Queensway Scunthorpe

Remediation Strategy

St. Modwen Developments Limited

16 October 2017

Contains *sensitive* information

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Glossary

Term	Meaning / Definition
CSM	Conceptual Site Model
OS	Ordinance Survey
NGR	National Grid Reference
PAH	Polycyclic aromatic hydrocarbons
CoC	Contaminants of Concern
BGS	British Geological Society
SPZ	Source Protection Zone
PPC	Pollution Prevention Control
COMAH	Control of Major Accident Hazards
IPPC	Integrated Pollution Prevention Control
PPL	Potential Pollutant Linkages
CDM	Construction Design Management
GQRA	Generic Quantitative Risk Assessment
TPH	Total Petroleum Hydrocarbons
SVOC	Semi Volatile Organic Compounds
VOC	Volatile Organic Compounds
PID	Photo-ionisation Detector

1. Introduction

1.1. Background

Atkins Limited (Atkins) has been appointed by St. Modwen Developments Limited (St. Modwen) to prepare a Remediation Strategy for the Queensway Scunthorpe site. This report has been carried out in support of a planning application, to allow the redevelopment of the Queensway Scunthorpe site.

The proposed development of this site is for the building of two retail units, with associated car parking for each retail unit. This remediation strategy has been compiled in order to address contamination potentially present on-site, and to address the assumed conditions which will result from a planning application to allow the proposed retail scheme for the site.

The location of the site is shown in Figure 1 and the proposed redevelopment is shown on Drawing No. 14-042A001, both are attached to this report.

1.2. Scope of Works

This report presents the following:

- Discussion of the site setting and background based on the Hydrock desk study and factual ground investigation report (Hydrock, 2017).
- Summary of intrusive investigation works and laboratory analysis undertaken by Hydrock (Hydrock, 2017).
- Summary of gas and groundwater monitoring undertaken by Hydrock (Hydrock, 2017).
- Summary of the Phase 2 Hydrock (Hydrock, 2017) Generic Quantitative Risk Assessment (GQRA), based on the ground investigation and laboratory work undertaken by Hydrock in December 2015.
- Updated Conceptual Site Model (CSM).
- Presentation of a Remediation Strategy for the removal of contamination presenting a risk to harm to human health and risk to controlled waters with respect to the redevelopment to a commercial end use.

1.3. Site Redevelopment

The proposed development scheme consists of the following proposal:

- Two retail units with adjacent car parking and the remaining portion to be developed in the future for a residential end use; and
- Junction improvements to the junction between Dudley Road and the Queensway

1.4. Scope of Works

Ground conditions can only be inferred between sampling locations and as such localised conditions on-site may vary. Interpretation of the soil parameters in this report are based on an assessment of data taken from exploratory holes. The exploratory holes sampled or tested represent a fraction of the ground being investigated and variations may occur between sampling points. Furthermore, observations made at the time of investigations and during monitoring visits may be subject to variation because of atmospheric, seasonal or other effects.

The opinions and recommendations presented in this report are based partly upon documents provided by third party sources and the ground investigation undertaken by Atkins. Atkins has not been able to verify

independently all third-party information and for the purposes of this assessment has assumed that such information is accurate and complete. Therefore, whilst this report and the opinions contained herein are accurate to the best of Atkins' knowledge and belief, Atkins cannot guarantee the completeness or accuracy of any descriptions or conclusions based on supplied third party information.

Atkins accepts no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known other than within the terms of the contract.

In addition, in accordance with Atkins' procedures and because of insurance restrictions, this report does not advise on measures to deal with asbestos. Detailed advice should be sought from a specialist contractor, where necessary.

2. Background

2.1. Site location

The site is located to the immediate north of the A18 (Queensway) and to the immediate east of Dudley Road in Scunthorpe. The nearest postcode is DN16 1RP. The National Grid Reference of the approximate centre of the site is 491237E, 408807N.

The site is currently disused land with hardstanding present in the west and soft landscaping in the north and south. Foundations, floor slabs and historical drainage are still in place from the historical usage of the site.

2.2. Surrounding land use

The site is located in an area of mixed land use on the outskirts of Scunthorpe. The surrounding land uses are as follows:

- North – Go Outdoors Retail Unit Scunthorpe, Queensway industrial estate and open land;
- East – Queensway industrial estate and Tata Steel;
- South – A18 (Queensway), open land, residential housing and Lakeside retail park; and
- West – open land and residential housing.

2.3. Site setting

The following sections have been summarised from data included in the Hydrock Desk Study and Ground Investigation Report (Hydrock, 2017). Only information that is relevant to the preliminary conceptual site model has been included.

2.3.1. Site walkover

Table 2-1 Site Walkover Details

Item	Brief Description
Site access	Site is accessed via a locked gate off Dudley Road.
Site area	Approximately 2.19 ha.
Elevation, topography and any geomorphic features	The site is generally flat lying at an elevation of approximately 20 m AOD. The site steps down to the east of the former buildings.
Present land use	The site is currently disused land with hardstanding present in the west and soft landscaping in the north and south. Foundations, floor slabs and historical drainage are still in place from the prior usage of the site.
Vegetation	A small copse of young trees is present in the southeast of the site and several young trees and bushes are present in the north of the site.
General site sensitivity	The site is in an urban setting, with residential buildings to the west and south of the site.
Site boundaries and surrounding land	The site is marked by wooden boarding along the eastern boundary and approximately 3.0 m high palisade fencing around the remaining area of the site. Queensway borders the south of the site and Dudley Road borders the west of the site with residential properties beyond the roads. A thin (10 m) strip of unused land

	borders the site to the north, with a retail unit lying beyond this. Land to the east is of industrial usage.

2.3.2. Site history

A summary of the site history taken from the Hydrock report (Hydrock, 2017) is detailed below. A full site history is contained within the Hydrock Desk Study Report (Hydrock, 2017).

2.3.3. On-site

The site was developed in the 1940s as an electricity company depot. In the late 1950s or early 1960s a poultry processing plant was developed in the north of the site. In the late 1970s an office building was constructed in the south of the site. Historical mapping indicates various tanks to have been present on the site. The previous reports identified that the poultry processing plant became a timber merchants after 1980 and also identify electricity substations present in the west of the site.

A historical petrol filling station was located on-site along the southern half of the eastern boundary in 1975, no further information is available regarding this historical use (Hydrock, 2017).

2.3.4. Surrounding Area

Earliest available mapping shows a sandpit located approximately 150 m south-east of the site from approximately 1885 to 1948 and a quarry is located approximately 500 m east of the site from approximately this time. Between 1955 and 1968 the ironstone quarry becomes a steelworks and continues expanding into present day Tata Steel. Industrial buildings were first present on the historical mapping to the east of the site from 1948 until the present day.

2.3.5. Unexploded Ordnance (UXO)/bombs

The site is located in an area considered to be a moderate UXO risk. A specialist UXO desk top study was commissioned which concluded that there was a low risk of encountering UXO (Hydrock, 2017).

2.3.6. Published Geology

The general geology of the site area is shown on the 1:50,000 geological map of Scunthorpe (Sheet 89) (British Geological Survey , 1982) and is summarised in Table 2-2 (Hydrock, 2017).

Table 2-2 Summary of geology on-site

Location	Age	Stratigraphic name	Description
On-site	Devensian	Sutton Sand formation	Fine-grained silty sand
	Early Jurassic	Frodingham Ironstone formation	Strong ironstone, weathers to sand

The only part of the site covered by the Sutton Sand superficial deposits is the very south-western tip (British Geological Survey, September 2016). Publicly available borehole logs on the Lakeside Parkway Industrial Site situated just south of the site record Ironstone between 2.7 m bgl (SE90, NW259) and 3.3 m bgl (SE90, NW260).

2.3.7. Hydrogeology

The aquifer designations given in Table 2-3 are based on the Environment Agency interactive aquifer designation map and taken from the Hydrock report (Hydrock, 2017). Additional information on the hydraulic characteristics of the geological units was also included in the Hydrock report (Hydrock, 2017).

Table 2-3 Main aquifer designations and characteristics

Stratum	Aquifer designations	Hydraulic characteristics
Made Ground (imported fill)	N/A	Moderate to high porosity because of unconsolidated nature, but permeability likely to be constrained to low or low to moderate because of poor sorting and clay content.
Sutton Sand formation	Secondary A aquifer	Dominated by high permeability sand; overall, this unit is likely to be isotropic in nature with horizontal permeability greater than vertical permeability (i.e. kh>kv). However, the strata's limited extents prevent any major abstraction.
Frodingham Ironstone formation	Secondary A aquifer	Dominated by high permeability sand, interbedded with cemented ironstone; overall, this unit is likely to be anistropic in nature with horizontal permeability greater than vertical permeability.

The site is not within a groundwater Source Protection Zone (SPZ). There are no licensed groundwater abstractions within 1000 m of the site (Hydrock, 2017).

2.3.8. Hydrology

The surface water features in the vicinity of the site are listed in Table 2-4 (Hydrock, 2017).

Table 2-4 Surface water features within 1 km

Feature	Location relative to site
Ashby Vile lake	Approximately 700 m south-east
Bottesford Beck	Approximately 850 m south

There is one licensed surface water abstraction for spray irrigation within 1 km of the site. It is located approximately 850 m to the south of the site by Holme Hall Golf Course (Hydrock, 2017). The proposed development is in Flood Zone 1 (with a low probability of flooding) and the area is greater than 1 ha. The environmental data report indicates a low risk of groundwater flooding. Therefore, a flood risk assessment will be required as part of the planning application for the development (Hydrock, 2017). No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

2.3.9. Waste management and hazardous substances

There is one waste management site recorded within 250 m of the site. It is owned by The Queensway Metal Company and is located approximately 10 m south-east of the site (Hydrock, 2017).

There are no records relating to the storage of radioactive materials within 1 km of the site (Hydrock, 2017).

There are three landfills recorded with 1 km of the site (Hydrock, 2017). The details of these are summarised in Table 2-5.

Table 2-5 Summary of landfills within 1 km

Operator	Waste type	Date waste accepted from / to	Approx. distance and direction from site
Hydroprest Concrete	Industrial	31 Dec 1948 / 31 Dec 1980	325 m east
Unknown	Inert	31 Dec 1992 / 25 Apr 1993	534 m east
Unknown	Inert / Industrial	31 Dec 1992 / 25 Apr 1993	659 m east

The site is within 500 m of a COMAH site. The Health and Safety Executive produces risk maps incorporating inner, middle and outer zones (HSE Consultation Zones), the size of which will vary depending on the nature of the site and the perceived hazard. Depending on the sensitivity of the development, the HSE will advise against granting planning permission for developments within particular zones. This advice is only provided to Local Planning Authorities (LPA) via the PADHI+ software decision support tool (planning advice for developments near hazardous installations). PADHI can be used to obtain HSE's advice on pre-planning enquiries (PPEs) in a similar way as formal consultations on planning applications, provided sufficient information is available (Hydrock, 2017).

2.3.10. Radon and natural soil chemistry

Public Health England have published an online map showing the risk from radon across the UK. This indicates that the site is in a Radon Affected Area where recorded radon levels in 3-5% of homes are above the action level and basic radon protection measures are required for new buildings at this location in line with current guidance (Public Health England, 2017).

Information contained within the environmental data report within the Hydrock desk study report (Hydrock, 2017) gives indicative natural concentration values (estimated) for the natural soils at the site for a selection of Contaminants of Potential Concern (CoPC). These have been reproduced in Table 2-6.

Table 2-6 Natural soil concentrations on-site

Element	Arsenic	Cadmium	Chromium	Lead	Nickel
Concentration (mg/kg)	25-35	<1.8	60-90	<100	30-45

2.3.11. Ecological sites

There are no ecological sites (e.g. sites of special scientific interest or RAMSAR sites) within 500 m of the site (MAGIC, 2017).

2.4. Previous investigations on the site

The following reports and other associated works have been undertaken at the site and reviewed by Hydrock as part of their report, the main findings of the Hydrock desk study produced in 2017 are summarised below: (Hydrock, 2017).

The Hydrock desk study includes review of a Phase 1 Geo-environmental Audit report produced by Halcrow in July 2009 (Rep. no. TQSBPS). The report also contained the following historical information:-

The site area to the south and east of the wall and palisade fencing was used by Yorkshire Electric Distribution Limited as a depot. The site was a registered waste transfer site which was authorised to handle waste including ferrous and non-ferrous metals, non-hazardous construction and demolition waste, non-hazardous fly tipped waste removed from Yorkshire Electricity substations and tins containing residues of Mdi (Methylenediphenyl Di-isocyanate).

An above ground oil switchgear tank was located in the west of the site. Hydrock identified Polychlorinated biphenyl's (PCBs) as a potential contaminant of concern. An underground diesel tank was also identified as being present on the site. However, the location and condition of the tank have not been confirmed. North Lincolnshire Council identified a slurry filled petrol tank located within the site boundary.

The report identified a number of potentially contaminative historical uses of the site and outlines work carried out in a previous ground investigation by Joynes Pike Associates (2007) which identified elevated concentrations of arsenic, nickel, TPH and PAH within Made Ground deposits and elevated levels of arsenic and nickel in the natural deposits. Elevated levels of TPH have also been recorded surrounding the location of an underground diesel tank and an oil sump within the north-west corner of the site. A full copy of the Joynes Pike Associates ground investigation report was not available for Hydrock to review

Human health risk assessment undertaken by Joynes, Pike & Associates and reviewed by Halcrow (2007) identified concentrations of hydrocarbons within Made Ground and the underlying Sutton Sand Formation to which pose a risk to future site occupants and neighbouring occupants.

Hydrock stated that the Halcrow report was prepared prior to the demolition of the site and as such some of these features may have been removed during the demolition.

Data from the above have been taken into account during the preparation of this report where considered to be relevant or appropriate.

2.5. Preliminary Conceptual Model

2.5.1. Introduction

The preliminary conceptual site model (PCSM) was developed as part of the Hydrock Phase 1 desk study (Hydrock, 2017). Potential sources of contamination have been identified in the Phase 1 desk study and a preliminary CSM developed, together with PCLs or source-receptor-pathway linkages. The preliminary conceptual site model provided in the Hydrock report is summarised in Table 2-7.

Table 2-7 Preliminary Conceptual Site Model

Source (discrete areas)	Pathway	Receptor	Risk / Comments
On-site sources • PCBs associated with former electrical substations. • Organic contamination (PAHs, TPHs, and potentially herbicides/pesticides) • Hydrocarbon fuels, lubricant and chlorinated solvents associated with the workshops, tanks, electric company's yard. • Metals, VOCs and other timber treatment chemicals from the former timber merchants. • Made Ground possibly including metals, metalloids, asbestos, PAH and petroleum hydrocarbons.	• Humans: ingestion, skin contact, inhalation of dust and outdoor air. • Plant life: root uptake. • Plant uptake: methane ingress to the root zone from the landfill site.	Humans (neighbours, site end users)	**Moderate Risk** Due to the prevalence of industry across the site there may be contaminants in the Made Ground on-site that would pose a risk to human site users
	• Surface water: - overland flow. - drainage discharge. - base flow to groundwater.	Groundwater: Secondary A aquifers.	**Moderate Risk** The bedrock is recorded to be at shallow level on-site and therefore any on-site contaminants in the on-site Made Ground and soil may easily migrate into the underlying aquifer.
	• Underlying groundwater: migration of contaminant via leachate dispersion through the unsaturated zone in the Sutton Sand Formation. • Underlying groundwater: migration of contaminant into the Sutton Sand Formation and Frodingham Ironstone Formation.		
	• Migration of ground gas through / in unsaturated bedrock zone.	Development end use (buildings, utilities and landscaping).	**Moderate / Low Risk** The presence of sands across the south-west corner of the site may increase the risk of gas migration in that area.
Off-site sources • Hydrocarbon fuels, lubricant and chlorinated solvents	• Humans: ingestion, skin contact, inhalation of dust and outdoor air.	Humans (neighbours, site end users).	**Moderate Risk** Due to the prevalence of industry across the site there may be contaminants in the Made Ground on-site

Source (discrete areas)	Pathway	Receptor	Risk / Comments
associated with the former petrol station off-site to the south-east. • Quarry backfill possibly including metals, metalloids, asbestos, PAH and petroleum hydrocarbons. • Ground gases (carbon dioxide and methane) from organic materials present in the landfill cells or quarry backfill.			that would pose a risk to human site users
	• Underlying groundwater: migration of contaminant via leachate dispersion through the unsaturated zone in the Sutton Sand Formation. • Underlying groundwater: migration of contaminant into the Sutton Sand Formation and Frodingham Ironstone Formation.	Groundwater: Secondary A aquifers.	**Moderate Risk** The presence of superficial deposits increases to the west and this could results in contaminants being brought on-site through the sands.
	• Migration of ground gas through / in unsaturated bedrock zone.	Development end use (buildings, utilities and landscaping).	**Moderate Risk** The permeable deposits and bedrock on-site mean ground gas may migrate easily onto site from off-site sources.

3. 2015 Ground Investigation

3.1. Ground Investigation Design

A ground investigation was carried out in 2015 by Hydrock Consultants Limited (Hydrock Consultants Limited, 2016) on the 8 and 9 of December 2015. The investigation carried out is as follows:

- 15 no. trial pits: to investigate the thickness of cover and samples for contamination and geotechnical testing and; to assess shallow ground conditions
- Eight no. window sample holes: to assess the deeper ground conditions; to allow for collection of samples for contamination and geotechnical testing and; to install groundwater and ground gas monitoring wells at selected locations TP07 – TP11 and WS04 – 07 were located in order to investigate possible contamination surrounding former tanks.

3.2. Recorded Ground Conditions

3.2.1. Topsoil

Topsoil was noted in three out of 23 exploratory holes on-site (TP01, TP02 and TP15). It was described as: dark brown, slightly gravelly, slightly clayey SAND with rootlets. Gravel is angular, fine to coarse.

Where the Made Ground was not encountered, in the south of the site, the exploratory holes encountered topsoil (Hydrock, 2017).

3.2.2. Made Ground

Made Ground was encountered in 23 exploratory holes on-site. Generally Made Ground was described as dark grey to grey, slightly sandy to sandy, angular, fine to coarse GRAVEL of limestone, concrete, brick, wood, metal, asphalt, flint and slag.

Grey concrete was encountered in 14 exploratory holes across the site at thicknesses ranging from 0.08 m (TP013) to 0.3 m (TP07). Black asphalt was encountered in TP10, WS01 and WS06 from ground level to 0.15 m bgl.

Made Ground was recorded in TP07 between 0.30 – 0.80 m bgl of Grey, gravelly, fine SAND. Gravel is angular, fine to coarse of brick, concrete, limestone, wood and metal.

The Made Ground is inherently variable and as such representative values of geotechnical properties are impracticable to determine. Geotechnical testing was only carried out on two samples from the Made Ground. The results from these two tests are summarised below:

Table 3-1 Geotechnical Testing Results

Borehole Number	Moisture Content	Liquid Limit %	Plastic Limit %	Plasticity Index %	Passing .425 mm %
WS01	67	70	30	40	65
WS02	20	-	-	-	-

3.2.3. Superficial Deposits

The results from WS01 indicated that the soils from WS01 would be classified as high plasticity (CH).Superficial Deposits

Superficial deposits of the Sutton Sand Formation were encountered in 12 of the 23 drilled exploratory holes on-site. It was generally described as either:

- Red/orange/brown, dark brown or light grey, slightly gravelly, slightly organic, silty, fine SAND. Gravel is angular, fine to coarse of ironstone or sandstone; or;
- Uncompacted, dark grey SILT sometimes with a slight organic odour.

Twenty-eight geotechnical tests were carried out on multiple samples from the Sutton Sandstone Formation. A summary of these tests is as follows:

- Natural moisture contents in the fine units of these materials range from 16% to 35%, and modified plasticity indices range from 12% to 26%. On this basis, these soils are classified as of intermediate to high plasticity (CL and CH soils) and of medium to high volume change potential (Hydrock, 2017).
- Eight Particle Size Distribution Tests by wet sieving were undertaken in the Sutton Sand Formation. The analysis indicates that these materials consisted of clay/silt 10 - 26%, sand 25 - 81% and gravel 8 - 60% (Hydrock, 2017).

3.2.4. Sandstone

The bedrock encountered at shallow depth beneath the site was described as strong, orange brown Ironstone from the Frodingham Ironstone formation. It was encountered in 17 of the 23 exploratory holes.

3.2.5. Visual and Olfactory Signs of Contamination

Made Ground was encountered in all exploratory holes. Gravel of limestone, concrete, brick, wood, metal, asphalt, flint and slag were common across the site and therefore these observations have not been included in Table 3-2.

Indications of potential contamination are detailed in Table 3-2 and include anthropogenic material, staining and odours.

Table 3-2 Indications of Potential Contamination in Exploratory Holes

Location	Depth (mbgl)	Strata	Observation
WS05	0.55 – 0.65	Made Ground	Organic odour
TP05	0.45 -0.80	Sutton Sand Formation	Organic odour
TP07	0.80 – 1.0	Sutton Sand Formation with brick	Slight odour of diesel

3.2.6. Asbestos Containing Material

Four samples from the 2015 investigation detected asbestos. These samples were sent for quantification analysis and the results are summarised in Table 3-3 below.

Table 3-3 Summary of ACM detected in Contamination samples

Location	Depth (mbgl)	ACM	Asbestos Results	Asbestos Level %
TP07	0.4	Insulation Board	Chrysotile	0.001
TP07	0.9	Insulation Board	Chrysotile & Crocidolite	0.003
TP10	0.45	Loose Fibres	Chrysotile	0.004
WS03	0.7	Loose Fibres	Chrysotile	<0.001

4. Risk Assessment Summary

4.1. Risk Assessment Methodology

Atkins has summarised the risk assessment undertaken by Hydrock for the site based on the information provided gained in the 2015 ground investigation. Under the National Planning Policy Framework 2012 the approach to risk assessment of land potentially affected by contamination follows the risk based tiered framework published by Defra and the Environment Agency in their guidance document 'Contaminated Land Report (CLR) 11: Model Procedures for the Management of Land Contamination' (Environment Agency, 2004). This guidance provides a technical framework for identifying and remediating land contamination through the application of a risk management process. The question of whether risk is acceptable on any particular case involves not only scientific and technical assessments but also appropriate criteria by which to judge the risk and conclude exactly what risk would be unacceptable.

The basic approach to the risk assessments given in CLR11 is application of the following hierarchy:

- Tier 1 - risk screening by the establishment of potential contaminant linkages, i.e. the conceptual site model with preliminary qualitative risk assessment (PQRA); and / or
- Tier 2 – generic quantitative risk assessment (GQRA) using generic assessment criteria (GAC) that represent 'minimal' or ;tolerable' risk; and / or
- Tier 3 – detailed quantitative risk assessment (DQRA) using site specific assessment criteria (SSAC) that represent 'unacceptable' risk where generic assessment criteria are not available or they are not applicable to the CSM.

This section summarises the findings of Human Health and Controlled Waters Risk Assessment. The Human Health and Controlled Waters assessments were taken to Tier 2.

4.1.1. Human Health GQRA

Fifteen soil samples were tested during the Hydrock ground investigation for a range of contaminants including metals, inorganics, PAHs, asbestos, pH, SOM and Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG). No exceedances were recorded in the Hydrock report in any of the soil samples when they were screened against a commercial land use using 1 % soil organic matter (SOM) values. However, it is unclear in the report which generic screening numbers were used. As such Atkins have also screened the soil results against Atkins Soil Screening Values (SSVs) and the Category 4 Screening Values (C4SL) for 1 % SOM for a commercial end use. This screening confirmed that no exceedances of the generic assessment criteria were identified.

4.1.2. Controlled Waters GQRA

Three groundwater samples were recovered from site during a sampling round on the 7 January 2016 from WS02, WS03 and WS06 by Hydrock.

The groundwater results were screened by Hydrock against EU Drinking Water Standards (DWS) due to the presence of a Secondary A Aquifer beneath the site and Environmental Quality Standards (EQSs) as groundwater provides base flow to nearby surface water features (Hydrock, 2017). The exceedances recorded from these results are summarised in Table 4-1 below taken from the Hydrock geo-environmental report (Hydrock, 2017).

Table 4-1 Summary of groundwater WQS exceedances

Determinand	DWS concentration (ug/l)	Number of exceedances	Maximum exceedance	Location of exceedance(s) [greatest exceedance in bold]
Fluoride	1500	2	3600	WS03 **WS06**
Ammonium as NH4	500	1	1800	**WS03**
Arsenic	10	1	23.8	**WS03**
Chromium (III)	4.7*	1	9	**WS06**
Copper	1*	2	6.5	WS02 **WS06**
Manganese	50	2	9900	WS02 **WS03**
*EQS screening value used				

Elevated levels of five metals, ammonium and fluoride were recorded in all three groundwater samples. All exceedances are marginal and therefore it is unlikely that these contaminants would pose a problem to the Secondary A aquifer underlying the site or due to the distance to the nearby surface water courses, have significant negative effect on the water quality. Furthermore, copper and manganese are known to be present in high concentrations in the Frodingham Ironstone Member (Hydrock, 2017).

4.1.3. Gas Risk Assessment

Following the ground investigation Hydrock undertook 12 rounds of ground gas monitoring in the four installed exploratory holes on-site (WS02, WS03, WS05 and WS06). Ground gas risk assessment of the results were undertaken in addition an assessment was made as to the likely impact on property and services from the presence of ground gas and vapours.

The maximum methane concentration recorded on-site during these monitoring rounds was 0.1 % v/v in all exploratory holes, this is equal to the gas analyser limit of detection. A maximum carbon dioxide reading was of 1.10 %v/v was recorded in WS05 on the 11 February 2016. Steady concentrations of carbon dioxide ranged from 0.2 %v/v in WS02 to 1.10 %v/v in WS05 across the 12 site visits (Hydrock, 2017). A maximum flow rate was <0.35 l/hr which is the minimum detection limit of the gas analyser.

The ground gas risk assessment carried out by Hydrock using the guidance within CIRIA report C665 (CIRIA 665, 2007) has derived a characteristic situation of 1 (CS1) 'very low risk'. The guidance states that if a site is classified as CS1 no special gas precautions are required to be incorporated into the building design.

4.1.4. CAT-WASTE^{SOIL} Screening

It is anticipated that some surplus materials may be generated during the works and a preliminary waste assessment has been undertaken by Atkins using the online Atkins waste classification tool CatWaste^{Soil} (Atkins, 2016). CatWaste^{Soil} has been designed to cover the European Waste Catalogue code number 17 05 03 "soil and stones containing dangerous substances". The assessment of chemical data to determine the potential non-hazardous / hazardous status has been developed with careful adherence to the relevant authoritative guidance.

All fifteen soil samples were screened using the CATWaste tool. No samples were classified as hazardous.

4.1.5. WAC testing

Material that is surplus to requirements is classified as waste and should be disposed of in accordance with the current waste management legislation and guidance. If the scheme does not require excavated material to be retained on-site and it is destined for landfill, Waste Acceptance Criteria (WAC) analysis will be required to demonstrate to the landfill that the material is acceptable for disposal at the specific landfill.

Two WAC tests were carried out during the site investigation. The two samples were taken from WS01 and TP13 at 0.6 m bgl. Several determinands were flagged as stable non-reactive hazardous or hazardous, these are summarised in Table 4-2 below.

Table 4-2 Summary of WAC test results

Determinand	Measured concentration	Landfill WAC Limits (limit)	Sample
Loss on Ignition (%)	38 %	Hazardous Waste Landfill (10 %)	WS01
Fluoride (mg/kg)	12 mg/kg 13 mg/kg	Inert Waste Landfill (10 mg/kg)	WS01 TP13
Sulphate (mg/kg)	4000 mg/kg	Inert Waste Landfill (1000 mg/kg)	WS01

5. Remediation Strategy

5.1. Strategy Overview

The finalised development levels for the unit to be developed by LIDL and formations levels for the further retail plot and proposed residential plot are shown on Figure 2 of this drawing. St. Modwen will be responsible for the following elements of the remediation strategy:

- Preparation of a Materials Management Plan to allow re-use of site won and imported fills
- Removal of surface and sub-surface concrete as necessary and crushing to 6F2 specification under a WRAP protocol;
- Turnover of the site to the agreed depths and removal of sub surface obstructions;
- Controlled removal of existing disconnected services and site drainage system and replacement with suitable site won or imported fill;
- Removal of any buried tanks, pits or basements followed by backfill with suitable fill;
- Removal of any contamination encountered during earthworks;
- Cut and fill works including testing of all site won and imported previously used fills to demonstrate suitability for use on-site;
- Placement of fills to the 600 Series specification;
- Monitoring of these works by a suitably qualified engineer; and,
- Verification testing and verification reporting on all works carried out to the formation level of each plot.

Following the completion of the works to achieve a formation level of 20.4m AOD for LIDL and Home and Bargain will be responsible for the following works on their respective plots:

- Import and placement of any further fills to achieve finished development levels;
- Installation of services and service runs;
- Construction of the stores;
- Installation of radon protection measures; and,
- Import, verification testing and placement of suitable depths of fill within landscaped areas.
- Provision of an additional verification report demonstrating the achievement of the remediation strategy objectives from formation level through to final construction of the plot.

The proposed residential plot will have all surface concrete removed and crushed to 6F2 specification under a WRAP protocol and prepared to a suitable fall to prevent surface ponding. All further works will be the responsibility of a residential developer under a separate remediation strategy to be agreed with North Lincolnshire Council prior to the commencement of any further development works on this plot.

5.2. Contingency Plan

Where any additional tanks, liquid hydrocarbon impacted pipework, contaminated materials and/or previously unidentified materials are encountered during the remediation works, works should be temporarily ceased to enable inspection (and testing if necessary) by a suitably qualified engineer. The area shall then be boarded off and made safe until the client and the Environment Agency have been contacted and a strategy for dealing with the contamination agreed.

Additional contaminated materials dealt with via the contingency plan shall include but not be limited to any material including groundwater showing signs visual or olfactory evidence of contamination, soils impacted by solvent or hydrocarbons, materials impacted by ACM whether fibrous, board or corrugated material, highly coloured materials or buried areas of biodegradable or domestic wastes.

All excavations will be sampled at a rate of one sample per 25m^2 face or base of excavation with a minimum of one sample per face and base of each excavation regardless of the size of the excavation.

Details of the location, type and final destination of all previously unidentified materials encountered during the works should be recorded.

6. Post Remediation Constraints and Development Requirements

6.1. Gas Protective Measures

Assessment of the ground gas data from both the 2015 investigation, outlined in Section 4.1.3, suggest that Characteristic Situation 1 (CS1) is representative of the ground gas regime on-site. Therefore in accordance with CIRIA 665, no special ground gas precautions need to be incorporated into any new building design.

Notwithstanding, the development requires basic radon protection to be installed. The designer should ensure that any radon protection is designed cognisant of foundation and floor slab design to ensure sensible and buildable detailing. Radon gas is regulated in NLC by building control and prior approval for any designed protection measures will be required.

6.2. Recycled Aggregates

It is envisaged that site won demolition materials in the form of crushed brick and concrete will be utilised for civil engineering works for the development. The materials from existing buildings pavements and roads will be screened and crushed to specification.

The resulting stockpiled crushed materials shall comply with the WRAP quality protocol for the production of aggregate to be used on site. All materials visibly impacted by contamination or odour i.e. materials displaying indications of impact from oil, fuels or solvents shall be removed to a sealed stockpile area tested and removed from site to appropriately licensed facilities.

6.3. Site Won & Imported Fill

There will be a requirement for fill to be imported to site for raising of levels to the development formation levels and for landscaped areas within the retail plots.

Verification testing for site won and imported fill materials are as presented below:

- Site won and imported fills beneath all buildings and hard surfaced external areas of the site 1 sample per 500m^3;
- Topsoil for landscaped areas 1 sample per 250m^3;
- Topsoil from a topsoil supplier 1 sample per 50m^3; and,
- Virgin aggregate identification of source.

The verification testing will be carried out to the testing suite and Assessment Criteria as shown in Table 6-1 below.

Table 6-1 Imported Fill Chemical Requirements

Determinand	Units	Assessment criteria	Source of assessment criteria
Arsenic	mg/kg	635	C4SL
Cadmium	mg/kg	410	C4SL
Chromium	mg/kg	20,800	SSV
Chromium Hexavalent	mg/kg	49.1	C4SL
Nickel	mg/kg	1770	SSV

Determinand	Units	Assessment criteria	Source of assessment criteria
Lead	mg/kg	2310	C4SL
Mercury (inorganic)	mg/kg	3600	SSV
Beryllium	mg/kg	14	SSV
Selenium	mg/kg	13,000	SSV
Vanadium	mg/kg	7490	SSV
Copper	mg/kg	106,000	SSV
Zinc	mg/kg	1,100,000	SSV
Acenaphthene	mg/kg	83,600	SSV
Anthracene	mg/kg	535,000	SSV
Benzo(a)anthracene*	mg/kg	9.52	SSV
Benzo(a)pyrene	mg/kg	76.3	SSV
Benzo(b)fluoranthene*	mg/kg	76.3	SSV
Benzo(g,h,i)perylene*	mg/kg	76.3	SSV
Benzo(k)fluoranthene*	mg/kg	76.3	SSV
Chrysene	mg/kg	13,400	SSV
Dibenzo(ah)anthracene*	mg/kg	76.3	SSV
Fluoranthene	mg/kg	72,200	SSV
Fluorene	mg/kg	66,500	SSV
Indeno(1,2,3-cd)pyrene*	mg/kg	76.3	SSV
Pyrene	mg/kg	54,100	SSV
Phenol	mg/kg	685	SSV
Naphthalene	mg/kg	90.1	SSV
TPH Aliphatic C5-C6	mg/kg	4490	SSV
TPH Aliphatic C6-C8	mg/kg	10,400	SSV
TPH Aliphatic C8-C10	mg/kg	1370	SSV
TPH Aliphatic C10-C12	mg/kg	7900	SSV
TPH Aliphatic C12-C16	mg/kg	34,000	SSV
TPH Aliphatic C16-C35	mg/kg	3,620,000	SSV
TPH Aromatic C5-C7 (benzene)	mg/kg	12.5	SSV
TPH Aromatic C7-C8 (toluene)	mg/kg	27,900	SSV
TPH Aromatic C8-C10	mg/kg	2210	SSV
TPH Aromatic C10-C12	mg/kg	12,300	SSV
TPH Aromatic C12-C16	mg/kg	41,300	SSV
TPH Aromatic C16-C21	mg/kg	1250	SSV
TPH Aromatic C21-C35	mg/kg	1250	SSV
Cyanide	mg/kg	373	SSV

*BaP surrogate

Any materials failing the specification shall be removed to a segregation area and isolated from other stockpiles. The material will then be disposed of off-site to the appropriate permitted facilities.

No materials impacted by visible signs of free phase hydrocarbon or fibrous corrugated or hard bonded asbestos shall be accepted at the site and all such material shall be segregated and removed from site to appropriately permitted facilities.

The appointed contractor will agree a Site-Specific Action Criteria for Asbestos prior to the commencement of works with North Lincolnshire County Council.

6.4. Service Installation

The developer of each store should carry out an assessment of the appropriate material of construction for all drinking water pipes and agree these with the statutory undertaker Severn Trent Water.

6.5. Landscape Areas

All landscape areas will consist of a geotextile layer at the base and a minimum placed depth of 450mm of clean topsoil tested to the frequencies (dependant on source) specified within table 6-1 above.

6.6. Ground and Construction Workers

Due to the presence of identified contamination within Made Ground and natural soils underlying the site, a short-term risk could exist to construction and ground workers involved in the redevelopment. The adoption of good hygiene procedures and suitable Personal Protective Equipment (PPE) should be sufficient to minimise the risks posed by exposure to such soils.

6.7. Verification Report

The verification reports for the Queensway Scunthorpe site for the remediation works shall be prepared by Atkins in accordance with CLR11 to show compliance with remediation objectives and criteria during the site preparation phase. The verification reports shall provide a complete record of the remediation activities on site and the data collected. It shall include detailed descriptions of the Works with associated as built drawings.

The verification report for Queensway Scunthorpe shall include:

- Background information – project and site details, Employer's requirements and remediation objectives,
- Remediation – design, techniques, methodology, programme, verification emissions controls, chemical and physical testing results, priority contaminants,
- Monitoring – status, remediation extent, outstanding risks further works,
- Final site conditions i.e. an account of the state of the site following completion of the site preparation works,
- Results of perched groundwater (if any), soil and soil borne vapour monitoring,
- Third party contacts – correspondence and approvals/agreements from regulators, site visits, statutory guidance, third party agreements,
- Supporting information – plans, as–built drawings, progress photographs and reports, analytical results, H&S, QA, environmental monitoring, method statements, copies of consignment notes.
- Details of the verification testing for imported fill.

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Figures

DO NOT SCALE

ATKINS

Key:

Site Location

Rev.	Description	By	Date	Chek'd	Auth
0	Draft	NM	Sep-17		

ATKINS
3100 Century Way
Thorpe Park
Leeds
LS15 8ZB

Client

ST.MODWEN

Project

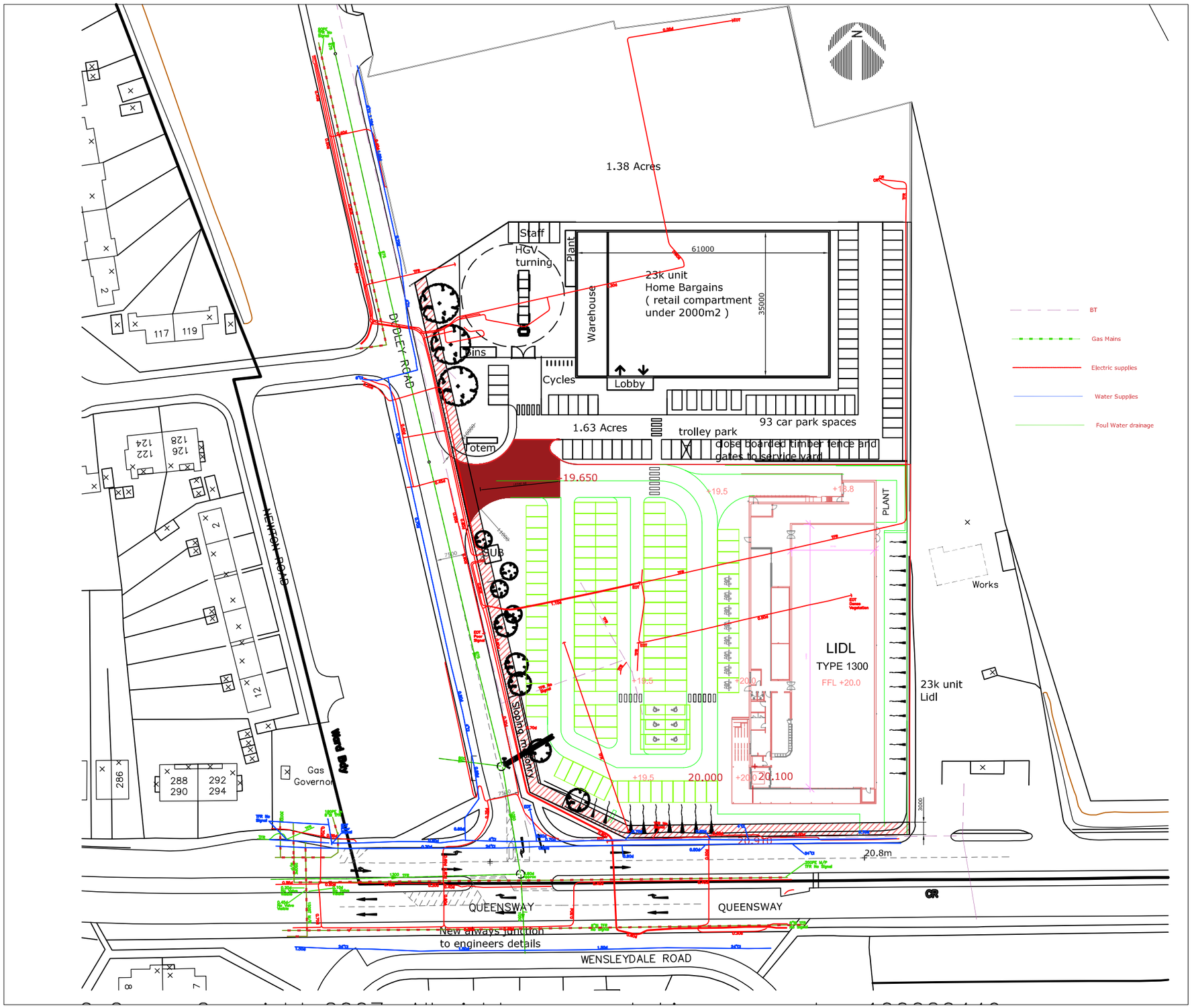
Queensway, Scunthorpe

Title

Site Location Plan

Drawing number

Figure 1



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Scunthorpe , Dudley Street - Services

14-042A001

Date: 21.03.2017 **Scale:** 1:1000@ A3 **Drawn by:** LDJ

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