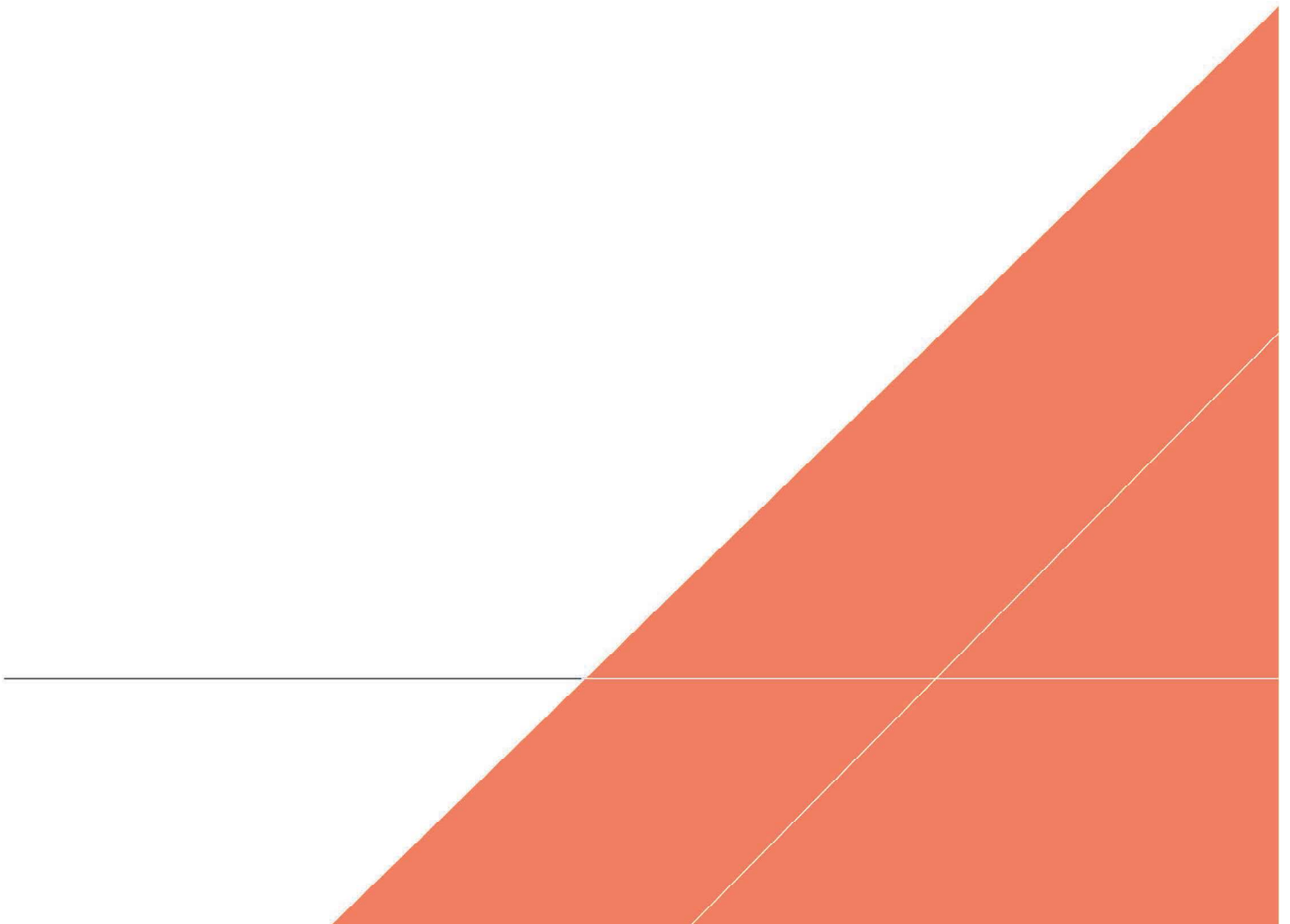


GEO-ENVIRONMENTAL DESK STUDY

Trevor Hire Boat Base, Wrexham

OCTOBER 2021

10050394-ARC-XX-XX-RP-ZZ-0001-01-Phase 1 Geo Environmental Desk Study



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Geo-Environmental Desk Study Report

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1 INTRODUCTION

1.1 Appointment

Arcadis Consulting (UK) Limited (Arcadis) was commissioned by the Canal and River Trust (The Trust) to complete a Phase 1 Geo-Environmental Desk Study for the site of the Trevor Hire Boat Base (the “site”) in Trevor, Wrexham LL20 7TP.

The site’s location is presented on Figure 1 in Appendix A.

1.2 Proposed Development

The site covers an approximate area of 1 hectare and is intended to be redeveloped for a commercial use, to include 3 rows of canal boat berths, a fuel storage and pump station, indoor commercial space, external bin and gas bottle stores, 21 parking bays and an access road connecting to Tower Hill Road to the north.

Within the site is a ‘Y’ shaped canal terminus which will be modified to accommodate the docks.

A proposed development plan is included in Appendix B.

1.3 Study Objectives

Considering the proposed development, the objectives of this desk study were to:

- Assess the environmental condition of the site and develop a preliminary Conceptual Site Model (CSM), in line with UK regulatory guidance; and,
- Assess potential geo-environmental constraints which could affect future development.

1.4 Scope of Works

To achieve the objectives the following scope of work was defined:

- Review the published and readily available information concerning the site including:
 - ✓ Recent Ordinance Survey (OS) mapping.
 - ✓ Site-specific Groundsure report.
 - ✓ Historical Ordnance Survey maps.
 - ✓ British Geological Survey (BGS) published maps and online GeoIndex including relevant archive borehole records.
 - ✓ A site-specific Coal Authority report; and,
 - ✓ Zetica website (unexploded ordnance (UXO) data).
- Develop a CSM and complete a Preliminary Risk Assessment.
- Evaluate potential construction related constraints; and,
- Reporting.

1.5 Previous Investigations

The Trust undertook a limited two-stage shallow soil sampling exercise in 2020 reported as follows:

- Anglo Welsh Ltd Base Relocation, Trevor Basin Contamination Report. Prepared by Tom Wilding, Graduate Environmental Scientist (Canal & River Trust), July 2021.

The report is presented in full (10 pages) in Appendix C.

The exercise comprised the collection of 5 soil (Made Ground) samples from 0.5 m below ground level (mbgl) in hand-dug pits formed around the canal docks (four in the central wharf “island” and one to the west of the western spur). These samples were tested for heavy metals, pH, hydrocarbons (including PAHs), asbestos, cyanide, sulphide and organic matter/carbon. Of the results, elevated lead was identified by the author and a further 5 samples were collected to be tested for lead only. The author concluded that the shallows soils are non-hazardous (NB any waste classification should be done separately) and do not pose a risk to end-users.

1.6 Reliability of Information / Limitations

Arcadis warrants that the services performed were conducted in a competent and professional manner in accordance with sound consulting practices and procedures.

Arcadis cannot warrant the actual property conditions described in this report beyond matters amenable to confirmation within the limits of this report.

The reader is referred to the Study Limitations, presented in Appendix D.

2 SITE SETTING

2.1 Site Location

The site is located north of New Rd, at the western boundary of the village of Trevor in the County Borough of Wrexham, in the Vale of Llangollen with an indicative postcode of LL20 7TP; centred around National Grid Reference: SJ272424. A site location plan is presented in Figure 1 (Appendix A).

2.2 Site Description

The site predominantly comprises a Y-shaped canal terminus lined with docks for berthing of hire boats with an access road connecting to Tower Hill Rd to the north. Aerial images show an office for a boat rental company on-site with a gravel parking lot attached.

The total area of the site covers approximately 1 hectare. Aerial imagery indicates the site slopes down towards the southeast with the maximum elevation towards the north-eastern side of the site. Elevations range from 106m Above Ordnance Datum (AOD) in the north to 98mAOD in the south; and from 103mAOD in the west to 99mAOD in the east.

Regionally, the site is on the northern valley side of the River Dee and the land slopes down to the south-east towards the confluence of a nearby brook (the Tref-y-nant Brook) and the River Dee.

The site is roughly elliptical in plan (long axis being north-east to south-west) with densely vegetated land at the eastern and western boundaries of the site centre. The site is bordered by Tower Hill Road to the north and New road to the south. The western boundary comprises undeveloped land to the south with the northern portion bounded by dense vegetation consisting of trees and shrubs. The eastern boundary consists of a line of trees to the south with an undeveloped land parcel beyond and a concrete surfaced parking lot along the northern section.

2.3 Surrounding Land-use

The site is situated within a predominantly rural area, albeit with urban and historical industrial uses nearby; surrounding land uses are described below:

- **North-west:** Dense vegetation consisting of tall trees and shrubs with residential properties beyond and agricultural land beyond that.
- **North-east:** Fields and a concrete surfaced Pontcysyllte Aqueduct Car Park with a former chemical works (now decommissioned and disused) beyond with residential properties beyond that.
- **South-east:** A line of tall trees with open undeveloped land beyond. A water treatment works and residential properties exist beyond the fields.
- **South-west:** Open field with the residential neighbourhood along with car parks of Trevor beyond.

3 ENVIRONMENTAL SETTING

3.1 Geological Aspects

3.1.1 Geology of the Area

The regional geological information was reviewed from the 1:50,000 scale map (Sheet Number 121, Solid and Drift Geology) and the BGS GeoIndex website. This was supplemented where possible by archived local borehole records (SJ24SE501 Located 260m south of site) and (SJ24SE498 located 260m south of site) available through the BGS GeoIndex (Appendix E) and Groundsure Report (Appendix F).

Table 1 – Regional Geology

Unit	Published Information	BGS Borehole Information
Made Ground	The available BGS mapping does not show the presence of Made Ground underlying the Site.	There are no historical borehole records directly related to the site. However, the presence of hardstanding from aerial photographs indicates the presence of made ground on site. Hand-dug pits formed by a Trust employee proved Made Ground to at least 0.5mbgl (see Appendix C) although no logs or photographs were produced.
Superficial Geology	The available BGS mapping indicates that the site is underlain by Diamicton glacial till of the Devensian Stage. Land immediately to the north-west has no superficial geology mapped, therefore on-site strata may be relatively thin or locally absent.	The available borehole records indicate the presence of grey mottled brown clay with angular to sub-rounded fine, medium and coarse gravel – this description is likely to be reflective of superficial strata on the subject site.
Weathered/ Bedrock Geology	The site is underlain by the Pennine Lower Coal Measures Formation and the Pennine Middle Coal Measures Formation of the Langsettian and Bolsovian substages of the Westphalian; consisting of layered mudstone, siltstone and sandstone. A coal seam (the Premier seam) is shown to underlie the access road area to the north of the canal basin. Strata dip in a south-easterly direction, therefore the Premier seam does not underlie the main development site. Groundsure and GeoIndex records indicate the presence of several faults in the area though no major fault lines traverse the site, minor faulting is likely to be present.	The available offsite borehole records indicate the coal measures strata to comprise distinct layers of laminated mudstone, sandstone and ironstone with occasional coal seam (thickness of 0.50m), and highly weathered layers of dark grey carbonaceous Mudstone (thickness of 0.11m). This was proven to have a depth of 23m.

3.1.2 Background Soil Chemistry

According to the Groundsure report (Appendix F), the background soil quality (based on nearby rural soils and/or stream sediment studies) includes the following metals with their typical local concentrations in parentheses: Arsenic (15 mg/kg), Cadmium (1.8 mg/kg), Chromium (60-90 mg/kg), Nickel (15-30 mg/kg) and Lead (100 mg/kg).

In relation to Arcadis in-house derived Generic Assessment Criteria (GAC) – substance concentration levels protective of residential end-use receptors – available estimated background concentrations do not exceed their respective values.

3.1.3 Radon Affected Areas

Upon review of the Groundsure report (Appendix F), the western part of the site is in a radon affected area, where between 3% - 5% of properties are affected, and therefore basic radon protective measures are likely to suffice for future development dwellings. Although the site is undergoing commercial development, it will need to keep the basic radon protective measures in indoor workspaces.

These distinctions are based on the highest readings recorded within a set area and are a relatively crude early screening tool. The exact status should be confirmed with the local Building Control department and via purchase of a site-specific radon report from the BGS.

3.1.4 Coal Mining Affected Areas

As per the site specific CON29M report on legacy coal mining risks (Appendix G), the site is located in an area potentially affected by coal mining. The northernmost section of the access road is potentially underlain by shallow coal mine workings and a coal outcrop/sub crop (the Premier seam) runs through the centre of the access road section of the site. Furthermore, a mine shaft is located immediately to the west of the site; however, this was identified as being infilled in the past and the site lies outside the calculated zone of influence of any mine entry. To the east of the site, probable shallow coal mine workings have been confirmed to exist.

Regarding coal stratigraphy, the site lies on a locally faulted bedrock block. The Premier seam dips to the east (generally) and therefore does not underlie the main site where structures are proposed. Beneath this seam is likely to be a sequence of shales, sandstones and mudstones typical of coal measures strata with the next named seam (the Llwyneinion Half Yard) being several metres below this, if present at all.

Given the locally isolated nature of the faulted bedrock blocks it is considered unlikely that workings will be present at depth beneath the site as indicated on the CON29M report (i.e. zones of workings lie outside the site boundary location).

Due to past underground mining in the northernmost section of the site (i.e. the end of the access road only), it is recommended that a visual inspection of the property by a suitably qualified and experienced person is undertaken to identify any mining related settlement or subsidence effects in this zone and that periodic inspections are undertaken after the road is constructed.

No active coal mining exists at present and nor is any planned for the future. No mine gas emissions were recorded on site and no claims regarding site subsidence have been made within 50m of the site since 31st October 1994.

3.1.5 Other Mining Activity and Dissolution Features

Upon review of the Groundsure report, the site is not in an area considered to be at significant risk of other non-coal related mining activity and/or dissolution features.

3.2 Hydrogeology and Groundwater Vulnerability

3.2.1 Aquifer Classification

The superficial geology is classified as a Secondary Undifferentiated Aquifer. Secondary Undifferentiated Aquifers are assigned where it is not possible to attribute either category A or B to a rock type. In general, these layers have previously been designated as both minor and non-aquifers in different locations due to the variable characteristics of the rock type.

The bedrock geology is classified as a Secondary A Aquifer. Secondary A Aquifers are defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

3.2.2 Groundwater vulnerability

The on-site classification indicates that the area falls under medium vulnerability for bedrock aquifer with low leaching and infiltration value of <40% in soil and low vulnerability in superficial geology.

3.2.3 Groundwater Abstraction

No active groundwater abstractions exist within 250m of the site.

3.2.4 Groundwater Flooding

The site is located in an area with low risk of groundwater flooding.

3.2.5 Source Protection Zones

The site is not located within a Source Protection Zone (SPZ) as designated by Natural Resources Wales (NRW).

3.3 Hydrology

3.3.1 Surface Water Features

A canal basin (terminus) of the Llangollen Canal is present within the site boundary, this is accessed from the southwestern boundary. Given the manmade nature of the canal the degree of continuity with local groundwater is unclear but should be negligible. Notwithstanding discharge to or from the canal plausible locally.

The local topography falls to the south-east broadly with the Tref-y-nant Brook flowing due south (approximately 50m east from the end of the proposed access road) to its confluence with the River Dee 325m south of the site. The River Dee or Afon Dyfrdwy is located 290m south of the site boundary (at its nearest point) flowing in an easterly to south-easterly direction. Groundwater at the site is likely to flow in a south-easterly direction, but this can only be confirmed through intrusive ground investigation.

3.3.2 Surface Water Abstractions

No active surface water abstractions exist within 250m of the site

3.3.3 Flooding Risk

The 'Flood Map for Planning and Long-term Flood Risk Assessment' website (accessed 6th September 2021) as well as the Groundsure report indicates that the site has a very low flood risk from rivers and the sea (RoFRaS) and from surface water, which means that each year this area has a chance of flooding of less than 0.1%.

3.3.4 Licensed Discharge Consents

According to the Groundsure report, a sewage discharge and storm sewer overflow is located 171m east of the site. The discharge consent belongs to Monsanto which permitted the now decommissioned chemical works to discharge its sewage waste to the Tref y Nant Brook.

As per the discharge of substances List I and II there is a record of an inactive discharge within 500m details of which are given below:

Location	Name	Receiving Water	Authorised discharge Substances
308m E	Flexsys Rubber Chemicals Ltd, Ruabon Works	-	Iron, Zinc, Toluene, Xylene.

3.3.5 Pollution Incidents to Controlled Water

According to the Groundsure report, there are 18 recorded incidents of pollutant release to surface water and public sewer within 500m of the site. However, all were category 3 (Minor) or 4 (No Impact) except for an incident 297m S of the site involving an unknown pollutant in 2003 which was a category 2 land impact (Significant) site.

3.4 Current Industrial Land-Use

The Groundsure report indicates the absence of industrial uses on-site; however, 6 “*industrial*” class sites/uses are present within 250m of the Site.

Location	Company	Activity	Category
18m NW	Shaft	Unspecified Quarries or Mines	Extractive Industries
103m SW	Anglo-Welsh waterways	Boat hiring service	Hire service
107mS	Dock	Moorings and Unloading Facilities	Water
153m W	Signature Executive Travel	Airlines and Airline Services	Transport, Storage and Delivery
171m NW	Spray 1	Industrial Coatings and Finishing's	Industrial Products
249m SE	Electricity Sub Station	Electrical Features	Infrastructure and Facilities

All of these are considered to be of low or negligible risk to human health or site infrastructure based on the information reviewed to date.

3.4.1 Environmental Permits / Classifications

There are 61 Part A(1) Environmental Permits (formerly Integrated Pollution Prevention and Control (IPPC) permits) within 500m of the site all related to the Ruabon Chemical Works for processes involving organic compounds, inorganic compounds, metals and halogens (broadly located 315m NE of the site).

A Part A(2) or Part B Environmental Permit was also granted to the Ruabon Chemical Works about the use of organic chemicals and acid processes.

The Flexsys Rubber Chemicals Ltd is also listed as a historical Control of Major Accident Hazards sites (COMAH) and is the only site located within 500m of the subject site.

3.4.2 Landfills and Waste Management Activities

According to the environmental database searches, there are:

- No records of active landfill data within 500m of the site;
- No record of a BGS/DoE non-operational landfill site within 500m of the site;
- No record of landfills from the local authority and historical mapping records within 500m of the site;
- 1 record of historical waste was recorded within 500m of the site at the Ruabon Chemical Works (293m east of the site) concerning the waste transfer of 37 tonnes of a substance classified as ‘very toxic’;
- No record of licenced waste sites within 500m of the site.
- 2 records of Historical landfill sites as per EA/NRW records are located within 500m of the site, the closest being Edward brickyard located 7m NW of the site with a waste licence for collection of inert, industrial and household waste. However, this was last operated in 1995.

3.5 Ecological Aspects

As per Part A(2) of the environmental protection act, development plans and planning applications are required to consider potential sensitivity of areas such as SSSIs, National parks, areas of Outstanding natural Beauty, Special Area of Conservation and wetlands of international importance (RAMSAR sites) to name a few for protection from adverse effects from pollution.

The site does not lie within 500m of a National Nature Reserve, Marine Nature Reserve, Ramsar Site, Special Protection Area, Local Nature Reserve, and/or World Heritage Site (ecological). The site does not lie within a Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) or Designated Ancient Woodland (DAW), however, the River Dee (Afon Dyfrdwy) is classified as both a SSSI and SAC, the boundary of which lies 290m southwest of the site.

The River Dee and its tributaries (namely the Afon Mynach, Afon Meloch, Afon Tryweryn and Afon Ceiriog) support several habitats and species of national conservation importance. As a result, they are designated as Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act 1981. The whole of the River Dee/ Afon Dyfrdwy and the tributaries listed are also designated as a Special Area of Conservation (SAC) under the EU Habitats Directive. The River Dee/ Afon Dyfrdwy is notified as a SSSI for mainly for the unique transitions through a range of river habitat types from eutrophic to mesotrophic. Considering the distance of the river from the site and the current and past activity at the site, we conclude that no further consideration of ecological receptors is necessary from a contaminated land assessment perspective.

3.6 Unexploded Ordnance

According to the Zetica website (accessed 6th September 2021), the site has a low Unexploded Ordnance (UXO) hazard level. Notwithstanding this, a Zetica Pre-Study Desk Assessment (PSDA) was obtained (Appendix H) and states that whilst the WWII bombing represents a low risk, a mortar was identified close to the site and readily available records have been found to indicate that a munitions factory was established in the vicinity of the site. It is recommended that a detailed desk study is commissioned to assess, and potentially zone, the Unexploded Ordnance (UXO) hazard level before any further intrusive investigation or construction works.

4 HISTORICAL INFORMATION

4.1 Site History

Based on historical maps presented in Appendix I, the site history is summarised below. If potentially contaminative land use along with geotechnical constraints is identified, associated likely Contaminants of Concern (CoC) and ground constraints are given in the table below:

Table 2 – Site History and Potential Contaminative Land-Use

Site Use	Period	Detail
Canal Wharf, railway Sidings and Freight Yard	1887 – 1912	The earliest available mapping (1887) shows the site to comprise a canal wharf and a railway freight yard, with the site being used to transfer items between railway and canal infrastructure.
		Due to the anticipated breakdown over time, only immobile and durable contaminants have been considered. CoC: Metals, asbestos, organic compounds Constraints: potential relict foundations from old buildings
Canal Dock with Cottages and abandoned railway lines.	1961 – Present	Canal dock with cottages on the western boundary with one of them being demolished after 1963. At some point, these cottages were converted for commercial use
		CoC: Petroleum hydrocarbons locally

4.2 Potentially Contaminative History of the Surrounding Area

Based on the information detailed in the historical Ordnance Survey maps (Appendix I) and on the Groundsure reports (Appendix F) the potentially contaminative current/historical activities surrounding the site along with geotechnical constraints are summarised in the table below with associated likely Contaminants of Concern (CoC) taking into account the nature of historical activities on site and the industrial setting of the area, only sites in close proximity to the site boundary have been considered:

Table 3 – Potentially Contaminative History of the Surrounding Area

Potential Source / Activity	Location	Period of Activity	Detail
Smithy	~80m W	1875 – 1961	It is unlikely that any remaining contaminants are mobile enough to impact the site and is therefore discounted at this stage.
			CoC: n/a
Clay Pit	~80m W	1875	This Clay Pit was seen on the map dated 1875 and was later shown to be covered with sand. It is unlikely that any remaining contaminants are mobile enough to impact the site and is therefore discounted at this stage.
			CoC: n/a

Potential Source / Activity	Location	Period of Activity	Detail
Fire Clay Works with storage tanks.	~30m W	1875 – 1963	It is unlikely that any remaining contaminants are mobile enough to impact the site and is therefore discounted at this stage
			CoC: Metals, hydrocarbons, organic compounds
Mine Shaft (Coal) and potential spoil heaps	~10m W	1899 – Present	The shaft was backfilled, and no reports of mine gas emissions have been noted; it has therefore been discounted at this stage, however, the likelihood of colliery spoil and other waste being present adjacent to the site remains. Contaminants associated with this are unlikely to have the potential to migrate across the site boundary.
			CoC: Metals, hydrocarbons, organic compounds
Bridge End Farm	~30m SE	1912 – 1977	The farm is located hydraulically downgradient from the site and is therefore discounted at this stage.
			CoC: n/a
Former Industrial works and Current Car park and Coach drop off	~40m N and E	1960 – 2010 2010 – Present	The historical maps as well as aerial photographs indicate the presence of a former industrial works (unspecified use) in the neighbouring area, this site is located in hydraulically down gradient area of the site. This industrial works has been demolished and converted into a car park and coach drop off area in the year 2010. It is unlikely that any remaining contaminants are mobile enough to impact the site and is therefore discounted at this stage.
			CoC: Metals, hydrocarbons, organic compounds
Sewage works	350m SW	1949- Present	The sewage works present is likely used for treatment works for nearby residential and commercial area, It is unlikely that any remaining contaminants are mobile enough to impact the site and is therefore discounted at this stage.
			CoC: Metals, hydrocarbons, organic compounds

4.3 Historical Information Evaluation

In summary, the site has been used as a freight hub for goods being transported via canals and railways with the railways removed between 1938 and 1949. Made ground used to construct the site could be sourced from local industrial processes (possible colliery spoil or other waste) and impacts from the operations as a hub could have resulted in local spills and/or leaks of any number of products. The most notable potentially contaminative uses of the surrounding area (current and historical) are the historic coal workings along the western boundary of the site; other industrial usage occurs down hydraulic gradient of the subject site.

5 PRELIMINARY CONCEPTUAL SITE MODEL

This section summarises the findings of the desk-based assessment in the form of a geo-environmental conceptual site model (CSM). The CSM provides a qualitative evaluation of potentially active “pollutant linkages”; these being plausible scenarios whereby a contamination source is connected to a possible receptor by one or more pathways.

The linkages between the following CSM elements are summarised in Table 4 below:

- Potential viable current and historical **sources** of contamination as identified in previous sections of this report.
- Potential active **pathways** by which potential contamination may migrate from on and off-site sources to sensitive environmental and human health receptors; and,
- Sensitive environmental and human health **receptors** relevant to construction-phase of development, and future end-use. With reference to Part 2a of the Environmental Protection Act (1990), the potential receptors to be considered in this scenario are as follows:

Table 4 –Plausible SPR Linkages Assessment

Category	Receptor	Pathway	Rationale
Human Health	Construction Workers	Direct contact pathways	Construction workers/contractors could be exposed to potential contaminants during construction processes (i.e. during ground works for any demolition / redevelopment).
		Airborne pathways (vapours and ground gases)	Exposure in outdoor air scenarios is typically of negligible risk due to dilution. Care will need to be taken in any confined spaces needed during construction.
	Site Workers (commercial workers)	Direct contact pathways	The proposed development will comprise a leisure boat hire and as such future on-site workers are the primary “human health” receptors of concern.
		Airborne pathways (vapours and ground gases)	The proposed main structure includes office and storage space and therefore exposure to vapours and ground gases (inc radon) could occur. Whilst commercial worker exposure patterns are reduced from residential exposures, on-site workers are the primary “human health” receptors of concern
	Visitors (customers/tourists)	Direct contact pathways	As a commercial site, there will be customers/tourists regularly visiting the site; however any contact with the ground or exposure to airspaces will be short-term, temporary and infrequent.
		Airborne pathways (vapours and ground gases)	

Category	Receptor	Pathway	Rationale
Ecological Receptors	SSSI and SAC designated River Dee		Considering the distance of the river from the site and the current and past activity of the site, we can discard the river as a potential "ecological" receptor.
Controlled Waters	Surface Water	Vertical migration/late migration of contaminants through the unsaturated zone into groundwater beneath the site and subsequent migration to watercourses.	The on-site canal basin is considered a potential receptor; albeit at low to negligible risk due to the constructed nature of the canal walls.
			The likely groundwater flow direction is due south-east - water course receptors points in that direction are likely to be over 500m away and therefore unlikely to be at risk given the geology and the relative permeabilities.
	Groundwater	Site derived impacts in soil or perched groundwater migrating vertically down to impact the underlying aquifer resource.	Both the superficial and bedrock aquifers are classed as Secondary aquifers. and both are considered potential receptors.
		Groundwater impacted by site activities migrating off-site.	There are no known groundwater abstractions in the area.
Buildings and services including water supply pipes	Potable water supply pipes	Direct contact with contaminants in the soil and Made Ground leading to tainting of water supply.	Made Ground is likely to be present due to historical development within the site; historical uses have potential residual contamination impacts.
	Structures (above and below ground)	Migration of ground gases into buildings and accumulation of gasses in confined and poorly ventilated spaces leading to explosive gases or asphyxiation risk.	The main structure will include office and storage space. External structures will be light weight and ventilated.
		Ground conditions aggressive to concrete.	Made Ground soils could contain sulphide bearing minerals and an assessment of the risk to future buried concrete is recommended.

6 PRELIMINARY RISK ASSESSMENT

Based on the Preliminary Conceptual Site Model, the table below describes and evaluates the plausible Source-Pathway-Receptor (SPR) contamination linkages and the preliminary risk to sensitive receptors.

Table 5 – Preliminary Risk Assessment

Class	Receptor	Preliminary Risk	Justification / Mitigation
Human Health	Future site workers and visitors	Low to negligible	- The historic use of the site indicates that the site is brownfield and could be contaminated with a range of CoCs; however, the proposed use of the site as a commercial hire base is a low-risk end-use. - Testing of soils from the central area of the site (where historical rail sidings existed) has been undertaken with the Trust concluding that the soils are non-hazardous and do not pose a risk to end-users. - Made Ground soils and coal measures strata are all potential sources of ground gas albeit with relatively low emission rates and correspond low risk. The site is also located in a radon affected area (according to the atlas). On this basis it has been suggested that the installation of a gas membrane (lapped and taped around all joints and penetrations) into the main structure would be a prudent and cost-effective measure. With this in place the risk to site workers and visitors is considered low to negligible.
	Construction Workers	Low to negligible	Due to the historic use of the site for transport of goods by canal and railways, the potential for a range of contaminants of concern is relevant; however, on the basis of the limited soil testing undertaken by the Trust and the adoption of normal personal protective equipment (alongside other standard safe systems of work), the risk to construction workers is considered low to negligible.
Ecological Receptors	Flora and Fauna	Negligible	The River Dee is the nearest ecologically sensitive area (SSSI and SAC), however, when considering the site conditions and likely flow-path distances, the ecology of the river is not considered to be at risk over and above consideration as a “controlled water”.
Controlled Waters	Onsite canal	Negligible	Due to the constructed nature of the canal and the likely local hydrogeological conditions (permeability and flow direction) there is a negligible risk to Controlled Water receptors.
	Surface Watercourses		
	Secondary Undifferentiated and Secondary A Aquifer		

Class	Receptor	Preliminary Risk	Justification / Mitigation
Buildings and structures including water supply pipes	Underground/ structures/services (water pipes, concrete, foundations).	Low to negligible	- Made Ground soils and coal measures strata are all potential sources of ground gas albeit with relatively low emission rates and correspond low risk. The installation of a gas membrane (lapped and taped around all joints and penetrations) into the main structure would be a prudent and cost-effective measure. With this in place the risk to the structure from hazardous ground gas ingress is considered low to negligible. - It will be necessary to confirm with Welsh Water the requirements for the protection of any piped freshwater supply. In the absence of the bespoke testing it would be prudent to assume a protectalene or cast iron solution to ensure the risk is negligible. - Testing of soils to ensure future buried concrete is protected from potentially aggressive ground conditions should be undertaken. If testing in line with BRE SD1 is undertaken and a corresponding design class defined, the risk to the structure's foundations will be negligible.

6.1.1 Potential Geo-environmental Constraints

In the context of the site history, the proposed end-use and the investigation information provided by the Trust, Arcadis concludes that the soils pose a low to negligible risk to future site users (commercial workers and tourists/visitors) and that no further action is required in this regard.

The risks from emissions of permanent ground gases is similarly considered to be low (restricted source potential) however it would be prudent to incorporate a ground gas resistant membrane (lapped and taped at edges and around all penetrations) in the building construction. This would also protect future users from the potential risk from radon emissions.

Design of future water supply pipes and buried concrete specifications should be undertaken following appropriate testing (to Welsh Water and BRE standards respectively).

During construction, should conditions be encountered that differ from those encountered in the Trust's investigation, a procedure should be in place to consult the Local Planning Authority's contaminated land officer to agree an acceptable management and mitigation plan.

7 PRELIMINARY ENGINEERING CONSTRAINTS APPRAISAL

7.1 Site Preparation

The site is ostensibly unsurfaced land toward the south and centre of the site with the northern portion of the site being an asphalt access road, the latter of which is to be retained.

Prior to development, local topsoil will need to be stripped and carefully stockpiled for potential later use in landscaping areas.

Should the presence of any invasive/controlled plant species (e.g., Japanese Knotweed or Himalayan Balsam) be recorded, appropriate investigation and management of any such species should be undertaken.

7.2 Foundations & Floor Slabs

Made Ground is known to underlie the site with Devensian Till superficial deposits then clay, coal, mudstone, siltstone and sandstone of the Pennine Lower Coal Measures Formation and Pennine Middle Coal Measures Formation underlying that up to a depth of about 20.5m.

Given the lightly loaded nature of the commercial structures, it is likely that the Devensian Till will provide a suitable bearing stratum; albeit subject to confirmatory testing and approval of the local Building Control department.

7.3 Pavement Design

New roads and pavements should be designed to accommodate the traffic and loads expected. The underlying superficial Made Ground is of unknown thickness and engineering properties and therefore exploratory holes should be formed to establish the nature and extent of the Made Ground prior to construction.

7.4 Drainage Considerations

The Diamicton glacial till shows the presence of grey mottled brown clay with angular to sub-rounded fine, medium and coarse gravel underlying the Made Ground is unlikely to permit soakaway drainage and whilst the solid bedrock maybe amenable (should fracture spacing and porosity be adequate) this is also an unlikely solution. An alternative sustainable urban drainage design should be explored to minimise the risk of flooding.

7.5 Concrete Classification

Design/mix of buried concrete should be undertaken in accordance with BRE (2005) and suitable testing should be carried out for all geological units that could come into contact with concrete substructure.

The geological stratum underlying the site is not explicitly listed in the SD1 guidance; nevertheless, comprehensive testing should be undertaken to manage this potential risk.

7.6 Excavations and Groundwater

It is considered likely that future excavations should be feasible with an appropriate scale of hydraulic plant using sump-and-pump methods.

7.7 Soil Re-use & Waste Arisings

Any excess soils for disposal off-site will need to be managed under the appropriate legislation. Allowance of cost and time should be made for adequate waste characterisation. On the basis of the known historical uses, likely, excess soils generated through the development (i.e. Made Ground) would be classed as "Non-Hazardous". It is plausible that local areas of fill contain substances that would trigger a "Hazardous" waste class; alternatively, clean, virgin materials could be classed as "Non-hazardous: Inert"; for both of these latter cases Waste Acceptance Criteria (WAC) testing will be needed and landfill tax implications will apply to any "Hazardous" waste.

If waste soils are generated which are classified as Hazardous Waste, additional WAC testing would be required as would pre-treatment before disposal, unless a re-use on site could be found under a Materials Management Plan.

Any re-use of soils on site should be undertaken under a defined permit, permit exemption, or materials management plan (in line with CL:AIRE guidelines). In order to complete a materials management plan it will be necessary to complete a remediation or design statement and further investigation of the soils in question to confirm their suitability for use maybe necessary.

7.8 Potable Water Supply

There are currently no national standards for the protection of potable water supply pipes in potentially contaminated ground.

Generally, inorganic contaminants are unlikely to enter supply pipes but may be perceived by the water supplier to represent a potential exposure risk to their employees. This risk may be reduced or eliminated by use of a “sterile” trench (i.e. not containing such contamination sources).

Where hydrocarbon impacted soils are suspected, the use of cast iron or “Protect-A-line” pipework may be stipulated by the water supplier.

Requirement of the same is subject to confirmation through intrusive ground investigation and testing specific to Welsh Water requirements.

7.9 Health, Safety & Environment

All future work on site should be conducted in accordance with appropriate Health and Safety guidance, with particular reference to HSG66 “Protection of Workers and the General Public During the Development of Contaminated Land”. Appropriate PPE should be provided at all times to protect from chemical and typical biological hazards.

Care should be taken to minimise the risk of potentially contaminative incidents occurring during redevelopment (both from contaminated soils, but also inert soils as dust and debris to watercourses).

Good working practices should be adopted during construction works in order to minimise the risk of contamination occurring as a result of spillage or leakage of fuels, oils or chemicals stored or used at the site during re-development. All such materials should be sited on an impervious base within a bund and should be adequately secured. In particular, care should be taken to prevent fuel, oils, or other mobile contamination sources from entering any surface water drains at the site.

Considering the current Pandemic situation all measures pertaining to COVID-19 need to be taken care of while the investigation works are ongoing on the site.

Throughout any redevelopment works, due regard should be given to potential detrimental effects on the surroundings including noise, vibration, odour, and dust.

8 CONCLUSIONS & RECOMMENDATIONS

This report presents an assessment of the geo-environmental information pertaining to the site based on readily available desktop / published and online sources alongside a small-scale shallow soils investigation undertaken by the Trust.

The objective of this assessment was to collate and review the available geo-environmental information to determine potential ground contamination risks and engineering geology constraints associated with the site in its current condition in the context of its proposed future end use as a boat hire base.

8.1 Contaminated Land Risk

The overall preliminary risk for the site in context of current land-use and proposed development is considered **LOW**. This conclusion is based on the following conditions being fulfilled:

- A gas resistant membrane (lapped and taped at all joints and penetrations) is incorporated into the main structure.
- Construction workers will be given this information and appropriate PPE and safe systems of work will be deployed during construction to ensure their protection
- That Welsh Water will be consulted over the protection of water supply pipes as they traverse the site
- That the structures foundations (buried concrete) will be designed with due regard to BRE-SD1 and commensurate protection from potentially aggressive ground conditions.

8.2 Engineering Geology Constraints

The site is mapped as being directly underlain by superficial geology and therefore ground strength would require verification from an engineering perspective. Top soil and a clayey weathered horizon is expected to be present across the site and this needs to be characterised in terms of physical presence and engineering competency to establish the best management strategies for foundations, floor slabs, pavements and drainage (including soakaway options).

Sub-surface obstructions could remain on site from past uses and awareness of this risk should be passed on to the construction contractor.

Heavily weathered bedrock as seen in the BGS borehole logs warrant the engineering characterisation of the soils and rock together with an appraisal of the site's hydrogeology.

Any re-use of materials/soils on site should be undertaken with due recognition of waste management legislation; specifically the potential need for a Materials Management Plan in line with the CL:AIRE code of practice on soils re-use. Any off-site disposal should be undertaken following a separate and dedicated waste characterisation assessment of the material to be disposed of.

8.3 Recommendations

This desk study report together with the appendices should be provided to the designers and contractors for the proposed structures and development works to ensure the measures assumed in the contaminated land risk assessment and defined in the engineering assessment can be accounted for as the development progresses.

Appendix A

Figure 1 Site Location Plan



TITLE:

SITE LOCATION PLAN

SITE:

Trevor Basin

CLIENT:

Canal and River Trust

PROJECT: **10043637**

FIGURE 1

DATE: **16/9/2021**

DRAWN BY: **AD**

DRG No: **10050394-ARC-XX-XX-DR-ZZ-0002-01-Site Location Plan**

SCALE: **1:4,500**

PRINT: **A4**



LEGEND

 Site Boundary

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 30 60 90 120

