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A487 New Dyfi Bridge

Environmental Statement - Volume 3: Appendix 10.6

Foundation Works Risk Assessment

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1 Introduction

The proposed development is for a new bridge over the River Dyfi known as the A487 New Dyfi Bridge scheme (Figure 2) The full scheme is to comprise a 1050m long new section of single carriageway road, associated 240m long tie-in to the existing A487 in the south and access to existing fields, including a cattle pass underbridge next to the northern abutment. Flood bunds and associated ramp access is proposed in the southern end of the scheme and along the northern boundary of the existing Eco Park. Provision of field access and turning heads is also planned immediately to the south of the Pont-ar-Ddyfi.

Due to the ground conditions present on site and the type of proposed development, piled foundations are required.

For the protection of sensitive receptors that are present in the vicinity of the site, a risk assessment is required to select an appropriate piling method.

This report presents the generic and site specific risk assessments of selected piling methods, which have been prepared in accordance with the Environmental Agency guidance ‘Piling and penetrative ground improvement methods on land affected by contamination: Guidance on Pollution Prevention’ (Reference [1]).

2 Site Setting

2.1 Site Location

The Dyfi Bridge site is located in the scenic Dyfi Valley in a hilly part of mid-Wales to the east of Cardigan Bay; see Figure 1. From the northern outskirts of Machynlleth, the proposed construction corridor traverses relatively flat to gently undulating ground associated with the floodplain of the Afon Dyfi. Much of this flat ground comprises grass pasture used mainly for grazing of sheep and cattle. Field boundaries are delineated by fences, hedgerows and trees.

2.2 Site Description

In the vicinity of the proposed river crossing, the proposed route crosses the National Cycle Network Route No. 8, a relatively new public footpath, bridleway, cycleway and bridge that runs for the most part along the south bank of the river. The scheme then crosses Afon Dyfi.

On the north bank of the river, the proposed route traverses a steep wooded slope, approximately 9m high, and continues on higher ground where bedrock out crops in a roadside cutting on the existing A487 carriageway.

The elevation of the floodplain section varies between 5m and 10mAOD, although typically between 8mAOD and 9mAOD, whereas the northern valley side rises steeply to above 200mAOD within 1km from the scheme.

2.3 Proposed Development

The scheme proposals for the A487 New Dyfi Bridge scheme were changed in March 2016 as the previous proposals were found to potentially have an adverse effect on flood levels in the area. The changes made are described in the Arup Preliminary Ground Investigation Report-Volume 1, July 2016 (Reference [2]).

The current proposals (Figure 2) comprise a 1050m long new section of single carriageway road, associated 240m long tie-in to the existing A487 in the south and access to existing fields, including a cattle pass underbridge next to the northern abutment. Flood bunds and associated ramp access is proposed in the southern end of the scheme and along the northern boundary of the existing Eco Park. Provision of field access and turning heads is also planned immediately to the south of the Pont-ar-Ddyfi.

The proposed route is to the south east of the existing route, which includes the Pont-ar-Dyfi Bridge. The proposed scheme includes a 730m long viaduct with approach embankments and a river bridge across the River Dyfi and associated floodplain. The existing A487 will be de-trunked between the two ends of the scheme, and the existing Pont-ar-Dyfi will be restricted to Non-Motorised Units only.

The preliminary design for the viaduct comprises 18 spans, predominantly of 34m length, as well as a 73m span across the main river channel and associated 50m backspan to the southwest. The piers are proposed to be supported on piles. An approach embankment to the south, less than 5m in height, will be required over significant depths of soft alluvium.

2.4 Site History

The site history is detailed in the Arup Preliminary Sources Study Report (Reference [3]), a summary is provided below.

In 1888/89 the site was predominantly fields. To the south west corner of the site, a road is shown running from Machynlleth in the south to Dovey Bridge in the north along a similar alignment to the current A487. To the south of the site is the Machynlleth Railway Station and associated tracks.

A single rail track runs in a north-easterly direction under the proposed alignment at around Ch. 1+090m. The Coflein database indicates this to be the Corris narrow gauge railway on 500m-long embankment. The River Dovey runs in an east to west direction to the north east of the site. Shingle bars are present on the southern edge of the meander and also in the centre of the river. Spot levels record a ground level of 23.7ftOD at Ch. 0+200m, and 53ftOD around Ch. 1+000m. Quarries are shown to the south of the railway station and to the north of Dovey Bridge.

By 1991 two ponds in the south west of the site have been backfilled and a small rectangular water structure has been built to the north of another pond.

By 1974 the Corris Railway had been dismantled and the River Dovey looks to have cut into the northern bank at around Ch. 0+920m, increasing the width of the river. A flood bund, approximately 220m long, had been constructed along the southern bank of the river. The northern bank of the river is now shown as being wooded.

By 1995, the railway sidings located to the north of the southern end of the site have been removed and the area is occupied by a garden centre and a garage. A large pond was also present at the eastern end of the flood bund. The shingle bars are on the southern edge of the River Dovey, causing narrowing of the channel at this point (Ch. 0+880).

A study of recent aerial photographs for the proposed development revealed several geomorphological features of interest along the present river channel including gravel bars and eroding banks. In addition, several short curvilinear patterns were noted on the surface of the floodplain that could indicate the presence of buried channels (palaeochannels). One such pattern correlates with a patch of wet ground identified during the site walkover at Ch. 0+780m.

Review of the aerial photographs from the Welsh Government archives further confirms the presence of palaeochannels. In particular, depressions in the ground are visible crossing the proposed alignment between Ch. 0+650m and 0+680m between the 1940s and 1960s. An area at lower elevation is also visible between 0+750m and 0+820m understood to correspond to an area flooded on a regular basis since the 1950s. The possible extents of an historical pond are present approximately 50m east of the Ch. 0+630m.

2.5 Geology

The geology of the site is detailed within the Arup Preliminary Sources Study Report (Reference [3]) and is summarised below.

Man-made ground is present near to the site, surrounding the Machynlleth railway station with smaller areas existing in the vicinity of more recent engineering activities associated with the construction of the National Cycle Network route. An historical borehole log on the upper north bank recorded 8.80m of made ground. However, this supposed area of made ground may actually correspond to the alluvial fan materials and head previously referred to above.

The superficial deposits are likely to be glacial till (boulder clay) typically comprising weathered grey-brown clays with poorly sorted and locally derived gravel and boulders. Other sources show head deposits at the location of the tie-in at the northern end of the route.

However, within the floodplain of the Afon Dyfi valley there may also be mixed alluvium associated with the river which consist of gravels with impersistent interbedded sandy clays, clays and silts. The flat tract of the floodplain is criss-crossed by historic river courses (palaeochannels) although these features have been greatly suppressed by successive cultivation. In addition, the glacial deposits have frequently been modified by periglacial action and in places have been entirely removed by erosion.

Unusual deposits of alluvial fan materials and head occur on the north bank of the river and within the route corridor. The alluvial fan materials consist mainly of crudely stratified debris, typically subangular to rounded pebbles and boulders with discontinuous lenses of gravelly and silty clay.

The bedrock underlying the glacial till comprises grey turbiditic mudstones and siltstones of the Borth Mudstone Formation of Silurian (Llandovery) age. The mudstone beds range from 0.2m to 0.6m thick and include a few thin sandstone and siltstone interbeds. It is present at the surface in a roadside cutting on the A487 in the vicinity of the tie-in at the north-eastern end of the scheme. Generally, the bedrock strata strike north-northeast and dip at moderate to steep angles.

The nearest significant fault is the Pennal Fault which runs east-west through the valley some 500m to the south of the river. It is a sub-vertical normal fault and downthrows some 150-200m to the north. No effects on the proposed development are anticipated.

2.6 Hydrogeology

The superficial deposits are classified as Secondary A aquifers described as permeable layers supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers.

The bedrock is classified as a Secondary B aquifer which are predominately lower permeability layers which may store and yield limited amount of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

2.7 Hydrology

National Resources Wales (NRW) classifies the Afon Dyfi (River Dyfi) as a 'Main River'. It is fast-flowing and meanders within the floodplain limits of approximately 1km in width. It generally flows in a south-westerly direction to the coast where it enters Cardigan Bay. The EnviroCheck Report records that it has a General Quality Assessment (GQA) Grade: River Quality A.

In the vicinity of the existing bridge, previous hydrological studies conducted in 2001, which can be found in the Options and Development Report (2010), indicate a 1 in 2 year flood event would result in the overtopping of the trunk road. At the bridge, the typical level of the Afon Dyfi ranges from 0.82mAOD to 2.08mAOD. Blocked drains and blocked drainage ditches combined with a low road vertical alignment has caused a persistent problem with flooding at the A487 Heol-y-Doll Rail Bridge (NG: SH 74418 01290), approximately 50m south of the southern end of the proposed development. To solve this problem, active consideration is being given to the construction of a pumping station. Significant implications exist for the highway drainage arising from the proposed development and in particular the position of outfalls.

2.8 Previous Investigations

Two previous site investigations have been undertaken within the area of the site:

- A487 Pont-ar-Dyfi Improvement, CJ Associates, November 2001.
- Millennium Footbridge, CJ Associates, September 1999.

2.8.1 A487 Pont-ar-Dyfi Improvement

The scope of the investigation comprised the following:

- 15No. cable percussive boreholes to depths of between 9.50m and 26.10m, five of which were extended by rotary coring to depths of between 18.80m and 29.00m.
- 6No. rotary boreholes were drilled to depths of between 1.85m and 15.50m
- 17No. trial pits were excavated to depths of between 0.50m and 3.00m.

The exploratory holes were not surveyed as part of the investigation work, therefore, accurate positions and levels are not available. Approximate exploratory hole locations, determined by overlaying plans, are shown on Figure 3.

Six boreholes BH3, BH4, BH5, BH6, BH7 and BH16, located within the alluvial plane, reached a maximum depth of 20.45mbgl and did not encounter bedrock. Three boreholes, BH17, BH18 and BH19 were located on the southern bank of the River Dyfi and encountered bedrock at approximately 21mbgl with BH19 reaching bedrock at 15.6mbgl. Boreholes BH20, BH21 and BH22 were located on the northern bank of the river and encountered bedrock between 6.5mbgl and 10.5mbgl.

The ground conditions recorded during the site investigation generally consisted of cohesive alluvial deposits overlying granular alluvial deposits which were underlain by bedrock.

2.8.2 Millennium Footbridge

A site investigation was undertaken by CJ Associates in 1999 for the construction of the Millennium Footbridge located at the northern end of the proposed scheme. The available extracts are presented in Volume 2 of the Preliminary Ground Investigation Report-Volume 1(Reference [2]).

The site investigation comprised the following:

- 7No. cable percussive boreholes drilled to a maximum depth of 13.70m.
- Standard penetration tests were undertaken in the boreholes, typically at 1.0m intervals.

Approximate exploratory hole locations, determined by overlaying plans, are shown on Figure 3.

The boreholes generally revealed 0.10m of topsoil overlying between 0.90m and 2.90m of cohesive alluvial deposits. These generally comprised soft to firm friable, grey brown sandy silty clay with occasional fine to medium gravel, though it was noted that the gravel content generally increased below 1.0m.

The cohesive deposits were underlain by medium dense, fine to medium, rounded and sub-rounded gravel in a grey, coarse sand matrix. The gravel was reported as being occasionally coarse and being dense below 10m depth. In boreholes BH1, BH2 and BH7, located on the southern side of the river, the base of the gravels was not proven. However, in Borehole BH3, BH4, BH5 and BH6, located on the northern side, the base of the gravels was proved at a depth of between 1.50m and 5.90m.

The gravels were underlain by dark grey shale recovered as moderately weak to moderately strong fragments.

3 Ground Investigation

A preliminary ground investigation was carried out by CC Geotechnical Ltd between 23rd November 2015 and 5th January 2016. Groundwater monitoring was undertaken up until 24th February 2016.

3.1 Scope of Works

This investigation was scoped by Arup based on the scheme proposals prior to the changes commissioned by Welsh Government in March 2016 (see Volume 1 Preliminary GIR). The impact of the scheme proposals changes on the scope of investigation is not considered significant at this stage of the scheme.

The investigation comprised:-

- 24No. machine dug trial pits.
- 5No. cable percussive boreholes, 1No. cored rotary follow-on.

Based on preliminary pile design calculations, all boreholes were advanced to depths below piled foundation as recommended in Annex B of Eurocode 7 Part 2.

The factual information for this investigation is provided in Preliminary GIR Volume 2 (Reference [4]). The as-built exploratory hole locations are shown on Figure 3 in relation to proposed scheme and historical ground investigation.

The results of the investigation are discussed further in this report.

3.2 Ground Conditions

The ground conditions described in the following section of the report represent the existing ground conditions on the site encountered during the previous and recent ground investigation.

3.2.1 Stratigraphy

A summary of the generalised sequence of strata encountered during the ground investigations is presented in Table 1.

Table 1: Summary of Ground Conditions

Alignment – Approx. Chainage Start (m)	Alignment – Approx. Chainage Finish (m)	Feature	Geology – Superficial Deposits – Topsoil – Estimated thickness (m)	Made Ground – Estimated thickness (m)	Cohesive Alluvium – Estimated thickness (m)	Head Deposits – Estimated thickness (m)	Glacial Sand and Gravel – Estimated thickness (m)	Solid Geology – Weathered Bedrock – Estimated thickness (m)	Solid Geology – Bedrock – Estimated depth to rockhead (m)	Groundwater Depth (m)	Reference (from Key Stage 3 investigation unless stated otherwise)
060	210	South embankment and tie-in	0.00 – 0.50	0.00 to 0.90	1.60 – >3.00 (locally containing 1.1m of glacial sands and gravels)	absent	23.0 max proven			1.0 – 1.50	BH1, TP01, TP02, TP03, TP04, TP05 TP1, TP2, TP3, BH3, BH14 (CJ Associates 2001)
210	820	Viaduct	0.20 - 0.30	absent	0.80 - >3.0	absent	28.4 max proven			0.40 – 2.50	BH1, TP01, TP02, TP03, TP04, TP05, BH2, BH3, BH4, TO06, TP07, TP08, TP09, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18
865	865	River Bridge- southern supports	0.25	absent	absent - 1.5	absent	13.5 - 18.9		15.6 – 20.4	1.0 – 1.80	TP17 to TP19 BH17 to BH19 (CJ Associates 2001)
940	940	River Bridge - northern abutment	0.10	4.80		absent	4.00	0.40	19.2	9.00	TP20, TP21, BH5
940	1025	Northern embankment	0.60	absent	absent	0.80	1.50 max proven			None encountered	TP22
1025	1100	Side road cutting	0.10	absent	absent	0.70 - 1.10	absent	0.30 - 0.9 max proven	01.5 - 1.7	None encountered	TP24, TP25

3.2.2 Topsoil

Topsoil has been encountered in all the exploratory holes carried out along the alignment of the proposed route.

The topsoil was generally described as being dark brown, clayey silty topsoil between 0.10m and 0.60m thick, with a typical thickness of 0.20m to 0.30m over the majority of the site.

Topsoil may be considered for re-use as “landscape fill” for future proposals, although its suitability for this purpose will need to be confirmed in accordance with the Earthworks Specification that will be prepared for the scheme prior to construction.

3.2.3 Made ground

Made ground has been identified in five exploratory holes at two locations, the embankment and the abutment, along the alignment of the proposed route. At the southern end of the viaduct structure it was encountered in trial pits TP01 and TP02, between Ch. 0+230m and 0+280m, where it was encountered with thickness between 0.40m and 0.60m. At the northern abutment in Trial Pits TP20 and TP21, between Ch. 0+935m and Ch. 1+025m, where it extended to the bottom of the trial pits at 3.1m depth. The log for BH5 did not identify any made ground. However, based on ground conditions encountered in TP20 and TP21 along with the hummocky ground identified during the site walkover, the 4.5m thick strata beneath the topsoil in BH5 is interpreted as made ground.

The made ground at the southern end of the scheme generally comprised brown, clayey, silty gravel with occasional red brick and mudstone gravels. In TP02 the made ground coincided with the presence of a 200mm diameter pipe. The pipe was not shown on any service plans and appeared to possibly be a disused gas main.

In the locality of the northern abutment, it was described as dark brown/grey, slightly silty, clayey, sand and gravel and some cobbles. The gravel and cobble comprised ceramics, tarmac, concrete, brick and stone, with plastic, wood, metal and disused tools present in the trial pits.

3.2.4 Alluvial soils

Brown clayey silt was recorded over the length of the proposed route to the south of the Afon Dyfi, in the low lying flood plain. These correspond to alluvial deposits shown on published geology map.

The thickness of the alluvium increased from typically around 1.50m in TP01, TP02 and TP03 close to the existing A487 at around Ch. 0+255m, to 2.75m in TP07 at Ch. 0+400m in the southern end of the viaduct. The alluvium was generally less than 2.0m thick under the remainder of the viaduct section, with the exception of TP16, close to the pond at Ch. 0+765m, where it was greater than

3.0m in thickness. A 1.30m thick layer of granular alluvial deposits was present within the cohesive deposits at this location.

In Trial Pits TP05 and TP06, close to Ch. 0+375m and Ch. 0+440m, a 100mm thick layer of organic matter comprising leaf matter was recorded at depths of 2.80m (5.11mAOD) and 3.0m (5.22mAOD) respectively.

The previous investigation (CJ Associates 2001 – Reference 11) indicates that alluvium is present along the alignment of the embankment and tie-in at the southern end of the scheme with thickness comprised between 1.9m and 3.2m. This is generally consistent with the ground conditions that were encountered in the recent investigation.

The alluvial deposits from the current investigation were described as brown clayey silt with the previous site investigation (CJ Associates 2001 – Reference 11) describing the alluvial deposits as soft and soft to firm, grey brown, silty clay.

3.2.5 Head deposits

Slightly sandy gravelly silt was encountered on the northern side of the Afon Dyfi in trial pits TP22, TP24 and TP25 in the vicinity of the cutting associated with the side road. This corresponds with head deposits shown on the published geology plan.

The head deposits were encountered beneath the topsoil, and above the weathered bedrock and were described as brown, slightly sandy, gravelly silt. The gravel was fine to coarse, and comprised siltstone and mudstone. The designer's supervising engineer noted that the deposits were typically of loose becoming medium strength in consistency, and were stable in the trial pits.

3.2.6 Glacial sand and gravels

Along the alignment of the southern embankment, the trial pits from the CJ Associates 2001 investigation did not encounter glacial sands and gravels. However these trial pits were terminated at 3.0mbgl and the glacial deposits are anticipated to be present at a greater depth.

Glacial sands and gravels were encountered in all the boreholes and trial pits on the low lying area between Ch. 0+230m, at the southern end of the viaduct and Ch. 0+800m, at the southern river bridge pier. They were also encountered in BH5 on the northern side of the Afon Dyfi beneath the made ground and overlying the bedrock.

On the southern bank of the Afon Dyfi, the glacial sand and gravel generally underlies the more recent alluvial deposits associated with the river. The surface of the glacial sands and gravels was typically around 6.50mAOD, and the material was in excess of 30m thick, which is not unusual for a steep sided glacial valley.

The ground investigation describes the glacial sands and gravels as medium dense becoming dense then very dense, grey, slightly silty, sand and gravel with occasional cobbles and boulders. The gravel was fine to coarse, angular to rounded and of various lithologies.

In the 2001 investigation, the glacial sands and gravels were recorded as granular alluvial deposits and generally comprised medium dense, grey, gravels with variable amounts of clay, silt and sand. Cobbles and boulders were also recorded in varying proportions. BH4 recorded quartz cobbles at between 13.50m and 13.80m depth.

3.2.7 Bedrock

Bedrock was encountered in three locations, BH5, TP24 and TP25 to the north of the Afon Dyfi during the current investigation at depths of 0.8mbgl to 8.8mbgl, also outcropping in a roadside cutting on the A487 close to the junction with the side road at Ch. 1+030m.

A weathered zone was encountered between 0.40m and 1.10m thick. In the borehole it was recovered as grey fragmented mudstone. However, in the trial pits, the weathered material was recovered as slightly silty, sand and gravel with occasional cobble. The sides of the trial pits were stable.

The intact bedrock could only be penetrated by approximately 0.20m in the trial pits excavated using a tracked excavator. In BH5 intact bedrock was encountered at a depth of 9.2m and drilled to a depth of 19.50m. In the 2001 investigation, bedrock was encountered to the north of the river in boreholes BH20, BH21 and BH22 at depths of 6.80m, 10.10m and 7.40m respectively. In addition, bedrock was recorded in the 1999 investigation for The Millennium Bridge in boreholes BH3, BH4, BH5 and BH6 at depths of 4.10m, 5.90m, 1.50m and 4.0m respectively.

The bedrock was described as grey, very thickly bedded mudstone, which coincides with the descriptions in the 2001 Report, which recorded that the bedrock generally comprised moderately strong to strong, grey, slightly weathered siltstone (turbiditic mudstone). In the 1999 investigation, the bedrock was recorded as dark grey shale recovered as moderately weak to moderately strong fragment. No rock core was recovered in the 1999 investigation. The discontinuities were recorded as being very widely spaced and fresh.

The previous investigation encountered bedrock to the south of the river in BH18 and BH19 at depths of 20.8m and 15.60m respectively. Bedrock was not encountered in BH4, which was drilled to a depth of 30m, suggesting that the rockhead profile falls away steeply to the south.

3.2.8 Groundwater

During the current site investigation, groundwater was generally encountered at the base of the alluvial deposits on the southern side of the Afon Dyfi. On penetrating the glacial sands and gravels, the groundwater typically rose to a depth of between 0.4m and 0.7mbgl.

Groundwater monitoring standpipes were installed in boreholes BH2, BH3 and BH4 and groundwater levels were measured on five occasions from January to March. During one site visit readings could not be taken due to the boreholes being flooded. The groundwater levels recorded the following:

Table 2: Summary of Groundwater Monitoring

Borehole	Response Zone	Visit 1 m	Visit 2 m	Visit 3 m	Visit 4 m	Visit 5 m
BH2	15 - 25	1.0	1.0	flooded	1.53	1.31
BH3	15 - 25	0.99	1.0	flooded	1.48	1.32
BH4	1 - 10	1.0	1.0	flooded	1.45	1.46

On the northern side of the river, groundwater was only encountered in BH5 at a depth of 9.0mbgl (6.65mAOD), which corresponded closely to the rockhead and river level.

4 Current Subsurface Contamination

4.1 Soils

During the 2015/2016 site investigation a total of 23 soil samples were submitted for chemical analysis, comprising 3 samples of top soil, 5 samples of made ground, 14 samples of alluvial soils and one sample of glacial sands and gravels.

All soil samples were analysed for a range of inorganic and organic chemical determinants, including metals, sulphide, phenols, asbestos, total and speciated petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons, and volatile organic compounds.

The screening assessment is summarised below, with all results and exceedances presented in Appendix A.

4.1.1 Assessment of Risk to Human Health

The results of the 23 soil samples were screened against assessment criteria which are protective to human health. The assessment criteria is for a residential end use which is deemed to be the most appropriate criteria for risk to construction workers. The following exceedances were recorded.

Table 3: Human health exceedances

Determinand	Units	GAC	Range	No.> GAC	Loc>GAC
Lead	mg/l	369	34.2 - 718	2	TP6 (0.3m), TP14 (0.6m)

Only 16 samples out of 23 were screened for the metals suite. There were 13 out of 23 levels of pH recorded below 6, ranging from 5.4 to 5.8.

4.2 Controlled Waters

CC Geotechnical Ltd collected groundwater samples from three boreholes, BH2, BH3 and BH4 in January 2016. The samples were delayed in being tested which caused the organics to deviate and therefore the results are less reliable. A second set of samples were collected from all three boreholes in February 2016 and tested for the same contaminants.

For the purpose of this review, the results of the groundwater analyses have been screened against current Environmental Quality Standards (EQSs) for freshwater environments, in the absence of which WHO guideline values and UK Drinking Water Standards have been used for comparison.

The results of the analyses undertaken are presented in Appendix B.

4.2.1 Groundwater Analyses Results

A review of both the groundwater analyses results obtained during the current investigation identified the following exceedances:

Table 4: Groundwater exceedances

Determinand	Units	EQS	DWS	Range	No.> GAC	Loc>GAC
Nickel	ug/l	4	20	<5 - 6	1	BH4 (24/02/16)
Zinc	ug/l	10.9	5000	15 - 29	6	BH2, BH3, BH4 (both visits)
Benzo(a)pyrene	ug/l	0.00017	-	0.02 – 0.21	6	BH2, BH3, BH4 (both visits)
Fluoranthene	ug/l	0.0063	-	0.05 – 0.28	6	BH2, BH3, BH4 (both visits)
Total (>C5-C40) Ali/Aro	ug/l	-	10	21.2 - 260	5	BH2, BH4 (12/02/16), BH2, BH3, BH4 (24/02/16)

The analysis had identified concentrations of nickel from the second round of sampling and zinc from both rounds of sampling slightly above their respective assessment criteria. It should be noted that this EQS value is for the bioavailable concentration of the metal in surface water and the GW results are total concentrations. Further testing may be required to determine the bioavailability of the metals which may reduce the levels recorded.

The elevated organic results from the first round of sampling were recorded as deviating due to an issue with sampling timescales, however elevated levels of PAHs and TPHs were also recorded from samples from the second round of sampling.

4.3 Ground Gas

Four rounds of ground gas monitoring was undertaken between January and March 2015 in three monitoring wells, BH2, BH3 and BH4 with response zones within the glacial sand and gravels. Refer to Figure 6 of the GIR (Reference [2]) for borehole locations. No sufficient thickness of made ground was encountered during the 2015 investigation to be able to monitor ground gas within this strata. No ground gas monitoring was included within the 2013 investigation.

4.3.1 Gas Assessment Methodology

The results of the monitoring undertaken at the site are presented in Appendix C.

Where a potential pollution linkage is identified in relation to ground gas a review of the available ground gas monitoring data is undertaken and assessment of risk is carried out based on the published guidance (CIRIA 2007) (Reference [5]). Due to the nature of the Scheme, i.e. no buildings are included within the development, the assessment involves only derivation of Gas Screening Values (GSVs) based on recorded maximum concentrations of methane and carbon dioxide, and the measured maximum gas flow. The derived GSV are then compared to GSV thresholds to obtain a risk classification.

The measured gases included methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide. Gas flow rate was also obtained. A summary of measured concentrations is summarised in Table 5 below. The full ground gas monitoring results are presented in the GIR Volume 2 (Reference [4]).

Table 5: Summary of ground gas monitoring results

BH ID	Methane % w/w	Carbon dioxide % w/w	Oxygen %w/w	Carbon monoxide ppm	Hydrogen sulphide ppm	Flow rate l/hr
BH2	Nil	<0.1-0.8	19.7-20.2	Nil	Nil	<0.1
BH3	Nil	<0.1-0.5	19.7-20.1	Nil	Nil	<0.1
BH4	Nil	<0.1-4.6	10.4-20	Nil	Nil	<0.1

The assessment of potential risk from ground gas was undertaken in line with CIRIA C665. The gas monitoring has recorded no elevated concentrations of methane, carbon monoxide or hydrogen sulphide. Low concentrations of carbon dioxide have been detected.

The GSV was calculated using the maximum measured concentration of carbon dioxide of 4.6% w/w with the maximum measured flow rate of 0.1% w/w.

Table 6: Calculation of GSV

Gas	Max conc (%)	Max Gas Screening Value (GSV) l/hr
Carbon dioxide	4.6	0.0046

The derived GSV for carbon dioxide indicates a very low risk from ground gases. Therefore no mitigation with regards to ground gas is required for the scheme.

5 Piling Method Selection

5.1 Geotechnical Considerations and Requirements for Piling and Ground Improvement Methods

Various foundation options have been considered for the structures that form the proposed development. Due to the presence of soft alluvium beneath the site, under the anticipated loading conditions, pad foundations would be susceptible to unacceptably large magnitudes of total and differential settlement. Whilst the differential settlements could be controlled through the construction of raft foundations, large total settlement are likely to remain an issue for such an option. Piled foundations shall therefore be required. No ground improvement is considered.

Bored piles are anticipated to be most suitable for the development. These would be driven through the made ground and alluvium, and toed into the sands and gravels. The pile diameters will be up to 1500mm and taken to a depth of 16mbgl.

5.2 Bored Piles

Bored piles are classified as non-displacement grout or concrete intruded piles in accordance with the EA guidance (Reference [1]). These piles will be formed by advancing temporary casing into the ground ahead of the boring. This is likely to be undertaken in stages. Due to the presence of groundwater which will migrate up through the base of the piles, water will need to be added to the pile bores to counteract the water pressure from below. On completion of the pile bore it is filled with concrete or cementitious grout introduced via a tremie pipe at the base of the pile.

Excavated material is brought to surface as arisings. These arisings need to be re-used or disposed of in an appropriate manner if they are not suitable for re-use within the site earthworks.

On completion, a reinforcing cage can, if required, be introduced into the plastic concrete in the pile assisted by vibration.

6 Potential Adverse Environmental Impacts – Generic Risk Assessment

This section of the report presents a generic assessment of potential hazards associated with selected methods of piling. The EA guidance (Reference [1]) identifies six potential Source-Pathway-Receptor linkages, so called pollution scenarios, which allow for identification of specific hazards associated with generic methods of piling. These are presented below.

6.1 Pollution scenario 1: Creation of preferential pathways, through a low permeability layer, to cause contamination of groundwater in an aquifer

Non-displacement piling methods involve the extraction of soil prior to the placing of the pile. Theoretically there should be no disturbance of the surrounding soil, however in the case of the standard bored piles, the piles will be formed within a temporary casing, which when removed may form a preferential pathway between the pile and the surrounding soils. This would generate a pathway from made ground, through the thin layer of cohesive alluvial clays to the permeable glacial sands and gravels beneath.

Therefore, further detailed risk assessment will be required.

6.2 Pollution scenario 2: Creation of preferential pathways to allow migration of landfill gas or contaminated vapours to surface

If any gas control systems are proposed on site their design must be clearly designed to take into account of any penetration by foundations.

Disturbance to the surrounding soil is not expected due to the installation of temporary casing prior to removal of the soils. However, as in Section 6.1 above, a preferential pathway will potentially be generated from the removal of the casing allowing gas to migrate along the length of the pile. Due to the presence of hydrocarbons within the groundwater, there is the possibility for ground gas and vapour migration to occur.

Further detailed risk assessment will be required.

6.3 Pollution Scenario 3: Direct contact with contaminated soil arisings that have been brought to the surface

Non-displacement piling methods necessitate bringing to the surface a volume of soil excavated from within the hole created to form the pile. The volume of arisings may be significant, with a 450mm diameter pile 6m deep generating some

$1m^3$ of arisings. The piles are to extended up to 16m deep and up to 1500mm in diameter, which may generate substantial volumes of arisings. These will be reused on site where possible.

During the pile instalment groundwater will be displaced, migrating up the pile shaft to the surface. The water will require to be contained and discharged of appropriately.

As there will be direct contact with contaminated soil arisings during handling operations and there is the potential for contaminated groundwater to migrate to the top of the pile and run off, further detailed risk assessment is required.

6.4 Pollution Scenario 4: Direct contact with contaminated soil or leachate causing degradation of pile materials

The proposed piling method uses concrete to form piles with the pile material coming in direct contact with the surrounding soil. The presence of aggressive ground conditions may affect the piles durability. There is a risk of degradation of piles due to direct contact with contaminated soil or leachate, which is likely.

Therefore further detailed risk assessment is required.

The use of higher quality of concrete (more easily achieved with pre-cast concrete piles) may be one of the mitigating measures.

6.5 Pollution Scenario 5: The driving of solid contaminants down into an aquifer during pile driving

Non-displacement methods will not, in normal circumstances, lead to soil being dragged down. Therefore, pollution scenario 5 is not considered further in relation to bored piles.

6.6 Pollution Scenario 6: Contamination of groundwater and subsequently surface waters by concrete, cement paste or grout

The bored piles are formed by placing concrete under pressure directly into the ground at the base of the pile. Even though the pile bore will be surrounded by the casing, there is the potential for leaching of wet concrete into fast flowing groundwater beneath. Therefore, further detailed risk assessment is required.

6.7 Summary

The generic risk assessment has indicated that further detailed risk assessment is required in relation to a number of hazards identified for each of the analysed piling methods, as summarised in Table 2 below.

Table 7: Summary of generic risk assessment

Pollution Scenario	Bored Piles
Pollution scenario 1: Creation of preferential pathways, through a low permeability layer, to cause contamination of groundwater in an aquifer	✓
Pollution scenario 2: Creation of preferential pathways to allow migration of landfill gas or contaminated vapours to surface	✓
Pollution Scenario 3: Direct contact with contaminated soil arisings that have been brought to the surface	✓
Pollution Scenario 4: Direct contact with contaminated soil or leachate causing degradation of pile materials	✓
Pollution Scenario 5: The driving of solid contaminants down into an aquifer during pile driving	✗
Pollution Scenario 6: Contamination of groundwater and subsequently surface waters by concrete, cement paste or grout	✓

7 Detailed Risk Assessment

The generic risk assessment, as presented in Section 5 of this report, identified a number of environmental hazards associated with the selected piling method. These hazards require further site specific risk assessments, which have been detailed in the following sections of the report.

7.1 Standard Bored Piles

The generic risk assessment identified five potential pollution linkages that may pose a risk to the environment. These are:

- creation of preferential pathways, through a low permeability layer, to cause contamination of groundwater in an aquifer (Pollution Scenario 1),
- creation of preferential pathways to allow migration of landfill gas or contaminated vapours to surface (Pollution Scenario 2),
- direct contact with contaminated soil arisings and groundwater that have been brought to the surface (Pollution Scenario 3),
- direct contact with contaminated soil or leachate causing degradation of pile materials (Pollution Scenario 4),
- contamination of groundwater and subsequently surface waters by concrete, cement paste or grout (Pollution Scenario 6).

These identified hazards will be assessed in detail in a context of the site setting as presented below.

7.1.1 Creation of preferential pathways, through a low permeability layer, to cause contamination of groundwater in an aquifer (Pollution Scenario 1)

The piles are to be extended through the alluvial clays to the glacial sands and gravels beneath, therefore generating a pathway which may cause contamination to migrate downwards.

The alluvial deposits were found to contain lead. However as it is likely to be background concentrations and also, as part of the pile cap construction the thin alluvial soils layer will likely be removed from the pile location, the risk of significant contamination migration towards the groundwater is very low.

Some of made ground within the north abutment is to be removed as part of the works. However, in this part of the scheme, the made ground is directly underlain by bedrock. Due to the piling technique, the concrete will be placed directly within the bedrock, preventing creation of preferential flow path into the rock. Therefore, any contamination arising from leaching of contaminants from the made ground would be unlikely to migrate into the rock along the piles. Therefore the risk of impacting the groundwater due to the preferential flow paths introduced by the piles is very low and therefore no further action is required.

7.1.2 Creation of preferential pathways to allow migration of landfill gas or contaminated vapours to surface (Pollution Scenario 2)

In Section 4.3 a ground gas assessment was undertaken which identified there to be a very low risk from ground gases beneath the site. Some of the made ground present in the north of the site is to be removed. It is estimated that approximately 2m of made ground would remain in the locale of the piles. As the development does not include any confined spaces in that part of the scheme, any ground gas that might migrated along the pile to the ground surface would disperse posing no significant risk to end scheme users. Consequently no significant risk has been identified and further action is not required.

7.1.3 Direct contact with contaminated soil arisings that have been brought to the surface (Pollution Scenario 3)

As discussed in Section 4 of the report, results from made ground and natural soils present on site were assessed against criteria for a residential end use which was deemed the most conservative for risk to construction workers. Elevated levels of lead was recorded above the assessment criteria for human health.

It is recommended that appropriate Personal Protective Equipment (PPE) is worn at all times for those that may have a direct contact with the arisings and that appropriate risk assessments are undertaken and health and safety measures are identified and implemented if materials other than those already identified are found.

A groundwater risk assessment, discussed in Section 4 of the report, has recorded elevated levels of nickel, zinc, benzo(a)pyrene and fluorathene above the EQS screening values and total petroleum hydrocarbons (TPH) recorded above the UK drinking water standards screening values. The EQS values for the heavy metals is for the bioavailable concentration of the metal in surface water and the groundwater results are total concentrations. It is therefore recommended that surface water samples are collected from the receiving waters, the River Dyfi to determine the bioavailability of the metals.

Groundwater will be displaced during the piling installation, migrating upwards to surface level and will require to be bunded to mitigate against run-off. Due to the presence of benzo(a)pyrene up to 0.21ug/l, fluoranthene up to 0.28ug/l and total TPH up to 260ug/l within the groundwater, it is likely the water will need to be treated prior to disposal to another water source. In addition, the displaced water is likely to be impacted by cement used to construct the piles and this will also require consideration prior to discharge. The treatment methods could include passing the water through settlement lagoons, settlement tanks and/or sediment filters. This will be detailed in the preliminary construction and environmental management plan. Regulatory approvals are required for any discharge into the river.

All materials are to be re-used in line with the Highways Earthworks Specification – Series 600 and should comply with the criteria set within the document.

7.1.4 Direct contact with contaminated soil or leachate causing degradation of pile materials (Pollution Scenario 4)

The concrete classification has been derived in the Arup Preliminary GIR Volume 1 (Reference [2]) as DS-1, AC-2z.The soil and groundwater environment present beneath the site is unlikely to cause significant degradation of buried concrete subject to the concrete meeting the derived class. Therefore, direct contact with the material from which the piles will be formed does not represent a significant environmental risk. Consequently no further action is required.

7.1.5 Contamination of groundwater and subsequently surface waters by concrete, cement paste or grout (Pollution Scenario 6)

The formation of the bored piles involves placement of wet concrete directly to the base of the excavated void therefore there is a potential risk of wet concrete migration into the groundwater and subsequently into surface water. There is also a risk of concrete overspill during the pile construction works.

As discussed in Section 1, two groundwater bodies are present beneath the site, one within the natural soils and one within the bedrock. In the north of the site groundwater was encountered as perched over the bedrock in the natural soils at the base of the alluvium and in the south of the site groundwater was present in the glacial sands and gravels.

In the south, the piles are to be terminated in the sands and gravels and will be cased during the pouring of the concrete which will seal the majority of the groundwater from the concrete. The concrete at the base of the pile is unlikely to spread far due to the quick setting nature of the material and the nature of the natural soils beneath. However, to minimise the concrete loss, particularly on granular deposits of made ground and fluvioglacial gravels, care should be taken during the formation of the piles to ensure that water and concrete pressures are balanced.

With the addition of the concrete groundwater is likely to migrate up the bore to surface. This water is likely to require treatment prior to disposal/discharge. Refer to Pollution Scenario 3 for details.

It is recommended that monitoring is undertaken to ensure that the concrete does not have an adverse impact on the groundwater and/ or surface waters. The monitoring could include monitoring of the River Dyfi or placement of monitoring boreholes.

8 Mitigation Measures

Both generic and detailed risk assessments of the selected piling method identified a number of mitigation measures that are required in order to prevent pollution occurring. These are listed below.

8.1 Bored Piles

- Adoption of good working practice & appropriate health & safety measures to control the level of exposure as a matter of course, including use of PPE, hygiene facilities and dust control measures.
- Appropriate treatment procedures is required for dealing with contaminated groundwater. Measures could include bunding, settlement lagoons/tanks and/or sediment filters. Any discharge into the river will require regulatory approval and will be required to comply with environmental standards for the protection of the quality of the receiving waters.
- To minimise the concrete loss, particularly within granular deposits of glacial sands and gravels, care needs to be taken during the formation of the piles that water and concrete pressures are balanced. It is also recommended that monitoring of the River Dyfi is undertaken. Bunding of the pile area will be required to minimise concrete migration to the surface waters due to overspills.

8.2 QA/QC Methods and Measures

The quality assurance and quality control methods and measures will the specified in the contract for the works and they should include the mitigation measures listed above. The contractor should provide the following documentation:

- Method statements for pile formation specifying the control measures to ensure that the rate of concrete placement is consistent and that water and concrete pressures are balanced.
- Health and safety procedures including appropriate risk assessments and proposed measures.
- Method statements for dealing with the water generated from the pile installation, including possible treatment and discharge requirements.

Material reuse criteria would usually be included in the verification plan for the site and the main site contractor would be responsible for its implementation.

9 Conclusions

It is proposed to construct a new bridge over the River Dyfi which will include a 1050m long new section of single carriageway road, associated 240m long tie-in to the existing A487 in the south and access to existing fields, including a cattle pass underbridge next to the northern abutment. Flood bunds and associated ramp access is proposed in the southern end of the scheme and along the northern boundary of the existing Eco Park. Provision of field access and turning heads is also planned immediately to the south of the Pont-ar-Ddyfi.

Due to the ground conditions beneath site and the expected loads from the bridge abutments, deep foundations are required. One piling method was considered for this development, standard bored piles. The risk assessments of this method indicated that it is suitable for use within the site setting and the risk of environmental impact is considered negligible.

However, this is subject to a number of mitigation measures, as discussed in Section 8. These will be implemented as part of the quality assurance and quality control regime specified in the contract for the works.

References

[1] Piling and penetrative ground improvement methods on land affected by contamination: Guidance on Pollution Prevention, EA, NC/99/73, 2001

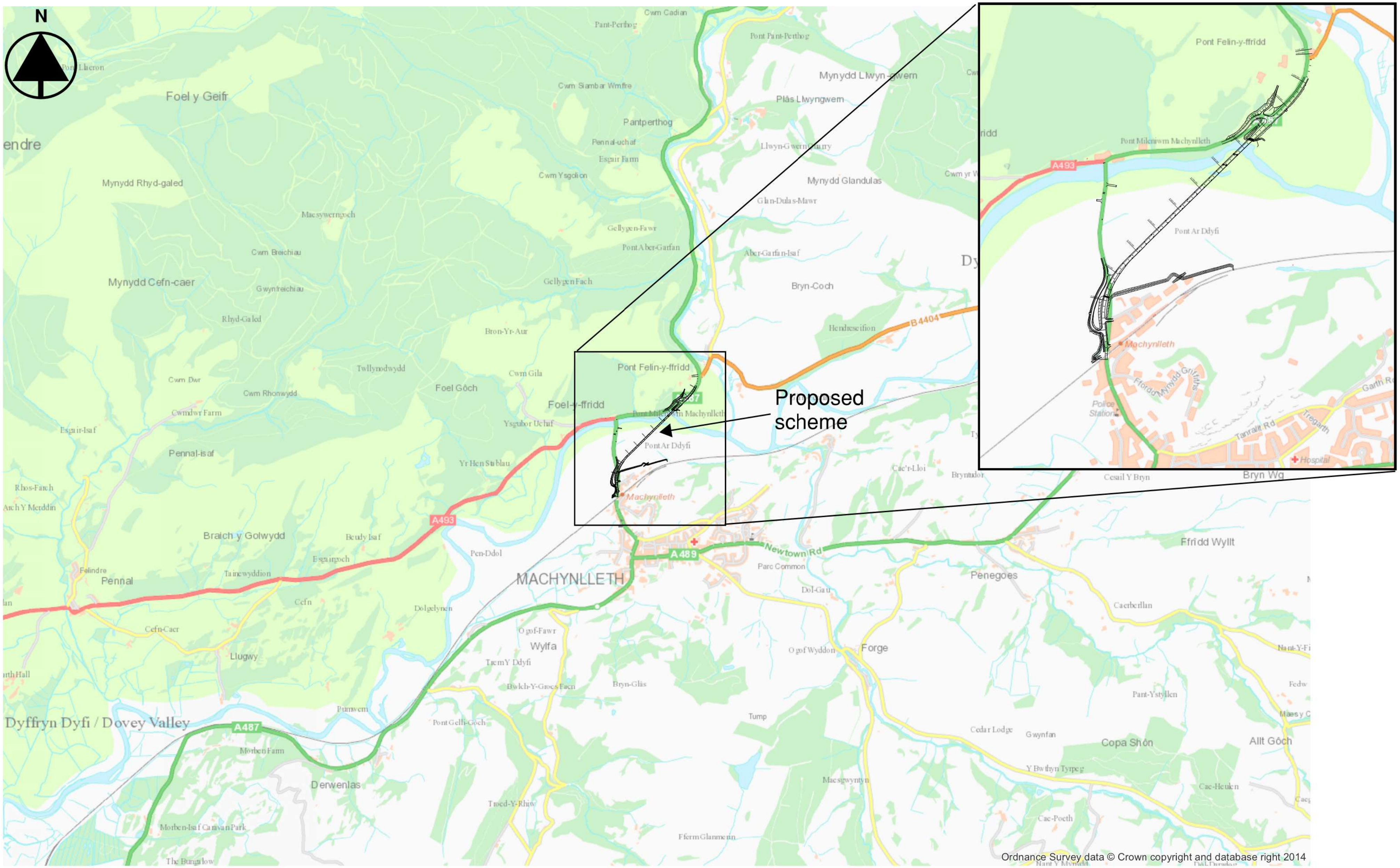
[2] Preliminary Ground Investigation Report - Volume 1, Arup, July 2016

[3] Preliminary Sources Study Report, Arup, April 2016

[4] Preliminary Ground Investigation Report - Volume 2, Arup, July 2016

[5] Assessing risks posed by hazardous ground gases to buildings, CIRIA C665, 2007.

Figures

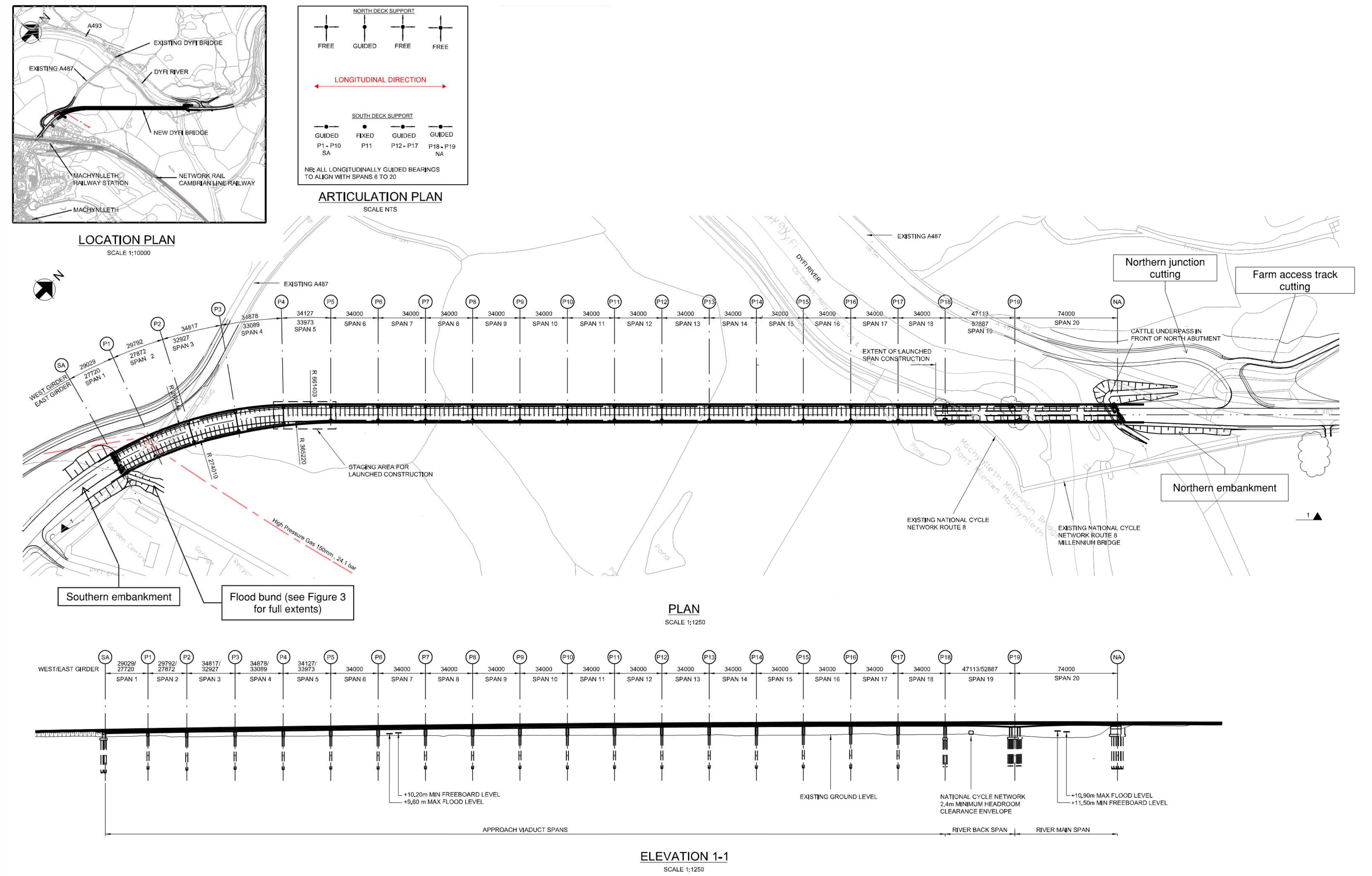


The scheme is centred approximately at National Grid Reference 274600, 301700

Site Location

244562

FIGURE **01**



NOTES

1. THIS DRAWING REPRESENTS A PRELIMINARY DESIGN ONLY FOR PURPOSE OF ILLUSTRATING THE STRUCTURAL FORM AND DESIGN INTENT. CONFIRMATION OF DESIGN INCLUDING THE KEY MEMBER SIZES IS SUBJECT TO DETAILED DESIGN AND THE RESULTS OF THE GEOTECHNICAL INVESTIGATION;
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE BRIDGE APPROVAL IN PRINCIPLE, DOCUMENT NO. 900237-ARP-XX-XX-CB-RP-00003;
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE PROJECT CDM RISK REGISTER;
4. THE POSITION OF BOREHOLES SHOWN ARE APPROXIMATE;
5. FLOOD LEVELS VARY ALONG THE BRIDGE LENGTH. 1 IN 100 YEAR PLUS CLIMATE CHANGE FLOOD AND FREEBOARD LEVELS AS GIVEN ARE TO BE CONFIRMED DURING DETAILED DESIGN;
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE;
7. ALL LEVELS ARE IN METERS ABOVE ORDNANCE DATUM (AOD) UNLESS STATED OTHERWISE.

Issue	Date	By	Chkd	Appd
P02	14/03/16	IE	DJ	SH
RIVER AND BACK SPANS AMENDED 5 SPANS ADDED AT SOUTH END				

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Client: Llywodraeth Cymru Welsh Government

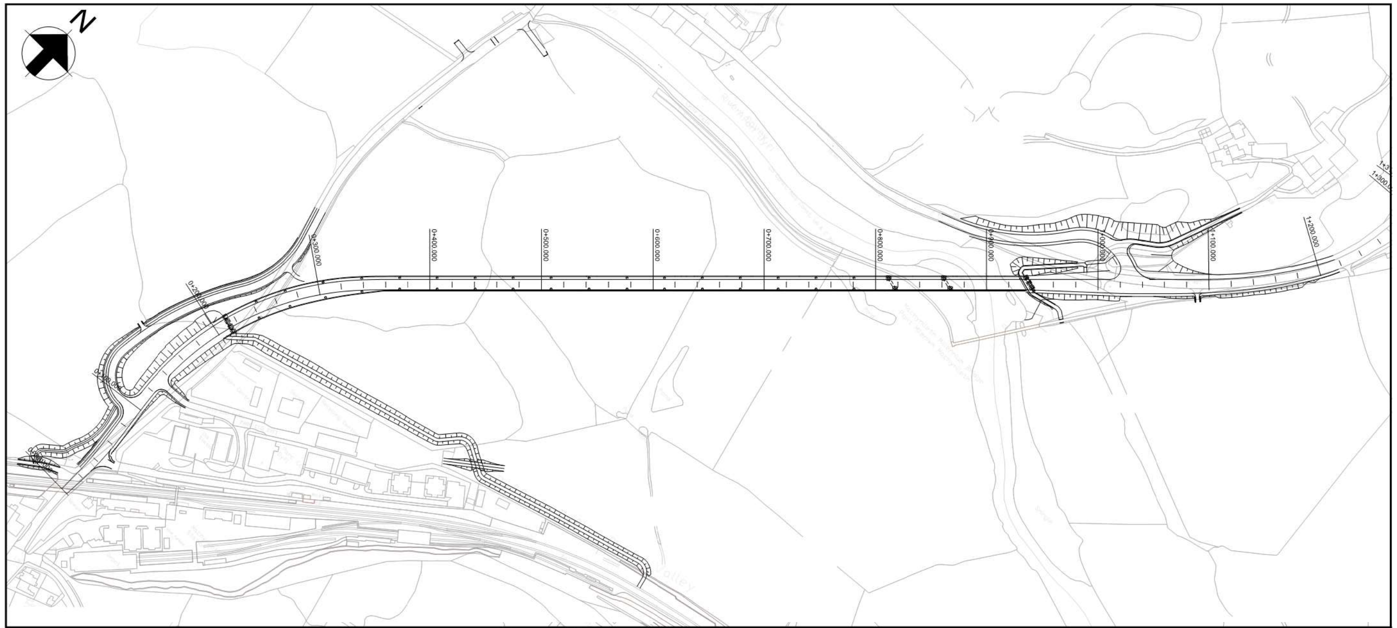
Project Title: A487 New Dyfi Bridge

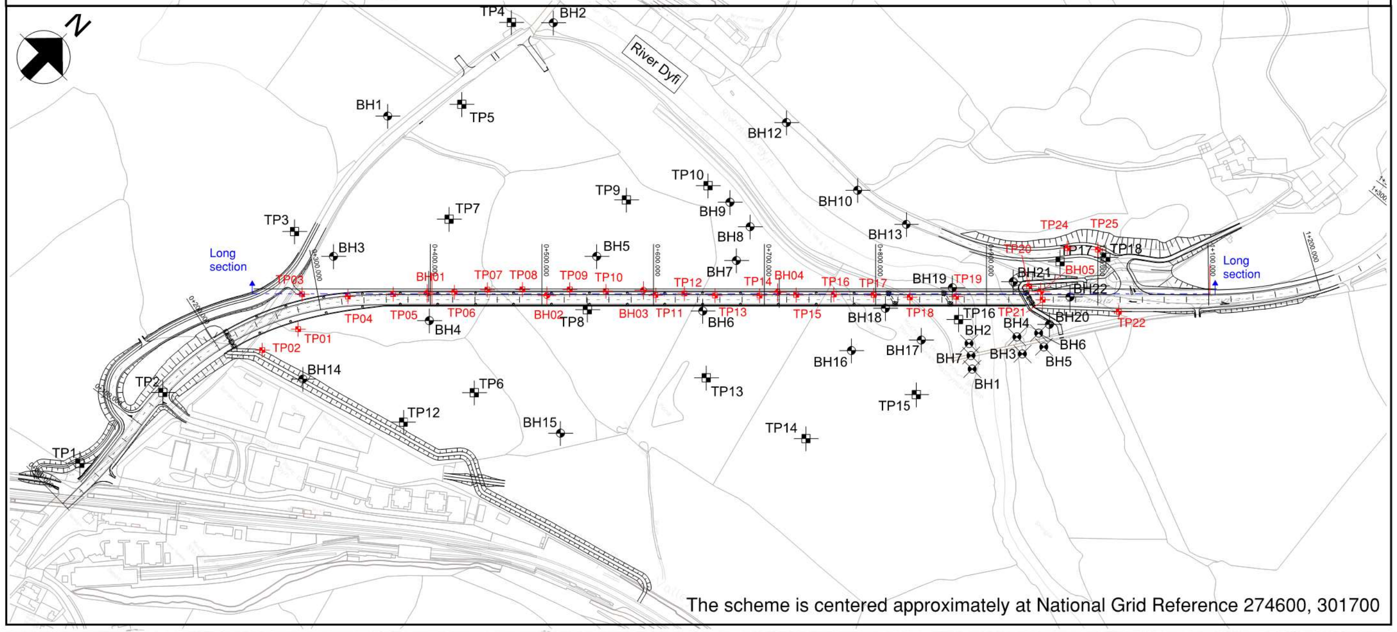
Drawing Title: New Dyfi Bridge General Arrangement Sheet 1 of 2

General Arrangement

FIGURE 02

Do not scale





Legend

- TP1 - Trial Pits CJ Associates (2001)
- BH1 - Boreholes CJ Associates (2001)
- BH1 - Boreholes CJ Associates (1999)
- TP1 - Trial Pits CC Geotechnical (2015-2016) - Key Stage 3
- BH1 - Boreholes CC Geotechnical (2015-2016) - Key Stage 3

Figure Title

EXPLORATORY HOLE LOCATIONS

FIGURE 03

Appendix A

Laboratory Soils Test Results

Soil Sample			TP1	TP2	TP3	TP4	TP5	TP6	TP8	TP9	TP10	TP11	TP12	TP13	TP14	TP15	TP16	TP17	TP18	TP19	TP20	TP20	TP21	TP22	TP25
Depth (m)			0.4	0.4	0.40	0.25	0.25	0.30	0.30	0.50	0.50	0.50	0.60	0.60	0.60	0.60	0.50	0.50	0.25	0.40	0.30	1.40	0.90	0.30	0.25
Ground Level (mOD)																									
Sample Level (mOD)																									
Stratum			MG	MG	ALUV	TS	TS	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	S&G	ALUV	MG	MG	MG	TS	ALUV
Date			25/11/16	25/11/16	25/11/16	25/11/16	25/11/16	25/11/16	25/11/16	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	26/11/2016	26/11/2016	26/11/2016	26/11/2016	26/11/2016
		Screening Criteria																							
Determinants	**Units**																								
Metals																									
Arsenic	mg/kg	**35**	13.2	12.5	21.3	-	16.4	15.7	9.4	-	11.9	-	13.4	-	15.7	-	10.2	-	9.4	14.9	9.9	-	9.6	11.7	11.9
Cadmium	mg/kg	**85**	0.6	0.5	0.6	-	0.6	0.7	0.7	-	<0.5	-	<0.5	-	0.9	-	0.6	-	<0.5	0.7	<0.5	-	<0.5	<0.5	<0.5
Chromium	mg/kg	**3010**	35.9	41.4	32.4	-	38.3	41.4	41	-	34.8	-	41.6	-	36	-	32.5	-	30.3	43.1	27.5	-	24.7	34.8	30.8
Copper	mg/kg	**6200**	63.9	50.5	56.6	-	128	110	46.8	-	33.6	-	51.2	-	60	-	42.8	-	32.1	48.3	30.1	-	26.7	32.2	32.7
Lead	mg/kg	**369**	227	201	299	-	348	432	258	-	153	-	85.8	-	718	-	315	-	228	319	46.1	-	98	73.1	34.2
Mercury	mg/kg	**238**	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5
Nickel	mg/kg	**130**	39.5	47.5	40.1	-	46.3	48.6	45.1	-	39.6	-	47.7	-	42.8	-	39.3	-	34.5	52	22.3	-	27.9	37.5	25.3
Selenium	mg/kg	**595**	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0	-	<1.0	-	<1.0	-	<1	-	<1	-	<1	<1	<1	-	<1	<1	<1
Zinc	mg/kg	**40300**	206	202	186	-	233	258	220	-	155	-	147	-	250	-	175	-	145	223	103	-	114	116	87
Miscellaneous		**0**				-																			
Ammoniacal nitrogen	mg/kg	**0**				-																			
Boron	mg/kg	**10300**				-																			
Free Cyanide	mg/kg	**6**				-																			
Total Cyanide	mg/kg	**0**	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	-	<1.0	<1.0	<1.0	-	<1.0	<1.0	<1.0
Exchangeable Ammonium	mg/kg	**0**				-																			
pH	units	**0**	5.6	5.7	5.6	5.7	5.5	5.7	5.7	5.7	6	5.8	6	6	5.5	5.4	5.7	5.5	6	6	7.9	11.2	8.5	6.3	6
Total Sulphate	%	**0**				-																			
Sulphide	mg/kg	**0**				-																			
Total Sulphur	mg/kg	**0**				-																			
Thiocyanate	mg/kg	**0**				-																			
Total Organic Carbon	units	**0**	3.9	1.7	3.8	-	1.9	1.2	1.4	-	0.73	-	0.52	-	0.69	-	0.5	-	0.99	0.49	0.88	-	0.21	0.8	1
TPH		**0**				-																			
Ali >C5-C6	mg/kg	**30**	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Ali >C6-C8	mg/kg	**73**	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Ali >C8-C10	mg/kg	**19**	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	-	<1	-	-
Ali >C10-C12	mg/kg	**93 (48)**	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	-	<1	-	-
Ali >C12-C16	mg/kg	**745 (24)**	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.9	-	<1	-	-
Ali >C16-C21	mg/kg	**8360 (8.5)**	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.8	-	<1	-	-
Ali >C21-C35	mg/kg	**8360 (8.5)**	17.6	4.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	132	-	2.5	-	-
Aro >C5-C7	mg/kg	**263**	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Aro >C7-C8	mg/kg	**607**	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Aro >C8-C10	mg/kg	**33**	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	-	<1	-	-
Aro >C10-C12	mg/kg	**177**	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	-	<1	-	-
Aro >C12-C16	mg/kg	**1240 (164)**	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	-	<1	-	-
Aro >C16-C21	mg/kg	**971 (53)**	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.5	-	<1	-	-
Aro >C21-C35	mg/kg	**1330**	9.1	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	85.2	-	<1	-	-
GRO (C4-C12)	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Aliphatics	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Aromatics	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH (Ali & Aro)	mg/kg	**0**	43.7	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	343	-	4.2	-	-
PAHs		**0**																							
Acenaphthene	mg/kg	**2020 (57)**	0.02	<0.01	<0.01	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	0.01	-	-	-	<0.01	<0.01
Acenaphthylene	mg/kg	**1950 (86)**	0.07	<0.01	<0.01	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-	-	0.03	<0.01
Anthracene	mg/kg	**19800 (1.2)**	0.11	<0.01	0.02	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	0.03	-	-	-	0.01	<0.01
Benzo(a)anthracene	mg/kg	**4**	0.6	0.01	0.07	-	0.01	<0.01	0.06	-	<0.01	-	0.03	-	<0.01	-	<0.01	-	0.01	0.09	-	-	-	0.06	<0.01
Benzo(a)pyrene	mg/kg	**1**	0.66	<0.01	0.07	-	0.01	<0.01	0.07	-	<0.01	-	0.02	-	<0.01	-	<0.01	-	0.01	0.07	-	-	-	0.08	<0.01
Benzo(b)fluoranthene	mg/kg	**7**	0.36	<0.01	0.05	-	0.01	<0.01	0.05	-	<0.01	-	0.02	-	<0.01	-	<0.01	-	0.01	0.04	-	-	-	0.06	<0.01
Benzo(ghi)perylene	mg/kg	**47**	0.35	<0.01	0.03	-	<0.01	<0.01	0.04	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	0.03	-	-	-	0.04	<0.01
Benzo(k)fluoranthene	mg/kg	**10**	0.78	0.01	0.07	-	0.01	<0.01	0.09	-	<0.01	-	0.03	-	<0.01	-	<0.01	-	0.02	0.09	-	-	-	0.11	<0.01
Chrysene	mg/kg	**9**	0.74	0.02	0.18	-	0.03	0.01	0.09	-	<0.01	-	0.04	-	<0.01	-	0.01	-	0.02	0.12	-	-	-	0.1	<0.01
Dibenzo(ah)anthracene	mg/kg	**1**	0.11	<0.01	0.02	-	<0.01	<0.01	0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-	-	0.02	<0.01
Fluoranthene	mg/kg	**972**	0.87	0.02	0.14	-	0.03	0.02	0.15	-	<0.01	-	0.08	-	<0.01	-	0.02	-	0.04	0.32	-	-	-	0.11	0.01
Fluorene	mg/kg	**1850 (31)**	0.04	<0.01	0.03	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-	-	<0.01	<0.01
Indeno(123-cd)pyrene	mg/kg	**4**	0.28	<0.01	0.02	-	<0.01	<0.01	0.03	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	0.02	-	-	-	0.03	<0.01
Naphthalene	mg/kg	**2**	0.04	<0.01	0.04	-	0.03	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-	-	0.01	<0.01
Phenanthrene	mg/kg	**834**	0.27	0.01	0.33	-	0.07	0.02	0.03	-	<0.01	-	0.03	-	<0.01	-	<0.01	-	0.01	0.14	-	-	-	0.05	<0.01
Pyrene	mg/kg	**2330**	0.79	0.02	0.13	-	0.03	0.01	0.14	-	<0.01	-	0.07	-	<0.01	-	0.02	-	0.03	0.25	-	-	-	0.11	<0.01
Total PAH	mg/kg	**0**	6.08	0.14	1.22	-	0.27	0.1	0.77	-	<0.04	-	0.35	-	<0.04	-	0.1	-	0.18	1.25	-	-	-	0.83	0.06
BTEX		**0**				-																			
Benzene	mg/kg	**0**	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-	-	<0.01	<0.01
Ethylbenzene	mg/kg	**167**	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-	-	<0.01	<0.01
m & p Xylene	mg/kg	**53**	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-	-	<0.01	<0.01
o-Xylene	mg/kg	**60**	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-	-	<0.01	<0.01
Toluene	mg/kg	**607**	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-	<0.01	<0.01	-	-	-	<0.01	<0.01
MTBE	mg/kg	**0**				-																			
VOCs/SVOCs		**#N/A**				-																			
1,1,1,2-Tetrachloroethane	mg/kg	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,1,1-Trichloroethane	mg/kg	**6**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,1,2,2-Tetrachloroethane	mg/kg	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,1,2-Trichloroethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,1-Dichloroethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,1-Dichloroethene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,1-Dichloropropene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,2,3-Trichlorobenzene	mg/kg	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,2,3-Trichloropropane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,2,4-Trichlorobenzene	mg/kg	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,2,4-Trimethylbenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,2-Dibromo-3-chloropropane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,2-Dibromoethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,2-Dichlorobenzene	mg/kg	**16**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,2-Dichloroethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,2-Dichloropropane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,3,5-Trimethylbenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,3-Dichlorobenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,3-Dichloropropane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
1,4-Dichlorobenzene	mg/kg	**42**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
2,2-Dichloropropane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
2,4,5-Trichlorophenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	-	<0.01	-	-
2,4,6-Trichlorophenol	mg/kg	**73**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-	<0.01	-	-
2,4-Dichlorophenol	mg/kg	**50**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	<0.01	-	-
2,4-Dimethylphenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	<0.01	-	-
2,4-Dinitrophenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
2,4-Dinitrotoluene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
2,6-Dinitrotoluene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
2-Chloronaphthalene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
2-Chlorophenol	mg/kg	**57**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
2-Chlorotoluene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
2-Isopropyl Phenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-

Soil Sample			TP1	TP2	TP3	TP4	TP5	TP6	TP8	TP9	TP10	TP11	TP12	TP13	TP14	TP15	TP16	TP17	TP18	TP19	TP20	TP20	TP21	TP22	TP25
Depth (m)			0.4	0.4	0.40	0.25	0.25	0.30	0.30	0.50	0.50	0.50	0.60	0.60	0.60	0.60	0.50	0.50	0.25	0.40	0.30	1.40	0.90	0.30	0.25
Ground Level (mOD)																									
Sample Level (mOD)																									
Stratum			MG	MG	ALUV	TS	TS	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	ALUV	S&G	ALUV	MG	MG	MG	TS	ALUV
Date			25/11/16	25/11/16	25/11/16	25/11/16	25/11/16	25/11/16	25/11/16	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	26/11/2016	26/11/2016	26/11/2016	26/11/2016	26/11/2016
		Screening Criteria																							
2-Methylnaphthalene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	<0.01	-	-
2-Methylphenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01	-	<0.01	-	-
2-Nitrophenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
4,6-Dinitro-2-methylphenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
4-Bromophenyl phenyl ether	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
4-Chloro-3-methylphenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-	<0.01	-	-
4-Chlorotoluene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
4-Isopropyltoluene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
4-Methylphenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
4-Nitrophenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Bis(2-chloroethoxy)methane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Bis(2-chloroethyl)ether	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Bis(2-chloroisopropyl)ether	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Bis(2-ethylhexyl)phthalate	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Bromobenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Bromochloromethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Bromodichloromethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Bromoform	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Bromomethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Butylbenzyl phthalate	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Carbazole	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	-	<0.01	-	-
Carbon Disulphide	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Carbon Tetrachloride	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Catechol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Chlorobenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Chloroethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Chloroform	mg/kg	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Chloromethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Chrysene	mg/kg	**9**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.14	-	0.01	-	-
cis 1,2-Dichloroethene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
cis 1,3-Dichloropropene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Cresols	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Dibenzofuran	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-	<0.01	-	-
Dibromochloromethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Dibromomethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Dichlorodifluoromethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Dichloromethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Diethyl phthalate	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Dimethyl phthalate	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Ethylbenzene	mg/kg	**167**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Fluorene	mg/kg	**1850 (31)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	-	<0.01	-	-
Hexachlorobenzene	mg/kg	**0.9 (0.2)**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Hexachlorobutadiene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Hexachlorocyclopentadiene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Hexachloroethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
iso - Propylbenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Isophorone	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Isopropylbenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Benzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
m & p Xylene	mg/kg	**53**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Napthol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
n-Butylbenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
n-Dibutylphthalate	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
n-Dioctylphthalate	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Nitrobenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
n-Nitroso-n-dipropylamine	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
n-propylbenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
o-Xylene	mg/kg	**60**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Pentachlorophenol	mg/kg	**22**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08	-	<0.01	-	-
Phenol	mg/kg	**310**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	-	0.02	-	-
Propylbenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Pyrene	mg/kg	**2330**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.76	-	0.02	-	-
Resorcinol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
sec - Butylbenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Styrene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
tert-Butylbenzene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Tetrachloroethene	mg/kg	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Toluene	mg/kg	**607**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
trans 1,2-Dichloroethene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
trans 1,3-Dichloropropene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Trichloroethene	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Trichlorofluoromethane	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Trimethylphenol	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Vinyl Chloride	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-
Xylenols & Ethylphenols	mg/kg	**0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<0.01	-	-

Appendix B

Laboratory Groundwater Results

Sample Identity						BH2		BH3		BH4			
Depth													
Date						12/01/16	24/02/16	12/01/16	24/02/16	12/01/16	24/02/16		
Response Zone													
Area	Units	Screening Criteria	Standard	Number of samples	Number of Exceedences	Sands and Gravels		Sands and Gravels		Sands and Gravels			
Metals													
Arsenic	mg/l	0.05	**FEQS**	**6**	**0**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
Cadmium	mg/l	0.005	**FEQS**	**6**	**0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Chromium	mg/l	0.0047	**FEQS**	**6**	**0**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
Copper	mg/l	0.001	**FEQS**	**6**	**0**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
Lead	mg/l	0.0012	**FEQS**	**6**	**0**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Nickel	mg/l	0.004	**FEQS**	**6**	**1**	<0.005	<0.005	<0.005	<0.005	<0.005	0.006		
Mercury	mg/l	0.00005	**FEQS**	**6**	**0**	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		
Selenium	mg/l	0.01	**FEQS**	**6**	**0**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
Zinc	mg/l	0.0109	**FEQS**	**6**	**6**	0.015	0.024	0.028	0.023	0.029	0.025		
Inorganics													
Sulphate as SO4	mg/l	400	**FEQS**	**3**	**0**	5.3	6.4	6.7					
Ammoniacal Nitrogen	mg/l	1	**FEQS**	**6**	**0**	0.2	0.3	<0.1	0.2	0.2	<0.1		
Total Cyanide	mg/l	0.5	**UK DWS**	**6**	**0**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
pH	mg/l	nc	**nc**	**6**	**0**	5.4	5.3	5.4	5.6	5.6	5.8		
TPH													
Aliphates >C5-6	mg/l	nc	**nc**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aliphates >C6-8	mg/l	nc	**nc**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aliphatics >C8-10	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	<0.05	0.0179	0.0127		
Aliphates >C10-12	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Aliphatics >C12-16	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Aliphatics >C16-21	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	<0.05	0.0192	0.0118		
Aliphatics >C21-35	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	0.0467	0.116	0.0721		
Total Aliphatics	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	0.0467	0.154	0.0966		
Aromatics >C5-C7	mg/l	nc	**nc**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aromatics >C7-C8	mg/l	nc	**nc**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Aromatics >C8-10	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Aromatics >C10-12	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Aromatics >C12-16	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
Aromatics >C16-21	mg/l	nc	**nc**	**6**	**0**	<0.05	<0.05	<0.05	0.0128	0.017	0.0115		
Aromatics >C21-35	mg/l	nc	**nc**	**6**	**0**	0.0395	<0.05	0.0212	0.048	0.0899	0.0747		
Total Aromatics	mg/l	nc	**nc**	**6**	**0**	0.0395	<0.05	0.0212	0.0608	0.107	0.0861		
TPH (Ali & Aro)	mg/l	0.01	**UK DWS**	**6**	**5**	0.0395	<0.05	0.0212	0.108	0.26	0.183		
BTEX													
Benzene	mg/l	0.01	**FEQS**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Ethylbenzene	mg/l	0.02	**FEQS**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
Toluene	mg/l	0.05	**FEQS**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
m & p - Xylene	mg/l	0.03	**FEQS**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
o-Xylene	mg/l	0.03	**FEQS**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
MTBE	mg/l	9.2	**DIV**	**6**	**0**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		
PAHs													
Acenaphthene	µg/l	nc	**nc**	**6**	**0**	0.02	0.01	<0.01	<0.01	<0.01	0.01		
Acenaphthylene	µg/l	nc	**nc**	**6**	**0**	0.02	0.01	<0.01	<0.01	<0.01	0.02		
Anthracene	µg/l	0.1	**FEQS**	**6**	**0**	0.04	0.02	0.01	0.01	0.01	0.03		
Benzo(a)anthracene	µg/l	nc	**nc**	**6**	**0**	0.1	0.04	0.02	0.02	0.02	0.14		
Benzo(a)pyrene	µg/l	0.00017	**FEQS**	**6**	**6**	0.13	0.05	0.02	0.02	0.04	0.21		
Benzo(b)fluoranthene	µg/l	nc	**nc**	**6**	**0**	0.12	0.05	0.02	0.02	0.04	0.15		
Benzo(ghi)perylene	µg/l	nc	**nc**	**6**	**0**	0.09	0.04	0.02	0.03	0.04	0.15		
Benzo(k)fluoranthene	µg/l	nc	**nc**	**6**	**0**	0.15	0.06	0.03	0.02	0.03	0.22		
Chrysene	µg/l	nc	**nc**	**6**	**0**	0.13	0.06	0.03	0.02	0.02	0.18		
Dibenzo(ah)anthracene	µg/l	nc	**nc**	**6**	**0**	0.02	0.01	<0.01	<0.01	<0.01	0.05		
Fluoranthene	µg/l	0.0063	**FEQS**	**6**	**6**	0.24	0.09	0.05	0.05	0.08	0.28		
Fluorene	µg/l	nc	**nc**	**6**	**0**	0.03	0.01	<0.01	<0.01	<0.01	<0.01		
Indeno(123-cd)pyrene	µg/l	nc	**nc**	**6**	**0**	0.08	0.03	0.02	0.03	0.03	0.15		
Naphthalene	µg/l	2	**FEQS**	**6**	**0**	0.06	0.07	0.07	0.06	0.05	0.1		
Phenanthrene	µg/l	nc	**nc**	**6**	**0**	0.15	0.06	0.04	0.05	0.07	0.14		
Pyrene	µg/l	nc	**nc**	**6**	**0**	0.2	0.08	0.04	0.04	0.07	0.28		
PAH (Total)	µg/l	nc	**nc**	**6**	**0**	1.59	0.71	0.4	0.37	0.5	2.11		
PAH sum of B[b] and B[k]	µg/l	0.03	**FEQS**	**0**	**0**								
PAH sum B[ghi] and Indeno[123]	µg/l	0.002	**FEQS**	**0**	**0**								
VOCs													
Dichlorodifluoromethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Chloromethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Vinyl Chloride	µg/l	0.5	**EU DWS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Bromomethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Chloroethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Trichlorofluoromethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
trans-1,2-Dichloroethene	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Dichloromethane	µg/l	20	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Carbon Disulphide	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
1,1-Dichloroethene	µg/l	30	**WHO**	**6**	**0**	<1	<1	<1	<1	<1	<1		
1,1-Dichloroethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
cis-1,2-Dichloroethene	µg/l	50	**WHO**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Bromochloromethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Chloroform	µg/l	12	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
2,2-Dichloropropane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
1,2-Dichloroethane	µg/l	10	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
1,1,1-Trichloroethane	µg/l	100	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
1,1-Dichloropropene	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Benzene	µg/l	10	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Carbon Tetrachloride	µg/l	12	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Dibromomethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
1,2-Dichloropropane	µg/l	0.1	**UK DWS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Bromodichloromethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Trichloroethene	µg/l	10	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
cis-1,3-Dichloropropene	µg/l	0.1	**UK DWS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
trans-1,3-Dichloropropene	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
1,1,2-Trichloroethane	µg/l	400	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Toluene	µg/l	50	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		
1,3-Dichloropropane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Dibromochloromethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
1,2-Dibromoethane	µg/l	nc	**nc**	**6**	**0**	<1	<1	<1	<1	<1	<1		
Tetrachloroethene	µg/l	10	**FEQS**	**6**	**0**	<1	<1	<1	<1	<1	<1		

Sample Identity						BH2		BH3		BH4			
Depth													
Date						12/01/16	24/02/16	12/01/16	24/02/16	12/01/16	24/02/16		
Response Zone													
Area	Units	Screening Criteria	Standard	Number of samples	Number of Exceedences	Sands and Gravels		Sands and Gravels		Sands and Gravels			
1,1,1,2-Tetrachloroethane	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Chlorobenzene	µg/l	300	WHO	6	0	<1	<1	<1	<1	<1	<1		
Ethylbenzene	µg/l	20	FEQS	6	0	<1	<1	<1	<1	<1	<1		
m & p - Xylene	µg/l	30	FEQS	6	0	<1	<1	<1	<1	<1	<1		
Bromoform	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Styrene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
1,1,2,2-Tetrachloroethane	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
o-Xylene	µg/l	30	FEQS	6	0	<1	<1	<1	<1	<1	<1		
1,2,3-Trichloropropane	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Isopropylbenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Bromobenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2-Chlorotoluene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
n-propylbenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4-Chlorotoluene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
1,2,4-Trimethylbenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4-Isopropyltoluene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
1,3,5-Trimethylbenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
1,2-Dichlorobenzene	µg/l	1000	WHO	6	0	<1	<1	<1	<1	<1	<1		
1,4-Dichlorobenzene	µg/l	300	WHO	6	0	<1	<1	<1	<1	<1	<1		
sec-Butylbenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
tert-Butylbenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
1,3-Dichlorobenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
n-butylbenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
1,2-Dibromo-3-chloropropane	µg/l	0.1	UK DWS	6	0	<1	<1	<1	<1	<1	<1		
1,2,4-Trichlorobenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
1,2,3-Trichlorobenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Hexachlorobutadiene	µg/l	0.1	FEQS	6	0	<1	<1	<1	<1	<1	<1		
SVOCs													
2,4,5-Trichlorophenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2,4,6-Trichlorophenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2,4-Dichlorophenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2,4-Dimethylphenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2,4-Dinitrotoluene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2,6-Dinitrotoluene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2-Chloronaphthalene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2-Chlorophenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2-Methylnaphthalene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2-Methylphenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2-Nitrophenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4-Bromophenyl phenyl ether	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4-Chloro-3-methylphenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4-Methylphenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4-Nitrophenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Acenaphthene	µg/l	nc	nc	6	0	0.02	0.02	<0.01	<0.01	<0.01	0.01		
Acenaphthylene	µg/l	nc	nc	6	0	0.02	0.01	<0.01	<0.01	<0.01	0.01		
Anthracene	µg/l	nc	nc	6	0	0.04	0.02	0.01	<0.01	<0.01	<0.01		
Azobenzene	mg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Bis(2-chloroethyl)ether	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Bis(2-chloroethoxy)methane	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Bis(2-ethylhexyl)phthalate	µg/l	1.3	FEQS	6	0	<1	<1	<1	<1	<1	<1		
Benzo(a)anthracene	µg/l	nc	nc	6	0	0.12	0.04	0.02	0.01	0.03	<0.01		
Butyl benzyl phthalate	µg/l	20	FEQS	6	0	<1	<1	<1	<1	<1	<1		
Benzo(b)fluoranthene	µg/l	nc	nc	6	0	0.16	0.06	0.02	0.02	0.03	0.15		
Benzo(k)fluoranthene	µg/l	nc	nc	6	0	0.13	0.06	0.03	0.02	0.03	0.16		
Benzo(a)pyrene	µg/l	0.00017	FEQS	6	6	0.13	0.05	0.03	0.02	0.01	0.2		
Benzo(ghi)perylene	µg/l	nc	nc	6	0	0.11	0.05	0.03	0.03	0.04	0.16		
Carbazole	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Chrysene	µg/l	nc	nc	6	0	0.12	0.05	0.03	0.02	0.03	<0.01		
Dibenzofuran	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
n-Dibutyl phthalate	µg/l	8	FEQS	6	0	<1	<1	<1	<1	<1	<1		
n-Dioctylphthalate	µg/l	20	FEQS	6	0	<1	<1	<1	<1	<1	<1		
n-Nitroso-n-dipropylamine	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Diethyl phthalate	µg/l	200	FEQS	6	0	<1	<1	<1	<1	<1	<1		
Dimethyl phthalate	µg/l	800	FEQS	6	0	<1	<1	<1	<1	<1	<1		
Dibenzo(ah)anthracene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Fluorene	µg/l	nc	nc	6	0	0.03	<0.01	<0.01	<0.01	<0.01	0.01		
Fluoranthene	µg/l	0.0063	FEQS	6	6	0.25	0.09	0.05	0.05	0.07	0.26		
Hexachlorobutadiene	µg/l	0.1	FEQS	6	0	<1	<1	<1	<1	<1	<1		
Hexachlorobenzene	µg/l	0.01	FEQS	6	0	<1	<1	<1	<1	<1	<1		
Pentachlorophenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Phenol	µg/l	30	FEQS	6	0	<1	<1	<1	<1	<1	<1		
Hexachloroethane	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Nitrobenzene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Naphthalene	µg/l	2	FEQS	6	0	0.08	0.08	0.08	0.07	0.05	0.08		
Isophorone	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Hexachlorocyclopentadiene	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
Phenanthrene	µg/l	nc	nc	6	0	0.16	0.07	0.04	0.03	0.06	0.13		
Pyrene	µg/l	nc	nc	6	0	0.22	0.09	0.05	0.04	0.05	0.27		
Indeno(123-cd)pyrene	µg/l	nc	nc	6	0	0.09	0.04	0.02	0.02	0.03	0.13		
Bis(2-chloroisopropyl)ether	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2,4-Dinitrophenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4,6-Dinitro-2-methylphenol	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
2 - Nitroaniline	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
3 - Nitroaniline	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4 - Chloroaniline	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4 - Chlorophenyl phenyl ether	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		
4 - Nitroaniline	µg/l	nc	nc	6	0	<1	<1	<1	<1	<1	<1		

Appendix C

Ground Gas Monitoring Results

GAS AND WATER MONITORING RESULTS

	Date:	12/01/16	20/01/16	27/01/16	17/03/16	24/03/15							
	Visit Number	1	2	3	4	5							
	Atmos Press mb	994	1019	998	1011	1019							
	Pressure Trend	Steady	Steady	Steady	Steady	Steady							
	Air Temp °C	4	-1	10	5	-3							
	Cloud cover	Overcast	Low cloud	Overcast	Overcast	Clear							
	Wind velocity	Windy	Breezy	Strong Wind	Light Breeze	Light Breeze							
	Precipitation	Rain	Dry	Heavy Rain	Rain	Dry							
	State of Ground	Wet	Wet	Flooded	Wet	Wet							
BH2	CH_4 (%) (max/steady):	Nil	Nil		Nil	Nil							
	CO_2 (%) (max/steady):	0.5	0.7		<0.1	0.8							
	O_2 (%) (max/steady):	20.2	19.9	Position Flooded	20.0	19.7							
	H_2S (ppm) (max/steady):	Nil	Nil		Nil	Nil							
	CO (ppm) (max/steady):	Nil	Nil		Nil	Nil							
	PID (ppm) (max/steady)	0.0	0.0		0.0	0.0							
	Flow (l/hr) (max/steady)	<0.1	<0.1		<0.1	<0.1							
	Water Level / depth to base (m):	1.0/25.0	1.00		1.53	1.31							
BH3	CH_4 (%) (max/steady):	Nil	Nil		Nil	Nil							
	CO_2 (%) (max/steady):	0.4	0.5		<0.1	0.3							
	O_2 (%) (max/steady):	19.9	19.7	Position Flooded	20.1	19.7							
	H_2S (ppm) (max/steady):	Nil	Nil		Nil	Nil							
	CO (ppm) (max/steady):	Nil	Nil		Nil	Nil							
	PID (ppm) (max/steady)	0.0	0.0		0.0	0.0							
	Flow (l/hr) (max/steady)	<0.1	<0.1		<0.1	<0.1							
	Water Level / depth to base (m):	0.99/25.0	1.00		1.48	1.32							
BH4	CH_4 (%) (max/steady):	Nil	Nil		Nil	Nil							
	CO_2 (%) (max/steady):	0.4	0.6		<0.1	4.6							
	O_2 (%) (max/steady):	20.0	19.7	Position Flooded	20.0	10.4							
	H_2S (ppm) (max/steady):	Nil	Nil		Nil	Nil							
	CO (ppm) (max/steady):	Nil	Nil		Nil	Nil							
	PID (ppm) (max/steady)	0.0	0.0		0.0	0.0							
	Flow (l/hr) (max/steady)	<0.1	<0.1		<0.1	<0.1							
	Water Level / depth to base (m):	1.0/10.0	1.00		1.45	1.46							
	CH_4 (%) (max/steady):												
	CO_2 (%) (max/steady):												
	O_2 (%) (max/steady):												
	H_2S (ppm) (max/steady):												
	CO (ppm) (max/steady):												
	PID (ppm) (max/steady)												
	Flow (l/hr) (max/steady)												
	Water Level / depth to base (m):												
	CH_4 (%) (max/steady):												
	CO_2 (%) (max/steady):												
	O_2 (%) (max/steady):												
	H_2S (ppm) (max/steady):												
	CO (ppm) (max/steady):												
	PID (ppm) (max/steady)												
	Flow (l/hr) (max/steady)												
	Water Level / depth to base (m):												

Job No: CCG-C-15-8700 | Site: Dyfi Bridge | Instrument: