



GROUNDTECH
CONSULTING

AFAN WAY, PROT TALBOT

PILING RISK ASSESSMENT

ALDI STORES LIMITED

JUNE 2023

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Plans		
<i>Plan Reference</i>	<i>Revision</i>	<i>Title</i>
GRO-20289-P01	-	Project Location Plan
GRO-20289-P02	-	Preliminary Development Constraints Plan
GRO-20289-P06	-	Soil Contamination Plan
GRO-20289-P10	-	Site Specific Risk Assessment – Piling

1.0 INTRODUCTION

1.1 Project Objectives

Groundtech Consulting Limited have been instructed by Craddys on behalf of Aldi Stores Ltd to undertake a Piling Risk Assessment for a site at Afan Way in Port Talbot.

Neath Port Talbot Council and Natural Resource Wales (NRW) have concerns over foundations and piling as activities with the potential to cause, or allow the migration of, pollution into controlled waters. In general this consists of sites which are underlain by aquifers and penetration of a clay layer previously providing protection to an underlying aquifer. Penetrating foundation solutions such as piles have the potential to cause negative environmental effects when utilised on contaminated sites. This is largely due to the downdrag associated with these solutions.

Neath Port Talbot Council have concerns over the noise generated by driven piles due to the surrounding residential areas. Discussions with National Resource Wales have been undertaken and NRW have suggested any piling solution will be accepted provided the current guidance has been followed and the risks of contamination have been kept as low as reasonably possible.

This assessment determines the appropriate piling method and any mitigation and monitoring measures required for piling on the subject site which is affected by contamination. Mitigation measures are discussed, and Quality assurance and quality control, and longer-term monitoring recommended.

The main constraints which will be addressed as part of this risk assessment are as follows:

- *Polluting substances in the ground that are in a leachable or mobile form*
- *The piling or ground improvement method of choice breach a low permeability layer (aquitard) or the basal liner of a closed landfill site, or penetrate an aquifer*
- *Hydraulic gradient that could cause contaminants in near surface deposits to migrate into an underlying aquifer or surface water body*
- *The pile made out of a material that could allow passage of contaminants*
- *The piling method of choice have the potential to create a preferential flowpath for the migration of contaminated perched water or leachate into an aquifer or surface water body*
- *The breaching of impermeable covers ('caps') by piling allowing the escape of landfill or ground gases*
- *Contaminated arisings being brought to the surface by piling work, with the risks of subsequent exposure to site workers and residents, and the need for appropriate handling*

There is the recognition of a lack of available scientific knowledge on the environmental implications and effects of piling resulting in a precautionary approach.

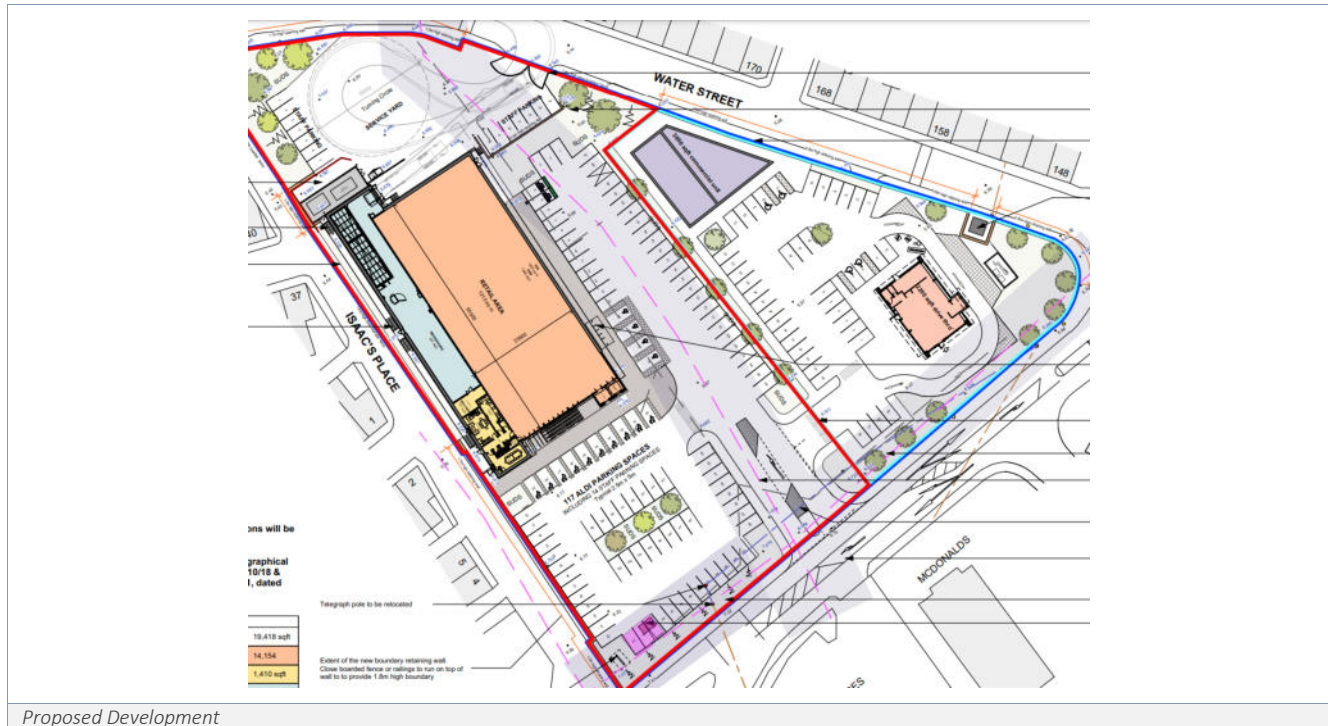
1.2 Site Details

The site is roughly triangular in shape covering an area of approximately 1.12 hectares, site elevations fall slightly from west to east.

The majority of the site is currently surfaced by grassland and shrubs with several stockpiles of material from previously demolished buildings. Some areas of site are hardsurfaced with tarmac. The foundations of the previous buildings on site are still in place. There is an electricity substation situated in the southern corner of site.

1.3 Proposed Development

The proposed development is commercial end use comprising the erection of a class A1 food store with associated access, car parking and soft landscaping.



1.4 Sources of Information

In preparing this Piling Risk Assessment the following documents were reviewed and should be read in conjunction with this report:

- *Groundtech Consulting Geo-Environmental Appraisal, dated 8th December 2021 (Ref. GRO-21252-3003).*
- *Groundtech Consulting Permanent Ground Gas Risk Assessment, dated 22nd April 2022 (Ref. GRO-21252-3237).*
- *Quantum Geotechnical Supplementary Phase II Ground Investigation – Interpretive Report dated June 2016 (Ref. G762/IR).*
- *Arcadis Ground investigation Report dated April 2018 (Ref. 10013618-AFS-GLR-G001).*

1.5 Limitations

Other conditions may exist on the site that have not been taken into account in this assessment as they are outside the scope of works. Groundtech Consulting are not responsible for these circumstances that are not outlined in the report.

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2.0 SUMMARY OF CONTAMINATIVE SOURCES

2.1 Site History and Consultations

History

The site was occupied by Burrows Tin Plate Works with numerous other buildings from 1881. In 1900 a pond in the western area of the site was infilled and redeveloped into railway tracks. A tank was placed in the centre of the site in 1939. In 1950 the eastern area of site was developed with Talbot Works Bakery Engineering with additional tanks and chimneys being added to the existing tin plate works. Residential dwellings and a well were constructed in the northern area. Between 1957 and 1962 a mortuary was developed east of the residential homes. In 1964 the bakery engineering works was redeveloped into sign post works. Between 1971 and 1993 all the buildings on site were assumed to be demolished as they were no longer shown on historical maps.

Environmental Information

The following environmental information was identified:

- No radon protection is indicated to be required within the proposed development at the site.
- The site does lie in a Coal Mining Reporting area.
- There are three recorded landfill/waste sites within 250m.
- There are 21 pollution incidents or discharge consents within 250m of site.
- The site is within a flood risk zone.

2.2 Geo-Environmental Testing Results - Soil

Geo-Environmental testing was scheduled by both Groundtech Consulting, Arcadis and Quantum as part of their respective investigations and the results are summarized in the table below based on commercial end use:

Contaminants of Concern	No. samples tested	No. elevations	Details
Metals	40	1	1 elevation for arsenic
Polycyclic Aromatic Hydrocarbons (PAHs)	44	1	1 elevation for Dibenzo(ah)anthracene
TPH CWG	50	5	2 elevations for p&m-xylene 1 elevation for o-xylene 1 elevation for ethylbenzene 1 elevated sample of benzene
Polychlorinated Biphenyl (PCBs)	30	0	-
Asbestos	45	27	Between <0.001% mass and 0.075% mass
Cyanide	40	2	2 elevations for cyanide

The locations of the contamination present within the soils are represented spatially on the Groundtech Soil Contamination Plan GRO-21252-P03.

2.3 Geo-Environmental Testing Results – Groundwater

Groundwater testing was also undertaken by Quantum, Arcadis and Groundtech Consulting which is summarized in the table below:

Contaminant of Concern	No. samples tested	No. elevations	Details
Metals	32	68	1 elevation of chromium 24 elevations of copper 21 elevations of zinc 4 elevations of lead 2 elevation of nickel 1 elevation of mercury 2 elevations of Cadmium 13 elevations of Manganese
Polycyclic Aromatic Hydrocarbons (PAHs)	32	3	3 elevations of PAHs. Elevations of Naphthalene
TPH CWG	38	5	5 elevations of TPH C10-C40
Cyanide	7	0	-

Quantum

Quantum tested samples from the perched groundwater. Of the samples tested by Quantum, extremely high concentrations of speciated TPH were recorded in five of the samples. Four of these elevations were from the area of site close to the former petrol filling station and are within the perched groundwater within the Made Ground. One sample was from the proposed location of the Aldi Store and was taken from the perched groundwater. Elevated concentrations of heavy metals including Arsenic, Copper, Nickel, Tin and Zinc were also encountered across the site particularly in the vicinity of the former PFS, council yard and former pond areas.

Arcadis

21 No. groundwater samples were collected from the mobile groundwater within the Secondary Undifferentiated aquifer and screened for metals. 13 No. exceedances in Copper, Manganese and Zinc were recorded. Zinc concentrations were recorded at 7 to 8 times the EQS. There is a modest degree of metallic impactation of the mobile groundwater due to infiltration and leaching from site soils.

All 21 No. groundwater samples screened for speciated PAHs were below the laboratory limit of detection in all three monitoring rounds.

All 21 No. groundwater samples screened for TPH CWG and BTEX were below the laboratory limit of detection. This indicates that previous results from the Quantum investigation in 2015 were a “false positive” and representative of water quality encountered in shallow excavations.

Groundtech Consulting

Four groundwater samples obtained from the aquifer were tested for a range of CoCs by Groundtech, one elevation of chromium was recorded.

3.0 GROUND MODEL

3.1 Ground Conditions

Made Ground

During the sites previous ground investigations, the exploratory holes encountered variable Made Ground to a maximum depth of 3.1m comprising clayey sandy gravel, clayey gravelly sand, and sandy gravelly clay with high cobble content. During the investigations several trial pits and boreholes were noted as being heavily contaminated with strong hydrocarbon odours, discolouration and oily sheens.

As part of the Groundtech Consulting investigation, Made Ground was encountered to depths of between 1.0m and 2.9m bgl. The Made Ground encountered in this investigation comprised brown sandy gravel, black sandy gravel and red brown silty gravelly sand. Groundtech Consulting noted had visual evidence of contamination including ash, coal and slag and olfactory evidence of contamination was noted within TP01, TP06, TP10, TP13, and TP15 with a moderate to strong hydrocarbon odour.

Natural Strata

From previous investigations, cohesive Estuarine Alluvium deposits comprising sandy gravelly Silt or soft to firm slightly sandy Clay was encountered at depths between 2.0m and 4.7m bgl. Granular Estuarine deposits comprising dense light orange brown sandy Gravel or very gravelly Sand with low to medium cobble content was encountered at depths between 3.5m and 6.6m bgl.

Three main natural stratifications were encountered during the investigation by Groundtech Consulting. Soft to firm grey sandy Clay was present from 1.35m to 4.0m bgl. Soft grey brown silty Clay was observed at depths between 1.2m and 5.3m bgl. Dense brown Sand and Gravel was encountered from depths of 1.9m bgl to a maximum observed depth of 7.5m bgl. Groundtech encountered discolouration and staining within the natural superficial deposits were noted within TP05 at 1.6m bgl, TP15 at 2.2m and 2.7m bgl, WS03 at 1.0m and 1.9m bgl.

Bedrock was not encountered during any investigation conducted on the site.

3.2 Groundwater

As part of the Groundtech Consulting investigation groundwater was encountered within the Made Ground and natural strata. Perched groundwater within the Made Ground was very localised and encountered between the depths of 1.0m bgl and 2.0m bgl. Groundwater strikes within natural Sand and Gravel and sandy silty Clay deposits were encountered at depths of between 2.4m bgl and 5.3m bgl.

Previous site investigations encountered groundwater between 2.5m and 4.5m bgl.

4.0 RECEPTOR

4.1 Hydrogeology

The superficial Estuarine Alluvium Deposits in this area are classified by the Environment Agency as a Secondary Undifferentiated Aquifer. The South Wales Middle Coal Measures Formation bedrock is classified as Secondary A Aquifer.

The site is not within 500m of a Source Protection Zone and there are no groundwater or potable water abstractions within 2000m of the site.

4.2 Hydrology

The nearest named watercourse is the River Afan which is circa 86m south. The nearest active surface water abstraction is circa 107m south east relating to process water for usage by Tata Steel UK Ltd.

5.0 PRELIMINARY ASSESSMENT AND INITIAL PILE SELECTION

Shallow foundations were not considered suitable by Groundtech consulting and Quantum Geotechnical due to low strength Clay at foundation depth and shallow groundwater. Piled foundations were recommended for the proposed development by Groundtech Consulting and Quantum.

The thickness of the impermeable aquitard separating the shallow perched groundwater and contaminated Made Ground and the deeper groundwater has ranged from a minimum of 0.9m to a maximum thickness of 2.5m in thickness in the Groundtech Consulting, Arcadis and Quantum's investigations. SPT 'N' values and site descriptions have classified the Clay to be soft to firm in consistency. Quantum and Groundtech Consulting have classified the Clay as being of medium plasticity based off the Geotechnical testing undertaken as part of their investigations. The clays are considered malleable.

The proposed location of the Aldi store is in the west of the site where soft Clay is at its thickest. The thickness of soft Clay in the west of the site across the three investigations ranged between 1.6m and 2.5m.

Neath Port Talbot Council have raised concerns about the noise pollution caused by driven piles and would prefer Continuous flight Auger (CFA) piles to be utilised to reduce the impact on the surrounding residential areas.

CFA piles are therefore considered to be the most suitable foundation solution for the proposed development transferring the load of the proposed store through the low strength soft Clay deposits into the underlying granular soils.

6.0 HAZARDS AND ADVERSE IMPACTS

6.1 Assessment Context and Approach

The installation of piled foundations can have significant environmental constraints if not adequately considered and adequately managed during the planning stage. The Environment Agency document '*Piling and penetrative ground improvement methods on land affected by contamination: Guidance on pollution prevention*' considers six pollution scenarios which could occur when installing piled foundations on contaminated sites.

The six scenarios considered are as follows:

1. *Creation of preferential pathways, through a low permeability layer (an aquitard), to allow potential contamination of an underlying aquifer*
2. *Creation of preferential pathways, through a low permeability surface layer, to allow upward migration of landfill gas, soil gas or contaminant vapours to the surface*
3. *Direct contact of site workers and others with contaminated soil arisings which have been brought to the surface*
4. *Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of pile materials (where the secondary effects are to increase the potential for contaminant migration)*
5. *The driving of solid contaminants down into an aquifer during pile driving*
6. *Contamination of groundwater and, subsequently, surface waters by concrete, cement paste or grout*

It is important to consider the potential pollution hazards associated with piling and ground improvement works in the context of the environment in which sites are located using Source-Pathway-Receptor (S-P-R) linkage. The overall level of risk is a product of the probability of harm occurring and the consequence of that harm (Environment Agency, 2000b).

The groundwater Vulnerability as discussed in Section 4.0 is of principal in Concern, a Secondary Undifferentiated Secondary A Aquifer and the River Afan are the receptors identified.

In the case of piling and ground improvement works, concerns about water protection are likely to be most acute when:

- *Contaminants are present on the site and ground works could allow them to migrate*
- *Piling would breach a low permeability layer or connect two previously discrete aquifers*
- *The site overlies an Aquifer*
- *The site is located within a Source Protection Zone*
- *Groundwater is currently of good quality*
- *The water table is shallow or likely to be intersected by piles*
- *The geological strata are fractured or fissured*
- *Works are close to a surface water body and run-off from arisings could pollute those waters*

NRWs stance to proposals for piling on contaminated sites will be based on the overall level of risk that piling is likely to present, the techniques, any mitigation measures and the quality assurance and control (QA/QC) methods discussed in Section 8.2.

6.2 Pollution Scenario(s)

Pollution Scenario 1

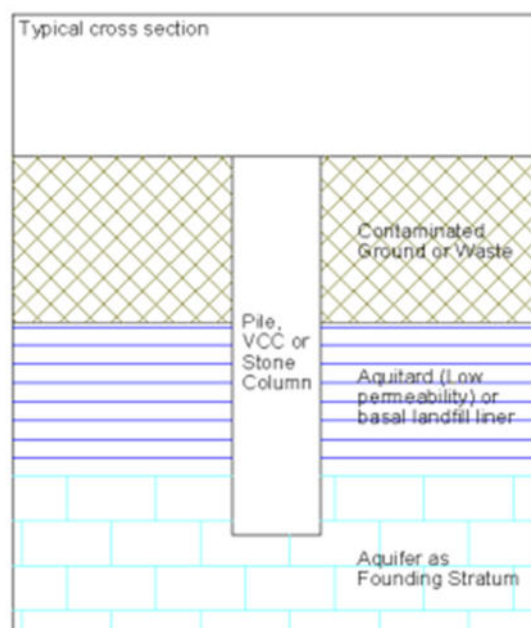
Upon review of 'Piling and penetrative ground improvement methods on land affected by contamination: Guidance on pollution prevention' it can be seen that the site corresponds to Pollution Scenario 1 - Creation of preferential pathways, through a low permeability layer (an aquitard), to allow potential contamination of an aquifer.

In this scenario a preferential pathway is created when an aquitard layer sits between perched water in overlying soils and an underlying aquifer. The disturbance of the aquitard layer when installing the piled foundation has the potential to create a migration pathway along the pile-soil interface and through the disturbed ground between the overlying perched water and the underlying aquifer when the aquitard is breached.

Non-displacement piling methods such as CFA piles involve the extraction of soil prior to the placing of the pile. Theoretically therefore there is no disturbance of the surrounding soil and provided that the pile is formed or placed in intimate contact with the surrounding soil there should be no formation of preferential pathways. Where there is no alternative to piling, continuous flight augered piles pose the least risk of groundwater pollution. The thickness of the aquitard is required to be at least 2 times the thickness of the pile. The clays underlying the site are considered malleable and should seal around the pile which means that the development of preferential flow paths around the outside of the piles is unlikely.

Poor workmanship could lead to the collapse of the boreholes or the creation of voids and create preferential pathways. Appropriate QA/QC methods should be incorporated into the works to enable workmanship to be monitored and verified.

In general, it is considered that provided good workmanship is practiced continuous flight augered piles have a very low risk of creating a pathway.



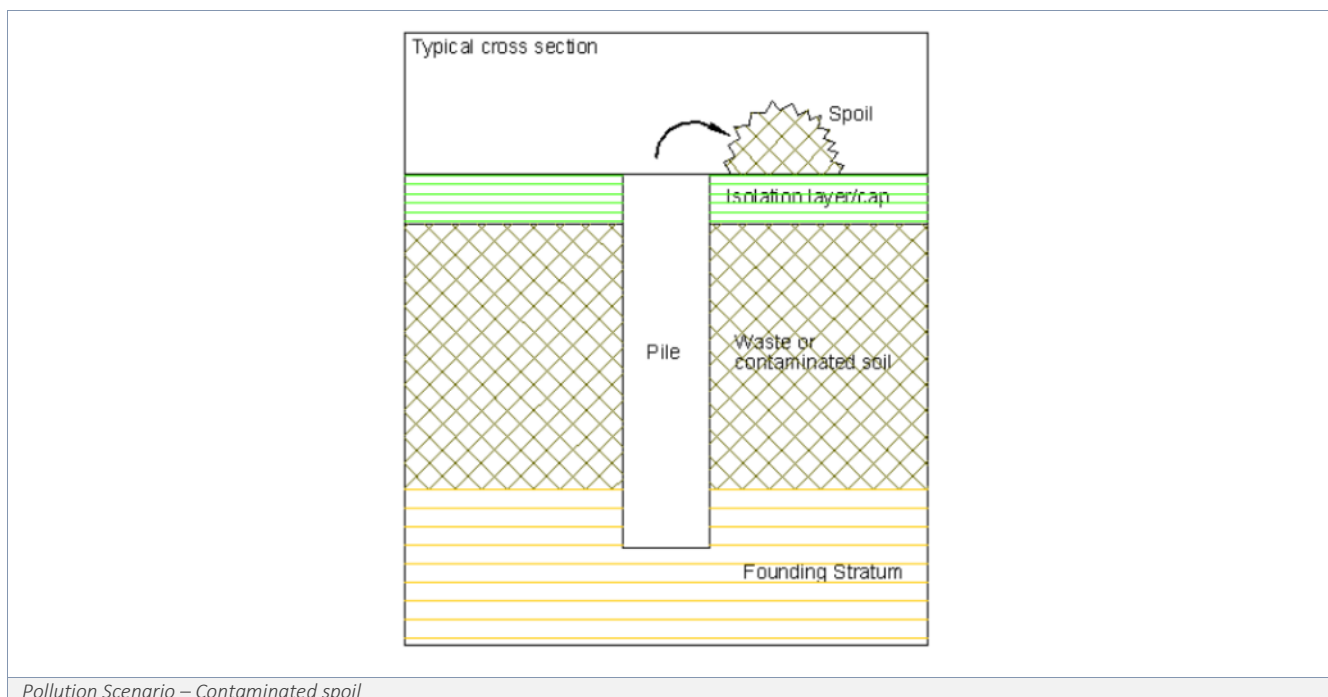
Pollution Scenario – Breaching an aquitard.

CFA piles are likely to form a seal provide that good workmanship is practiced. Contaminated Made Ground is removed as the borehole is drilled limiting potential exposure to the groundwater. There is no downdrag of contaminated materials.

Pollution Scenario 3

Pollution Scenario 3: Direct contact of site workers and others with contaminated soil arisings that have been brought to the surface. This is in regards to the spoil produced by the CFA piles when boring. The piling process is likely to mix contaminated and uncontaminated soils, leading to an increased volume of contaminated materials for disposal. As the soil contains asbestos the creation of arisings may be particularly undesirable. Contaminated piling arisings may also cause cross-contamination to isolation layers.

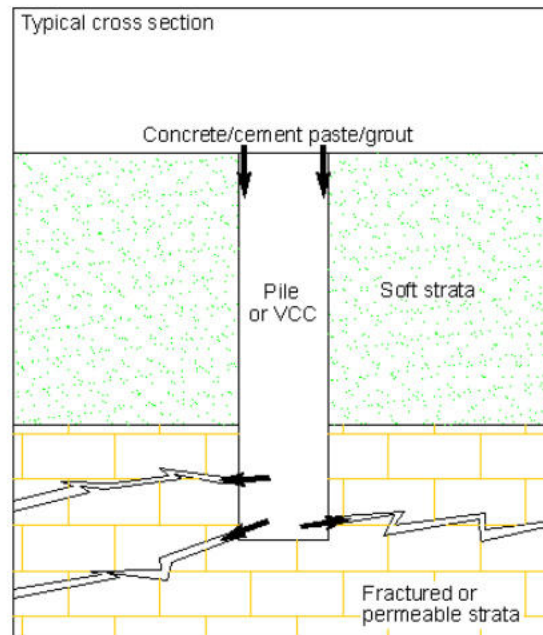
Air monitoring at the site should be undertaken to confirm that airborne asbestos fibre concentrations were always within safe limits. Arisings ideally should be reused on site.



Pollution Scenario 6

Pollution Scenario 6: Contamination of groundwater and, subsequently, surface waters by wet concrete, cement paste or grout. Loss of wet concrete, cement paste or grout may occur in fast-flowing groundwater, probably associated with fractured or jointed rocks such as permeable gravel formations found on site. Migration may occur until setting of the concrete, cement paste or grout occurs; this would generally occur on a timescale of a few minutes. Use of retarder additives could extend this timescale to a few hours, although their effectiveness would be reduced by dilution. In most circumstances, therefore, the impact, if any, is likely to be localised.

A piling method which avoids the risk of loss (e.g. use of permanent casing) would generally be chosen when piling through permeable strata. A method statement and appropriate QC/QA should be undertaken to ensure good workmanship.



Pollution Scenario – Injection of concrete into groundwater.

7.0 SITE SPECIFIC RISK ASSESSMENT

A site specific risk assessment has been undertaken to identify any realistic pollution linkages which may arise from the proposed piling works in order to quantify the risk controlled waters. The site specific risk assessment is presented as Groundtech Plan GRO-21252-P10.

The objective of this section is to propose a robust, effective and transparent decision making process that allows designers to select an appropriate piling method and mitigation measures, if required, when piling on contaminated sites.

Sufficient information is available in order to allow judgements regarding the applicability of each potential S-P-R linkage at the site and the potential for the preferred piling method to create additional linkages.

The following Pollution Scenarios are not considered applicable to the subject site:

- *Pollution Scenario 2: Creation of preferential pathways, through a low permeability surface layer, to allow migration of landfill gas, soil gas or contaminant vapours to the surface – **groundwater table not a gas source***
- *Pollution Scenario 4: Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of pile materials – **contaminated soils and groundwater perched above significant clay aquitard and correct pile material to be selected by piling contractor.***
- *Pollution Scenario 5: The driving of solid contaminants down into an aquifer during pile driving – **No material is driven down when CFA piles are used.***

8.0 CONFIRMATION OF PILING METHOD

8.1 Final Assessment

Based on the information gathered by the site specific risk assessment, the most appropriate foundation solution for the proposed development is considered to be Continuous Flight Auger. Within the building's footprint 1.6m to 2.5m of soft cohesive clay exists.

The cohesive material is considered malleable and will create a good seal around the pile which will prevent migration of the contaminated shallow perched groundwater and leached contaminants through the cohesive deposits into the underlying Sand and Gravel aquifer along the pile-soil interface. Based on a 300mm diameter pile, three to eight pile widths of the soft Clay aquitard exists between the Made Ground and the underlying aquifer.

Another consideration is the groundwater testing undertaken by Groundtech Consulting, Arcadis and Quantum as part of their investigation which demonstrates that the underlying groundwater within the deeper aquifer has been impacted with metals potentially through leaching of onsite contaminants. Arcadis suggested from their investigation that there is a local background level of metal that impact site. There is no evidence that the hydrocarbon contaminated perched shallow groundwater has affected the deeper groundwater body. One of the reasons for a piling risk assessment is if the groundwater quality in the aquifer is good, this is not the case in this instance due to offsite and onsite sources impacting the groundwater quality.

The piling risk assessment has confirmed that no monitoring requirements are necessary.

The hardsurfacing and drainage strategy will prevent infiltration and perched groundwater levels will be permanently lowered.

8.2 Quality Assurance and Quality Control

The selected specialist piling contractor should be responsible for undertaking Quality Assurance and Quality Control processes.

A method statement will be produced by the piling contractor which will include a watching brief being maintained during the piling works. Good workmanship will be required when installing the piles to ensure the assumptions in this report are met.

The Quality Assurance and Control procedures should ensure the pile type/material is durable to contaminated land. The procedures implemented should also prevent contamination of groundwater and, subsequently, surface waters by wet concrete, cement paste or grout.

In general, all site works should be carried out under an appropriate quality assurance and quality control (QA/QC) regime, which should be rigorously specified in the contract. In the case of potential environmental impacts, appropriate methods and measures for quality assurance and quality control need to be detailed. Groundwater monitoring may be necessary where the overall risks to groundwater are greatest, taking account of the level and mobility of contamination, engineering techniques applied and environmental setting. Groundwater monitoring will generally only be required on areas of Principal Aquifers, or within Source Protection Zones unless there are specific issues of local concern that justify monitoring in others locations.

Those responsible for workmanship should be made aware of the reasoning behind the required procedures discussed above.

9.0 RELEVANT INDUSTRY REFERENCES

Building Research Establishment (1986). Choosing Piles for New Construction, BRE Digest 315.

Boutwell, G.P., Nataraj, M.S. and McManis, K.L. (2000). Deep Foundations on Brownfields Sites. PRAGUE 2000 Conference, Prague.

Chellis, R.D. (1961). Pile Foundations. 2nd Edition. McGraw-Hill.

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Environment Agency (1998). Policy & Practice for the Protection of Groundwater. The Stationery Office.

Matheson, N.C. & Wain, D.E. (1989). Methods of Constructing Piles on Heavily Contaminated Sites. Proceedings of the 3rd International Conference of Piling and deep Foundations. London. AA Balkema: Rotterdam.

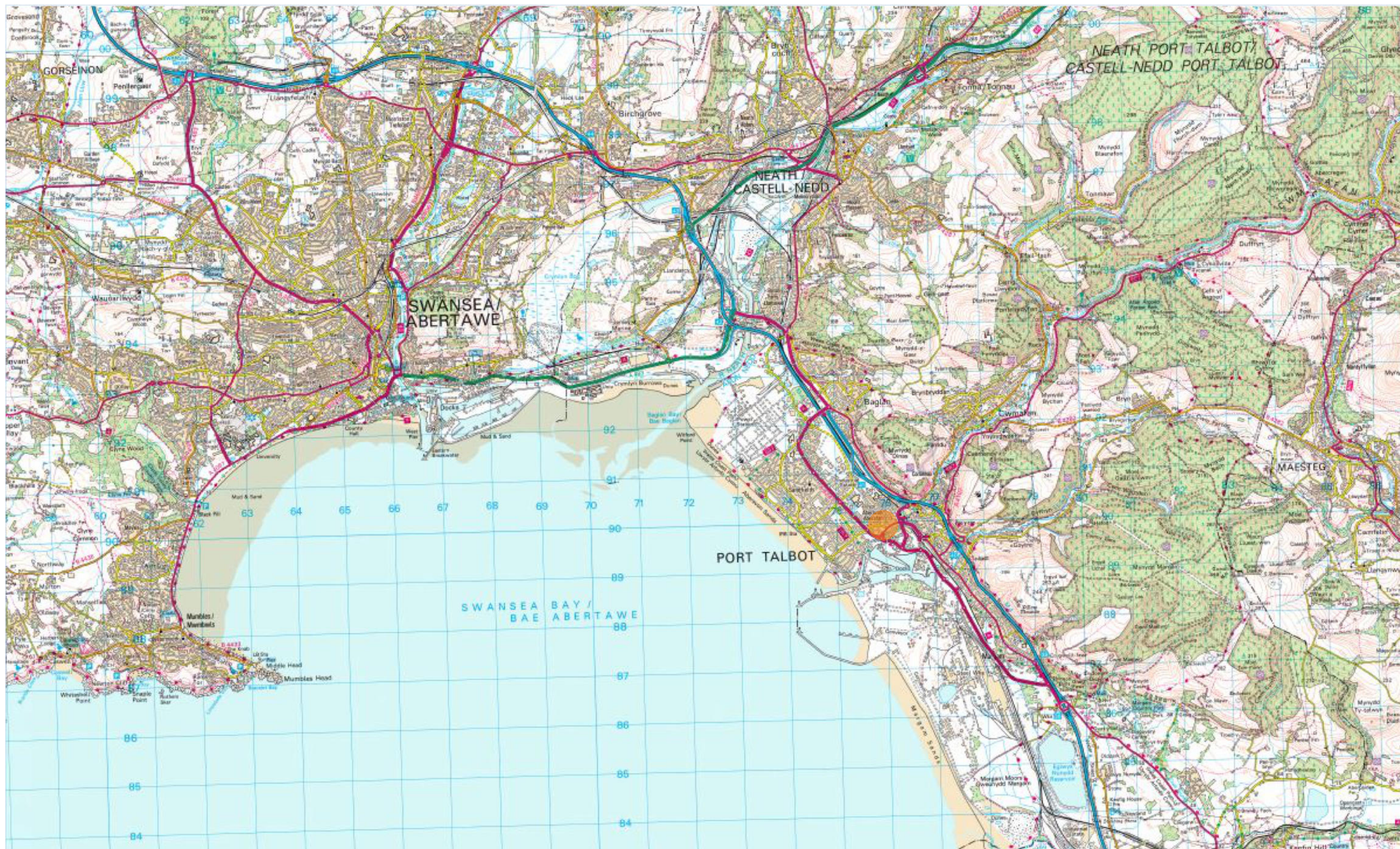
Piling and penetrative ground improvement methods on land affected by contamination: Guidance on pollution prevention. Environment Agency, 2001.

Piling into contaminated sites. Environment Agency, 2002.

Piling in layered ground: risks to groundwater and archaeology. Environment Agency, 2006.

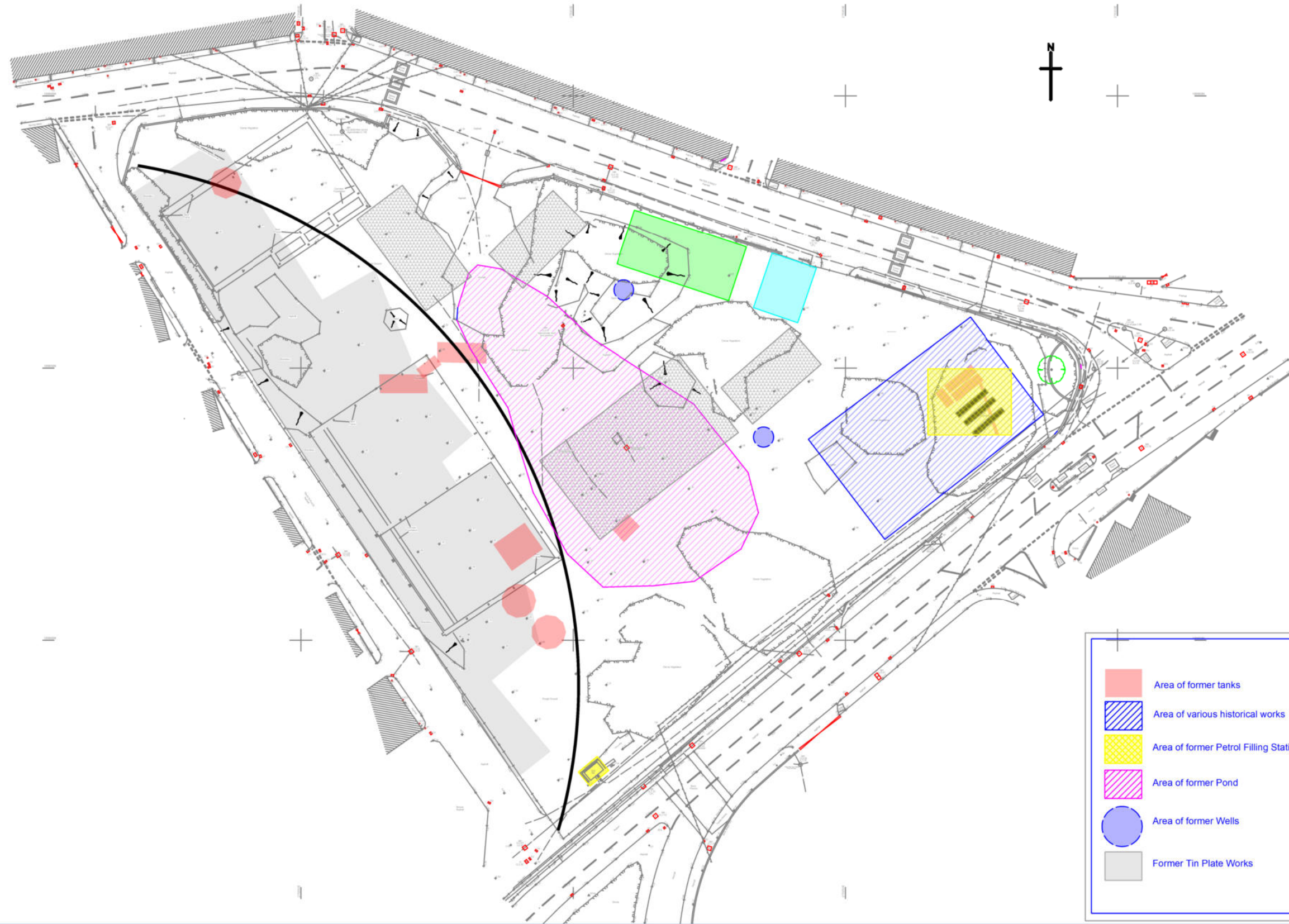
Piling in layered ground: risks to groundwater and archaeology summary. Environment Agency, 2006.

APPENDIX 1 - Plans



GROUNDTECH CONSULTING	CLIENT	DATE			Status	Notes SITE LOCATION
	ALDI STORES LTD	NOVEMBER 2021			Preliminary	
	PROJECT TITLE	SCALE			Draft	
	AFAN WAY, PORT TALBOT	NTS			Issued	
	PLAN TITLE	PLAN NUMBER			For Comment	
	PROJECT LOCATION PLAN	GRO-21252-P01	Rev.	Details	Date	Approved





LEGEND	
	Area of former tanks
	Area of various historical works
	Area of former Petrol Filling Station
	Area of former Pond
	Area of former Wells
	Former Tin Plate Works
	Former residential buildings
	Former Mortuary
	Substation
	Former Corporation Depot
	Historical Railway

SOURCES

- A. Contaminated Soils / Made Ground.
- B. Contaminated Shallow Perched Groundwater

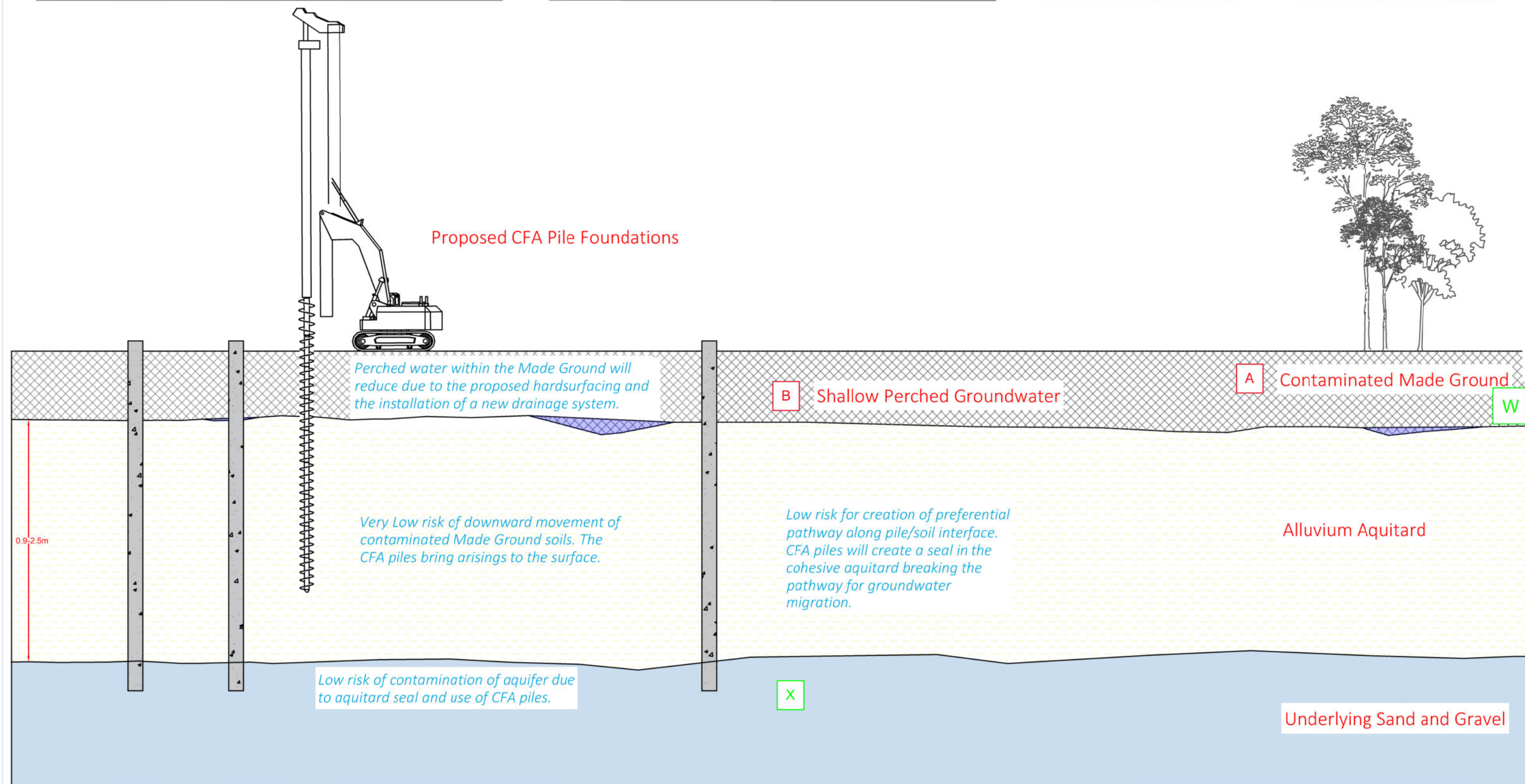
A. Contaminated Soils / Made Ground.
B. Contaminated Shallow Perched Groundwater

POLLUTION LINKAGES
P1. Creation of Preferential Pathway. P2. Perched Water. P3. Contamination of Underlying Aquifer.

- P1. Creation of Preferential Pathway.
- P2. Perched Water.
- P3. Contamination of Underlying Aquifer.

RECEPTORS
W. Afan River located c.86m south. X. Groundwater within the underlying Sand and Gravel Aquifer.

W. Afan River located c.86m south.
X. Groundwater within the underlying Sand and Gravel Aquifer.



APPENDIX 2 - Limitations

