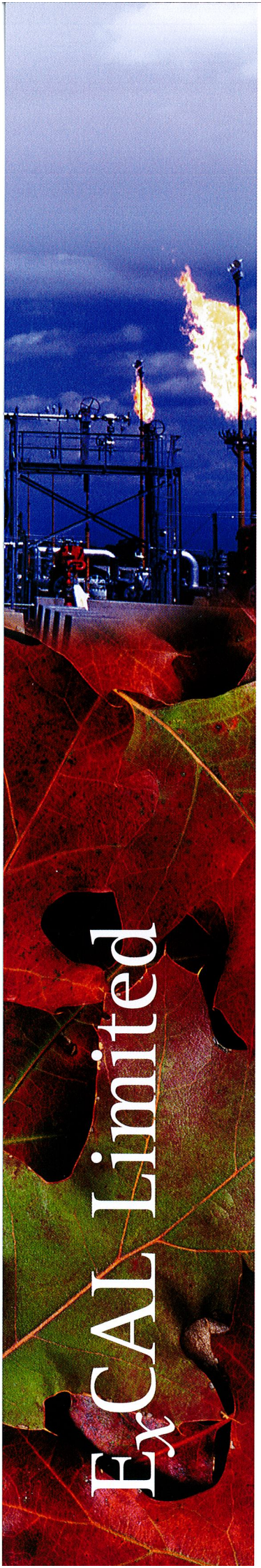

SOLAR PARK, BARRY

GEO-ENVIRONMENTAL RISK ASSESSMENT

SEPTEMBER 2014

Prepared for:

ABP Mer
Quayside Suite
Medina Chambers
Town Quay
Southampton
SA14 2AQ

ExCAL House, Capel Hendre Industrial Estate, Ammanford,
Carmarthenshire. SA18 3SJ
Tel: 01269 831606
Fax: 01269 841867

DOCUMENT CONTROL SHEET

PROJECT:	**SOLAR PARK, BARRY**
TITLE:	**GEO-ENVIRONMENTAL RISK ASSESSMENT**

PROJECT REF:	**234-02-01**
REPORT No.:	234-02-01.R2

PREPARED BY:

D Simons: .....

APPROVED BY:

S Whitehouse: .....

Version	Date	Amendments
Original	August 2014	
Revision 1	September 2014	

SOLAR PARK, BARRY

GEO-ENVIRONMENTAL RISK ASSESSMENT

Contents **Page**

1.0 INTRODUCTION

ABP wishes to develop a 10MW (Peak Power) Solar Farm on a previously developed parcel of land at their site at Barry Docks.

The location of the site is shown on Figure 1.1 below.

Figure 1.1 Site Location

ABP MER have engaged ExCAL Limited to undertake a Geo-environmental Risk Assessment for the project that will supplement documents to be submitted as part of the Planning Application.

The study incorporated a desk study review to assess potential geo-environmental risk followed by collection and laboratory testing of surface soil samples and water samples from the watercourse that adjoins the site.

Information collected during the Desk Study phase is contained in Appendix A and the pertinent points are summarised within this report.

Desk study assessment and site inspection suggested that much of the site is covered by hardstandings, including buildings, concrete, tarmac, compacted roadstone, and inert compacted fill. In order to verify the extent of these materials, site investigations were undertaken by hand excavated trial pit.

This document summarises the findings of the study and provides a summary of geo-environmental risk together with recommendations for future site management.

2.0 SITE SETTING

2.1 Site Location

The proposed development site is located approximately 2 Km west of Sully and 2 km east of Barry and lies within the confines of the existing Barry Dock Port.

The Grid Reference for the approximate centre of the site is 312998, 167344.

The site is accessed from Wimbourne Road which joins Ffordd Y Mileniwm to the North or Hayes Road to the South.

Figure 2.1 shows the boundary of the study area within the setting of the Port.

Figure 2.1 – Location Plan

2.2 Site Description

Topographical survey data, provided by ABP, and observations from our site team have been used to compile Figure 2.3, which provides a key to the description of the site.

Figure 2.3 Designations for parcels of land within the site boundary

Parcel A is formed by a relatively level plateau of inert fill material that is at an approximate elevation of 12m AOD which is up to 4m higher that the remaining area of the site to the north of it. The land is occupied by an inert material recycling facility. It is estimated that approximately 4m thickness of inert materials forms a capping to the site.

Parcel B is comprised of dense scrub and semi-improved neutral grassland and lies at an elevation of around 9m AOD.

One Scheduled Ancient Monument is recorded within the site boundary located in Parcel B. The Scheduled Ancient Monument is a round barrow and is located at Grid Reference ST13136739, however, the monument falls outside the anticipated development boundary

Parcel C is covered by concrete hardstanding and was formerly a coal yard which lies at an elevation of between 8 and 9m AOD. The edge of the coal yard is surrounded by bunds up to 5m in height

Parcels D comprises buildings that are currently leased and used as industrial premises, or formerly contained industrial uses. The ground elevation is around 7.5 – 8 m AOD.

Parcel E comprises the remaining roads and paving within the development, the levels of which are in continuity with the surrounding parcels of land.

The ABP Port ownership extends beyond the study boundary to the North and West.

The site is bounded to the south by the Cadoxton River, on the other side of which lies Residential and Industrial Development.

To the East the site is bounded by Wimbourne Road, with further dock facilities and buildings beyond the road. The site entrance is located on Wimbourne Road, which can be accessed from Hayes Road or Ffordd Y Mileniwm.

The study area is predominately level. The most significant change to the site level is around the Inert Recycling facility, where the level has been raised using inert fill by approximately 4 meters. There are bunds of

approximately 1m height around the top of the inert recycling facility with several bunds also located around the site which act as boundaries between developments, buildings and parcels of the land.

3.0 HISTORICAL REVIEW

3.1 Historical Data

The available historical data collected during the desk study is contained within sections 1-3 of the report contained in Appendix A, with historical maps of the site included in Appendix B. Relevant elements that are pertinent to this assessment are summarised below. Figure 3.1 has been developed to assist interpretation of the historical data.

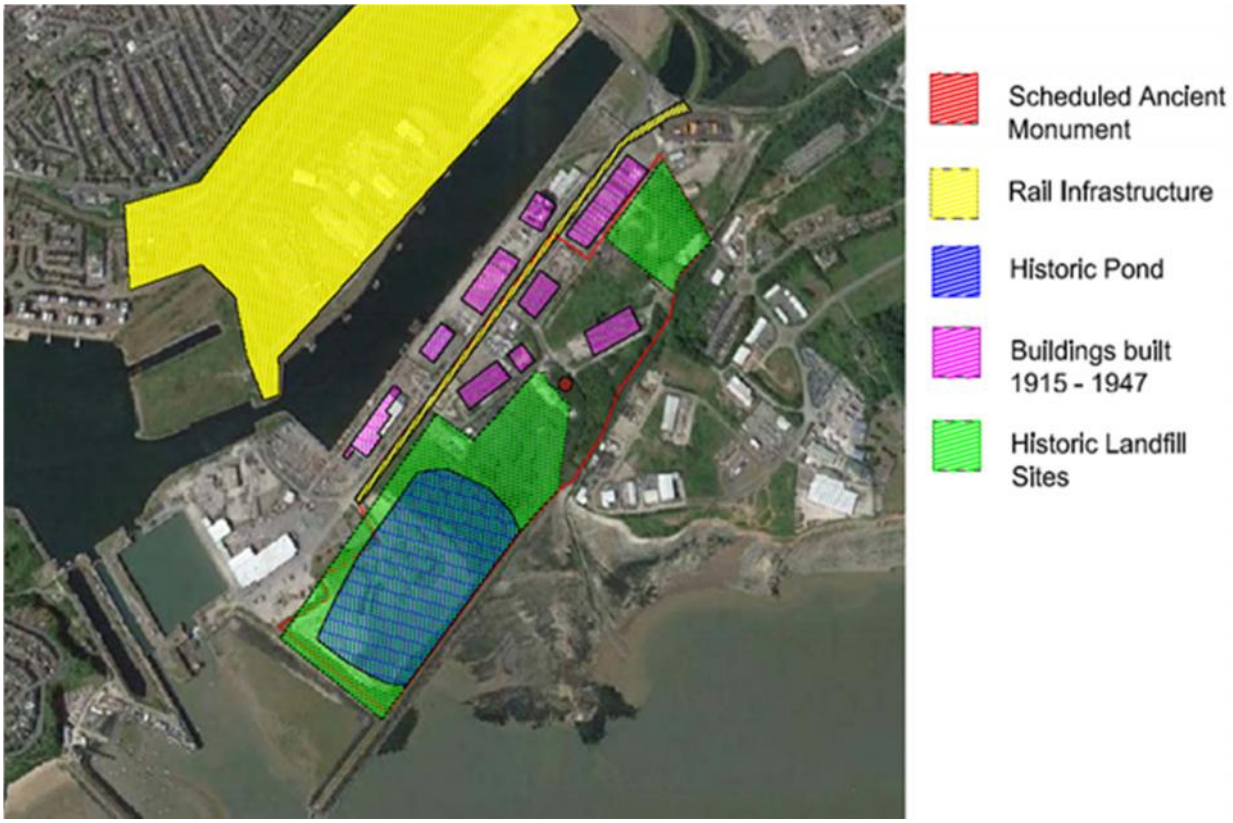

Figure 3.1 Plan of Pertinent Historical Data.

Review of the historical maps reveals that Barry Docks was constructed between 1878 and 1898 by infilling and impounding an area of the bay.

The majority of buildings in the development area were erected between 1915 and 1947. A summary of the key developments on site and within the docks are summarised in Table 1 below, with key locations shown in Figure 3.1 above.

Table 1 – Key Site History

Item	Description	Date
1	Scheduled ancient monument (shown in Figure 3.1)	
2	Dock constructed by infilling bay	1884 - 1889
3	Oval pond within development boundary present as a residue of the former estuary. (shown in Figure 3.1)	1898 - 1982
4	Extensive Rail Network shown to the North of the site servicing the docks (shown in Figure 3.1)	1898 - 1982
5	First building erected on land to the south of Number 2 Dock – Transit Shed	1915 - 1921
6	Rail Infrastructure present around development site south of Number 2 dock for the first time (shown in Figure 3.1)	1921 - 1947
7	Most existing site buildings constructed, understood to have constructed for war time use (shown in Figure 3.1)	1921 - 1947
8	BP infill oval pond and surrounding area with records indicating it was used as a landfill site. Records of separate landfill at the Northern end of the development	Between 1973-2002
9	BP Landfill area appears fully infilled (shown in Figure 3.1)	2002
10	Inert Aggregate Facility established, level of site raised with inert capping	Between 2002-2014

3.2 Surrounding industries and land uses

The area to the north of the site was formerly occupied by the BP chemical works and it is published that contaminative land uses were undertaken in that area.

Landfilling has taken place within one of the former Docks in the area known as Arno Quay, East Quay, West Pond and South Quay to the west of the site.

There are several current industrial sites in the vicinity of the development site, with the closest being the Barry Aluminium Chlorohydrate Plant 49m to the North-west of the study area and the Barry Flour Mill, which lies128m to the North.

The Dow Corning silicon facility lies approximately 700m north east of the site, with a Dow Corning industrial landfill associated with the site located 337m north east of the site.

The Momentive and Hexion chemical plants are also located approximately 1200m East-Northeast of the site.

3.3 Discharge Consents

Desk study records indicate 64 licensed discharge consents within 500m of the site. However, closer inspection reveals that most of these have been revoked.

Pertinent current discharge consents that may affect water quality in the Cadoxton River, which passes the site, are summarised below: -

- Pumping station sewerage discharge for the Atlantic Trading Estate 20m south of the Site;
- The Windward terminal in the Port of Barry 65m West of the site;
- STP serving Barry Pilots Lodge 272m South-west of the site;
- Factory on David Davies road 357m North-west of the site;
- Barry Yacht Club 386m South-west of the site.

3.4 Nearby Sensitive Designations

The site borders the Hayes Point to Bendrick Rock Site of Special Scientific Interest (SSSI) to the Southeast, with the Barry Island SSSI 598m to the Southwest of the study site. These sites are listed as a SSSI's due to the Triassic rock types present and their value geological value.

Coed-yr-Hayes ancient woodland lies 344m to the Southeast of the study site.

Research undertaken has shown there is also a scheduled ancient monument within the site boundary. This is a Round Burial Barrow.

3.5 Geology

Desk study data suggests that the whole of the study site is covered by an undefined thickness of Made Ground.

Superficial natural soil deposits are noted as brown sand and tidal flat deposits comprising clay, silt and sand. The permeability of the natural superficial soils varies with particle size.

Geological records suggest that there are five designations of bedrock underlying the study site, namely: -

- Quartz Conglomerate Group (south Wales) - Interbedded Sandstone And Conglomerate;
- Blue Anchor Formation – Mudstone;
- Mercia Mudstone Group – Mudstone;
- Mercia Mudstone Group – Conglomerate;
- Mercia Mudstone Group – Mudstone.

There is one known fault line which crosses the northwest corner of the site and which trends southwest to northeast. (see figure 1.3, page 12 of the Geo-insight report contained in Appendix A)

Several other faults are recorded in the vicinity of the site but they all lie outside of the proposed development.

The risk of shrink / swell clay, collapsible deposits, running sand, soluble rocks and landslides are negligible or very low.

3.6 Hydrogeology

The superficial geology contains a Secondary (A) aquifer, the near surface boundary of which bisects the site in a northwest to southeast direction just to the north of the former coal yard. The remainder of the superficial geology is designated as Secondary Aquifer (undifferentiated layers), with an area underlying the Inert Recycling Facility carrying no designation.

Three types of aquifer exist in the underlying geology (see Figure 5a and 5b, pages 38 and 39 of the Enviroinsight report contained in Appendix A). The South west corner of the site is denoted as a Secondary (A) aquifer. The rock underlying the western half of the landscape strip and in the far North-west of the site is denoted as a Secondary (B) aquifer, whilst the remainder of the underlying bedrock is denoted as a Principal (A) aquifer.

The site does not lie within a source protection zones (SPZ), nor are any recorded within 500m of the site.

There no surface water or potable water abstraction licenses within 1000m of the site.

One historic groundwater abstraction license was identified 971m to the west of the site boundary at Grid Reference 311620, 166620 for a borehole at Barry Island Pleasure Park. The license expired in 2002.
It is likely that groundwater beneath the site is affected by the tidal cycle and saline inclusion.

It is anticipated that the overall groundwater flow direction will be from the higher ground to the north towards the south and into the sea.

3.7 Hydrology

The Hydrology of the site has been significantly altered by the completion of the docks in 1889.

The Number 2 Dock lies to the north of the site. This was formed by an impoundment of tidal waters during the dock construction.

Prior to development of the dock, the Cadoxton River flowed from the north, approximately 250m to the north of the site, and emptied into the bay around the north east edge of the current day Number 2 Dock.

The Cadoxton River was re-routed during the development of the dock and now flows from northeast to southwest adjacent to the south-eastern boundary of the site, where it discharges into the sea via a deepened channel in the rock.

Surface water flow is towards the southwest and into the sea.

3.8 Flooding

Most of the study site does not lie within a designated flood zone based on Environment Agency flood maps. However, a central region of the study site is designated as a Zone 2 and Zone 3 floodplain.

The study site is also surrounded on all sides by Zone 2 and Zone 3 Flood Zones, predominantly on the southern and eastern boundaries where the River Cadoxton and Bristol Channel are located.

There are no areas used for flood storage within 250m of the site.

The site does not benefit from flood defences nor are there any areas within 250m of the study site that benefit from flood defences.

British Geological Survey data for the site indicates that there are areas within 50m of the site that are susceptible to groundwater flooding, this is associated with superficial deposits flooding,

The British Geological Survey indicate that based on underlying geological conditions, the highest susceptibility to groundwater flooding can be classified as “Potential at surface”.

3.9 Mining History

There are no recorded coal mining areas within 1000m of the site.

The data obtained identifies several non-coal mining areas on and within 1000m of the study site, which are identified as mineral veins. The data obtained however assesses the likelihood that these veins were mined as rare or highly unlikely.

There are no records of Brine extraction, Gypsum extraction, Tin mining or clay mining within 1000m of the site.

4.0 SITE SAMPLING

4.1 Introduction

Desk study research revealed that the site has been subjected to a varied history of mixed industrial uses.

Available data suggests the potential presence of made ground over the study area. However, site inspections and a detailed review of the development history, suggested that much of the site is now covered by either an impermeable hardstanding, buildings or a substantial thickness of inert cover.

In an attempt to quantify the potential environmental risks that may be posed by residual contamination caused by historic uses to the proposed development and to the surrounding environment, three types of further investigation were carried out, namely: -

- Near surface soil sampling and subsequent laboratory analysis to determine the concentrations of key contaminants;
- Collection of water samples from the River Cadoxton, from locations upstream and downstream of the site and testing in the laboratory for a range of contaminants;
- Detailed site inspection and excavation to confirm the extent of hardstandings in the areas not currently developed.

These investigations and their outcomes are detailed below.

4.2 Surface Soil Sampling

A site walkover followed by a soil sampling exercise was undertaken on Monday 21st July 2014.

It was noted during the site walkover and during the sampling exercise that there was extensive hardstanding across the site, which was in addition to that which could have been anticipated by studying the maps that show the roads and building slabs across the site.

Areas of fly tipping were evident in derelict areas of the site.

Buildings within the site boundary were noted to contain asbestos or asbestos containing materials.

Hardstanding was also observed beneath the numerous earth bunds that run across the site, as well as under areas of overgrown scrubland which predominantly had a thin layer of soil on top of the hardstanding from which the plants and bushes have grown.

The presence of hardstanding limited the areas in which samples could be taken. Some soils from which the samples were collected were noted as being thin and located above a layer of hardstanding.

Surface soil samples were obtained from seven representative locations across the study site. Samples were sent for analysis at a UKAS and MCERTS accredited laboratory.

Figure 4.1 below shows the sampling locations.

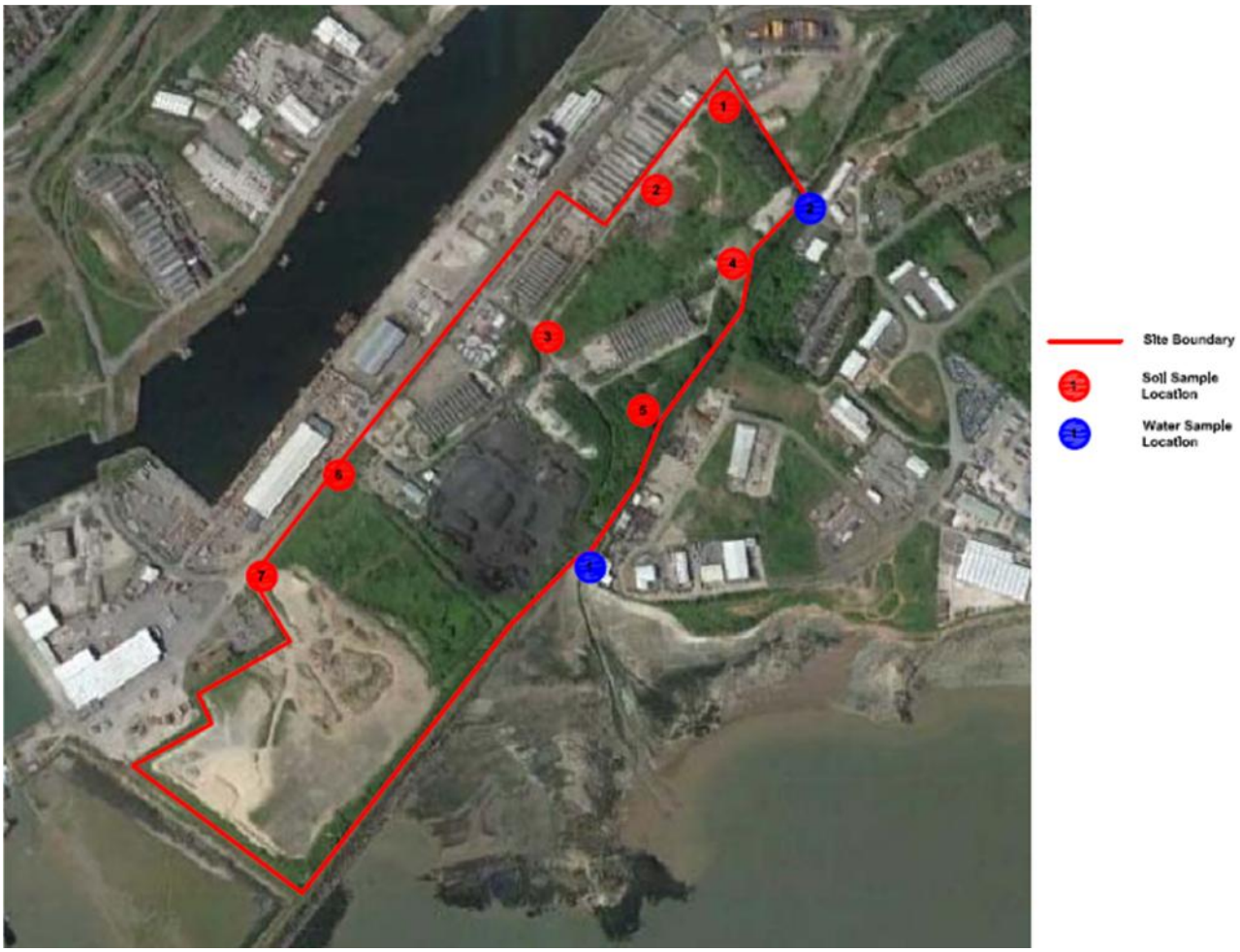

Figure 4.1 Sampling Locations

The samples were analysed for a suite of determinands that was selected to provide a good screening assessment based upon site history.

Tests were undertaken on soils for pH, Total Petroleum Hydrocarbons (TPH) and Total and Leachable Metals (Arsenic, Cadmium, Chromium, Copper, Nickel, Zinc, Lead)

Laboratory analysis certificates for the soil samples are contained in Appendix B.

The analysis results are summarised in Table 4.1 below and are compared to the Soil Guideline Value (SGV) for Commercial end use. Where contaminant concentrations exceed the commercial SGV they are highlighted.

Determinand	Units	S1	S2	S3	S4	S5	S6	S7	Generic Acceptance Criteria (GAC)
pH	pH units	8.90	8.28	9.00	8.12	8.52	8.69	9.02	
TPH	mg/kg	<1.00	<1.00	<1.00	<1.00	6.14	<1.00	1.83	500
As (Total)	mg/kg	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	640
As (Leachable)	mg/kg	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	
Cd (Total)	mg/kg	1.80	6.54	1.56	2.43	6.28	28.25	2.31	230
Cd (Leachable)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	
Cr (Total)	mg/kg	84.43	53.46	34.01	37.45	35.42	68.83	31.69	30400
Cr (Leachable)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	
Cu (Total)	mg/kg	51.89	388.7	73.23	147.6	150.7	220.2	53.73	71700
Cu (Leachable)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	
Ni (Total)	mg/kg	15.19	41.39	23.47	29.2	28.58	37.31	20.47	1800
Ni (Leachable)	mg/kg	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	
Zn (Total)	mg/kg	154.9	1193	235.4	379.1	272.0	618.0	156.7	665000
Zn (Leachable)	mg/kg	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	
Pb (Total)	mg/kg	118.3	1941	106.3	431.1	241.4	462.2	110.7	750
Pb (Leachable)	mg/kg	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	

The results of chemical analysis on soil samples confirms that the soils lie within normal accepted levels for a commercial / industrial end use.

4.3 Water Sampling

No known operational boreholes exist within the site.

The desk study suggested that a surface water body, trended north to south, crosses the site. However, following site walkover, the surface water body appears to have been culverted, with an outlet feeding into the River Cadoxton. The outlet from the culvert was dry during the site visit, therefore no sample could be obtained from this point.

Surface water samples were taken from the River Cadoxton both upstream and downstream of the site.

The locations of the water samples are shown on Figure 4.1 on the previous page.

The water samples were sent for analysis at a UKAS and MCERTS accredited laboratory and were analysed for pH, TPH, Total Metals (Arsenic, Cadmium, Chromium, Copper, Nickel, Zinc, Lead), Ammonia and Chloride.

The laboratory analysis certificates for the water samples are contained in Appendix B and are summarised in Table 4.2 below, where they are compared to the freshwater Environmental Quality Standard (EQS).

Determinand	Units	S1	S2	Surface Water EQS/GAC
pH	pH units	7.61	7.87	6-9
TPH	mg/l	11.96	4.16	50 µg/l
As (Total)	µg/l	5.27	5.91	50
Cd (Total)	µg/l	<5.00	<5.00	5
Cr (Total)	µg/l	<7.00	<7.00	5-50
Cu (Total)	µg/l	20.58	6.52	5-112
Ni (Total)	µg/l	<8.00	<8.00	20
Zn (Total)	µg/l	9.59	3.91	30-50
Pb (Total)	µg/l	<19.00	<19.00	5-20
Ammonia	mg/l NH_4	0.47	0.85	1
Chloride	mg/l Cl	8.3	1.8	250

The results of laboratory analysis confirm that the quality of water in the River Cadoxton lies within anticipated limits for the area.

The results showed that TPH was elevated when compared to EQS but the concentration downstream of the site is less than upstream of the site.

A slight increase in Ammonia was observed, which is likely to be due to a sewage discharge.

4.4 Investigation of extent of hardstanding and visual inspection of the site

A detailed inspection of the site and of the surrounding area was undertaken to inform the geo-environmental risk assessment.

At the southern boundary, the site forms low cliffs that fall onto the stone and shingle beach. The cliff faces along the southern boundary of the site were visually inspected, where the interface between the underlying rock and superficial natural deposits are clearly evident. An examination was undertaken to identify any evidence of groundwater seepage from the site, but none was found.

The site inspection and targeted trial pit investigation confirmed the presence of hardstanding or inert soil cover in the locations indicated on Figure 4.3 below.

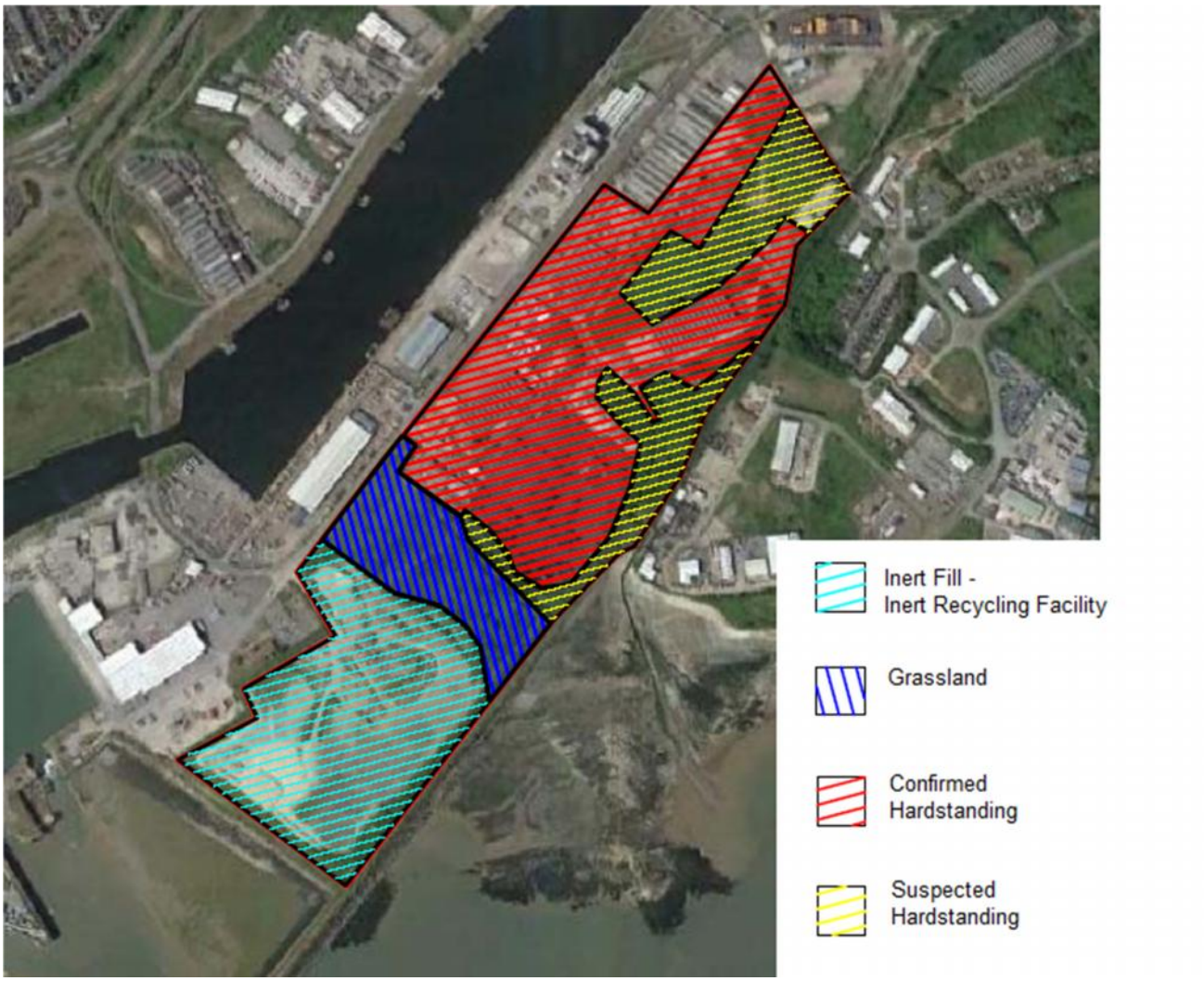

Figure 4.3 – Surface Types

Hand dug trial pits were excavated through the very shallow soils in order to determine the approximate extent of hardstanding in the areas shown as suspected hardstanding in figure 4.3 above.

Hardstanding typically comprising compacted gravel was encountered below the shallow surface soils present in the investigation areas.

Following completion of the works above, the whole development site has been confirmed to comprise hardstanding at surface level, or just below shallow soils, where these are present.

5.0 GEO-ENVIRONMENTAL RISK ASSESSMENT

5.1 Source – Pathway – Receptor Model

UK policy frameworks for contaminated land adopt the Source – Pathway – Receptor model.

In order for a risk to be present, contamination from the source must travel via a pathway to the receptor.

Typically the source could be contamination caused by residual chemicals from industrial processes that may be present in soils or groundwater.

A pathway between the source and the receptor could typically be migration of soluble contaminants via groundwater, generation of windblown dust from the site surface causing inhalation or ingestion by occupants or neighbours and direct dermal contact with contaminants.

Receptors could be workers on the site, residents in the area and the aquatic and terrestrial environment around the site.

Where a contamination source is present or anticipated, suitable risk reduction can often be achieved by breaking the pathway between the source and the receptor.

5.1.1 Soils

Detailed assessment of the site history site indicates that past uses could have potentially caused residual contamination to remain in the soils and groundwater beneath the site.

Detailed inspection of the site surface shows that the majority of the site surface is capped with either impermeable hardstandings, buildings or their floor slabs or thick (3m +) deposits of inert materials.

There are no known historical incidents of pollution in soil or groundwater that have caused regulatory intervention or special assessments to be initiated.

The proposed development of the site as a Solar Power generation facility, ensures that there will be no requirements for any significant excavations and it is likely that the existing hardstanding will be utilised to form the platform upon which the solar panels will be established.

The existence of the hardstanding, together with the nature of the development, means that the pathway between potential contaminants in soil and receptors with respect to soil contamination are broken.

The small shallow near surface soils, where these were found, were tested in the laboratory and found to be of low risk to commercial development.

Based upon the data collected during this study, it is considered that potential risks that may be posed by residual contamination in deeper soil horizons is reduced to an acceptable level by the presence of competent capping layers.

5.1.2 Water

Analysis of water samples collected from the Cadoxton River, which passes the site, did not determine any detectable deterioration in surface water quality as it passes the site.

The impermeable hardstanding surfaces prevent infiltration of surface water into the underlying soils.

The direction of groundwater flow through the site is likely to be towards the south and into the sea, although this could be reversed during tidal cycles during prolonged dry periods. Despite several site inspections, there is no discernable evidence of groundwater breaching the ground surface to the south of the site.

To the north and east of the site, the land remains within he ownership of ABP and consequently any intermittent groundwater flow in these directions would be onto the landholding of the developer.

Based upon the findings of the desk study there is no direct evidence that contaminated groundwater is having an adverse impact upon the surface water receptors in the vicinity of the site.

5.1.3 Development Phase Recommendations

The data collected during this study suggests that current risk from residual contamination is likely to within acceptable levels for the area.

During the development phase, changes will take place that should be managed to ensure that risk associated with potential contamination do to increase.

These should include: -

- Retention of concrete floor slabs to buildings that are to be demolished to maintain capping to the site;
- Careful removal of asbestos containing materials to a suitably licensed facility;
- Capping of areas that are not currently covered by hardstanding.

In addition, we would recommend that a number of boreholes are installed around the periphery of the proposed development to enable groundwater quality to be determined. A programme of routine monitoring should be agreed with the Regulator to provide comfort that the risks to groundwater do not deteriorate as a result of the development.

5.1.4 Environmental Enhancement

The proposed development presents an opportunity to utilise current derelict land for a beneficial use.

Existing buildings within the footprint of the proposed development, which contain asbestos and asbestos containing materials will be removed.

Fly tipped waste will be removed from the site.

The proposed development presents the opportunity for significant ecological enhancement works as it will be a managed but un-manned development. Due to the coastal location, ecological regeneration could prove particularly beneficial for ground nesting birds in addition to other local flora and fauna which could be encouraged to develop on site.