advocated by CIRA 552 is focused on risks associated with contaminated land, however this industry best practice approach is considered applicable for the purpose of this assessment of risks to groundwater receptors and also aligns with requirements of EA Remedial Targets Methodology (Environment Agency, 2006) and Environment Agency (2018).

Table 3.1: Classification of consequence

Classification	Definition
Severe	Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Statutory Guidance for Part IIA of the Environment Protection Act 1990. Short term risk of pollution (note; Water Resources Act contains no scope for considering significant pollution) of sensitive water resource. Catastrophic damage to building/property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem.
Medium	Chronic damage to human health ('significant harm', as defined by the Statutory Guidance for Part IIA of the Environment Protection Act 1990). Pollution of sensitive water resources (note; Water Resources Act contains no scope for considering significant pollution). A significant change in a particular ecosystem, or an organism forming part of such an ecosystem.
Mild	Contamination present although unlikely to constitute a significant chronic health risk. Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.

Classification	Definition
Minor	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc.). Potential minor release of contamination to local water features. Easily reparable effects of damage to buildings, structures and services (harm which may result in a financial loss or expenditure to resolve). Short term, localised damage may occur to eco-systems; consequences are spatially and temporally limited.

Table 3.2: Classification of probability

Classification	Definition
High likelihood	There is a contaminant linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a contaminant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a contaminant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period that such an event would take place, and is even less likely in the shorter term.
Unlikely	There is a contaminant linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Table 3.3: Matrix of consequence against probability to gain a risk classification

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

Table 3.4 considers the CSM and remaining uncertainties and in this context assesses likely risks to identified receptors in relation to the proposed increased water discharge.

Table 3.4: Contaminant linkage assessment

Source / hazard	Pathway	Receptor	Consequence	Probability	Risk	Risk management / comment
Acceptance of additional inert waste types (which require testing)	Leaching through unsaturated zone	Groundwater in the High Tor Limestone Formation (Principal A aquifer)	Medium	Low likelihood	Moderate/ Low risk	Tarmac employs strict waste acceptance controls at the Site (Appendix C). In addition, the proposed frequency of testing (Section 2.2) provides confidence that non-inert waste will not be accepted to the Site, removing the source.
Acceptance of additional inert waste types (which require testing)	Leaching through unsaturated zone and subsequent groundwater pathways	Groundwater including nearest abstraction point (Maxibrite Ltd 300 m NNE)	Medium	Low likelihood	Moderate/ Low risk	As above plus: All known groundwater abstractions are located upgradient of the Site. Downgradient abstractions (>3 km) mean that any effluent will be subject to significant dilution.
Acceptance of additional inert waste types (which require testing)	Leaching through unsaturated zone, subsequent groundwater and surface water pathways	Ely Valley SSSI, 230 m south of Site	Medium	Low likelihood	Moderate/ Low risk	Groundwater flow is determined to be from east to west through the Site, within the Carboniferous Limestone meaning that there may be a pathway between the Site and the River Ely. There is a contaminant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period that such an event would take place and is even less likely in the shorter term. In addition to above; The is c 530 m of groundwater pathway followed by 500 m of surface water pathway along the River Ely until it meets the SSSI designation, downstream. Risk of adverse impact from the Site on the Ely Valley SSSI is considered unlikely due to significant attenuation and dilution potential. It is considered that no pathway exists between the Carboniferous Limestone and the Avon Group (Mudstone) as groundwater levels indicate distinct aquifers.

Source / hazard	Pathway	Receptor	Consequence	Probability	Risk	Risk management / comment
Increase of discharge volume from 750 m^3/day to 5,000 m^3/day to existing soakaway	Leaching through unsaturated zone	Groundwater in the Carboniferous Limestone (Principal A aquifer)	Medium	Unlikely	Low risk	The risk rating reflects the possible presence of a potential contaminant linkage, though it is not certain if this pathway exists. The discharge has been demonstrated to be predominately rainfall, with a small volume of groundwater. The discharge is to groundwater via soakaway, which is likely to be dominated by fracture flow. Site operating procedures (Appendix H) for the Site ensure that fuel and oil are stored securely and appropriately at the Site. Refuelling procedures ensure that spills from re-fuelling do not occur or are addressed in a timely manner such that fuel cannot enter the water management system. As such fuel and oil are unlikely to pose a risk to groundwater or subsequent receptors from the Site. As mentioned previously, strict waste acceptance procedures will ensure negligible risk of incident rainfall coming into contact with non-inert waste and resulting leachate potential. As such it is considered that the water discharge poses very low risk
Increase of discharge volume from 750 m^3/day to 5,000 m^3/day to existing soakaway	Risk of localised flooding	School Road and users of School Road.	Severe	Unlikely	Moderate/ Low risk	A risk of flooding exists as the increase from 750 m^3/day to 5,000 m^3/day is large. However, it should be acknowledged that the 5,000 m^3/day reflects actual volumes which have been discharged at the Site since it began operating. There are no existing issues relating to flooding at the Site. There are no increased risks of contaminant transport or loading with the increased discharge volumes. In fact, a lowered risk may be attributed in the form of dilution of groundwater.
Accidents i.e. fire, vandalism	Airbourne, unmitigated release to environment	Nearby residential receptors (closest 100 m	Medium	Unlikely	Low risk	There is no more risk of accidents, noise and vibration emissions from the proposed increase in discharge volume and acceptance of additional inert waste types.

Source / hazard	Pathway	Receptor	Consequence	Probability	Risk	Risk management / comment
Noise and vibration	Airbourne	west on A4119)	Medium	Unlikely	Low risk	
Fugitive (dust, litter, pests)	Windblown, airbourne, overland		Medium	Unlikely	Low risk	There is the potential to accept waste with additional potential for litter, or material which may attract pests, however given the strict waste acceptance criteria, this risk is considered to be negligible.

3.5.1 Waste types

The perceived risk from the acceptance of additional waste types, i.e. the increased potential to accept a rogue load has undergone prior assessment (Caulmert, 2018) and has been determined to be acceptable. In addition, strict WAP (Appendix C) and verification testing (Section 2.2) will be employed, which will serve to mitigate any potential risk. It is considered that these measures will ensure the Site will not cause harm to the environment.

3.5.2 Discharge volume increase

The dewatering of Hendy Quarry void comprises predominately rainfall run-off from the quarry catchment area (ESI, 2018b). The increase serves to represent water discharge rates already occurring at the Site and does not represent an increased risk to the environment.

It is acknowledged that the quarry sump, from where rainwater collects and is pumped from, is in continuity with the groundwater. As such, there may be an element of groundwater within the discharge, though it is almost entirely rainwater. A small volume of groundwater may be abstracted during dry weather conditions for use in the wheelwash.

3.6 Stability Risk Assessment

The physical properties of the waste to be accepted to the Site (mixture of granular and cohesive waste), upon which the original Stability Risk Assessment (SRA) was based, will remain unchanged (Crestwood, 2004). As such, it is considered that no update is required to the existing SRA.

3.7 Landfill Gas Risk Assessment

The waste types to be accepted to the Site will remain inert, with inherently low organic content. It is considered that the principles contained within the Landfill Gas Risk Assessment section of the Working Plan (Crestwood, 2004), remain appropriate for the Site.

3.8 Monitoring

Monitoring is currently undertaken at the Site in accordance with Schedule 4 of the Permit (EPR/BT1088ID/V004) for the point source discharge, groundwater (level and quality) and landfill gas. It is proposed that Table S4.1 of Permit EPR/BT1088ID/V004 is updated to reflect the values in Table 3.5.

Table 3.5 Proposed amendments to Table S4.1 of the Permit - point source emissions to water

Emission point	Parameter	Limit including unit	Monitoring frequency	Reference period	Source
Discharge to soakaway at NGR 0538 8136	Volume	5,000 m^3/day	Daily	Spot sample	Discharge from the quarry
	Rate of discharge	58 l/s	Weekly		
	Suspended solids	100 mg/l	Quarterly		
	Mineral oil	5 mg/l	Quarterly		
	pH	6-9	Quarterly		

There are no other proposed changes to the existing Site monitoring.

It was requested by NRW (Appendix A) that monitoring infrastructure allowed representative samples to be taken from the outset. It is acknowledged that at present, samples cannot be

obtained from downgradient locations PZ07-08 and PZ08-08. Monitoring data collected from these wells suggest that they have collapsed internally, such that water samples cannot be obtained.

It is proposed that both boreholes are replaced in approximately the same locations. The existing installations will be appropriately decommissioned. A Construction Quality Assurance (CQA) Plan will be produced for both the installation and decommissioning of the boreholes for review by NRW.

3.9 Closure and Aftercare

There are no proposed changes to the closure and aftercare plans for the Site.

4 REFERENCES

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Caulmert, 2018. Hendy Landfill Site Hydrogeological Risk Assessment Review 2017, Doc ref: 3145-CAU-XX-XX-RP-O-0301.S0.C1, 12 January 2018.

CIRIA, 2001. Contaminated land risk assessment. A guide to good practice. C552. CIRIA London. ISBN 0-86017-552 9.

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Crestwood, 2004. Working plan, version 4, 2004.

EC, 2003. Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC, Official Journal of the European Communities, 16 January 2003.

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ESI, 2014. Hendy Quarry - Assessment of run-off, 62847TN1, ESI Ltd, December 2014

ESI, 2018a. Hendy Quarry Water Features Survey, ESI report reference 62847TN2, August 2018.

ESI, 2018b. Hendy Quarry Drainage Assessment, ESI report reference 62847TN3, August 2018.

NRW, 2016. National Resource Wales, form guidance (Part a, c2, c6, f1 and f2), National Resource Wales, 01 July 2016

NRW, 2017. National Resource Wales, form guidance (Part c4, c6, f1 and f2), National Resource Wales, 02 August 2017

NRW, 2018. Email from National Resources Wales (Tyrone Ward) to Tarmac (Lisa Sumner), dated 03 July 2018.

APPENDICES

Appendix A

NRW pre-application correspondence

TARMAC
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Lisa Sumner <lisa.sumner@tarmac.com>

RE: Permit Variation Enquiry NRW:00682954

1 message

Ward, Tyrone <Tyrone.Ward@cyfoethnaturiolcymru.gov.uk> 10 April 2018 at 16:28
To: Lisa Sumner <lisa.sumner@tarmac.com>, Enquiries <enquiries@cyfoethnaturiolcymru.gov.uk>
Cc: "Harvey, Caitriona" <Caitriona.Harvey@cyfoethnaturiolcymru.gov.uk>, "Lewis, Gareth" <Gareth.E.Lewis@cyfoethnaturiolcymru.gov.uk>, "Doherty, Martin" <Martin.Doherty@cyfoethnaturiolcymru.gov.uk>, "Roberts, Kay" <Kay.Roberts@cyfoethnaturiolcymru.gov.uk>, "Taylor, Richard" <Richard.Taylor@cyfoethnaturiolcymru.gov.uk>

Afternoon Lisa,

We've received your enquiry and I confirm the proposal would constitute a normal variation.

http://naturalresources.wales/media/682401/environmental-permitting-charging-guidance-2017-18.pdf

https://naturalresources.wales/media/682402/environmental-permitting-charging-scheme-2017-18.pdf

Charges for 2018/19 are unchanged.

The 2 waste streams are…..

19 13 02 solid wastes from soil remediation other than those mentioned in 19 13 01

19 12 12 other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11

Experience has shown these particular wastes can be problematical; we therefore expect Tarmac would need to demonstrate rigorous sampling and testing procedures (WAP) We would also expect that monitoring infrastructure allows representative samples to be taken at the outset.

As NRW have some potential concerns I suggest we discuss further as part of our next site meeting and inspection.

Regards Ty

T W Ward
Swyddog Rheoleiddio/Regulatory Officer
Tîm Rheoli Diwydiant a Gwastraff – Rhymni ac Ebwy / Industry and Waste Regulation Team – Rhymney and Ebbw

Cyfoeth Naturiol Cymru / Natural Resources Wales

Ffôn/Tel: 03000 653151

Ffôn symudol /Mb: 07795 390168
E-bost/E-mail: tyrone.ward@cyfoethnaturiolcymru.gov.uk

Gwefan / Website: www.cyfoethnaturiolcymru.gov.uk / www.naturalresourceswales.gov.uk

---------- Original Message ----------
From: lisa.sumner@tarmac.com
Received: Mon Mar 26 2018 16:14:10 GMT+0100 (GMT Daylight Time)
To: Enquiries Queue; HZW-005344; HZW-006866
Subject: Permit Variation Enquiry

Hi Enquiries,

We are looking at the possibility of varying our inert landfill permit at Hendy permit reference BT1088ID, to add a couple of waste coded namely 19.13.02 and 19.12.12. The waste would WAC tested to confirm it compiled with the waste acceptance criteria for inert landfills prior to acceptance.

Would this constitute a minor technical variation?

Regards,

Lisa

Lisa Sumner
Permitting and Compliance - Technical Manager

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M +44 748 490 8719
lisa.sumner@tarmac.com

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Appendix B

Site-specific Opra spreadsheet (electronic appendix)

Opra Spreadsheet
for Waste Facilities

Version:	NRW v1	Release Date:	01-Apr-15

Permit No:	BT1088ID	Site Name:	Hendy Landfill
Date:	14/11/2018	Operator:	Tarmac Limited

Attribute	Bands	Points
Complexity(s):	C	35
Emissions:	C	15
Location:	C	3
Operator Performance:	A	2
	Total:	**55**

Fees and Charges	
Application Fee	£9,405
Normal Variation	£7,645
Full Surrender	£6,875
Part Surrender	£6,875
Subsistence	See Charge Tables

Compliance Rating	

Subsistence Multiplier **100%**

Reference Sheet

Complexity Attribute

Site Type: A05 **Complexity Band:** C

2nd Site Type: ... **2nd Band:**

Complexity Bands are based on a lookup table (see References tab)

More than one Complexity (Site Type) is required only in circumstances where the permit in question covers a landfill activity **and** a treating/keeping activity. In all other circumstances only one site type should be entered. Where more than one site type applies, the one carrying the highest relevant complexity band is used.

Emissions Attribute (Waste Input)

Waste Type	Annual Tonnage	Emission Threshold	Emission Index
Inert	450,000	1000	450
Non Hazardous (Non Bio)		750	
Non Hazardous (Bio)		500	
Hazardous		250	
		Total:	450

Band: C

Emission Bands are based on total index: <10=A, <100=B, <1000=C, <10000=D, >=10000=E

Location Attribute

Question	*Answer*	*Points*	*Question*	*Answer*	*Points*
Proximity to Human Occupation:	50m-250m	3	Direct run-offs:	Yes - No interceptors	2
Assessment under wildlife, countryside or habitats legislation:	CRoW	2	Air Quality Management Zone:	No	
Groundwater/Aquifers:	Yes - Outside GPZ	1	Flood Plain:	No	
Sensitivity of surface water:	Grade 5	1	**Total Points:**	9	**Band:** C

Location Bands are based on total points: 0-4=A, 5-8=B, 9-12=C, 13-18=D, >18=E

Complexity Band (Activity) Risk Level: **MEDIUM**

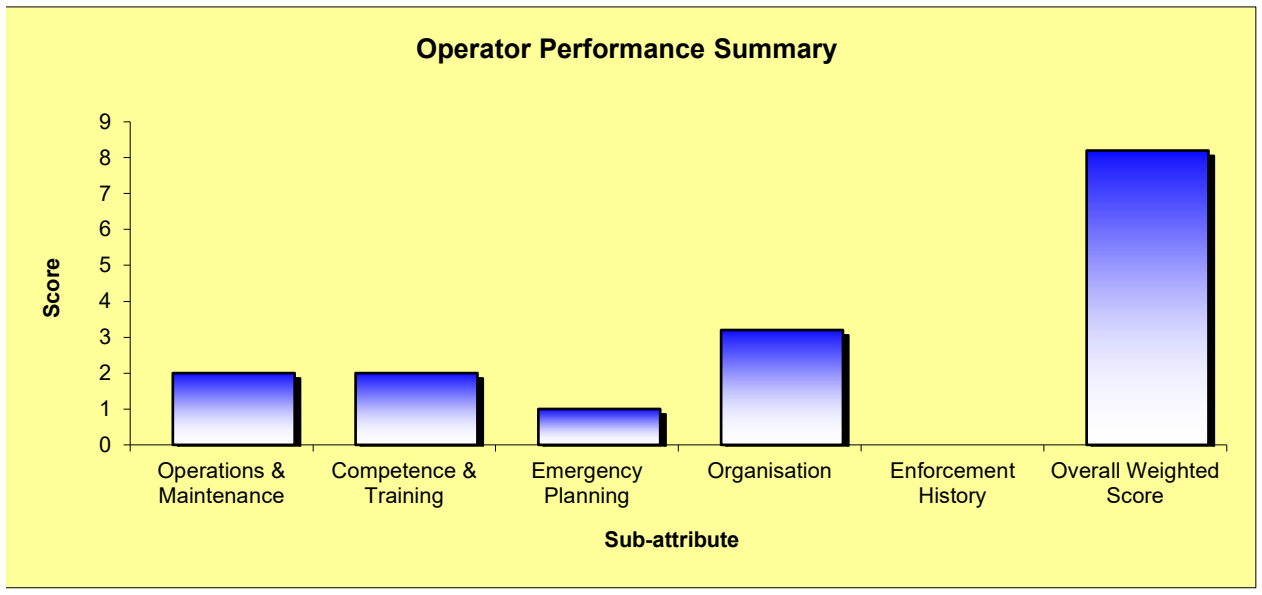
Operations & Maintenance				
1	Do you have documented operating procedures for operations that may have an adverse impact on the environment?	**Yes**	4	
2	Is there a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative maintenance regime is appropriate?	**Yes**	2	
			0	
4	Do you have a preventative maintenance programme for items of plant whose failure could lead to impact on the environment?	**Yes**	2	**Max = 12**
5	Does the preventative maintenance programme include regular checks and formal inspections of infrastructure items such as tanks, pipework, retaining walls, bunds and ducts?	**Yes**	2	**Weight = 20%**
6	Are the reports, results and recommendations arising from your own audits made available to senior management on a regular basis?	**Yes**	2	**Weighted Score**
	Operations and Maintenance Total		**12**	**2.0**

Competence and Training - 20%				
1	Has a training needs assessment been carried out which: □ Identifies all posts for which specific environmental awareness training is required; and □ Identifies the scope and level to which such training is to be given?	**Yes**	3	
2	Are training systems in place for all relevant staff that cover the following factors:			
	□ the regulatory requirements associated with the Permit as they affect their roles and responsibilities;	**Yes**	2	
	□ likely potential environmental impacts which may be caused by plant under their control. This should cover both normal and abnormal circumstances;	**Yes**	2	
	□ reporting procedures to inform supervisors or managers of deviations from permit conditions;	**Yes**	3	
	□ procedures to be used by supervisors or managers for the reporting of deviations from permit conditions to the regulator	**Yes**	2	
	□ prevention of accidental emissions and action to be taken when accidental emissions occur?	**Yes**	2	**Max = 17**
3	Do you assess the potential environmental risks posed by the work of contractors and provide instructions to contractors about protecting the environment while working on site?	**Yes**	3	**Weight = 20%**
4	If there are industry standards for training in this sector (e.g. WAMITAB) do you apply them? (If no industry standards please leave blank)	**Yes**	0	**Weighted Score**
	Competence Training Total		**17**	**2.0**

Emergency planning - 20%				
1	Is there an accident plan that complies with guidance covering the following aspects of foreseeable scenarios: likelihood, consequences,actions to prevent, action to take in the event it occurs?	**Yes**	6	
2	Has the plan identified areas where improvement is needed?	**No**	0	
3	Where improvement has been identified, does the plan include an implementation programme with acceptable timescales to the regulator? If not, points will be deducted.		0	
4	Do you have written procedures for handling, investigating, communicating and reporting actual or potential non compliance with operating procedures or emission limits?		0	
			0	**Max = 12**
			0	**Weight = 20%**
			0	**Weighted Score**
	Emergency planning Total		**6**	**1.0**

	Organisation - 40%			
	Internal/External Environment Management Systems: **Answer either Question 1 or Question 2** **NB: If your externally audited system is ISO9001 but you also have an internal environmental management system, you may be able to obtain a better score by providing answers to question 2**			
1	Do you have a certified Environmental Management System, subject to external audit, which covers the activities allowed by this permit? If so which one?	ISO1400	15	
	Sub Total		**15**	
2	**If you do not operate an externally audited environmental management system but have an internal one, assess your system against the criteria below:**			
2.1	Has your company adopted an environmental policy and programme which :			
	□ includes a commitment to continual improvement and prevention of pollution?		0	
	□ includes a commitment to comply with relevant legislation, and with other requirements that the organisation subscribes to?		0	
	□ identifies, sets, monitors and reviews environmental objectives, independently of the permit?		0	
2.2	Do you have an environmental policy and programme which is subject to audit by your company?		0	
2.3	Are there annual reports on environmental performance, objectives and targets, future planned improvements and/or do you participate in local community liaison meetings?		0	**Max = 12**
3	Does your company produce a public environmental statement? You may score in this box for ISO 14001 and industry systems but not for EMAS as this is a requirement for EMAS.	**Yes**	1	**Weight = 40%**
4	Within the past 5 years have you failed to meet an improvement condition set by the regulator in a Permit or Variation by the due date, without prior agreement? (minus 2 for each failure). ADD NUMBER OF FAILURES NOT Y OR N	**0**	0	**Weighted Score**
	Organisational Total:		**16.0**	**3.2**

	Enforcement History (0 to -40% weighting) **Please enter the number of times relevant enforcement actions have been pursued in connection with your site. Note: the timescales over which action remains relevant depends on the type of enforcement action and is contained in the questions below**			
1	Number of Enforcement, Improvement, Works, Compliance or Restoration Notices issued in the past year by the Environment Agency under any legislation, by the Health and Safety Executive relevant to the COMAH Regulations or by local authorities under Part I of the Environmental Protection Act 1990 or relevant notice or Abatement Notices issued by local authorities or magistrates courts under Part III of the Environmental Protection Act 1990 (in all cases, other than any overturned on appeal by the Operator)	**0**		
2	Number of Formal Cautions, Enforcement Undertakings or Fixed Monetary Penalties issued by the Environment Agency in respect of offences under relevant legislation in the last 3 years.	**0**		
3	Number of Prohibition, Stop, Suspension or Revocation Notices issued by the Environment Agency under any legislation, by the HSE relevant to the COMAH Regulations or by local authorities under Part I of the Environmental Protection Act 1990, (other than any overturned on appeal by the Operator) in the last 3 years	**0**		
4	Number of Convictions on prosecutions brought by the regulator under any legislation, by the HSE relevant to the COMAH regulations or by local authorities (in respect of offences under Parts I or III of the Environmental Protection Act 1990) in last 5 years (or 10 years where a term of imprisonment was imposed on the Operator) (other than any overturned on appeal). Or number of any Variable Monetary Penalties issued.	**0**		**Max = -40** **Weight = 40%** **Weighted Score**
			0	**0.0**
	Overall Operator Performance Score:			**8.20**
	Band E= less than 2 D= 2 to 3.99, C= 4 to 5.99, B= 6 to 7.99 , A= 8 to 11		**BAND=**	**A**



Operator Performance Summary	
Operations & Maintenance	2.0
Competence & Training	2.0
Emergency Planning	1.0
Organisation	3.2
Enforcement History	0.0
Overall Weighted Score	8.2

Complexity Bands	
…	
A01	EEE
A01-Closed	B
A02	EE
A02-Closed	B
A03	E
A03-Closed	B
A04	DD
A04-Closed	B
A04-Dredgings	B
A05	C
A05-Closed	A
A06	C
A06-Closed	A
A07	C
A07-Closed	A
A08	C
A08-Closed	A
A09	D
A10	B
A11	C
A12	D
A13 (non-haz)	B
A13 (haz)	C
A14	B
A15	A
A16 (non-haz)	A
A16a (haz)	D
A17	E
A18	D
A19	C
A19a	B
A20	C
A21	E
A22	C
A23	C
A24	B
A25	B
A26	n/a
A27	A
A29	B
L05	C
L05-Closed	A

2015/16

Charge Multipliers							
App	£171	Nor Var	£139	Full Surr	£125	Part Surr	£125
Subs	NA						

Converting Bands to Opra Score

Band	A	B	C	D	E	DD	EE	EEE
Complexity	4	10	35	50	65	100	130	195
Emissions	3	7	15	30	40			
Location	1	2	3	5	7			
Op Perf	2	4	7	10	14			
Compliance Rating	0.95	1	1.1	1.25	1.5	3		
Band	A	B	C	D	E	F		

EMS	Points
No	0
EMAS	20
ISO14001	15
Other Accredited	12
ISO 9001	8

Appendix C

Waste acceptance procedure

CONTROLLED DOCUMENT	
Document Issued For Use From:	December 15

CONTENTS

1 Introduction

This procedure is written specifically for Tarmac Landfill and Recycling sites to ensure that waste materials and substances are handled, treated, stored and disposed of in accordance with legislation and environmental best practice.

Failure to comply with the controls set out in this procedure could lead to prosecution for both Tarmac and any employee or contractor found guilty of environmental negligence.

2 Scope

This procedure applies to all operations and Landfill and Recycling locations for which Tarmac has responsibility.

3 Definitions

Permit

Any EPR permit, exemption or Waste Management Licence in England, Scotland or Wales

RAP Manager

Recycled Asphalt Planings (RAP) Manager.

Regulator

Environment Agency, Scottish Environment Protection Agency or Natural Resources Wales.

RM

Recycling Manager.

Site

Any Landfill, Recycling or Recycled Asphalt Plant (RAP) facility.

Site Manager

Site Manager or Supervisor.

SN Database

Site Notification Database.

TCM

Technical Competent Manager.

WAC Coordinator

Waste Acceptance Criteria (WAC) Coordinators.

4 General Management Requirements: All Sites

4.1 Information displayed

In addition to the other requirements of the environmental management procedures, the following information should also be

displayed at the weighbridge area:

- The waste related permits for the site
- Site waste acceptance list
- Technical Competent Manager (TCM) Certificates, including current Continual Competence certificates
- Any local and emergency rules specific to the site
- Banned drivers

All documents should be updated as and when required.

4.2 Checks

The Site Manager should complete their daily and weekly inspections in order to comply with the permit and the Environmental Management System. In addition to this, the following should be considered specific to Landfill & Recycling:

4.2.1 Daily Checks

- Condition of tipping area
- Condition of haul roads
- Wheel wash is operational (if applicable)
- Housekeeping of any quarantined area
- Site diary is completed in accordance with this procedure

4.2.2 Weekly Checks

- The TCM has attended the site for the required frequency
- Waste Carrier File is up to date
- Materials are within permitted area

4.3 Landfill Site Grid Plan or GPS Device

All Landfill sites will produce and maintain a gridded site plan or have a working GPS device to be able to easily identify and record tipping locations on a weekly basis in the site diary.

4.4 Site Diary

A Site Diary will be completed on a daily basis with details of:

Landfill Sites	Recycling Sites
Weather	Weather
Personnel on site including the person providing any TCM cover and the time the TCM is on site	Operations carried out on site
Site development works	Details of any rejected loads

Area of landfill currently being infilled including GPS location or grid reference	TCM attendence on site
Plant breakdowns	Any emergencies, Environmental Incidents and Audits
Environmental monitoring or sampling undertaken	Number of loads
Details of rejected loads	Number of duty of care checks
Any emergencies, Environmental Incidents, Audits and observations	
Number of loads	
Recorded duty of care checks at landfill face	

4.5 Site Files

The site manager will ensure the following files are produced and maintained on site in the weighbridge area and copies placed into the Site Environmental Management Plan (SEMP) (where applicable):

- 2 years of Duty of Care checklist files with sheets in date order
- Waste rejection report file with sheets in date order (waste rejection reports uploaded to Section 9 of the SEMP)
- Weekly site inspection file with sheets in date order (added into Section 9)
- Waste Carriers licence file filed alphabetically with index listing name and expiry date

5.0 Duty of Care Checks and Waste Inspections at all sites

Forms MS-EP-A&A-01/01 Landfill Acceptance Procedure and MS-EP-A&A-01/02 Recycling Acceptance Procedure provide a flow chart for the acceptance of waste at Landfill and Recycling sites, as well as who has responsibility for each stage.

5.1 Acceptable Waste

Whilst the exact type and quantity of waste able to be received onto site will be stipulated in local permits, MS-EP-A&A-01/03 provides guidance on the restrictions on waste permissible for inert landfills in general, detailing the checks required to understand whether or not waste can be received.

Additionally, MS-EP-A&A-01/04 provides site level guidance of the process for receiving compliant waste onto site. This should be used to ensure that only acceptable waste is received onto site.

5.2 Weighbridge Duty of Care Checks

Every load will be checked at the weighbridge to ensure it complies with the Site Acceptable Waste list and Permit. The flow chart in MS-EP-A&A-01/05 should be consulted and followed to ensure that the site undertakes sufficient verification.

The weighbridge reception should check that the details on Apollo match the customer and the material origin and that there is a valid SN reference on the database (Restore) (the pre-acceptance checks). The SN reference should be then recorded on the weightbridge ticket and the ticket generated.

If the weighbridge reception is unable to validate the customer and material origin, and/or no SN reference is found on Restore, or the system is not working, then they should contact the Landfill & Recycling Team immediately. Customers that arrive on site without pre-notification should be directed to the Landfill & Recycling Team.

A Waste Transfer Note must accompany each load of waste received and that it is carried by a Waste Carrier with an up to date Waste Carriers Licence (03708 506506 is the enquiry line to check).

Any doubts of material acceptability will be brought to the attention of the TCM (or the Landfill & Recycling Team) for further checks. The material will not be accepted and the vehicle will not be allowed to proceed to the tipping point until these checks are complete. The vehicle may wait at a designated point at the site until the matters are resolved.

In cases where a load will be presented without a transfer note you should offer the driver of the vehicle a blank Waste Transfer Note (see MS-EP-CORE-07/01). The driver must complete it themselves.

Under no circumstance should any employee of Tarmac complete or modify a Waste Transfer Note on behalf of any third party. The driver must initial any modification to a Waste Transfer Note.

The weighbridge must then complete a visual inspection of the waste in any un-sheeted or open top vehicle to see that it conforms to the Waste Transfer Note accompanying it and the Site Acceptable Waste List. Only once the Duty of Care Checks are completed and are all found to be in order should the Duty of Care Note be signed as this demonstrates that checks have been undertaken and the waste is acceptable at the site. Both the driver and the weighbridge operator will also sign the weighbridge tickets and this will also indicate that the waste has passed the Duty of Care checks. The Duty of Care record sheet should also be completed.

Any doubts of material acceptability will be brought to the attention of the TCM (or the Landfill and Recycling Team if TCM not available) for further checks/advice. The material will not be accepted and the vehicle will not be allowed to proceed to the tipping point until these checks are complete. The vehicle may wait at a designated point at the site until the matters are resolved.

Any load that does not comply will be rejected and recorded in the site diary and a waste rejection form.

5.3 Site System Failure

If for any reason, eg internet connection failure, site systems cannot be accessed, then the Landfill and Recycling should be informed and they will provide further advice as to how the site can continue to operate in order to continue to comply with this procedure eg the L&R team provide pre-acceptance confirmation for each load.

If the site cannot comply with this procedure, then waste must cease to be accepted

The Site Manager/TCM shall be informed of the systems failure and it shall be recorded in the site diary.

6.0 Waste Inspections following deposit

6.1 Landfill and Recovery Sites Only

Every landfill must have supervised tipping face while waste is accepted.

Site operatives should inspect all loads as they are ejected from the carrier to see they conform to the material the vehicle should be carrying and in accordance with the Site Acceptable Waste list detailed in the Permit. Two random inspections should be recorded on the instigation of the weighbridge operator (each load if fewer than 2 loads received). A record should be kept of the check in the site diary, detailing time, ticket number and that it conforms.

Should any of the load be found to contain wastes not acceptable at that site the rejection of unacceptable loads procedure should be followed in section 4.6.4.

6.2 Recycling Sites Only

All Recycling sites must have waste and product stockpiles signposted. Acceptable material must be visually inspected to ensure it complies with the Site Acceptable Waste List, the Permit, and the material in the stockpile, and then mechanically handled into the correct material stockpile.

If it does not comply then the load will be rejected.in accordance with section 6.4.

6.3 RAP Sites Only

Material must be PAK tested at the frequency set out in the scheme relevant to the job in accordance with the current version of 'Testing for tar in Road Planings' Document.

Material failing the PAK test will be isolated and separately stockpiled until classification of its hazardous nature confirmed or otherwise and its ultimate acceptance or rejection is determined in accordance with procedures in the current version of 'Testing for tar in Road Planings' document.

Acceptable material must be also visually inspected to ensure that it complies with the Site Acceptable Waste List, the Permit and the material in the stockpile, and then mechanically handled into the correct material stockpil

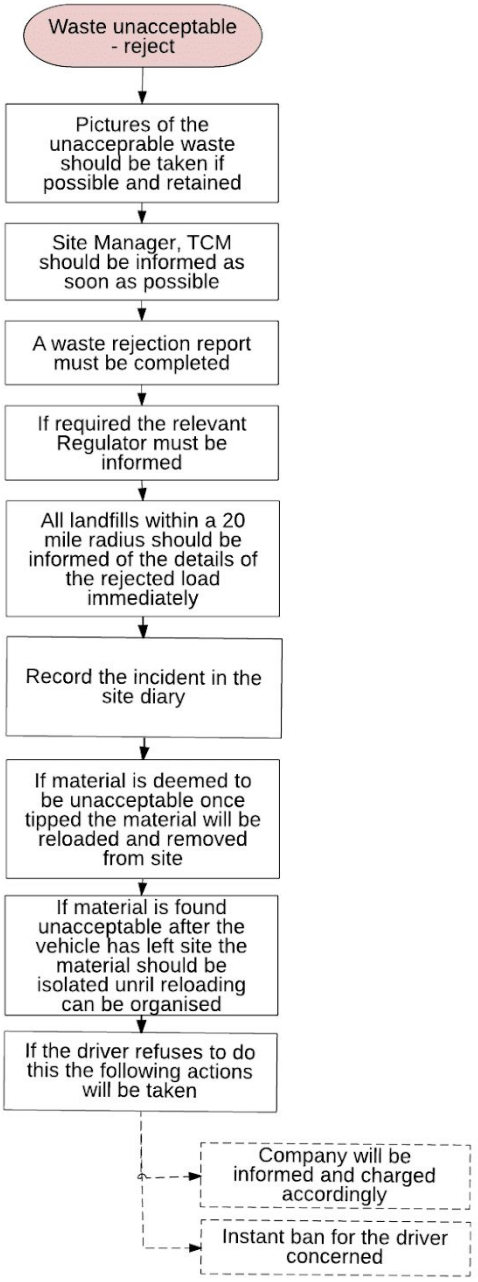
6.4 Rejection of Unacceptable Waste

If material is deemed to be unacceptable once tipped and the Waste carrier is still on site then if safe to do so the material will be reloaded and removed from site.

1. If material is found unacceptable after the vehicle has left site, or if the Waste Carrier is still on site but refuses to remove the waste, the material should be quarantined if safe to do so and the Landfill & Recycling Team informed so they arrange removal of the material.
2. Pictures of the rejected load should be taken
3. Site Manager or TCM should be informed as soon as possible, who should report it as required by the Environmental Incident Procedure and to the Landfill and Recycling Team.
4. Complete a waste rejection form.
5. If required the relevant Regulator must be informed.
6. Record the incident in the site diary and on Apollo

7. All Tarmac recycling and landfill sites within a 20 mile radius should be informed of the details of the rejected load immediately

The below flow diagram should be consulted:



7.0 Testing and Sampling at Landfills

7.1 Compliance Testing

Compliance testing for a given waste stream should be carried out in accordance with the schedule identified by the Landfill and Recycling Team at the Basic Characterisation waste acceptance stage.

If any sampling or testing is required then the weighbridge operative shall inform the Site Manager and/or TCM and make a record in the Site Diary of which load is being sampled (including duty of care information so that checks can be made once

the sampling results are returned). The appropriate testing or sampling will then be organised and carried out and recorded in the Site Diary, including the final location of the waste in the landfill. Once received sampling results should be cross checked against the pre-acceptance information, and the Duty of Care Note/weighbridge ticket, and recorded in the site diary. All sample results should be forwarded to the Landfilll and Recycling Team for assessment..

7.2 On-site verification sampling

On-site verification sampling should be done at the frequency outlined in permit conditions, or at the frequency specified for the site by the Landfill & Recycling Team. The Site Manager and/or TCM will then arrange for the sampling to be carried out and a record will be kept in the Site Diary, including the location of the waste in the landfill. Once received sampling results should be cross checked against the pre-acceptance information, and the Duty of Care Note/weighbridge ticket, and recorded in the site diary. Any sampling results found to not be in compliance with the original waste classification should be forwarded to the Landfill and Recycling Team for further action.

8.0 Technical Competence and Training

8.1 Training

The Site Manager must ensure that **all** site personnel and contractors involved in any permitted activity on site, including the site engineering, reception and handling of the waste, is given adequate training on these instructions: the permit, any material testing and PAK spraying operation and requirements and company procedures relevant to their area of work.

Records of training, and any training review should be recorded on a training record and stored in Section 1 of the SEMP.

8.2 TCM Arrangements

The TCM is a legal requirement that enables us to demonstrate that we have technically competent people with the right knowledge and skills to ensure waste sites comply with the Environmental Permitting Regulations 2010, and the condition of the permit for the site. Every site must have a nominated TCM that attends the site on a regular basis as stipulated in the EA/NRW/SEPA guidance, please contact the Permit and Compliance Team for more information. Organisation and provision of the TCM arrangements is the responsibility of the site in conjunction with the Landfill and Recycling Team.

Any changes to the TCM arrangements must be notified to the Landfill and Recycling Team by the site or production manager immediately so they can monitor TCM arrangements. Changes to TCM should also be notified to the relevant Regulator if required by the permit conditions. The training record must also be updated.

9.0 Landfill Development Plan

A Landfill Development Plan must be developed for each site, one copy retained on site and one sent to the Landfill & Recycling Team. This is to identify how the site will comply with the permit improvement conditions and pre-operational conditions, as well as including current and planned lined areas and including phasing in line with the

permit, planning permission and operational extraction plan. This should be uploaded into Section 12 of the SEMP. The Landfill Development Plan should be reviewed and updated annually, usually at the same time as the SEMP.

Landfill Development Plans should be reviewed regularly, not less than every 12 months, to enable forward planning for the site and to ensure that they remain current.

10 ASSOCIATED DOCUMENTS

Document Name	Type	Retention Period
Environmental Incident Procedure	Procedure	N/A

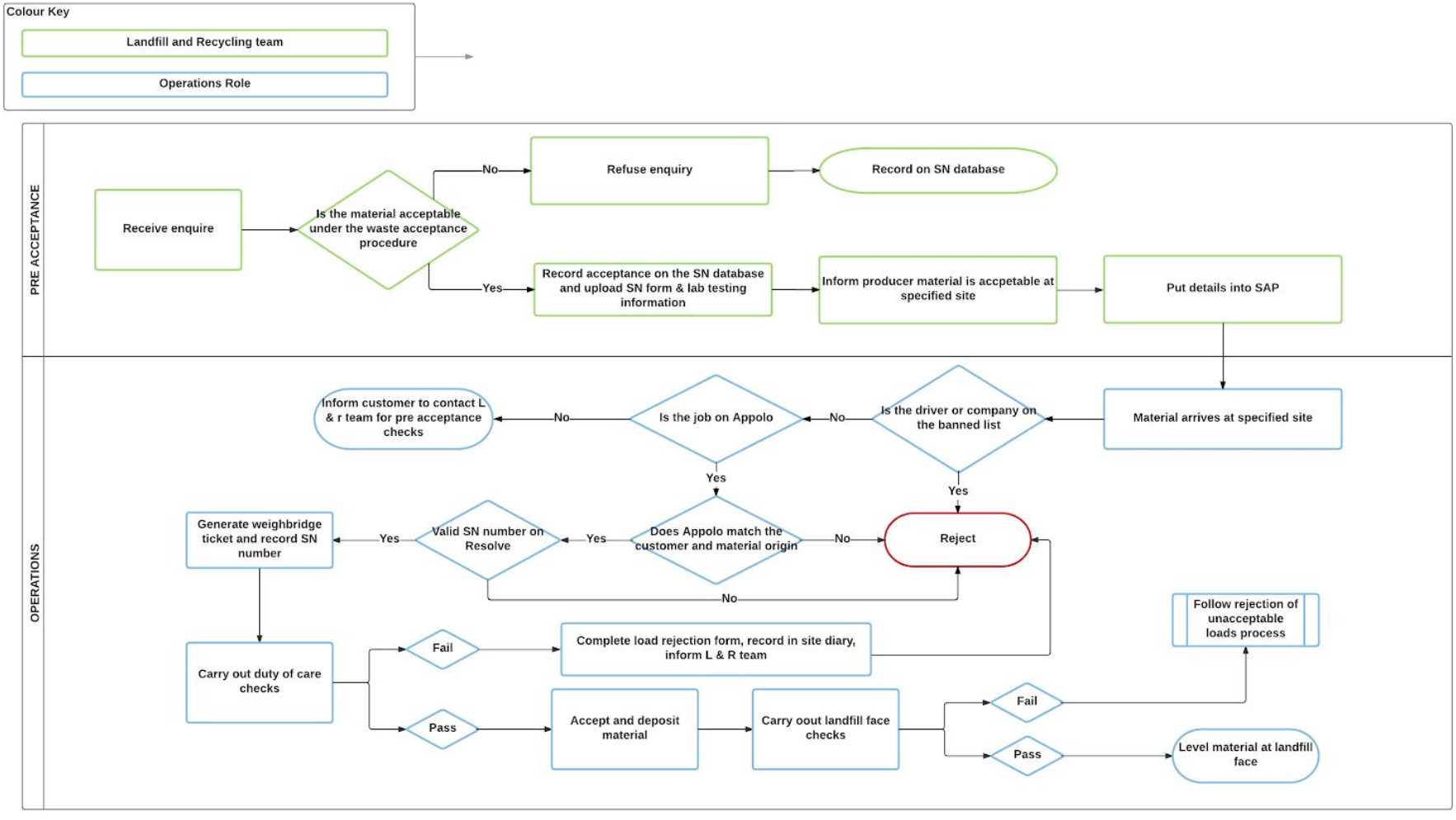
*C (Commercial) - Tarmac requirement; *S (Statutory) - Legal Requirement

11 DOCUMENT CONTROL

Issue Date	Revision No.	Details of Change	Owner
September 15	1	First Copy	Environment Manager
August 16	2	Document Re-Issue	Environment Manager

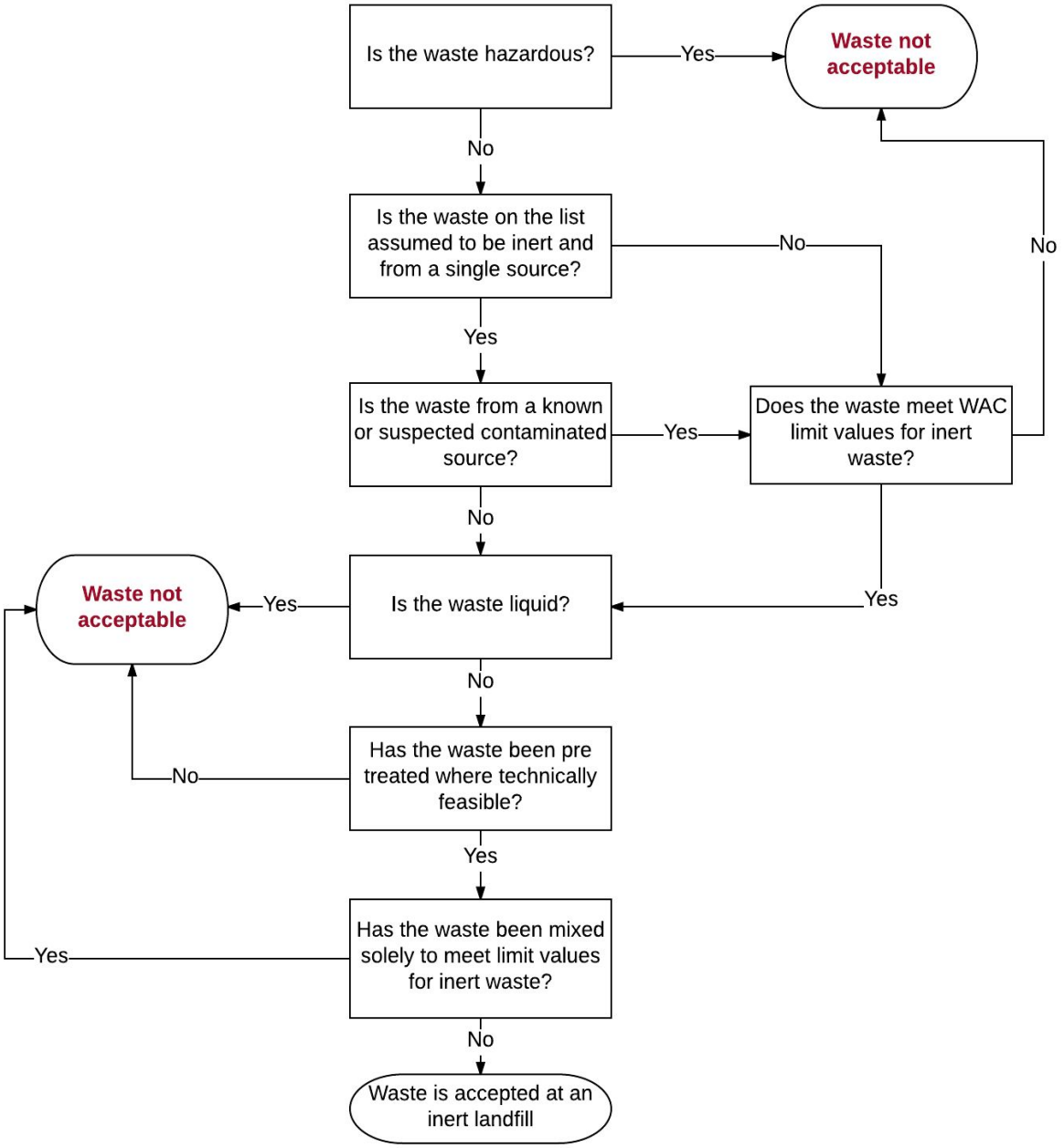
Landfill Acceptance Process

Reference No: MS-EP-A&A-01/01	Revision No: 1	Date: Sep-16



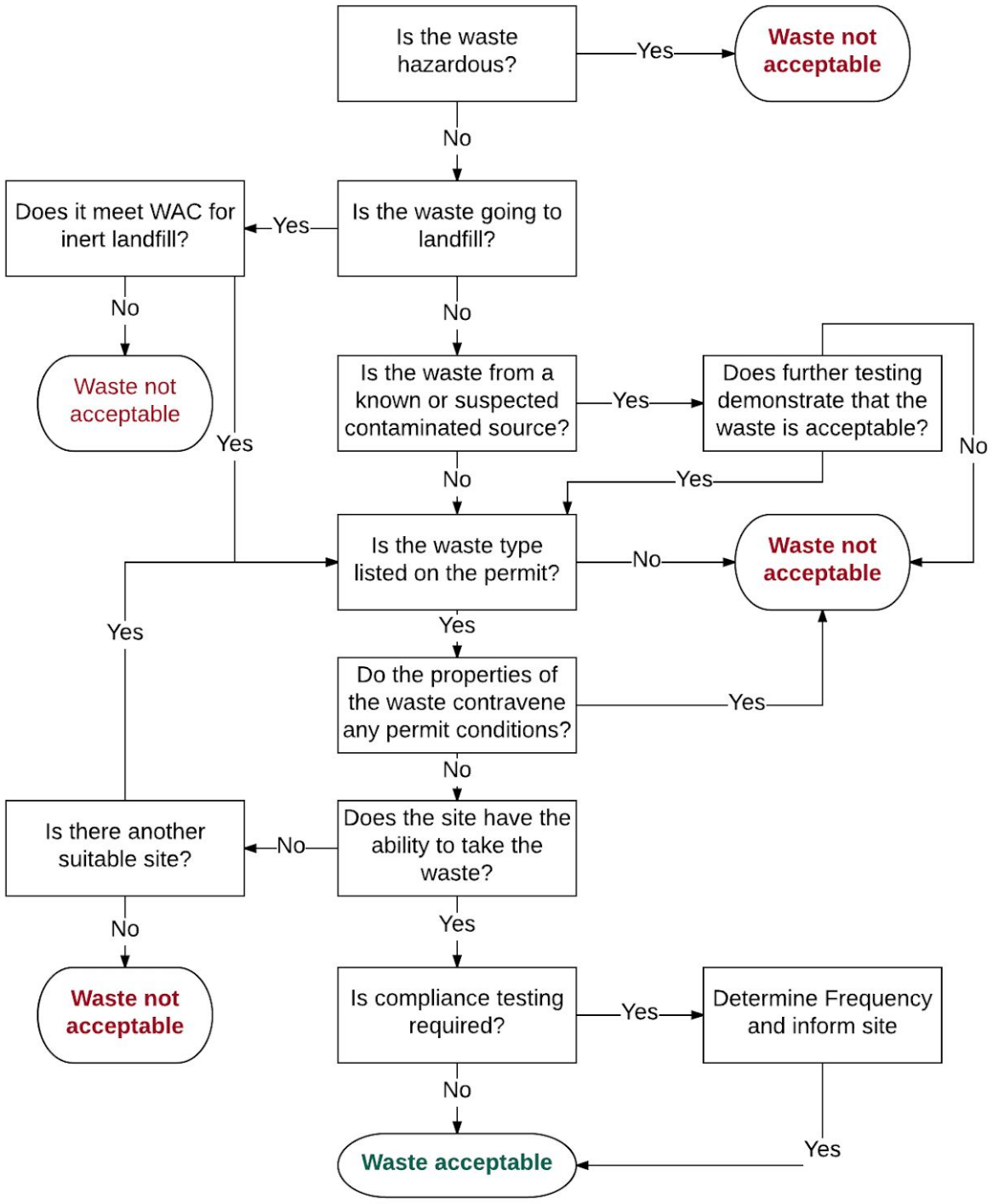
Inert Landfill Waste Acceptance Criteria Process Flow

The below process flow must be followed for determining any waste that can be received into an inert landfill:

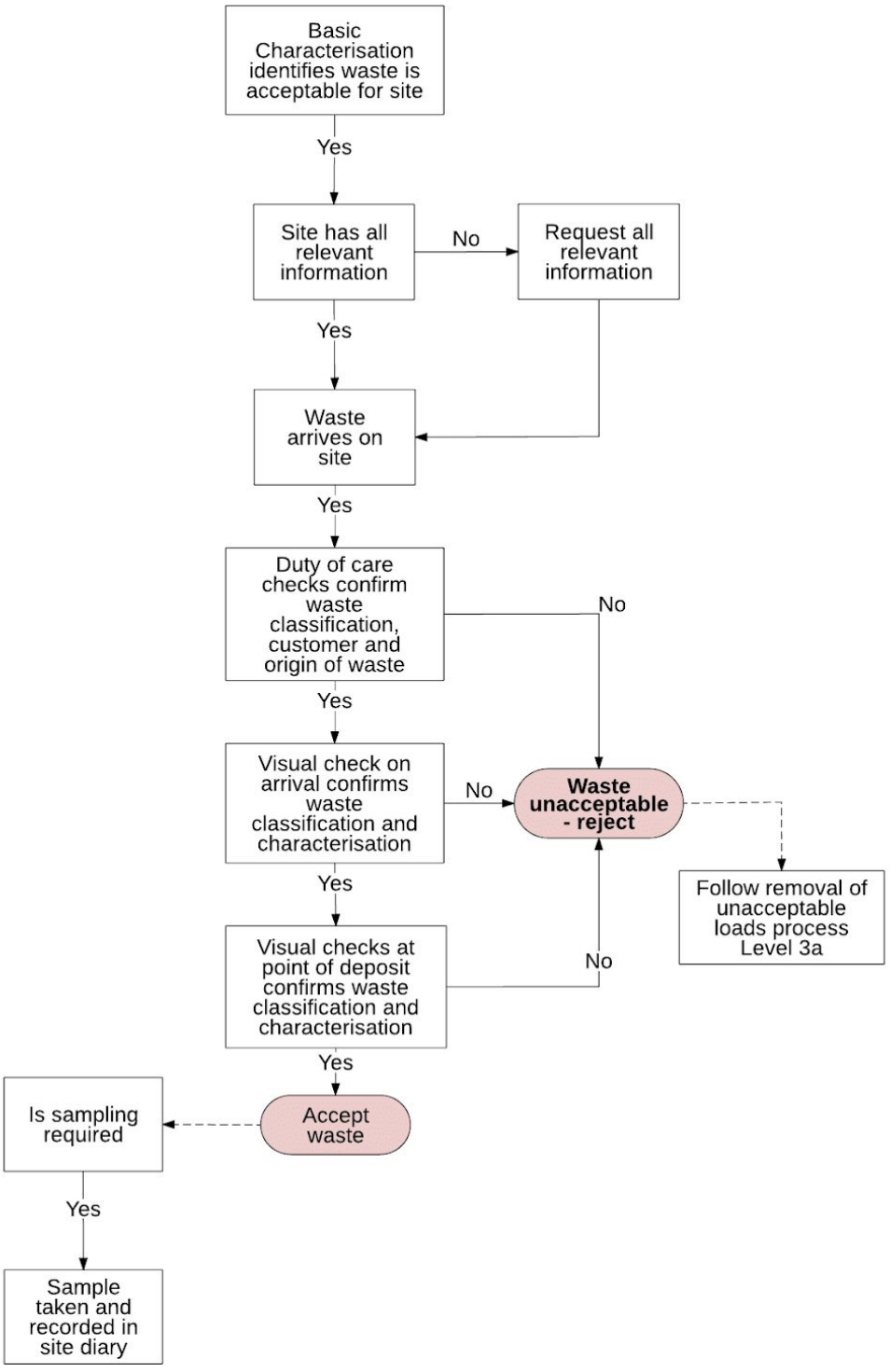


Landfill Waste Acceptance Criteria Process Flow

The below process flow must be followed for any waste being received into an inert landfill:



The below processflow must be followed for any waste being received into an inert landfill:



Appendix D

Evidence of technical competence management

Certificate No. OCC7319

Operator Competence Certificate

Title:

Managing Landfill - Non Hazardous Waste - 4MLNH

This Certificate is awarded to

Andrew Bevan

Awarded: 22/11/2016

Authorised

WAMITAB Chief Executive Officer

CIWM Chief Executive Officer

The Chartered Institution of Wastes Management

This certificate is jointly awarded by WAMITAB and the Chartered Institution of Wastes Management (CIWM) and provides evidence to meet the Operator Competence requirements of the Environmental Permitting (EP) Regulations, which came into force on 6 April 2008.

00092091

wamitab

Qualification Title:

WAMITAB Level 4 Diploma in Waste Management Operations : Managing Landfill - Non Hazardous Waste - 4MLNH

Qualification Accreditation Number:

600/0329/7

This Certificate is awarded to

Andrew Bevan

Awarded: 22/11/2016

Serial No:25707/4MLNH/1

Authorised

Chris James
Chief Executive Officer, WAMITAB

Regulated by Ofqual

For more information see http://register.ofqual.gov.uk

Corff dyfarnu cydnabyddedig
CYMWYSTERAU CYMRU QUALIFICATIONS WALES
Recognised awarding body

The qualifications regulators logos on this certificate indicate that the qualification is accredited only for England, Wales and Northern Ireland.

00092096

Credit certificate
This certificate determines credit awarded to:
Andrew Bevan

Units gained:

		Credit Value	Credit Level
Y6015875	Monitor procedures to safely control work operations	4	3
K6009711	Manage physical resources	3	4
M6009712	Manage the environmental impact of work activities	5	4
K6021423	Procedural compliance	6	4
M6021424	Manage and maintain effective systems for responding to emergencies	19	4
D6021435	Control maintenance and other engineering operations	13	4
T6009601	Provide leadership and direction for own area of responsibility	5	4
Y6021451	Develop schemes for the restoration and aftercare of non hazardous waste landfill sites	18	4
R6021609	Manage the reception of non hazardous waste	7	4
A6021670	Manage the movement, sorting and storage of waste	7	3
L6021897	Manage site operations for the disposal of non hazardous waste to landfill sites	13	4
K6021504	Manage improvements to waste management operations	7	4

Awarded: 22/11/2016 **Serial No.:** 25707/HSS3/1

Authorised

Chris James
Chief Executive Officer, WAMITAB

Regulated by Ofqual

For more information see http://register.ofqual.gov.uk

Corff dyfarnu cydnabyddedig
Cymwysterau Cymru Qualifications Wales
Recognised awarding body

The qualifications regulators logos on this certificate indicate that the qualification is accredited only for England, Wales and Northern Ireland.

00092095

Certificate No. OCC7318

Operator Competence Certificate

Title:

Open Inert Landfill

This Certificate is awarded to

Andrew Bevan

Awarded: 22/11/2016

Authorised

WAMITAB Chief Executive Officer

CIWM Chief Executive Officer

The Chartered Institution of Wastes Management

This certificate is jointly awarded by WAMITAB and the Chartered Institution of Wastes Management (CIWM) and provides evidence to meet the Operator Competence requirements of the Environmental Permitting (EP) Regulations, which came into force on 6 April 2008.

00092090

wamitab

Qualification Title:

WAMITAB Level 4 Medium Risk Operator Competence for Open Inert Landfill

Qualification Accreditation Number:

601/8529/6

This Certificate is awarded to

Andrew Bevan

Awarded: 22/11/2016

Serial No:25707/MROC7/1

Authorised

Chris James
Chief Executive Officer, WAMITAB

Regulated by Ofqual

For more information see http://register.ofqual.gov.uk

Corff dyfarnu cydnabyddedig
CYMWYSTERAU CYMRU QUALIFICATIONS WALES
Recognised awarding body

The qualifications regulators logos on this certificate indicate that the qualification is accredited only for England, Wales and Northern Ireland.

00092097

Credit certificate
This certificate determines credit awarded to:
Andrew Bevan

Units gained:

		Credit Value	Credit Level
Y6015875	Monitor procedures to safely contol work operations		
M6009712	Manage the environmental impact of work activities		
A6021670	Manage the movement, sorting and storage of waste		
L/508/0888	Manage the reception of inert waste	5	4
Y/508/1008	Managing disposal operations of inert waste to land	8	4
Y/508/1011	Prepare landfill sites for the acceptance of inert waste	8	4

Awarded: 22/11/2016

Serial No.: 25707/OCS01/1

Authorised

Chris James
Chief Executive Officer, WAMITAB

Regulated by Ofqual

For more information see http://register.ofqual.gov.uk

Corff dyfarnu cydnabyddedig
CYMWYSTERAU CYMRU QUALIFICATIONS WALES
Recognised awarding body

The qualifications regulators logos on this certificate indicate that the qualification is accredited only for England, Wales and Northern Ireland.

00092098

Appendix E

Summary EMS and ISO 14001 certification

bsi.

By Royal Charter

Certificate of Registration

ENVIRONMENTAL MANAGEMENT SYSTEM - ISO 14001:2015

This is to certify that:

Tarmac
part of Tarmac Holdings Limited
Portland House
Bickenhill Lane
Solihill
Birmingham
B37 7BQ
United Kingdom

Holds Certificate Number: EMS 506166

and operates an Environmental Management System which complies with the requirements of ISO 14001:2015 for the following scope:

Please see scope page.

For and on behalf of BSI:

Andrew Launn, EMEA Systems Certification Director

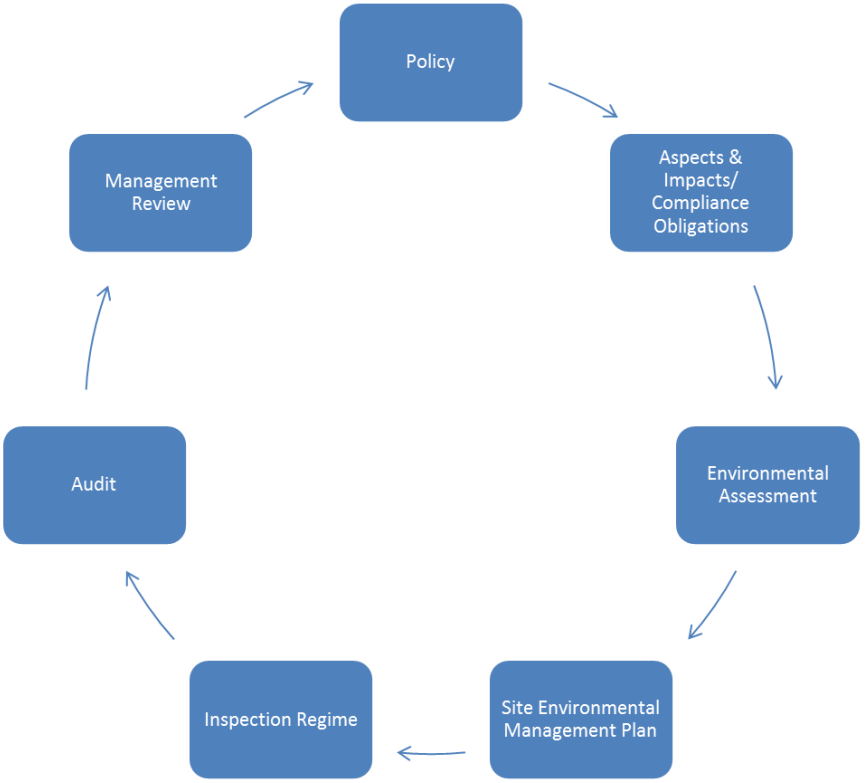
Original Registration Date: 2006-03-23
Latest Revision Date: 2018-02-09

Effective Date: 2016-12-09
Expiry Date: 2021-02-12

...making excellence a habit.™

Summary of Environmental Management System

Lafarge Tarmac Trading Limited (LT) has in place an Environmental Management System (EMS) that is certified to the international standard: ISO 14001. The site will be operated under the overarching Core EMS which covers a number of LT sites across the UK. The specific EMS procedures to support the operation of this type of regulated facility under an Environmental Permit in England have been developed with reference to relevant guidance produced by the EA. The EMS follows the Plan Do Check Act (PDCA) cycle described in EA guidance [1] as illustrated below:



A copy of the EMS will be held at the site and will be available for inspection once the site is operational following the issue of the Environmental Permit for the site. A summary of the key elements of the EMS is provided below.

Company Environmental Policy

The EMS is underpinned by the company Environmental Policy which outlines its' high level vision, how it expects operations to be managed and its environmental performance to be

[1] England and Wales - How to comply with your environmental permit.
Scotland –
Northern Ireland -

communicated to its stakeholders and to enable the effective deployment of the related principles across its operational sites.

LT is committed to preventing its activities polluting the environment and the continual improvement of its environmental performance. Through a dedicated environmental and sustainability panel business objectives are developed. Environmental performance measures are also monitored by these forums and targets set to enable performance levels to be continuously improved.

LT aims to minimise the environmental impact of its activities by:

- regularly monitoring the effective deployment of the EMS through a series of graded audits
- prior to undertaking work on behalf of LT, all sub-contract personnel will be made aware of site-specific environmental concerns and vulnerabilities through the site induction process
- reducing the amount of waste materials generated by their activities; attempting to recycle and reuse such materials wherever practical and where this is not achievable, disposing of such waste in a responsible manner
- seeking to use raw materials in an efficient manner, replacing them with substitute recycled raw materials where practicable and safe to do so
- promoting the efficient and reduced use of water, fuels and energy, thereby reducing carbon emissions and mitigating the potential for climate change
- purchasing, utilising and storing materials in a manner which poses minimal risk to both individuals and the environment, as far as is practical.

The EMS will be deployed effectively through the company's management organisation. Managers and employees will be assigned environmental responsibilities and will be expected to play a full and active part in managing the environmental aspects of the activities for which they have responsibility. Operational management will be supported by a team of competent advisors and performance will be monitored by environmental auditors.

Company Environmental Standards

All operational sites will be the subject of an Environmental Assessment and will maintain an up to date Site Environmental Management Plan (SEMP). This will identify specific activities

that its' aspects impact upon the environment, enabling the site to control them which is then supported by our audits which help to monitor compliance.

Landfill

The following aspects have been identified having regard to the protection of the environment, compliance with any environmental permits and the highest standards of operation. These are in addition to the core company aspects described above.

The following aspects relevant to the Landfill site at Hendy will be managed in accordance with any relevant company policies and procedures, site authorisations and statutory obligations.

1. Dust and particulate matter – LANDFILL, RECYCLING, RECOVERY
2. Mud, litter and other debris - LANDFILL, RECYCLING, RECOVERY
3. Noise - LANDFILL, RECYCLING, RECOVERY
4. Security - LANDFILL, RECYCLING, RECOVERY
5. Waste acceptance and rejection - LANDFILL, RECYCLING, RECOVERY
6. Water management - LANDFILL, RECYCLING, RECOVERY
7. Working face operations – LANDFILL
8. Gaseous management – LANDFILL INSTALLATIONS
9. Leachate management - LANDFILL INSTALLATIONS

Environmental Assessment

The site manager shall be responsible for the Environmental Assessment of the operations, in normal and abnormal conditions, to identify the key environmental aspects of its activities. Through this process the aspects of the operations, that may have a significant impact on the environment, can be identified, prioritised for corrective action and improvement together with an evaluation of legal compliance at the site. The site manager/ supervisor, together with representatives from the site/area and the compliance and environmental permitting personnel shall identify and prioritise the potential significant environmental impacts of the operations. The potential impacts most relevant to the Landfill site at Hendy have been identified to be:

1. Bio-diversity and Ecological Management Visual Impact
2. Dust
3. Fuel & Chemical Storage
4. Gaseous emissions monitoring

5. Groundwater monitoring Management
6. Legislation and Documentation
7. Noise
8. Solid Waste Management
9. Vegetation Management
10. Vibration
11. Traffic
12. Surface water management
13. Gas management
14. Groundwater management

Site Environmental Management Plan

The Environmental Assessment provides the prioritised potential significant environmental impacts for inclusion in the SEMP. The plan shall identify objective(s) and target(s) for each significant impact and ensure that they are relevant to achieving the overall objectives of the Business Unit. The objective (the improvement action) shall be specific to the corrective/preventative action. The target for the improvement shall have a date for completion, the person responsible for the action and verification of the completion by the authorising person. The SEMP shall be reviewed regularly and shall be consistent with legislation, environmental procedures and the LT environmental policy. The SEMP may be updated at any time in order to implement changes/corrective actions identified by any management mechanism.

Each site shall undertake all necessary monitoring and measuring of operational activities, as required by legislation, such as environmental permits and planning consents. All such monitoring and measuring information shall be documented and recorded on a monitoring schedule.

Environmental occurrence/non-conformance reporting system

The environmental occurrence/non-conformance reporting system has been developed in order to document, investigate and mitigate significant impacts on the environment and for initiating and implementing corrective and preventative action. All incidents shall be reported, whether or not an external person/agency is involved. Any system non-conformances are also to be documented for corrective and preventative action.

Inspection regime and audit

The Environment Manager shall establish and monitor an annual inspection programme ensuring that all sites are audited by an 'independent' manager who has no responsibility for the site. The auditor shall complete an associated audit summary sheet, agreeing and summarising as necessary a list of recommended actions in consultation with the site manager. The audit summary sheet shall then be included in the SEMP and priorities and timescales assigned. A date for a follow-up visit to ensure close out of any actions has been completed will be set up by the visiting auditor and the manager/ supervisor. The follow up visit must also be used to ensure previous actions implemented are continuing to work and are effective.

Management Review

There will be a tiered review of the EMS at top management level, local area level and at site management level including the procedures, environmental policy and the objectives and targets for the company in order to support its ongoing effectiveness, suitability, adequacy and stability.

Appendix F

Hydrogeological risk assessment review 2017

Report Reference: 62487R1rev1
Report Status: Final

CAULMERT LIMITED

Engineering, Environmental & Planning

Consultancy Services

Hendy Landfill Site

Tarmac

Hydrogeological Risk Assessment Review 2017

Prepared by:

Caulmert Limited

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Email: sarahvenning@caulmert.com

Web: www.caulmert.com

Doc ref: 3145-CAU-XX-XX-RP-O-0301.S0.C1

Issue date: **12th January 2018**

Caulmert

Engineering, Environmental and Planning

APPROVAL RECORD

Site:	**Hendy Landfill Site**
Client:	**Tarmac**
Project Title:	**Hydrogeological Risk Assessment**
Document Title:	**HRA Review Report**
Document Ref:	**3145-CAU-XX-XX-RP-O-0301.S0.C1**
Report Status:	**Final**
Project Manager:	**Andy Stocks**
Caulmert Limited:	**5 Farrington Way, Eastwood Link Business Park, Eastwood, Nottingham, NG16 3BF**
Tel:	**01773 749132**

Author	Sarah Venning	**Date**	12/01/2018
Reviewer	Andy Stocks	**Date**	12/01/2018
Approved	Andy Stocks	**Date**	12/01/2018

DISCLAIMER

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Drawing 3145.HRA.03A	Conceptual Model – cross-section perpendicular to flow
Drawing 3145.HRA.04A	Conceptual Model – cross-section perpendicular to flow

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Appendix 1	Environmental Monitoring Data
Appendix 2	Enhanced Monitoring Proposal

1 INTRODUCTION

1.1 Report Context

1.1.1 Caulmert Limited have been commissioned Tarmac Trading Limited (the operator) to review the current hydrogeological assessment of Hendy Quarry Landfill Site, Miskin, in accordance with their Permit BT1088ID Condition 3.2.4

1.1.2 The current hydrogeological risk assessment review was submitted in May 2009. The current guidance requires the hydrogeological risk assessment to be reviewed every six years. This submission forms the next review. It is our understanding that no reviews have been submitted in the interim period. Therefore the objective of this review is to assess whether there has been any significant change in conditions at the site, whether the site remains in compliance with the Groundwater Daughter Directive. The review will also reflect changes in the regulatory environment.

1.1.3 A summary of Permit variations since the original permit was granted is included in Table 1 below. It is noted that Permit Variation BT1088ID/VAR004 added a series of improvement conditions to the permit. Specifically these included the assessment of groundwater compliance levels.

Table 1: Summary of Permit Variations.

Permit/ Variation No.	Date	Description
BT1088ID	17th Sept 2002	Original Permit granted
Variations		
VP3130LA (EPR/BT1088ID/V002)	20/12/05	Removal of daily limit for the importation of waste
XP3933MR (EPR/BT1088ID/V003)	22/06/07	Consolidation and update by EA to standard Permit Template
PP3738XM (EPR/BT1088ID/V004)	09/10/09	Amendments to tables S1.2, S1.4, S4.1, S4.2, S4.3, S4.4, S5.1 and added Table S1.3
KP3795FU (EPR/BT1088ID/V005)	01/11/13	Variation to change: company name, registered office address and correspondence address to Lafarge Tarmac Trading Limited.
KP3795FU (EPR/BT1088ID/V006)	16/11/15	Variation to change company name to Tarmac Trading Limited

1.1.4 This report utilises the Environment Agency's template for Hydrogeological Risk Assessment Reviews (2009) and adopts the terminology within the Groundwater Daughter Directive and Environmental Permitting Regulations 2016.

1.1.5 The following reports have been used for reference purposes:

- BCL Consultant Hydrogeologists Ltd, 2000, Hendy Quarry: Hydrogeological Assessment to support Planning Application for Restoration of Quarry Infill with Inert Materials.
- BCL Consultant Hydrogeologists Ltd, 2009, Review of Hydrogeological Risk Assessment for Inert Landfill.
- Tarmac Ltd, Oct 2016, Hendy Landfill (BT1088ID) Improvement Conditions 6 & 7, Review of Groundwater Monitoring Results and Monitoring Frequency.
- Crestwood Ltd, Nov 2009, Environmental Management and Monitoring Programme: Groundwater Management and Monitoring Plan, Hendy Quarry Landfill BT1088ID.
- Tarmac Ltd, January 2017, Hendy Quarry Landfill, Annual Report Permit Reference BT1088ID, January 1st 2016 to December 31st 2016.
- ESI, December 2014, Hendy Quarry – Assessment of Run-off, 62847TN1

1.1.6 Third party information supplied by Tarmac Trading Ltd has been used in good faith within this document. Caulmert Ltd has not attempted to verify the information.

2 CONCEPTUAL HYDROGEOLOGICAL SITE MODEL

2.1 Introduction:

2.1.1 The conceptual model for the site was developed in 2000 as part of the Planning application for the restoration of the quarry via landfilling.

2.1.2 The hydrogeological risk assessment presented by BCL in 2009 updates the hydrogeological setting and presents the risks associated with the infilling of the quarry with inert material. A number of new piezometers were installed prior to the 2009 risk assessment review. These were assessed as part of the improvement conditions 6 & 7 and compliance levels were determined. It was recognised within the submission that these compliance limits would need to be reviewed as more data became available and recommended that these were re-assessed as part of any subsequent HRA review. These are assessed as part of the groundwater pathway below.

2.1.3 A summary of the conceptual model is presented below.

2.2 Source term:

2.2.1 Inert waste was first accepted into the site in September /October 2002 (Ref. BCL 2009). A permit was granted for the site in 2002 under the transitional arrangements of the Landfill Directive.

2.2.2 The site accepts strictly inert waste under the definition within the Landfill Directive which defines the waste as one which does not undergo any physical, chemical or biological transformations; It does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health. Its' total leachability and pollutant content and the ecotoxicity of its leachate are insignificant and, in particular, do not endanger the quality of any surface water or groundwater.

2.2.3 It is acknowledged that waste acceptance procedures are paramount to ensuring that only inert waste in accordance to the definition above are accepted at the site. The operator has waste acceptance procedures in place. It is understood that no non-conformances have been raised by NRW with respect to the waste acceptance procedures at the site. It is however recommended that compliance testing be undertaken of regular waste streams in accordance with industry guidance.

2.2.4 Under the transitional arrangements, there was no requirement for leachate infrastructure to be installed, neither is there any requirement to collect leachate for inert sites under the LFD.

Offsite source of contamination

2.2.5 The 2009 HRA Review states that the Tynewydd Farm Landfill site is located approximately 200m east of the site boundary. This site is reported to have accepted similar waste streams including construction and demolition waste along with dredging waste. This site is considered to be up gradient of the site based on the current groundwater flow direction.

2.2.6 Llwynpennau Farm Landfill is also present approximately 700m east of the site, although the operator went into administration in 2009 and it is not known whether this remains active. This site is also considered to be up gradient of the site based on the current groundwater flow direction.

2.2.7 Three historic landfill site have also been identified in close proximity to the site these include:

- Bute Quarry 250m WNW (down gradient of the site)
- Bute Cottages Quarry 300m N (cross gradient from the site)
- Brofiscin Quarry 1.25km E (up gradient of the site). Records indicate it accepted industrial and chemical waste including toxic substances, solvents, heavy metals and PCBs. (reference HRA 2009).

2.2.8 The above off-site sources indicate that there is the potential for poor quality groundwater to be present up gradient of the site. This is discussed further below.

2.3 Pathways

2.3.1 No additional information has been attained on the pathways from the site. Pre-landfill Directive waste was placed directly in the base of the quarry, which was industry practise at the time. There are no records available to confirm if an engineered geological barrier has historically been placed at the site. All future areas of waste deposit will require the placement of a geological barrier in accordance with the Environmental Permitting Regulations. The conceptual model for the site assumes that the geological barrier is absent across the base of the current waste footprint.

2.3.2 The remaining conceptual model remains largely unaltered. It is summarised below for completeness.

Geology

2.3.3 The geological setting remains unaltered however, the nomenclature has changed and is summarised in accordance with the terms used within the BGS Lexicon[1] of geological names.

Table 2: Summary of Geology

	Group description	Thickness	Formations/ members
Hunts Bay Oolite Group	Mainly ooidal limestones, with subordinate skeletal, peloidal and oncolitic limestones and calcite mudstones	245m	Hunts Bay Oolite Group (undifferentiated)
			Cefnyrhendy Oolite Member
Pembroke Group	Skeletal and ooidal limestones with some calcite and dolomite-mudstones, sandstones and mudstones	Up to 1250m	High Tor Limestone Fm
			Caswell Bay Mudstone Fm
			Gully Oolite Fm
Black Rock Limestone Group	Thin- to thick-bedded, dark grey to black, foetid, fine- to coarse-grained skeletal [mainly crinoid] packstones with subordinate thin beds of shaly argillaceous skeletal packstone and mudstone	500m	Friars Point Limestone Fm
			Brofiscin Oolite Fm
			Barry Harbour Limestone Fm
Avon Group (formerly Lower Limestone Shales	Interbedded grey mudstones and thin- to medium-bedded skeletal packstones with one to several thick units of ooidal and skeletal grainstones. Thin units of calcite mudstone and mudstone locally present. Sparse thin ironstones. Represents mid to inner shelf/ramp deposits with coeval barrier, back barrier and coastal plain sediments.	140m	Cwmyniscay Mudstone Fm
			Castell Coch Fm
			Tongwynlasi Fm

Note: Thickness of groups taken from the BGS Lexicon of descriptions for the Vale of Glamorgan and represent maximum thicknesses.

2.3.4 The quarry is excavated into the Black Rock Limestone Subgroup which is described as skeletal and argillaceous packstones with minor oolites, shales and mudstones. Karstic

[1] British Geological Survey, Accessed July 2017, The BGS Lexicon of Named Rock Units: http://www.bgs.ac.uk/lexicon/home.html

features have been observed in the top 5m (pre quarrying levels). These have been widened and infilled with clays, silts and sands.

2.3.5 Faults and major joint sets within the Lower Carboniferous Limestone Series are orientated north northwest to south southeast with a second joint set orientated east northeast to west southwest. A third set of joints is reported to coincide with the bedding orientation (30-35 degrees to the north).

Hydrogeology

2.3.6 The Carboniferous Limestone is defined as a principal aquifer with flow dominated by fracture flow. Karstic behaviour is reported to be present in upper 5m of the strata which is above the base of the quarry.

2.3.7 The Avon Group (Lower Limestone Shale) is classified as Secondary A. It is noted that this strata was previously classified as a non-aquifer. Although the change in classification reflects a greater understanding of the potential for this strata to transmit groundwater, site investigation and monitoring data collected over the development of the site confirm that the original conceptual model remains valid where there is no groundwater migration towards the south. This is confirmed by the presence of two boreholes along the southern boundary (installed within the Avon Group) which have significantly higher groundwater levels in comparison to those installed within the permeable fractured limestone. Therefore notwithstanding the permeability contrast between the limestone and Avon group, the hydraulic gradient is such that there is no possible groundwater flow towards the south. The water levels within the Avon Group boreholes are considered to represent water in the superficial deposits and weathered zone. Therefore it is considered that these strata effectively form a barrier to flow in a southern direction at the site. The orientation and dip of this strata is considered to constrain the groundwater flow to the south and therefore the principal groundwater flow is along the strike of the beds towards the west.

2.3.8 Limited information is available in the permeability of the underlying limestone. Records of a regional permeabilities and transmissitives are limited. A search of the BGS Physical Properties of the major aquifers of England and Wales[2] has indicated that there is only one transmissivity value available within 10km of the site. This is from a former abstraction

[2] British Geological Survey & Environment Agency, 1997,The physical properties of major aquifers in England and Wales, BGS technical Report WD/97/34, EA R&D publication 8

borehole at the Crown Brewery (now a housing estate) located 1.2km to the north-north west. The borehole appears to be located within the Hunts Bay Oolite Group. The transmissivity was reported as 130m^2/day. Assuming at 30m saturated thickness this would equate broadly to a permeability of 4.3m/day or 5 x 10^{-5}m/s. This value is at the upper end of the range of transmissivities reported for the region which is between 4 m^2/day to 130 m^2/day with a geometric mean of 34m^2/day.

2.3.9 There is additional evidence from the quarry soakaway in support of the high transmissivity values. The discharge limit (to soakaway) is 750m^3/day, however in the assessment of run-off[3], ESI stated that volumes of up to 8,031m^3/day have been discharged.

2.3.10 Many reference within the literature are made to the potential for high permeability conduits within the limestone formation and fracture flow with limited potential for attenuation is considered to dominate the hydrogeological regime at the site.

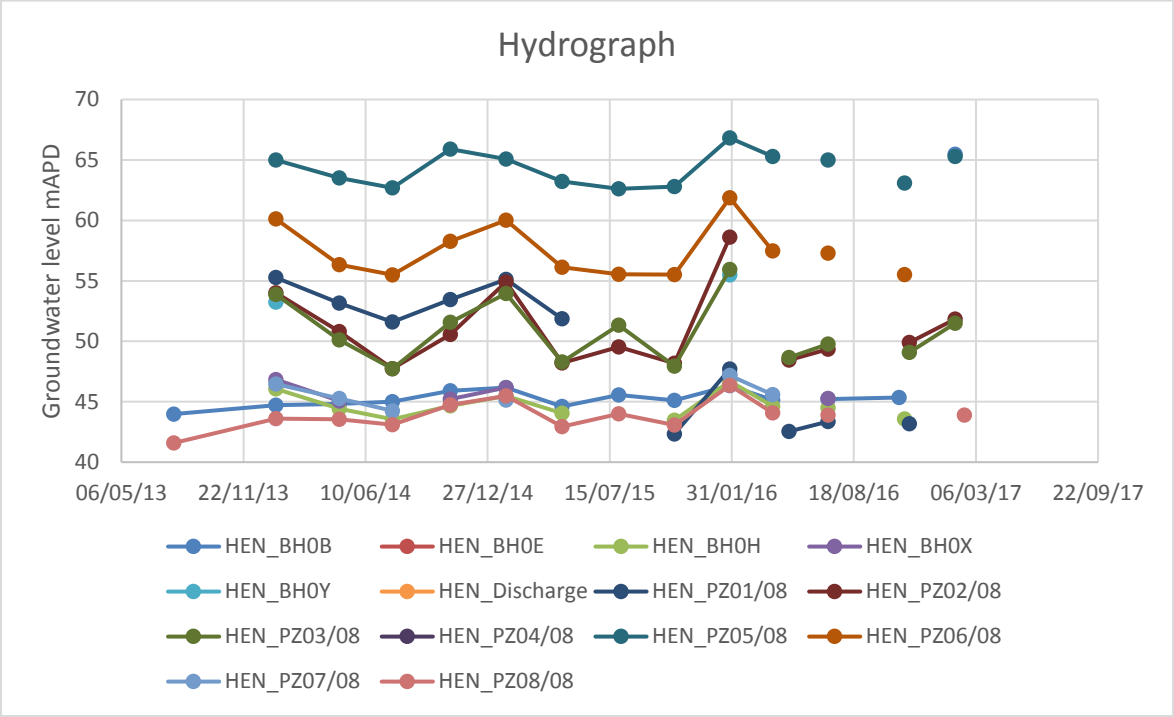
Groundwater Levels and Unsaturated zone

2.3.11 Groundwater levels have been monitored routinely throughout the development of the site.

2.3.12 The groundwater levels have remained relatively consistent with time. The location PZ05/08 and PZ06/08 are located on the outcrop of the Avon Group. These two locations display a significantly higher groundwater level than all other locations at the site and are considered to represent water levels within the weathered shale units. The locations of these boreholes is shown on Drawing 01.

2.3.13 Groundwater levels within the other boreholes indicate consistent groundwater gradient from the east to the west. The quarry sump appears to be in continuity with the groundwater with the water level in the sump recorded as 44.6 mAOD on the June 2017 survey. The depth of the sump is unknown. The nearest borehole to the sump is HEN-BH0B (which typically has levels recorded circa 45 mAOD. It is noted that the boreholes to the east of the sump (up gradient wells PZ02/08 and PZ03/08) display a higher seasonal variation compared to those to the west of the sump.

[3] ESI, Dec 2014, Hendy Quarry – Assessment of runoff, Ref 62847TN1



2.3.14 The base of the quarry is circa 45-46 mAOD. This is similar to the minimum water levels monitored within the up gradient boreholes which indicates that there is no significant (>1m) unsaturated zone beneath the base of the site, however there is no reported groundwater ingress within the base of the quarry.

Groundwater Monitoring and Quality.

2.3.15 The groundwater quality is monitored in two up gradient (PZ02/08, PZ03/08)and two down gradient monitoring wells (PZ07/08, PZ08/08), however previously groundwater quality has been monitored across the wider quarry area and all data available has been assessed with respect to the groundwater quality around the site.

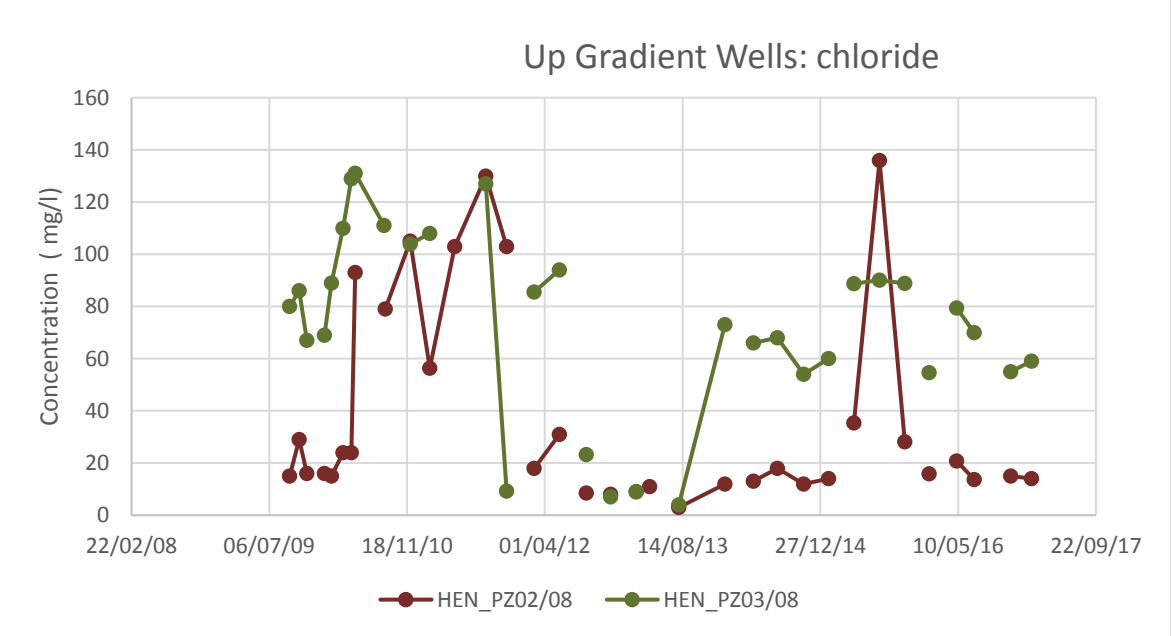
2.3.16 All available monitoring data between 2009 and 2017 has been used within this section. It is noted that a number of boreholes were dry or had insufficient liquid to sample on a number of occasions throughout this review period. Most significantly the down gradient monitoring well PZ07/08 has been dry for the past 4 years and therefore is not suitable to monitor the groundwater in this location.

2.3.17 The time series data presented in Appendix 1 has been assessed in terms of likely putrescible waste indicator species that is ammoniacal nitrogen and chloride, in order to identify if the inert waste mass is preforming as expected.

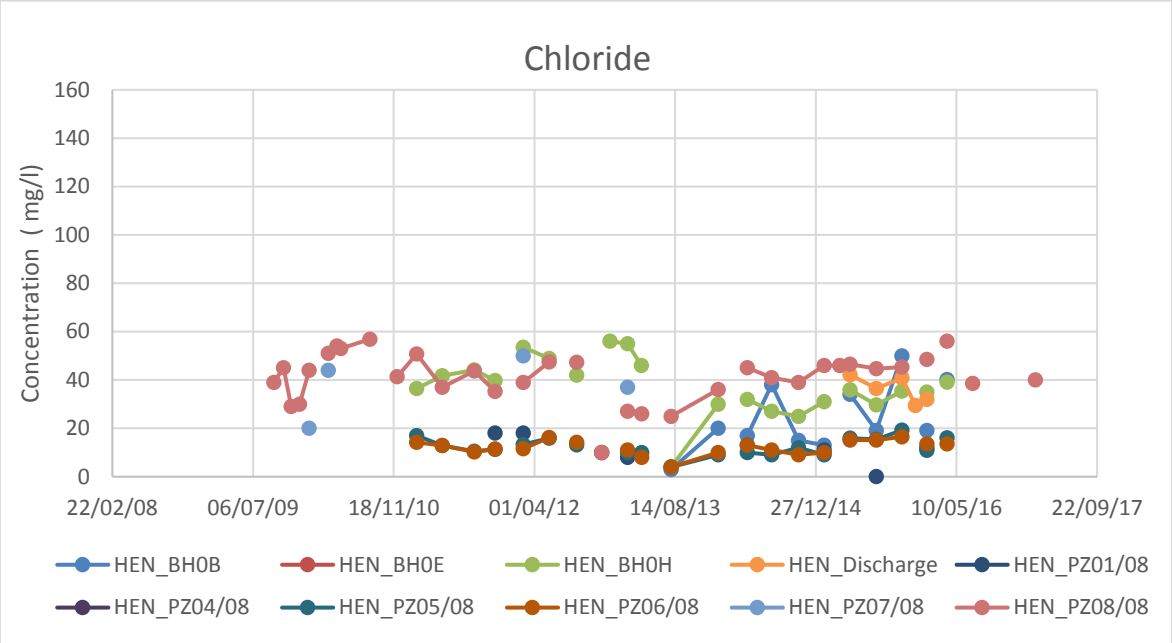
2.3.18 The graphs and statistics assume that all results recorded at less than the laboratory detection limit are at this level to enable them to be displayed and conservatively included in the statistic.

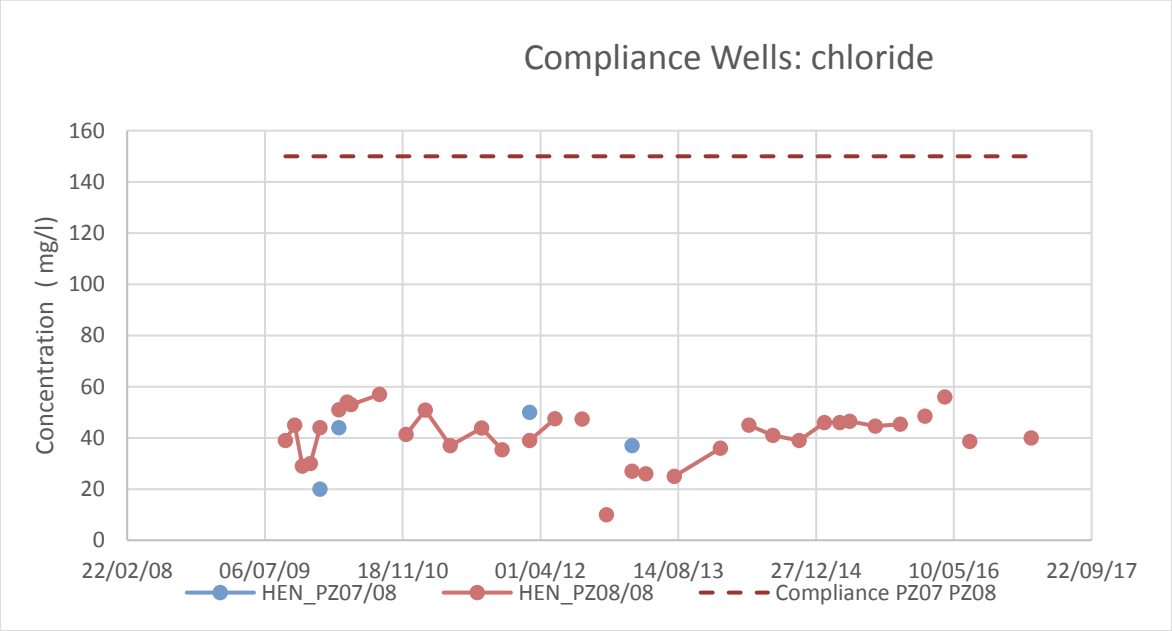
2.3.19 The chloride concentrations presented in the graphs below indicates that there is a distinct difference in concentrations observed in the up gradient boreholes (particularly PZ03/08) and all other locations. The time series graph below indicates that consistently higher chloride concentrations are observed in PZ03/08 which is up gradient of the site. Although this is not accompanied by any discernible increase in ammoniacal nitrogen concentrations, there is a discernible difference in sodium concentrations between PZ02/08 and PZ03/08. An ionic balance between the chloride and sodium concentrations is variable with time and on occasion within 10% (Jan 2017) which may indicate an impact from salt, however the concentrations are very low and therefore if the source is salt, it is unlikely to be in close proximity to this borehole. It is noted that recent data for PZ02/08 is comparable to the other borehole since 2014 with one exception.

2.3.20 All results for PZ07/08 and PZ08/08 are lower than the compliance level of 150 mg/l.



2.3.21 There are no discernible trends within the down gradient data.

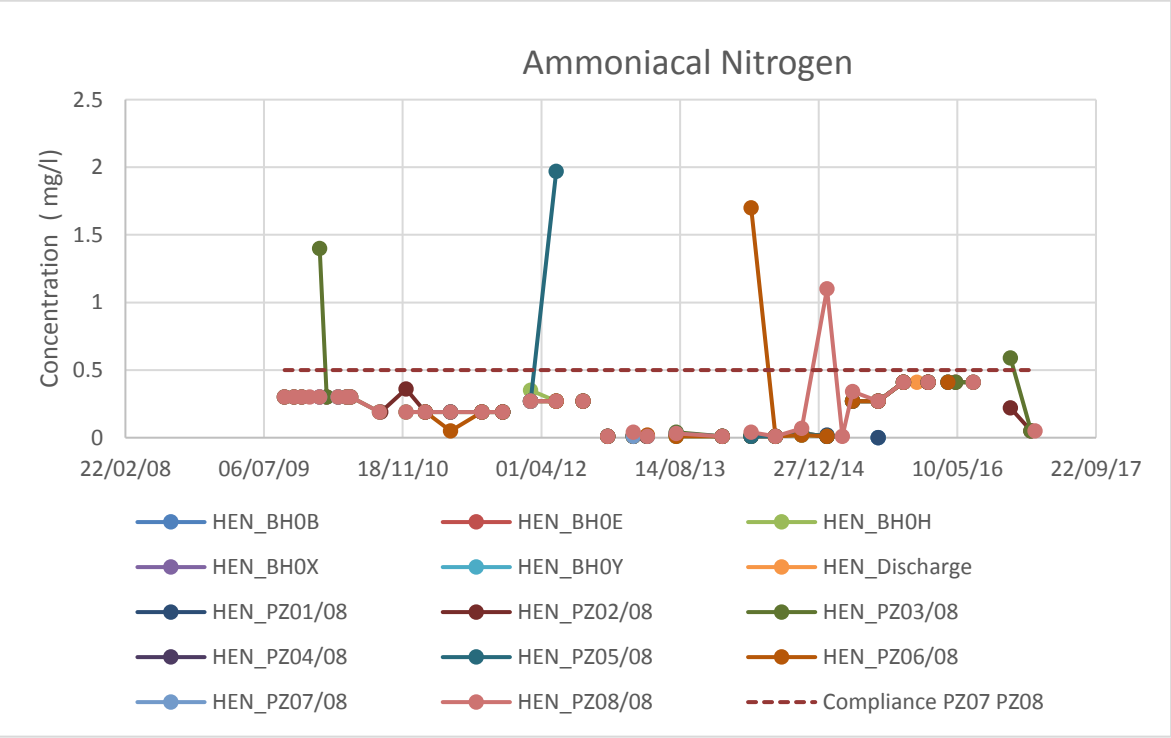


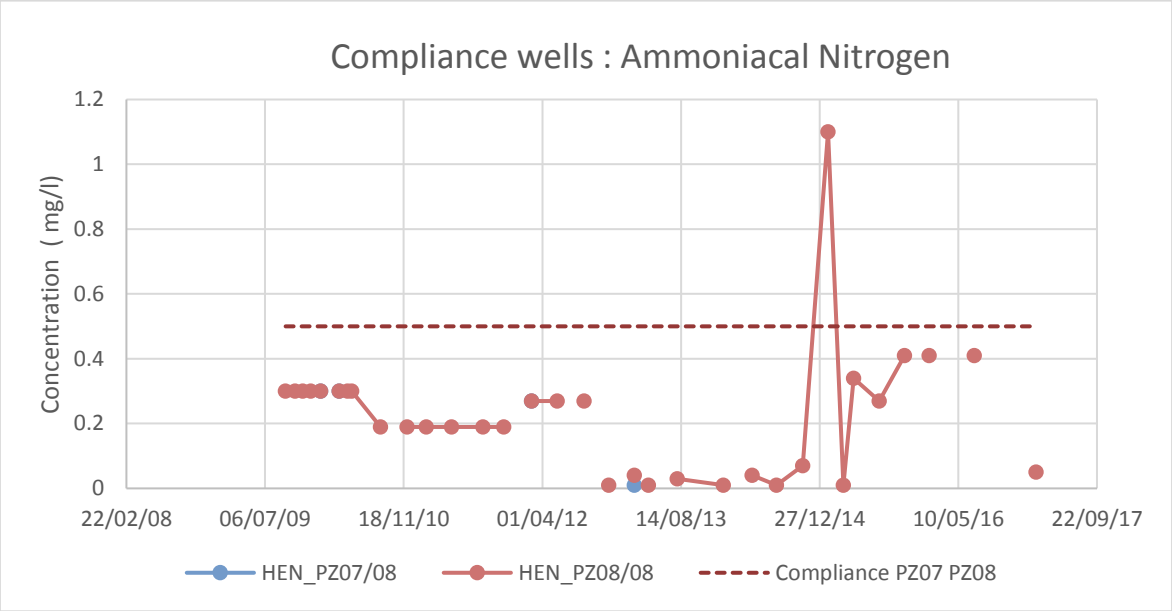


2.3.22 The ammoniacal nitrogen concentrations are typically recorded at less than the lab detection limit, however it is noted that this has varied between <0.41 mg/l and <0.01 mg/l. In recognition of this issue, the detection limit from April 2017 onwards is <0.05 mg/l. Where recorded the ammoniacal nitrogen concentrations are generally lower than the compliance criteria of 0.5 mg/l. Within the compliance wells, only one exceedance of the compliance criteria is recorded in PZ08/08 with an additional value of 10.7 mg/l excluded on the basis that previous and following samples had results of <0.3 mg/l, in addition there is no increase of similar magnitude in other parameters (particularly chloride) and therefore

the result is not considered to be due to 'leachate' from the waste mass. Any such 'leachate' would be expected to have a similar proportionate rise in concentrations of other indicator species and be sustained over a longer period.

2.3.23 A second exceedance was observed in December 2014 with a value of 1.2 mg/l. The timeseries graphs below also show that this was not part of any prolonged deterioration in groundwater quality nor associated with any of the 'spikes' in non-compliance borehole, neither is it associated with any increase in chloride concentrations within the borehole. Therefore it is very unlikely that this result is due to an impact from waste deposited under the conditions of the Permit.



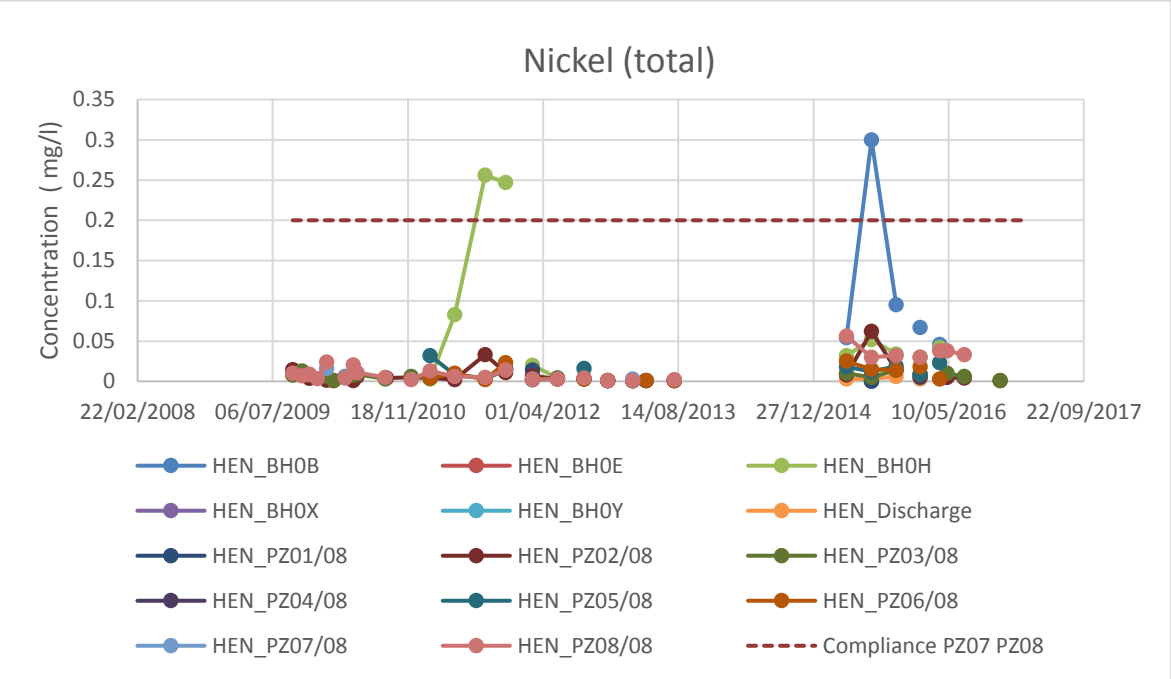


2.3.24 Nickel is reported as total and dissolved concentrations. The latter is only present for a short period between March 2013 and March 2014 (see Appendix 1 for timeseries graph) whereas all other periods it is reported as total Nickel (mg/l). In recognition of this issue all metal concentrations since April 2017 have been monitored as dissolved concentrations and all timeseries data has been separated between total and dissolved concentrations with only selected graphs presented below.

2.3.25 The dissolved nickel concentrations are significantly below the compliance limit for PZ07/08 and PZ08/08 and are also significantly lower than the total nickel concentrations preceding and postdating this monitoring. This difference between total and dissolved concentrations illustrates the issues of particulate matter and colloidal matter which could occur within the samples.

2.3.26 The total nickel concentrations are generally significantly below the compliance limit for PZ07/08 and PZ08/08. The time series chart below indicates that there are two results higher than this level in BH0H in 2011 which then drop from 0.25 mg/l to 0.02 mg/l by the next result. The cause of this initial peak (2 results) is unknown however due to its limited longevity it is not considered to be associated with the waste operations as it is not associated with any increase in other parameters. In addition, there is a single isolated result in July 2015 in BH0B which is also above this level, however this considered to be a sporadic result and is not considered further. The sporadic nature of the results is considered to reflect the potential impact of sediments within the sample when analysed

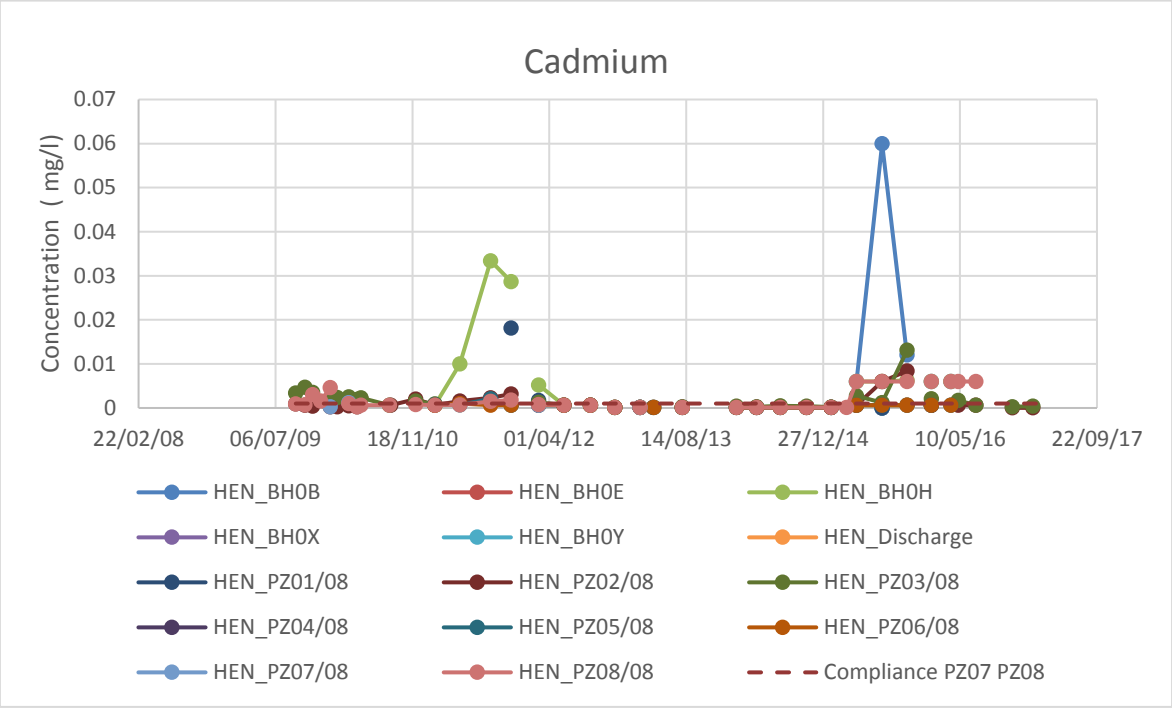
for total metal concentrations. It is therefore not considered to be representative of dissolve pollution within the groundwater.



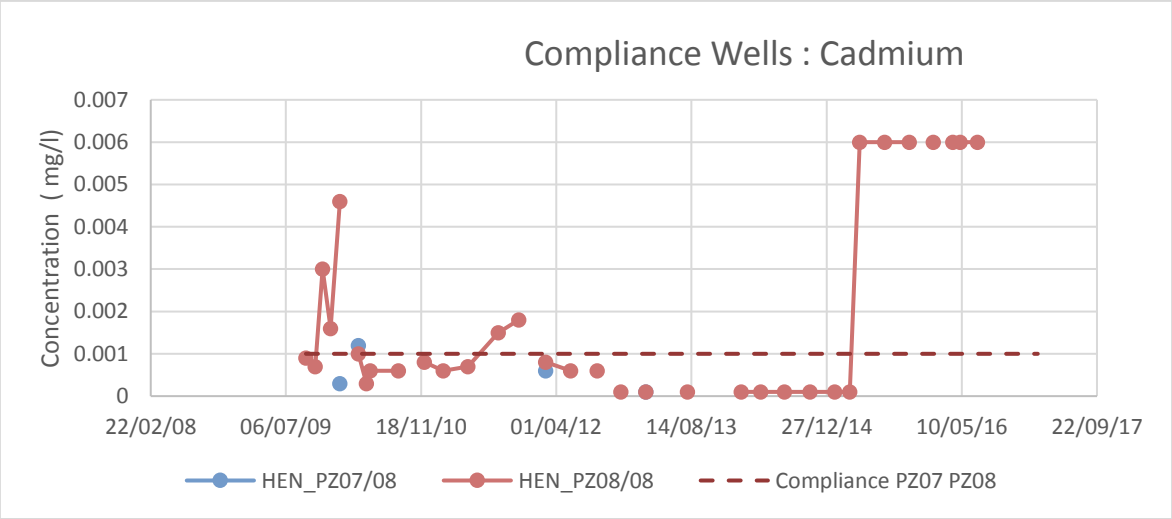
2.3.27 A review of the cadmium monitoring data indicates that prior to 2013 the cadmium concentrations were more varied across the site. No limits of detection are present in the data between 2009 and 2013 and therefore all concentrations are recorded as 'real' results. The most apparent feature is a spike in cadmium in borehole BH0H. The cause is unknown however it appears to mirror the nickel concentrations and may be due to sediment within the sample.

2.3.28 Post 2013, the boreholes with the exception of PZ03/08 generally record cadmium below the detection limit with only one recorded concentration in BH0H (0.0063 mg/l) and two recoded concentrations in PZ02/08 (0.006 mg/l and 0.0084 mg/l). In contrast, the results for PZ03/08 only have one result recorded as being less than the detection limit over the same time period with all other results marginally above the detection limit range between 0.0002 mg/l to 0.0131 mg/l). This is consistent with the conclusions of the previous HRA review which identified relatively higher concentration of cadmium in PZ03/08 compared to the remaining boreholes.

2.3.29 The data within the graphs are presented at their detection limit and therefore the spike portrayed for BH0B in July 2015 is misleading as this value is less than the detection limit.

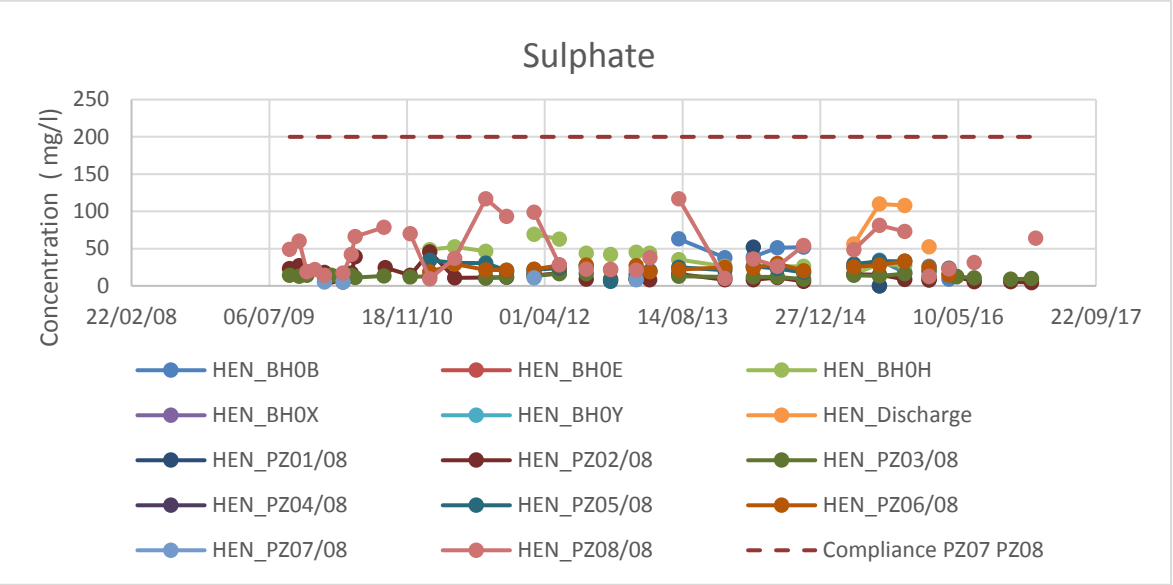


2.3.30 The cadmium concentrations for the compliance wells are presented in the graph below. This implies that the compliance criteria was exceeded in PZ08/08 from April 2016 onwards, however this is a result of the laboratory detection limit increasing to 0.006 mg/l within the database. All samples were recorded below this level and prior to April 2016 the concentrations were generally below 0.0001 mg/l. Therefore these results are not considered to represent an increase in concentrations with time but reflect the change in lab detection limits and consequently unable to demonstrate compliance. In reflection of these observations, the monitoring of cadmium since April 2017 has been reviewed and targeted for dissolved metal with a detection limit of 0.02ug/l.



2.3.31 The cadmium concentrations appear consistent with the previous HRA, with respect to no consistent results above the detection limit other than in PZ03/08 (up gradient).

2.3.32 Sulphate concentrations remain below the compliance limit for the duration of this review period. This remains consistent with the previous HRA review in 2009.



2.3.33 Naphthalene concentrations are consistently low across the site. The detection limit for all samples take on 7/7/2016 was <2 ug/l which is higher than the usual detection limit of <0.01ug/l. Therefore the graph below appear to show an increase on this occasion, however it is a reflection of the variation in detection limits. Naphthalene remains in compliance with permit criteria.

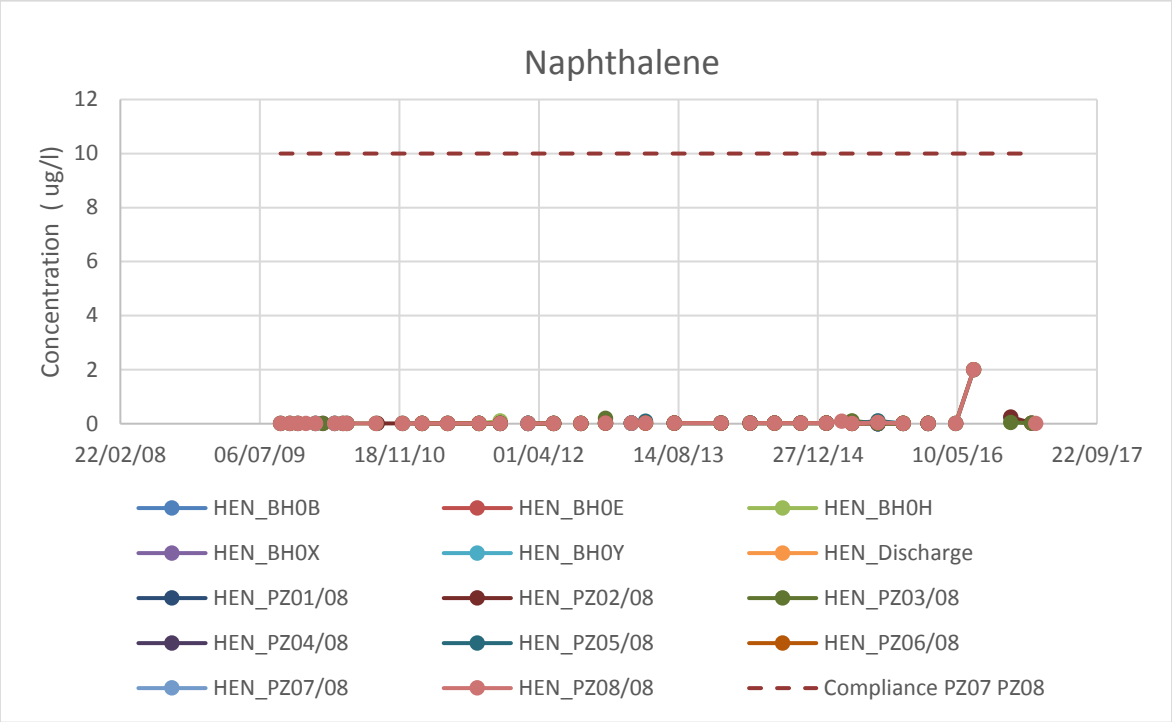

Naphthalene
Concentration (ug/l)
12
10
8
6
4
2
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

Table 3: Summary Statistics 2009-2017 for parameters with compliance limits

	HEN_BH0B	HEN_BH0E	HEN_BH0H	HEN_BH0X	HEN_BH0Y	HEN_Discharge	HEN_PZ01/08	HEN_PZ02/08	HEN_PZ03/08	HEN_PZ04/08	HEN_PZ05/08	HEN_PZ06/08	HEN_PZ07/08	HEN_PZ08/08
Chloride (mg/l)														
Compliance													150	150
Min	3		4			29.5	8	3	4		4	4	20	10
Average	24		38			36	13	37	73		12	12	38	41
Max	50		56			42.2	18	136	131		19.2	16.5	50	56.9
Count	11		21			5	6	34	32		21	21	4	34
Ammoniacal Nitrogen (mg/l)														
Compliance													0.5	0.5
Min	0.01		0.01			0.27	0.01	0.01	0.01		0.01	0.01	0.01	0.01
Average	0.16		0.18			0.35	0.15	0.21	0.26		0.25	0.24	0.22	0.23
Max	0.41		0.41			0.41	0.41	0.41	1.4		1.97	1.7	0.3	1.1
Count	12		20			5	6	34	32		21	21	4	33
Cadmium (mg/l)														
Compliance													0.001	0.001
Min	0.0001		0.0001			0.0006	0.0001	0.00002	0.0001		0.0001	0.0001	0.0001	0.0001
Average	0.0082		0.0053			0.0006	0.0035	0.0010	0.0017		0.0005	0.0004	0.0006	0.0019
Max	0.06		0.0334			0.0006	0.0181	0.0084	0.0131		0.0021	0.001	0.0012	0.006
Count	11		21			4	6	34	32		21	21	4	33
Nickel (mg/l) (total)														
Compliance													0.2	0.2
Min	0.046		0.001			0.003	0.001	0.0009	0.0009		0.001	0.001	0.003	0.001
Average	0.112		0.054			0.004	0.0091	0.008	0.006		0.010	0.008	0.007	0.015
Max	0.3		0.256			0.006	0.0165	0.062	0.014		0.032	0.025	0.016	0.056
Count	5		15			4	4	28	26		16	16	4	27

	HEN_BH0B	HEN_BH0E	HEN_BH0H	HEN_BH0X	HEN_BH0Y	HEN_Discharge	HEN_PZ01/08	HEN_PZ02/08	HEN_PZ03/08	HEN_PZ04/08	HEN_PZ05/08	HEN_PZ06/08	HEN_PZ07/08	HEN_PZ08/08
Nickel Dissolved (mg/l)														
Compliance													0.2	0.2
Min	0.001		0.001			0	0.001	0.001	0.001		0.001	0.001	0	0.001
Average	0.001		0.001				0.001	0.001	0.001		0.001	0.001		0.001857
Max	0.001		0.001			0	0.001	0.001	0.001		0.001	0.001	0	0.004
Count	6		6			0	2	6	6		6	6	0	7
Sulphate (mg/l)														
Compliance													200	200
Min	9.1		16			52.5	8.5	4.3	8	0	6	14.7	0	9.6
Average	35.5		33.1			81.7	21	12.8	12.5	0.0	25.4	24.9		53.0
Max	63		69.2			110	52	45.6	16.4	0	34.3	33.1	10.7	117
Count	10		19			4	5	34	32	0	21	21	4	33
Naphthalene (ug/l)														
Compliance													10	10
Min	0		0.01			0.01	0.01	0.01	0.01		0.01	0.01	0.01	0.01
Average	0.02		0.02			0.01	0.015	0.08	0.08		0.02	0.02	0.01	0.07
Max	0.02		0.1			0.017	0.02	2	2		0.1	0.04	0.02	2
Count	10		20			4	6	34	32		20	20	4	34

Assessment of Hazardous Organic Contaminants

2.3.34 The publication of the assessment of hazardous substances by UKTAG in 2017, reclassified lead as a hazardous substance and consequently this has been discussed separately below.

2.3.35 Organic contaminants have been recorded above the detection limit in all locations between 2013 and 2017. Prior to this date the database does not include less than identifiers and for the purpose of assessing the occurrence has been exclude for the table below. The number of occasions above detection limit is presented in Table 4 below:

Table 4: Number of recorded occurrences of Hydrocarbons in Groundwater

	HEN_PZ 05/08	HEN_PZ 01/08	HEN_PZ 06/08	HEN_Discharge	HEN_PZ 02/08	HEN_PZ 08/08	HEN_PZ 03/08	HEN_BH0B	HEN_BH0H
TPH	1	2	2	6	3	6	4	6	6
TPH Band >C16-C24)	1	2	2	6	3	6	4	6	6
TPH Band >C24-C40	1	2	2	6	3	6	4	6	6
Total PAH	1	2	2	4	5	8	9	10	11
Chrysene	1	2	2	2	3	6	5	7	8
Benzo-b-fluoranthene		1	1		1	1	1	2	2
Benzo-k-fluoranthene	1	2	2	2	3	6	5	7	8
TPH (ug/l)				3	2	2	4	2	2
Fluoranthene	1	2	2	2	3	6	5	7	8
Benzo-ghi-perylene	1	2	2	2	3	6	5	7	8
Benzo-a-anthracene	1	2	2	2	3	6	5	7	8
Benzo-a-pyrene	1	2	2	2	3	6	5	7	8
Naphthalene	1	2	2	4	5	8	9	9	10
Dibenz-ah-anthracene	1	2	2	2	3	6	5	7	8
Indeno-123-cd-pyrene*	1	2	2	2	3	6	5	7	8
Fluorene	1	2	2	2	3	6	5	7	8
Pyrene	1	2	2	2	3	6	5	7	8
Phenanthrene	1	2	2	2	3	6	5	7	8
Anthracene*	1	2	2	2	3	6	5	7	8
Acenaphthene*	1	2	2	2	3	6	5	7	8
Acenaphthylene	1	2	2	2	3	6	5	7	8

2.3.36 The table indicates that Borehole BH0B and BH0H have the highest number of occurrences of organics in the samples. The highest concentration are observed in BH0B and BH0H rather than BH08/08 which implies that the source of the contamination lies to the north

of the waste mass. It is noted that these boreholes are located close the weighbridge and yards areas. It is considered unlikely that these concentrations are due to the landfilled inert waste due to the distance of these boreholes from the waste mass (cross-gradient). Similar number of occurrences are observed within the surface water discharge, the up gradient wells (PZ02/08 and PZ03/08) and the down gradient well PZ08/08.

2.3.37 The maximum and average concentrations (calculated based on the assumption that concentrations <detection limit are at detection), are presented below.

Table 5: Maximum concentrations of Hydrocarbons recorded in Groundwater

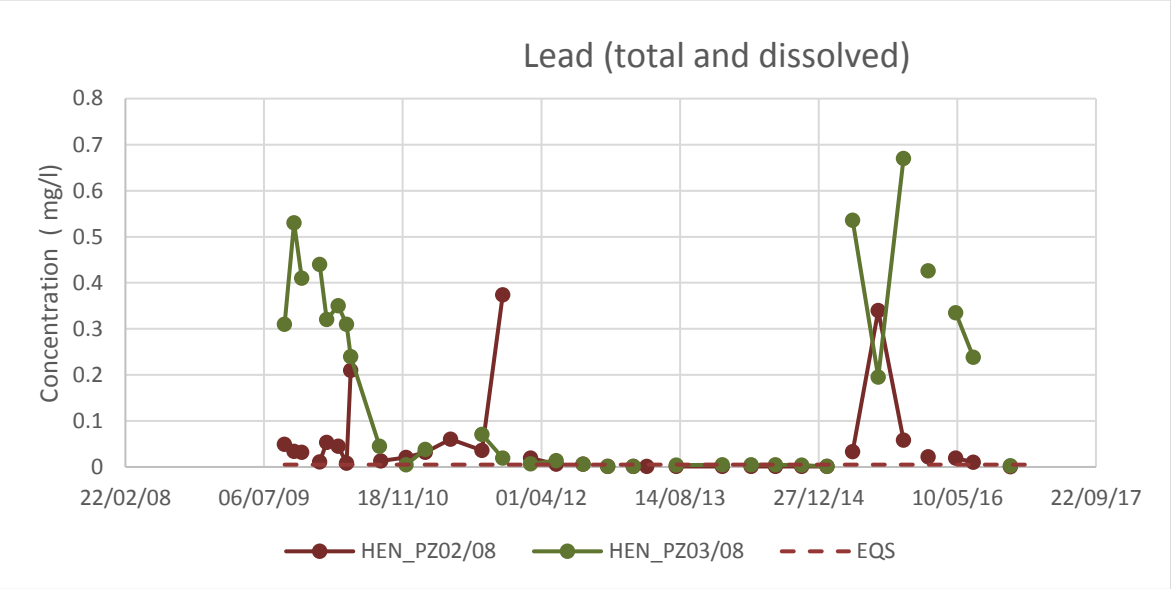
		Max	Associated well	Date
TPH	mg/l	1.67	BH0H	14/01/2014
TPH (ug/l)	ug/l	98	PZ03/08	04-May-16
TPH Band >C16-C24)	mg/l	1.16	BH0H	14/01/2014
TPH Band >C24-C40	mg/l	0.37	BH0H	14/01/2014
Acenaphthene	ug/l	0.124	BH0H	28/04/2015
Acenaphthylene	ug/l	0.031	BH0B	27/10/2014
Anthracene	ug/l	0.071	BH0B	27/10/2014
Benzo-a-anthracene	ug/l	0.415	BH0B	27/10/2014
Benzo-a-pyrene	ug/l	0.558	BH0B	27/10/2014
Benzo-ghi-perylene	ug/l	0.489	BH0B	27/10/2014
Benzo-k-fluoranthene	ug/l	0.258	BH0B	27/10/2014
Benzo-b-fluoranthene	ug/l	0.915	BH0B	27/10/2014
Chrysene	ug/l	0.479	BH0B	27/10/2014
Dibenz-ah-anthracene	ug/l	0.168	BH0B	27/10/2014
Fluoranthene	ug/l	0.544	BH0B	27/10/2014
Fluorene	ug/l	0.15	BH0H	14/01/2014
Indeno-123-cd-pyrene	ug/l	0.544	BH0B	27/10/2014
Naphthalene	ug/l	0.25	PZ02/08	17/11/2016
Phenanthrene	ug/l	0.155	BH0B	26/01/2015
Pyrene	ug/l	0.479	BH0B	27/10/2014
Total PAH	ug/l	10	Hen (Discharge)	29/10/2015

Lead

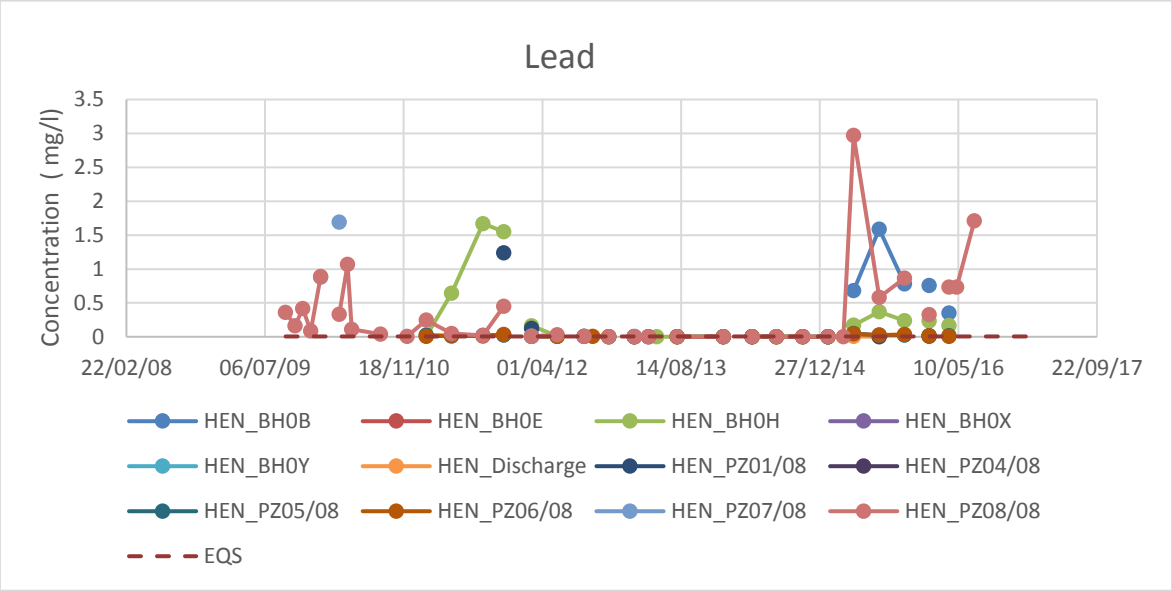
2.3.38 Lead is found naturally occurring within groundwater. UKTAG defines values for hazardous substance which 'concentrations in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided (an annual mean ug/l). For lead this value is 5 ug/l. It is noted that this technical report postdates the values (AA of 1.2 ug/l and MAC of 14 ug/l) presented by the EA(England) in their guidance on surface water risk assessment and that the UKTAG values are specific to groundwater as opposed to surface water environments. Therefore it is considered more consistent with the technical

guidance to adopt the values presented for groundwater for the hydrogeological review for the site.

2.3.39 The up gradient groundwater quality is inferior to this as indicated in the time series chart below. It is recommended that future analysis is for dissolved lead only to avoid and spikes in concentration associated with sediments with the sample and to allow direct comparison to the relevant standard. The period of dissolved lead monitoring between 2012 and 2015 indicated consistent levels below this criteria. The high concentrations are reported for samples where total lead has been monitored.



2.3.40 The down gradient monitoring wells display a similarly erratic trend with concentrations ranging from <0.001 to 3 mg/l.



2.3.41 In order to set compliance limits for this parameter, it is necessary to have confidence in the natural concentrations of dissolved lead within this environment. Therefore due to the uncertainties within the database displayed as erratic results, it is not proposed to include this hazardous substance in the list of parameters for compliance monitoring.

Other Parameters:

2.3.42 Timeseries charts are presented in Appendix 1 for all other parameters monitored at the site. The graphs indicate that there has potentially been issues with units for the total iron concentrations and total manganese concentrations. Alternatively there is the potential for these results to represent colloidal sediment in the sample.

2.3.43 The potassium and sodium concentrations are relatively stable however the calcium and magnesium concentrations show a spike in July 2015 in both the up gradient and down gradient locations. The cause of this spike is unknown however the concentrations returned rapidly to background levels.

2.3.44 The chromium concentrations have a have a higher degree of variability from 2015 onwards in BH0B, BH0H and PZ08/08, however this may reflect the change from dissolved concentrations to total chromium concentrations. It is noted that the detection limit also increases accordingly at this time. Boreholes BH0B and BH0H are down gradient of the waste mass and as this event is observed in all three locations, it is not considered to represent a deterioration in the water quality associated with the waste mass.

Technical Precautions

2.3.45 All new areas will be engineered in compliance with the Landfill Directive. The technical precautions will include the placement of a geological barrier with a minimum thickness of 1m and permeability of 1 x 10^{-7}m/s.

2.3.46 The current site relies on the waste acceptance policy and procedures to ensure that only inert waste is accepted at the site.

2.4 Receptors

2.4.1 The primary receptor remains the groundwater within the Carboniferous Limestone which ultimately discharges to the River Ely. A recent review of the licenced and unlicensed abstractions was undertaken in 2009. It is assumed that these receptors remain valid.

2.4.2 The 2009 report also identifies the presence of a SSSI along a stretch of the Ely Valley located approximately 2km down gradient of the site. Due to the distance from the SSSI, the site is considered to be a low to moderate sensitive locations with respect to the potential impact on the SSSI.

2.5 Suitability of Environmentally Acceptable Levels

2.5.1 In 2009 the background water quality data was reviewed to provide site specific compliance limits for the groundwater quality at the site. The priority contaminants selected were based on the likely potential contaminants such as hydrocarbons, ammoniacal nitrogen and chloride which may be associated with contaminated soils and top soils within rogue loads. It is considered that these remain valid. The assessment levels were based on a combination of background water quality and water quality standards at the time. We note that a number of the water quality standards (specifically Nickel) have been revised in accordance with the Water Framework Directive, together with the reclassification of cadmium as a non-hazardous substance. (UKTAG January 2017).

Table 6: Environmentally Acceptable Levels

Parameter	Quality standard		Standard	Up Gradient groundwater 95%ile	Selected EAL
	AA	MAC			
Ammoniacal Nitrogen		0.5	Water supply Regulations	0.41^	0.5
Naphthalene ug/l	2	130	EQS (WFD)	0.035	2
Nickel ug/l	4 (bio)	32	EQS (WFD)	14	20
Cadmium ug/l	0.25*	1.5*	EQS (WFD)	3.4#	3.4
Chloride mg/l		250	Water supply Regulations 2016	128	150
Sulphate mg/l		400	Water supply Regs 2016	26	75

Notes: ^ 95%ile values is the same as the laboratory detection limit.

*Average alkalinity for up gradient locations is 288 mg/l CaCO3. Standard selected on this basis

- anomalous data point of removed from calculation of 95%ile (0.0131mg/l discarded)

2.6 Summary/Discussion

2.6.1 The key conclusions with regards to the conceptual site model since the last HRA/HRA Review was submitted are:

- No change in permitted waste types accepted at the site ;
- No change in pathways;
- A geological barrier will be installed in all new areas providing additional protection;
- Groundwater quality indicates no discernible change in quality.
- Receptors - no change in receptors.

3 HYDROGEOLOGICAL RISK ASSESSMENT

3.1 The Nature of Hydrogeological Risk Assessment

3.1.1 The Groundwater Directive does not apply to the site since the materials to be imported are strictly inert as defined by the Environmental Permitting Regulations. The site is located in a high sensitivity setting with respect to the groundwater and surface water environment. However the Environment Agency's technical guidance (as adopted by NRW) indicates that the appropriate complexity of risk assessment for a landfill site should be determined from the potential risks posed by the development which is linked to the sensitivity of the site setting.

3.1.2 The guidance provides indicative risk assessment levels for a range of scenarios. Adopting this guidance, the site is an inert waste facility, located on a highly permeability principal aquifer and with the base sub water table. Based on this setting the guidance recommends a generic risk assessment. It is noted that previous assessments for the site have been based on risk screening approach.

3.1.3 It is therefore considered that a simple risk assessment for the site is required to ensure compliance with the Environmental Permitting Regulations. This deviated from the 2004 risk assessment where only risk screening was undertaken.

3.2 The Proposed Assessment Scenario

Life Cycle Phase, Accidents and their Consequences

3.2.1 It is considered that a risk assessment of life cycle phases is not appropriate, given that the landfill by definition, will not produce any leachate that could result in a significant discharge of hazardous substances or non-hazardous pollutants throughout the development of the site.

3.2.2 Strict waste acceptance procedures will be adopted at the site to minimise the risk of noncompliant loads being accepted at the site. Any waste material not meeting the waste acceptance criteria will be removed from site.

3.2.3 The technical precautions comprising the geological barrier will not be subject to long term degradation.

3.3 The Priority Contaminants to be Modelled

3.3.1 There are no proposed changes to the priority contaminants identified in 2009. These were selected to represent potentially non inert component of a rogue load such as organic contamination of soils from fuel spills etc., degradable material which would be identified by chloride and ammoniacal nitrogen concentrations and mobile metal ions nickel.

3.4 Review of Technical Precautions

3.4.1 Under the Landfill Directive all new areas of disposal are required to be lined with a geological barrier. The specification for an inert facility is 1m at 1 x 10^{-7} m/s or equivalent with the geological barrier being a minimum of 0.5m thick. No construction details are available with regards to the current area and therefore conservatively, it is assumed within the assessment that no geological barrier is present.

3.4.2 Due to the nature of the waste, there is no technical requirement for leachate management infrastructure or engineered cap.

3.5 Numerical Modelling

3.5.1 *Justification for modelling approach and software*

3.5.2 As indicated above, site is considered to meet the requirement for a simple /generic risk assessment. This has been undertaking by reviewing the potential flow in the underlying aquifer, the potential leakage rates based on infiltration through the surface of the waste mass. This is based on a deterministic approach with realistic worst case values used within the calculations.

3.5.3 *Model parameterisation*

Assessment of Dilution in Limestone

3.5.4 The conceptual model presented above indicates that the flow within the Carboniferous Limestone is limited to fracture flow. The parameter used within this assessment are discussed in Section 2 above. It is assumed that the majority of flow will usually occur within the top 10 -30 m of the water table. The transmissivity is adopted from the nearest literature value which is 130m^2/day.

3.5.5 Based on Darcy's law the flow within the limestone immediately below the base of the site is calculated to be:

Q= K * I * A

Where K is 13 m/day (transmissivity divided by the saturated thickness 10m)

I is 0.02 (groundwater contours see Drawing 3145HRA 02)

A is thickness (10m) * flow width (300m - base of site perpendicular to groundwater flow)

Q = 702 m^3/day

If the average transmissivity of the unit is used within the calculation (34 m2/day) the predicted groundwater flow is 183 m^3/day.

Calculation of potential leakage rate

3.5.6 Under steady state conditions, the potential leakage from the site will be controlled by the infiltration through the restoration soils. No site specific long term rainfall data is available and this generic assessment is based on long term annual rainfall figures taken from Technical bulletin 35[4]. It is recognised that this reference is old and a further 10% has been added to account for climate change.

3.5.7 Based on the rainfall of 1172 mm/yr and potential evapotranspiration rate of 510 mm/yr (for grass land), the effective rainfall to the site would be 660 mm/ yr. Therefore taking into account climate change (10%) 720 mm/yr potential infiltration to the site. Such high rainfall rates are likely to generate runoff from the site such that not all rainfall would infiltrate the waste mass. Information presented in the ESI report[-1] indicates a run off coefficient of 0.67 would apply. This reduces the potential infiltration rate to 238 mm/yr.

3.5.8 Therefore based on a surface are of the restored quarry of (15Ha) the volume of leakage through the base of the site is equivalent to 97 m^3/day.

3.5.9 In addition it is important to consider that this is inert waste and only rogue loads would have the potential to generate any leachate of discernible quality. Therefore assuming a 1

[4] Ministry of agriculture Fisheries and Food, Technical Bulleting 35, The Agricultural Climate of England and Wales.

in 100 rogue load, the generation of potentially contaminating water would be approximately 1m^3/day.

3.5.10 Therefore there is 700 times more water flowing beneath the site than the potential contaminated leakage rate.

3.5.11 Rogue loads within inert waste sites are unlikely to contain significant putrescible waste or hydrocarbons as such load would be identified as being unacceptable in accordance with the waste acceptance procedures. Therefore with 700 times dilution, it is considered unlikely that there is any potential risk to the groundwater environment from the waste mass.

3.5.12 *Sensitivity analysist*

3.5.13 Limited information is available on the permeability of the underlying limestone. Therefore the sensitivity of the model to this parameter will be assessed.

3.5.14 Assuming the average literature value for groundwater flow there is 180 times dilution within the aquifer. However evidence from site on the discharge rates to soakaway indicates that the permeability is likely to be close to the maximum literature value.

3.5.15 *Model validation*

3.5.16 The model indicates that there should be no discernible impact from the site on the groundwater quality in the down gradient monitoring boreholes. The examination of the groundwater monitoring data presented in Section 2 above indicates that there is no evidence of contamination from the waste mass itself.

3.6 Emissions to Groundwater

Assessment of significance of leachate

3.6.1 The above calculations indicate that the potential to generate a leachate is very small in comparison to the flow within the aquifer beneath the base of the site. In order to understand the significance of these finds an arbitrary assessment of a nominal contaminant loading indicates that there would be no unacceptable discharge at the point of groundwater emergence. This assessment is based on dilution within the aquifer only and no attenuation or dispersion has been considered.

3.6.2 *Hazardous substances*

3.6.3 The waste accepted at the site will be inert waste in accordance with article 2 of the LFD. Therefore, by definition, it will not pose a risk to groundwater with respect to hazardous substances.

3.6.4 *Non-hazardous pollutants*

3.6.5 The waste accepted at the site will be inert waste in accordance with article 2 of the LFD. Therefore, by definition, it will not pose a pollution risk to groundwater with respect to non-hazardous pollutants.

3.7 Hydrogeological completion criteria

3.7.1 The site accepts inert waste which by definition does not degrade. Therefore no completion criteria are applicable to the site.

3.8 Review of Technical Precautions

3.8.1 Capping – the waste comprises inert fill material and as such does not require a low permeability capping layer.

3.8.2 Lining Design - a geological barrier will be placed in all new areas in accordance with the landfill Directive. The geological barrier is required to have a minimum thickness of 0.5m with a permeability equivalent to 1m at 1 x 10^{-7} m/s.

3.8.3 Leachate drainage systems and head control - due to the inert nature of the waste, there is no requirement to collect and manage the leachate at the site.

3.8.4 Groundwater management - there is no requirement for groundwater management at the site.

4 REQUISITE SURVEILLANCE

4.1 Risk Based Monitoring

4.1.1 Environmental Permitting Regulations transpose the Landfill Directive requirement that Requisite surveillance is undertaken where disposal of hazardous substances or non-hazardous pollutants has been authorised. Although the waste stream is inert as defined by article 2 of the LFD, there remains a requirement to monitor groundwater to demonstrate that there is no adverse impact on the groundwater environment.

4.2 Leachate Monitoring

4.2.1 Due to the nature of the waste, no leachate collection infrastructure is required at the site and no monitoring is required.

4.3 Groundwater Monitoring

4.3.1 The environmental permit (PP3738XM 9 Oct 2009) states that the following monitoring is required to monitor the performance of the site (waste area).

Table 7: Groundwater Monitoring Requirements

Location	Frequency	Parameter
Groundwater		
Upgradient: PZ02/08, PZ03/08	Quarterly	Water level (mbgl). pH, EC, DO, temp, ammoniacal nitrogen, chloride, alkalinity, TON, TOC, sulphate, Sodium, Potassium, Calcium, Magnesium, iron, manganese, cadmium, chromium, copper, nickel, lead, zinc, TPH, PAH, naphthalene
Down gradient PZ07/08, PZ08/08	Quarterly	

4.3.2 All groundwater monitoring is undertaken in compliance with the groundwater management plan (HNDY_GMMPv1.0 FINAL).

4.3.3 The following recommendations have been made:

- PZ07/08 and PZ08/08 are refurbished or reinstatement to meet the requirements of two down gradient boreholes
- the laboratory detection limits for ammoniacal nitrogen, nickel and naphthalene are reviewed against the compliance limits and lower detection limits are adopted where appropriate.
- metal ion concentrations are for dissolved concentrations only.

4.3.4 *Review of compliance levels*

The compliance levels were derived in response to the improvement conditions IC6 and IC7. These were based on a combination of site specific values and environmental water quality standards. These values have been further reviewed as part of this assessment as indicated in section 2.5 environmentally acceptable limits. Control levels have been proposed for early identification of atypical groundwater quality at the site. These have been based on the time series graphs and are between the 95%ile up gradient water quality values and the compliance standard.

Table 8: Groundwater Control and Compliance Limits

Determinand	PZ07/08		PZ08/08	
	Control Limit*	Compliance Limit	Control Limit*	Compliance Limit
Chloride (mg/l)	100	150	100	150
Ammoniacal Nitrogen (mg/l as N)	0.3	0.5	0.3	0.5
Cadmium (ug/l)	-	1	-	1
Nickel (mg/l)	0.02	0.034	0.02	0.034
Sulphate (mg/l)	100	200	100	200
Naphthalene (ug/l)	2	10	2	10

Note: Greyed out cells represent proposed change to reflect change in status to nickel and reduction in the water quality standard.

4.4 Surface Water Monitoring

4.4.1 There are no surface water receptors in close proximity to the site. Surface water runoff from the site is currently discharged to soakaway.

Table 9: Surface Water Monitoring Requirements

Location	Frequency	Parameter	Limit
Surface Water			
Discharge to soakaway at ST 0538 8136	Daily	Volume	750 m^3/day
	Weekly	Rate of discharge	25 l/s
	Quarterly	Suspended solids mineral oils, pH	100 mg/l 5 mg/l 6-9

4.4.2 There are no proposed changes to the monitoring regime however it is noted that the daily volume limitation on the discharge is currently under review. The site discharges to soakaway and therefore there are no external surface water monitoring locations.

5 CONCLUSIONS

5.1 Compliance with the Environmental Permitting Regulations 2016

5.1.1 The review has indicated that there has been no significant change in the conceptual model over the review period. The waste material permitted at the site remains inert waste as defined by the LFD and appropriate waste acceptance procedures are employed at the site. Therefore under the LFD there is no requirement to collect leachate from the site, install an artificial sealing layer nor provide a low permeability cap to the site.

5.1.2 Future areas for disposal will meet the requirements for a geological barrier with a minimum of 1m at 1 x 10^{-7}m/s or equivalent placed in all new areas in accordance with the a CQA plan.

5.1.3 This report has demonstrated that the site remains in a high sensitivity setting with respect to the groundwater environment and that the assessment of accidents and consequences has indicated that there would be no discernible impact on the receptor.

5.1.4 Requisite surveillance has been detailed to monitor the performance of the site and enable its compliance with the Environmental Permitting Regulations. The current groundwater monitoring regime is considered to be adequate based on the site's environmental setting. Recommendations include the instatement or refurbishment of PZ07/08 to comply with the minimum requirement of 2 down gradient monitoring boreholes.

REFERENCES

NRW 2017, Webpages Protecting groundwater link: https://naturalresources.wales/guidance-and-advice/business-sectors/planning-and-development/advice-for-developers/protecting-groundwater/?lang=en

Environment Agency, March 2017, Groundwater Protection Position statements

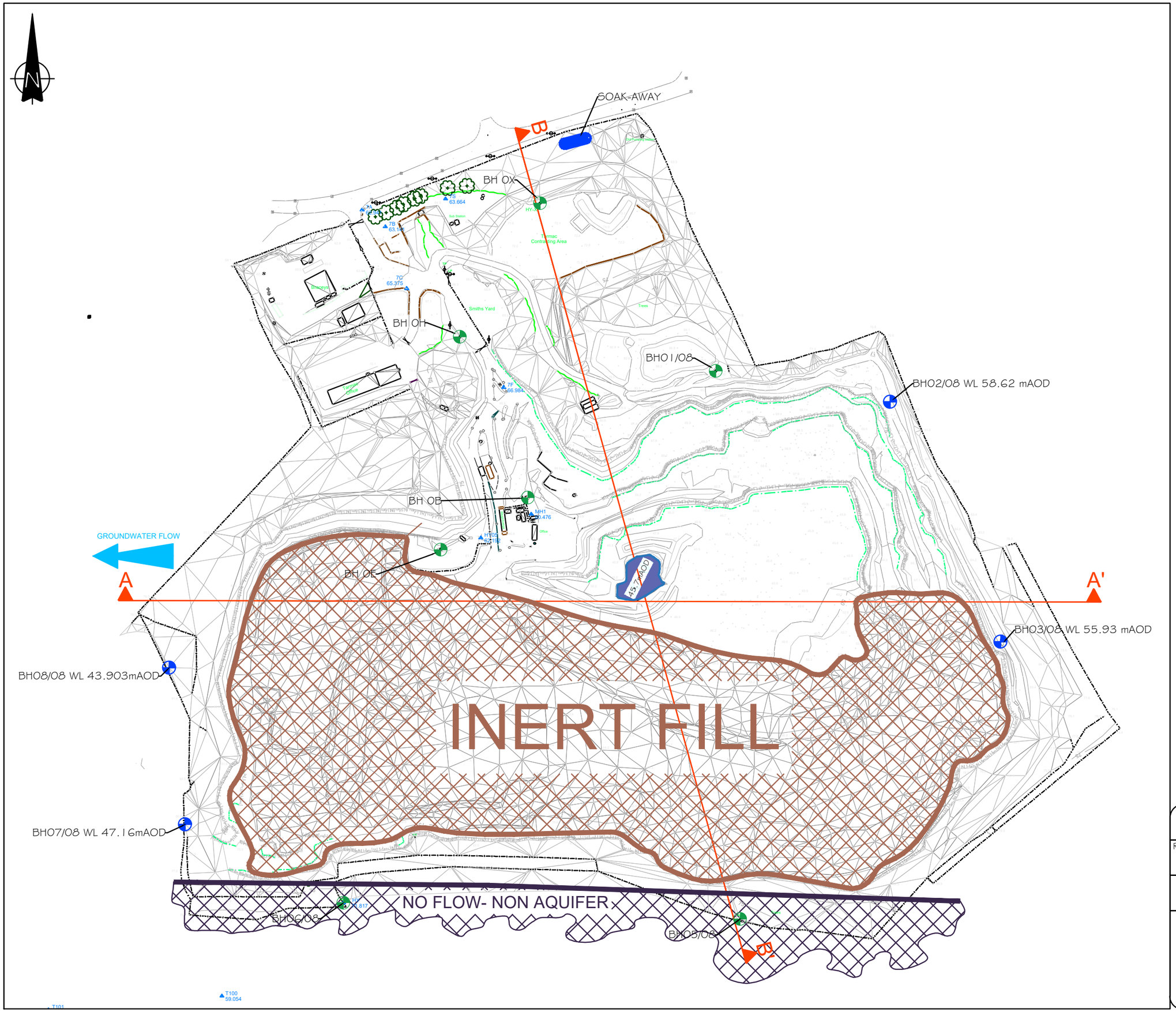
Environment Agency, Feb 2016, indicative risk assessment levels for a range of scenarios

Environment Agency, Feb 2016, groundwater risk assessment for your environmental permit, https://www.gov.uk/guidance/groundwater-risk-assessment-for-your-environmental-permit

Environment Agency, Feb 2016, Landfill Developments: groundwater risk assessment for leachate https://www.gov.uk/guidance/landfill-developments-groundwater-risk-assessment-for-leachate

Environment Agency 2014, Hydrogeological risk assessment for landfills: 4 yearly review template https://www.gov.uk/government/publications/hydrogeological-risk-assessment-for-landfills-4-yearly-review-template

DRAWINGS



LEGEND

- PZ02/0 — PERMIT BOREHOLE LOCATION
- PZ — ADDITIONAL BOREHOLE LOCATIONS
- SOAK-AWAY

PROJECT	HENDY
REPORT TITLE	BOREHOLE LOCATION PLAN
HRA 01	REPORT REF 3145

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NOTE

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2. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING WILL BE ALLOWED WITHOUT THE PRIOR PERMISSION IN WRITING.

3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS.

LEGEND

- INERT FILL
- NON FLOW, NON AQUIFER
- GROUNDWATER CONTOUR- 28.04.2015

GROUNDWATER FLOW

INERT FILL

NO FLOW- NON AQUIFER

BH-H - 44.05mAOD

BH-B - 44.61mAOD

BH-E - 62.192mAOD

BH01/08 51.87mAOD

BH02/08 - 48.22mAOD

BH03/08 - 48.3mAOD

BH04/08 - 63.22mAOD

BH05/08 - 62.192mAOD

BH06/08 - 56.12mAOD

BH07/08

BH08/08 - 42.94 mAOD

PRELIMINARY DRAWING FOR INFORMATION PURPOSES ONLY

REV	MODIFICATIONS	BY	RE	AP	DATE
B	BOREHOLES ID AMENDED	EJD	SV	SV	09.01.18
A	GROUNDWATER CONTOURS	RP	SV	SV	18.09.17

TARMAC

PROJECT: HENDY

TITLE: CONCEPTUAL MODEL

DRAWN BY	DATE	
RP	04.07.2017	
REVIEWED BY	SCALE @ A1	JOB REF:
SV	N.T.S.	3145
AUTHORISED BY	ISSUE	REVISION
SV	-	B

DRAWING NUMBER: 3145.02

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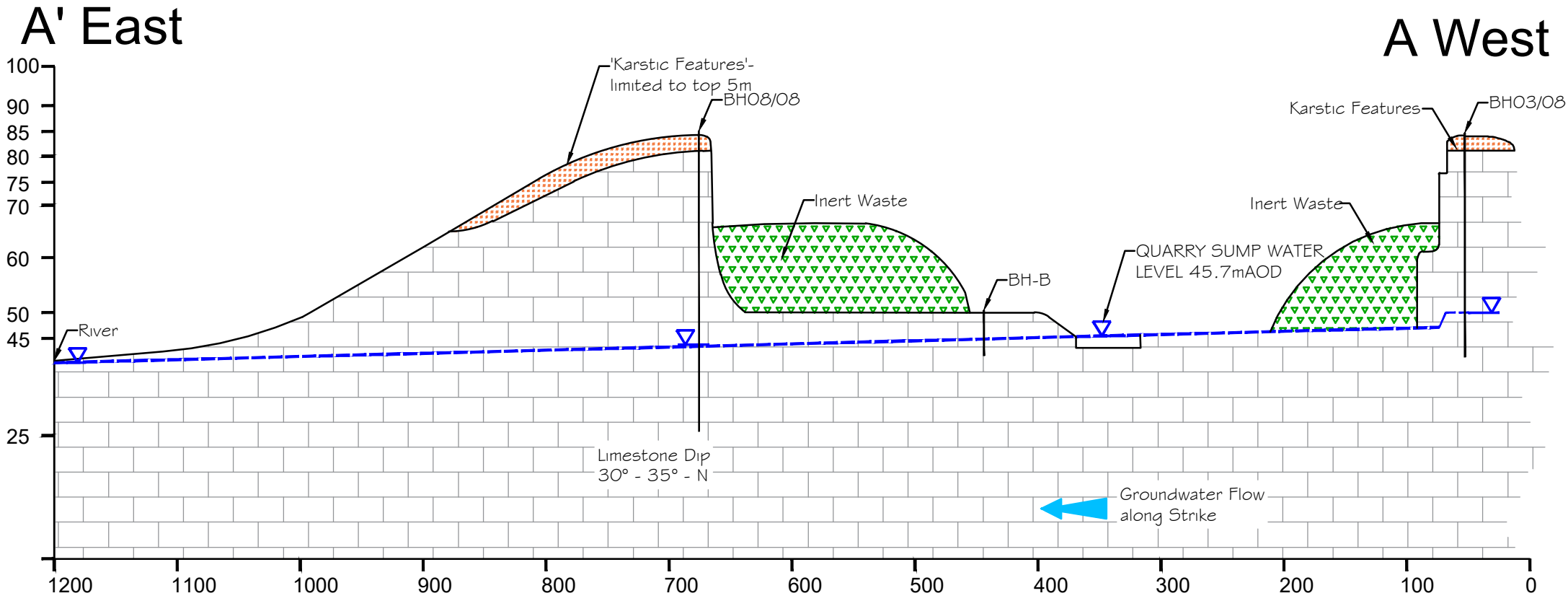

PROJECT
HENDY

REPORT TITLE
CONCEPTUAL MODEL

CROSS SECTION A-A

REPORT REF
3145.03

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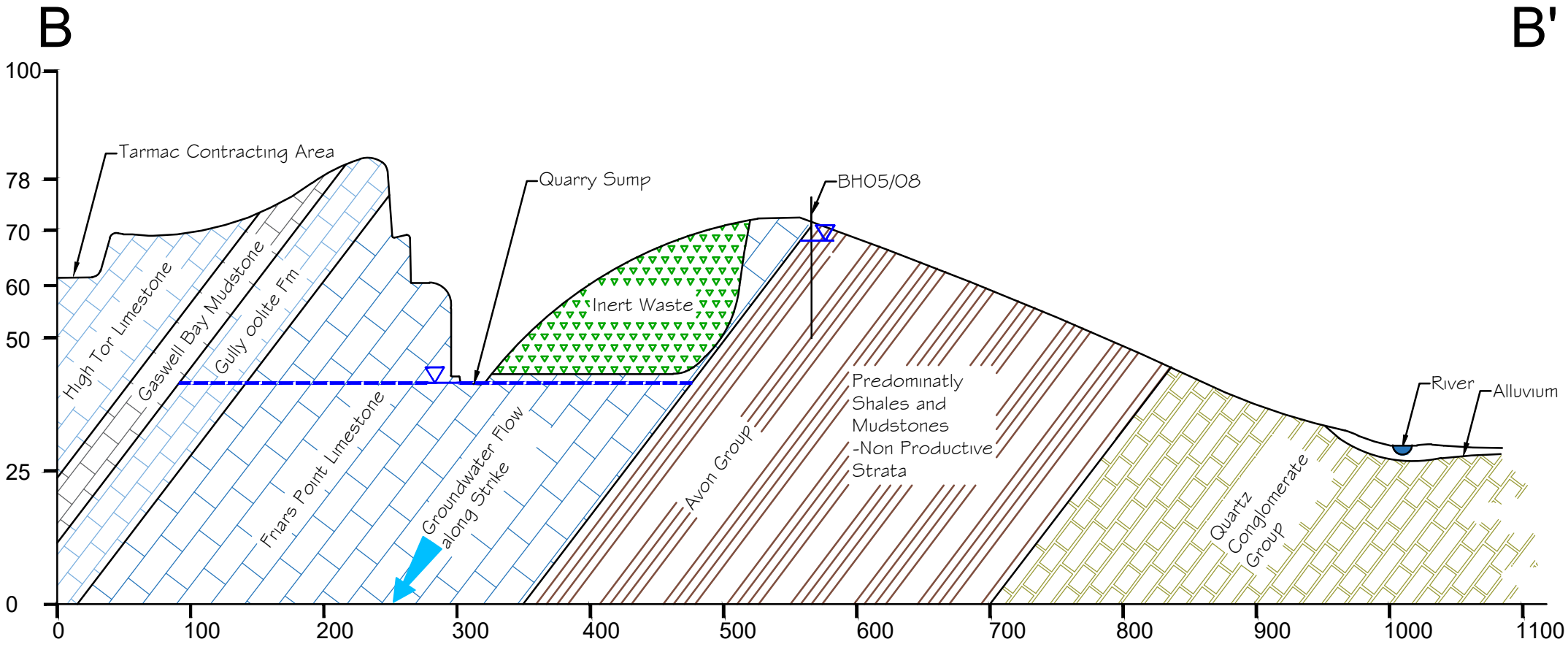

PROJECT
HENDY

REPORT TITLE
CONCEPTUAL MODEL

CROSS SECTION B-B

REPORT REF
3145.04

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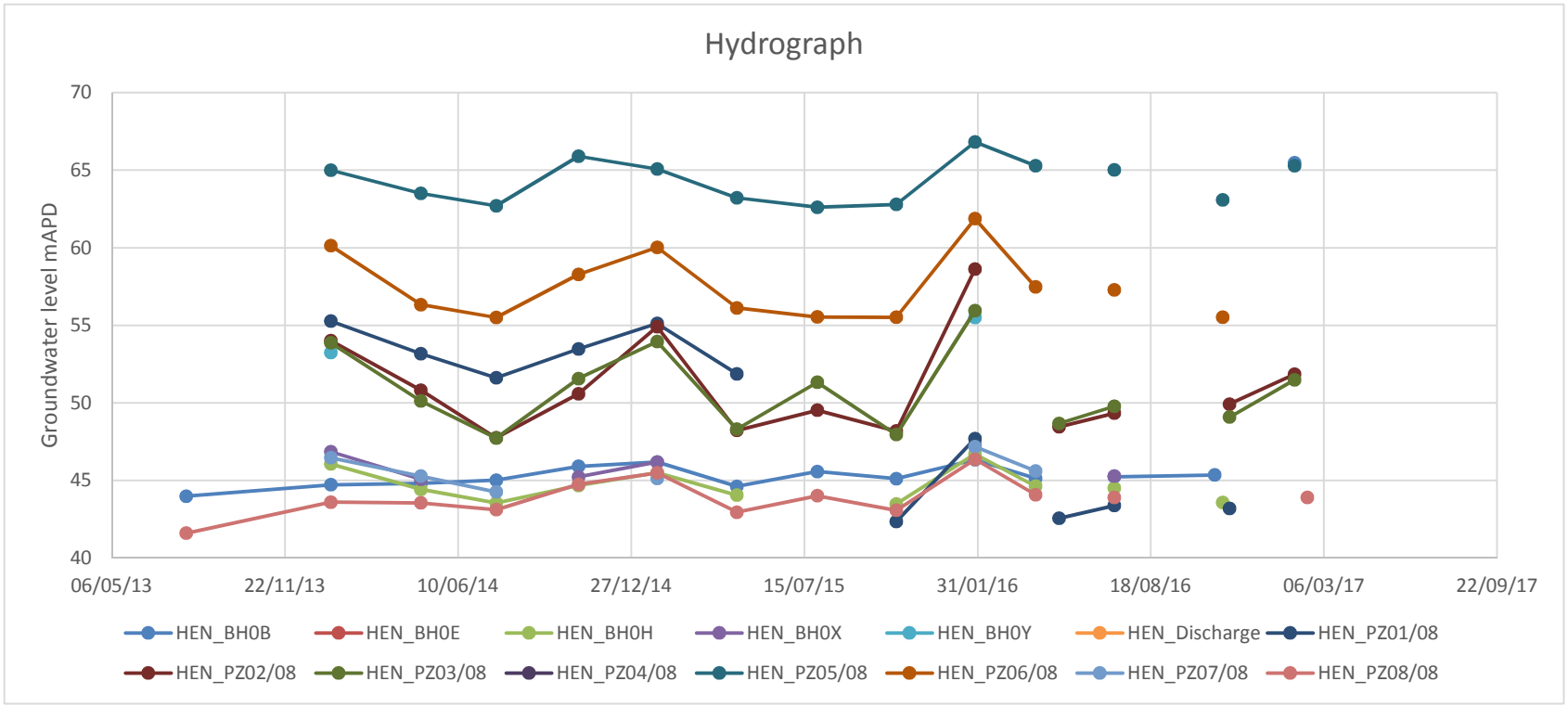
APPENDIX 1

Environmental Monitoring Data

DATE	HEN_BH0B	HEN_BH0E	HEN_BH0H	HEN_BH0X	HEN_BH0Y	HEN_Discharg	HEN_PZ01/08	HEN_PZ02/08	HEN_PZ03/08	HEN_PZ04/08	HEN_PZ05/08	HEN_PZ06/08	HEN_PZ07/08	HEN_PZ08/08
31/07/13	43.98													41.59
14/01/14	44.72		46.06	46.84	53.24		55.27	54.01	53.87		65	60.13	46.46	43.593
28/04/14	44.81		44.42	45.07			53.16	50.8	50.12		63.51	56.33	45.27	43.543
24/07/14	45.01		43.55				51.61	47.74	47.73		62.7	55.5	44.25	43.103
27/10/14	45.9		44.67	45.22			53.46	50.57	51.56		65.9	58.27		44.743
26/01/15	46.178		45.49	46.18			55.11	54.91	53.95		65.08	60.01	45.13	45.483
28/04/15	44.608		44.05				51.87	48.22	48.3		63.22	56.12		42.943
30/07/15	45.568							49.52	51.32		62.61	55.54		44.003
29/10/15	45.108		43.475				42.343	48.185	47.955		62.788	55.517		43.073
28/01/16	46.328		46.695	47.286	55.49		47.693	58.615	55.935		66.818	61.867	47.165	46.353
07/04/16	45.128		44.625								65.288	57.467	45.595	44.073
04/05/16							42.553	48.455	48.665					
07/07/16	45.228		44.505	45.276			43.373	49.335	49.765		65.008	57.287		43.903
31/10/16	45.348													
09/11/16			43.565								63.078	55.527		
17/11/16							43.183	49.915	49.085					
31/01/17	65.475		-23.32	-25.91				51.84	51.48		65.28			
15/02/17														43.903

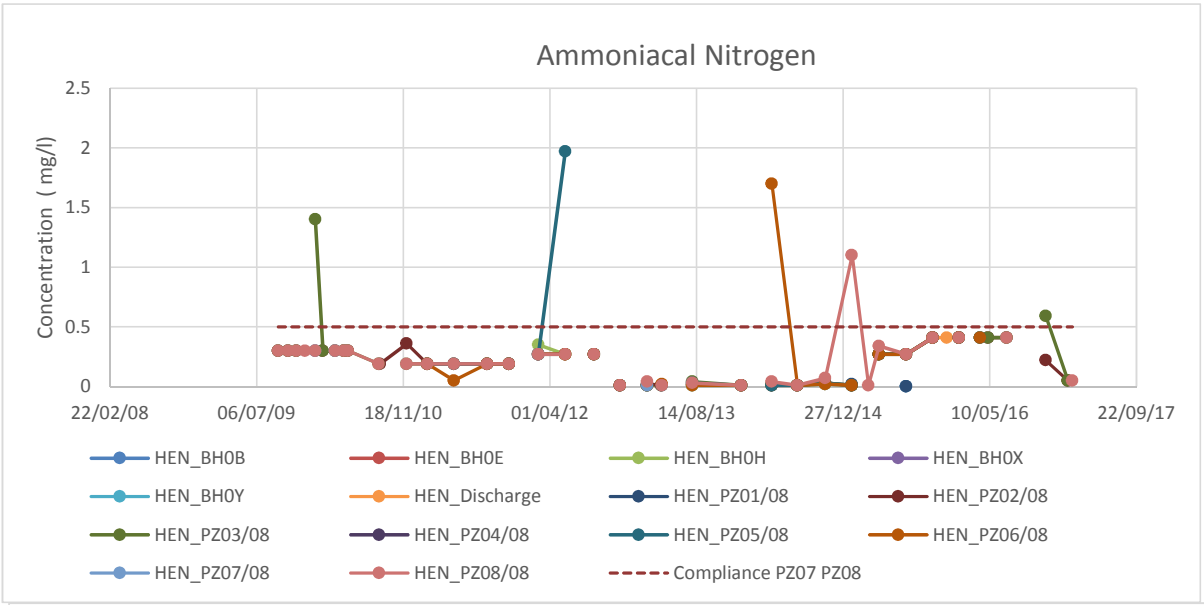

Hydrograph
Groundwater level mAPD
70
65
60
55
50
45
40
06/05/13
22/11/13
10/06/14
27/12/14
15/07/15
31/01/16
18/08/16
06/03/17
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

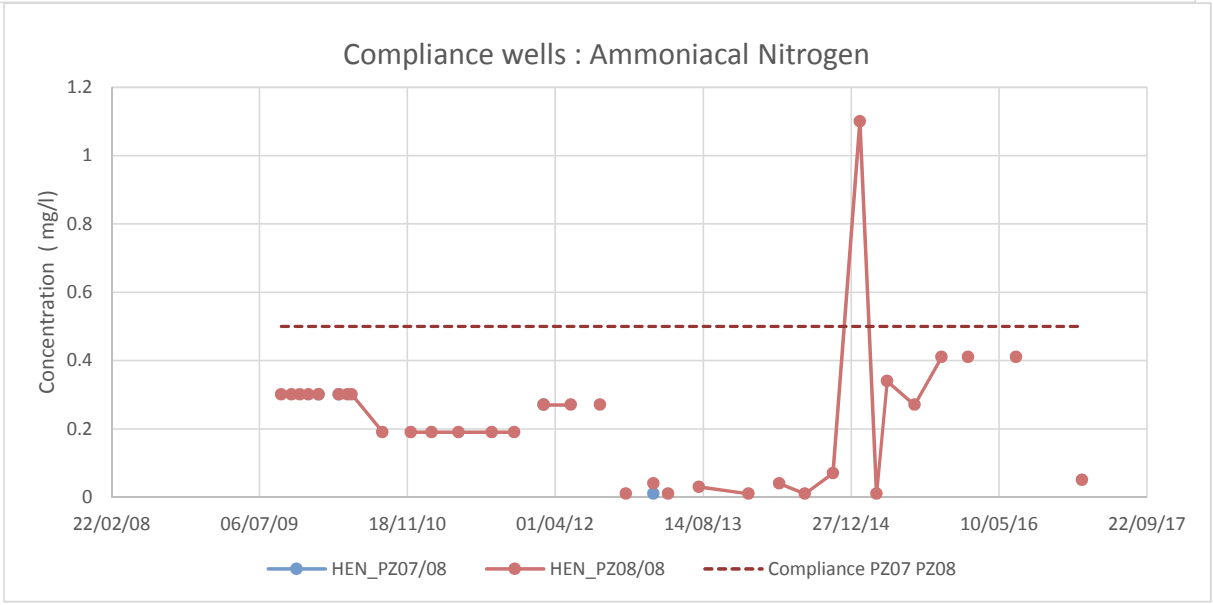
	HEN BH0	HEN BH0	HEN BH0	HEN BH0	HEN BH0	HEN Disc	HEN PZ01	HEN PZ02	HEN PZ03	HEN PZ04	HEN PZ05	HEN PZ06	HEN PZ07	HEN PZ08
Chloride (mg/l)														
Compliance														
Min	3		4			29.5	8	3	4		4	4	20	10
Average	24		38			36	13	37	73		12	12	38	41
Max	50		56			42.2	18	136	131		19.2	16.5	50	56.9
Count	11		21			5	6	34	32		21	21	4	34
Ammoniacal Nitrogen (mg/l)														
Compliance														
Min	0.01		0.01			0.27	0.01	0.01	0.01		0.01	0.01	0.01	0.01
Average	0.16		0.18			0.35	0.02	0.21	0.26		0.25	0.24	0.22	0.23
Max	0.41		0.41			0.41	0.41	0.41	1.4		1.97	1.7	0.3	1.1
Count	12		20			5	6	34	32		21	21	4	33
Cadmium (mg/l)														
Compliance														
Min	0.0001		0.0001			0.0006	0.0001	0.00002	0.0001		0.0001	0.0001	0.0001	0.0001
Average	0.0082		0.0053			0.0006	0.0035	0.0010	0.0017		0.0005	0.0004	0.0006	0.0019
Max	0.06		0.0334			0.0006	0.0181	0.0084	0.0131		0.0021	0.001	0.0012	0.006
Count	11		21			4	6	34	32		21	21	4	33
Nickel (mg/l)														
Compliance														
Min	0.046		0.001			0.003	0.001	0.0009	0.0009		0.001	0.001	0.003	0.001
Average	0.112		0.054			0.004	0.009	0.008	0.006		0.010	0.008	0.007	0.015
Max	0.3		0.256			0.006	0.0165	0.062	0.014		0.032	0.025	0.016	0.056
Count	5		15			4	4	28	26		16	16	4	27
Nickel Dissolved (mg/l)														
Compliance														
Min	0.001		0.001				0.001	0.001	0.001		0.001	0.001		0.001
Average	0.001		0.001				0.001	0.001	0.001		0.001	0.001		0.001857
Max	0.001		0.001				0.001	0.001	0.001		0.001	0.001		0.004
Count	6		6			0	2	6	6		6	6	0	7
Sulphate (mg/l)														
Compliance														
Min	9.1		16			52.5	8.5	4.3	8		6	14.7	0	9.6
Average	35.5		33.1			81.7	21.0	12.8	12.5		25.4	24.9		53.0
Max	63		69.2			110	52	45.6	16.4		34.3	33.1	10.7	117
Count	10		19			4	5	34	32		21	21	4	33
Naphthalene (ug/l)														
Compliance														
Min	0		0.01			0.01	0.01	0.01	0.01		0.01	0.01	0.01	0.01
Average	0.02		0.02			0.01	0.02	0.08	0.08		0.02	0.02	0.01	0.07
Max	0.02		0.1			0.017	0.02	2	2		0.1	0.04	0.02	2
Count	10		20			4	6	34	32		20	20	4	34

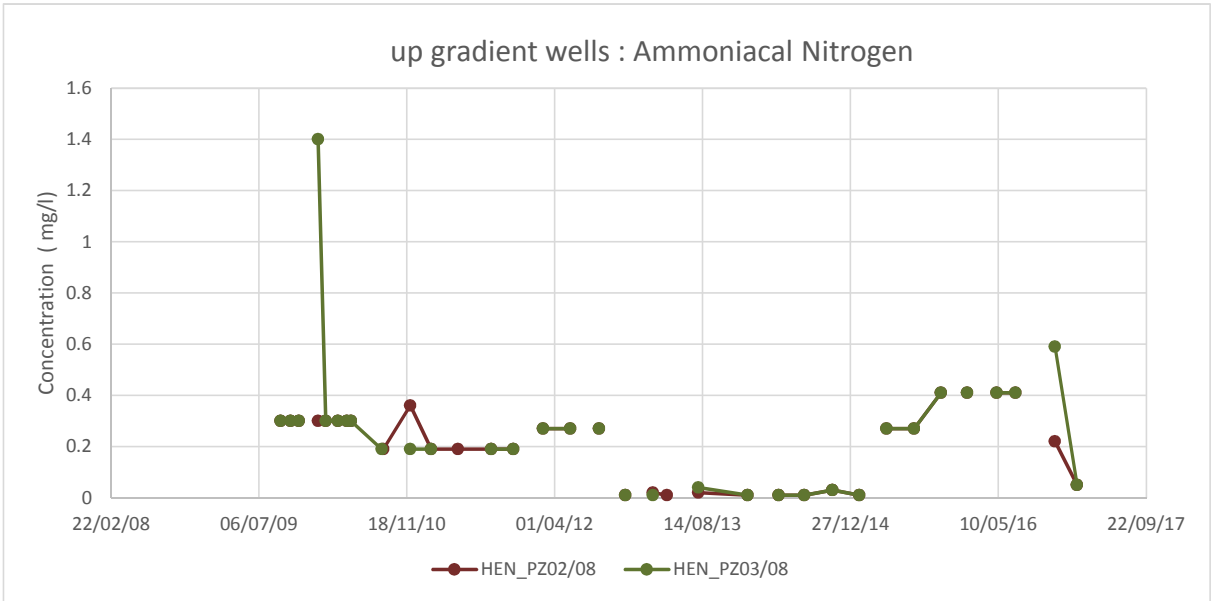
	HEN_BH0B	HEN_BH0E	HEN_BH0H	HEN_BH0X	HEN_BH0Y	HEN_Discharge	HEN_PZ01/08	HEN_PZ02/08	HEN_PZ03/08	HEN_PZ04/08	HEN_PZ05/08	HEN_PZ06/08	HEN_PZ07/08	HEN_PZ08/08
pH														
Min	7.70		7.30			7.50	7.00	7.3	6.7		7.50	7.50	7.40	7.10
Average	8.10		7.78			8.02	7.67	8.0	7.8		7.83	7.83	7.90	7.75
Max	8.80		8.70			8.70	8.20	8.8	8.5		8.50	8.50	8.30	8.80
95%	8.69		8.20			8.52	8.14	8.6	8.4		8.30	8.40	8.29	8.44
no.	12		22			19	7	34	32		21	21	4	33
Electrical Conductivity (US/cm)														
Min	390		462			558	265	241	312		425	443	666	601
Average	490		601			694	362	342	776		536	531	666	724
Max	613		863			884	483	699	950		655	605	666	885
95%	593		760			839	458	482	929		610	603	666	829
no.	11		13			8	6	15	14		21	13	1	16
Alkalinity (mg/l as CaCO3)														
Min	183		235			0	132	108	124		217	240	279	222
Average	961		605			0	164	265	312		299	301	279	406
Max	2650		4125			0	210	1470	546		376	370	279	1230
95%	2370		1840			0	205	877	393		348	356	279	743
no.	11		20			1	6	23	21		20	20	1	22
Calcium (mg/l)														
Min	55		51			77	44	45	8		78	74	109	7
Average	274		141			89	361	111	106		93	101	150	230
Max	909		518			98	1890	1010	174		121	226	214	1280
95%	745		474			97	1437	198	165		115	141	204	620
no.	11		21			4	6	34	32		21	21	4	34
Chromium total (mg/l)														
Min	0.001		0.000			0.002	0.001	0.001	0.001		0.001	0.001	0.001	0.001
Average	0.026		0.009			0.002	0.002	0.003	0.004		0.003	0.002	0.004	0.010
Max	0.046		0.035			0.002	0.004	0.009	0.010		0.009	0.006	0.007	0.037
95%	0.044		0.032			0.002	0.004	0.009	0.010		0.007	0.006	0.007	0.031
no.	5		15			3	4	27	25		14	15	4	26
Copper (Total) (mg/l)														
Min	0.002		0.001			0.009	0.0001	0.001	0.001		0.001	0.001	0.002	0.001
Average	0.083		0.077			0.009	0.0398	0.012	0.027		0.006	0.005	0.020	0.029
Max	0.180		0.347			0.009	0.169	0.065	0.206		0.012	0.015	0.048	0.144
95%	0.173		0.343			0.009	0.139	0.042	0.069		0.012	0.013	0.045	0.090
no.	5		14			1	5	26	24		14	14	4	27
Dissolved Oxygen (mg/l)														
Min	0.9		3.6			3.0	2.4	0.1	0.5		0.7	1.9	4.8	2.4
Average	5.2		6.7			6.9	8.6	6.3	5.4		4.4	4.7	6.7	5.1
Max	8.3		11.3			10.3	11.1	11.3	9.9		8.7	7.4	8.2	9.4
95%	8.2		10.0			9.9	11.0	10.4	9.3		8.5	7.1	8.1	8.7
no.	11		19			4	6	34	32		21	21	4	34
Iron (total) (mg/l)														
Min	16.60		0.01			0.23	0.01	0.01	0.01		0.01	0.01	0.01	0.01
Average	31.46		66.95			0.57	8.8	3.02	2.24		4.54	6.86	3.35	6.85
Max	57.20		286.00			1.36	28.2	16.10	5.20		16.10	30.40	9.22	24.70
95%	51.44		247.00			1.22	24.9	7.98	4.99		12.80	22.98	8.43	23.85
no.	5.00		14.00			5.00	4	27.00	25.00		16.00	16.00	4.00	28.00
Potassium (mg/l)														
Min	2.0		0.8			3.8	0.65	0.5	0.8		2.1	2.5	2.4	1.0
Average	4.4		3.6			5.0	2.4	1.7	2.4		3.8	4.4	2.9	2.9
Max	18.0		13.9			6.2	6.7	4.3	3.6		5.3	6.4	3.5	5.8
95%	11.1		9.9			6.1	5.9	3.0	3.4		5.1	6.0	3.5	5.1

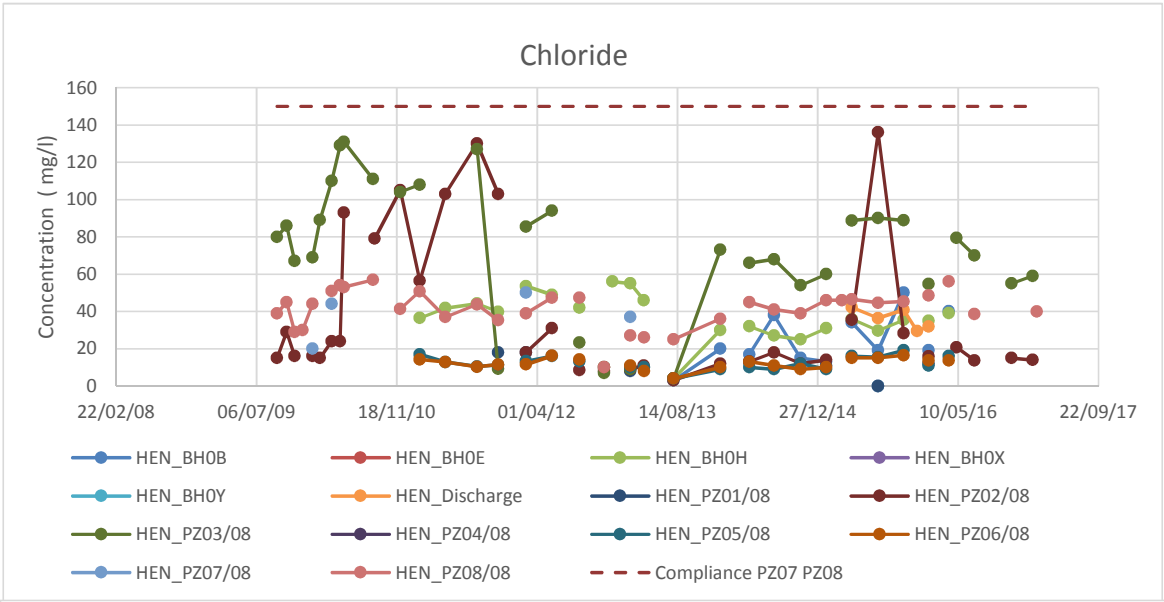
	HEN_BH0E	HEN_BH0E	HEN_BH0H	HEN_BH0X	HEN_BH0Y	HEN_Discharge	HEN_PZ01/08	HEN_PZ02/08	HEN_PZ03/08	HEN_PZ04/08	HEN_PZ05/08	HEN_PZ06/08	HEN_PZ07/08	HEN_PZ08/08
no.	11		21			4	4	34	32		21	21	4	33
Magnesium (mg/l)														
Min	14		12			21	16	6	2		23	21	33	2
Average	74		36			24	225	35	37		27	27	45	59
Max	247		132			28	842	437	115		33	36	70	271
95%	199		126			27	719	72	59		32	32	66	176
no.	11		21			4	4	34	32		21	21	4	32
Manganese (mg/l)														
Min	0.002		0.002			0.044	0.002	0.002	0.002		0.002	0.002	0.044	0.002
Average	3.05		8.73			0.08	3.32	0.40	0.30		0.30	1.19	0.83	1.80
Max	13.10		67.60			0.16	11.7	6.36	1.04		2.25	7.85	1.92	15.70
95%	9.67		57.00			0.15	10.2	0.82	0.85		0.92	6.56	1.82	8.26
no.	11		21			4	4	34	32		21	21	4	34
Sodium (mg/l)														
Min	3		0.5			16	4.1	5	4		5	5	11	7
Average	16		19			21	6.5	19	41		7	7	17	22
Max	31		33			24	9.3	65	72		8	8	22	41
95%	31		30			24	9.0	56	66		8	7	22	34
no.	11		21			4	5	34	31		21	21	4	34
TOC (mg/l)														
Min	3.90		0.97			2.60	0.70	0.07	0.55		0.28	0.07	0.70	0.70
Average	5.68		1.98			4.10	0.70	1.32	1.78		1.02	0.63	1.08	2.34
Max	8.90		3.90			5.60	0.70	7.00	9.00		4.60	0.70	1.72	11.00
95%	8.47		3.25			5.45	0.70	3.79	4.75		2.68	0.70	1.63	5.10
no.	4		11			2	3	24	23		11	11	3	22
TPH (mg/l)														
Min	0.05		0.02			0.03	0.02	0.01	0.01		0.01	0.01	2.88	0.02
Average	0.11		0.27			0.07	0.07	0.05	0.02		0.04	0.04	2.88	0.06
Max	0.19		1.67			0.17	0.13	0.17	0.04		0.24	0.17	2.88	0.17
95%	0.18		1.14			0.14	0.12	0.17	0.04		0.17	0.12	2.88	0.15
no.	6		8			6	3	8	7		8	8	1	9
TPH Band (C16-C24) (mg/l)														
Min	0.02		0.01			0.01	0.01	0.01	0.01		0.01	0.01	0.01	0.01
Average	0.04		0.09			0.02	0.01	0.01	0.01		0.01	0.01	0.07	0.01
Max	0.06		1.16			0.05	0.02	0.09	0.02		0.01	0.01	0.23	0.08
95%	0.06		0.29			0.04	0.02	0.01	0.01		0.01	0.01	0.20	0.04
no.	6		17			10	5	25	25		16	16	4	27
TPH Band >C24-C40 (mg/l)														
Min	0.03		0.01			0.02	0.04	0.01	0.01		0.01	0.01		0.01
Average	0.07		0.10			0.04	0.06	0.01	0.02		0.01	0.01		0.03
Max	0.13		0.37			0.11	0.07	0.02	0.03		0.01	0.01		0.06
95%	0.12		0.30			0.09	0.07	0.02	0.03		0.01	0.01		0.05
no.	6		6			6	2	6	6		6	6	0	7
Total PAH (mg/l)														
Min	0.00		0.01			0.17	0.01	0.01	0.01		0.01	0.01	0.01	0.01
Average	1.90		0.55			2.67	0.09	0.11	0.05		0.09	0.09	0.09	0.07
Max	5.15		2.35			10.00	0.18	1.72	0.17		0.24	0.17	0.32	0.24
95%	4.85		2.07			8.54	0.17	0.20	0.17		0.17	0.17	0.28	0.19
no.	11		20			4	6	34	32		21	20	4	35

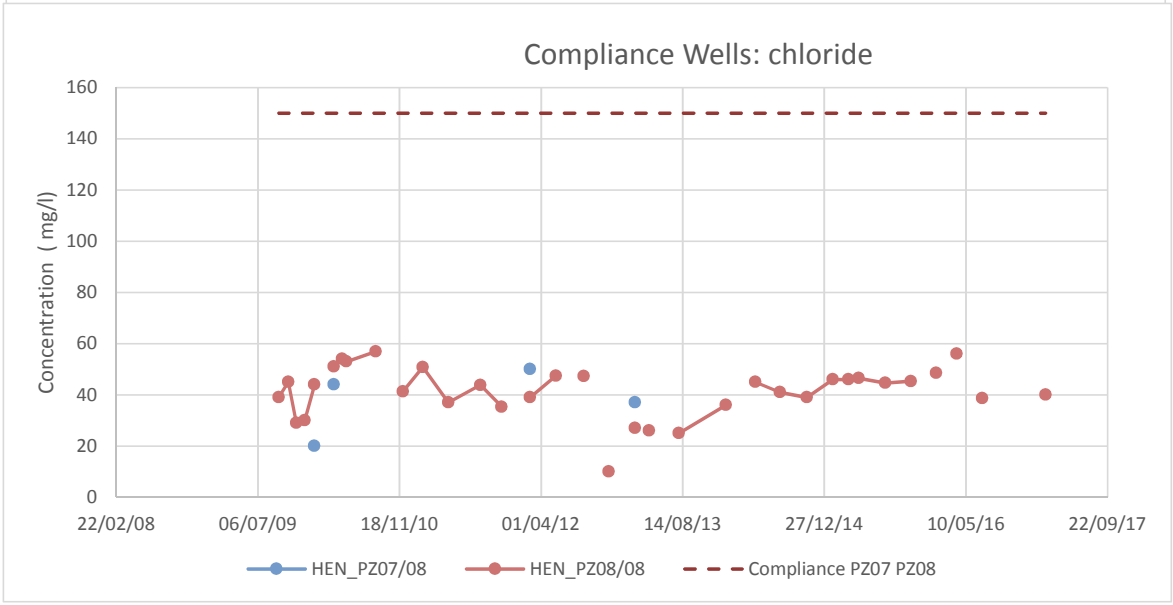
All values at less than detection are at assumed to be at detection
Anomalous results (defined as visually significant above the data or >5x max) have been removed from above stats.

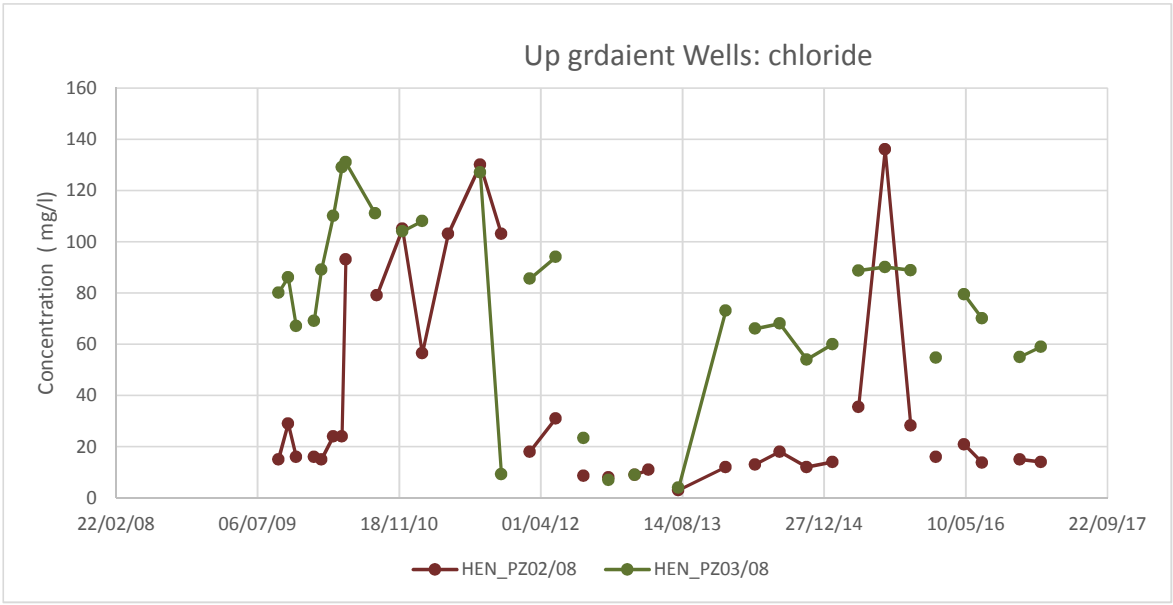

Ammoniacal Nitrogen
Concentration (mg/l)
2.5
2
1.5
1
0.5
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

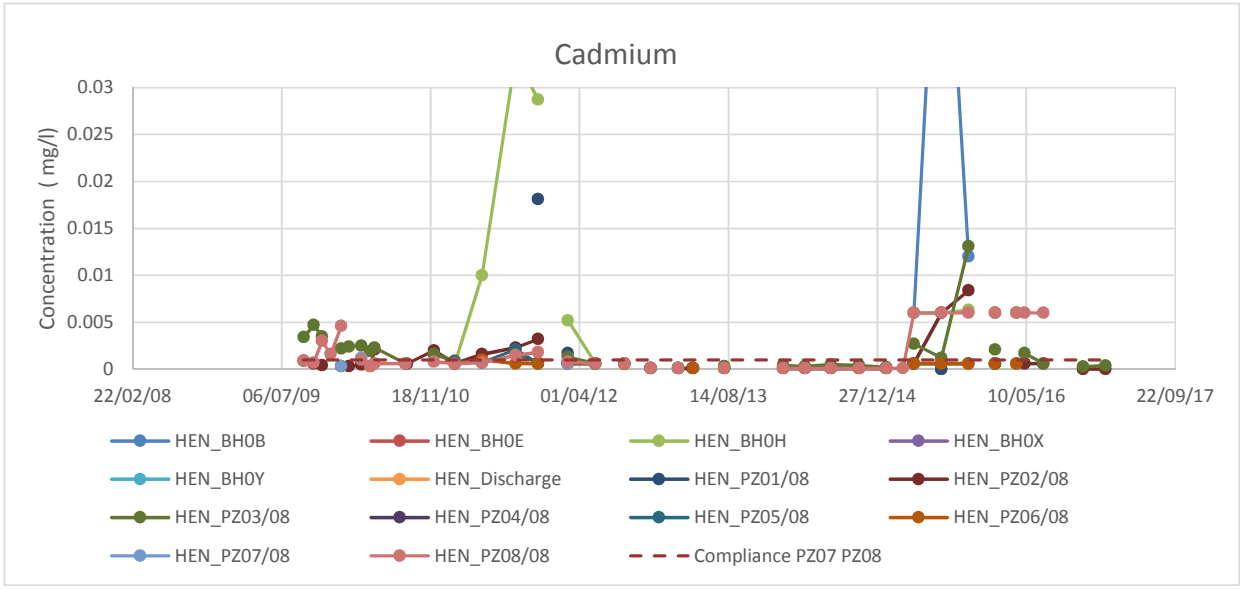

Compliance wells : Ammoniacal Nitrogen
Concentration (mg/l)
1.2
1
0.8
0.6
0.4
0.2
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

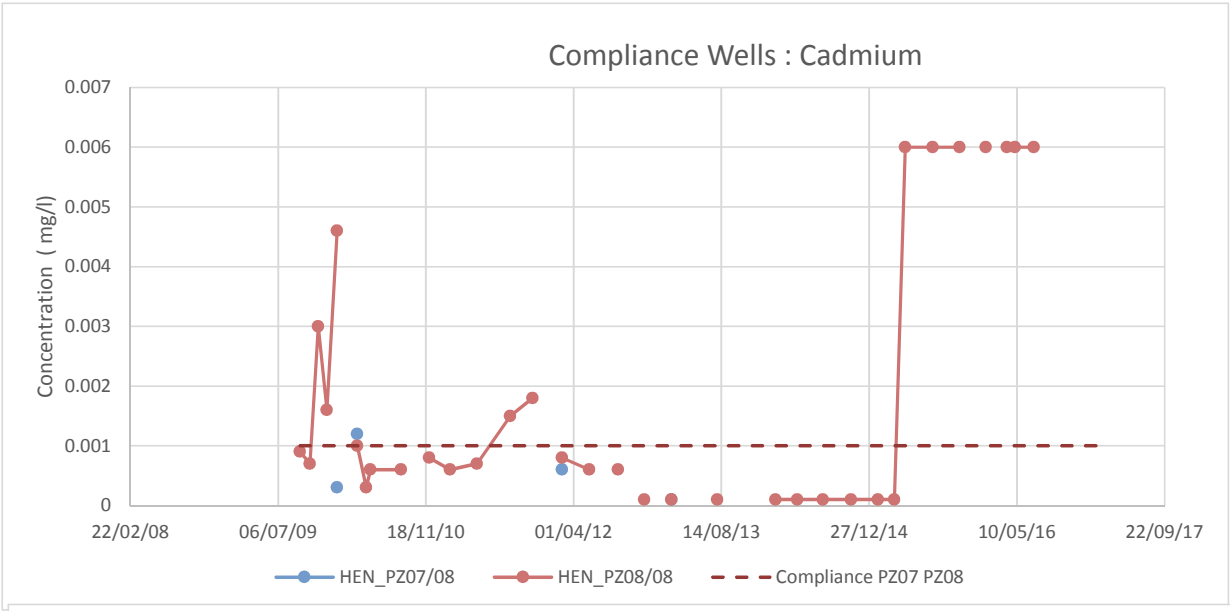

up gradient wells : Ammoniacal Nitrogen
Concentration (mg/l)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ02/08
HEN_PZ03/08

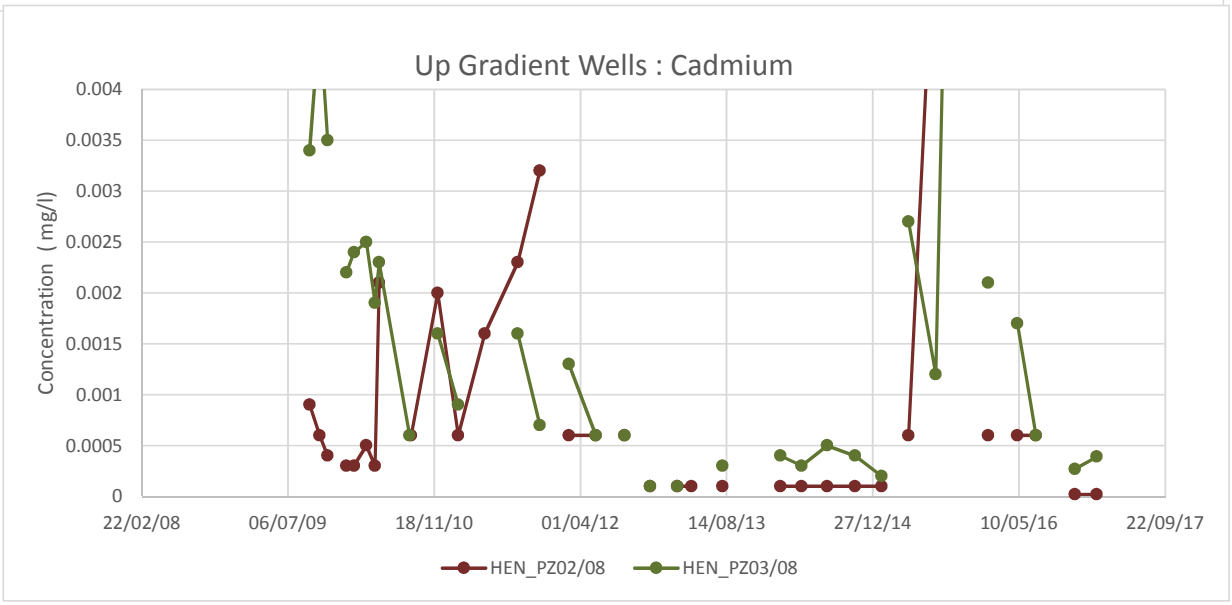

Chloride
Concentration (mg/l)
160
140
120
100
80
60
40
20
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

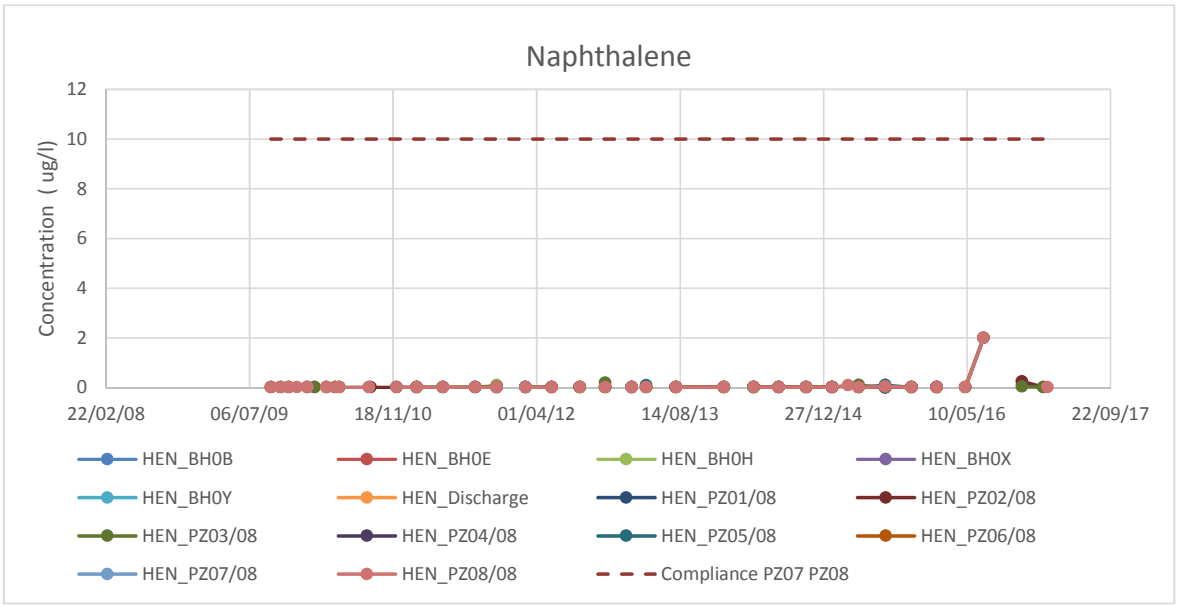

Compliance Wells: chloride
Concentration (mg/l)
160
140
120
100
80
60
40
20
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

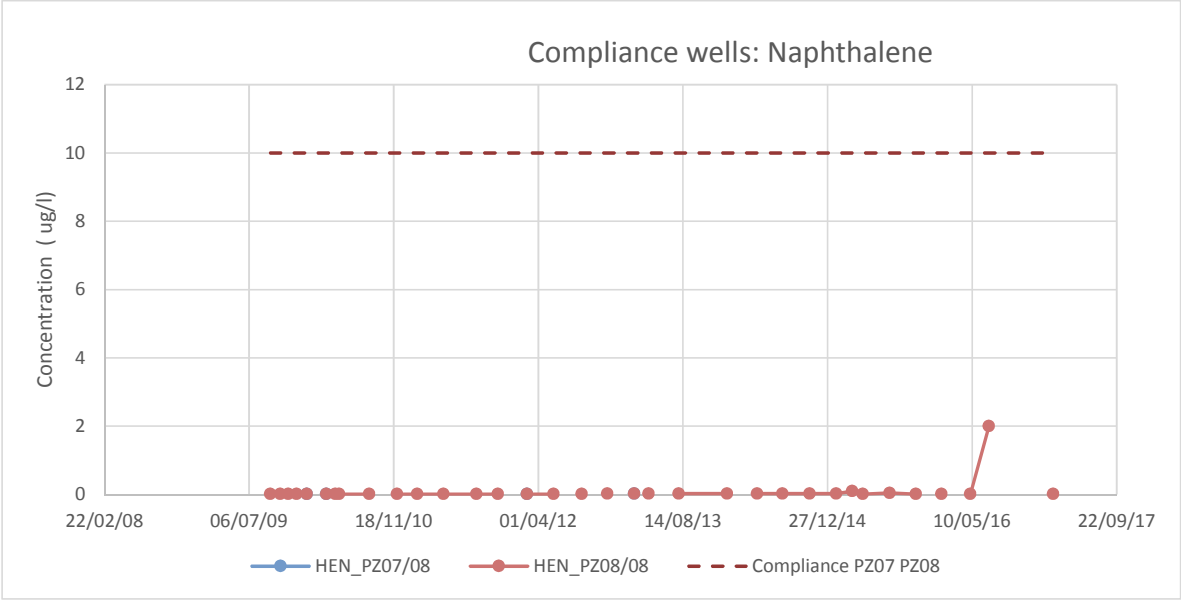

Up grdaient Wells: chloride
Concentration (mg/l)
160
140
120
100
80
60
40
20
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ02/08
HEN_PZ03/08

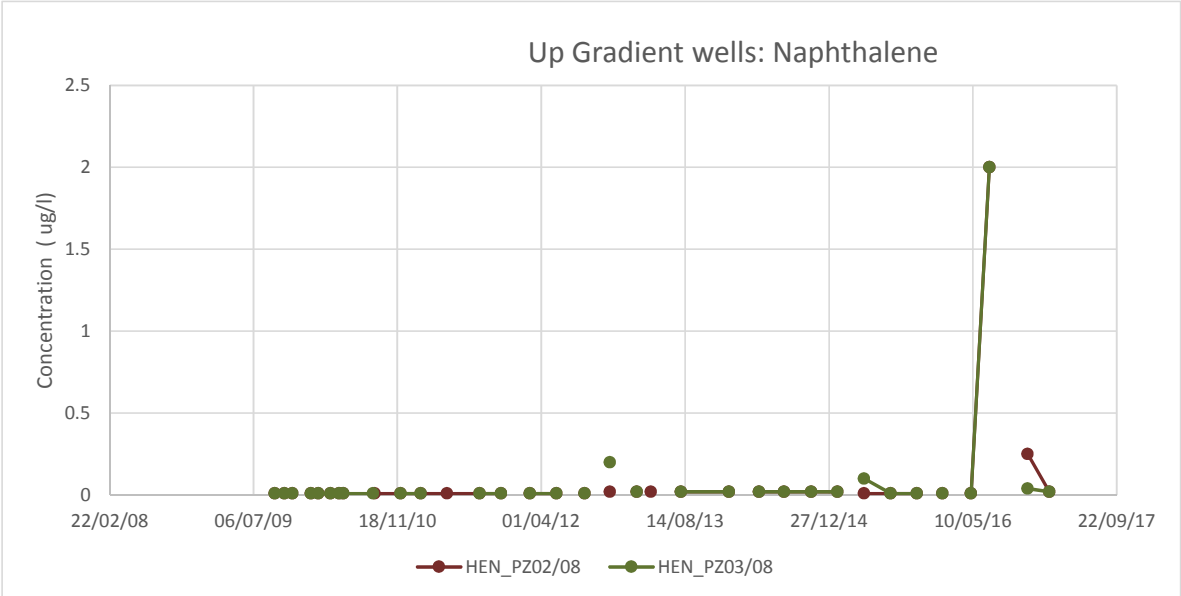

Cadmium
Concentration (mg/l)
0.03
0.025
0.02
0.015
0.01
0.005
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

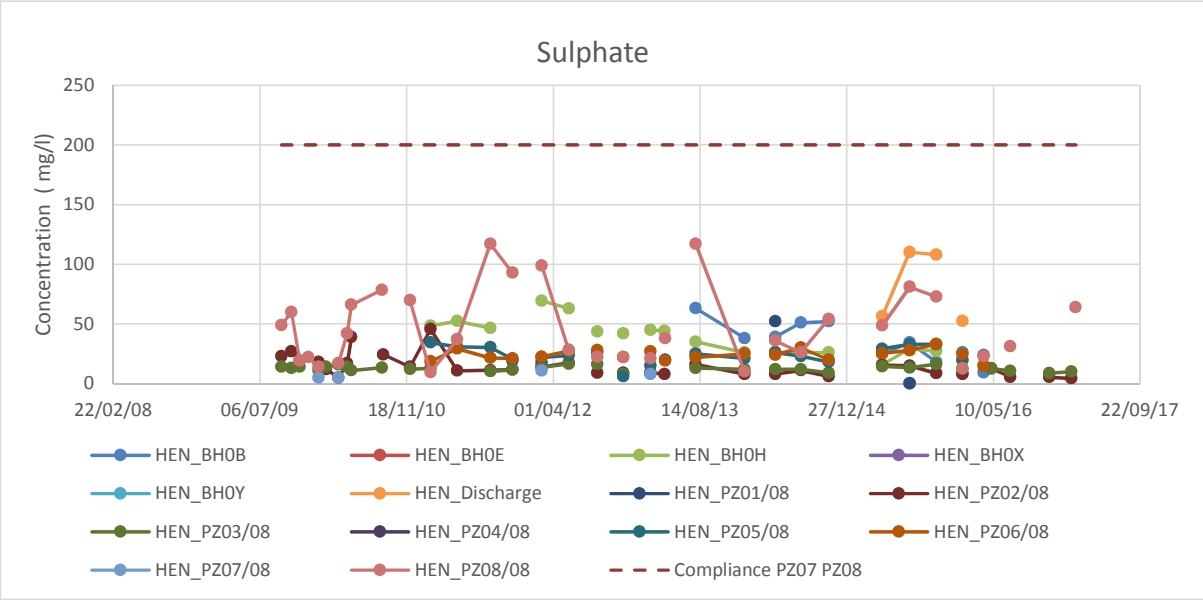

Compliance Wells : Cadmium
Concentration (mg/l)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

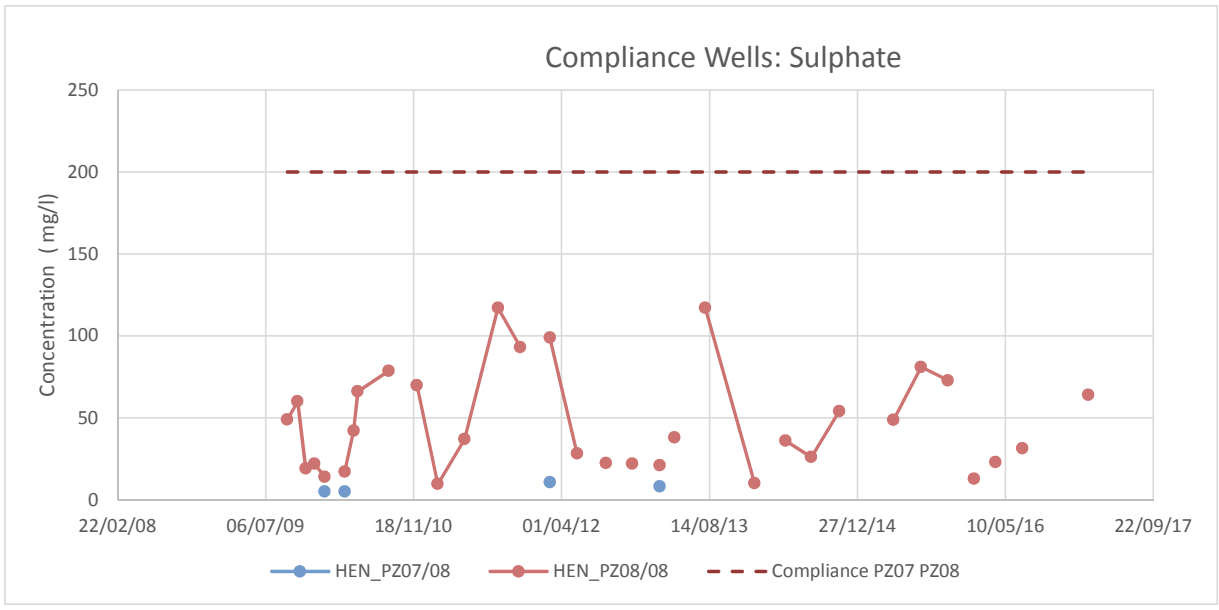

Up Gradient Wells : Cadmium
Concentration (mg/l)
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ02/08
HEN_PZ03/08

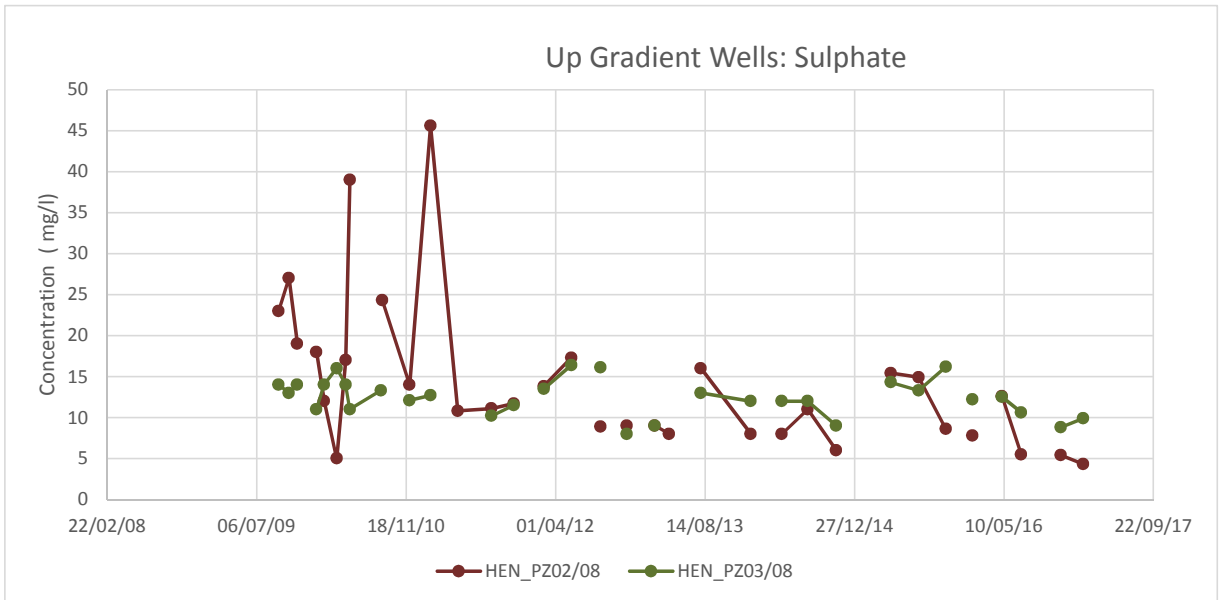

Naphthalene
Concentration (ug/l)
12
10
8
6
4
2
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

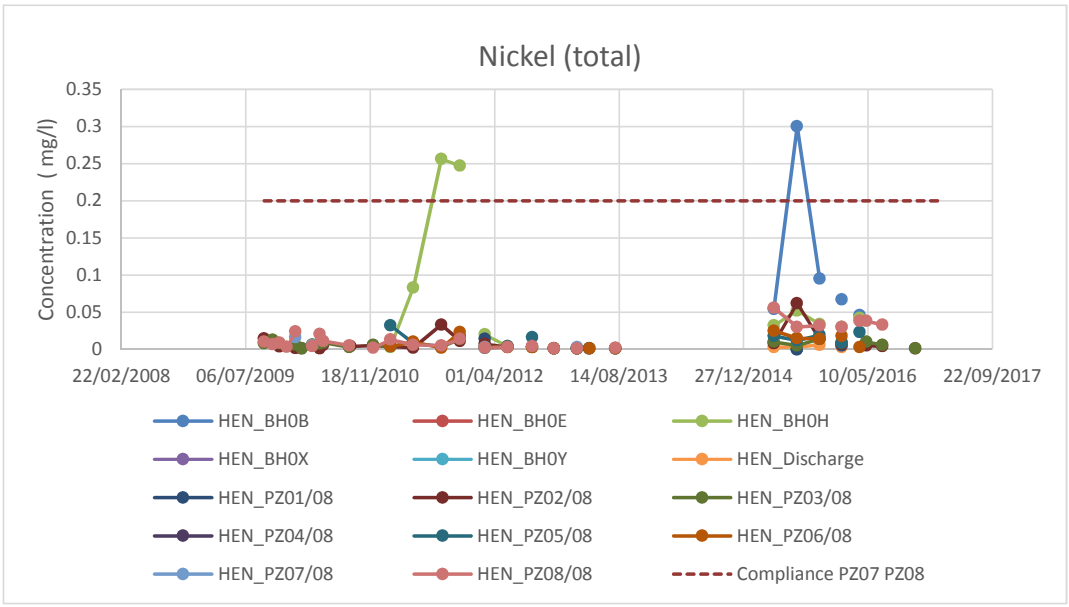

Compliance wells: Naphthalene
Concentration (ug/l)
12
10
8
6
4
2
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

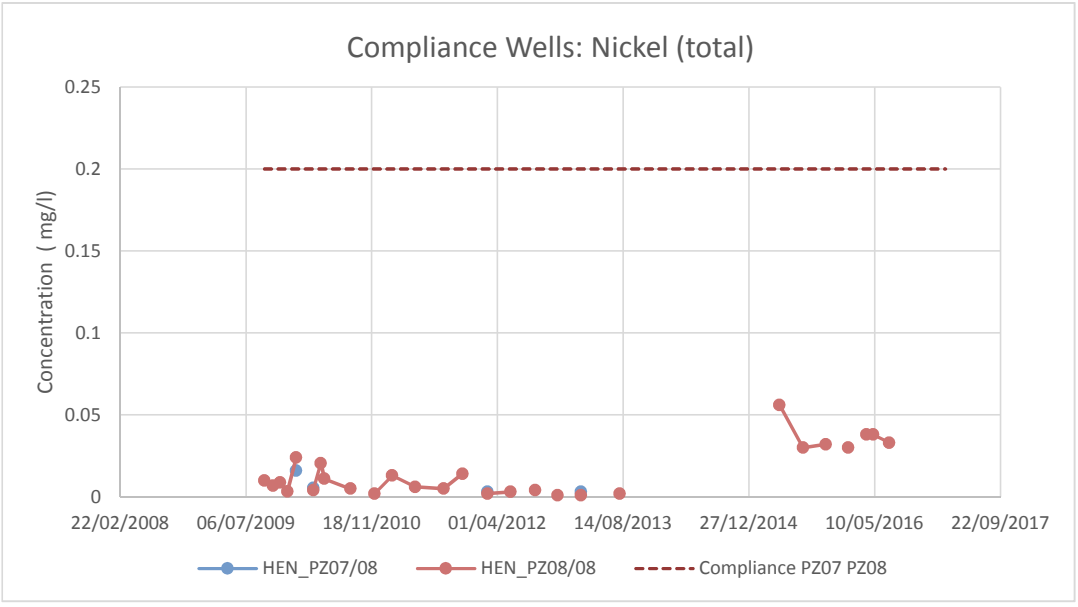

Up Gradient wells: Naphthalene
Concentration (ug/l)
2.5
2
1.5
1
0.5
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ02/08
HEN_PZ03/08

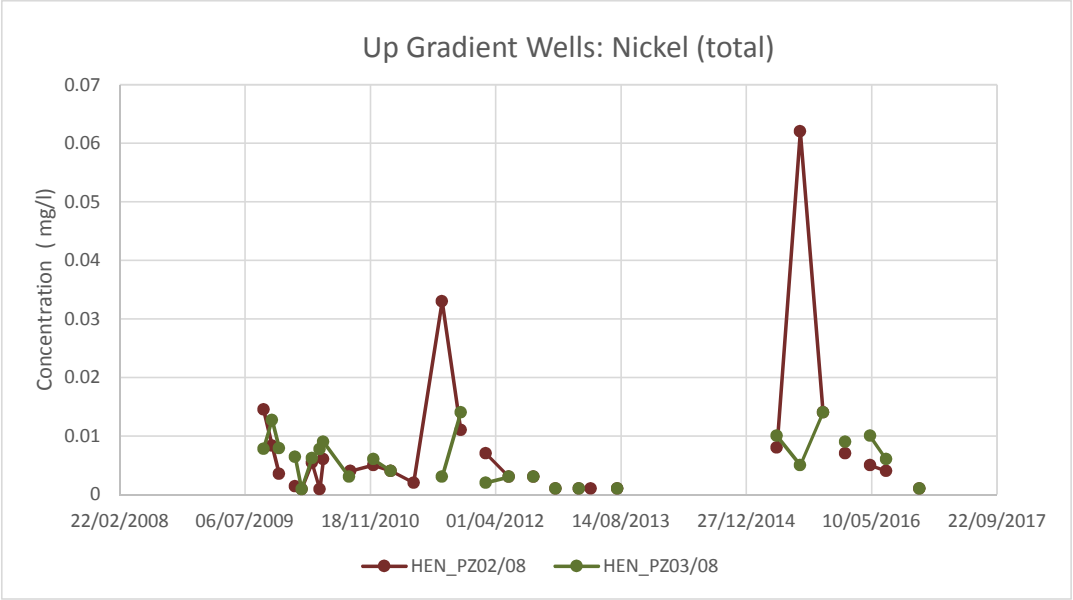

Sulphate
Concentration (mg/l)
250
200
150
100
50
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

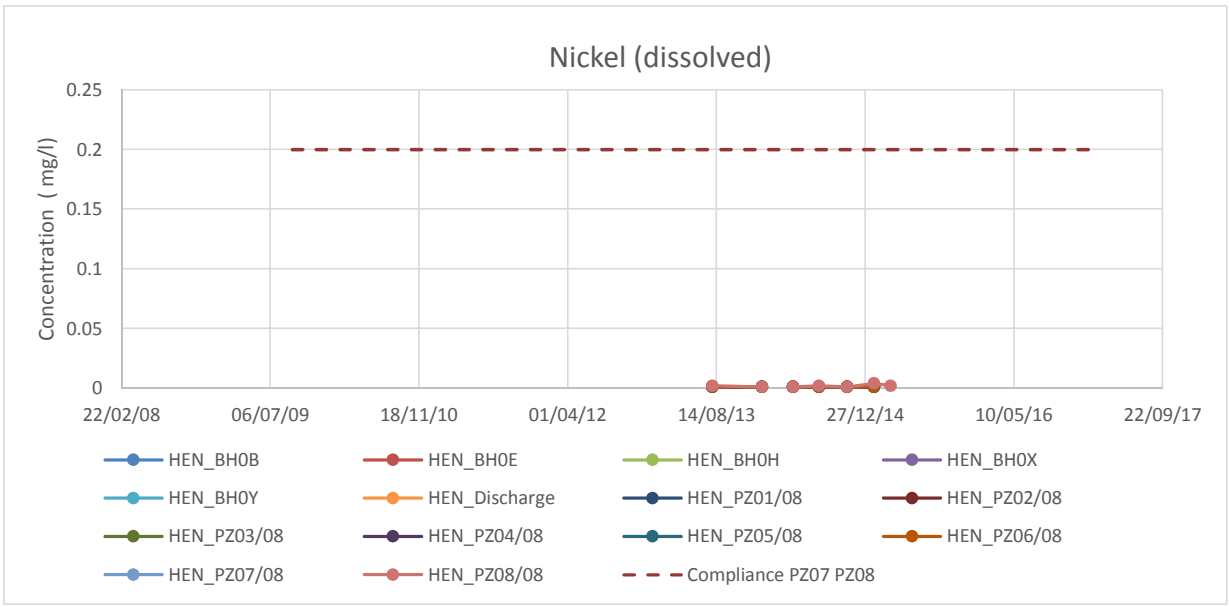

Compliance Wells: Sulphate
Concentration (mg/l)
250
200
150
100
50
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

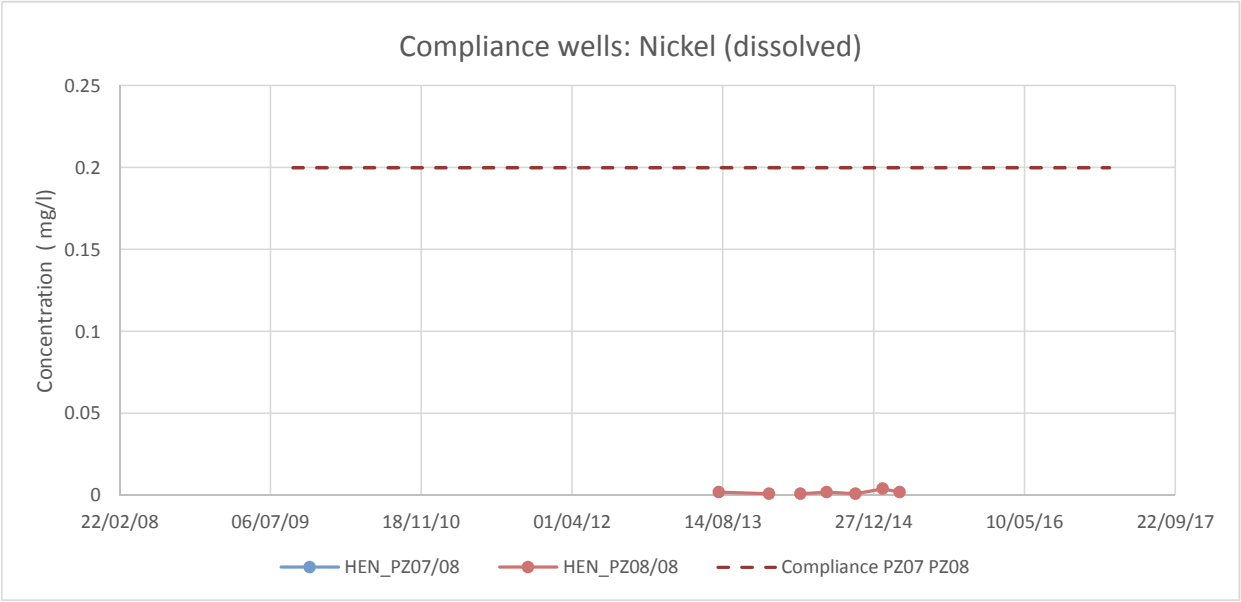

Up Gradient Wells: Sulphate
Concentration (mg/l)
50
45
40
35
30
25
20
15
10
5
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ02/08
HEN_PZ03/08

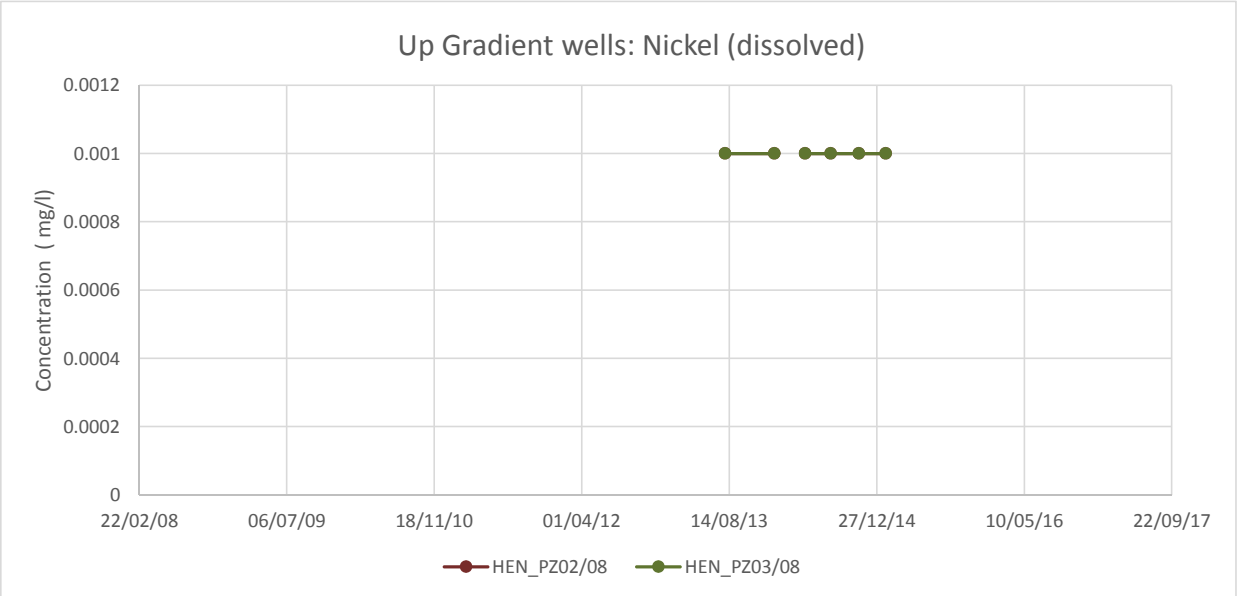

Nickel (total)
Concentration (mg/l)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
22/02/2008
06/07/2009
18/11/2010
01/04/2012
14/08/2013
27/12/2014
10/05/2016
22/09/2017
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

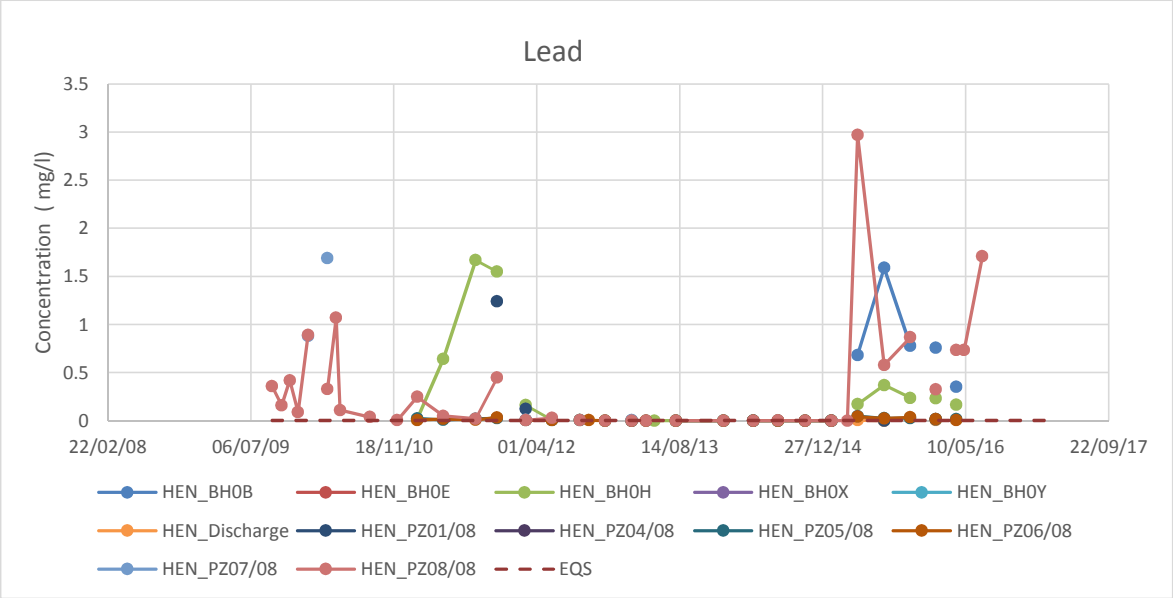

Compliance Wells: Nickel (total)
Concentration (mg/l)
0.25
0.2
0.15
0.1
0.05
0
22/02/2008
06/07/2009
18/11/2010
01/04/2012
14/08/2013
27/12/2014
10/05/2016
22/09/2017
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

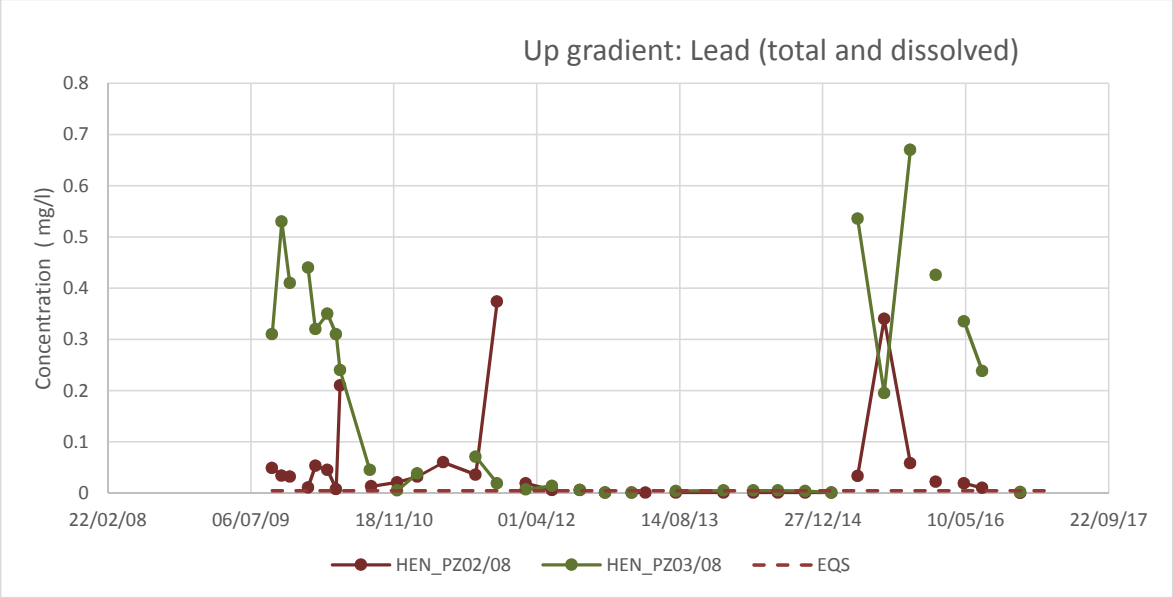

Up Gradient Wells: Nickel (total)
Concentration (mg/l)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
22/02/2008
06/07/2009
18/11/2010
01/04/2012
14/08/2013
27/12/2014
10/05/2016
22/09/2017
HEN_PZ02/08
HEN_PZ03/08

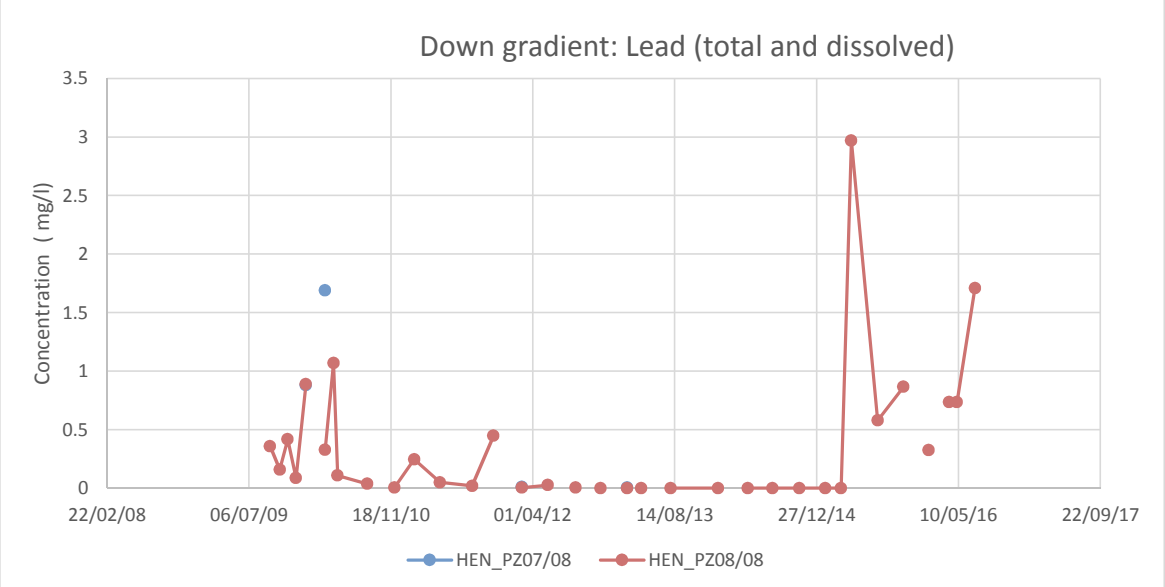

Nickel (dissolved)
Concentration (mg/l)
0.25
0.2
0.15
0.1
0.05
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

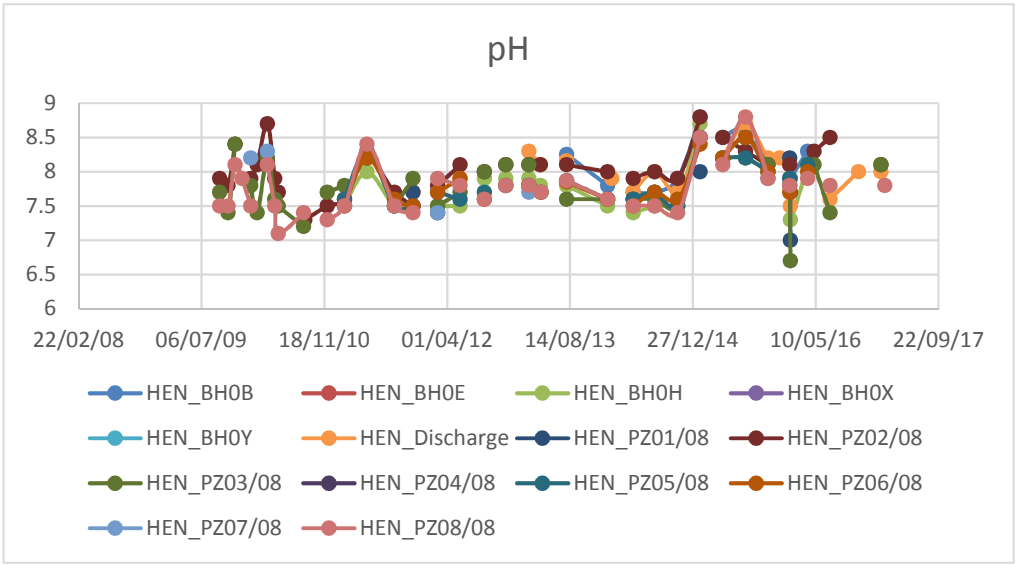

Compliance wells: Nickel (dissolved)
Concentration (mg/l)
0.25
0.2
0.15
0.1
0.05
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ07/08
HEN_PZ08/08
Compliance PZ07 PZ08

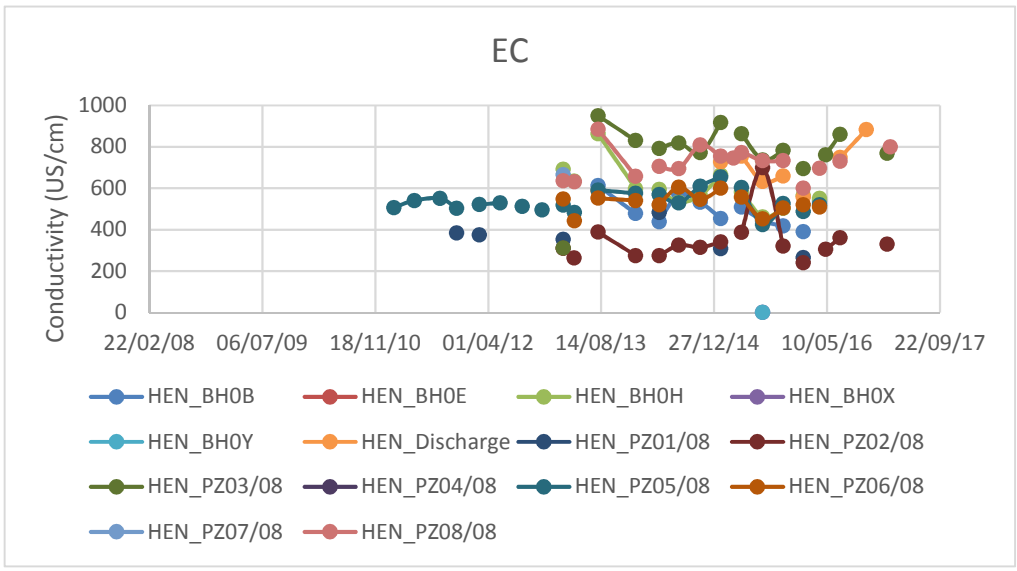

Up Gradient wells: Nickel (dissolved)
Concentration (mg/l)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ02/08
HEN_PZ03/08

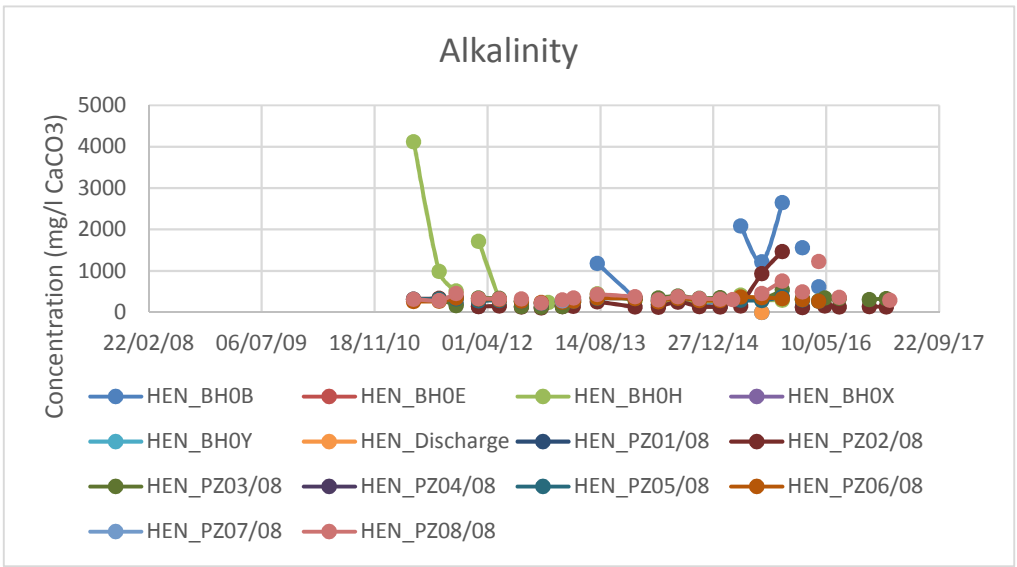

Lead
Concentration (mg/l)
3.5
3
2.5
2
1.5
1
0.5
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08
EQS

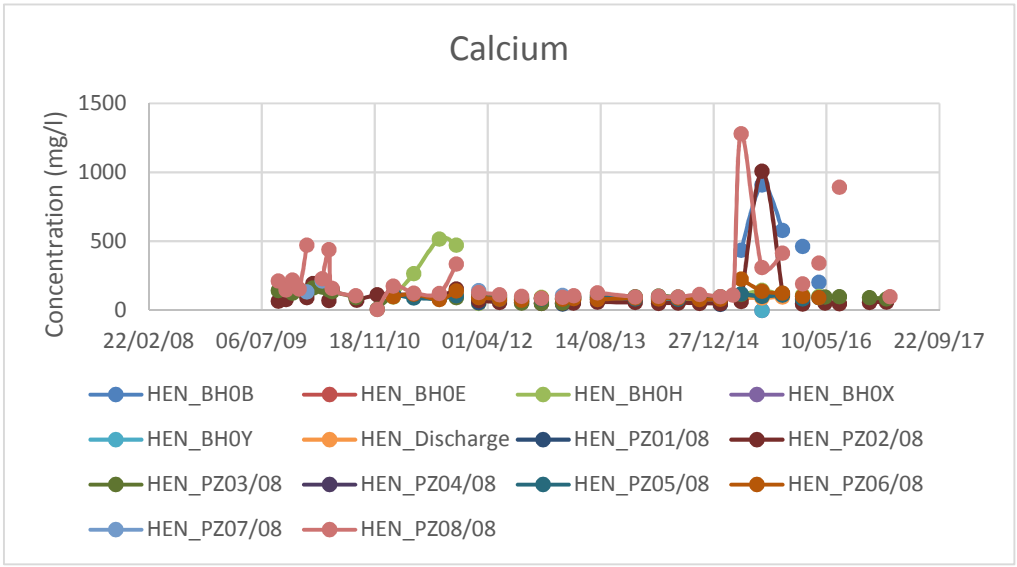

Up gradient: Lead (total and dissolved)
Concentration (mg/l)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ02/08
HEN_PZ03/08
EQS

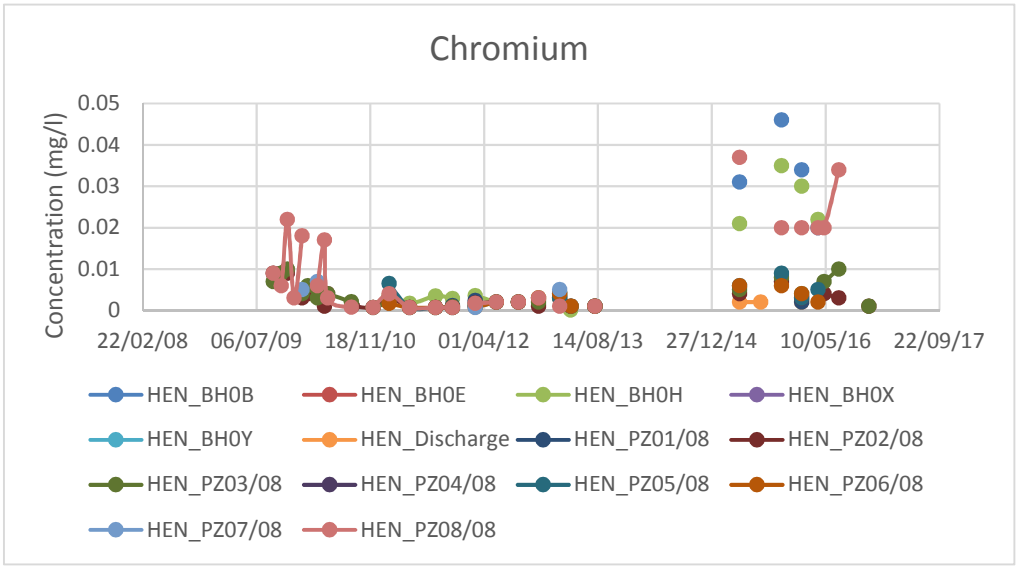

Down gradient: Lead (total and dissolved)
Concentration (mg/l)
3.5
3
2.5
2
1.5
1
0.5
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_PZ07/08
HEN_PZ08/08

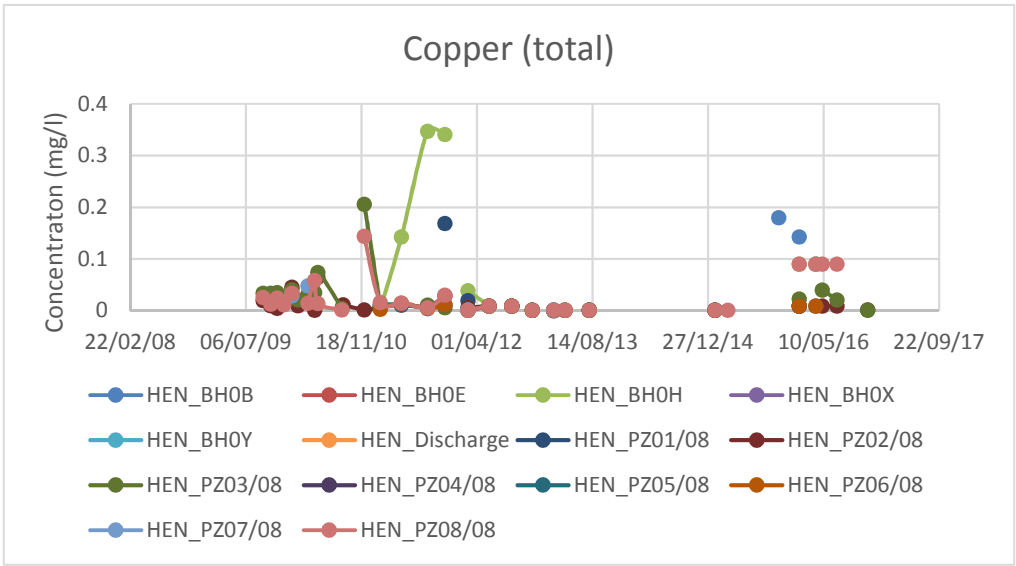

pH
9
8.5
8
7.5
7
6.5
6
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

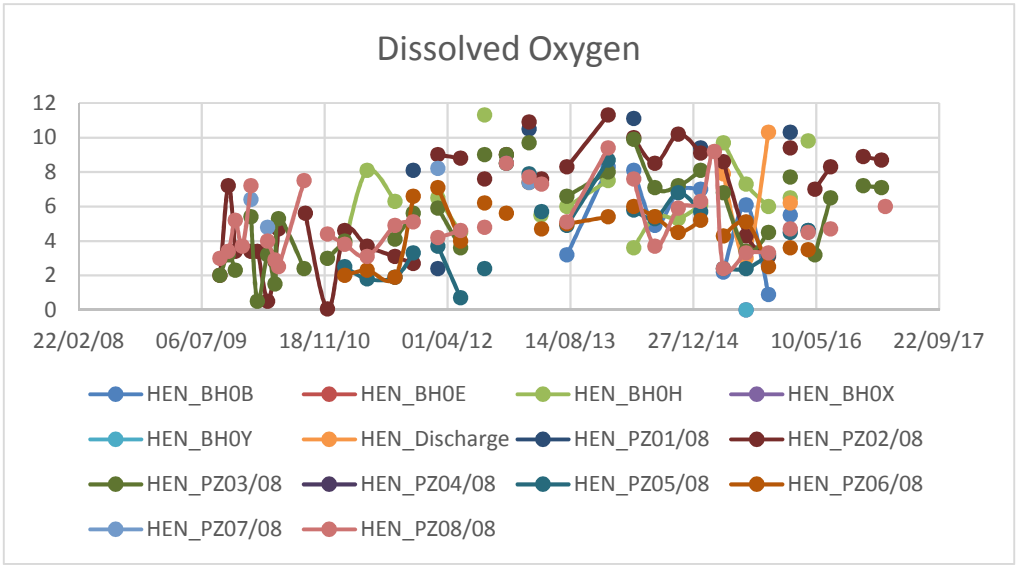

EC
Conductivity (US/cm)
1000
800
600
400
200
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

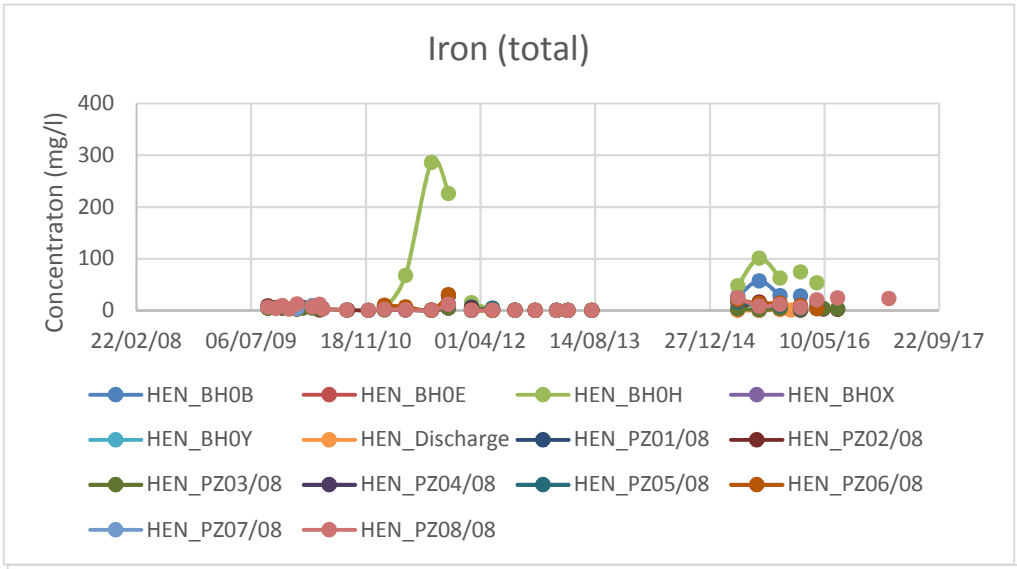

Alkalinity
Concentration (mg/l CaCO3)
5000
4000
3000
2000
1000
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

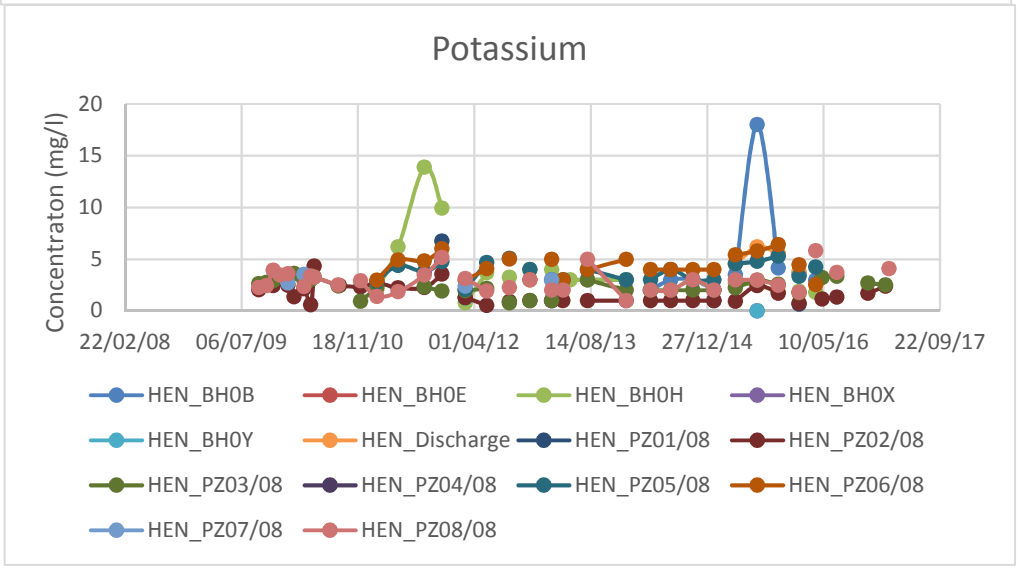

Calcium
Concentration (mg/l)
1500
1000
500
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

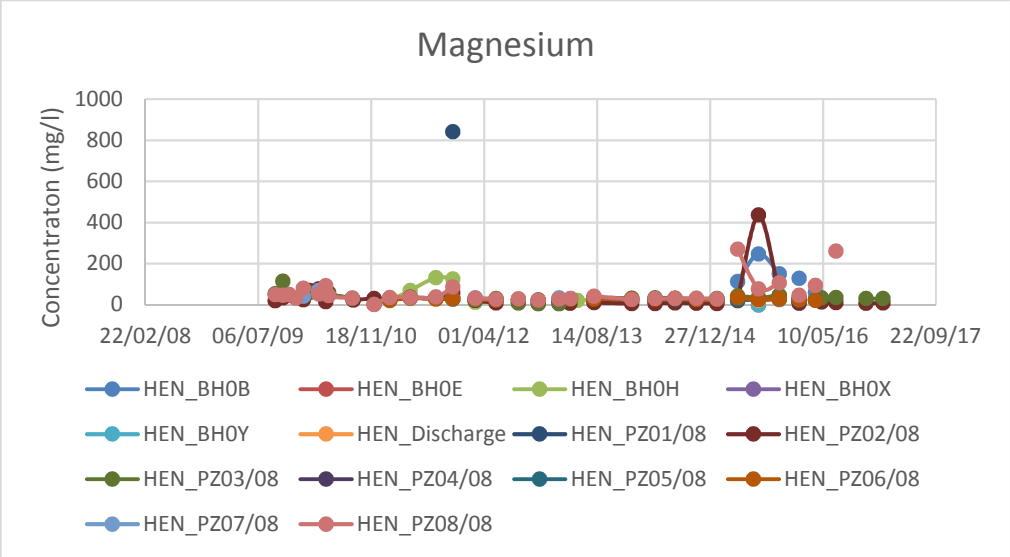

Chromium
Concentration (mg/l)
0.05
0.04
0.03
0.02
0.01
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

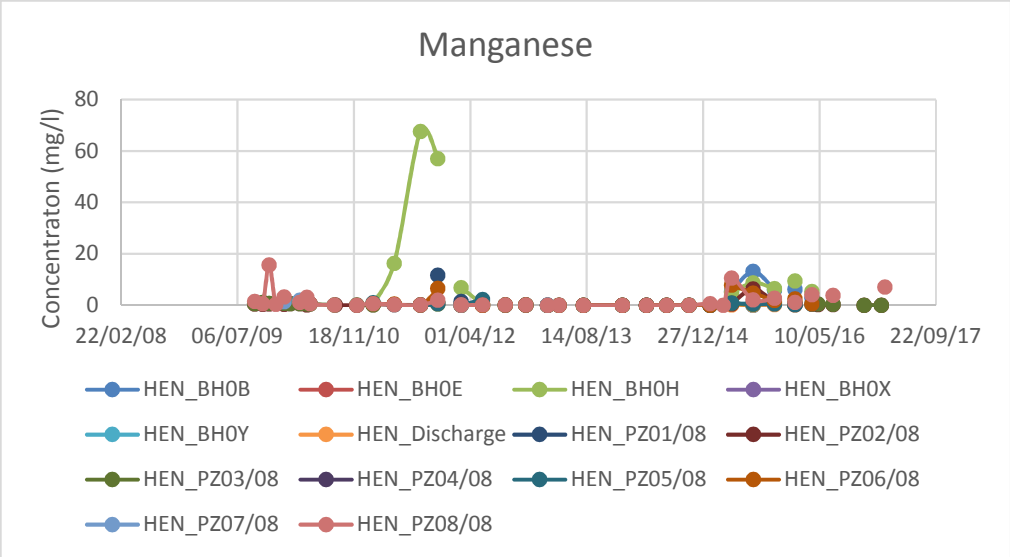

Copper (total)
Concentraton (mg/l)
0.4
0.3
0.2
0.1
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

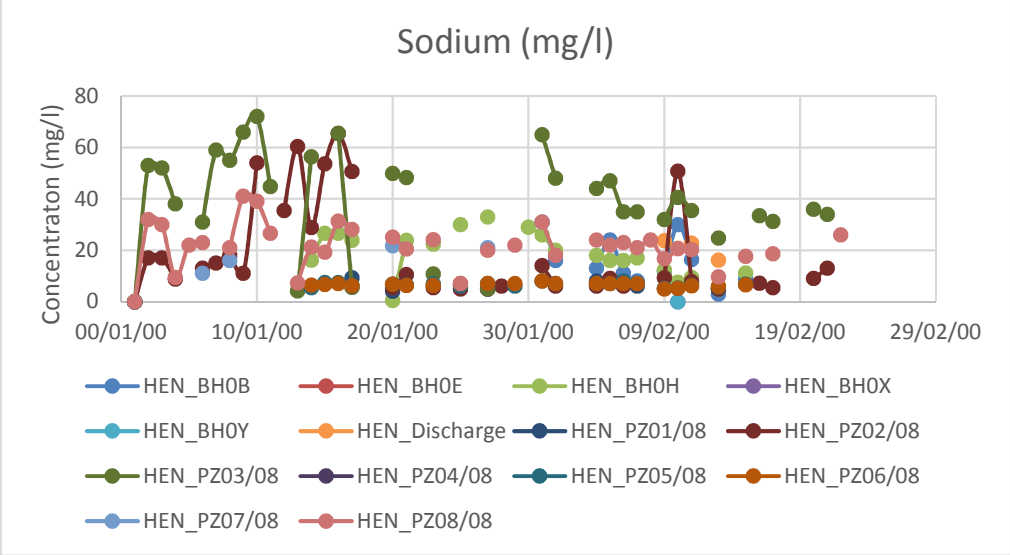

Dissolved Oxygen
12
10
8
6
4
2
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

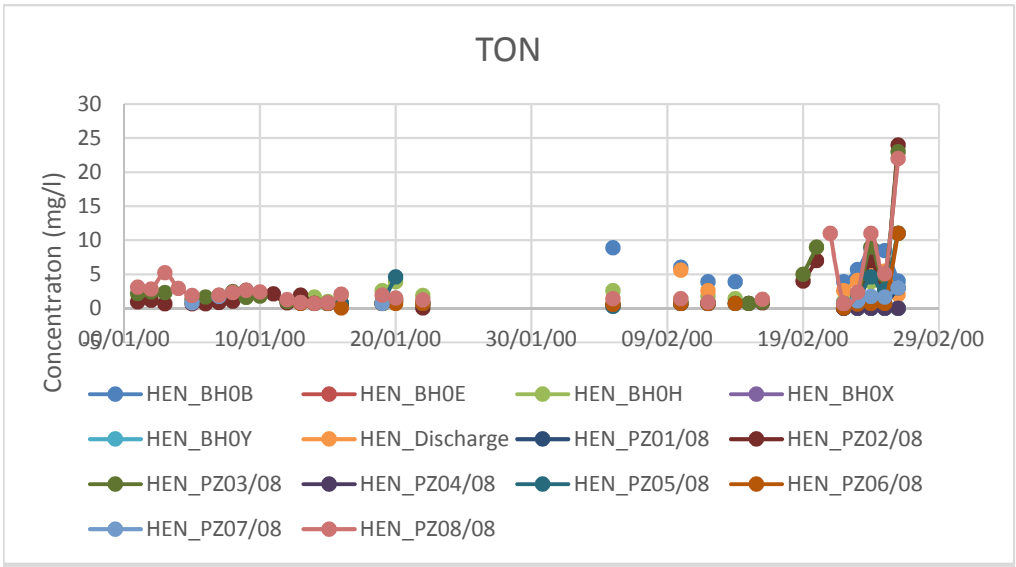

Iron (total)
Concentraton (mg/l)
400
300
200
100
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

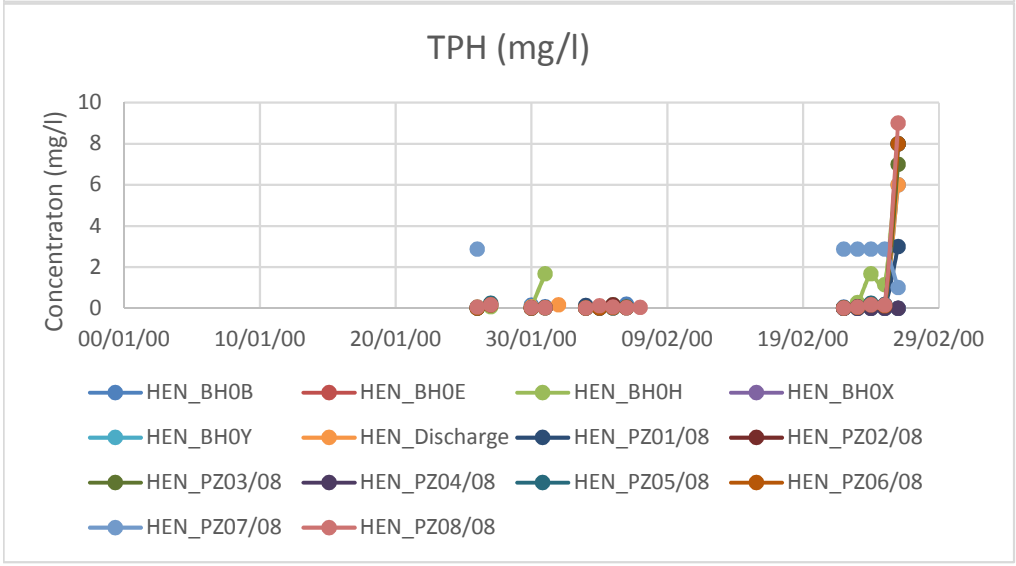

Potassium
Concentraton (mg/l)
20
15
10
5
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

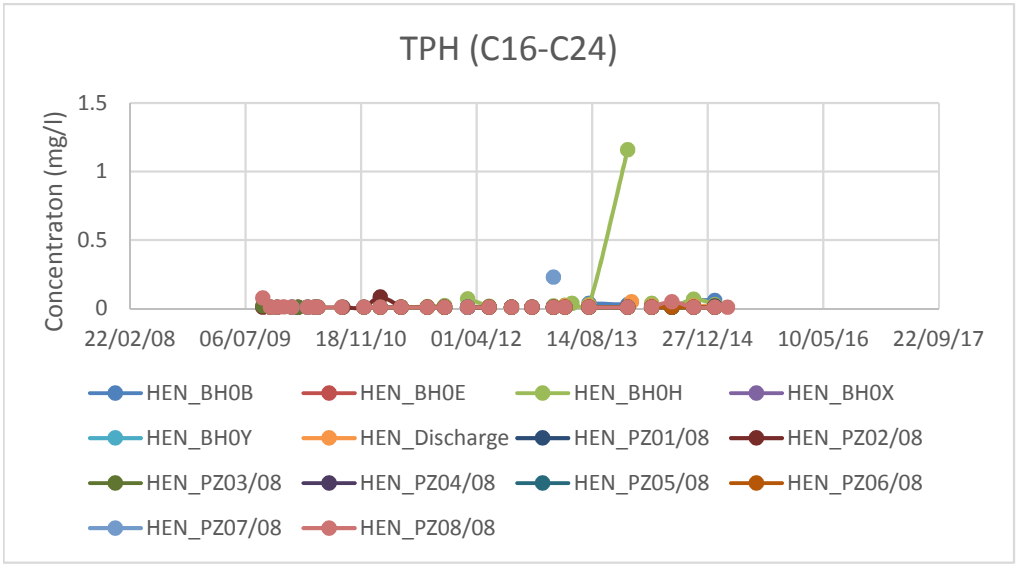

Magnesium
Concentraton (mg/l)
1000
800
600
400
200
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08


Manganese
Concentraton (mg/l)
80
60
40
20
0
22/02/08
06/07/09
18/11/10
01/04/12
14/08/13
27/12/14
10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08


Sodium (mg/l)
Concentraton (mg/l)
80
60
40
20
0
00/01/00
10/01/00
20/01/00
30/01/00
09/02/00
19/02/00
29/02/00
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08


TON
Concentraton (mg/l)
30
25
20
15
10
5
0
09/01/00
10/01/00
20/01/00
30/01/00
09/02/00
19/02/00
29/02/00
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08


TPH (mg/l)
Concentraton (mg/l)
10
8
6
4
2
0
00/01/00
10/01/00
20/01/00
30/01/00
09/02/00
19/02/00
29/02/00
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
HEN_PZ03/08
HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08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10/05/16
22/09/17
HEN_BH0B
HEN_BH0E
HEN_BH0H
HEN_BH0X
HEN_BH0Y
HEN_Discharge
HEN_PZ01/08
HEN_PZ02/08
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HEN_PZ07/08
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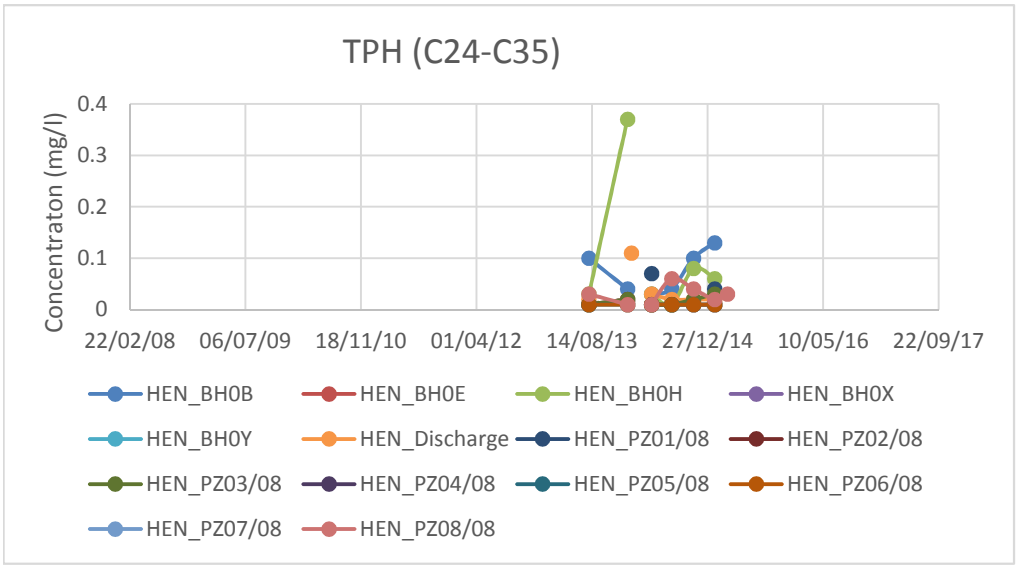
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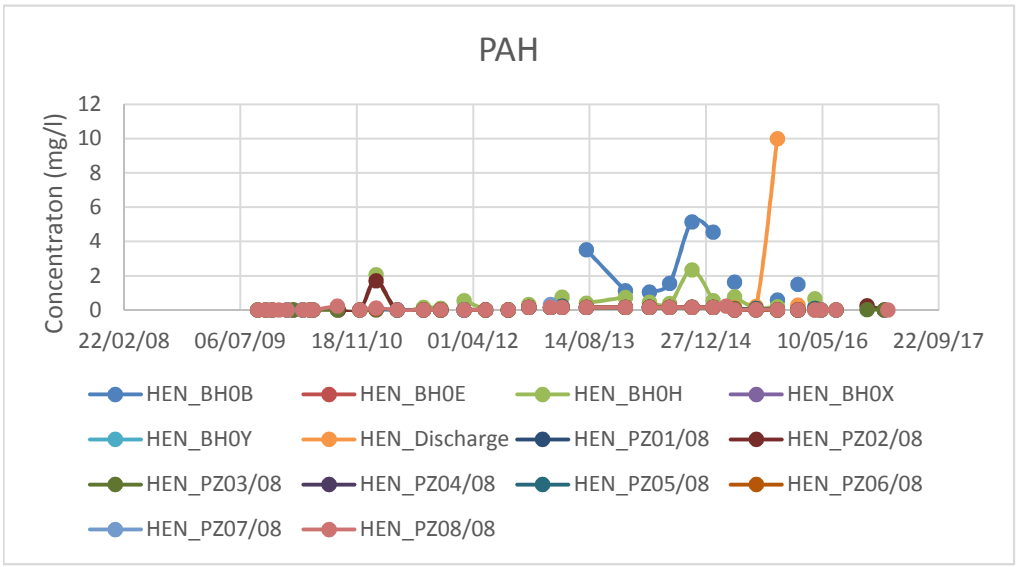
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HEN_PZ04/08
HEN_PZ05/08
HEN_PZ06/08
HEN_PZ07/08
HEN_PZ08/08

APPENDIX 2

Proposed Enhanced Monitoring

In recognition of the absence of an artificially enhanced geological barrier under the existing waste mass, it was agreed between Tarmac and NRW to enhance the monitoring regime at the site to provide additional confidence with regards to the environmental impact on the groundwater regime.

The report above has been amended to further discuss the potential groundwater flow and therefore discharge zones associated with the site and has concluded that although the Avon Group has been reclassified as a Secondary A aquifer, the groundwater levels monitored within the former Lower Limestone Shale Formation indicate that there is no groundwater flow path towards the south (higher groundwater head in the shale formation compared to the limestone). Therefore groundwater flow/discharge is considered to remain along strike towards the west and the River Ely.

No 'new' receptors have been identified and groundwater within the limestone remains the primary receptor with the River Ely being the ultimate receptor of groundwater from beneath the site. The Ely Valley SSSI referred to by NRW is designated based on a particular plant species (monk hood) which thrives along the wooded river banks. The data appears to indicate that that the soil and woodland conditions appear to control its distribution rather than any specific groundwater quality.

Monitoring Infrastructure

It is acknowledged that the groundwater monitoring network requires the reinstatement of the down gradient monitoring borehole BH07/08 and BH08/08. It is considered that replacement boreholes within similar locations would be sufficient to identify any significant contamination arising from the site. The borehole BH07/08 is considered to be downgradient of the long flow path with respect to the existing waste mass. The replacement of BH8/08 adjacent to its existing positions would provide a similar flow path on completion of the site. The boreholes are broadly 100m apart and are considered to meet the requirements of current guidance.

Monitoring frequency

It is proposed (following installation of boreholes) that the groundwater monitoring frequency be increased to monthly with a review after 12 months. This increased monitoring will focus upon leachate indicator species, specifically ammoniacal nitrogen and chloride (together with field

parameters of pH, EC, Temp, and DO). These parameters have been selected following consideration of the potential types 'non inert' material of which topsoil and organic degradable material is considered to be the most likely. These could potential release both ammoniacal and chloride to the environment. It is considered that enhancing the monitoring frequency for metal ions is unlikely to provide any additional confidence in the impact of the site due to the low concentrations of these substances in any leachate and the likely dilution within the aquifer. This may be reconsidered should and significant increase in chloride or ammoniacal nitrogen become apparent. Metals and other parameters will still be monitored as part of the routine monitoring requirements.

Monitoring of surface water

The potential monitoring of the surface water has been considered however boreholes BH07/08 and BH08/08 (or their replacements) are considered to intercept the pathway between the site and the ultimate groundwater discharge to the River Ely and therefore are considered sufficient to monitor this pathway. In addition the rate of groundwater discharge (from beneath the site) is considered to be very low in comparison to the surface water flow within the River Ely and therefore the large dilution within the river raises questions over the suitability for surface water monitoring point to be able to identify any impact from the site.

Although not material consideration in the assessment of whether surface water monitoring is required, the status of the river bank as a SSSI may restrict the ability to site suitable and safe monitoring points in locations suitable to meet the monitoring objectives.

Therefore in consideration of the above factors, it is considered that an enhanced monitoring regime comprising monthly groundwater monitoring in (reinstated) down gradient monitoring wells would reduce the uncertainty with respect to the impact of no artificially enhanced geological barrier below the existing waste. Due to the permeable nature of the limestone and the period over which waste has been placed, it is expected that any impact would be apparent in these down gradient monitoring wells.

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Appendix G

Drainage Assessment

Report Reference: 62487R1rev1
Report Status: Final

Technical Note:

Hendy Quarry - Assessment of discharge 2018

Published by ESI Limited

September 2018

Document reference:
62847TN03

Report status:
Final

T1.03

CONFIDENTIAL
Prepared by ESI Limited

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Prepared for Tarmac Trading Ltd

Document reference: 62847TN03, September 2018

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	Name	Signature
Author	Henry Kelly	
Checked by	Christopher Berryman	
Reviewed by	Barnaby Harding/ Robert Sears	

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APPENDICES

1 Introduction

1.1 Background

Surface water run-off at Hendy Quarry (the Site) is discharged via a soakaway located at the northern end of the Site immediately adjacent to School Road (B4264) (Figure 2.1). All runoff within the main quarry catchment drains into the quarry sump and is then discharged to the soakaway location. A topographical survey is included in Appendix A and photos of the sump and soakaway are included in Appendix B.

Tarmac currently hold an Environmental Permit (EPR/BT1088ID/V003) for inert landfill, with the Directly Associated Activity (DAA) to discharge, predominately rainfall runoff to a soakaway, with a daily limit of 750 m^3. An informal agreement between Tarmac and NRW exists, which permits the reporting of the monthly average discharge values to account for the fluctuations in discharge requirements caused by the variation in receiving rainfall. Despite this allowance, the mean daily discharge regularly exceeds the consented volumetric limit.

A technical assessment was undertaken by ESI (2014) to investigate the likely rainfall runoff rates from at the Site and therefore inform an application to revise the volumetric discharge limit. This report concluded that rainfall runoff was the primary component of the discharge water and that the receiving geological stratum at the soakaway location (fractured Carboniferous Limestone) was capable of receiving the quantities of water which have been discharged to the feature in recent years.

Natural Resources Wales (NRW) has subsequently requested further information as to the makeup of water being discharged to the soakaway (NRW, date unknown) and how much of this, if any, is groundwater derived (as opposed to surface water runoff). Further to this, if there is a groundwater component to the discharge water, what impact is this having on the surrounding groundwater and is there an element of water recycling occurring i.e. water being discharged to the soakaway and abstracted again from the sump.

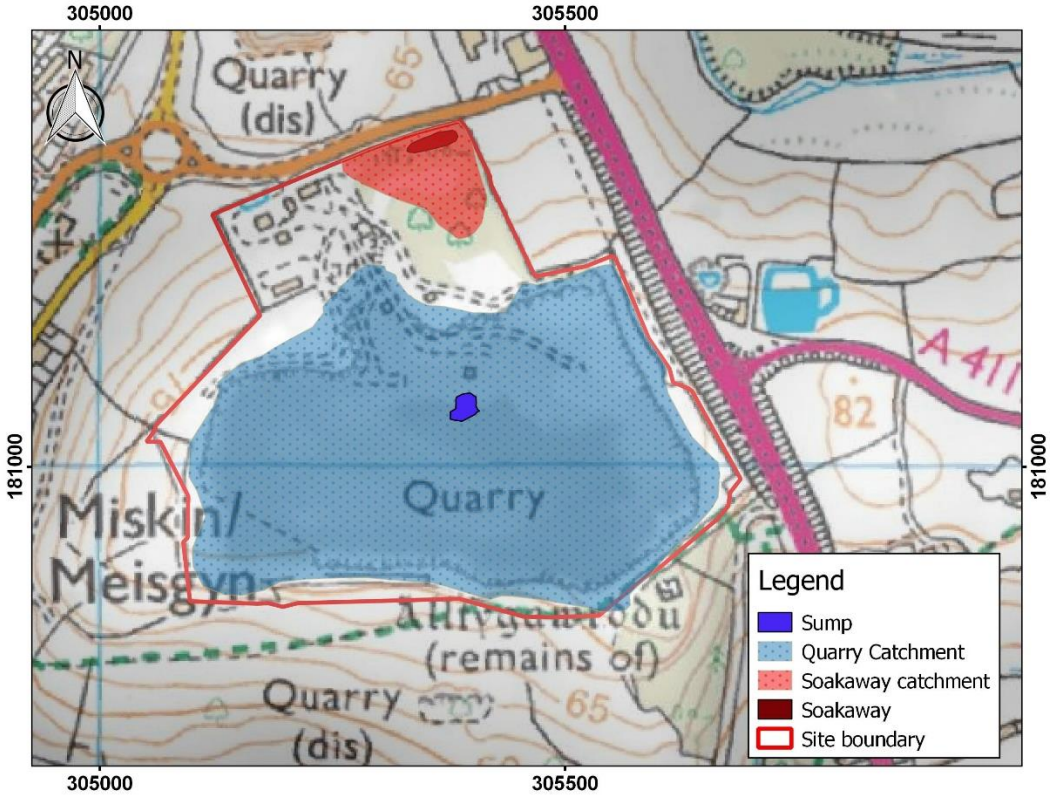
This technical note provides further analysis and information to provide answers to NRW's question above.

2 Site details

2.1 Current Conceptual Model

Mineral extraction at Hendy Quarry has created a sub-catchment across much of the Site which drains to the quarry sump. The soakaway in the north of the Site also has a separate sub-catchment. A site plan is included in Figure 2.1.

Figure 2.1 Site plan



The main quarry catchment is principally covered with bare rock with some areas of inert fill. ESI (2014) estimated the proportion of runoff from incoming rainfall (the runoff coefficient) using the established Coal Board (1982) nomogram method as being 0.67. Linear Regression of daily pumping and rainfall data yielded a coefficient of 0.71 which appeared to validate the high proportion of rainfall being diverted to runoff which may be expected in a heavily modified quarry catchment.

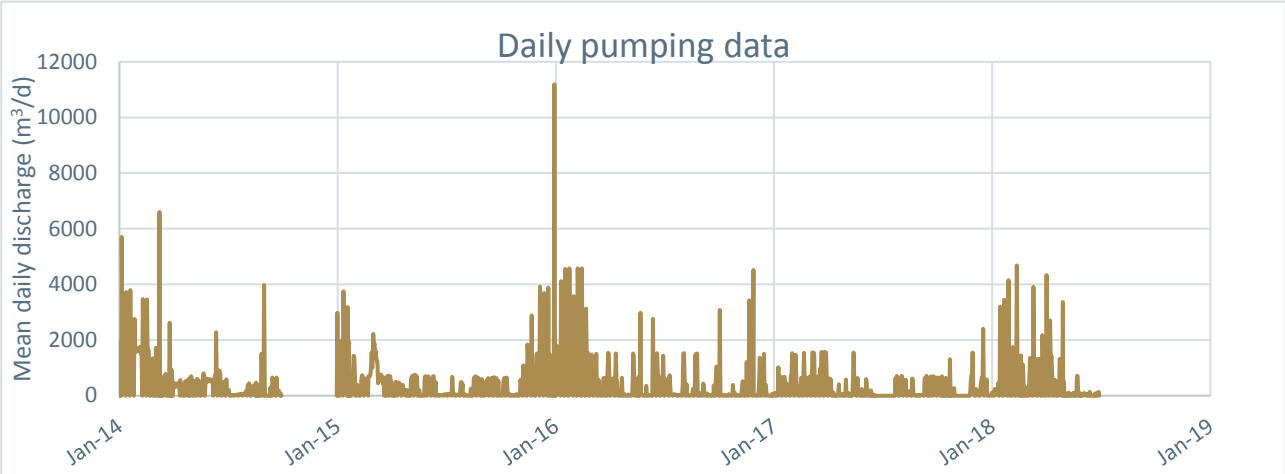
The sump is at an elevation of around 45 mAOD (Appendix A). Water levels are not regularly recorded in this feature although historic site topographical surveys put the sump water level at between 44.5 and 46.0 mAOD. Water level in the sump was noted to be 44.7 mAOD in June 2018. The sump level is controlled by submersible pump which is engaged manually by quarry staff.

The Site's 2017 Hydrogeological Risk Assessment Review (HRAR) (Caulmert, 2018) provided an updated hydrogeological conceptual model for the Site – Appendix C provides an excerpt of the figures which graphically show the conceptual model and groundwater contours across the Site. In general, the base of the quarry is inferred to be very close to the ambient groundwater level, with no significant unsaturated zone (<1 m). However, there is no evidence of groundwater flooding over the base of the void. Water in the sump is considered by Caulmert to be in continuity with groundwater. During a site visit in August 2018 water was observed in the sump following a period of very dry weather. The Quarry Manager (2018) stated at this time that following the occasional pumping that was undertaken over the 2018 summer, water levels in the sump would recover, confirming the connection with groundwater. A comparison of groundwater and sump levels is presented in Section 4.

2.2 Pumping Data

Raw daily pumping data was provided by Tarmac for the period January 2014 to June 2018 inclusive and is presented in Figure 2.2 below. An electronic copy of this data is provided as Appendix D. This shows the high variability of the pumping rate on a daily basis. Note that the high recorded value in December 2015 is likely a summed value over several days and should be discounted.

Figure 2.2 Raw daily discharge data



Over the observed period, the monthly discharge totals (expressed as a daily average) exceeded the consented volumetric limit on 8 occasions – this represents 16% of the data record.

The discharge record is highly variable. The pump capacity is currently unknown although values in excess of 6,000 m^3/d (69 l/s) seem unlikely to be accurate and are probably a result of accrued totals. The maximum daily totals are considered likely to be in the order of 4,000 m^3/d – 5,000 m^3/d. The Site has confirmed the pump runs for 24 hrs following periods of heavy rainfall and that no flooding of the soakaway occurs during these times.

3 Rainfall runoff analysis

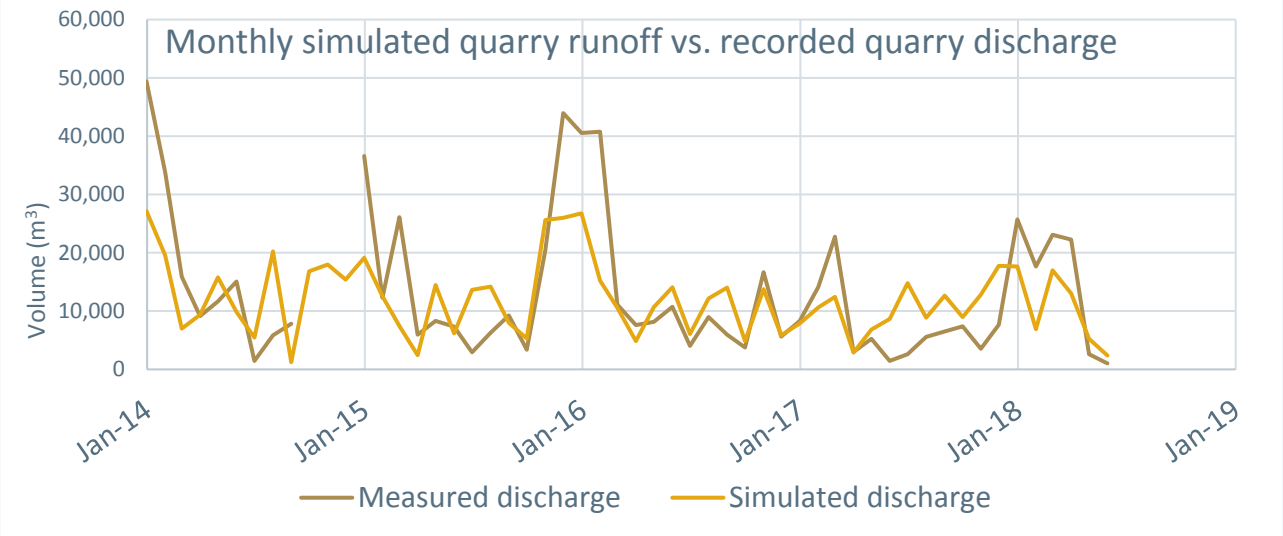
This work builds upon that undertaken in ESI (2014). Using rainfall data obtained from the gauge at the Rhiwsaeson sewage treatment works, 2.25 km northeast of the Site, monthly runoff totals were calculated based upon the runoff coefficient previously established through Linear Regression (0.71). Monthly simulated runoff totals were compared with monthly sum discharge figures, which have previously been used as a proxy for total site runoff, to gauge the relative proportion of total discharge which is likely to be sourced from runoff alone. The latest quarry topographic survey was reviewed as part of this work to assess any change in the catchment area.

The results are presented below as mean totals per quarter, with the first quarter being January to March and so on. This is to show the variability over the year. Monthly totals are also presented in Figure 3.1.

Table 3.1 Recorded discharge vs simulated runoff at the Site (mean values for period Jan 2014 to June 2018)

Quarter	Average of recorded discharge (m^3)	Average of simulated runoff (m^3)	Difference (m^3)
Q1	25,216	13,959	11,257
Q2	7,966	8,452	-486
Q3	5,603	10,948	-5,344
Q4	12,485	14,264	-1,779
Sum	**51,271**	**47,623**	**3,648**

Figure 3.1 Monthly simulated runoff vs recorded site discharge



The results in Table 3.1 suggest that overall runoff is expected to represent the majority of all site discharge, with total simulated flow being 93% of the total recorded discharge (when comparing the summed values). Over the year there is a lot of variation, with recorded discharge being significantly above the simulated flows in the first quarter – this is also clear to see in Figure 3.1. This possibly indicates that the contribution of groundwater to total discharge increases at this time of year, when the water table is at its maximum elevation.

It was noted during a site visit in August 2018 that off-site discharge has been minimal over the dry summer of 2018. Over May and June 2018, recorded rainfall at the Rhiwsaeson rain gauge totalled just 50.0 mm and 22.6 mm, with recorded discharge averages being just 86 m^3/d and 34 m^3/d

respectively. The maximum daily simulated runoff, as calculated for the period 2014-2018, was 5,281 m^3 which was as a result of 47.4 mm of rainfall on 21st July 2017 (Appendix D).

Based on an assessment of the data provided in Figure 2.2 and the maximum daily simulated runoff for the Site (5,281m^3), it is considered that it would be appropriate to increase the discharge limit, which is currently being exceeded due to a gross underestimate of rainfall to the Site, to **5,000 m^3**/day.

4 Groundwater levels

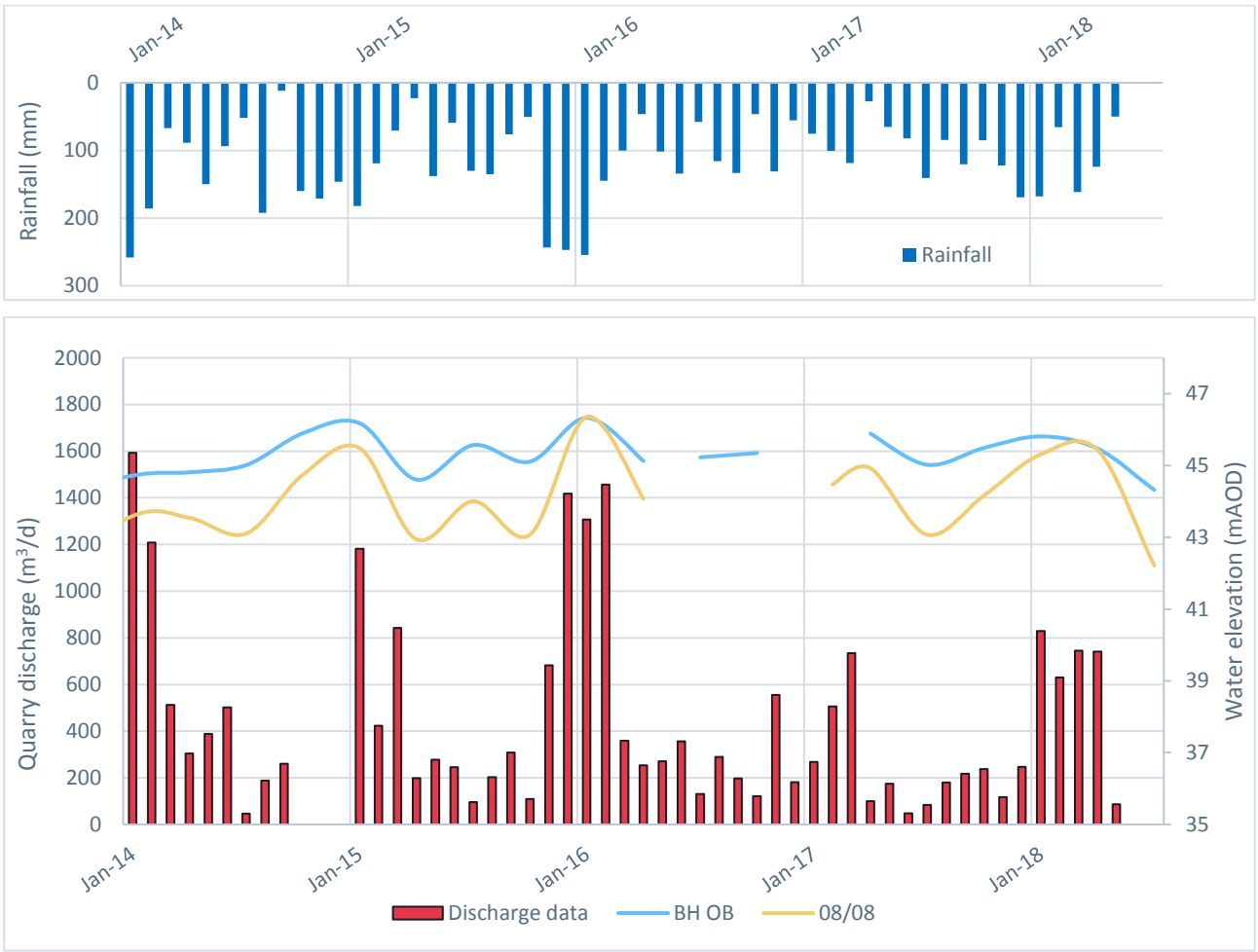
Groundwater monitoring is undertaken at ten locations around the Site. Locations of the monitoring locations are shown on Figure 4.2 and Figure 4.3. In general, the groundwater gradient is from east to west across the Site.

The most proximal borehole to the sump is BH OB, located 70 m to the northwest. Groundwater levels at BH OB and PZ08-08 (a more remote location from the sump) have been plotted below along with pumping rates (monthly average data) and rainfall (monthly sums). The data show that groundwater levels and pumping rates both appear to correlate well with total rainfall i.e. in wetter periods there is more runoff to the sump and the groundwater levels rise such that there is also likely to be an increased groundwater discharge to the sump.

Whilst there are no groundwater monitoring wells very close to the sump, there is no evidence that pumping from the sump actually draws groundwater in i.e. there is unlikely to be any zone of depression in groundwater forming due to pumping. The pumping simply removes excess groundwater which has discharged into the sump due to the prevailing hydraulic gradient.

What is also evident in the Figure 4.1 is the BH OB has a smaller amplitude than PZ08/08. This is most likely due to variations in storage which might well be related to the relative degree of fissuring at the locations.

Figure 4.1 Comparisons of rainfall, discharge and groundwater elevation at the Site



Summer and winter groundwater contours have been calculated for the Site using data collected in July 2017 and January 2018 respectively. These are presented in Figure 4.2 and Figure 4.3 along

with an east-west profile through the Site showing topography data (LiDAR) and interpolated groundwater levels.

The profiles confirm that the summer groundwater level is similar to or below the sump level, whilst the winter groundwater level is higher than it. This confirms that there is likely to be a component of groundwater discharge to the sump in the winter months with a reduced or absence of discharge in the summer months. Winter groundwater levels do not show any influence from sump pumping.

Figure 4.2 Summer groundwater contours at the Site – data recorded in July 2017

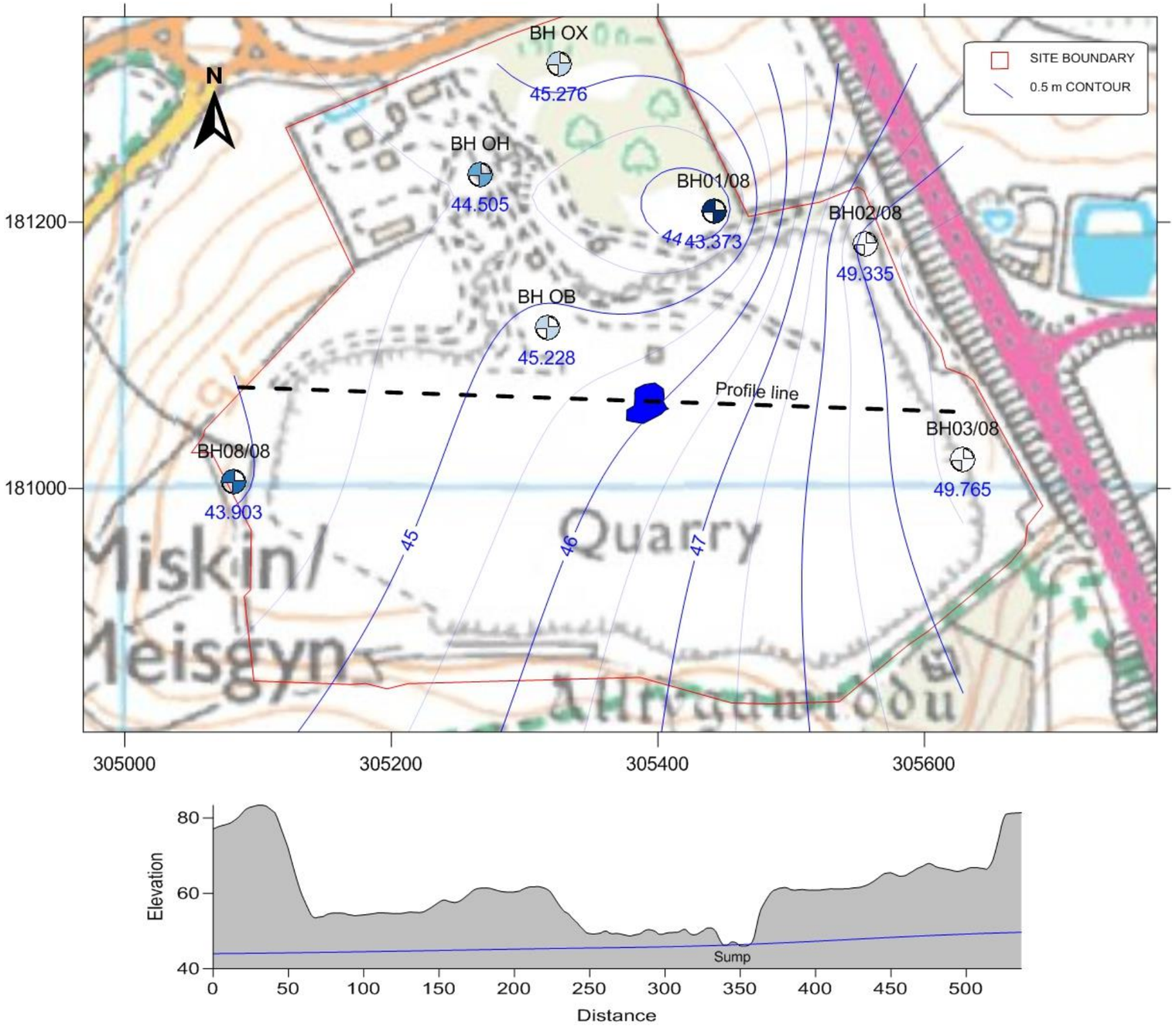
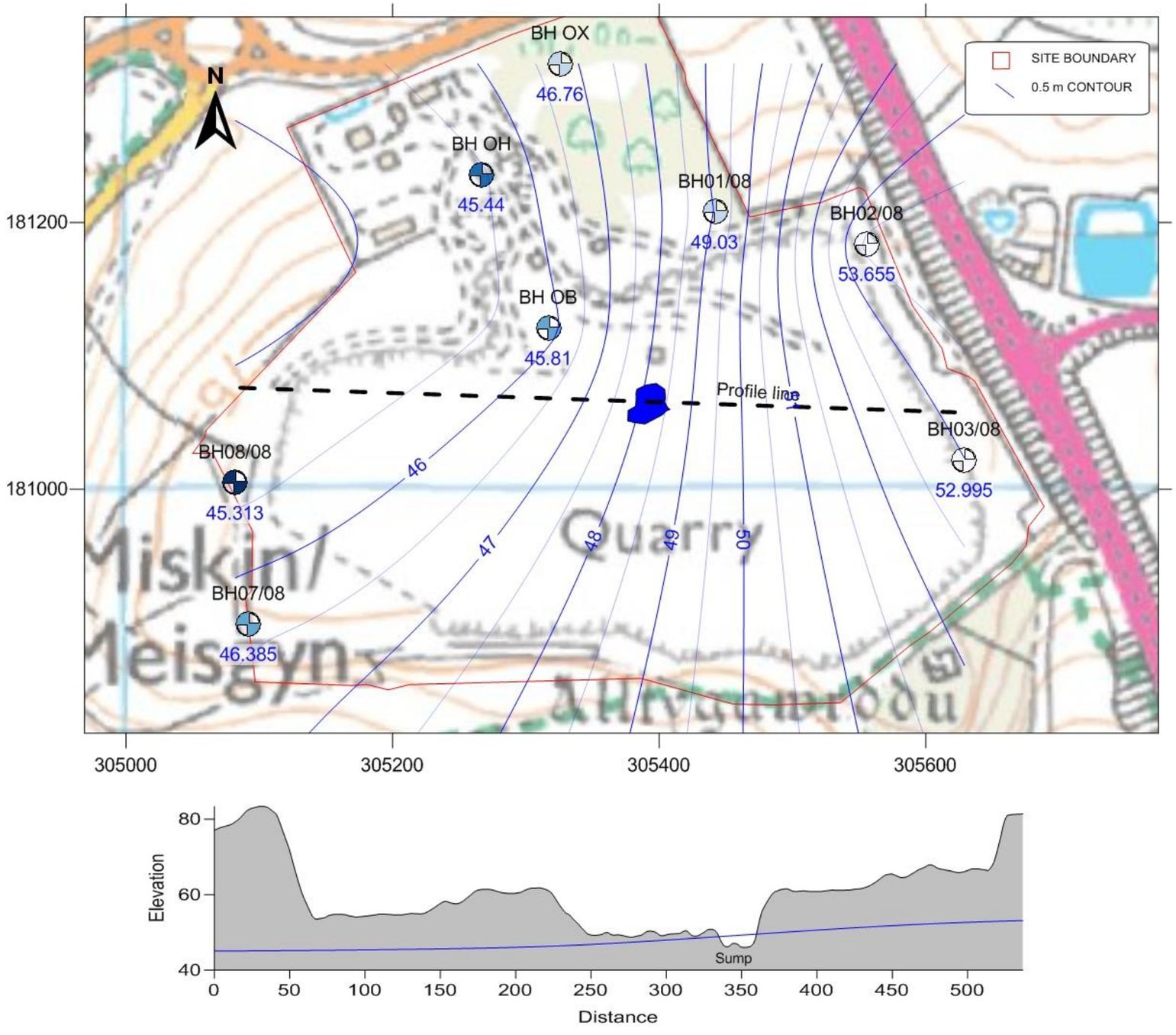


Figure 4.3 Winter groundwater contours at the Site – data recorded in January 2018



5 Conclusions

The Hendy quarry sump is at an approximately equal elevation to the local groundwater table (within the Carboniferous Limestone). Water within the sump is likely to be in hydraulic continuity with groundwater, at least during the wetter winter months. When groundwater levels are high, groundwater discharges to the sump and this water, along with runoff, is pumped out to the soakaway. During the drier, summer months, the groundwater level falls below the base of the sump and the only contribution to the sump is runoff.

There is no evidence that removal of excess groundwater that discharges into the sump has any significant effect on groundwater flow rate or direction. There will be a very small effect as a volume of groundwater is being removed at one location and returned to ground in another location, but this does not appear to affect overall flow rates or directions.

The proportion of rainfall diverted to runoff in the quarry catchment is relatively high, being in the order of 71% as demonstrated in previous work (ESI, 2014). Calculated rainfall runoff on a monthly basis using the established coefficient gives volumes which approach the total magnitude of the recorded discharge totals. In general, pumping rates correlate very well with rainfall totals which would not be expected if the major component of abstracted water was derived from groundwater. This suggests that the majority of pumped water in any given year from the sump is derived from surface water runoff.

The degree of any recycling of water between the soakaway and the sump is likely to be negligible. This is due to the distance between the sump and soakaway and the absence of a hydraulic gradient between the sump and the soakaway.

REFERENCES

Caulmert, 2018. Hendy Landfill Site - Hydrogeological Risk Assessment Review 2017. Doc ref: 3145-CAU-XX-XX-RP-O-0301.S0.C1

ESI, 2014. Hendy Quarry - Assessment of run-off. 62847TN03.

National Coal Board, 1982. Technical Management of Water in the Coal Mining Industry. National Coal Board, Mining Department. Brighton

Natural Resources Wales, date unknown. Letter from Natural Resources Wales to Tarmac – exact date unknown although assumed to be early 2017. Subject of letter: Response to SLR/Tarmac request to vary volumetric discharge limit and ESI's technical note 6284TN03.

Quarry Manager, 2018. Conversation between Henry Kelly (ESI) and Hendy Quarry Manager (Owen Llewellyn) during site visit, 02 August 2018.

APPENDICES

Appendix A

Topographical survey

TARMAC
A CRH COMPANY

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Bristol, Avon. BS48 3QD
Tel +44(0)1275 465714
e-mail: stuart.blackhurst@tarmac.com

H074 - HENDY

TOPOGRAPHIC PLAN
4th JUNE 2018

LSS Models Used To Create Plot

H074 HENDY QU 2018-06-04

Drawn By	Date
SJB	JUNE 2018
Scale	**Drawing No.**
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Appendix B

Site photos

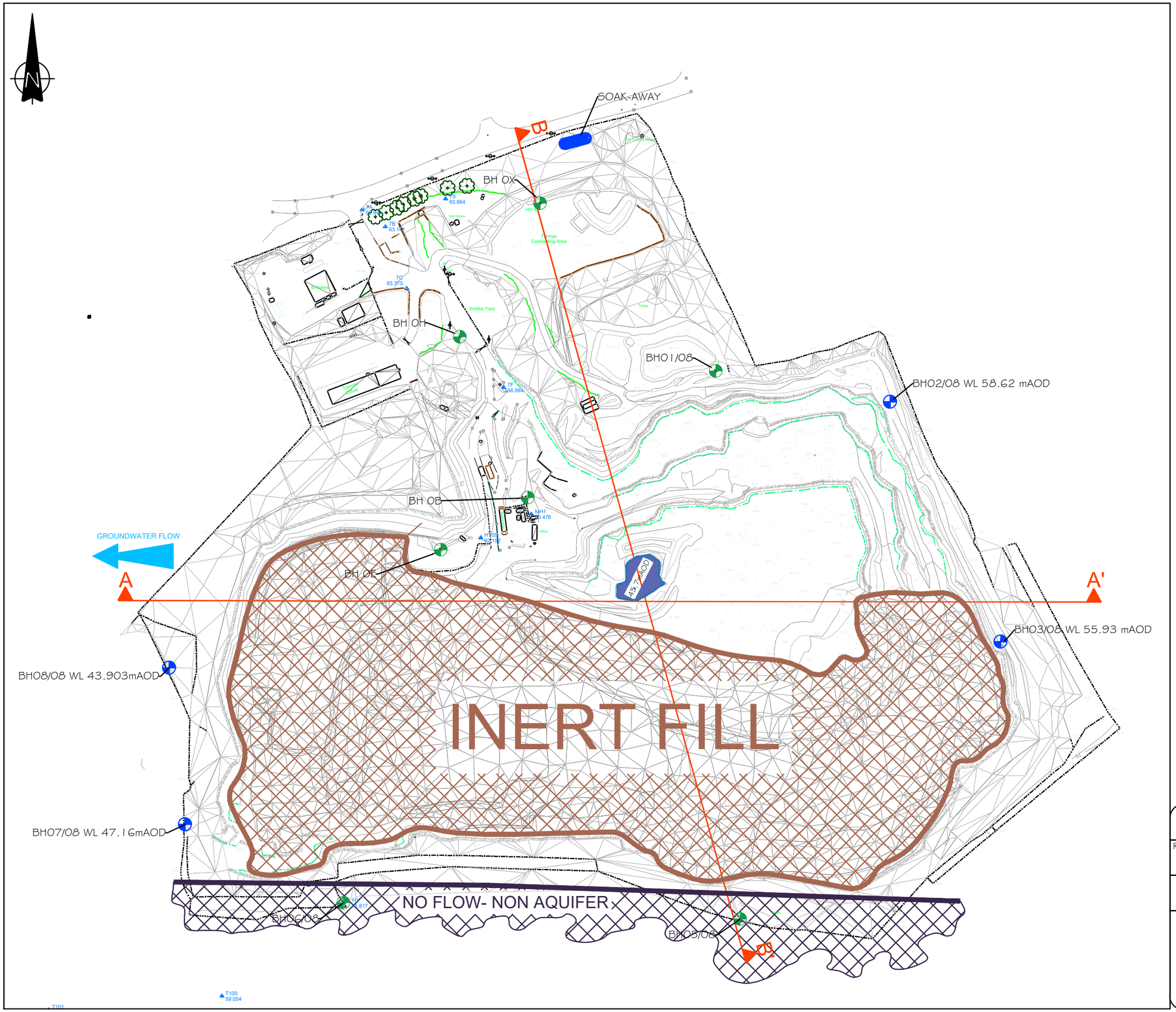
Site photos – 02/08/2018

Hendy sump

Hendy soakaway

Appendix C

Hydrogeological conceptual model drawings (Caulmert, 2018)



LEGEND

- PZ02/0 — PERMIT BOREHOLE LOCATION
- PZ — ADDITIONAL BOREHOLE LOCATIONS
- SOAK-AWAY

PROJECT	HENDY
REPORT TITLE	BOREHOLE LOCATION PLAN
HRA 01	REPORT REF 3145

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NOTE

1. DO NOT SCALE FROM THIS DRAWING, WORK FROM FIGURED DIMENSIONS ONLY. ALL DIMENSIONS ARE IN MILLIMETRES AND ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM U.N.O.

2. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING WILL BE ALLOWED WITHOUT THE PRIOR PERMISSION IN WRITING.

3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS.

LEGEND

- INERT FILL
- NON FLOW, NON AQUIFER
- GROUNDWATER CONTOUR- 28.04.2015

GROUNDWATER FLOW

INERT FILL

NO FLOW- NON AQUIFER

BH-H - 44.05mAOD

BH-B - 44.61mAOD

BH-E - 62.192mAOD

BH01/08 51.87mAOD

BH02/08 - 48.22mAOD

BH03/08 - 48.3mAOD

BH04/08 - 63.22mAOD

BH05/08 - 62.192mAOD

BH06/08 - 56.12mAOD

BH07/08

BH08/08 - 42.94 mAOD

PRELIMINARY DRAWING FOR INFORMATION PURPOSES ONLY

REV	MODIFICATIONS	BY	RE	AP	DATE
B	BOREHOLES ID AMENDED	EJD	SV	SV	09.01.18
A	GROUNDWATER CONTOURS	RP	SV	SV	18.09.17

TARMAC

PROJECT: HENDY

TITLE: CONCEPTUAL MODEL

DRAWN BY	DATE	
RP	04.07.2017	
REVIEWED BY	SCALE @ A1	JOB REF:
SV	N.T.S.	3145
AUTHORISED BY	ISSUE	REVISION
SV	-	B

DRAWING NUMBER: 3145.02

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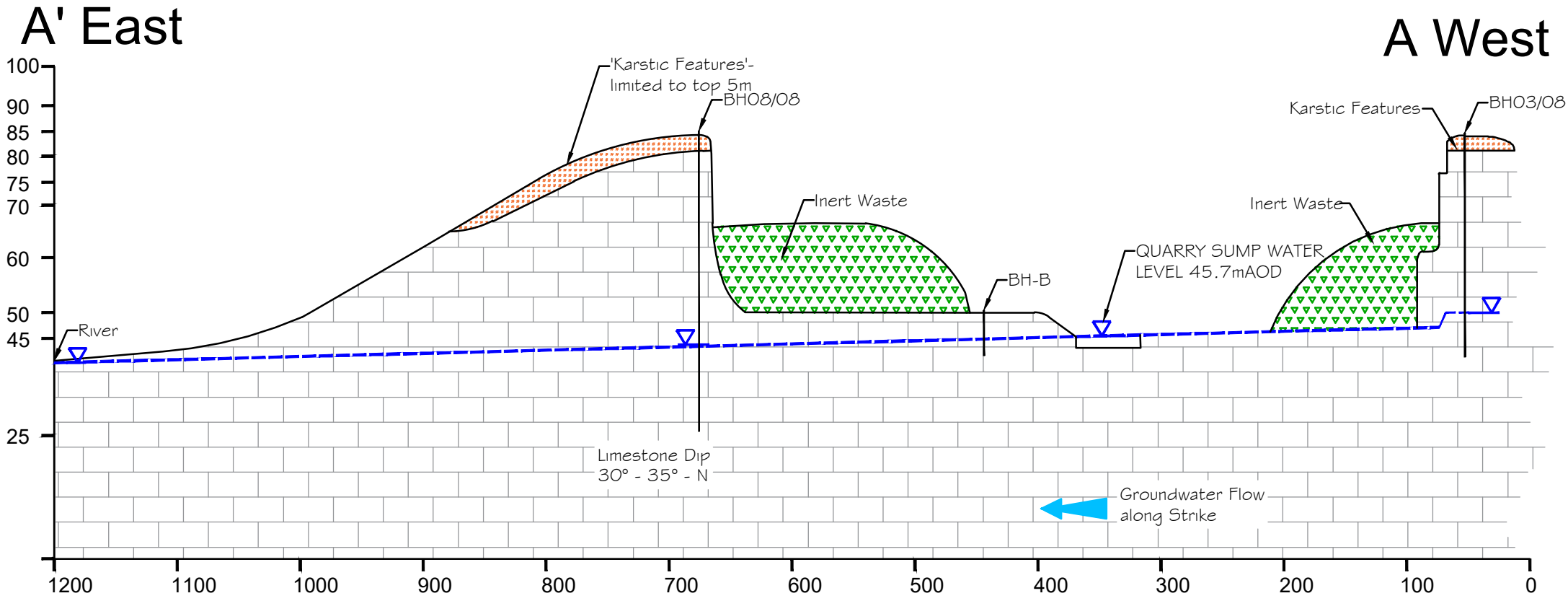

PROJECT
HENDY

REPORT TITLE
CONCEPTUAL MODEL

CROSS SECTION A-A

REPORT REF
3145.03

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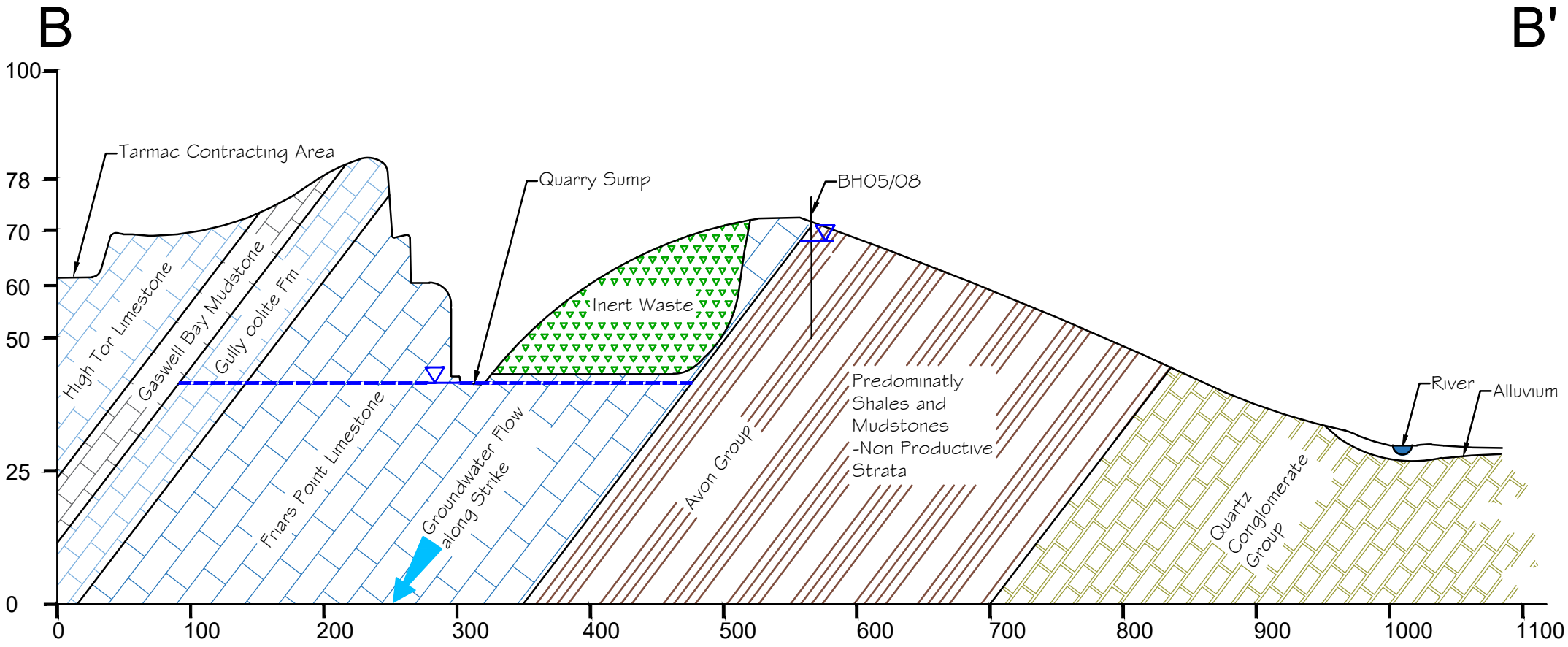

PROJECT
HENDY

REPORT TITLE
CONCEPTUAL MODEL

CROSS SECTION B-B

REPORT REF
3145.04

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Appendix D

Raw data calculation worksheet (electronic)

Appendix H

Site protection and monitoring programme

Environmental Management and Monitoring

Surface Water Management Plan

Hendy Quarry Landfill

Permit Reference EPR/KP3795FU

Plan Reference HNDY/SWMP
November 2018
Version 3.0

SURFACE WATER MANAGEMENT PLAN

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Drawings

1. INTRODUCTION AND BACKGROUND

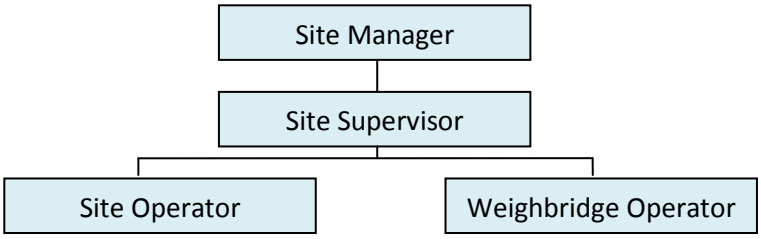
1.1 Report Context

1.1.1 The Surface Water Management Plan (SWMP) provides a framework for the management of surface water at the Hendy Quarry landfill Site, Miskin, Pontyclun, National Grid Reference ST 05425 80991. The SWMP forms part of the Environmental Management and Monitoring Program for the site that covers all the different monitoring regimes at the installation.

1.1.2 This SWMP complies with the requirements of the Environmental Permitting regime and regulatory guidance note LFTGN02 'Guidance on Monitoring Landfill Leachate, Groundwater and Surface Water' issued by the Environment Agency and forms part of the Environmental Permit (EP) for the site, reference EPR/KP3795FU.

1.2 Management Structure

1.2.1 The Site Manager, who is supported by the Site Supervisor undertakes overall management and supervision of the site. The management structure for the site is as follows:



1.2.2 Suitably qualified technicians who are experienced and trained in the use of monitoring and sampling equipment and interpretation of the data obtained will carry out all water monitoring at the installation. Standard operating procedures are in place for surface water monitoring.

1.3 Summary of Conceptual Hydrogeological Model.

1.3.1 The quarry is excavated into the Black Rock Limestone Subgroup which is described as skeletal and argillaceous packstones with minor oolites, shales and mudstones. The Carboniferous Limestone is defined as a principal aquifer with flow dominated by fracture flow.

1.3.2 The Avon Group (Lower Limestone Shale) is classified as Secondary A. It is noted that this strata was previously classified as a non-aquifer. Although the change in classification reflects a greater understanding of the potential for this strata to transmit groundwater, site investigation and monitoring data collected over the development of the site confirm that the original conceptual model remains valid where there is no groundwater migration towards the south. This is confirmed by the presence of two boreholes along the southern boundary (installed within the Avon Group) which have significantly higher groundwater levels in comparison to those installed within the permeable fractured limestone. Therefore notwithstanding the permeability contrast between the limestone and Avon

group, the hydraulic gradient is such that there is no possible groundwater flow towards the south. The water levels within the Avon Group boreholes are considered to represent water in the superficial deposits and weathered zone. Therefore it is considered that these strata effectively form a barrier to flow in a southern direction at the site. The orientation and dip of this strata is considered to constrain the groundwater flow to the south and therefore the principal groundwater flow is along the strike of the beds towards the west.

1.3.3 To the south and west of the site the land steeply slopes to the river valley of the Ely, approximately 300m from the boundary of the site.

1.3.4 The site lies within the catchment of the River Ely, with the river flowing towards the south east. At its closest reach the river passes some 300m from the site. Tributaries of the River Ely drain the hilly area the quarry is located within. The River Ely is the principal watercourse in the vicinity.

1.3.5 An un-named stream arises 550m east of the quarry boundary (in the vicinity of Croffta Farm) and flows south westwards towards the River Ely. At its closest approach it passes some 250m south of the site. A second un-named stream passes 200m to the north east of the site. It arises at Brofiscin Farm, some 1.5km to the east of the site and flows westward towards the site then northwards to its confluence with Afon Clun, some 1.1km to the north of the site. Ultimately the stream discharges into the River Ely.

1.3.6 A detailed summary of the hydrogeological regime local to the site is referenced in the report entitled 'Hydrological and Hydrogeological Assessment to Support Planning Application for Restoration of Quarry by Infill with Inert Materials' produced by BCL Consultant Hydrogeologists Ltd in August 2000 and 'Hendy Landfill Site, Hydrogeological Risk Assessment Review 2017', produced by Caulmert.

1.3.7 Surface water within the site is collected in the sump located in the base of the quarry. The water is pumped from the quarry sump to a soakaway located at NGR ST 0538 8136. The discharge is a directly associated activity of permit reference EPR/KP3795FU.

2. MONITORING REQUIREMENTS

2.1 Monitoring Scheme

2.1.1 The current surface water emissions limits and monitoring frequencies are specified in Table S4.1 of the permit and are presented in Table 1 below.

Table 1 – Hendy Quarry Surface Water Emissions Limits and Monitoring Frequencies.

Emission Point Reference and Location	Parameter	Limit	Monitoring Frequency
S1 – discharge to soak away.	Volume	750m^3/day*	Daily
	Rate of discharge	25 lts / sec	Weekly
	Suspended Solids	100mg/l	Quarterly
	Mineral oil	5 mg/l	Quarterly
	pH	6 - 9	Quarterly

* Informal agreement in place with NRW to use month average daily discharge to account for the varying requirements to discharge following periods of heavy rain.

2.2 Measurement Techniques and Monitoring Strategy

2.2.1 All water monitoring at the site will be carried out by suitably qualified technicians who are knowledgeable and experienced in the use of equipment when taking field measurements and interpretation of the data obtained.

2.2.2 Any field measurements, if necessary, will be monitored utilising a hand held portable meter which will be regularly tested and calibrated and maintained to the manufacturer's guidance.

2.2.3 Laboratory analysis will be undertaken by a third party UKAS accredited laboratory.

2.2.4 The flow meter on site will be regularly inspected and maintained to the manufacturer's specifications.

2.3 Assessment Criteria and Contingency Actions

2.3.1 The compliance limits for the surface water monitoring point S1 are specified in Table 1. Control limits will be deemed to have been breached if the three point rolling average, relative to a particular limit demonstrates a rising trend. If a limit is breached the actions in Table 2 will be undertaken:

Table 2 – Contingency Actions

Contingency Action	Response Time
Advise NRW	As soon as practicable
Increase Survey Frequency to monthly	1 month
If exceedance continues Undertake investigation into source of contaminants	6 months
Report to NRW on the re-appraisal of risk and options for corrective measures	12 months
If the risks are acceptable re-evaluate the assessment criteria. If the risks are unacceptable implement agreed corrective measures.	18 months

2.4 Emergency Actions

2.4.1 Emergency contingency measures will be employed at the site in the event of a fuel spillage from a storage tank as a result of a leak or from poor re-fuelling or filling procedures. The procedure is included as part of the Sites Environmental Management System.

3. MONITORING PROTOCOLS

3.1 Surface Water sampling

3.1.1 The type of sampling equipment used will depend on the size and type of water body to be sampled. Where surface water bodies are accessible safely the sample bottles can be filled directly from the water body. This method cannot be used if the sample bottles contain fixatives or preservatives.

3.1.2 If the sampling cannot be safely accessed lower clean bailer or bucket into the surface water from safe access point. If the location is further away throw the bucket or bailer from the bank or use a long reach sampler

3.1.3 Discard the first sample on to the ground not back into the water body as it will cause further disturbance.

3.1.4 Allow the bottle to fill to the brim to exclude air unless otherwise specified. Clearly labelled with the company name, site, location code and date.

3.1.5 Take field readings as required.

3.1.6 Make a note of the colour of the sample, any odour and other relevant comments on the sample such as presence of solids.

3.1.7 For discharge permits note if there is any visible oil or grease present or not and make a record if there is no discharge at the time of the visit.

3.1.8 Avoid getting any disturbed debris in the sample or excess vegetation and solids.

3.2 Sample Storage and Transport

3.2.1 On completion of sampling check that all the bottles are labelled correctly.

3.2.2 Samples should be kept upright to prevent spillage and wrapped in bubble wrap provided by the laboratory.

3.2.3 Samples should be transferred into suitable boxes for transportation to the laboratory. Storage in cool boxes with ice packs or refrigerated transport should be used.

3.2.4 Analysis requested should be completed and checked. (chain of custody). The request should accompany the samples to the laboratory and a copy of the request should be kept.

3.3 Reporting

3.3.1 All data is entered into a central Environmental Monitoring database. The data is reviewed against the compliance limits and where limits are exceeded the Environmental Monitoring Manager shall be informed.

Data will be submitted to NRW on a quarterly basis in accordance with the requirements of the permit.

DRAWINGS

Legend:

- Environmental Permit Boundary Reference BT1088ID
- 73m — Permitted Restoration Contours
- SW1 — Location of Surface Water Monitoring Point

Final revision:	Date:	Description:
-	-	-
-	-	-

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Site: **HENDY QUARRY LANDFILL**

Drawing Title: **SURFACE WATER MONITORING LOCATION POINTS**

Drawn By:	Date:	Scale:	Page Size:
J.D.	21 August '08	1:2,000	A3

Status:	Final Revision:	Drawing No:
FINAL	-	HNDY/SWMP/01