St. Athan Northern Access Road

Land Contamination Risk Assessment

Welsh Government

Project Number: 60509148

July 2017

Quality information

Prepared by	Checked by	Approved by
		
Millie Sephton Graduate Environmental Consultant	Joanne Foy Associate	Geoffrey Jones

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Prepared for:

Welsh Government

Prepared by:

Millie Sephton
Graduate Environmental Consultant
T: 02920 674716
E: millie.sephton@aecom.com

AECOM Limited
1 Callaghan Square
Cardiff
CF10 5BT
UK

T: +44 (2920) 674 600
aecom.com

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1. Introduction

1.1 Terms of Reference

This document has been prepared by AECOM Limited (AECOM) on behalf of the Welsh Government (Client).

The Welsh Government has appointed AECOM to design a new access road to serve the Aerospace Business Park (ABP) in St. Athan. The new road, which is referred to as the Northern Access Road (NAR), will provide a link from the B4265 near Llantwit Major in the west to Eglwys Brewis Road in Picketston in the east.

1.2 Purpose of Report

This report has been produced in light of the Statutory Pre-Application Consultation letter received from Natural Resources Wales (NRW) dated 28th April 2018 (NRW Ref: CAS-31559-K2Z6 28) and comments from the Vale of Glamorgan Council detailed in a memo reference, SRS/E/DMM/2017/00564/FUL, dated19 June 2017, from: Deborah Margetson of the Shared Regulatory Services: Environment Team. For both documents/comments, this report is intended to provide further information on the land contamination aspects of the development. Comments relating to other subjects in those documents are not addressed in this report.

The proposed planning conditions requested by the Shared Regulatory Services are summarised below.

TABLE 1 Summary of Proposed Planning Conditions

Reference	Subject	Summary
PC14A	Contaminated Land Measures - Assessment	Prior to commencement of the development an assessment of the nature and extent of contamination shall be submitted to and approved by the LPA. The report shall include a desk study, an intrusive investigation and an assessment of potential risks to: Human health, Groundwaters and surface waters Adjoining land Property (existing or proposed) Ecological systems Other receptors An appraisal of remedial options
PC14B	Remediation and Verification Plan	Prior to commencement a detailed remediation scheme and verification plan to bring the site to a suitable condition shall be submitted to and approved in writing by the LPA
PC14C	Remediation and Verification	The remediation approved under PC14B must be undertaken in full prior to occupation of any part of the development. The verification report must be submitted to and approved in writing by the LPA.
PC14D	Unforeseen Contamination	In the event that unforeseen contamination is found then the works will be stopped and the LPA notified within 2 days. Works will not recommence until agreed with the LPA.
PC15A	Imported soil	Requirement for pre-approval of materials by the LPA with verification testing undertaken prior to use.
PC15B	Imported aggregate	
PC15C	Use of site won materials	Requirement for pre-approval of materials by the LPA with verification testing undertaken prior to use.

This assessment aims to provide the client with the means of applying to discharge proposed pre-commencement planning conditions as above through:

- Refinement of the Conceptual Site Model established in the Phase 1 report (referenced below) indicating sources, pathways and controlled waters receptors for the Development Site and immediate surrounding area
- Preliminary Risk Assessment identifying potentially unacceptable risks arising from contamination, both existing and as a result of the development works

- A detailed risk assessment, based on the findings of an intrusive ground investigation and based on this, assess the requirement, or otherwise, for any remedial action.
- Outline Inspection and Discovery Strategy for identifying unsuspected contamination.

1.3 Other Reports

This report supplements and should be read in conjunction with the following reports:

- Ref 1: AECOM (2016) St. Athan Northern Access Road, Phase 1 Geo-Environmental Assessment (60509148/CFRP0006)
- Ref 2: AECOM (2017) St. Athan Northern Access Road (NAR) - Outline Geotechnical Design Report (St. Athan/60509148)
- Ref 3: AECOM (2017) St. Athan Northern Access Road (NAR) – Factual Ground Investigation Report
- Ref 4: WYG (2017) St. Athan Northern Access Road – Ecological Assessment, Pre-Application Consultation Draft (A097705)
- Ref 5: AECOM (2017) St. Athan Northern Access Road – Historic Environment Desk Based Assessment (60509148/LD001)

1.4 Limitation

The information, views and conclusions drawn concerning the site are based, in part, on information supplied to AECOM by other parties. AECOM has proceeded in good faith on the assumption that this information is accurate. AECOM accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied to AECOM from others.

The investigation itself was designed generally to meet the objectives of an exploratory investigation, as defined by BS10175:2011+A1:2013 Investigation of Potentially Contaminated Sites: Code of Practice (BSI). As an exploratory investigation, the results may not provide sufficient data to make detailed estimates of the quantities involved in any remediation work, if required.

The exploratory holes carried out during the fieldwork, which investigate only a small volume of the ground in relation to the size of the site, can only provide a general indication of site conditions. The comments made and recommendations given in this report are based on the ground conditions apparent at the site of the exploratory holes. There may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.

The comments made on groundwater conditions are based on observations made during site work and the monitoring programme undertaken. It should be noted that groundwater levels might vary owing to seasonal or other effects. It should be noted that the effects of ground and water borne contamination on the environment are constantly under review, and authoritative guidance values are potentially subject to change. The conclusions presented herein are based on the guidance values available at the time this report was prepared, however, no liability by AECOM can be accepted for the retrospective effects of any changes or amendments to these values.

The opinions expressed in this report concerning any contamination found and the risks arising there from are based on current good practice simple statistical assessment and comparison with available soil guideline values, AECOM generic assessment criteria and other guidance values.

2. Site Environmental Setting

2.1 Introduction

The following baseline information is a summary of information reported previously in the AECOM (2016) St. Athan Northern Access Road, Phase 1 Geo-Environmental Assessment (60509148/CFRP0006) (Ref 1) and associated Landmark Envirocheck report.

2.2 Site Location

The Scheme includes the provision of a new Link Road to connect the proposed development with the existing settlement of Picketston to the North and Llantwit Major to the West. The Link Road will be an all-purpose road approximately 2.2 kilometres (km) in length and will extend from the B4265 and will tie in to the existing Eglwys Brewis Road.

The scheme is located in St. Athan, South Wales approximately 6.3 km west of Cardiff airport. The National Grid coordinates for the middle of the site are 299069E, 169035N and the approximate post code for the site is CF62 4DN.

The location of the proposed scheme is detailed in Figure 1.

2.3 Site Description

The route passes through open countryside which has a mainly agricultural use, including fields north of Eglwys-Brewis. There are a number of properties close to the route including farms, houses and a caravan park.

The eastern and western extent of the route occupies existing roadways. The western extent joins the route to the B4265. The eastern extent joins Eglwys Brewis Road, west and south of the Eglwys-Brewis housing estate.

As part of the AECOM Phase 1 Geo-environmental Assessment, a site walkover was conducted by AECOM on the 28th July 2016. Generally, the site was noted to be predominantly located within an agricultural context. The walkover did not identify potentially significant contamination sources within the site boundaries.

2.4 Geology

2.4.1 Published Geology and Borehole Data

The geology of the site has been initially assessed by making reference to the British Geological Survey's (BGS) 1:50,000 geological map of Bridgend – Sheet 262 (Solid and Drift).

Based on the published information available, Table 2 presents a summary of the anticipated geology for the site. All strata thicknesses are based on the geological map unless stated.

TABLE 2 Summary of Published Geology

GEOLOGY	NAME	GEOLOGICAL MAP DESCRIPTION / ANTICIPATED PRESENCE	THICKNESS (m)
Superficial	Alluvium (Quaternary)	Clay, silt, sand and gravel. Appears to be only present in proximity to watercourses in the area.	Not indicated
Solid	Porthkerry Member	Interbedded limestone and mudstone.	120m+

In addition localised made ground may be encountered in areas that have been previously developed although limited as generally conditions along the route can be considered as "greenfield".

2.5 Hydrology

Llanmaes Brook, which is classed as a primary river, crosses the proposed route running north to south at Ch. 415m, towards the western end of the route. At Ch. 1520m an un-named tertiary river runs north to south of the route, converging with Boverton Brook at Ch. 1590m south of the route which then runs parallel to the route.

At the eastern extent of the proposed route, a spring is noted at Ch. 2200m flowing to the east, which becomes the Nant y Stepsau primary river at Ch. 2400m.

The site was noted as being at risk from flooding from surface waters according to the Envirocheck Report obtained in December 2016. An existing flood water storage area was indicated where the Llanmaes Brook crosses the route at Ch. 415m and classed as having a low risk (1000 year return) of extreme flooding without defences. Between Ch. 1500m and Ch. 1600m in the middle of the route a low risk of extreme flooding without defences is also noted. A low risk of flooding is also noted between Ch. 1700m and Ch. 2400m in the east of the proposed route.

2.6 Hydrogeology

The superficial Alluvium deposits across the area have no designated aquifer status. The underlying Porthkerry Member has been classed as a Secondary A Aquifer with intermediate to high vulnerability to surface water permeation.

There were four discharge consents to surface water listed within 1km of the site, of which two had expired and two were surrendered under EPR 2010.

There were fifteen recorded pollution incidents to controlled waters within 1km of the site, ten of which were located within 500 m. The nearest of these was located 146m south east of the site (Ch. 1180m) and related to a 'Category 2 – Significant' to waters. This occurred in 2011 and the pollutant is listed as 'Organic Chemicals/Products: Surfactants and Detergents'.

2.7 Site History

Mapping since 1885 shows that the proposed route typically comprised undeveloped fields surrounded by a mixture of residential and military land uses. In 1885 the historical maps for the eastern section of the site shows a church, farm and associated buildings, a smithy and an Old Rectory; by 1969 the hamlet had expanded to include an approximate area of 1km^2 of residential housing and RAF associated buildings as well as St Athan Airfield, constructed on agricultural land. By 1974, major residential development had taken place in Llantwit Major to the south of the Northern Access Road site, a caravan park had been developed approximately 100m north of the site and RAF Station St Athens had been developed. By 1983, the B4265 road was built, and surrounding land use started to increase in development density. Potentially contaminative land uses within 250m include Eglwys-Brewis village and farm, unknown tank and St. Athan airfield.

Table 3 summarises the potentially contaminative historical land uses identified on and within 500m of the site.

TABLE 3 Potential Historical Sources of Contamination On and Within 500m of the Proposed Route

LOCATION	DESCRIPTION
Within 250m	Eglwys-Brewis village including farm (1985-2016) (Ch. 2700m)
	Tank containing unknown substance (1921) (Ch. 2300m)
	St Athan Airfield (1969-2016)
Between 250 and 500m	Tank: approximately 350m south east (1972 -1996) (Ch. 2700m)
	Airfield including 3 potential tanks: 300m north (1999-2016) (Ch. 2100m)
	Great House Farm: 350m north (1885-2016) (Ch. 200m)
	Tremains Farm: approximately 350m north west (1972-2016) (Ch. 0m)
	Bridge House Farm: approximately 400m north west (1885-2016) (Ch. 0m)
	Boverton Place Farm: approximately 450m south (1885-2016) (Ch. 300m)

2.8 Radon

According to the Enviroc heck Report the site is within a radon area as between 3% and 30% of homes are above the action level. As a result, it may be necessary to consider basic to full radon protective measures in the construction of newdwellings or extensions. It should be noted that no such works are proposed as part of the NAR development.

2.9 Regulatory Information

No permitted activities were identified on site.

Three Local Authority Pollution Prevention and Controls (LAPPC) entries within between 250m and 1km of the site, one of which was permitted and two revoked were identified.

There was one enforcement and prohibition notice 500m from the site (Ch. 2650m), two Integrated Pollution Controls (IPC) (one revoked) both 850m from the site (Ch. 2700m) and three Local Authority Pollution Prevention and Controls 270m (Ch. 2660m), 850m (CH. 2700m) and 950m (Ch. 2700m) from the site.

There were no Integrated Pollution Prevention and Control (IPPC) or Local Authority Integrated Pollution Prevention and Control (LAIPPC) sites or Local Authority Pollution Prevention and Control Enforcements (LAPPCE) within 1km of the site. There were two Substantiated Pollution Incident Register entries 150m (Ch. 1190m) and 730m (Ch. 0m) from site and two Water Industry Act Referrals approximately 850m (Ch. 2700m) from site.

There were no Prosecutions Relating to Authorised Processes, Prosecutions Relating to Controlled Waters within 1km of the site.

According to the Envirocheck Report there were two Registered Radioactive Substances within 1km of the proposed route both located at St. Athan. One located 520m from Ch. 100m was for disposal of radioactive waste and the other located 858m east of Ch. 2700m has been superseded.

2.10 Unexploded Ordnance

In 2008, Parsons Brinckerhoff Ltd (PB) was commissioned to undertake and Explosive Ordnance Phase 1 Desk Study of RAF St. Athan to assess the risk that potential explosive ordnance could have on development and construction activities.

Following a review of the available information, PB assessed the levels of risk in the areas of the site covered by the Northern Access Road to be low to low-moderate. The risk from unexploded ordnance is low in areas to the east.

2.11 Quarrying, Mining and Landfilling

There are a number of historical open cast limestone quarries along the proposed route which have now ceased operation. Within 250m of the proposed route they are located at Parwg, Boverton (40m to the south of the site at Ch. 420m) and Great Farm, Llanmaes (68m to the north of the site at Ch. 940m).

The site is not within an area affected by coal mining. There is no hazard listed in relation to the non-coal mining related mined areas of Great Britain.

There are two licensed waste management facilities entries within 250m of the site and one between 250m and 500m of the site all linked to St. Athan. Two licences have been surrendered/revoked and one modified. The modified entry is located 310m south from site (Ch.1830m).

2.12 Sensitive Sites

There are no Environmentally Sensitive Areas, Special Areas of Conservation, Special Protection Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones, National Parks, Areas of Outstanding Natural Beauty, Marine /National Nature Reserves, Forest Parks, Ramsar Sites, Sites of Special Scientific Interest (SSSI), Areas of Adopted Greenbelt or Areas of Unadopted Green Belt within 1km of the site.

3. Preliminary Conceptual Site Model: Phase 1 Assessment

3.1 Introduction

This Conceptual Site Model is a summary of that presented in the Phase 1 assessment (2016) report (Ref 1). In order to verify whether the current site conditions posed a risk to human health or to controlled waters, a preliminary conceptual site model of potential or actual contaminant linkages was developed to evaluate the likely impacts.

To assess the potential environmental impacts associated with the site, a risk assessment has been undertaken using the source-pathway-receptor approach, promoted by DEFRA and the Environment Agency. For there to be an identifiable risk, not only must there be contaminants present on the site (source) i.e. contaminated ground or groundwater but also there must be a receptor and a pathway which allows the source to impact on the receptor. All three elements must be present to form a contaminant linkage before there can be a potential risk to specific receptors.

3.2 Sources

The following potential sources were identified from the information collated. It is noted that the site walkover conducted by AECOM on the 28th July 2016 did not identify potentially significant contamination sources. The site setting was generally defined by agricultural use.

- Onsite
  - Made Ground – possibly present as a feature of the historical stages of redevelopment at the site and containing contaminants including asbestos;
  - Roads – fuel leakage from vehicles and run off;
  - Unexploded Ordnance – potential for ordnance to be present due to the proximity to a military facility; and
  - MOD site;
  - Radon – The site is in a radon area where between 3% and 30% of homes are estimated to be above the action level.
- Offsite
  - Fuel Tanks – of unknown contents related to the historical air field 100m north of Ch.2100m;
  - Unexploded Ordnance – potential for ordnance to be present due to the proximity to a military facility;
  - Radioactive Material – radium has previously been identified in the Flcketston area; and
  - Natural Strata – previous ground investigations have identified elevated concentrations in the soils on adjacent sites.
  - Made Ground – present off site as a feature of the historical stages of redevelopment of the

3.3 Pathways

The following potential pathways were identified:

- Leaching through soil;
- Impact and migration of groundwater;
- Dermal contact, inhalation or ingestion of the contaminants present in topsoil or underlying strata, during works and post-development;
- Migration of airborne-contaminants (e.g. dust particulates) during the development works.

3.4 Receptors

The following potential receptors were identified:-

- Humans – construction personnel during development works on-site;
- Humans – site occupants in adjacent areas during works;
- Humans – maintenance personnel after development works;
- Building materials and services – after development works
- Controlled Waters – Groundwater -Secondary A Aquifer, Surface waters including Llanmaes Brook, Boverton Brook and Nant-Stepsau
- Flora and Fauna.

3.5 Summary of Potential Contaminant Linkages

The initial CSM from the AECOM 2016 Phase 1 Geo-environmental Assessment report identified the following potentially complete linkages. These relate to potential soil and groundwater contamination.

- Risks to off-site receptors (human health) through the generation and exposure to wind-blown dusts during construction from contaminated soils.
- Risks to groundwater within the Porthkerry Secondary A Aquifer formation through migration of contaminants from existing soil or groundwater contamination.
- Risks to surface waters through migration of contaminants from existing soil or groundwater contamination.
- Risks to road infrastructure through:
  - Direct contact with contaminants within Made Ground / soils, leachate and groundwater,
  - unexploded ordnance,
  - sulphates /aggressive ground conditions
  - radioactive materials
- Areas of Landscaping/Planting through direct contact with contaminants within Made Ground / soils, leachate and groundwater.

The preliminary risk evaluation identified a very low risk to adjacent site users and controlled waters and a low risk to road infrastructure and areas of landscaping.

4. Site Investigation

4.1 Scope of Works Completed

AECOM was commissioned by the Welsh Government to carry out a site investigation across the proposed development area. No point sources were identified, however the site investigation was completed to inform the development design.

The site work comprised the following:

- 11no. Trial Pits to a maximum depth of 1.40m (bgl) (SK501-SK510 & TP501)
- 10no. Soakaway Tests undertaken in machine excavated trial pits (SK501 – SK510).
- 4no. Boreholes to a maximum depth of 8.50m bgl utilising Dynamic Sampling and Rotary Coring (BH501 to BH504)
- Installation of monitoring wells within the boreholes. It is noted that all wells except BH502 were installed to allow water ingress from the bedrock. BH502 was installed to allow water ingress from the alluvium.
- Following installation of the monitoring wells at BH501, BH502, BH503 and BH504, three monthly rounds of groundwater monitoring were undertaken.

Chemical analysis was carried out on selected soil samples and water samples taken from the monitoring wells.

The findings are detailed in the AECOM (2017) St. Athan Northern Access Road (NAR) - Outline Geotechnical Design Report (Ref 2) and AECOM (2017) St. Athan Northern Access Road (NAR) – Factual Ground Investigation Report (Ref 3) and summarised below. Intrusive investigation locations are shown on Figure 2.

4.2 Site-wide Ground Conditions

Geological findings based on the AECOM 2016 intrusive investigation broadly reflect the sequence indicated by the published geology. The exploratory holes encountered Made Ground and Topsoil overlying Alluvium and the Porthkerry Member. The investigation highlighted the presence of Alluvium at several intrusive investigation locations which was not suggested by the published geological records. There are a number of watercourses which intersect the site and alluvial deposits are likely to be associated with these features. Trial pit and borehole logs are included in Appendix A for reference.

Table 4 gives a summary of the site wide ground conditions encountered in the AECOM 2016 site investigation.

Table 4 Summary of the site wide ground conditions

STRATUM	DEPTH OF TOP OF STRATUM (m BGL (m AOD))	THICKNESS (m)
Topsoil	G.L. (41.53 – 44.96)	0.25 – 0.45
Made Ground (5 locations)	G.L. – 0.25 (43.01 – 44.71)	0.4 – 0.65
Alluvium	0.2 – 0.45 (41.46)	0.35 – 2.2
Porthkerrry Member	0.35 – 2.4 (41.18 – 39.49)	Not proven (max thickness encountered 7.8m)

4.2.1 Topsoil Description

Topsoil was encountered in all fifteen investigation locations. The top of the stratum was encountered at ground level and ranged in thickness from 0.25 to 0.45m. The material was generally described as grass over soft dark brown slightly gravelly sandy CLAY with frequent rootlets. The gravel was limestone.

4.2.2 Made Ground Description

Anthropogenic materials were recorded in five locations, recorded as fragments of brick with topsoil / made ground. The brick fragments were generally recorded within a matrix of slightly sandy gravelly CLAY. These stratums were encountered either from ground level or beneath a layer of topsoil with a thickness ranging from 0.3 m – 0.65m.

4.2.3 Alluvium Description

Alluvium was encountered in most recent exploratory holes across the St. Athan site. The surface of the Alluvium was encountered at depths ranging from 0.2m to 0.45m. The thickness of the deposit ranged from 0.35m to 2.2 m. The material was generally described as soft becoming firm yellowish brown slightly gravelly CLAY. The gravel is limestone and mudstone.

4.2.4 Porthkerry Member Description

The Porthkerry Member was encountered in all of the exploratory holes. The base of this unit was not encountered but it was proven to a maximum thickness of 7.8m. The top of the Porthkerry Member ranged from 0.35m bgl to 2.4m bgl. The material was generally described as medium strong to extremely weak grey weathered LIMESTONE with sub-horizontal and sub-vertical closely spaced open fractures infilled with soft dark brown slightly sandy silty clay. The Rock Quality Designation (RQD) classifies the rock as poor to excellent. Generally, this represents sections of densely fractured rock intermittent with thick bands of good to excellent rock.

4.2.5 Groundwater

Groundwater was encountered during fieldwork at the depths indicated in Table 5

Table 5 Summary of Groundwater Observations during Fieldwork

BOREHOLE	STRIKE m BGL (m AOD)	RISE m BGL (m AOD)	STRATUM
SK503	1.3 (42.88)	1.2 (42.78)	Weathered Porthkerry Member
SK504	0.8 (42.46)	0.7 (42.36)	Weathered Porthkerry Member
SK507	0.8 (41.22)	No rise recorded	Weathered Porthkerry Member
SK508	0.95 (41.02)	0.6 (40.67)	Weathered Porthkerry Member
SK509	1.2 (40.51)	1.1(40.41)	Alluvium
BH501	1.3 (41.71)	No rise recorded	Weathered Porthkerry Member
BH502	0.7 (41.29)	1.2* (41.79)	Alluvium
BH503	1.2 (40.63)	No rise recorded	Weathered Porthkerry Member
BH504	0.8 (41.11)	1.35* (41.66)	Weathered Porthkerry Member

*Water level fell

The results of the groundwater monitoring programme undertaken following the completion of boreholes is summarised in Table 6. Full groundwater observation data is presented in Appendix B.

Table 6: Summary of Groundwater Monitoring Results

BOREHOLE	DEPTH (m BGL)		ELEVATION (m AOD)		STRATUM
	Min	Max	Min	Max	
BH501	1.37	Dry*	41.06	Dry*	Weathered Porthkerry Member

BOREHOLE	DEPTH (m BGL)		ELEVATION (m AOD)		STRATUM
	Min	Max	Min	Max	
BH502	0.60	0.99	40.90	41.29	Alluvium
BH503	0.99	1.20	40.63	40.84	Weathered Porthkerry Member
BH504	1.26	1.39	40.52	40.65	Weathered Porthkerry Member

* BH501 – depth to base was 4.0 mbgl.

Groundwater levels are likely to be susceptible to fluctuations in level as a result of seasonal variations.

4.3 Assessment of Potential Contamination

4.3.1 Contamination Testing

During the site investigation, environmental soil samples were collected from the borehole cores and soakaway/trial pit excavations by an AECOM site engineer. Samples were collected into laboratory supplied containers suitable for the proposed analysis and kept cool using ice whilst couriered to the laboratory under chain of custody conditions.

In addition to the water level measurements, groundwater samples were collected from the monitoring wells. These works were carried out by an AECOM site engineer and included:

- Measurement of the groundwater depth within the boreholes using an interface probe capable of detecting free-phase product.
- Purging of standing water and monitoring of wellhead water quality parameters (pH, temperature, electrical conductivity, redox potential and dissolved oxygen) using a flow-through cell.
- Sampling of groundwater, where present, within BH501-504 using dedicated sampling tubing. Samples were collected into laboratory supplied containers suitable for the proposed analysis and kept cool using ice whilst couriered to the laboratory under chain of custody conditions.

4.3.2 Soil observations

All 11 trial pits completed were excavated to the top of the weathered bedrock (Porthkerry Member). The only exception was the aborted excavation at SK501A , where a suspected archaeological feature was encountered, it is noted that SKA501B was excavated as a replacement and reached bedrock. The site engineer only recorded made ground at the following locations:

- SK501 (westernmost location undertaken): Made ground recorded between 0.25 and 0.65 mbgl with brick and limestone gravel noted. Based on the historical maps presented in the Phase 1 report [1], this location is in the vicinity of a former lime kiln. In addition, a buried wall was recorded on the first attempt at this trial pit (SK501A). It is possible therefore that this made ground was associated with those previous uses/observations.
- SK505 (in the central area of the proposed development): Made ground recorded between 0.4 and 0.65 mbgl with brick and limestone gravel noted. Based on the historical maps presented in the Phase 1 report, this location is within a former farm and close to an established footpath.

Brick fragments were also recorded at SK502, SK503 and BH501, although it is noted that the relevant strata have been recorded as topsoil in the logs.

At the remainder of the locations, only topsoil and probable alluvium was recorded. The site engineer recorded no visual or olfactory evidence of contamination in the topsoil, made ground, probable alluvium or bedrock encountered.

The four boreholes were extended further into the bedrock, with topsoil and probable alluvium recorded above the bedrock at all four locations. Made ground was not encountered. The logs indicate that visual and olfactory evidence of contamination was not encountered.

4.3.3 Groundwater observations

Three groundwater sample rounds were undertaken as follows:

- Sampling round one, 8th December 2016, one week after drilling was completed. Weather during the visit was overcast and dry. All four monitoring wells were visited, however BH501 was not sampled as there was insufficient water for a sample. The remaining three monitoring wells were sampled. There was no visual or olfactory evidence of contamination noted during sampling.
- Sampling round two, 9th January 2017. Weather during the visit was wet and windy. Three of the four monitoring wells were sampled; again there was insufficient water in BH501 to allow sampling to be undertaken. There was no visual or olfactory evidence of contamination noted during sampling.
- Sampling round three, 9th February 2017. Weather during the visit was overcast and windy. All four boreholes were sampled. There was no visual or olfactory evidence of contamination noted during sampling.

Water samples from each visit were sent to an MCERTS accredited laboratory, Derwentside Environmental Testing Services, under chain of custody. Laboratory Results Certificates are presented in the AECOM (2017) St. Athan Northern Access Road (NAR) – Factual Ground Investigation Report (Ref 3).

4.3.4 Laboratory Analysis

The selected laboratory analytical suites were based on the findings of the Phase 1 Geo-environmental Assessment report, according to the substances associated with the route and adjacent sites. Analyses were also selected based on the sample depth and type of soil encountered.

Soil Samples

During the site investigation a total of 28 soil samples were collected. Soil samples were analysed for part or all of the following suite of analysis:

- Asbestos screen.
- Contaminated Land Exposure Assessment (CLEA) Metals (arsenic, barium, beryllium, boron, cadmium, total chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc).
- Hexavalent Chromium.
- Criteria Working Group Total Petroleum Hydrocarbons (CWG TPH) / Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) and Methyl Tertiary Butyl Ether (MTBE).
- 16 Speciated Polycyclic Aromatic Hydrocarbons (PAHs).
- Volatile Organic Compounds (VOC).
- Total Organic Carbon (TOC).
- pH.
- Free cyanide.

Groundwater samples

During the three groundwater monitoring visits a total of 10 water samples were recovered, three each from BH502, BH503, BH504 and one from BH501. Groundwater samples were analysed for the following:

- Contaminated Land Exposure Assessment (CLEA) Metals;
- Hexavalent Chromium;
- Criteria Working Group Total Petroleum Hydrocarbons (CWG TPH) / Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) and Methyl Tertiary Butyl Ether (MTBE);
- Speciated Polycyclic Aromatic Hydrocarbons (PAHs);

- Volatile Organic Compounds (VOC);
- Monohydric Phenol;
- Sulphate; and
- Cyanide.

4.4 Laboratory Analytical Findings

The factual laboratory analytical results are presented on the laboratory certificates, included in the AECOM Factual Report (AECOM, 2017).

A summary of the soil and water results is presented below.

Table 7: Summary of Soil Analytical Results

Analyte	Number of samples	Units	Detection Limit	Number of Detections	Maximum Detected Concentration
TPH CWG (with carbon chain length and aliphatic/aromatic split)	28	mg/kg	0.01 to 3.4	0	N/A
Metals					
Arsenic	24	mg/kg	N/A	24	15
Barium	24	mg/kg	N/A	24	140
Beryllium	24	mg/kg	N/A	24	1.5
Cadmium	24	mg/kg	N/A	24	0.9
Chromium (III+VI)	24	mg/kg	N/A	24	28
Hexavalent Chromium	24	mg/kg	1.0	0	N/A
Copper	24	mg/kg	N/A	24	100
Lead	24	mg/kg	N/A	24	53
Mercury	24	mg/kg	0.05	6	0.24
Nickel	24	mg/kg	N/A	24	32
Selenium	24	mg/kg	0.5	14	1.2
Vanadium	24	mg/kg	N/A	24	37
Zinc	24	mg/kg	N/A	24	250
Boron (water soluble)	24	mg/kg	N/A	24	2.1
PAH (remaining PAHs were not detected above the detection limit of 0.03 mg/kg)					
Phenanthrene	28	mg/kg	0.03	1	0.07
Fluoranthene	28	mg/kg	0.03	2	0.08
Pyrene	28	mg/kg	0.03	2	0.05
Benz(a)anthracene	28	mg/kg	0.03	1	0.05
Benzo(b)fluoranthene	28	mg/kg	0.03	1	0.04
VOCs (remaining VOCs were not detected above the detection limit of 0.01 mg/kg)					
n-butylbenzene	28	mg/kg	0.01	1	0.01
1,2-dichlorobenzene	28	mg/kg	0.01	6	0.01
1,2-dibromo-3-chloropropane	28	mg/kg	0.01	3	0.03
1,2,4-trichlorobenzene	28	mg/kg	0.01	3	0.04
Hexachlorobutadiene	28	mg/kg	0.01	4	0.05
1,2,3-trichlorobenzene	28	mg/kg	0.01	4	0.07
Miscellaneous					
Cyanide (Free)	24	mg/kg	0.1	7	0.2
pH	28	pH units	N/A	28	8.6

Analyte	Number of samples	Units	Detection Limit	Number of Detections	Maximum Detected Concentration
TOC	28	%	N/A	28	3.5
Asbestos	14	N/A	N/A	0	N/A

Table 8: Summary of Groundwater Analytical Results

Analyte	Number of samples	Units	Detection Limit	Number of Detections	Maximum Detected Concentration
TPH CWG					
>C5-C6 Aliphatics	10	µg/l	0.1	1	3.6
>C6-C8 Aliphatics	10	µg/l	0.1	2	4.6
>C8-C10 Aliphatics	10	µg/l	0.1	2	2.4
>C10-C12 Aliphatics	10	µg/l	1	0	N/A
>C12-C16 Aliphatics	10	µg/l	1	0	N/A
>C16-C21 Aliphatics	10	µg/l	1	0	N/A
>C21-C35 Aliphatics	10	µg/l	1	0	N/A
>EC5-EC7 Aromatics	10	µg/l	0.1	2	2.2
>EC7-EC8 Aromatics	10	µg/l	0.1	0	N/A
>EC8-EC10 Aromatics	10	µg/l	0.1	0	N/A
>EC10-EC12 Aromatics	10	µg/l	1	0	N/A
>EC12-EC16 Aromatics	10	µg/l	1	1	4.7
>EC16-EC21 Aromatics	10	µg/l	1	1	4.3
>EC21-EC35 Aromatics	10	µg/l	1	0	N/A
Metals (filtered)					
Arsenic	10	µg/l	N/A	10	0.74
Barium	10	µg/l	N/A	10	46
Beryllium	10	µg/l	0.1	0	N/A
Boron	10	µg/l	100	3	260
Cadmium	10	µg/l	0.03	5	0.04
Chromium (III+VI)	10	µg/l	N/A	10	5.7
Hexavalent Chromium	10	µg/l	7	0	N/A
Copper	10	µg/l	0.4	9	5.5
Lead	10	µg/l	0.09	4	0.46
Mercury	10	µg/l	0.01	1	0.02
Nickel	10	µg/l	N/A	10	5.5
Selenium	10	µg/l	0.25	9	6.2
Vanadium	10	µg/l	0.6	2	0.8
Zinc	10	µg/l	N/A	10	16
PAH (remaining PAHs were not detected above the detection limit of 0.01 µg/l)					
Naphthalene	10	µg/l	0.01	2	0.02

Analyte	Number of samples	Units	Detection Limit	Number of Detections	Maximum Detected Concentration
VOCs (remaining VOCs were not detected above the detection limit of 1 µg/l)					
Methyl-tert-butyl-ether (MTBE)	10	µg/l	1.0	1	3.6
1,1-dichloroethane	10	µg/l	1.0	4	4.0
Chloroform	10	µg/l	1.0	1	1.0
Benzene	10	µg/l	1.0	2	2.2
Trichloroethene	10	µg/l	1.0	3	1.0
Miscellaneous					
Cyanide (Free)	4	mg/l	0.02	0	N/A
Cyanide (Total)	6	mg/l	0.04	0	N/A
Phenol	7	µg/l	0.5	0	N/A
Phenols (monohydric)	3	µg/l	100	0	N/A
Sulphate	10	mg/l	N/A	10	48

5. Phase 2 Conceptual Site Model and Risk Assessment

5.1 Preliminary Conceptual Site Model: Potential Risks

The initial CSM from the AECOM 2016 Phase 1 Geo-environmental Assessment report identified the following potentially complete linkages as detailed in Section 3.5 above. These relate to potential soil and groundwater contamination.

- Risks to off-site receptors (human health) through the generation and exposure to wind-blown dusts during construction from contaminated soils.
- Risks to groundwater within the Porthkerry Secondary A Aquifer formation through migration of contaminants from existing soil or groundwater contamination.
- Risks to surface waters through migration of contaminants from existing soil or groundwater contamination.
- Risks to road infrastructure through:
  - Direct contact with contaminants within Made Ground / soils, leachate and groundwater,
  - unexploded ordnance,
  - sulphates/aggressive ground conditions
  - radioactive materials
- Areas of Landscaping/Planting through direct contact with contaminants within Made Ground / soils, leachate and groundwater.

Each of these potential linkages is discussed in more detail below, with a Quantitative Risk Assessment approach used where appropriate. Analytes that were not detected in any of the samples analysed (i.e. TPH fractions, asbestos, some VOCs and some PAHs) do not require further assessment and are not considered further.

5.2 Other Potential Risks

The proposed planning conditions, as detailed in Section 1, required consideration of the following receptors with specific regard to contaminated land:

- Human health: included above.
- Groundwaters and surface waters: included above
- Adjoining land: given the low potential for contamination and the low concentrations detected in the site investigation, risks to adjoining land are not considered to be present. It is also noted that no specific point source contamination sources have been identified within the development boundary. The potential for contamination to be unique to the development site and migrating to adjoining land is therefore considered to be low.
- Property – existing or proposed: included above for the proposed road development: Risks to existing property are considered to be similar and there are few buildings present on the site. Given the lack of point source contamination sources on the site and low concentrations of contaminants detected, assessment of risks to offsite livestock is not considered to be warranted i.e. the development land is not considered to pose a risk that would not be posed by adjoining land.
- Ecological systems: As above, the potential for contamination unique to the development is considered to be low, therefore specific risk assessment is not considered to be warranted. Areas of landscaping and planting are included above. The Pre-Application Ecological Assessment report (Ref 4) notes that there are no statutorily designated sites or non-statutory sites for nature conservation within the site. The site is largely dominated by grassland and arable fields. Protected species surveys identified hazel dormice, badger setts, invertebrates and common bird species. No evidence of water vole, otter or great crested newt was recorded and no bat roosts were observed on site. It is noted that the design of the development has focused on retention, enhancement and protection of important

habitats and includes mitigation measures to ensure that habitat connectivity is maintained through and around the site.

- Archaeological sites and ancient monuments: given the low potential for soil and groundwater contamination identified, it is considered unlikely that risks would be posed from that contamination to such features. It is also noted that the Historic Environment Desk Study (Ref 5) did not identify archaeological features within the site boundary.
- Other receptors identified: no other receptors have been identified.

5.3 Wind-blown dust risks to off-site human receptors

The preliminary risk assessment and conceptual model developed in the Phase 1 report identified the potential for asbestos and inorganic and organic contaminants to be present in the ground and as a result to pose a potential health risk to off-site human receptors. The critical exposure pathway for this is the inhalation of fugitive dust emissions from the site during construction activities.

In general, reported concentrations of organic contaminants were low (all below 1 mg/kg) with only five PAHs and six VOCs detected. In addition, TPH fractions were reported to be below the detection limits in the samples analysed. Of the PAHs, benzo(a)pyrene, often used as a marker compound due to its elevated toxicity compared to other PAHs was not detected.

It is noted that made ground was only recorded at five locations, with samples of made ground collected for analysis. Of the analytes detected in one or more samples, with the exception of arsenic, chromium (total) and nickel, the highest concentrations were not detected in the samples of made ground i.e. they were detected in samples recorded as either topsoil or probable natural alluvium. For these exceptions:

- Arsenic, maximum detection of 15 mg/kg. This is consistent with background soil chemistry arsenic values provided within the Envirocheck commissioned for the Phase 1 report, which shows background levels <15 mg/kg.
- Chromium, maximum detection of 28 mg/kg. This is consistent with background soil chemistry chromium values provided within the Envirocheck commissioned for the Phase 1 report, which shows background levels 20-40 mg/kg. It is noted also that hexavalent chromium was not detected in the samples analysed.
- Nickel, maximum detection of 32 mg/kg. This is slightly higher than background soil chemistry nickel values provided within the Envirocheck commissioned for the Phase 1 report, which shows background levels 15-30 mg/kg.

It is therefore considered, on the basis of the results obtained:

- The results do not indicate widespread elevated levels of hydrocarbon related contaminants including petroleum hydrocarbons, PAHs or VOCs.
- Made ground is not present across the whole area, and where present does not appear, on the basis of the current results, to pose a substantially different risk to that from the natural soils.

Overall, the potential risks posed by organic or inorganic contaminants in soil dust generated during construction remains very low. No further action or assessment is considered warranted in this specific regard.

5.4 Risks to groundwater within the Porthkerry Aquifer

This aquifer is classified as a Secondary A Aquifer and whilst the Envirocheck did not identify abstractions for drinking water, it is a theoretical resource. It is noted that the two groundwater abstractions identified in the Envirocheck are both associated with remediation and are therefore not used as drinking water. The presence of such remediation may preclude it being used as a resource; however that detail is not known. For completeness therefore a Generic Quantitative Risk Assessment (GQRA) has been undertaken on the soil and groundwater results for those analytes detected in the samples collected.

The GQRA compares the reported results to generic published criteria. In this instance, Drinking Water Standards (DWS) are considered applicable to the scenario. All values have been back calculated for soils by AECOM from the published water GAC as described in Appendix C. This represents Stage 2 Generic

Quantitative Risk Assessment, as set out in the EA/ Defra guidance document CLR11[2]. The screened data tables are presented in Appendix C. The following exceedances of the criteria are present in the data collected:

- Metals: Arsenic, barium, cadmium, nickel, lead, vanadium and zinc were reported at concentrations in excess of their respective criteria in one or more soil samples. It is noted that these metals did not exceed the criteria in the groundwater samples collected.
- TPH Fractions: Two of the groundwater samples collected in the final round had concentrations of C5-C7 aromatic hydrocarbons above the criteria of 1 µg/l with the maximum concentration being 2.2 µg/l. These concentrations relate to the benzene exceedance detailed below.
- VOCs:
  - 1,1-dichloroethane. Three of the groundwater samples collected were reported to have concentrations above the criteria of 2.8 µg/l (US EPA Regional Screening Level May 2016) with the maximum reported concentration being 4 µg/l.
  - 1,2-dibromo-3-chloropropane, hexachlorobutadiene, 1,2,3-trichlorobenzene and 1,2,4-trichlorobenzene were reported at concentrations above their respective criteria in three or four shallow soil samples (from 0.3 m below ground level (bgl)). In all four cases, the exceedances were minor and they were not detected in the groundwater samples collected.
  - Benzene: Two of the groundwater samples collected in the final round were reported to have concentrations of benzene above the criteria of 1 µg/l (Water Supply Regulations 2016 (England/Wales)) with the maximum reported concentration being 2.2 µg/l.

These exceedances are not considered to warrant further assessment or action as:

- There are no relevant groundwater abstractions identified, this assessment is therefore considered to be conservative for this site.
- The majority of the soil exceedances are not also identified in the groundwater results. It is recognised that the soil assessment is conservative due to the assumptions used in the back calculations from the water criteria and is therefore less relevant (particularly for metals) than water results.
- Where groundwater exceedances have been identified (benzene and 1,1-dichloroethane) these are minor.

5.5 Risks to Surface Waters

A number of surface waters have been identified in the vicinity of the proposed development therefore a Generic Quantitative Risk Assessment (GQRA) has been undertaken on the soil and groundwater results for those analytes detected in the samples collected.

As in section 9.6.3 above the GQRA compares the reported results to generic published criteria. In this instance, Environmental Quality Standards (EQS) for fresh water are applicable to the scenario. All values have been back calculated for soils by AECOM from the published water GAC as described in Appendix C.

The screened data tables are presented in Appendix C. The following exceedances of the criteria are present in the data collected:

- PAHs
  - Fluoranthene and benzo(b)fluoranthene both exceeded the criteria in one soil sample from SK504, with fluoranthene also exceeding for one sample from SK509. With regard SK509, fluoranthene was not detected in the deeper soil sample. Neither was detected in the groundwater samples collected.
- Metals
  - cadmium, copper, lead, nickel, vanadium and zinc were reported at concentrations in excess of their respective criteria in one or more soil samples.

[2] Contaminated Land Report 11. Model Procedures for the Management of Land Contamination. Environment Agency, 2004.

  - Copper was reported at concentrations in excess of the criteria (1 µg/l) in five of the ten water samples at concentrations up to 5.5 µg/l.
  - Nickel and zinc also exceeded the criteria in one of the groundwater samples collected from BH502. It is noted that these were minor exceedances and within the same order of magnitude as the criteria (lead – 5.5 µg/l against a criteria of 4 µg/l and zinc – 16 µg/l against a criteria of 10.9 µg/l)
- VOCs:
  - It is noted that there are no criteria available for the detections of n-butylbenzene, 1,2-dichlorobenzene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and 1,2-dibromo-3-chloropropane detected in soils. These compounds were not detected in the groundwater samples collected.
  - There is also no criterion available for the 1,1-dichloroethane detected at low concentrations in the groundwater.
- Cyanide. Seven of the soil results exceeded the criteria for free cyanide in soils. There were no exceedances in the five groundwater samples analysed.

These exceedances are not considered to warrant further assessment or action as:

- The most sensitive receptor is considered to be the Llanmaes Brook which crosses the development close to SK502 and BH501. With the exception of one copper result (groundwater at BH501), cyanide (soils at BH501) and some metals in soils (SK502) the exceedances noted are not from these locations.
- The Nant-y-Stepsau is close to the eastern end of the development, with BH504 and SK510 the closest investigation locations. With the exception of one copper result (groundwater at BH504), and some metals in soils (BH504 and SK510) the exceedances noted are not from these locations.
- The majority of the soil exceedances are not also identified in the groundwater results. It is recognised that the soil assessment is conservative due to the assumptions used in the back calculations from the water criteria and is therefore less relevant (particularly for metals) than water results.
- Where groundwater exceedances have been identified, these are considered to be minor.

5.6 Risks to road infrastructure

The Phase 1 report identified potential risks to the road infrastructure from a number of potential contamination sources, each of which is discussed below with reference to the site investigation (Ref 3):

- Direct contact with contaminants within Made Ground / soils, leachate and groundwater. Given the low concentrations of contaminants detected, this is considered to be unlikely.
- Unexploded ordnance. This has not been assessed further through this assessment.
- Sulphates/aggressive ground conditions. This is considered in the geotechnical report (Ref 2).
- Radioactive materials. The previous report identified sites licensed to dispose of radioactive waste at distances of approximately 800m and 1.2km from the western end of the proposed development. Radioactive materials have not been assessed further through this assessment.

5.7 Areas of Landscaping/Planting

Given the low concentrations of contaminants detected, the risks to planting are considered unlikely to be realised, however no quantified risk assessment has been undertaken. It is noted that the site is currently planted/colonised and the development is unlikely to affect this should similar species be used. In addition, excessively low or high pH values were not recorded in soils with the range of pH values reported to be 6.3 to 8.6. No further assessment or other action is therefore considered warranted.

5.8 Risk Assessment Conclusions

Collection of soil and groundwater samples from the site investigation locations has allowed further assessment of potential risks identified in the Phase 1 report. In general, the range and concentration of contaminants

detected in the soil and groundwater samples was low. It is noted also that asbestos was not detected in the soil samples screened. Whilst the Generic Quantitative Risk Assessment identified some concentrations in soil and groundwater above appropriate criteria these are not considered to present an unacceptable risk to the identified receptors.

In view of the nature of the proposed low sensitivity development (road infrastructure) and absence of significant sources of contamination, no remedial works are considered necessary.

6. Development Requirements

6.1 Introduction

Whilst the results of the site investigation and subsequent risk assessment do not indicate widespread contamination to be present at the site it is acknowledged that there may be areas of higher levels of contamination between sample points. It is therefore possible that contamination may be discovered during the development, albeit this is considered unlikely. This potential will be identified to the development contractor during the tendering process. In addition, control over the re-use and import of material will be required during development. The following sections detail the information that will be provided to the contractor.

Site workers will be expected to employ appropriate health and safety practices and personal protective equipment (PPE) during the construction and maintenance activities that involve earthworks or entering confined spaces.

6.2 Identification of unforeseen contamination

If ground conditions other than those encountered during the ground investigations covered by this report (as described in Section 4) are identified and are suspected to be contaminated (by visual or olfactory evidence) then the Contractor shall undertake the necessary testing to confirm the chemical status of the material and notify the Supervisor. Should contamination not previously identified be found then it will be reported in writing within two days to the Local Planning Authority (LPA) and no further development will be permitted within the affected area until agreement has been reached with the LPA as to how it will be dealt with. It is anticipated that a risk assessment will be required to establish the potential risks associated with the identified contamination.

If hazardous materials or suspected hazardous materials are encountered they will be excavated separately and if retained on site temporarily before either treatment and / or disposal will be stored to prevent any nuisance being caused or adverse impact to human health or the environment. This shall include the appropriate control of dust, vapours, surface water, leachate and groundwater.

Where the Made Ground comprises in part or wholly demolition rubble, vigilance will be maintained for potential asbestos containing material (ACM). Earthwork contractors will be trained in the identification of ACM, and be aware of the procedures to be followed if encountered.

Site workers will be expected to employ appropriate health and safety practices and personal protective equipment (PPE) during the construction and maintenance activities that involve earthworks or entering confined spaces.

Areas where ground works are being carried out shall be secure from public access.

6.3 Re-use of Reworked Materials

It is anticipated that materials arising from the scheme will comprise mostly natural or reworked strata. It is therefore concluded that, given the assessment above, most of the materials will be suitable for reuse depending on cut and fill balances requirements and the geotechnical suitability of the materials.

The Contractor will demonstrate the suitability that any materials excavated at the site are suitable for reuse. The Contractor will carry out testing to demonstrate the suitability of materials, including, where necessary leaching tests. All materials to be re-used will be tested at a minimum frequency of one sample for each type of material encountered and for every 100 m^3 thereafter. Analysis will include testing for Total Petroleum Hydrocarbons (Criteria Working Group analysis) (TPH CWG), Polycyclic Aromatic Hydrocarbons (PAHs), Volatile Organic Compounds (VOCs), asbestos screen, and metals. All requested soils analysis shall be carried out by a laboratory with MCERTS accreditation for that particular parameter.

Analytical results for excavated materials for reuse will not exceed the relevant reuse/import objective for the proposed end uses of the materials. Generic Assessment Criteria Values for protection of Controlled Waters (Environmental Quality Standards – Fresh Water) and for protection of the aquifer which may provide a drinking water resource (Drinking Water Standards) presented in Appendix C of this report will be used to screen the analytical data. Where two values are provided, the lowest should be used. If no value is presented for a

compound that is detected, further advice will be sought to establish an appropriate screening value. The Detection Limits shall be at or lower than the concentration/value given for each relevant chemical parameter as set out in Appendix C.

This should be controlled using a suitable Material Management Plan under the CL:AIRE: Definition of Waste – Development Industry Code of Practice, version 2, March 2011 or an Environmental Permit.

The management of waste is regulated by The Environmental Permitting Regulations. As such, there is a statutory duty on the waste producer to comply with the interpretation of waste operations exempt from Environmental Permitting.

6.4 Material Import

Should imported material be required for the development it will be notified to the Overseeing Organisation (the Welsh Government) in advance with evidence of provenance of the imported soils including chemical test data provided by the supplier. Only material approved by the Overseeing Organisation will be used. Suitability will be verified as follows:

- All materials (topsoil or aggregate) imported to site should be subject to testing for the same suite of analysis as above for re-used materials with the same requirements for laboratory accreditation. The exception to this is virgin quarry stone.
- Each source must be submitted for approval by the Overseeing Organisation in advance of the testing of the soils proposed for importation to confirm no other contaminants should be analysed for other than those shown above. Where other contaminant testing is required the Overseeing Organisation shall advise of the relevant Reuse/Import Objective for the additional contaminant testing required.
- All imported fill shall not exceed the relevant reuse/import objective for the proposed end uses of the fill. As above, the GAC included in Appendix C of this report will be used to screen the data. Additional GAC may be calculated as required.
- In addition to the limits prescribed above, no materials imported and/or used on site shall fall within the definition of Hazardous Waste.
- The number and the frequency of testing will be agreed with the Overseeing Organisation. As a minimum one sample will be required for testing for each new source of material and for every 250m^3 thereafter.

6.5 Reporting

Following analysis, a report will be provided to the client that will include, for both site won and imported materials:

- Location of sample, including depth where necessary
- Unique sample code or reference
- Date/time sample taken
- Name of laboratory including sub-contract laboratories
- Date sample analysis completed
- Parameter analysed, including whether sample preserved or stabilised on site
- Whether analysis carried out on a dried or “as submitted” basis
- Result of analysis must be on a dry-weight basis
- Other relevant comments such as visual characteristics of the sample and other pre-treatment
- Chromatograms where appropriate
- Method of analysis and details of any accreditation

This report will then be provided to the LPA for their records.

7. Conclusions

The Planning Application has been submitted for this development with supporting documentation including a Phase 1 desk study report. That report concluded that whilst the potential for risks to be present from soil and groundwater contamination could not be ruled out, the risks were likely to be low. The site investigation undertaken provides further evidence that these risks are low with no further action considered warranted.

Following review of the planning application documents, the Environment Shared Regulatory Services Team for Bridgend, Cardiff and the Vale of Glamorgan requested inclusion of a number of proposed planning conditions. Each proposed condition has been considered by AECOM as detailed below.

Table 9: Proposed Planning Conditions: Conclusions

Reference	Subject	Summary	AECOM Response/Conclusions
PC14A	Contaminated Land Measures - Assessment	Prior to commencement of the development an assessment of the nature and extent of contamination shall be submitted to and approved by the LPA. The report shall include a desk study, an intrusive investigation and an assessment of potential risks to:	This report provides a summary of the 2016 Phase 1 previously submitted. It is considered that there are no substantial increases in the potential risks, over and above as previously reported; therefore the preliminary risk assessment as presented is considered to be appropriate. This report also provides the results of the site investigation undertaken along the proposed development with risks assessment where appropriate as below.
		Human health,	The main risk to human health has been identified to be from wind blown dusts during development. The risk assessment presented in this report (Section 5.3) indicates a very low risk level with no further action considered to be warranted. Risks to workers during development should be controlled through compliance to health and safety legislation and correct use of risk assessed method statements for the works as well as compliance with the Construction Environmental Management Plan (CEMP).
		Groundwaters and surface waters	Risks to controlled waters in both the aquifer and surface waters close to or crossing the development have been assessed. The risk assessments presented in this report (Section 5.4 and 5.5) indicate some exceedances of Generic Assessment Criteria however these are minor and are not considered to warrant further action. The contractor will be required to protect surface waters from materials entering them during the development works.
		Adjoining land	Given the results of the Phase 1 study and the Phase 2 site investigation, it is considered unlikely that contamination is present within the development that is not present across the wider area.
		Property (existing or proposed)	Risks to road infrastructure following development have not been identified. Risks to other buildings and structures are therefore also considered to be unlikely. Given the results of the Phase 1 study and the Phase 2 site investigation, it is considered unlikely that contamination is present within the development that is not present across the wider area therefore consideration of risks from the development to livestock etc. on adjoining land is not considered warranted.
		Ecological systems	Given the results of the Phase 1 study and the Phase 2 site investigation, it is considered unlikely that contamination is present within the development that is not present across the wider area and therefore specific assessment is not considered warranted.
		Other receptors	No other receptors have been identified.
		An appraisal of remedial options	No remediation is considered to be required on the basis of the risk assessments undertaken.

Reference	Subject	Summary	AECOM Response/Conclusions
PC14B	Remediation and Verification Plan	Prior to commencement a detailed remediation scheme and verification plan to bring the site to a suitable condition shall be submitted to and approved in writing by the LPA	As remediation is not considered to be required, no remediation plan (or verification plan for that remediation) is required.
PC14C	Remediation and Verification	The remediation approved under PC14B must be undertaken in full prior to occupation of any part of the development. The verification report must be submitted to and approved in writing by the LPA.	As above, this is not considered to be applicable as no remediation is required.
PC14D	Unforeseen Contamination	In the event that unforeseen contamination is found then the works will be stopped and the LPA notified within 2 days. Works will not recommence until agreed with the LPA.	This report details the measures to be taken should unforeseen contamination be identified (Section 6.2). It is noted that this information will be provided to the Contractor during the tendering process.
PC15A	Imported soil	Requirement for pre-approval of materials by the LPA with verification testing undertaken prior to use.	This report details the notification and testing requirements of imported materials (Section 6.4)
PC15B	Imported aggregate		
PC15C	Use of site won materials	Requirement for pre-approval of materials by the LPA with verification testing undertaken prior to use.	This report details the verification required of site won materials intended for re-use and imported materials (Section 6.5).

It is envisaged that the details included in this report should allow discharge of the proposed planning conditions as detailed above.

8. Literature References

British Standards Institution: BS5930 + A2, Code of Practice for Site Investigations, 2010.

British Standards Institution, BS10175: Code of Practice for the Investigation of Potentially Contaminated Sites, 2001

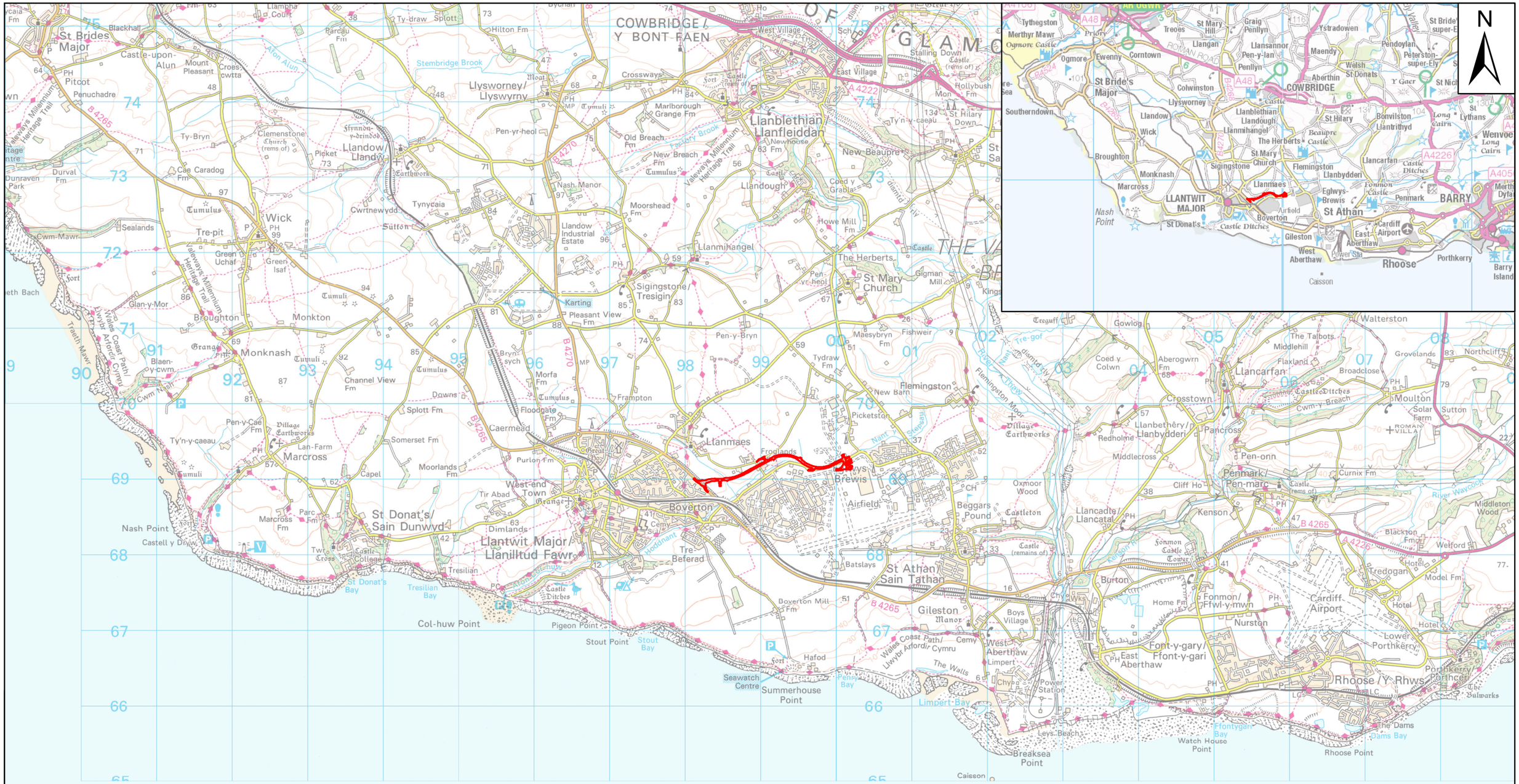
Contaminated Land Exposure Assessment (CLEA) MODEL (2004) Model Procedures for the management of Contaminated Land, CLR11 DEFRA / Environment Agency

Construction Industry Research and Information Association (2001) Report C552: Contaminated Land Risk Assessment, A guide to Good Practise. CIRIA

Department for Environment, Food and Rural Affairs (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance. London, HMSO.

Department for Environment, Food and Rural Affairs and Environment Agency (2004) Model Procedures for the Management of Land Contamination. Bristol, Environment Agency. (Contaminated Land Report 11)

Figures



KEY

Site Boundary

1000 0 1000 2000 3000 4000 5000 m

Client: Welsh Government

Project: St Athan Northern Access Road

Title: FIGURE 1
LOCATION PLAN

AECOM
2 City Walk
Leeds
LS11 9AR
T +44-113-391-6800
www.aecom.com

Drawn: FG	Chk'd: LC
App'd: FL	Date: 10/01/2017
Scale at A3: 1:50,000	
Drawing No: FIGURE_1_Location_170110	Rev: 01

ISO A1 594mm x 841mm

Project Management Initials: Designer: MC Checked: MB Approved: CE

Last saved by: ELENA.MARTIN Last Plotted: 2017-01-25

N

SK506

SK505

SK504

SK503

BH501

SK502

SK501 A

SK501 B

FINAL LOCATION

ARCHAEOLOGICAL STRUCTURE ENCOUNTERED

0 50 100 m

1:2000 @ A1

AECOM

PROJECT

ST. ATHAN NORTHERN ACCESS ROAD

CLIENT

WELSH GOVERNMENT

Llywodraeth Cymru
Welsh Government

CONSULTANT

AECOM
1 CALLAGHAN SQUARE
CARDIFF
CF10 5BT
TEL: (029) 20674600
FAX: (029) 20674699

KEY

PROPOSED KEY INFORMATION

BOREHOLE	BH
TRIAL PIT	TP
SOAKAWAY TEST	SK

ISSUE/REVISION

IR	DATE	DESCRIPTION
A	23/01/2017	FINAL VERSION

KEY PLAN

PROJECT NUMBER

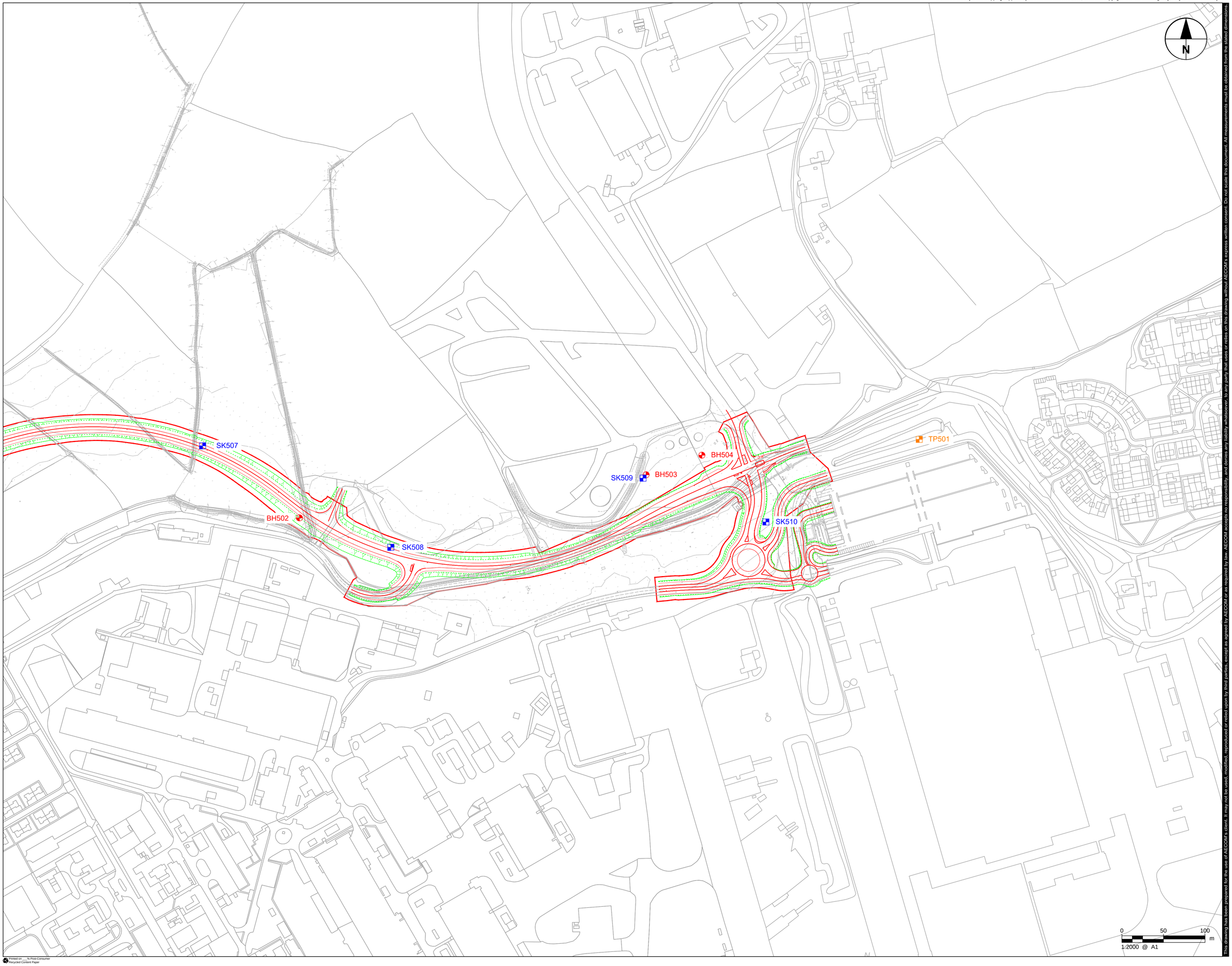
60509148

SHEET TITLE

ST. ATHAN
EXPLORATORY HOLE LOCATION PLAN
SHEET 1 OF 2

SHEET NUMBER

60509148-SHT-30-0000-CT-0652



ISO A1 594mm x 841mm

Project Management Initials: Designer: MC Checked: MB Approved: CE

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PROJECT

ST. ATHAN NORTHERN ACCESS ROAD

CLIENT

WELSH GOVERNMENT

Llywodraeth Cymru
Welsh Government

CONSULTANT

AECOM
1 CALLAGHAN SQUARE
CARDIFF
CF10 5BT
TEL: (029) 20674600
FAX: (029) 20674699

KEY

PROPOSED KEY INFORMATION

BOREHOLE	BH
TRIAL PIT	TP
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ISSUE/REVISION

IR	DATE	DESCRIPTION
A	23/01/2017	FINAL VERSION

KEY PLAN

PROJECT NUMBER

60509148

SHEET TITLE

ST. ATHAN
EXPLORATORY HOLE LOCATION PLAN
SHEET 2 OF 2

SHEET NUMBER

60509148-SHT-30-0000-CT-0653

Appendix A – Site Investigation Borehole and Trial Pit Logs

KEY TO BOREHOLE, TRIAL PIT AND WINDOW SAMPLE LOGS

SOIL STRATA

SAMPLES

U100	Open Drive Tube Sample (100mm nominal diameter) - UNR denotes 'no recovery'.
UT100	Open Drive Thin Wall Tube Sample (100mm nominal diameter) - UNR denotes 'no recovery'.
U38	Open Drive Tube Sample (38mm nominal diameter)
P	Piston Sample (100mm nominal diameter unless noted otherwise) - PNR denotes 'no recovery'.
D	Small Distrubed Sample
B	Bulk Disturbed Sample
BLK	Block Sample
C	Rotary Core Sample (taken for laboratory testing)
G	Gas Sample
J	Jar Sample
TUB	Tub Sample
ES	Environmental Sample
W	Water Sample
SS	Split Spoon Sample
CSS	Cutting Shoe Sample
L	Liner Sample

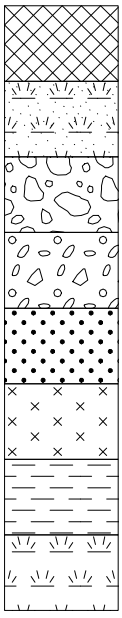
IN SITU TESTING

S	Standard Penetration Test using the Split Spoon Sampler.
C	Standard Penetration Test using a solid cone.

Where a test has been completed the type of test and the N-value will be reported. Where the full 300mm penetration of the main drive has not been completed, the number of blows (not an N-value) will be reported. The Field Records column on the log will show each set of blow counts per 75mm of penetration including seating blows and will also indicate the partial penetration achieved (mm) for incomplete tests.

V	Field vane test, vane shear strength quoted for peak (P) and remoulded (R) tests in kPa.
PP	Pocket Penetrometer measurements (kN/m2).
k	Field Permeability Test, R denotes Rising Head, F denotes Falling Head, C Constant Head.
So	Field Soakage Test in a borehole.
PID	Photo Ionisation Detector (PID) readings for volatile hydrocarbon screening (ppm).
cu	Undrained shear strength triaxial test result (kN/m2)

STRATA



Made Ground / Fill

Topsoil

Cobbles and Boulders

Gravel

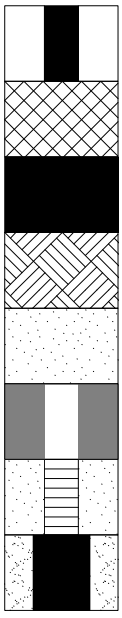
Sand

Silt

Clay

Peat

BACKFILL / INSTALLATIONS



Top Cap

Backfill With Arisings

Bentonite Seal

Cement

Filter

Grout

Slotted Pipe

Piezo Tip

WATER

Initial Level of Water Strike

Level of Water Strike Rise After 20 Mins

Composite soil types shown by combined symbols
(primary + secondary constituents)

AECOM
12 Regan Way
Chetwynd Business Park, Chilwell
Nottingham, NG9 6RZ
Tel: 0115 9077000
Fax: 0115 9077001
www.aecom.com

AECOM
Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
www.aecom.com

Borehole No. BH501

Sheet: 1 of 2

Equipment & Methods:
0.00 - 8.50 Hand Tools - Comacchio 205

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 298644.305
N: 169054.476

Ground Level (m): 43.01 AOD

Date Started: 30/11/2016
Date Completed: 30/11/2016

In Situ Testing			Coring Information			DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)	Backfill/ Instrument
Depth (m)	Type	Result	TCR SCR RQD	FI	Core Run					
0.00- 0.35	B					TOPSOIL: Grass Over: Soft slightly reddish brown slightly gravelly sandy CLAY with abundant roots. Gravel is subangular to rounded fine of limestone and rare brick. Sand is fine to medium **(TOPSOIL)**	42.66		(0.35) 0.35	
0.30	ES					Soft locally firm slightly reddish brown silty CLAY with occasional roots and low cobble content. Cobbles are subangular of limestone **(PROBABLE ALLUVIUM)**	42.31		(0.35) 0.70	
0.50	ES					Strong grey partially weathered medium bedded LIMESTONE with occasional shell fragments and two sets of irregular fractures infilled with firm clay. First set: Subhorizontal, closely spaced, planar rough, open infilled with firm greenish yellowish brown silty clay. Second set: Subvertical (~50°), closely spaced, planar rough, tight with orange surface staining **(PARTIALLY WEATHERED PORTHKERRY MEMBER)**				
0.35- 0.70	B									
0.70	SPT (C)	N>50 8,17 for 40mm/35,15 for 40mm			1.00					
1.00- 2.50	C		93 57 57	6		At 2.00m bgl: Soft orangish brown clay fracture infill (~6cm thick) present.				
					2.50	At 2.50m bgl: Soft orangish brown clay fracture infill (~4cm thick) present. At 2.60m bgl: Assumed clay fracture infill washed out (~10cm thick).				
2.50- 4.00	C		86 65 65	7		At 3.00m bgl: Assumed clay fracture infill washed out (~10cm thick).				
					4.00	At 4.00m bgl: Infill of soft to firm greenish greyish brown clay (~10cm thick) present. From 4.00m bgl: Subvertical (~80°) calcite veins present (~2mm thin).			(7.80)	
4.00- 5.50	C		100 93 86	5						

Water Strikes		Hole Diameter		Progress					Remarks
Strike Depth	Flow Remarks	Hole Dia (mm)	Depth of Hole (m)	Date	Time	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	
1.30	Standing	300	0.70	30-11-2016	14:30	8.50	1.00	1.30	1. Borehole located in third party field north of the Eglwys Brewis Road. 2. Buried services inspection pit excavated by hand refused at 0.70m bgl on natural rock. 3. Borehole advanced by Rotary Coring with water recirculation: 0.70m - 8.50m bgl. 4. Borehole completed to 8.50m bgl. 5. Topography: Gently sloping. 6. Standing water encountered at 1.30m bgl. 7. No visual or olfactory evidence of contamination. 8. 50mm standpipe installed to 4.00m bgl and backfilled with bentonite from 4.00m to 8.50m bgl upon completion, as instructed by the engineer.
		140	1.00	01-12-2016	15:30	8.50		1.37	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:25

Logged By: MC

Checked By: MB

AECOM
Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
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Borehole No. BH501

Sheet: 2 of 2

Equipment & Methods:
0.00 - 8.50 Hand Tools - Comacchio 205

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 298644.305
N: 169054.476

Ground Level (m): 43.01 AOD

Date Started: 30/11/2016
Date Completed: 30/11/2016

In Situ Testing			Coring Information			DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)	Backfill/ Instrument
Depth (m)	Type	Result	TCR SCR RQD	FI	Core Run					
					5.50					
5.50- 7.00	C		100 93 87	5						
					7.00					
7.00- 8.50	C		87 87 76	6		At 8.10m bgl: Assumed clay fracture infill washed out. At 8.30m bgl: Assumed clay fracture infill washed out.				
8.50	SPT (C)	N>50 25 for 25mm/50 for 5mm				**End of Borehole 8.50 m** (Thickness of basal layer not proven)	34.51		8.50	

Water Strikes		Hole Diameter		Progress					Remarks
Strike Depth	Flow Remarks	Hole Dia (mm)	Depth of Hole (m)	Date	Time	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	1. Borehole located in third party field north of the Eglwys Brewis Road. 2. Buried services inspection pit excavated by hand refused at 0.70m bgl on natural rock. 3. Borehole advanced by Rotary Coring with water recirculation: 0.70m - 8.50m bgl. 4. Borehole completed to 8.50m bgl. 5. Topography: Gently sloping. 6. Standing water encountered at 1.30m bgl. 7. No visual or olfactory evidence of contamination. 8. 50mm standpipe installed to 4.00m bgl and backfilled with bentonite from 4.00m to 8.50m bgl upon completion, as instructed by the engineer.
		120	8.50	30-11-2016 01-12-2016	14:30 15:30	8.50 8.50	1.00	1.30 1.37	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:25

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Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
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Borehole No. BH502

Sheet: 1 of 2

Equipment & Methods:
0.00 - 8.00 Hand Tools - Comacchio205

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 299568.328
N: 169207.301

Ground Level (m): 41.89 AOD

Date Started: 23/11/2016
Date Completed: 01/12/2016

In Situ Testing			Coring Information			DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)	Backfill/ Instrument
Depth (m)	Type	Result	TCR SCR RQD	FI	Core Run					
						TOPSOIL: Grass Over: Soft to firm dark brown slightly gravelly CLAY with frequent roots. Gravel is subangular medium of limestone **(TOPSOIL)**	41.69		(0.20) 0.20	
0.30	ES					Firm brown slightly gravelly sandy CLAY. Gravel is angular to rounded fine to medium of limestone. Sand is fine to medium **(PROBABLE ALLUVIUM)**	41.29		(0.40) 0.60	
0.50	ES					Firm light grey mottled yellowish orange silty CLAY **(PROBABLE ALLUVIUM)**				
0.75	ES									
0.60- 0.95	B									
0.95- 1.20	D					At 1.00m bgl: Becomes stiff.				
1.20	SPT (C)	N=10 2,2/ 2,3,2,3								
1.40- 2.00	D					From 1.50m bgl: Becomes very stiff.			(1.80)	
2.00- 2.40	D									
2.40	SPT (C)	N>50 16,9/50 for 35mm					39.49		2.40	
					2.50	Strong dark grey medium bedded shelly LIMESTONE with calcite veins and subvertical (~45°) closely spaced, planar rough, partly open with orange surface stained fractures. Interbedded with hard very dark grey CLAY with shell fragments and Gryphaea fossil (~30mm) **(PORTHKERRY MEMBER)**				
				6						
2.50- 4.00	C		100 56 56							
				8						
					4.00	From 4.00m to 4.20m bgl: Clay washed out (core loss).				
4.00- 5.50	C		87 50 44	6		From 4.65m to 4.77m bgl: Fractured zone present. Recovered as angular medium to coarse gravel.				

Water Strikes		Hole Diameter		Progress				
Strike Depth	Flow Remarks	Hole Dia (mm)	Depth of Hole (m)	Date	Time	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
0.70	Falling to 1.20m bgl after 20 mins	300 140	0.95 2.50	23-11-2016 01-12-2016	16:00 16:00	0.95 8.00	2.50	0.70

Remarks
1. Borehole located in third party field north of the Eglwys Brewis Road.
2. Buried services inspection pit excavated by hand refused at 0.95m bgl on natural rock.
3. Borehole advanced by dynamic sampling: 0.95m-2.40m bgl; Rotary Coring with water recirculation: 2.40m-8.00m bgl.
4. Borehole completed at 8.00m bgl.
5. Topography: Level ground.
6. Groundwater encountered at 0.70m bgl falling to 1.20m bgl after 20mins.
7. No visual or olfactory evidence of contamination.
8. 50mm standpipe installed to 2.30m bgl and backfilled with bentonite from 2.30m to 8.00m bgl upon completion, as instructed by the engineer.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:25

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Borehole No. BH502

Sheet: 2 of 2

Equipment & Methods:
0.00 - 8.00 Hand Tools - Comacchio205

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 299568.328
N: 169207.301

Ground Level (m): 41.89 AOD

Date Started: 23/11/2016
Date Completed: 01/12/2016

In Situ Testing			Coring Information			DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)	Backfill/ Instrument
Depth (m)	Type	Result	TCR SCR RQD	FI	Core Run					
									(5.60)	
					5.50	From 5.50m bgl: Becomes thickly bedded interbedded with extremely weak black thinly laminated mudstone.				
5.50- 7.00	C		100 100 100	2						
					7.00	At 7.20m bgl: Veined/fractured zone (~100mm thick) present.				
7.00- 8.00	C		100 73 56	3						
8.00	SPT (C)	N>50 25 for 25mm/50 for 5mm					33.89		8.00	
						End of Borehole 8.00 m (Thickness of basal layer not proven)				

Water Strikes		Hole Diameter		Progress				
Strike Depth	Flow Remarks	Hole Dia (mm)	Depth of Hole (m)	Date	Time	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
		120	8.00	23-11-2016	16:00	0.95		
				01-12-2016	16:00	8.00	2.50	0.70

Remarks
1. Borehole located in third party field north of the Eglwys Brewis Road.
2. Buried services inspection pit excavated by hand refused at 0.95m bgl on natural rock.
3. Borehole advanced by dynamic sampling: 0.95m-2.40m bgl; Rotary Coring with water recirculation: 2.40m-8.00m bgl.
4. Borehole completed at 8.00m bgl.
5. Topography: Level ground.
6. Groundwater encountered at 0.70m bgl falling to 1.20m bgl after 20mins.
7. No visual or olfactory evidence of contamination.
8. 50mm standpipe installed to 2.30m bgl and backfilled with bentonite from 2.30m to 8.00m bgl upon completion, as instructed by the engineer.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:25

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Fax: 01793 508501
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Borehole No. BH503

Sheet: 1 of 2

Equipment & Methods:
0.00 - 0.80 Hand Tools

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 299985.073
N: 169259.091

Ground Level (m): 41.83 AOD

Date Started: 21/11/2016
Date Completed: 29/11/2016

In Situ Testing			Coring Information			DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)	Backfill/ Instrument
Depth (m)	Type	Result	TCR SCR RQD	FI	Core Run					
0.00- 0.35	D					TOPSOIL: Grass Over: Soft to firm dark brown slightly gravelly CLAY with frequent roots. Gravel is subangular medium of limestone **(TOPSOIL)**			(0.35)	
0.30	ES						41.48		0.35	
0.50	ES					Soft becoming firm light yellowish brown slightly gravelly CLAY. Gravel is subangular fine of limestone **(PROBABLE ALLUVIUM)**				
0.35- 0.80	D								(0.45)	
0.80	SPT (C)	N>50 25 for 40mm/50 for 10mm					41.03		0.80	
0.80- 1.00	D					Medium strong locally weak light grey weathered medium bedded LIMESTONE with occasional calcite-replaced shell fragments, calcite veins and two fracture sets. First fracture set: Subvertical (~45°), closely spaced, planar rough, open with orange surface straining. Second fracture set: Horizontal, closely to very closely spaced, planar rough, open with firm dark greenish brown clay infill **(PARTIALLY WEATHERED PORTHKERRY MEMBER)**				
					1.00					
1.00- 2.50	C		91 59 49	11		At 1.20m bgl: Layer of weathered stiff dark greenish brown clay (~10cm thick) present. From 1.45m to 1.65m bgl: Layer of weathered stiff dark greenish brown clay present.				
					2.50					
2.50- 4.00	C		87 79 67	6		From 2.96m to 3.04m bgl: Layer of weathered stiff dark greenish brown clay present.				
					4.00					
4.00- 5.50	C		100 90 77	6					(7.70)	

Water Strikes		Hole Diameter		Progress					Remarks
Strike Depth	Flow Remarks	Hole Dia (mm)	Depth of Hole (m)	Date	Time	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	1. Borehole located in the St. Athan Ministry of Defence (MoD) base north of the Eglwys Brewis Road. 2. Buried services inspection pit excavated by hand refused at 0.80m bgl on natural rock. 3. Borehole advanced by Rotary Coring with water recirculation: 0.80m - 8.50m bgl. 4. Borehole completed at 8.50m bgl. 5. Topography: Level ground. 6. Standing water encountered at 1.20m bgl. 7. No visual or olfactory evidence of contamination. 8. 50mm standpipe installed to 3.80m and backfilled with bentonite from 3.80m to 8.50m bgl upon completion, as instructed by the engineer.
1.20	Standing	300	0.80	21-11-2016	13:00	0.80			
		140	1.00	29-11-2016	16:00	8.50	1.00	1.20	
				30-11-2016	14:45	8.50		1.35	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:25

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Borehole No. BH503

Sheet: 2 of 2

Equipment & Methods:
0.00 - 0.80 Hand Tools

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 299985.073
N: 169259.091

Ground Level (m): 41.83 AOD

Date Started: 21/11/2016
Date Completed: 29/11/2016

In Situ Testing			Coring Information			DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)	Backfill/ Instrument
Depth (m)	Type	Result	TCR SCR RQD	FI	Core Run					
						At 5.10m bgl: Layer of weathered stiff dark greenish brown clay (~5cm thick) present.				
					5.50	At 5.45m bgl: Layer of very stiff dark grey clay (~10cm thick) present.				
5.50- 7.00	C		100 82 65	6						
					7.00					
7.00- 8.50	C		100 95 95	4						
8.50	SPT (C)	N>50 25 for 25mm/50 for 15mm				**End of Borehole 8.50 m** (Thickness of basal layer not proven)	33.33		8.50	

Water Strikes		Hole Diameter		Progress					Remarks
Strike Depth	Flow Remarks	Hole Dia (mm)	Depth of Hole (m)	Date	Time	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	1. Borehole located in the St. Athan Ministry of Defence (MoD) base north of the Eglwys Brewis Road. 2. Buried services inspection pit excavated by hand refused at 0.80m bgl on natural rock. 3. Borehole advanced by Rotary Coring with water recirculation: 0.80m - 8.50m bgl. 4. Borehole completed at 8.50m bgl. 5. Topography: Level ground. 6. Standing water encountered at 1.20m bgl. 7. No visual or olfactory evidence of contamination. 8. 50mm standpipe installed to 3.80m and backfilled with bentonite from 3.80m to 8.50m bgl upon completion, as instructed by the engineer.
		120	8.50	21-11-2016	13:00	0.80			
				29-11-2016	16:00	8.50	1.00	1.20	
				30-11-2016	14:45	8.50		1.35	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:25

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Borehole No. BH504

Sheet: 1 of 2

Equipment & Methods:
0.00 - 8.30 Hand Tools - Comacchio 205

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 300052.146
N: 169282.685

Ground Level (m): 41.91 AOD

Date Started: 21/11/2016
Date Completed: 28/11/2016

In Situ Testing			Coring Information			DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)	Backfill/ Instrument
Depth (m)	Type	Result	TCR SCR RQD	FI	Core Run					
0.00- 0.45	D					TOPSOIL: Grass Over: Soft to firm dark brown slightly gravelly CLAY with frequent roots. Gravel is subangular medium of limestone **(TOPSOIL)**			(0.45)	
0.30	ES						41.46		0.45	
0.50	ES					Soft becoming firm orangish brown slightly gravelly CLAY. Gravel is subangular fine of limestone **(PROBABLE ALLUVIUM)**			(0.35)	
0.45- 0.80	D						41.11		0.80	
				15	1.00	Medium strong to weak grey weathered thinly to thickly laminated LIMESTONE with orangish brown staining and closely spaced, planar rough, open with orange surface stained fractures **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**				
				0						
1.00- 2.50	C		100 73 49						(1.70)	
				8						
					2.50	Strong locally medium strong grey partially weathered LIMESTONE with occasional shell fragments and two fracture sets. First fracture set: subhorizontal, closely spaced, planar rough, open with orange surface straining. Second fracture set: subvertical (~85°), undulating rough, tight with orange surface staining **(PARTIALLY WEATHERED PORTHKERRY MEMBER)**	39.41		2.50	
2.50- 4.00	C		100 84 62	86						
					4.00	From 4.00m bgl: Becomes dark grey less weathered with very low persistant calcite veins and subvertical fractures become very close, rough stepped, partly open with pyrite and calcite mineralisation.				
4.00- 5.30	C		100 55 51	10						

Water Strikes		Hole Diameter		Progress					Remarks
Strike Depth	Flow Remarks	Hole Dia (mm)	Depth of Hole (m)	Date	Time	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	1. Borehole located in the St. Athan Ministry of Defence (MoD) base north of the Eglwys Brewis Road.
0.80	Falling to 1.35m bgl after 20 mins	300	0.80	21-11-2016	15:00	0.80			2. Buried services inspection pit excavated by hand refused at 0.80m bgl on natural rock.
		140	1.00	28-11-2016	16:00	8.30	1.00	1.30	3. Borehole advanced by Rotary Coring with water recirculation: 0.80m-8.30m bgl.
				29-11-2016	15:30	8.30		1.47	4. Borehole completed at 8.30m bgl.
									5. Topography: Level ground.
									6. Surface water at location. Groundwater encountered at 0.80m bgl falling to 1.35m bgl after 20 mins.
									7. No visual or olfactory evidence of contamination.
									8. 50mm standpipe installed to 8.30m bgl upon completion as instructed by the engineer.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:25

Logged By: MC

Checked By: MB

Report ID: STANDARD COREHOLE LOG - SWINDON || Project: ST. ATHAN ACCESS ROAD 10.01.2017 MC.GPJ || Library: AECOM AGS 4_0 LIBRARY V6_25102016.GLB || Date: 10 January 2017

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United Kingdom
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Borehole No. BH504

Sheet: 2 of 2

Equipment & Methods:
0.00 - 8.30 Hand Tools - Comacchio 205

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 300052.146
N: 169282.685

Ground Level (m): 41.91 AOD

Date Started: 21/11/2016
Date Completed: 28/11/2016

In Situ Testing			Coring Information			DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)	Backfill/ Instrument
Depth (m)	Type	Result	TCR SCR RQD	FI	Core Run					
					5.30				(5.80)	
5.30- 6.80	C		90 72 68	7		From 6.00m bgl: Fractures (~70°) are very closely and planar smooth with orange surface staining.				
					6.80	From 6.80m to 6.87m bgl: Very weak thinly laminated black weathered orange mudstone present.				
6.80- 8.30	C		100 100 91	6		At 7.45m to 7.52m bgl: Very weak thinly laminated black weathered orange mudstone present.				
							33.61		8.30	
						End of Borehole 8.30 m (Thickness of basal layer not proven)				

Water Strikes		Hole Diameter		Progress					Remarks
Strike Depth	Flow Remarks	Hole Dia (mm)	Depth of Hole (m)	Date	Time	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	1. Borehole located in the St. Athan Ministry of Defence (MoD) base north of the Eglwys Brewis Road. 2. Buried services inspection pit excavated by hand refused at 0.80m bgl on natural rock. 3. Borehole advanced by Rotary Coring with water recirculation: 0.80m-8.30m bgl. 4. Borehole completed at 8.30m bgl. 5. Topography: Level ground. 6. Surface water at location. Groundwater encountered at 0.80m bgl falling to 1.35m bgl after 20 mins. 7. No visual or olfactory evidence of contamination. 8. 50mm standpipe installed to 8.30m bgl upon completion as instructed by the engineer.
		120	8.30	21-11-2016	15:00	0.80			
				28-11-2016	16:00	8.30	1.00	1.30	
				29-11-2016	15:30	8.30		1.47	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:25

Logged By: MC

Checked By: MB

KEY TO BOREHOLE, TRIAL PIT AND WINDOW SAMPLE LOGS

SOIL STRATA

SAMPLES

U100	Open Drive Tube Sample (100mm nominal diameter) - UNR denotes 'no recovery'.
UT100	Open Drive Thin Wall Tube Sample (100mm nominal diameter) - UNR denotes 'no recovery'.
U38	Open Drive Tube Sample (38mm nominal diameter)
P	Piston Sample (100mm nominal diameter unless noted otherwise) - PNR denotes 'no recovery'.
D	Small Distrubed Sample
B	Bulk Disturbed Sample
BLK	Block Sample
C	Rotary Core Sample (taken for laboratory testing)
G	Gas Sample
J	Jar Sample
TUB	Tub Sample
ES	Environmental Sample
W	Water Sample
SS	Split Spoon Sample
CSS	Cutting Shoe Sample
L	Liner Sample

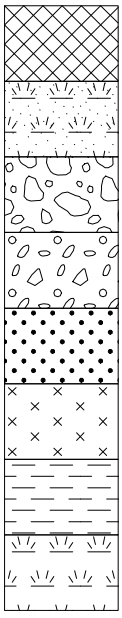
IN SITU TESTING

S	Standard Penetration Test using the Split Spoon Sampler.
C	Standard Penetration Test using a solid cone.

Where a test has been completed the type of test and the N-value will be reported. Where the full 300mm penetration of the main drive has not been completed, the number of blows (not an N-value) will be reported. The Field Records column on the log will show each set of blow counts per 75mm of penetration including seating blows and will also indicate the partial penetration achieved (mm) for incomplete tests.

V	Field vane test, vane shear strength quoted for peak (P) and remoulded (R) tests in kPa.
PP	Pocket Penetrometer measurements (kN/m2).
k	Field Permeability Test, R denotes Rising Head, F denotes Falling Head, C Constant Head.
So	Field Soakage Test in a borehole.
PID	Photo Ionisation Detector (PID) readings for volatile hydrocarbon screening (ppm).
cu	Undrained shear strength triaxial test result (kN/m2)

STRATA



Made Ground / Fill

Topsoil

Cobbles and Boulders

Gravel

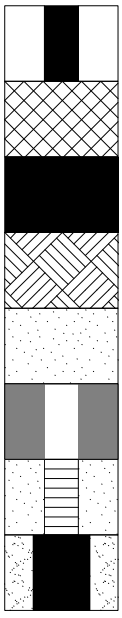
Sand

Silt

Clay

Peat

BACKFILL / INSTALLATIONS



Top Cap

Backfill With Arisings

Bentonite Seal

Cement

Filter

Grout

Slotted Pipe

Piezo Tip

WATER

Initial Level of Water Strike

Level of Water Strike Rise After 20 Mins

Composite soil types shown by combined symbols
(primary + secondary constituents)

AECOM
12 Regan Way
Chetwynd Business Park, Chilwell
Nottingham, NG9 6RZ
Tel: 0115 9077000
Fax: 0115 9077001
www.aecom.com

AECOM
Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
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Trial Pit No. SK501

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 298335.157
N: 168941.925

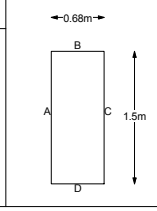
Ground Level (m): 44.96 AOD

Date Started: 23/11/2016
Date Completed: 23/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					TOPSOIL: Grass Over: Soft dark brown slightly gravelly sandy CLAY with frequent roots. Gravel is subangular to rounded fine to coarse of limestone. Sand is fine to coarse **(TOPSOIL)**			(0.25)
						44.71		0.25
0.30		ES V	38 kPa(P) 27 kPa(R)		MADE GROUND: Soft becoming firm brown slightly gravelly silty CLAY with rare rootlets. Gravel is subrounded to rounded fine to medium brick and limestone **(MADE GROUND)**			
0.25- 0.65		B						(0.40)
0.50		ES V	36 kPa(P) 21 kPa(R)					
						44.31		0.65
0.75		ES			Medium strong to weak grey weathered crystalline LIMESTONE Recovered as: Grey angular to subangular cobbles with soft orangish brown silty clay infill **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**			
0.65- 1.40		B						(0.75)
					End of Trial Pit 1.40 m (Thickness of basal layer not proven)	43.56		1.40

Groundwater Observations			
Strike Depth	Post Mins	Post Depth	Flow

Plan View



Remarks

1. Machine-Excavated Trial Pit located within Third Party Land in Plot 17 Boverton Court Farm towards the west of the field.
2. Machine-Excavated Trial Pit completed to 1.40m bgl after encountering natural rock (Medium Strong Limestone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Level ground.
5. Groundwater not encountered.
6. No evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:12.5 | Logged By: MC | Checked By: MB

AECOM
Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
www.aecom.com

Trial Pit No. SK502

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 298511.703
N: 169002.432

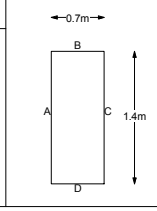
Ground Level (m): 44.76 AOD

Date Started: 23/11/2016
Date Completed: 23/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					TOPSOIL: Grass Over: Soft dark brown slightly gravelly silty sandy CLAY with frequent roots. Gravel is subangular to rounded fine to medium of limestone, mudstone and rare brick. Sand is fine to medium **(TOPSOIL)**			(0.25)
						44.51		0.25
0.30		ES V	38 kPa(P) 31 kPa(R)		Soft becoming firm orangish brown slightly gravelly silty CLAY. Gravel is angular to subrounded medium of limestone **(PROBABLE ALLUVIUM)**			(0.10)
						44.41		0.35
0.35- 0.70		B			Medium strong to very weak grey weathered LIMESTONE with subhorizontal and subvertical closely spaced, planar rough, open fractures with orange surface staining and soft brown clay infill Recovered as: Grey very angular to subangular cobbles with soft brown clay infill **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**			(0.35)
						44.06		0.70
					End of Trial Pit 0.70 m (Thickness of basal layer not proven)			

Groundwater Observations			
Strike Depth	Post Mins	Post Depth	Flow

Plan View



Remarks

1. Machine-Excavated Trial Pit located within Third Party Land in Plot 16 Tremains Field adjacent to the northern boundary fence.
2. Machine-Excavated Trial Pit completed to 0.70m bgl after encountering natural rock (Medium Strong Limestone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Gently sloping.
5. Groundwater not encountered.
6. No evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

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Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
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Trial Pit No. SK503

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 298759.892
N: 169081.211

Ground Level (m): 44.18 AOD

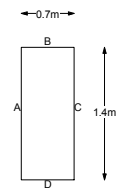
Date Started: 25/11/2016
Date Completed: 25/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.30		ES V	20 kPa(R)		TOPSOIL: Grass Over: Soft locally firm slightly sandy slightly gravelly silty CLAY with roots and rootlets. Gravel is subrounded medium of brick, limestone and mudstone. Sand is fine **(TOPSOIL)**	43.88		(0.30) 0.30
0.30- 0.70 0.50		B ES			Firm locally soft dark brown slightly sandy silty CLAY with medium cobble content. Cobbles are subangular of limestone. Sand is fine **(PROBABLE ALLUVIUM)**			(0.45)
0.7 0.75		V ES	12 kPa(R)		Medium strong to weak grey weathered crystalline LIMESTONE with extremely closely spaced (~2-5mm), planar rough, open fractures infilled with orangish brown clay Recovered as: Grey angular to subangular cobbles of limestone **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**	43.43		0.75 (0.55)
					End of Trial Pit 1.30 m (Thickness of basal layer not proven)	42.88		1.30

Groundwater Observations

Strike Depth	Post Mins	Post Depth	Flow
1.30	20.00	1.20	Rising

Plan View



Remarks

1. Machine-Excavated Trial Pit located within Third Party Land in the central field of Plot 14 Millands Farm.
2. Machine-Excavated Trial Pit completed to 1.30m bgl after encountering natural rock (Medium Strong Limestone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Level ground.
5. Groundwater encountered at 1.30m bgl rising to 1.20m bgl after 20mins.
6. No visual or olfactory evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

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Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
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Fax: 01793 508501
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Trial Pit No. SK504

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 298881.314
N: 169149.165

Ground Level (m): 43.26 AOD

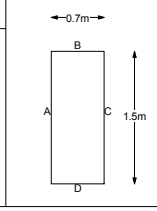
Date Started: 25/11/2016
Date Completed: 25/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.30 0.30- 0.40		ES V B	8 kPa(R)		TOPSOIL: Grass Over: Very soft to soft dark brown slightly sandy silty CLAY with abundant rootlets and low cobble content. Cobbles are angular to rounded of limestone. Sand is fine **(TOPSOIL)**			(0.40)
0.50		ES V	23 kPa(R)		Soft light yellowish brown slightly sandy silty CLAY with medium cobble content. Cobbles are angular to rounded of limestone **(PROBABLE ALLUVIUM)**	42.86		0.40 (0.35)
0.50- 0.75		B			Medium strong locally weak light grey locally yellowish orange weathered LIMESTONE **(PARTIALLY WEATHERED PORTHKERRY MEMBER)**	42.51 42.46		0.75 (0.05) 0.80

End of Trial Pit 0.80 m
(Thickness of basal layer not proven)

Groundwater Observations			
Strike Depth	Post Mins	Post Depth	Flow
0.80	20.00	0.71	Rising

Plan View



Remarks

1. Machine-Excavated Trial Pit located within Third Party Land in the eastern field of Plot 14 Millands Farm.
2. Machine-Excavated Trial Pit completed to 0.80m bgl after encountering natural rock (Medium Strong Limestone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Level ground.
5. Groundwater encountered at 0.80m bgl rising to 0.71m bgl after 20mins.
6. No evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

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Swindon, SN1 1BY
United Kingdom
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Trial Pit No. SK505

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 299067.672
N: 169210.291

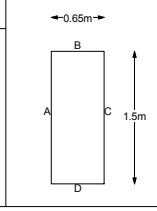
Ground Level (m): 43.03 AOD

Date Started: 24/11/2016
Date Completed: 24/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.30		ES V	27 kPa(P) 15 kPa(R)		MADE GROUND: Grass Over: Very soft to soft dark brown slightly sandy silty CLAY with numerous roots. Sand is fine **(TOPSOIL)**			(0.40)
						42.63		0.40
0.50		ES V	32 kPa(P) 19 kPa(R)		MADE GROUND: Soft light orangish brown slightly sandy silty CLAY with rare gravel and frequent rootlets. Gravel is rounded fine of brick and limestone **(MADE GROUND)**			(0.25)
						42.38		0.65
0.65- 0.90		B			Medium strong to weak light grey locally mottled yellowish orange weathered LIMESTONE with extremely closely spaced (~2-5mm), rough planar, open (~1-2mm) fractures infilled with soft dark brown slightly sandy silty clay **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**			(0.25)
						42.13		0.90
					End of Trial Pit 0.90 m (Thickness of basal layer not proven)			

Groundwater Observations			
Strike Depth	Post Mins	Post Depth	Flow

Plan View



Remarks

1. Machine-Excavated Trial Pit located within Third Party Land in the western field of Plot 12 Froglands Farm.
2. Machine-Excavated Trial Pit completed to 0.90m bgl after encountering natural rock (Medium Strong Limestone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Level ground.
5. Groundwater not encountered.
6. No evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:12.5 | Logged By: EW | Checked By: MB

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Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
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Trial Pit No. SK506

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 299152.675
N: 169307.883

Ground Level (m): 42.97 AOD

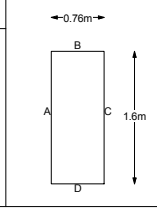
Date Started: 24/11/2016
Date Completed: 24/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.30		ES			TOPSOIL: Grass Over: Very soft to soft slightly sandy silty CLAY with frequent roots. Sand is fine **(TOPSOIL)**			(0.35)
		V	32 kPa(P) 18 kPa(R)			42.62		0.35
0.50		ES			Medium strong to extremely weak grey weathered LIMESTONE with subhorizontal and subvertical closely spaced, planar rough, open fractures with orangish brown surface staining and soft to firm orangish brown silty clay infill Recovered as: Grey angular to subangular cobbles of limestone with soft to firm orangish brown silty clay infill **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**			
0.35- 1.20		B						(0.85)
					End of Trial Pit 1.20 m (Thickness of basal layer not proven)	41.77		1.20

Groundwater Observations

Strike Depth	Post Mins	Post Depth	Flow

Plan View



Remarks

1. Machine-Excavated Trial Pit located within Third Party Land in the eastern field of Plot 12 Froglands Farm.
2. Machine-Excavated Trial Pit completed to 1.20m bgl after encountering natural rock (Medium Strong Limestone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Level ground.
5. Groundwater not encountered.
6. No visual or olfactory evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

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Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
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Fax: 01793 508501
www.aecom.com

Trial Pit No. SK507

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 299452.038
N: 169293.941

Ground Level (m): 42.02 AOD

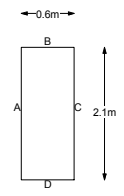
Date Started: 23/11/2016
Date Completed: 23/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					TOPSOIL: Grass Over: Soft dark brown slightly sandy CLAY with abundant roots **(TOPSOIL)**			(0.25)
						41.77		0.25
0.30		ES			Soft becoming firm light brown mottled light grey slightly gravelly sandy CLAY. Gravel is angular to subrounded fine to medium of limestone and mudstone **(PROBABLE ALLUVIUM)**			
0.35		V	30 kPa(P) 20 kPa(R)					
0.30- 0.55		B						
0.50		ES						(0.45)
0.55		V	32 kPa(P) 20 kPa(R)					
						41.32		0.70
0.70- 0.80		B			Firm light grey mottled light orangish brown CLAY **(PROBABLE ALLUVIUM)**			(0.10)
0.75		ES V	30 kPa(P) 10 kPa(R)			41.22		0.80
					Medium strong light grey weathered crystalline LIMESTONE **(PARTIALLY WEATHERED PORTHKERRY MEMBER)**			(0.10)
						41.12		0.90
					End of Trial Pit 0.90 m (Thickness of basal layer not proven)			

Groundwater Observations

Strike Depth	Post Mins	Post Depth	Flow
0.80	20.00	0.80	Standing

Plan View



Remarks

1. Machine-Excavated Trial Pit located within Third Party Land in centre of Plot 6 Great House Farm adjacent to hedgerow.
2. Machine-Excavated Trial Pit completed to 0.90m bgl after encountering natural rock (Medium Strong Limestone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Level ground.
5. Groundwater encountered at 0.80m bgl rising to 0.70m after 20mins.
6. No evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:12.5 | Logged By: MC | Checked By: MB

AECOM
Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
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Trial Pit No. SK508

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 299678.218
N: 169171.911

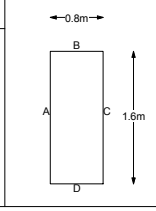
Ground Level (m): 41.97 AOD

Date Started: 22/11/2016
Date Completed: 23/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					TOPSOIL: Grass Over: Soft brown slightly gravelly sandy CLAY with abundant roots. Gravel is angular to subangular firm to medium of limestone. Sand is fine to medium **(TOPSOIL)**			(0.20)
						41.77		0.20
0.30		ES			Firm friable brown mottled light grey slightly sandy gravelly CLAY with very frequent roots. Gravel is subangular to subrounded firm to medium of limestone and mudstone. Sand is fine to medium **(PROBABLE ALLUVIUM)**			
0.20- 0.50		B V	56 kPa(P) 34 kPa(R)					(0.30)
0.50		ES				41.47		0.50
0.6		V	68 kPa(P) 34 kPa(R)		Firm becoming stiff orangish brown mottled light grey slightly gravelly CLAY. Gravel is angular to subrounded firm to medium of mudstone and limestone **(PROBABLE ALLUVIUM)**			
0.50- 0.95		B						(0.44)
					Medium strong locally weak light grey locally yellowish orange weathered LIMESTONE **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**	41.03		0.94
						41.02		(0.01)
								0.95
					End of Trial Pit 0.95 m (Thickness of basal layer not proven)			

Groundwater Observations			
Strike Depth	Post Mins	Post Depth	Flow
0.95	20.00	0.60	Rising

Plan View



Remarks

1. Machine-Excavated Trial Pit located within Third Party Land in Plot 9 Great House Farm adjacent to access road.
2. Machine-Excavated Trial Pit completed to 0.95m bgl after encountering natural rock (Medium Strong Mudstone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Level ground.
5. Groundwater encountered at 0.95m bgl rising to 0.60m bgl after 20mins.
6. No evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:12.5 | Logged By: MC | Checked By: MB

AECOM
Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
www.aecom.com

Trial Pit No. SK509

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 299981.456
N: 169255.033

Ground Level (m): 41.71 AOD

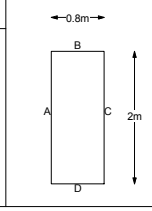
Date Started: 22/11/2016
Date Completed: 23/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.00- 0.30		B			TOPSOIL: Grass Over: Soft becoming firm dark brown slightly gravelly CLAY with frequent roots. Gravel is subangural medium of limestone and mudstone **(TOPSOIL)**			(0.35)
0.30		ES V	37 kPa(P) 22 kPa(R)			41.36		0.35
0.50		ES V	34 kPa(P) 30 kPa(R)		Soft becoming firm light yellowish brown slightly gravelly CLAY. Gravel is subangular firm of limestone and mudstone **(PROBABLE ALLUVIUM)**			
0.35- 0.80		B						(0.45)
0.75		ES				40.91		0.80
0.80- 1.30		B			Firm becoming stiff greyish brown slightly gravelly CLAY. Gravel is subangular fine to medium of limestone and mudstone **(PROBABLE ALLUVIUM)**			(0.50)
					Medium strong locally weak brown weathered thinly laminated MUDSTONE interbedded with medium strong grey LIMESTONE Recovered as: Brown and grey medium to coarse angular to subangular gravel of mudstone and limestone with medium cobble content. Cobbles are subangular of mudstone and limestone **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**	40.41 40.39		1.30 (0.02) 1.32
					End of Trial Pit 1.32 m (Thickness of basal layer not proven)			

Groundwater Observations

Strike Depth	Post Mins	Post Depth	Flow
1.20	20.00	1.10	Rising

Plan View



Remarks

1. Machine-Excavated Trial Pit located in the St. Athan Ministry of Defence (MoD) base north of the Eglwys Brewis Road.
2. Machine-Excavated Trial Pit completed to 1.32m bgl after encountering natural rock (Medium Strong Limestone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Level ground.
5. Groundwater encountered at 1.20m bgl rising to 1.10m bgl after 20mins.
6. No evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:12.5 | Logged By: MC | Checked By: MB

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Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
www.aecom.com

Trial Pit No. SK510

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 300129.129
N: 169202.376

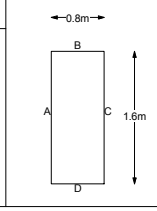
Ground Level (m): 41.53 AOD

Date Started: 22/11/2016
Date Completed: 22/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.00- 0.30		B			TOPSOIL: Grass Over: Firm greyish brown sandy very gravelly CLAY with frequent roots. Gravel is fine to coarse angular to subangular of crystalline limestone. Sand is fine to medium **(TOPSOIL)**			(0.35)
0.30		ES V	76 kPa(P) 32 kPa(R)			41.18		0.35
0.35- 0.60 0.50		B ES			Medium strong to weak grey weathered crystalline LIMESTONE with subhorizontal and subvertical closely spaced, planar rough, partly open with firm orangish brown clay infill Recovered as: Grey clayey fine to coarse angular to subangular gravel of limestone with high cobble content. Cobbles are angular to subangular of limestone **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**			(1.05)
0.6		V	82 kPa(P) 31 kPa(R)		At 1.40m bgl hard layer of strong grey limestone present.	40.13		1.40
					End of Trial Pit 1.40 m (Thickness of basal layer not proven)			

Groundwater Observations			
Strike Depth	Post Mins	Post Depth	Flow

Plan View



Remarks

1. Machine-Excavated Trial Pit located in the St. Athan Ministry of Defence (MoD) base south of the Eglwys Brewis Road.
2. Machine-Excavated Trial Pit completed to 1.40m bgl after encountering natural rock (Medium Strong Limestone).
3. Soakaway Test undertaken (see separate report sheet for results).
4. Topography: Level ground.
5. Groundwater not encountered.
6. No evidence of contamination.
7. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:12.5 | Logged By: MC | Checked By: MB

AECOM
Tricentre 3
Newbridge Square
Swindon, SN1 1BY
United Kingdom
Tel: 01793 508500
Fax: 01793 508501
www.aecom.com

Trial Pit No. TP501

Sheet: 1 of 1

Equipment & Methods: JCB 3CX

Project Name: St. Athan Northern Access Road
Project Location: St. Athan
Client: Welsh Government

Job No: 60509148

Co-ordinates:
E: 300313.446
N: 169301.712

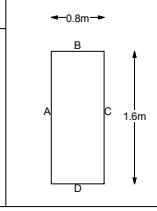
Ground Level (m): 41.66 AOD

Date Started: 22/11/2016
Date Completed: 22/11/2016

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					TOPSOIL: Grass Over: Soft brown gravelly sandy CLAY with frequent roots **(TOPSOIL)**			(0.20)
						41.46		0.20
0.30		ES V	35 kPa(P) 32 kPa(R)		Firm brown slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse gravel of limestone. Sand is fine to coarse **(PROBABLE ALLUVIUM)**			(0.45)
0.20- 0.65		B						
0.50		ES						
0.6		V	69 kPa(P) 37 kPa(R)					
						41.01		0.65
0.65- 1.40		B			Medium strong to weak grey weathered crystalline LIMESTONE with fossil fragments (~2-5mm Ø) and subhorizontal and subvertical extremely closely spaced, planar rough, partly open fractures with orange surface staining Recovered as: Grey subangular cobbles of limestone with firm orangish brown clay infill **(DISTINCTLY WEATHERED PORTHKERRY MEMBER)**			(0.75)
					End of Trial Pit 1.40 m (Thickness of basal layer not proven)	40.26		1.40

Groundwater Observations			
Strike Depth	Post Mins	Post Depth	Flow

Plan View



Remarks

1. Machine-Excavated Trial Pit located in the St. Athan Ministry of Defence (MoD) base south of the Eglwys Brewis Road.
2. Machine-Excavated Trial Pit completed to 1.40m bgl after encountering natural rock (Medium Strong Limestone).
3. Topography: Level ground.
4. Groundwater not encountered.
5. No evidence of contamination.
6. Backfilled with arisings upon completion.

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Scale: 1:12.5 | Logged By: MC | Checked By: MB

Appendix B – Groundwater Sampling Field Data and Observations

Appendix B
Groundwater Field Results
St Athan: Northern Access Road
Welsh Government

		Location_Code									
		BH501	BH502			BH503			BH504		
		09 February 2017	08 December 2016	09 January 2017	09 February 2017	08 December 2016	09 January 2017	09 February 2017	08 December 2016	09 January 2017	09 February 2017
Surface elevation	mAOD	43.01	41.89			41.83			41.91		
Depth to base (from ground level)	m	4.00	2.30			3.80			8.10		
Depth to water (from ground level)	m	1.95	0.60	0.99	0.69	1.20	1.20	0.99	1.26	1.39	1.24
Water level	mAOD	41.06	41.29	40.90	41.20	40.63	40.63	40.84	40.65	40.52	40.67
Dissolved Oxygen	mg/L	3.67	0.05	0.18	0.28	0.12	0.03	1.48	0.01	-0.04	0.20
Electrical Conductivity	µS/cm	755	527	560	555	511	607	515	497	520	633
Field Redox	mV	62.6	72.9	27.4	26.9	78.3	40.0	37.2	76.7	20.0	54.6
pH	pH_Units	9.06	7.16	7.08	8.30	7.22	7.14	9.82	7.25	7.12	9.61
Purge Rate	L/s	0.0042	0.0083	0.0087	0.0083	0.0067	0.0083	0.0083	0.0067	0.0083	0.0083
Purge Time	s	1200	1860	1380	1200	2100	1860	1200	1860	1680	1200
Purge Volume	L	5.0	15.5	12.0	10.0	14.0	15.5	10.0	12.4	14.0	10.0
Redox	mV	273	280	235	237	285	247	247	283	227	265
Temperature	°C	7.02	11.28	9.85	7.08	11.78	10.65	7.12	11.85	10.83	7.13

mAOD	Metres above ordnance datum
m	Metres
mg/L	Milligrams per litre
µS/cm	Microsiemens/centimetre
mV	Millivolts
L/s	Litres per second
s	Seconds
L	Litres
°C	Degrees Centigrade

Appendix C – Generic Quantitative Risk Assessment Basis and Screening Tables

Appendix C
Soils Analytical Results
St Athan: Northern Access Road
Welsh Government

	Units	Method Detection Limit	GAC_WTV_EN /WA_DWS_SA ND1%TOC	GAC_WTV_EN /WA_EQS-Coast_SAND1 %TOC	Location	BH501		BH502			BH503		BH504		SK501	
					Average Depth (m)	0.3	0.5	0.3	0.5	0.75	0.3	0.5	0.3	0.5	0.3	0.5
					Date	30/11/2016	30/11/2016	23/11/2016	23/11/2016	23/11/2016	21/11/2016	21/11/2016	21/11/2016	21/11/2016	23/11/2016	23/11/2016
Boron (Water Soluble)	mg/kg					**1**	**0.5**	**1.6**	**1.1**	-	**1.4**	**0.7**	**1.8**	-	**0.9**	**0.7**
TPH (Ali & Aro)	mg/kg					<10	<10	<10	<10	<10	<10	-	<10	<10	<10	<10
Aliphatics >C5-C6	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Asbestos Identification	None					0	-	0	-	-	-	-	0	-	0	0
TPH																
>C6-C8 Aliphatics	mg/kg		**621**[#2]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
>C8-C10 Aliphatics	mg/kg		**92.1**[#2]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
>C10-C12 Aliphatics	mg/kg		**722**[#2]			<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	-	<1.5	<1.5	<1.5	<1.5
>C12-C16 Aliphatics	mg/kg		**16.100**[#2]			<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	-	<1.2	<1.2	<1.2	<1.2
>C16-C21 Aliphatics	mg/kg		**1.890.000**[#2]			<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	-	<1.5	<1.5	<1.5	<1.5
>C21-C35 Aliphatics	mg/kg		**22.800.000**[#2]			<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	-	<3.4	<3.4	<3.4	<3.4
>C5-C35 Aliphatics	mg/kg					<10	<10	<10	<10	<10	<10	-	<10	<10	<10	<10
>EC5-EC7 Aromatics	mg/kg		**0.000731**[#1]	0.00584[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
>EC7-EC8 Aromatics	mg/kg		**1.47**[#2]	0.155[#4]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
>EC8-EC10 Aromatics	mg/kg		**4.78**[#2]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
>EC10-EC12 Aromatics	mg/kg		**2.27**[#2]			<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	-	<0.9	<0.9	<0.9	<0.9
>EC12-EC16 Aromatics	mg/kg		**4.51**[#2]			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5
>EC16-EC21 Aromatics	mg/kg		**12.7**[#2]			<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	-	<0.6	<0.6	<0.6	<0.6
>EC21-EC35 Aromatics	mg/kg		**113**[#2]			<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	-	<1.4	<1.4	<1.4	<1.4
>EC5-EC35 Aromatics	mg/kg					<10	<10	<10	<10	<10	<10	-	<10	<10	<10	<10
BTEX																
Benzene	mg/kg		**0.000731**[#1]	0.00584[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Toluene	mg/kg		**1.47**[#3]	0.155[#4]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	mg/kg		**1.36**[#3]	0.0905[#12]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Xylene (m & p)	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Xylene Total	mg/kg		**2.29**[#3]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Xylene (o)	mg/kg		**0.82**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Oxygenates																
MTBE	mg/kg		**0.00572**[#3]	0.0991[#13]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Chlorinated Hydrocarbons																
Vinyl chloride	mg/kg		**0.000148**[#1]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,1-dichloroethene	mg/kg		**0.11**[#3]			<0.2	<0.2	<0.2	<0.2	<0.2	-	-	<0.2	-	<0.2	<0.2
trans-1,2-dichloroethene	mg/kg		**0.239**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,1-dichloroethane	mg/kg		**0.00115**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
cis-1,2-dichloroethene	mg/kg		**0.0164**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Chloroform	mg/kg		**Use trihalomethanes**[#1]	0.00138[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,1,1-trichloroethane	mg/kg		**2.8**[#3]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Carbon tetrachloride	mg/kg		**0.0077**[#1]	0.0308[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Trichloroethene	mg/kg		**Use PCE + TCE**[#1]	0.0148[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,1,2-trichloroethane	mg/kg		**0.000312**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Tetrachloroethene	mg/kg		**Use PCE + TCE**[#1]	0.0277[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
VOC																
2,2-dichloropropane	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Bromochloromethane	mg/kg		**0.028**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,1-dichloropropene	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,2-dichloroethane	mg/kg		**0.000729**[#1]	0.00243[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,2-dichloropropane	mg/kg		**0.0225**[#3]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Dibromomethane	mg/kg		**0.00365**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Bromodichloromethane	mg/kg		**Use trihalomethanes**[#1]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
cis-1,3-dichloropropene	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
trans-1,3-dichloropropene	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,3-dichloropropane	mg/kg		**0.216**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Chlorodibromomethane	mg/kg		**Use trihalomethanes**[#1]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,1,1,2-tetrachloroethane	mg/kg		**0.00205**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Styrene	mg/kg		**0.0657**[#3]	0.164[#12]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Bromoform	mg/kg		**Use trihalomethanes**[#1]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Isopropylbenzene	mg/kg		**5.2**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,2,3-trichloropropane	mg/kg		**7.61E-7**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
n-propylbenzene	mg/kg		**8.16**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,3,5-trimethylbenzene	mg/kg		**0.896**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
tert-butylbenzene	mg/kg		**18.6**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,2,4-trimethylbenzene	mg/kg		**0.213**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
sec-butylbenzene	mg/kg		**126**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
p-isopropyltoluene	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
n-butylbenzene	mg/kg		**35.5**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,2-dibromo-3-chloropropane	mg/kg		**0.000749**[#3]			<0.01	<0.01	<0.01	<0.01	<0.01	**0.02**	-	<0.01	<0.01	<0.01	<0.01
Hexachlorobutadiene	mg/kg		**0.011**[#1]	0.0658[#5]		<0.01	<0.01	<0.01	<0.01	<0.01	**0.05**	-	<0.01	<0.01	<0.01	<0.01
PAH																
Naphthalene	mg/kg		**0.039**[#15]	0.013[#6]		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Acenaphthylene	mg/kg		**0.328**[#15]			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Acenaphthene	mg/kg		**0.423**[#15]			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Fluorene	mg/kg		**0.339**[#15]			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Phenanthrene	mg/kg		**0.22**[#15]			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Anthracene	mg/kg		**5.06**[#15]	0.00563[#6]		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Fluoranthene	mg/kg		**0.728**[#3]	0.00115[#6]		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Pyrene	mg/kg		**1.46**[#15]			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Benz(a)anthracene	mg/kg		**2.72**[#15]			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Chrysene	mg/kg		**3.85**[#15]			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Benzo(a) pyrene	mg/kg		**0.0129**[#1]	0.000219[#6]		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Indeno(1,2,3-c,d)pyrene	mg/kg		**Use PAHs (sum of 4)**[#1]	see BaP and notes[#7]		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Dibenz(a,h)anthracene	mg/kg		**0.13**[#15]			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Benzo(g,h,i)perylene	mg/kg		**Use PAHs (sum of 4)**[#1]	0.00342[#5]		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Benzo(b)fluoranthene	mg/kg		**Use PAHs (sum of 4)**[#1]	0.0178[#5]		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
Benzo(k)fluoranthene	mg/kg		**Use PAHs (sum of 4)**[#1]	0.0251[#5]		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03
PAH 16 Total	mg/kg					<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1
Halogenated Benzenes																
Chlorobenzene	mg/kg		**0.769**[#3]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Bromobenzene	mg/kg		**0.208**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
2-chlorotoluene	mg/kg		**1.79**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
4-chlorotoluene	mg/kg		**2.43**[#9]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,3-dichlorobenzene	mg/kg					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,4-dichlorobenzene	mg/kg		**2.14**[#3]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
1,2-dichlorobenzene	mg/kg		**6.96**[#3]			<0.01	<0.01	<0.01	<0.01	<0.01	0.01	-	<0.01	0.01	<0.01	<0.01
1,2,4-trichlorobenzene	mg/kg		**0.0023**[#1]	Refer to 'Trichlorobenzene (total)'[#7]		<0.01	<0.01	<0.01	<0.01	<0.01	**0.04**	-	<0.01	<0.01	<0.01	<0.01
1,2,3-trichlorobenzene	mg/kg		**0.00257**[#1]	Refer to 'Trichlorobenzene (total)'[#7]		**0.01**	<0.01	<0.01	<0.01	<0.01	**0.06**	-	<0.01	<0.01	<0.01	<0.01
Halogenated Hydrocarbons																
1,2-dibromoethane	mg/kg		**0.000193**[#3]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Metals																
Arsenic	mg/kg		**5**[#1]	12.5[#4]		**9.3**	**9**	**9.4**	**9.7**	-	**9.8**	**14**	**7.7**	-	**8.8**	**9.4**
Barium	mg/kg		**28.7**[#3]			**51**	**42**	**75**	**70**	-	**29**	**58**	**58**	-	**42**	**34**
Beryllium	mg/kg		**20.4**[#3]			0.7	0.7	0.8	1	-	0.6	1.5	0.9	-	1	0.7
Cadmium	mg/kg		**0.5**[#1]	0.02[#6]		**0.7**	**0.7**	**0.6**	0.3	-	0.5	0.4	**0.6**	-	0.2	0.2
Chromium (III+VI)	mg/kg		**Cannot back calculate. Incomplete PhysChem**[#1]			16	17	26	26	-	16	21	21	-	23	14
Copper	mg/kg		**200**[#1]	0.376[#4]		20	20	24	22	-	20	22	100	-	20	25
Lead	mg/kg		**26.9**[#1]	3.5[#6]		20	12	**29**	16	-	10	20	**53**	-	11	14
Mercury	mg/kg		**Use Mercury (total)**[#1]	Use Mercury (total)[#5]		<0.05	<0.05	0.05	<0.05	-	<0.05	0.06	<0.05	-	<0.05	<0.05
Nickel	mg/kg		**10**[#1]	4.3[#6]		**16**	**19**	**15**	**29**	-	**23**	**30**	**16**	-	**21**	**24**
Selenium	mg/kg		**0.5**[#1]			<0.5	<0.5	**0.6**	**0.7**	-	<0.5	**0.7**	**0.6**	-	**0.6**	<0.5
Vanadium	mg/kg		**1.09**[#9]	1.26[#12]		**19**	**18**	**36**	**32**	-	**21**	**28**	**26**	-	**26**	**17**
Zinc	mg/kg		**114**[#3]	0.259[#4]		74	50	73	32	-	55	39	**250**	-	40	37
Chromium (hexavalent)	mg/kg		**Use Chromium (total)**[#1]	0.0108[#4]		<1	<1	<1	<1	-	<1	<1	<1	-	<1	<1
Organics																
TOC	%					1.7	1.1	3.5	0.8	0.4	0.6	1.2	1.2	0.7	0.9	0.5
Inorganics																
Cyanide (Free)	mg/kg		**Use Cyanide Total**[#1]	0.00994[#11]		0.2	0.1	0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1
pH (Lab)	pH_Units					8.1	7.6	7.8	7.8	8	7.4	8.1	7.3	7.4	6.3	7.9

Comments
#1 WS Regs 2016 (Eng/Wal)
#2 WHO Petroleum DWG 2008
#3 WHO DWG 2011
#4 WFD England/Wales. 2015 - Saltwater Standards
#5 WFD England/Wales. 2015 - MAC-EQS Trans./Coastal
#6 WFD England/Wales. 2015 - AA-EQS Trans./Coastal
#7 Water Env't Regs (Scotland) 2015. AA-EQS Coast
#8 USEPA RSL (tapwater) [May 2016]
#9 USEPA RSL (tapwater)
#10 SEPA WAT-SG-53 Marine EQS - MAC - 2013
#11 SEPA WAT-SG-53 Marine EQS - AA - 2015
#12 SEPA WAT-SG-53 Marine EQS - AA - 2013
#13 PNEC (EU REACH) - Coastal
#14 California Draft health protective concentration
#15 AECOM DWG (WHO method)
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed
DWS: Drinking Water Standard
EQS: Environmental Quality Standard

Key

XXX	Exceedance of GAC_WTV_EN/WA_DWS_SAND1%TOC
XXX	Exceedance of GAC_WTV_EN/WA_EQS-Coast_SAND1%TOC

Appendix C
Soils Analytical Results
St Athan: Northern Access Road
Welsh Government

		SK502	SK503		SK504	SK505		SK506		SK507			SK508		SK509		SK510		TP501	
		0.3	0.3	0.5	0.3	0.3	0.5	0.3	0.5	0.3	0.5	0.7	0.3	0.5	0.3	0.5	0.3	0.5	0.3	0.5
	Units	23/11/2016	25/11/2016	25/11/2016	25/11/2016	24/11/2016	24/11/2016	24/11/2016	24/11/2016	23/11/2016	23/11/2016	23/11/2016	22/11/2016	22/11/2016	22/11/2016	22/11/2016	22/11/2016	22/11/2016	22/11/2016	22/11/2016
Boron (Water Soluble)	mg/kg	**1.3**	**0.5**	**1.8**	**2.1**	**0.7**	**1.3**	**1**	**-**	**0.6**	**-**	**-**	**0.6**	**0.8**	**0.4**	**1.9**	**0.6**	**1.7**	**0.9**	**-**
TPH (Ali & Aro)	mg/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	<10	<10	<10	<10	<10	<10	<10	<10
Aliphatics >C5-C6	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Asbestos Identification	None	-	-	-	0	0	0	0	-	-	-	-	0	-	0	0	0	-	0	-
TPH																				
>C6-C8 Aliphatics	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
>C8-C10 Aliphatics	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
>C10-C12 Aliphatics	mg/kg	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	-	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
>C12-C16 Aliphatics	mg/kg	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	-	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
>C16-C21 Aliphatics	mg/kg	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	-	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
>C21-C35 Aliphatics	mg/kg	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	-	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4
>C5-C35 Aliphatics	mg/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	<10	<10	<10	<10	<10	<10	<10	<10
>EC5-EC7 Aromatics	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
>EC7-EC8 Aromatics	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
>EC8-EC10 Aromatics	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
>EC10-EC12 Aromatics	mg/kg	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	-	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
>EC12-EC16 Aromatics	mg/kg	<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	<0.5	<0.5
>EC16-EC21 Aromatics	mg/kg	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	-	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
>EC21-EC35 Aromatics	mg/kg	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	-	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
>EC5-EC35 Aromatics	mg/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	<10	<10	<10	<10	<10	<10	<10	<10
BTEX																				
Benzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Toluene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Xylene (m & p)	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Xylene Total	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Xylene (o)	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Oxygenates																				
MTBE	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Chlorinated Hydrocarbons																				
Vinyl chloride	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,1-dichloroethene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-	-	-	-	<0.2	-	-	-	<0.2	<0.2	<0.2
trans-1,2-dichloroethene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,1-dichloroethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
cis-1,2-dichloroethene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Chloroform	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,1,1-trichloroethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Carbon tetrachloride	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Trichloroethene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,1,2-trichloroethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Tetrachloroethene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
VOC																				
2,2-dichloropropane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Bromochloromethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,1-dichloropropene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,2-dichloroethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,2-dichloropropane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Dibromomethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Bromodichloromethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
cis-1,3-dichloropropene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
trans-1,3-dichloropropene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,3-dichloropropane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Chlorodibromomethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,1,1,2-tetrachloroethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Styrene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Bromoform	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Isopropylbenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,2,3-trichloropropane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
n-propylbenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,3,5-trimethylbenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
tert-butylbenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,2,4-trimethylbenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
sec-butylbenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
p-isopropyltoluene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
n-butylbenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,2-dibromo-3-chloropropane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorobutadiene	mg/kg	<0.01	**0.05**	<0.01	<0.01	<0.01	<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
PAH																				
Naphthalene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Acenaphthylene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Acenaphthene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Fluorene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Phenanthrene	mg/kg	<0.03	<0.03	<0.03	0.07	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Anthracene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Fluoranthene	mg/kg	<0.03	<0.03	<0.03	0.08	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	0.06	<0.03	<0.03	<0.03	<0.03	<0.03
Pyrene	mg/kg	<0.03	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	<0.03
Benz(a)anthracene	mg/kg	<0.03	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Chrysene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Benzo(a) pyrene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Dibenz(a,h)anthracene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Benzo(g,h,i)perylene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Benzo(b)fluoranthene	mg/kg	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Benzo(k)fluoranthene	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
PAH 16 Total	mg/kg	<0.1	<0.1	<0.1	0.3	<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
Halogenated Benzenes																				
Chlorobenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Bromobenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
2-chlorotoluene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
4-chlorotoluene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,3-dichlorobenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,4-dichlorobenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,2-dichlorobenzene	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
1,2,4-trichlorobenzene	mg/kg	<0.01	**0.04**	<0.01	<0.01	<0.01	<0.01	**0.02**	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3-trichlorobenzene	mg/kg	<0.01	**0.07**	<0.01	<0.01	<0.01	<0.01	**0.04**	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Halogenated Hydrocarbons																				
1,2-dibromoethane	mg/kg	<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	<0.01	<0.01	<0.01	<0.01
Metals																				
Arsenic	mg/kg	**12**	**13**	**8.6**	**13**	**14**	**15**	**15**	-	**12**	-	-	**7.1**	**6.1**	**14**	**13**	**9.2**	**6.6**	**9.1**	-
Barium	mg/kg	**73**	**73**	**71**	**72**	**97**	**63**	**110**	-	**48**	-	-	**41**	**33**	**73**	**140**	**41**	**30**	**59**	-
Beryllium	mg/kg	0.9	0.8	0.8	0.8	0.8	1.1	0.8	-	0.6	-	-	0.4	0.5	1.1	0.7	0.5	0.5	0.9	-
Cadmium	mg/kg	**0.8**	**0.8**	**0.6**	**0.7**	**0.6**	**0.6**	**0.9**	-	0.5	-	-	0.3	0.4	**0.9**	**0.7**	0.3	0.5	**0.8**	-
Chromium (III+VI)	mg/kg	28	20	20	23	21	28	24	-	16	-	-	8.5	14	24	16	18	13	25	-
Copper	mg/kg	33	30	27	25	34	34	21	-	22	-	-	9.1	54	24	22	18	13	19	-
Lead	mg/kg	23	**37**	19	25	**50**	24	**27**	-	16	-	-	10	9.5	26	**34**	17	10	21	-
Mercury	mg/kg	<0.05	0.05	<0.05	<0.05	0.1	0.06	<0.05	-	<0.05	-	-	<0.05	0.24	<0.05	<0.05	<0.05	<0.05	<0.05	-
Nickel	mg/kg	**27**	**18**	**20**	**21**	**23**	**32**	**27**	-	**26**	-	-	**14**	**12**	**24**	**17**	**14**	**11**	**20**	-
Selenium	mg/kg	**0.8**	**1**	**0.7**	**1.2**	<0.5	**0.9**	**1.2**	-	**0.9**	-	-	<0.5	<0.5	**0.7**	0.5	<0.5	<0.5	<0.5	-
Vanadium	mg/kg	**37**	**26**	**25**	**29**	**27**	**32**	**30**	-	**19**	-	-	**11**	**15**	**36**	**26**	**17**	**16**	**28**	-
Zinc	mg/kg	83	100	98	76	86	71	66	-	39	-	-	39	56	46	66	36	34	54	-
Chromium (hexavalent)	mg/kg	<1	<1	<1	<1	<1	<1	<1	-	<1	-	-	<1	<1	<1	<1	<1	<1	<1	-
Organics																				
TOC	%	2.4	2.6	1.4	2.2	1.2	1.7	2.5	-	0.7	2.4	0.4	0.5	0.7	1.9	2.8	3.5	0.8	1.2	-
Inorganics																				
Cyanide (Free)	mg/kg	<0.1	0.2	<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	-
pH (Lab)	pH_Units	7.7	7.4	7.4	7.3	7.1	7.4	7.2	-	8.1	7.6	8.2	8.2	8.6	7.8	8	8.2	8.4	7.9	-

Comments
#1 WS Regs 2016 (Eng/Wal)
#2 WHO Petroleum DWG 2008
#3 WHO DWG 2011
#4 WFD England/Wales. 2015 - Saltwater S
#5 WFD England/Wales. 2015 - MAC-EQS
#6 WFD England/Wales. 2015 - AA-EQS Tr
#7 Water Env't Regs (Scotland) 2015. AA-E
#8 USEPA RSL (tapwater) [May 2016]
#9 USEPA RSL (tapwater)
#10 SEPA WAT-SG-53 Marine EQS - MAC
#11 SEPA WAT-SG-53 Marine EQS - AA -
#12 SEPA WAT-SG-53 Marine EQS - AA -
#13 PNEC (EU REACH) - Coastal
#14 California Draft health protective concer
#15 AECOM DWG (WHO method)
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed
DWS: Drinking Water Standard
EQS: Environmental Quality Standard

Key

XXX	Exceedance of GAC_WTV_
XXX	Exceedance of GAC_WTV_

Appendix C
Waters Analytical Results
St Athan: Northern Access Road
Welsh Government

	Units	Method Detection Limit	GAC_WTV_EN/ WA_DWS	GAC_WTV_EN/ WA_EQS-Fresh	Location	BH501	BH502			BH503			BH504		
					Date	09/02/2017	08/12/2016	09/01/2017	09/02/2017	08/12/2016	09/01/2017	09/02/2017	08/12/2016	09/01/2017	09/02/2017
					Sample Type	normal	Normal	Normal	normal	Normal	Normal	normal	Normal	Normal	normal
					Monitoring_Round	February 2017	December 2016	January 2017	February 2017	December 2016	January 2017	February 2017	December 2016	January 2017	February 2017
TPH (Ali & Aro)	µg/L					**<10**	**<10**	**<10**	**<10**	**<10**	**<10**	**<10**	**<10**	**<10**	**22**
PAH : Total :- (Polynuclear Aromatic	µg/l					<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
TPH															
>C5-C6 Aliphatics	µg/L		**15,000**[#2]			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	3.6
>C6-C8 Aliphatics	µg/L		**15,000**[#2]			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	4.1	<0.1	<0.1	4.6
>C8-C10 Aliphatics	µg/L		**300**[#2]			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2.4	<0.1	<0.1	1.4
>C10-C12 Aliphatics	µg/L		**300**[#2]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
>C12-C16 Aliphatics	µg/L		**300**[#2]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
>C16-C21 Aliphatics	µg/L		**300**[#2]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
>C21-C35 Aliphatics	µg/L		**300**[#2]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
>C5-C35 Aliphatics	µg/L					<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC5-EC7 Aromatics	µg/L		**1**[#1]	10[#6]		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**2**	<0.1	<0.1	**2.2**
>EC7-EC8 Aromatics	µg/L		**700**[#2]	74[#5]		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC8-EC10 Aromatics	µg/L		**300**[#2]			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
>EC10-EC12 Aromatics	µg/L		**90**[#2]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
>EC12-EC16 Aromatics	µg/L		**90**[#2]			<1	<1	<1	<1	<1	<1	<1	<1	<1	4.7
>EC16-EC21 Aromatics	µg/L		**90**[#2]			<1	<1	<1	<1	<1	<1	<1	<1	<1	4.3
>EC21-EC35 Aromatics	µg/L		**90**[#2]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
>EC5-EC35 Aromatics	µg/L					<10	<10	<10	<10	<10	<10	<10	<10	<10	13
BTEX															
Benzene	µg/L		**1**[#1]	10[#6]		<1	<1	<1	<1	<1	<1	**2**	<1	<1	**2.2**
Toluene	µg/L		**700**[#3]	74[#5]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/L		**300**[#3]	20[#13]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (m & p)	µg/L					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Xylene Total	µg/L		**500**[#3]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (o)	µg/L		**190**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Oxygenates															
MTBE	µg/L		**15**[#3]	5,100[#14]		<1	<1	<1	<1	<1	<1	<1	<1	<1	3.6
Chlorinated Hydrocarbons															
Chloromethane	µg/L		**190**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Vinyl chloride	µg/L		**0.5**[#1]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/L		**21,000**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethene	µg/L		**140**[#3]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,2-dichloroethene	µg/L		**360**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	µg/L		**2.8**[#9]			<1	**4**	<1	<1	<1	<1	<1	**4**	**3**	2
cis-1,2-dichloroethene	µg/L		**36**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	µg/L		**Use trihalomethanes**[#1]	2.5[#6]		<1	<1	<1	<1	1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	µg/L		**2,000**[#3]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/L		**3**[#1]	12[#6]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	µg/L		**Use PCE + TCE**[#1]	10[#6]		<1	1	<1	<1	<1	<1	<1	1	1	<1
1,1,2-trichloroethane	µg/L		**0.28**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	µg/L		**Use PCE + TCE**[#1]	10[#6]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
VOC															
2,2-dichloropropane	µg/L					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/L		**83**[#9]			<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
1,1-dichloropropene	µg/L					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	µg/L		**3**[#1]	10[#6]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	µg/L		**40**[#3]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	µg/L		**8.3**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	µg/L		**Use trihalomethanes**[#1]			<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
cis-1,3-dichloropropene	µg/L					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	µg/L					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	µg/L		**370**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorodibromomethane	µg/L		**Use trihalomethanes**[#1]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	µg/L		**0.57**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Styrene	µg/L		**20**[#3]	50[#13]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	µg/L		**Use trihalomethanes**[#1]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	µg/L		**450**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	µg/L		**0.076**[#9]	140[#5]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	µg/L		**0.00075**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
n-propylbenzene	µg/L		**660**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethylbenzene	µg/L		**120**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
tert-butylbenzene	µg/L		**690**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethylbenzene	µg/L		**15**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
sec-butylbenzene	µg/L		**2,000**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
p-isopropyltoluene	µg/L					<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
n-butylbenzene	µg/L		**1,000**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	µg/L		**1**[#3]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L		**0.1**[#1]	0.6[#4]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PAH															
Naphthalene	µg/L		**6**[#16]	2[#6]		<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Acenaphthylene	µg/L		**18**[#16]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	µg/L		**18**[#16]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	µg/L		**12**[#16]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	µg/L		**4**[#16]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	µg/L		**90**[#16]	0.1[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	µg/L		**4**[#3]	0.0063[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	µg/L		**9**[#16]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benz(a)anthracene	µg/L		**3.5**[#16]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	µg/L		**7**[#16]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a) pyrene	µg/L		**0.01**[#1]	0.00017[#6]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-c,d)pyrene	µg/L		**Use PAHs (sum of 4)**[#1]	see BaP and notes[#7]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	µg/L		**0.07**[#16]			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	µg/L		**Use PAHs (sum of 4)**[#1]	0.0082[#4]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	µg/L		**Use PAHs (sum of 4)**[#1]	0.017[#4]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	µg/L		**Use PAHs (sum of 4)**[#1]	0.017[#4]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenolics															
Phenol	µg/L		**5,800**[#9]	7.7[#5]		<0.5	-	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5
Phenols (Mono)	µg/L					-	<100	-	-	<100	-	-	<100	-	-
Halogenated Benzenes															
Chlorobenzene	µg/L		**300**[#3]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	µg/L		**62**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	µg/L		**240**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	µg/L		**250**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L					<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-dichlorobenzene	µg/L		**300**[#3]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L		**1,000**[#3]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L		**0.1**[#1]	Refer to 'Trichlorobenzene (total)'[#7]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	µg/L		**0.1**[#1]	Refer to 'Trichlorobenzene (total)'[#7]		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Halogenated Hydrocarbons															
Dichlorodifluoromethane	µg/L		**200**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	µg/L		**7.5**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	µg/L		**5,200**[#9]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	µg/L		**0.4**[#3]			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Metals															
Arsenic (Filtered)	µg/L		**10**[#1]	50[#5]		0.74	0.42	0.46	0.53	0.28	0.29	0.38	0.27	0.36	0.4
Barium (Filtered)	µg/L		**700**[#3]			23	21	22	26	23	24	20	39	46	36
Beryllium (Filtered)	µg/L		**12**[#3]			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	µg/L		**1,000**[#1]	2,000[#12]		<100	240	<100	<100	220	<100	<100	260	<100	<100
Cadmium (Filtered)	µg/L		**5**[#1]	0.08[#6]		0.03	0.04	<0.03	<0.03	0.03	0.04	<0.03	<0.03	<0.03	0.04
Chromium (III+VI) (Filtered)	µg/L		**50**[#1]			5.7	2.8	4.2	2.3	5.5	5.2	4.9	5.4	1.5	3.2
Copper (Filtered)	µg/L		**2,000**[#1]	1[#5]		5.5	1.8	1.4	<0.4	0.8	1	2.3	1.8	1	0.6
Lead (Filtered)	µg/L		**10**[#1]	1.2[#6]		0.46	<0.09	0.14	0.22	<0.09	<0.09	<0.09	<0.09	<0.09	0.12
Mercury (Filtered)	µg/L		**1**[#1]	0.07[#4]		0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (Filtered)	µg/L		**20**[#1]	4[#6]		3.5	5.5	2.8	3	1.7	1.6	1.7	2.9	1.7	1.6
Selenium (Filtered)	µg/L		**10**[#1]			0.83	6.2	1.2	0.43	2.4	0.74	0.39	0.46	0.54	<0.25
Vanadium (Filtered)	µg/L		**86**[#9]	20[#13]		<0.6	0.8	<0.6	<0.6	<0.6	0.6	<0.6	<0.6	<0.6	<0.6
Zinc (Filtered)	µg/L		**3000**[#3]	10.9[#5]		4.1	16	4.5	4.5	5.6	2.5	4.1	4.3	3.8	3.3
Chromium (hexavalent)	µg/L		**Use Chromium (total)**[#1]	3.4[#5]		<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
Inorganics															
Cyanide (Free)	mg/L		**Use Cyanide Total**[#1]	0.001[#12]		<0.02	-	-	<0.02	-	-	<0.02	-	-	<0.02
Sulphate	mg/L		**250**[#1]	400[#12]		37	48	42	37	18	16	20	11	6.2	7.4
Cyanide Total	mg/L		**0.05**[#1]	0.001[#5]		-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-

Comments
#1 WS Regs 2016 (Eng/Wal)
#2 WHO Petroleum DWG 2008
#3 WHO DWG 2011
#4 WFD England/Wales. 2015 - MAC-EQS Inland
#5 WFD England/Wales. 2015 - Freshwater Standards
#6 WFD England/Wales. 2015 - AA-EQS Inland
#7 Water Env't Regs (Scotland) 2015. AA-EQS Inland
#8 USEPA RSL (tapwater) [May 2016]
#9 USEPA RSL (tapwater)
#10 SEPA WAT-SG-53 Fresh EQS - MAC - 2015
#11 SEPA WAT-SG-53 Fresh EQS - MAC - 2013
#12 SEPA WAT-SG-53 Fresh EQS - AA - 2015
#13 SEPA WAT-SG-53 Fresh EQS - AA - 2013
#14 PNEC (EU REACH) - Freshwater
#15 California Draft health protective concentration
#16 AECOM DWG (WHO method)
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed
DWS: Drinking Water Standard
EQS: Environmental Quality Standard

Key

XXX	Exceedance of CW/WE Water. DWS - England/Wales
XXX	Exceedance of CW/WE Water. Aquatic Toxicity - England/Wales - Freshwater

Level 1 assessment methodology detailed in the EA Remedial Target Methodology (RTM) - P20 (EA, 2006).

A partitioning equation (EA, 2006) is used to back-calculate the soil threshold concentration.

- *Soil partitioning equation*: $Cs = C_T (K_d + (\theta_w + \theta_a H^{/}) / \rho_b)$
- *for non-polar organic chemicals:* $K_d = K_{oc} f_{oc}$

Where:

- Cs: concentration in soil (mg/kg)
- C_T: concentration in porewater (mg/l)
- K_d: soil-water partition coefficient (l/kg)
- θ_w: water-filled soil porosity (l_{water}/l_{soil})
- θ_a: air-filled soil porosity (l_{air}/l_{soil})
- $H^{/}$: Henry's law constant (unitless)
- ρ_b: dry soil bulk density (g/cc)
- K_{oc}: organic carbon partition coefficient (l/kg)
- f_{oc}: fraction of organic carbon (-)

The organic carbon partition coefficient (K_{oc}) and Henry's law constant are chemical-specific with values sourced from physchem reviews published in connection with the derivation of human health GAC.

The RTM methodology allows the use of literature values for soil parameters (e.g. porosity and bulk density) providing they are appropriate to soil conditions on site. The properties selected for the GAC are presented below, and based on literature values for a sand, which is considered appropriate for a wide number of sites given the high bulk density and low water filled porosity produce conservatively low GAC. Site specific organic carbon content is tested on each site as recommended in the RTM, and these data are used to select either a 0.2% fraction of organic carbon (foc) GAC or a 1% foc GAC. The foc values were selected to cover the range of foc typically detected in unsaturated soils on site. Total Organic Carbon values for the 28 samples analysed in 2016 ranged from 0.4 to 3.5%. An assumed TOC of 1% has therefore been used.

Table 1. Parameters Selected

Parameter	Value	Reference
Total porosity (%)	30	Todd, D.K., 1980. Ground Water Hydrology, 2d ed., New York: Wiley, P. 535.
Water filled porosity (%)	7.5	Brady, N.C., 1984. The nature and properties of soils. Macmillan Publishing Company, New York, pp. 750.
Air filled porosity (%)	22.5	Calculated from total and water filled porosities
Bulk density of soil (g/cm^3)	1.86	Calculated from total porosity assuming solid particle density is 2.65 g/cm^3 (Ref: Freeze & Cherry, 1979)

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