



COMPLEX CHALLENGES ... MADE SIMPLE

Table 7.0		Refined Conceptual Site Model				
Source	Pathway	Receptor	Severity	Probability	Risk definition	Comments
						soil vapour has been undertaken to assess the likely risks posed to human health from soil vapour. Concentrations measured are below commercial GACs.
		Construction Workers	Medium	Unlikely	Low	Due to the depth of the contaminated groundwater it is considered unlikely that this will pose a risk to construction workers. If proposed construction works are likely to come into contact with groundwater in these areas of the site, suitable mitigation measures (appropriate PPE, control measures and welfare facilities) will be required.
		Future Site User: Residents, commercial site users and users of areas of public open space	Medium	Unlikely	Low	Given the depth of this contamination it is considered unlikely that it would migrate at significant concentrations into buildings on site. It is noted that basement construction is not included within the proposed buildings on Plot NT02 and NT03. If this changes in future revisions to the development plans it may be necessary to re-assess this linkage.
	Chemical attack and permeation	Below ground infrastructure & construction	Medium	Unlikely	Low	Unlikely that utilities will come into contact with contaminated groundwater due to depth below site
	Ground gas Migration / Accumulation	Construction workers	Severe	Unlikely	–Moderate/low	It is unlikely further significant sources of ground gas exist off-site with the potential to impact the current site. However, gas protection measures have been recommended and appropriate personal ground gas detection equipment should be deployed by all site operatives when working in below ground or confined spaces.
		Current / Future Site Users	Severe	Unlikely	–Moderate/low	

7.0.1 The refined conceptual site model has identified the following potentially complete pollutant linkages requiring mitigation:

NT02 and western area of Plot NT03

- On site made ground soil contamination (Heavy metals, PAH, TPH and asbestos in made ground) and chlorinated VOC in soils from historic site usage - boltworks) – future residential site users - direct contact in areas of public open space – ingestion, dermal, dust/fibre inhalation and ingestion.
- On site made ground soil contamination (Heavy metals, PAH, TPH and asbestos in made ground and from historic site usage - boltworks) – adjacent site users and public open space users - direct contact in areas of public open space or from wind blown dust – ingestion, dermal, dust/fibre inhalation and ingestion.
- On-site contamination (made ground, and chlorinated VOC in soils from historic site usage - boltworks) - current/future buildings and services - direct contact with contaminated soils or groundwater - chemical attack.
- On-site contamination (Heavy metals, PAH, TPH, in made ground) – Principal aquifer – leaching from soils/ percolation to aquifer/ lateral migration of dissolved phase etc.
- On-site contamination (Chlorinated VOC in unsaturated soils and from historic site usage - boltworks) – Future residential site users – inhalation exposure with impacted soil and groundwater.
- On-site contamination (Chlorinated VOC in unsaturated soils from historic site usage - boltworks) – Principal aquifer – leaching from soils/ percolation to aquifer/ lateral migration of dissolved phase etc.
- On-site made ground - ground gas (methane and carbon dioxide) - current/ future site users – commercial / residential users - migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation
- On-site made ground - ground gas (methane and carbon dioxide) - current/ future buildings and services - migration and ingress of ground gases into buildings, build-up in confined spaces and explosion

NT04 and eastern area of Plot NT03

- On site made ground soil contamination (Heavy metals, PAH, TPH and asbestos in made ground) – future residential site users - direct contact in areas of public open space – ingestion, dermal, dust/fibre inhalation and ingestion.
- On site made ground soil contamination (Heavy metals, PAH, TPH and asbestos in made ground) – adjacent site users and public open space users - direct contact in areas of public open space or from wind blown dust – ingestion, dermal, dust/fibre inhalation and ingestion.
- On-site contamination (made ground) - current/future buildings and services - direct contact with contaminated soils or groundwater - chemical attack.
- On-site contamination (Heavy metals, PAH, TPH, in made ground) – Principal aquifer – leaching from soils/ percolation to aquifer/ lateral migration of dissolved phase etc.
- On-site made ground - ground gas (methane and carbon dioxide) - current/ future site users – commercial / residential users - migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation

COMPLEX CHALLENGES ... MADE SIMPLE

- On-site made ground - ground gas (methane and carbon dioxide) - current/ future buildings and services - migration and ingress of ground gases into buildings, build-up in confined spaces and explosion

Summary of ground contamination risks

- 7.0.2 Re-appraisal and reassessment of the conceptual site model (following completion of investigation works) has serious sources of contamination likely requiring remediation. Due the nature and extent of some of the onsite contamination (particularly, chlorinated solvent contamination), a Detailed Quantitative Risk Assessment has been completed and is provided as an inclusion to this report
- 7.0.3 The results of the Detailed Quantitative Risk Assessment has been used to support the development of a Phase 3a Remediation Strategy for the site. Under the current proposals the majority of the site will be covered in buildings and areas of hardstanding. While hardstanding will inhibit exposure pathways between site users and contaminated soils, areas of soft landscaping have the potential to expose future site users to contaminants. In addition, construction workers will be exposed to these contaminants during excavation works and may also release mobile contaminants that may be stored in any below ground relic structures.
- 7.0.4 A detailed remediation design should be undertaken as part of a Remediation Strategy for the site but are likely to include the provision of a clean soil capping system in areas of proposed soft landscaping, with a minimum thickness of 600mm, of which 150mm should be topsoil. This system should also be subject to a validation system of its own including chemical testing and validation excavations. Vapour control measures may also be required as recommended by the Remediation Strategy.
- 7.0.5 Furthermore, an area of chlorinated solvent contamination has been identified in plot NT02. This is considered to comprise a potentially significant area of contamination with the potential to affect controlled waters and human health risk receptors. Remediation of this source will be required, likely to comprise at minimum, the excavation and treatment of site soils, and possibly also including groundwater treatment. The remedial requirements will be determined following the completion of the DQRA and development of Remedial Targets in the Remediation Strategy.
- 7.0.6 Given the potential presence of the aforementioned contamination within the area of Plot NT02 and potential risks posed towards construction / demolition contractors during the enabling works phase, it is recommended that the proposed remedial works are completed (ideally) in advance of any below ground excavations or slab removal. The demolition of buildings to ground level would still be possible but, given the potential vapour exposure risks with soils in this area, grubbing out works of foundations and drainage etc should be captured as part of the remediation works. Further the ground floor slab will act as a barrier to site operative and protect the ground for surface water leaching, until such time as the remediation is ready to progress.

Ground Gas Protection Measures

- 7.0.7 Ground gas protection measures are anticipated as a requirement in new buildings in accordance with a CIRIA C665 CS2 scenario on Plots NT02 and NT03. The installation of these gas protection measures should be completed at all new residential buildings by suitably qualified specialist contractors in accordance with the specifications and expectations outlined in BS 8485:2015.
- 7.0.8 The local planning authority will require evidence of the installation of these protective measures as part of the discharge of any pre-occupation planning conditions relating to ground quality that may be imposed on the development.
- 7.0.9 This validation should include photographic records during the installation of all gas membranes (including evidence of adequate jointing / service penetration sealing) within all new structures at all 4 sites. Specifications for materials used and evidence of competent contractors being appointed to complete the installation should also be provided as part of the validation report to the local planning authority.

General

- 7.0.10 It is recommended all construction contractors take reasonable precautions to control environmental impacts that may occur as a result of redevelopment works with respect of soil and groundwater quality. These measures should include (and not be limited to):
- 1) Any sources of contamination uncovered during site development works should be brought to the immediate attention of RoC Consulting for consideration and comment. As required, the findings and recommendations of the current assessment may require amendment to reflect changes in site condition.
 - 2) The operation of plant, refuelling facilities and general basement excavation works should include appropriate provision to reduce the risk of leakage / spillage, particularly into the site's groundwater table or exposed natural soils.
 - 3) Appropriate dust mitigation measures should be deployed during basement excavation works, particularly when handling and excavating made ground deposits.
 - 4) All excavated materials stockpiled should be periodically dampened down to control dust release. Similarly, the disposal of any material from site should be completed using covered wagons.

7.1 Uncertainties

7.1.1 Remaining uncertainties and data gaps in the refined conceptual site model have been identified in the table below along with the key implications.

Item	Details	Implications
Source(s) of TPH/benzene predominantly in groundwater in the MM in the southwest of the site	The source(s) of the dissolved phase benzene in the southwest/west of NT02 at RBH502 P2 is uncertain. The presence of the highest benzene concentrations in the shallow MM rather than the overlying CHES and the absence of benzene in unsaturated soils tested at the site possibly points to an off-site source as discussed in more detail in Section 4.4.1. Only one round of groundwater testing has been undertaken for 500 series monitoring wells including RBH502 P2 where the highest benzene and TPH concentration were recorded in the MM.	Whilst it is possible that a so far undetected source of benzene is present on site up gradient of BH502 the presence of benzene predominantly at depth in the MM rather than the overlying CHES indicates a lower risk to controlled waters. Should evidence of a potential source of benzene/TPH be identified in the remediation and ground works at the site (in accordance with a watching brief for unexpected contamination) potential controlled waters linkages relating to this source should be further assessed.
Lateral extents of the TCE soil plume	The TCE soil source has been shown to cover the southern portion of Plot NT02 up to its eastern site boundary and across into Plot NT03 at RBH504. To date limited soils testing for TCE has been undertaken in the southwest of Plot NT03 and thus the eastern extent of the soil source is uncertain. In addition, limited testing for TCE has been undertaken in the northern warehouse adjoining the southern portion of Plot NT02 due to access restrictions during fieldworks.	For the purposes of the DQRA model the source area was assumed to cover the extent of the historic bolt works. The model is shown to have low sensitivity to the source dimensions, therefore whilst it is important to understand the full extent of the source area for remediation design, further delineation of the soil TCE source is unlikely to significantly affect modelled concentrations and/or modelled remedial target values.
The variation in TCE concentration between monitoring rounds at RBH203, LKBH03 and RBH303 is uncertain and it is possible that highest dissolved phase chlorinated VOC concentrations not yet detected	Due to the likely age of the TCE source >60 years, it is considered unlikely that the observed changes in concentration represent an overall downward trend in concentrations due to the relatively short duration of monitoring undertaken (~1 year). There is the potential for higher concentrations of chlorinated VOC to be present in the dissolved phase beneath the site due to the sampling depth targeting the top 1m to 2m of the monitoring well response zones. whereas TCE may migrate towards the bottom of the water column due to its higher density than water when in the free phase form (DNAPL).	An increase in maximum dissolved phase VOC concentrations is considered highly unlikely to alter the conclusions drawn from the DQRA results, since exceedances of the DWS are already reported at the 50m compliance point and the calculated RTVs are not reliant on input concentrations.

**COMPLEX CHALLENGES ...
MADE SIMPLE**

Item	Details	Implications
	However, no DNAPL was detected during any of the monitoring rounds by the interface probe and the maximum measured TCE concentration recorded at the site of 0.572mg/l is two orders of magnitude less than 1% of the solubility limit for TCE and as such, it is considered unlikely that a DNAPL source is present beneath the site.	
No UKWIR water pipe risk assessment undertaken	No UKWIR risk assessment has been undertaken to assess the risk posed to water supply pipes by contaminants within site soils. Given the nature of the site it is possible that barrier pipes will be required to mitigate the risk of contamination of water supply.	It is recommended that once water supply pipe routes are established that testing is undertaken in line with UKWIR guidance in order to establish if any protection measures are required for water supply pipes on site.

8.0 Preliminary Waste Assessment

- 8.0.1 Site soils may be considered to comprise waste depending on the circumstances. The Waste Framework Directive (WFD) defines materials as waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Naturally occurring soils are not typically considered waste if reused on the site of origin for the purposes of development. Excavation arisings from the development may therefore be classified as waste if surplus to requirements or unsuitable for reuse. A large volume of laws, permitting and regulations govern the management of waste on construction sites, including Environmental Permits, Materials Management Plans and Construction Environmental Management Plans. The below assessment only provides some useful information which may inform future planning.
- 8.0.2 For the purposes of waste assessment the site soils have been divided into five assessment areas as shown on drawing 4328-ROC-ZZ-XX-DR-ES-ES207 presented in Appendix A. The soils assessed comprise predominantly shallow Made Ground soils which are anticipated to undergo significant excavation and movement. Waste properties for natural soils are also discussed in this section. The waste assessment areas are summarised in the table below.

Waste assessment area	Details
1	Current Love Factory site including all Plot NT02 building
2	Below ground areas of former Ryan Topsoil yard (excluding mounds)
3	Earth stockpiles in former Ryan Topsoil yard
4	Soils in current Network Rail Mound
5	Eastern part of the site, roughly corresponding to NT04

8.1 Hazardous Waste Assessment

- 8.1.1 A methodology for the classification of waste, and requirement for sampling, is specified in Technical Guidance WM3 (EA, 2021). The level of sampling should be proportionate to the volume of waste and its heterogeneity. The preliminary assessment provided below is indicative based only upon the available sample results and may not be sufficient to adequately classify the waste.
- 8.1.2 Envirolab, an RSK company, has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool to assess the hazardous properties to support potential off-site disposal of materials in the future. Note that it is ultimately for landfills to confirm what wastes they are able to accept within the constraints of their permit.
- 8.1.3 The results are summarised in the table overleaf and presented in full in Appendix G.

COMPLEX CHALLENGES ...
MADE SIMPLE

Soil Assessment Area	No. samples tested	No. samples with hazardous properties	Details
1	54	12	TP202 @0.50m Carcinogenic HP7 Toxic for Reproduction HP10 Ecotoxic HP14 Mutagenic HP11 TP203 @ 0.3m Carcinogenic HP7 Mutagenic HP11 TP203 @ 1.2m Carcinogenic HP7 Mutagenic HP11 Visible asbestos cement (2.563%) WS301 @0.50m Carcinogenic HP7 Ecotoxic HP14 Mutagenic HP11 WS301 @ 3.5m Carcinogenic HP7 Mutagenic HP11 WS308 @ 1.0m Carcinogenic HP7 Mutagenic HP11 WS305 @ 0.5m Carcinogenic HP7 Mutagenic HP11 WS303 @ 0.4m, 1.2m, 1.8m, 3.1m Carcinogenic HP7 Mutagenic HP11 Toxic for Reproduction HP10 Ecotoxic HP14 RBH203 @ 3.0m Carcinogenic HP7 Mutagenic HP11 RBH502 @1.0m Acute toxicity HP6 Carcinogenic HP7 Mutagenic HP11 Ecotoxic HP14

**COMPLEX CHALLENGES ...
MADE SIMPLE**

Soil Assessment Area	No. samples tested	No. samples with hazardous properties	Details
			RBH504 @ 1.4m Carcinogenic HP7 Toxic for reproduction HP10 Mutagenic HP11 Ecotoxic HP14 RBH504 @ 1.9m Carcinogenic HP7 Toxic for reproduction HP10 Mutagenic HP11 Ecotoxic HP14
2	16	7	WS310 @0.40m Carcinogenetic HP7 Mutagenic HP11 TP310 @0.50m Carcinogenetic HP7 Ecotoxic HP14 MP302 @ 1.0m Ecotoxic HP14 MP304 @ 1.0m Ecotoxic HP14 TP305 @0.50m Ecotoxic HP14 TP309 @0.40m Carcinogenetic HP7 Mutagenic HP11 TP309 @1.00m Carcinogenetic HP7
3	1	1	MP301 @1.00m Ecotoxic HP14
4	13	3	RBH403 @0.50m Carcinogenic HP7 Ecotoxic HP14 RBH403 @3.50m Carcinogenic HP7 Mutagenic HP11 Ecotoxic HP14

COMPLEX CHALLENGES ...
MADE SIMPLE

Soil Assessment Area	No. samples tested	No. samples with hazardous properties	Details
			RBH401 @1.00m Carcinogenic HP7 Mutagenic HP11 Ecotoxic HP14
5	18	11	TP216 @1.20m Carcinogenic HP7 Toxic for Reproduction HP10 Ecotoxic HP14 TP217 @0.50m Carcinogenic HP7 Toxic for Reproduction HP10 Ecotoxic HP14 TP215 @1.00m Carcinogenic HP7 Toxic for Reproduction HP10 Ecotoxic HP14 TP214 @0.80m Carcinogenic HP7 Toxic for Reproduction HP10 Ecotoxic HP14 TP218 @0.50m Carcinogenic HP7 Ecotoxic HP14 TP219 @0.50m Carcinogenic HP7 Ecotoxic HP14 WS209 @0.40m Carcinogenic HP7 Toxic for Reproduction HP10 Ecotoxic HP14 WS208 @0.40m Carcinogenic HP7 Mutagenic HP11 Ecotoxic HP14 TP306 @0.50m Carcinogenic HP7 Ecotoxic HP14

**COMPLEX CHALLENGES ...
MADE SIMPLE**

Soil Assessment Area	No. samples tested	No. samples with hazardous properties	Details
			TP304 @0.50m Carcinogenetic HP7 Ecotoxic HP14 TP304 @1.50m Carcinogenetic HP7 Ecotoxic HP14

Asbestos Assessment

- 8.1.4 The Environment Agency publication 'Guidance on the classification and assessment of waste – WM3 (2018)', requires that within a mixed waste, the separately identifiable wastes be assessed separately. For instance, where waste soil contains identifiable pieces of asbestos (visible to the naked eye) the asbestos should, where feasible, be separated from the soil and classified separately. This should be disposed of within a hazardous, stable non-reactive hazardous waste landfill or a special cell in a non-hazardous waste landfill.
- 8.1.5 With reference to WM3 (2018), wastes containing greater than 0.1% free and dispersed asbestos fibres are classified as **hazardous waste** with the code 17 05 03* (soils and stones containing hazardous substances). Where a waste contains identifiable pieces of ACM, then these pieces must be assessed separately.
- 8.1.6 Visible asbestos in the form of chrysotile and amosite cement has been identified in TP203 at 1.20m bgl (located within Soil Assessment Area 1). The quantification value of this has been assessed to be 2.563%. It should be noted that this analysis does not constitute a specialist assessment and only a small portion of the site soils have been observed. As such, other instances of visible asbestos may be present within made ground soils at the site which have not been analysed. The feasibility of removing visible pieces of ACM (and thus managing the hazardous potential of the soils) should be assessed by a specialist contractor. It may be possible, through additional sampling and analysis, to zone areas of asbestos containing soils, although, due to the density of sampling points required to provide confidence in this approach, this is likely to be a costly exercise with no guaranteed benefit.
- 8.1.7 Asbestos identifications in the Soil Assessment Areas are summarised in the table below:

Soil Assessment Area	No. samples tested	No. samples with positive asbestos identification	No. quantified above 0.1% hazardous threshold	Details
1	34	12	1	TP203 @1.20m 2.563% Chrysotile and Amosite cement
2	17	5	0	-
3	1	0	0	-
4	11	0	0	-
5	18	1	0	-

- 8.1.8 Laboratory testing has encountered positive identification of asbestos fibres within soils in three out of the five soil assessment areas, and these have undergone quantification assessment. In one of the soil assessment areas, analysis has recorded visible asbestos above the hazardous waste threshold of 0.1%. Consequently, it is feasible that Made Ground soils in Soil Assessment Area 1 contains asbestos above the hazardous waste threshold and can be characterised as requiring disposal at a hazardous waste facility.

8.2 Waste Classification

- 8.2.1 The above assessment indicates that some of the Made Ground will require disposal at a suitably permitted hazardous waste landfill or treatment facility. Soils in all the assessment areas display hazardous properties and/or asbestos containing materials. It is noted that, while soils in Soil Assessment Area 3 display these properties relatively rarely, we would also apply this designation to this area. Soils in Assessment Areas 1 display high concentrations of Trichloroethene. This specific determinant is not specified as part of the hazardous waste assessment, but nonetheless is objectively hazardous.
- 8.2.2 It is noted that soils remediation works are anticipated to be undertaken in Soil Assessment Area 1. It is feasible that the disposal options for some material from this location could be re-evaluated following completion of these works.
- 8.2.3 Notwithstanding the above, the waste assessment is a preliminary review of site investigation data and no targeting to delineate spatial distribution of waste has taken place. As such it should be considered as indicative and further testing completed across the site by contractors to further refine waste classifications and associated disposal costs.

8.3 WAC Assessment

- 8.3.1 Additionally, a testing regime has been established in '*Waste Sampling and Testing for Disposal to Landfill*' (2013) to determine the suitability of soils for disposal. This regime does not supersede the hazardous properties assessment presented above.
- 8.3.2 We have scheduled testing of samples for Waste Assessment Criteria on this basis, the results of which are presented in Appendix G. The testing is summarised in the table below:

Waste Assessment Area	Samples tested	Exceeds Acceptance Criteria for Hazardous Waste Landfill
1	WS203 @0.50m	No*
	WS305 @1.00m	No
	WS304 @1.00m	No*
	WS309 @1.00m	No*
	RBH305 @0.50m	No
2	TP310 @0.50m	No*
	TP301 @0.50m	No*
3	MP301 @1.00m	No*
	MP302 @1.00m	No*

**COMPLEX CHALLENGES ...
MADE SIMPLE**

	MP304 @1.00m	No*
4	HP301 @0.50m	No*
	RBH402 @5.30m	No
	RBH403 @3.50m	No*
	WS211 @0.30m	No*
5	TP306 @0.50m	No*
	TP304 @0.50m	No*
*May require pre-treatment to achieve suitability for designated landfill class, due to high levels of total organic carbon		

- 8.3.3 The results of the WAC testing indicate that the leaching limit values and/or* the additional criteria for hazardous waste have not been exceeded and therefore the waste is suitable for disposal at an appropriately licenced **none hazardous waste landfill**. We note that as specified above, the landfill may specify pre-treatment owing to high levels of organic carbon.

8.4 Preliminary Waste Assessment Notes

- 8.4.1 With reference to the Environment Agency's *publications Waste Sampling and Testing for Disposal to Landfill (2013)* and *Waste acceptance at landfills (2010)*, naturally occurring soils not likely to be affected by contamination can be classified as inert waste, with a EWC code of 17 05 04. Should any of the naturally deposited soils be suspected to contain contamination (by virtue of visual or olfactory evidence) upon excavation, then such soils should be stockpiled appropriately, and additional testing carried out as considered necessary. Based on evidence obtained during our investigations, we are of the opinion that the soils of the Devensian Till Formation, Chester Formation and Manchester Marls Formation at the site are not likely to be affected by chemical contamination and thus can be classified as inert waste.
- 8.4.2 The assessment of this report in regard to waste are indicative only and provide useful information to support future management of waste on site, which should be comprehensive and address all other legal and regulatory requirements. Extensive earthworks are anticipated at the site that will require Environmental Permits and Materials Management Plans. Further environmental testing of soils and subsequent treatment and processing may also be required. It may be necessary to consult with the Environment Agency before works commence to verify the proposed works and establish that material can be declassified as waste and re used on site in accordance with the most current guidance and Article 6(1) of the Waste Directive. These applications are the responsibility of the contractor. We can consult on these matters on request.
- 8.4.3 We recommend this report is provided to the selected contractors and landfill facilities to confirm (or otherwise) that waste can be managed and disposed of as above. Please be aware that landfill sites are obligated to undertake in house quality assurance tests and thus may require further WAC testing for any soils encountered as part of this investigation. There is no obligation on any landfill operator to accept waste if they choose not to and waste operators may require additional testing of untested waste soils prior to acceptance at landfill in accordance with the landfill regulations

9.0 Geotechnical & Foundation Design Assessment

Background Information

- 9.0.1 It is understood that the site is to be developed with a mixture of high and medium rise residential buildings, with the former to heights of between 20 and 35 stories and the latter to heights of between 4 and 8 storeys. The development is also anticipated to include small areas of soft landscaping, a new access road passing between NT02 and NT03 and continuing to the east along the southern site boundary and a retaining wall to retain soils in the Network Rail mound to the south of Plot NT03.
- 9.0.2 Site investigations indicated made ground to be present across the site, predominantly comprising demolition fill type material, underlain by Devensian Till Deposits predominantly comprised of clay which are generally thinner in the western portion of the site and thicker in the east. In some areas made ground directly overlies the weathered bedrock. There is a transition from the Chester Formation being the bedrock immediately underlying drift deposits to the Manchester Marls Formation in the vicinity of Plot NT03.

9.1 New Building Foundation Design

- 9.1.1 Site investigations have identified a variable thickness of made ground deposits beneath the site. It is not recommended new building foundations be constructed on top of made ground deposits. The variable composition and in-situ strength of these materials is such that unacceptable levels of total and differential settlement will occur as a result. Similarly natural superficial soils at the site have also been proven to be thin and unevenly distributed across the site where present.
- 9.1.2 Given the anticipated building loadings coupled and the presence of contaminated soils the adoption of conventional shallow foundations is not considered appropriate in this instance. The use of a piled foundation solution is recommended, with piles taken to competent rock within the Chester Formation and Manchester Marls Formations. Information has also been provided to allow the consideration of alternative foundation arrangements, such as a settlement reducing piled raft foundation, should the design team choose to further investigate this option.
- 9.1.3 A summary of rock quality across the site is presented in the table below. The rock shows signs of weathering or faulting with relatively poor rates of recovery and RQD. It should be noted that much of rock core recovered was not of sufficient quality for testing and the samples tested should not be taken as representative of the rock as a whole.



**COMPLEX CHALLENGES ...
MADE SIMPLE**

Table 9.1: Summary of UCS Values

Geological Unit	UCS tests (MPa)	Minimum Point Load Test I_{s50} (MPa)	Maximum Point Load Test I_{s50} (MPa)	Conversion Factor*	Mean Equivalent UCS (MPa)	Mean UCS (Direct Testing) (MPa)	Nominal UCS of sampled material (MPa)**
Chester Formation (Sandstone)	5.73	0.01	0.19	21.45	1.01	5.73	3.37
Manchester Marls (Shallow) <15.00m	8.11	0.02	1.42	21 - 21.45	4.33	8.02	6.17
	0.65						
	0.53						
	11.80						
	19.00						
Manchester Marls (Deep) > 15.00m	15.9	0.02	1.2	21 - 21.45	4.44	16.24	10.34
	12.4						
	10.4						
	15						
	25.5						
	18.1						
	17.4						
	10.8						
	20.7						
* Conversion factors for point load testing in relevant geologies in Aitalesh et al (2015).							
** Nominal UCS values are averages of directly measured and derived UCS values. These values refer to tested material only and design should note that, as much of each strata is unrecoverable, these values may not be typical of the strata.							

**COMPLEX CHALLENGES ...
MADE SIMPLE**

- 9.1.4 Piling specifications should be established with a piling specialist following distribution of this report and associated logs and test records. The piling depth should be sufficient to penetrate the weathered zone as detailed in Section 5.1.
- 9.1.5 Given the presence of contamination within site soils the consideration will need to be given to choosing a method that limits the potential for contaminant pathways to be created through site soils and into the underlying aquifer. Given the contaminative sources at the site, prior to foundation construction, a piling risk assessment (Foundation Works Risk Assessment) should be undertaken. It is also likely that a comprehensive enabling works package to break out and remove the existing below ground structures. A piling risk assessment will be required (regardless of the chosen method).

Plot NT02

- 9.1.6 Peak potential sulphate concentrations range between 10 and 1470mg/l with soil pH values ranging between 7.16 and 10.56 providing a characteristic pH of 7.62 and a characteristic sulphate of 940mg/l. Based on these results, it is considered that well compacted buried concrete should be designed in accordance with Class DS-2 AC-2 requirements as specified in BRE Digest Special Digest 1:2005 *Concrete in aggressive ground: Version 3*.

Plot NT03

- 9.1.7 Peak potential sulphate concentrations range between 22 and 1740mg/l with soil pH values ranging between 7.64 and 9.4 providing a characteristic pH of 7.8 and a characteristic sulphate of 1490mg/l. Based on these results, it is considered that well compacted buried concrete should be designed in accordance with Class DS-2 AC-1s requirements as specified in BRE Digest Special Digest 1:2005 *Concrete in aggressive ground: Version 3*. It should be noted that in a groundwater sample obtained from WS311 within made ground deposits a water soluble sulphate concentration of 2,650mg/l was reported. This would equate to DS-3 and it is recommended any concrete in contact with the water body in this area of the site match this specification.

Network Rail Mound

- 9.1.8 Peak potential sulphate concentrations range between 28 and 1450mg/l with soil pH values ranging between 7.86 and 8.67 providing a characteristic pH of 7.875 and a characteristic sulphate of 1435mg/l. Based on these results, it is considered that well compacted buried concrete should be designed in accordance with Class DS-2 AC-1s requirements as specified in BRE Digest Special Digest 1:2005 *Concrete in aggressive ground: Version 3*.

Plot NT04

- 9.1.9 Peak potential sulphate concentrations range between 10 and 504mg/l with soil pH values ranging between 6.78 and 9.30 providing a characteristic pH of 7.38 and characteristic sulphate of 405mg/l. Based on these results, it is considered that well compacted buried concrete should be designed in accordance with Class DS-1 AC1s requirements as specified in BRE Digest Special Digest 1:2005 *Concrete in aggressive ground: Version 3*.



**COMPLEX CHALLENGES ...
MADE SIMPLE**

9.2 Ground Floor Construction

- 9.2.1 In view of the thickness of made ground at the site, we recommend that either suspended ground floor slabs are adopted, or that ground improvement is undertaken to support the ground floor.

9.3 Below Ground Drainage

- 9.3.1 Buried services constructed in unimproved Made Ground soils may be subject to settlement and this should be considered during design. In particular water and sewerage pipes should not utilise shallow gradients that render them vulnerable to settlement.

9.4 Below Ground Obstructions

- 9.4.1 The site has been extensively developed with numerous historic phases of construction and demolition. Only a small portion of the below ground area has been investigated, and this has identified several relic structures and areas of loose ground. Further such obstructions and voids should be anticipated, which will have implications for the construction phase, such as presenting a potential obstacle to piling works.

9.5 Earthworks

- 9.5.1 Detailed recommendation relating to earthworks are presented in the following previously issued documents:

- Groundwork Specification: Excavating & Filling (ref. RDB-ROC-XX-XX-SP-C-600)
- Enabling Works Performance Specification (re. RDB-ROC-XX-XX-SP-C-0600)

- 9.5.2 Extensive geotechnical testing has been undertaken to enable design of earthworks. Samples from five locations have been subject to extensive testing to allow classification with respect to Table 6/2 in the SHW Series 600. The locations of these samples are indicated on drawing 4328-ROC-ZZ-XX-DR-ES-ES207 in Appendix A. Samples have been graded based on Particle Size Distribution and Uniformity Coefficient. The moisture content of samples, and dry density / moisture content relationship, has been determined through 4.5kg compaction testing.

Location	Top depth	Class (Grading)	Uniformity Coefficient	95% of Maximum Dry Density	Received Moisture Content	Achieves 95% at Received MC	Final Class
TP309	0.5	1A/1B	250	1.60	19	Yes	1A
TP306	0.5	1A/1B	250	1.84	22	No	1A
TP304	0.5	1A/1B	450	1.63	26	No	1A
RBH305	0.5	1A/1B	150	2.00	10	Yes	1A
HP301	0.5	2A/2B	-	1.42	23	Yes	2B

9.6 Network Rail Mound

- 9.6.1 A programme of works to investigate the ground conditions within and beneath the Network Rail mound was undertaken in September 2023. A total of 3 dynamic sample boreholes were formed with 2 of those being advance further with rotary drilling methods to a maximum depth of 21.00mbgl.
- 9.6.2 General ground conditions within the mound were found to comprise a surface layer of granular fill material with a significant organic content suspected to be comprise predominantly of wood mulch. Other constituents included ash and various anthropogenic inclusions including glass, plastic, clinker and brick. This initial granular material varied in depth from 1.00 to 3.50mbgl and commonly emitted a hydrocarbon odour. At RBH403 this surface layer was underlain by a clayey gravelly sand to 5.30mbgl, containing brick, metal, plastic and glass and emitting a hydrocarbon odour.
- 9.6.3 Underlying this initial granular layer were cohesive made ground deposits generally comprising a sandy gravelly clay containing brick, glass, clinker, coal and plastic. Hydrocarbon odours were also present within this material but generally reduced with depth. Some bands of granular made ground were also reported within this material. The predominantly cohesive material varied in depth from 9.20 to 10.50mbgl.
- 9.6.4 Natural soils were encountered underling cohesive made ground deposits and were generally encountered as sandy gravels, gravelly sands and silty sands with a layer of clay also encountered at RBH403. Bedrock was encountered at 19.30mbgl and 19.50mbgl in RBH401 and RBH403 respectively and comprised an extremely weak mudstone commonly weathered to clay.
- 9.6.5 The design sulphate classification for concrete within the mound is DC-2 AC-1s.
- 9.6.6 A number of exceedances of residential without plant uptake GACs were reported within the made ground deposits of the mound as detailed in section 6 of this report.
- 9.6.7 PSD and hydrometer testing was undertaken on samples obtained from all layers of soil contained within the mound to understand grading and is summarised in the table presented overleaf.



**COMPLEX CHALLENGES ...
MADE SIMPLE**

BH ID	Depth	Passing 63mm	Passing 2mm	Passing 0.063mm	Passing 0.002mm	D60	D10	Cobbles / Boulders %	Gravel %	Sand %	Silt/Clay %	Clay %	Uc	Soil Type
RBH401	0.2-1	100	66	20		1.18	0.063	0	34	46	20	0	18.73016	Granular
	12-13.20	86	42	10		20	0.063	14	44	32	10	0	317.4603	Granular
RBH402	5.3	99	97	64	26	0.063	-	1	2	33	38	26	-	Cohesive
	10.5-12	88	86	26		0.212	-	12	2	60	26	0	-	Granular
	10	96	94	68		0.063	-	4	2	26	68	0	-	Cohesive
RBH403	3.5-5.3	100	62	25		2	-	0	38	37	25	0	-	Granular
	17.5	99	97	43		0.212	-	1	2	54	43	0	-	Cohesive

COMPLEX CHALLENGES ... MADE SIMPLE

- 9.6.8 It is understood a piled retaining structure is proposed within the area of the current mound feature, the construction of which will require access onto the upper portion for piling plant (with associated mat), formation of piles to socket in the underlying Mudstone (depth circa 19.5m below top of mound); and removal of surplus soils on the northern face to increase the developable area across the Plot NT03 site. The intention will be to reuse site won soils from the mound area as backfill material behind the retaining structure and to form a slope to the boundary fence subject to its suitability in both geo-environmental and geotechnical parameters.
- 9.6.9 As noted, the current mound comprises a range of soil types including a significant quantity of made ground material from a range of origins (some of which includes deleterious materials such as wood chip, plastic wastes and glass). It is evident from review of historical map records in this area the mound up to the existing railway was formed initially to facilitate the construction of a (now demolished) signal box, and that the slope has been subsequently added to and enlarged as a result of more recent soil storage operations on site. These operations are reflected in the variability of ground conditions reported during ground investigation works in this area, with no apparent consideration or specification of the material that have been used to form the slope feature.
- 9.6.10 Given the above, the direct reuse of site won made ground from the mound feature as backfill behind the proposed wall is not recommended, as its performance and suitability as bulk engineered fill cannot be guaranteed. If made ground is required for reuse it will be necessary to excavate, screen, process and sort the material into useable fractions (removing the aforementioned deleterious material that is noted) with appropriate segregation of suitable / unsuitable soils on site and geotechnical testing (in accordance with the requirements of Series 600 Specifications) to confirm its suitability for use. Similarly, site won made ground intended for reuse in this function will also need to comply with the chemical validation testing requirements to ensure no sources of contamination are present (as outlined in the Phase 3a Remediation Strategy for the site).
- 9.6.11 With respect to the reuse of natural soils, these were found to be of a predominantly granular nature, although were encountered at depths circa 9.20 to 10.50m below existing mound top level. Their reuse as engineered fill would be possible, subject to appropriate geotechnical and chemical validation screening and testing. Although, noting the depths at which this material occurs below ground level, it is unlikely natural soils will be excavated in significant quantities during earthworks operations.
- 9.6.12 All processing and reuse of soils within the mound remodelling works should fall within the wider Materials Management Plan for the site, with the contractors being responsible for discharging all of their statutory and legal requirements with respect to Waste Management legislation and regulations.

9.7 General Comments

- 9.7.1 No entry should be permitted into excavations exceeding 1.2m depth without appropriate risk assessments, shoring and support. Whilst groundwater was not encountered in superficial deposits, the bedrock groundwater level is relatively shallow, and it is feasible that this will rise during winter months. Appropriate provisions should be made to dewater excavations as and when required.



**COMPLEX CHALLENGES ...
MADE SIMPLE**

- 9.7.2 Similarly it is not recommended foundation excavations to underlying clay be left open and exposed to the elements as rainwater ingress will damage and reduce its strength. Similarly, no vehicular movements should be permitted within exposed foundation locations.
- 9.7.3 The geotechnical assessment has been collated based on the proposed development type, layout, and likely loadings at the time of report publication. It should be noted that future alterations to these proposals or loadings (including alterations in the site layout or new building scale) will require the re-interpretation of the current assessment. In such an instance updated design information should be provided to RoC Consulting and the current assessment updated accordingly.

10.0 Conclusions & Recommendations

- 10.0.1 The site is to be redeveloped for residential led apartment style end uses comprising a number of proposed high rise, midrise and low-rise buildings with some areas of soft landscaping. The development will comprise three distinct areas termed Plot NT02, NT03 and NT04 (as indicated on RoC drawing 4328-ROC-ZZ-XX-DR-ES-ES200 within Appendix A).
- 10.0.2 Site investigations have revealed variable depths of made ground across the site. Made ground material was found to generally comprise demolition fill type material most likely originating from the demolition of historic buildings on site, although anthropogenic inclusions such as coal, clinker and ash were also noted that may have originated from historical processes undertaken on site. Made ground deposits were generally underlain by cohesive Devensian Till deposits with some beds of granular material. Devensian Till is underlain by bedrock of the Chester Formation and Manchester Marl. The upper horizons of the bedrock are significantly weathered, and deeper rocks are also subject to faulting.
- 10.0.3 Made ground was typically found to extend to depths ranging between the following depths beneath development plots:
- Plot NT02: 0.65 and 3.20mbgl
 - Plot NT03: 0.20 and 3.30mbgl
 - Network Rail Mound: 9.20 and 10.50mbgl
 - Plot NT04: 0.60 and 9.00mbgl (results are distorted by presence of material stockpiles in this plot)
- 10.0.4 As noted, Devensian till (or River Terrace Deposits beneath the Network Rail Mound) underlain made ground at the majority of locations with the weathered fractions of either sandstone or marl bedrock noted at the following range of depths beneath each plot:
- Plot NT02: 2.00 and 3.00mbgl (Sandstone)
 - Plot NT03: 2.00 and 7.80mbgl (Sandstone/ Marl)
 - Network Rail Mound: 19.30 and 19.50mbgl (Marl)
 - Plot NT04: 4.70 and 10.00mbgl (Marl)
- 10.0.5 Overall the spatial distribution of made ground across the site was found to be variable, with locally deeper deposits clustered around areas of former industrial development or where terraced residential housing with now backfilled cellars were present. The bedrock topography indicates a fall in level from roughly east to west across the site, related to a fault line that is known to pass through the site roughly toward its centre with a north / south orientation.
- 10.0.6 Groundwater monitoring identified a groundwater body to be present in both the Chester Formation (which forms a Principal Aquifer) and the Manchester Marls Formation (which forms a Secondary B Aquifer); a shallow perched water table is also present within made ground and permeable drift deposits which is in contact with (and potential hydraulic connectivity with) the underlying bedrock formations.

COMPLEX CHALLENGES ... MADE SIMPLE

10.0.7 The results from the initial Oct 2022 Phase 2 SI works have been complemented by the formation of supplementary deep boreholes and monitoring wells to further refine understanding of the site hydrogeological condition. The results indicate a degree of variability with groundwater tables, aquifer characteristics and groundwater flows, with a mixture of highly permeable and lower permeability bedrock formations beneath the site separated by a geological fault roughly along its centre. This geology is reflected by variance in hydraulic heads between monitoring wells and increases in hydraulic gradient. Overall, the groundwater flow is trending from east to west toward the River Irk and in line with local surface topographical features in the Manchester Marl, and to the north / north east in the Chester Formation. The results from both rounds of investigations have been used to increase our understanding of groundwater flows and potential interactions with contaminants present on site.

Geo-environmental Comments

10.0.8 Evidence of contamination has been recorded across the site in Made Ground deposits, including metals, asbestos and TPH. These contaminants are currently contained beneath building and of hard standing across the majority of the site and are not considered to pose a significant risk to users of the temporary event space in NT02. However, this contamination poses a potential risk to users of the proposed residential development and application of a capping system should be considered within the remediation strategy for the site, refer to section 7.0.5.

10.0.9 Evidence of Trichloroethene contamination (TCE) was also noted within the area of the Plot NT02 portion of the site, and a limited section of the NT03 site, believed to be as a result of former metal working or bolt manufacturing historically located to the south of this plot. The contamination distribution in soils was found to cluster toward the southern portion of the existing warehouse although a data gap is noted within the data beneath the warehouse to the north due to its current use as a temporary event space and associated restricted access. The spatial distribution of this TCE contamination (both depth and spatial terms) does not show a correlation with a “point source” type release and instead most probably relates to longer term leakage and spillage of degreasing agents used in this former operation into drainage networks, through cracks in floor slabs, or through distribution due to demolition activities.

10.0.10 The TCE contamination has the potential to affect human health, groundwater and the River Irk. The source of the contamination is considered to be onsite and has been further considered via the completion of a Detailed Quantitative Risk Assessment. The overall spatial extent of this contamination plume has been defined based on data from various ground investigation works. However, further sampling and assessment will be required during the demolition and enabling works phase to confirm its precise extent.

10.0.11 The results of the Detailed Quantitative Risk Assessment indicate the TCE contamination (and its daughter products) pose a risk to off-site receptors and will warrant remediation. The subsequent interpretive assessment of modelling works has allowed Remedial Target Values to be derived for the treatment of soil and groundwaters beneath the site which will need to be considered as part of the wider design for ground remedial works.

**COMPLEX CHALLENGES ...
MADE SIMPLE**

- 10.0.12 Given the potential presence of the aforementioned contamination within the area of Plot NT02 and potential risks posed toward construction / demolition contractors during the enabling works phase, it is recommended that any ground remediation works are completed (ideally) in advance of main construction contract. If the demolition of buildings in this area is proposed existing floor slabs should be retained and not removed until any ground remediation works are instructed and underway. This is owing to the fact they currently impeded the infiltration of rainwater and surface water run-off into site soils and associated contamination mobility and leachate generation.
- 10.0.13 On the basis of hazardous waste testing, Trichloroethene contamination, and identification of Asbestos in soils at the site, it is likely that areas of Made Ground soils at the across Plot NT02 (and other areas of the site) will require disposal as Hazardous Waste. Further testing should be completed by contractors during the earthworks process to confirm these classifications and your attention is drawn to our initial waste screening assessment within Section 8 of the current report for further information on this issue.
- 10.0.14 Ground gas monitoring has revealed elevated levels of Carbon Dioxide and depleted Oxygen levels in monitoring wells installed into made ground and shallow natural deposits on Plot NT02. Carbon Dioxide levels are consistently above 5% on this plot and on occasion in exceedance of 10% and therefore the Plot has been assessed as being a Characteristic Situation 2 and thus requiring a gas membrane to be installed. Gas monitoring of Plot NT03 has revealed elevated levels of Carbon Dioxide Plot NT04 has been characterised as Characteristic Situation 1 and no remedial measures are envisaged in regard to ground gas.

Geotechnical Comments

- 10.0.15 The bedrock encountered on site was found to vary between the Chester Formation (sandstone) and Manchester Marls Formation (Predominantly mudstone with bands of siltstone and sandstone). The former was present on Plot NT02 only and is underlain by bedrock of the Manchester Marls formation. The Chester Formation is present only in the west of the site, where superficial deposits directly overly the Manchester Marl. A potential geological fault was identified through the site in the Phase 1 Desk Study Report.
- 10.0.16 Given the anticipated building loadings and the presence of contamination beneath the site, the adoption of a piled foundation solution is recommended for the development. Piles should be founded in the competent rock of the Chester Formation and Manchester Marls Formation. Sufficient information is provided for detailed pile design by a specialist contractor. It is noted that bedrock recovery at the site is relatively poor, and the rock may have been affected by faulting.
- 10.0.17 The site has been extensively developed with numerous historic phases of construction and demolition. Only a small portion of the below ground area has been investigated, and this has identified several relic structures and areas of loose ground. Further such obstructions and voids should be anticipated, which will have implications for the construction phase, such as presenting a potential obstacle to piling works. Removal of these obstructions may be required prior to development.

**COMPLEX CHALLENGES ...
MADE SIMPLE**

10.0.18 Detailed information is provided on the foundation arrangements for the Network Rail Viaduct to the southern site boundary. Findings of our investigation into the presence of a wall to the rear of the Network Rail mound are published in a separate report.

Recommendations for Further Works

10.0.19 We would make the following recommendations for work areas to support the sites redevelopment for intended high rise apartment style residential end uses:

- 1) A Phase 3a Remediation Strategy should be prepared for the site within which details of all associated remediation requirements should be outlined, along with validation and monitoring requirements.
- 2) Efforts should be made to mark and protect all existing groundwater monitoring wells across the site to prevent any future damage from occurring. These wells may be required for future monitoring and groundwater remediation trial testing to confirm the design of TCE treatment methods. A plan showing well locations should be shared with site owners and any persons using the site and efforts made to protect them (e.g., enclosing with concrete manhole rings at ground level and clearly marking with warning signs and paint).
- 3) The updated DQRA model report should be shared with the regulatory authorities for consideration and comment.
- 4) Initial discussions should be held with remediation contractors and copies of the current report provided for consideration as part of a wider remediation options appraisal process. These remediation works are likely to comprise the treatment of grossly impacted soils in the areas of known contamination and potential treatment of groundwater (depending on the results of the DQRA process).
- 5) Other remedial measures such as a general watching brief during construction works with any suspected sources of contamination discovered during the site development (outside those discussed in this report) brought to the attention of RoC Consulting and their implications assessed. Depending on the extent and severity, the findings and assessment of the current study may require re-interpretation.
- 6) A soil capping layer should be employed within areas of soft landscaping in order to inhibit any potential pathways from site soils to future site users. The extent and nature of remediation works should be detailed by a future Remediation Strategy.
- 7) It is recommended that, once the locations of buried water pipes and any remedial works have been established, a United Utilities Risk Assessment is completed along the proposed route of water supply pipes following the completion of bulk earthworks operations.
- 8) A piling risk assessment in accordance with published Environment Agency Guidance "Piling into Contaminated Sites" will be required prior to development and discussions should be held with piling contractors to confirm most appropriate pile types, carrying capacities and termination depths as part of the wider design process.



**COMPLEX CHALLENGES ...
MADE SIMPLE**

- 9) The presence of below ground obstructions should be anticipated beneath the site and it would be prudent to prepare a series of historical development overlay plans showing the extent of various phases of development and areas where deeper obstructions may be present. Earthworks operations should include for the removal of below ground obstructions encountered and around pile locations.
- 10) Dewatering may be required locally depending on depths of excavations and groundwater table levels. This may encounter contaminated groundwater beneath the site depending on the timing of excavation works (in context of any remediation works) and their location. Due consideration should be given by contractors as to how to manage groundwater ingress and its subsequent disposal.
- 11) Copies of this report and the previous Phase 1 desktop study should be provided to the regulatory authorities (Manchester City Council and the Environment Agency) for consideration and comment as part of the wider planning process.



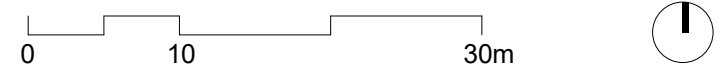
COMPLEX CHALLENGES ...
MADE SIMPLE

APPENDIX A – SITE DRAWINGS



© Maccreanor Lavington Ltd.

Do not scale from this drawing. Verify all dimensions on site.
Drawing should be read in conjunction with information from
all other design consultants and contractors. All drawings in
digital format are for reference only, paper copies are
available on request.



Legend

- Application boundary
- Land owned or controlled by the applicant

P10.01	S0-Initial Status
P09.04	S0-Initial Status
P09.01	S0-Initial Status
P08.01	S0-Initial Status
P07.04	S0-Initial Status

Rev Details

02/06/2023
13/04/2023
31/03/2023
16/03/2023
14/03/2023

Date

**MACCREANOR
LAVINGTON**

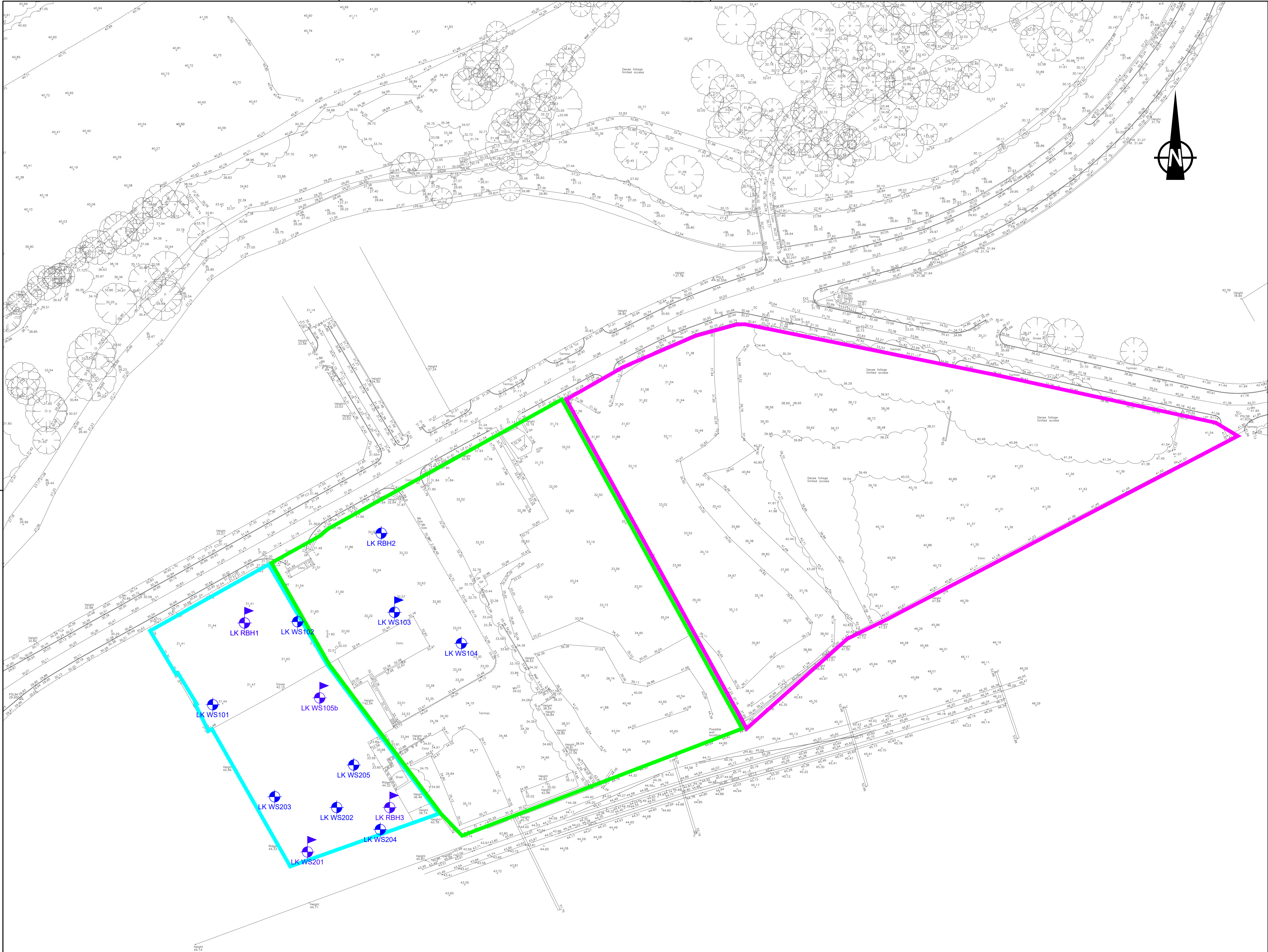
Proj. No. RDB
Project Red Bank NT04
Sheet Name
Site Plan

CDE ID RDB-MLA-00-XX-DR-AR-01110000

Vijverhofstraat 47
3032 SB Rotterdam
The Netherlands
+31(0)10 443 96 60

Status
S0-Initial Status
Client
FEC

Scale 1:500
Size A1
Rev P10.01



THIS DRAWING IS THE PROPERTY OF RgCp. COPYRIGHT IS RESERVED BY THEM AND THE DRAWING IS ISSUED ON THE CONDITION THAT IT IS NOT COPIED, REPRODUCED, RETAINED OR DISCLOSED TO ANY UNAUTHORISED PERSON EITHER WHOLLY OR IN PART WITHOUT THE WRITTEN CONSENT OF RgCp

NOTES

- LK RBHX LK ROTARY BOREHOLE WITH MONITORING WELL
- LK WSX LK WINDOW SAMPLE BOREHOLE WITH MONITORING WELL
- LK WSX LK WINDOW SAMPLE BOREHOLE
- LK RBHX LK CONSULT ROTARY BOREHOLE
- APPROX PLOT NTO2 BOUNDARY
- APPROX PLOT NTO3 BOUNDARY
- APPROX PLOT NTO4 BOUNDARY

DRAWING NOTES

- TO BE READ IN CONJUNCTION WITH ROC CONSULTING PHASE 1 DESKTOP STUDY REF: 4328-ROC-ZZ-XX-RP-ES-PH1DTS AND PHASE 2 SITE INVESTIGATION REPORT REF: 4328-ROC-ZZ-XX-RP-ES-P2-101.
- EXPLORATORY HOLE LOCATIONS SHOWN AT APPROXIMATE EXTENTS.
- EXISTING SITE LEVEL INFORMATION TAKEN FROM PARAGON SURVEYS TOPOGRAPHICAL SURVEY REF:PS-2158-TS-00
- ROC CONSULTING ACCEPTS NOT RESPONSIBILITY FOR ANY DAMAGES OR LOSS ARISING AS A RESULT OF THE USE OF THIS DRAWING

01	JUN 23	FIRST ISSUE	RM	LR
REV	DATE	DETAILS	DRN	CHK

DRAWING STATUS INFORMATION

RIBA STAGE

RIBA STAGE

ROC
CONSULTING

Commercial Wharf
6 Commercial Street
Manchester M15 4PZ
T 0161 214 5390
W roccoconsulting.com

DRAWN RM	DATE JUN 23	SCALES 1:500
CHECKED LR	DATE JUN 23	THE ABOVE SCALES APPLY WHEN PLOTTED AT A1 SIZE -DO NOT SCALE-
APPRVD. LR	DATE JUN 23	EMAIL FOR DRAWINGS info@roccoconsulting.com

CLIENT

FAR EAST CONSORTIUM INTERNATIONAL LTD

PROJECT TITLE

PLOTS NTO2, NTO3 & NTO4 NORTHERN GATEWAY

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS LK

DRAWING No. 4328-ROC-ZZ-XX-DR-ES-ES201A	REV. 01
--	-------------------

© RgCp Ltd.