



Islington Wharf Phase 4, Ancoats

Piling Risk Assessment

For Waterside Places

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1. INTRODUCTION

Hydrock has been commissioned by Waterside Places to undertake a piling risk assessment for a development site known as Islington Wharf Phase 4, located to the southeast of the Junction of Old Mill Street and Great Ancoats Street, Manchester. This assessment should be read in conjunction with other reports produced by Hydrock, detailed in Section 1.2 below.

The proposed development, as shown on Ryder Architecture drawing (ref. IW4-RYD-00-XX-VS-A-3610), presented in Appendix A, is to comprise a mixed commercial and residential end use with associated car parking in the south west and soft landscaping at the north and east perimeter. The apartment blocks will vary in height between 16 storeys and 11 storeys high.

Due to the nature of the proposed development, and the ground conditions underlying the site, piled foundations are required. This assessment has been undertaken to determine if there are any increased environmental risks from previously identified soil contamination to controlled waters and human health that may arise as a result of the piling.

The assessment has been carried out using guidance contained within Environment Agency Report “Piling and penetrative ground improvement methods on land affected by contamination: Guidance on pollution prevention” (REF: NC/99/73), in particular, the risk assessment flow chart included as Figure 6.1.

Reference is also made to Environment Agency Report “Piling in layered ground: risks to groundwater and archaeology” (REF: SC020074/SR).

1.1 SITE LOCATION AND DESCRIPTION

The site is located immediately to the southeast of the Junction of Old Mill Street and Great Ancoats Street, Manchester, M4 6DN. The National Grid Reference of the approximate centre of the site is 385246,398249.

The site is vacant, covering approximately 0.18 ha and currently comprises an area of relatively flat brownfield land. The site has recently been used as a construction compound for the adjacent Islington Wharf Phases.

The majority of the site is surfaced with asphalt hardstanding with some areas of exposed sub base material and relic concrete base/floors.

Local ground levels across the site vary slightly, largely depending on the presence of hardstanding areas. The site falls towards the west, from a high point of 51.11m OD in the east to a low point of 46.10m OD in the west.

1.2 PREVIOUS WORKS

The site has been the subject of environmental investigations and assessments carried out by Hydrock. These reports are listed below.

In preparing this report, the following documents (and all documents referenced within) were consulted and should be read in conjunction with this report:

- Hydrock, Ground Conditions Desk Study, Islington Wharf Phase 4, October 2018, ref. IW4-HYD-XX-XX-RP-GE-0001_Desk_Study.

- Hydrock, Ground Investigation Report, Islington Wharf Phase 4, June 2020, ref. 10042-HYD-XX-XX-RP-GE-0002_S02_P03.
- Hydrock, Technical Design Note: Investigation of PAH, Arsenic and Lead impacted soils, June 2020, ref. 10042-HYD-XX-XX-RP-GE-0003.
- Hydrock, Remediation Strategy, Islington Wharf Phase 4, October 2020, ref. IW4-HYD-XX-XX-RP-GE-0004.

1.3 SITE HISTORY

From 1851 the site was completely covered by buildings and associated yards comprising a public house, a timber yard, a smithy and a number of houses. The east of the site was occupied by a building and yard associated with Moore's cotton mill, which extended off-site towards the north and east, with houses in the southeast of the site.

By 1889 the timber yard and smithy in the west had gone, and Moore's mill had been demolished and replaced with a school, with buildings and playgrounds forming the eastern part of the site. Some of the buildings present in 1938 in the north western part of the site had disappeared in the 1948 maps, indicating possible damage from German bombing.

The school in the east of the site had been demolished by 1985, with the east of the site being left as open ground. The remaining buildings occupying the site had been completely cleared by 1987, and the site left vacant until 2017 when it was used as a construction compound.

2. GEOLOGY AND PROVEN GROUND CONDITIONS

The general geology of the site area is shown on the British Geological Survey (BGS) 1:50,000 geological map of Manchester (Sheet 85) and is summarised in Table 1.0.

Table 1.0: Geology

Ref. for Figures	Location	Stratigraphic Name	Description
Superficial Deposits			
1	Beneath the whole site.	Glacial Till	Typically firm to stiff clays and silts with varying amounts of sand, gravel and cobbles of mixed lithology. Locally may also contain occasional boulders.
Solid Geology			
1	Beneath the whole site.	Chester Formation	Typically red or brown pebbly sandstones with generally thin, subordinate siltstones and mudstones.

A variable thickness of Made Ground will underlie the entire site associated with the site's historical use.

There are no faults shown to run beneath, or within influencing distance of, the site.

The Hydrock 2020 ground investigations proved the following ground conditions:

- Made Ground – between 1.2 and 4.0m below ground level (bgl), comprising clayey gravel and cobbles and sandy gravel and cobbles with brick, concrete, metal and plastic fragments.
- Upper cohesive Glacial Till – underlying the Made Ground proven to depths between 15.0m and 17.0m bgl. Comprising firm becoming stiff brown slightly silty gravelly clay.
- Lower granular Glacial Till – underlying the cohesive Glacial Till and proven to 21.6 and 26.0m bgl. The base of this strata is unproven. Comprising very dense sand and gravels with low to medium cobble content.

3. HYDROGEOLOGY

The Made Ground is classified by the Environment Agency as Unproductive Strata. The Glacial Till is classified as being a Secondary (undifferentiated) aquifer, and the Chester Formation is a Principal aquifer.

The Hydrock 2020 ground investigations proved the following groundwater conditions:

- Groundwater was encountered at depths between 3.1m bgl and 11.5m bgl during the investigation.
- Water levels recorded post-fieldwork ranged from 1.23m bgl to 21.55m.
- There is shallow groundwater in the Made Ground and cohesive Glacial Till. A deeper groundwater unit is present at approximately 21m below ground level (bgl) within lower granular Glacial Till.

The Glacial Till is classified as a Secondary (undifferentiated) aquifer, however it is important to note that whilst there are localised perched water bodies sat within isolated granular lenses within the upper Glacial Till cohesive deposits, the general cohesive nature of these deposits will act to significantly restrict vertical migration of contaminants into the underlying more permeable strata within the lower granular Glacial Till.

4. HYDROLOGY

The nearest surface water bodies are canals, located 50m and 70m away, and an unnamed river located 240m away. The River Medlock is located 465m to the southwest of the site.

The site is not within a groundwater Source Protection Zone (SPZ) and there are no active, licensed groundwater abstractions within 1km of the site.

5. SUMMARY OF RISK ASSESSMENTS

5.1 Human Health

Based on the results of the investigations and risk assessments, the following contaminants in soils are identified as representative of the contamination present posing a risk to end users of the site:

- Significantly elevated concentrations of localised PAH, in the Made Ground.
- Significantly elevated concentrations of localised Arsenic and Lead in the Made Ground at TP02 and TP106-TP108.
- Asbestos fibres (<0.001%v/v of chrysotile) detected in the Made Ground at three locations (BH02, TP03 and TP01) and one asbestos cement fragment identified in TP05.
- Elevated concentrations of petroleum hydrocarbons Aliphatic 12-16 and Aromatics >EC21-EC35 at BH02.

5.2 Controlled Waters

Elevated concentrations of metals, inorganics, PAH and petroleum hydrocarbons have been identified in the perched groundwater in the Made Ground within BH02. There is however no evidence of any free phase hydrocarbons being present, which presents a low possibility of an additional pathway being created. on this basis Hydrock consider the risk from perched groundwater to the underlying aquifers to be low during piling works.

5.3 Ground Gas

There is a low risk from ground gases and CS1 conditions apply.

6. SELECTION OF FOUNDATIONS

Whilst the proposed loadings have not been provided, piled foundations extending into the very dense granular Glacial Till have been recommended to support the structural loadings of the new building. Although the strength of superficial deposits does eventually increase with depth, it is not until approximately 14.0 – 15.0m bgl that the Glacial Till becomes stiff. Based on the borehole data the very dense sand and gravel is recorded at approximately 17.0 – 20.0m below current ground level equivalent to 30.18m AOD – 27.18m AOD.

Pile lengths are expected to be in the range of 20 to 25m.

Depending on column loads and layouts, piles will likely be required to extend through the Made Ground and cohesive Glacial Till and end bear a suitable depth into the underlying granular Glacial Till. A proportion of the support will be achieved through shaft friction within the Glacial Till with adequate allowance being made for negative skin friction with the Made Ground.

At this stage it is assumed that Continuous Flight Auger (CFA) piles or Continuous Helical Displacement (CHD) piles with casing are to be used. As the piling method has not yet been confirmed the use of driven piles are also considered in the assessment.

The principal construction differences between these piling methods are:

- CFA – soil is extracted from the piling hole via an auger and a tremie pipe used to pump pressurised concrete to the base of the hole as the auger is withdrawn;
- CHD – an auger is also used however the principal difference to the CFA piles are that the soils pushed aside by the auger resulting in minimal returns. As above, tremie pipe used to pump pressurised concrete to the base of the hole as the auger is withdrawn; and
- Driven Piles – pre-fabricated piles are driven from the surface with no soil returns.

The choice of pile installation method and plant selection will need to consider the presence of obstructions both within the Made Ground and the underlying natural deposits. As a minimum, localised measures will be required to address potential for voids and obstructions in the made ground prior to piling.

7. SITE SPECIFIC RISK ASSESSMENT

7.1 Context

The purpose of the following risk assessment is to identify what additional risks to the environment piling may introduce and if necessary, to put in place mitigation measures that will remove any significant adverse impacts. The six pollution scenarios suggested in Report NC/99/73 will be considered in terms of their potential Source-Pathway-Receptor (S-P-R) linkages on this site.

Within the Proposed Piling Footprint

The Made Ground in the north east of the site contains localised significantly elevated concentrations of PAHs, arsenic and lead. The Made Ground at the site also contains sporadic loose asbestos fibres and one occurrence of asbestos-containing materials (ACM).

Outside of the Proposed Piling Footprint

The Made Ground at BH02 contains elevated concentrations of petroleum hydrocarbons Aliphatic 12-16 and Aromatics >EC21-EC35 at BH02.

The perched groundwater within the Made Ground at BH02 contains elevated concentrations of metals, inorganics, PAH and petroleum hydrocarbons.

For further details refer to Hydrock contamination zonation plan (ref. 10042-HYD-XX-XX-DR-GE-0004) and Hydrock remediation zonation plan (ref. 10042-HYD-XX-XX-DR-GE-0009) provided in Appendix A.

7.2 Pollution Scenario 1 - Creation of Preferential Pathways - Groundwater

The following potential pollutant linkage has been assessed:

- Source – Contaminated Made Ground.
- Pathway – Pile / soil interface.
- Receptor – Groundwater in Secondary (Undifferentiated) Aquifer of the Glacial Till and the Principal Aquifer of the Chester Formation.

In terms of pollutant linkages, the following factors have been considered:

- » Significantly elevated levels of PAHs, arsenic and lead have been identified in Made Ground following the ground investigations;
- » The upper Glacial Till is composed almost entirely of low permeability clay and essentially constitutes an aquiclude, protecting the lower granular Glacial Till and the Principal Aquifer of the Chester Formation;
- » the upper cohesive Glacial Till is of significant thickness, proven to depths of between 10.0m bgl and 15.0m bgl;
- » there are no licensed groundwater abstractions within 1km of the site; and
- » the site is not within a designated groundwater source protection zone (SPZ).

7.2.1 CFA and CHD piles

CFA or CHD piles are installed by the use of an auger. On reaching the proposed depth of installation, concrete is tremied to the base of the auger under pressure and the auger gradually withdrawn at an appropriate rate.

For CFA piles, any disturbance to the ground is minimal and there should be no formation of preferential pathways, as the concrete is cast in intimate contact with the surrounding soil upon completion.

For CHD piles, granular Made Ground and superficial deposits will be densified as the soil is displaced laterally and there should be no formation of preferential pathways, as the concrete is cast in intimate contact with the surrounding soil.

The piling will be carried out by experienced operators who will monitor piling operations to maintain the quality of the installations and ensure a good soil/pile interface.

7.2.2 Driven piles

By using driven piles, the granular Made Ground and superficial deposits will be densified as it is displaced laterally. This will reduce the permeability and will inhibit groundwater flow in the Made Ground and superficial deposits.

In permeable soils, the densifying effect of the driving of large displacement piles will set up high soil stresses that will improve the soil/pile shaft contact. A suitable analogy would be to compare the driving of a nail into a block of wood; the harder the wood, the more difficult it is to extract the nail because of the grip that the wood exerts. Hence the pile should be in intimate contact with the ground.

In less permeable ground conditions (e.g. the upper, cohesive Glacial Till) the soil will remould around the pile shaft¹, thereby sealing off any possible pathways for transfer of shallow contaminants vertically down into the groundwater in the lower Glacial Till or underlying Chester Formation.

7.2.3 Conclusion

When addressing the potential for new pathways to be created by the above piling methods, the type of contamination and exposure time should also be considered.

Because there has been no contamination identified in liquid or leachate form within the piling footprint, it is considered less likely a contaminant pathway will be created in the absence of characteristically mobile contaminants.

The contact time between any contamination from the Made Ground and the pile /soil interface is envisaged to be short-lived in each instance due to pile installation time and the sealing of soil around the pile interface once completed. Therefore, should any potential pathway be created, this would likely be temporary until the pile has been installed.

Taking into account the above factors it is considered that the risk of piling creating an additional pathway is negligible and either driven or CFA/CHD piles are considered suitable.

7.3 Pollution Scenario 2 – Creation of Preferential Pathways, through a low permeability layer, to allow migration of landfill gas, soil gas or contaminant vapours to the surface.

This scenario is not considered applicable, as the groundwater present in the permeable lower Glacial Till beneath the low permeability upper Glacial Till is not a significant contaminant source.

7.4 Pollution Scenario 3 – Direct Contact of Site Workers

The following potential pollutant linkage has been assessed:

- Source – Contaminated soil.
- Pathway – Direct contact with excavated arisings.
- Receptor – Construction workers.

For CHD piles, granular Made Ground and superficial deposits soil will be densified as the soil is displaced laterally and minimal soil is brought to the surface.

For driven piles there is normally no removal of soil, and consequently this is not a significant risk.

¹ SC020074 indicates that for a cylindrical pile, a good seal is achieved when through a clay thickness of at least 2 pile diameters. The upper clay layer in the Glacial Till is substantially thicker than this.

In the case of CFA piles, soil held on the flights of the auger is brought to surface during the withdrawal of the auger and could potentially include contaminated material.

The contractor will be familiar with their obligations in respect to protection of his workforce and will be obliged to comply with ‘duty of care’ and the use of appropriate mitigation measures (e.g. PPE and good hygiene). If contaminated material is present, it will be segregated and disposed of offsite at an appropriately licensed waste management facility in accordance with Part II of EPA 1990 and supporting regulations.

Taking into account the above factors, it is considered that the risk of direct contact of contaminated soils with site workers is low if mitigation measures are employed. However, due to the potential for asbestos to be present in the Made Ground soils, in order to reduce ongoing health and safety and occupational health risks, the preferred option is to install driven piles, which will result in no contaminated spoil being derived.

7.5 Pollution Scenario 4 – Degradation of Pile Materials

The following potential pollutant linkage has been assessed:

- Source – Elevated concentrations of contaminants in soil/groundwater.
- Pathway – Direct contact with pile.
- Receptor – Built development – piles.

The concrete piles proposed will be designed to be capable of resisting the levels of contamination indicated and concrete will be designed to resist sulphate attack, and so there is no significant risk.

Included within the Hydrock ground investigation report is a risk assessment for buried concrete based on guidelines provided in BRE Special Digest 1 (BRE 2005). The assessment indicates that the Made Ground can be classified as Design Sulphate Class DS-1 and ACEC Class AC-1, the Glacial Till can be classified as Design Sulphate Class DS-1 and ACEC Class AC-1.

Furthermore, no Non-aqueous Phase Liquid (NAPL) has been identified and as such the opportunity for degradation of pile materials is limited.

On the basis of the above guidance the risks in relation to Pollution Scenario 4 are perceived to be low. In order to mitigate the risk, all below ground concrete will be designed for the aggressive environment in accordance with recommendations in Special Digest 1.

7.6 Pollution Scenario 5 – Driving Down Solid Contaminants

The following potential pollutant linkage has been assessed:

- Source – Elevated concentrations of contaminants in soil.
- Pathway – Soil driven down with pile.
- Receptor – Groundwater in Secondary (Undifferentiated) Aquifer of the Glacial Till and the Principal Aquifer of the Chester Formation.

For CFA and CHD piles, there is no risk of driving down solid contaminants as soil is either displaced laterally or brought to the surface.

Driven piles of solid cross section displace soil laterally rather than downwards. The precast concrete piles are usually manufactured with a pointed or slightly convex “domed” end to the pile toe,

minimising the risk of driving down contaminants. The nail into a block of wood analogy can also be applied here; the nail will not push even soft wood ahead of the point and removing the point to simulate the pile toe has no further detrimental effect.

As stated in NC/99/73, some vertical downwards movement of soil due to frictional down drag can occur along the sides of the pile shaft but this is typically limited and Hydrock consider this to not represent a significant risk.

7.7 Pollution Scenario 6 – Contamination by Concrete, Cement or Grout

The following potential pollutant linkage has been assessed:

- Source – Concrete, cement paste or grout.
- Pathway – Flow within highly permeable or fractured strata.
- Receptor – Groundwater and abstractions.

For CFA and CHD piles the void created by the auger is filled with wet concrete, cement paste or grout. In general, it is noted that there have been cases of increased turbidity and pH in groundwater abstracted from public supply wells as a result of piling operations having been undertaken in close proximity. Pollution Scenario 5 is of primary significance in fast flowing groundwater environments, such as fractured or jointed chalk or very permeable sand and gravel formations. Whilst Granular Glacial Till has been proven at depth beneath the site and is the proposed founding horizon for the piles, given the depth and density of this strata Hydrock would consider the permeability likely to be moderate.

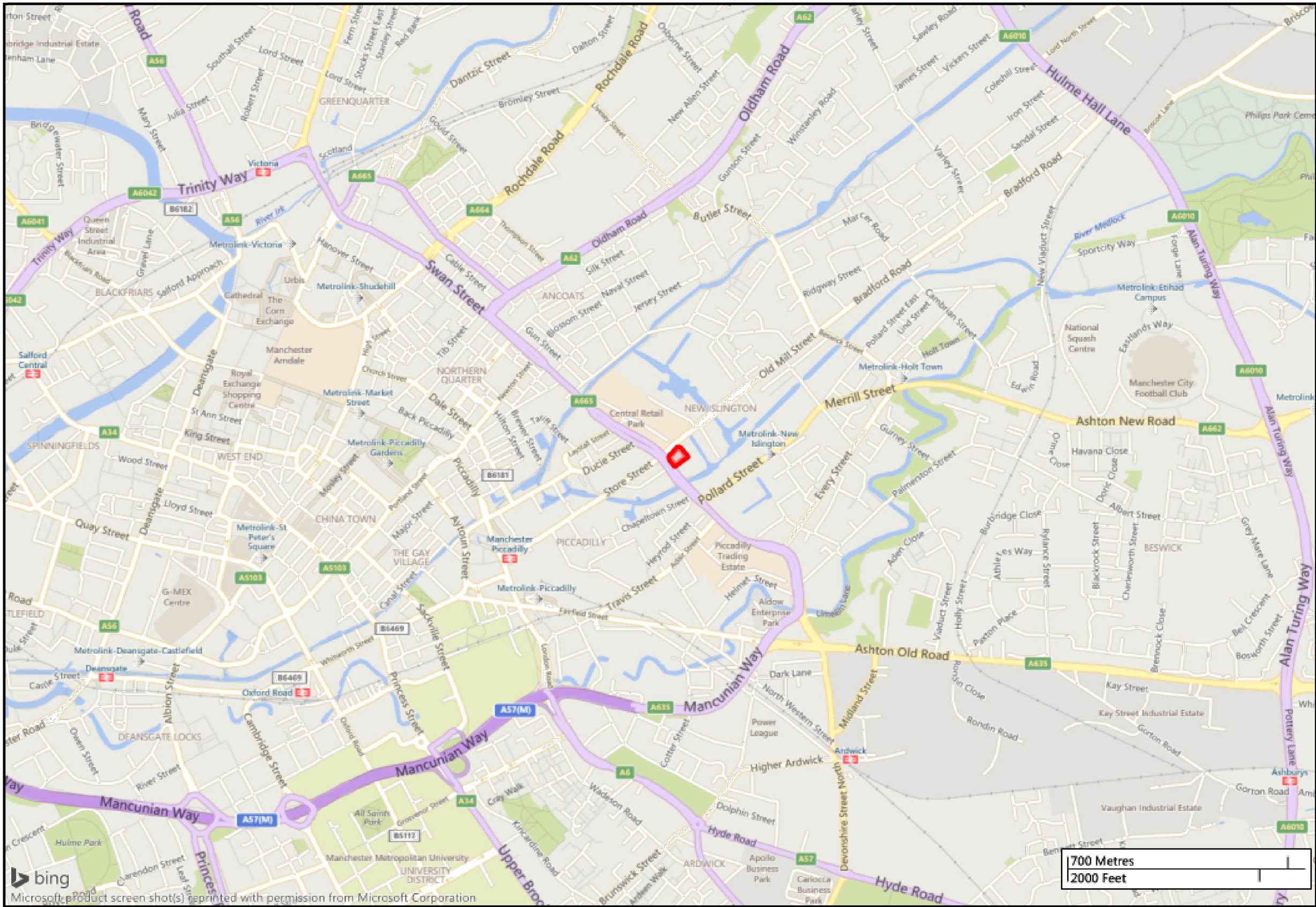
It is also noted that there are no active licensed groundwater abstractions for potable supply in the vicinity of the site. On this basis, the risk of significant groundwater contamination by cement from CFA or CHD piles is perceived to be low, and any effect is likely to be highly localised and temporary.

Driven piles are manufactured off site and there is no risk of increased turbidity or pH in groundwater due to wet concrete, cement paste or grout.

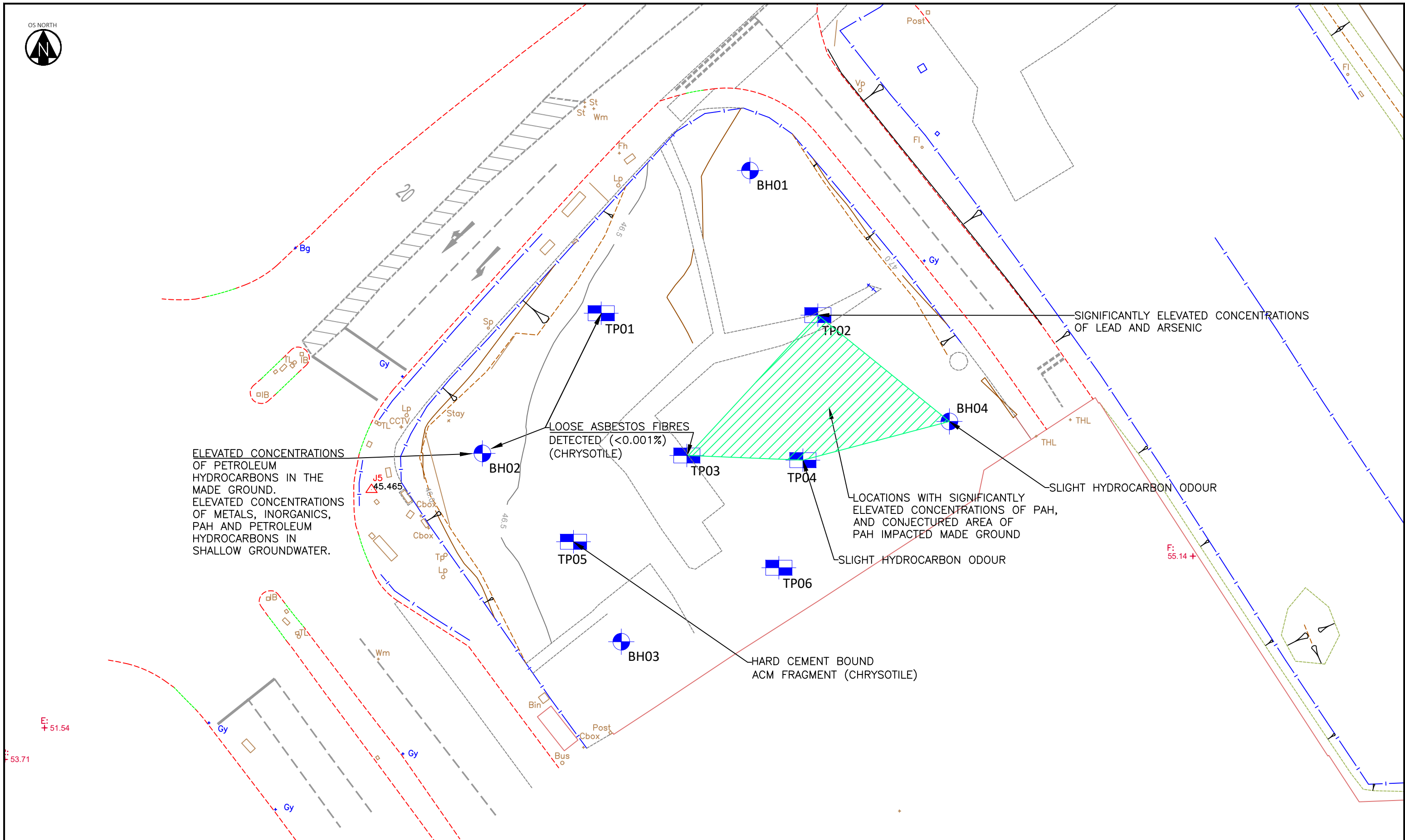
8. CONCLUSIONS

In conclusion, Hydrock considers that the use of piles (driven, CFA or CHD) at the site will not create additional risks to human health via direct contact or to the Secondary A aquifer of the Glacial Till or Principal Aquifer of the Chester Sandstone Formation.

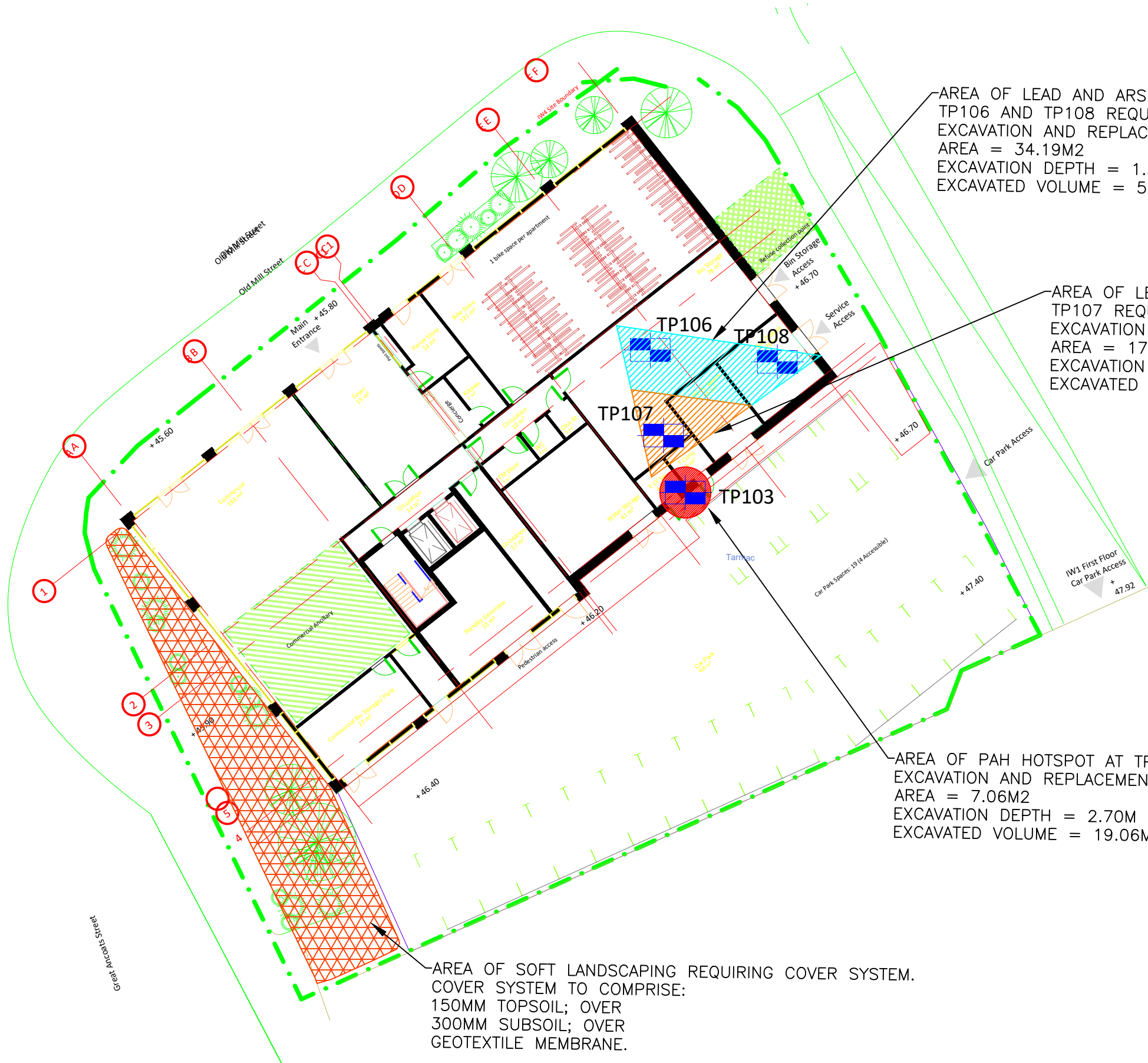
Appendix A Drawings



Rev	Date	Description	By	Ckd
Architect :				
  Hydrock Consultants Ltd 4 Lakeside Festival Park Stoke-on-Trent ST1 5RY T +44 (0)1782 261919 stoke@hydrock.com www.hydrock.com				
Client :				
MUSE DEVELOPMENTS				
Project Title:				
ISLINGTON WHARF PHASE 4				
Drawing Title:				
Site Location Plan				
Reference:				
IW4-HYD-XX-XX-DR-GE-0001				
Hydrock Job No:				
C-10042-C				
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TW	DH	As Shown	05/10/18	08/10/18
Revision:			Status:	
P01			S2	



KEY TPXX BHXX	Hydrock Trial Pit	NOTES 1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing. 2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications. 3. This drawing has been based on the following drawings and information: xxxxxxxx				Hydrock 4 Lakeside Festival Way Stoke-on-Trent ST1 5RY t: +44(0) 1782 261919 e: stoke@hydrock.com or visit www.hydrock.com	TITLE		
	CONTAMINATION ZONATION PLAN								
	HYDROCK PROJECT NO. C-10042						SCALE @ A3 NTS		
	PURPOSE OF ISSUE SUITABLE FOR INFORMATION						STATUS S2		
	DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 10042-HYD-XX-XX-DR-GE-0004						REVISION P1		
	Hydrock Borehole						CLIENT		
							WATERSIDE PLACES		
							PROJECT		
							ISLINGTON WHARF PHASE 4		



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							HYDROCK PROJECT NO. C-10042		SCALE @ A3 NTS	
							PURPOSE OF ISSUE SUITABLE FOR INFORMATION		STATUS S2	
							DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) 10042-HYD-XX-XX-DR-GE-0009		REVISION P1	