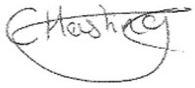


GROUNDTECH
CONSULTING

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Report type:	Geo-Environmental Appraisal
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SUMMARY

Site Details		
Site Location		*The site is located circa 588m east of Holbeach Town Centre. The site is approximately centred on National Grid Reference 536403, 324719.*
Site Area		*The site is roughly rectangular in shape and approximately 0.81 hectares in area. The topography is generally flat lying with no notable sloped/ramped areas.* *The site is occupied by two rectangular shaped buildings, one along the western boundary of the site and one within the eastern area of the site.*
Preliminary Risk Assessment		
History		*The site was initially part of a field with a building in the northern area and a pond in the south eastern area and later utilised as a sewage works. A drain was present at the site between 1904 and 1977. The current buildings on site were constructed within 1969 and 1977.*
Geology/Hydrogeology		*The superficial deposits at the site are indicated to be Tidal Flat Deposits comprising of Clay and Silt. The Bedrock Geology is the West Walton Formation comprising Mudstone and Siltstone*
Environmental Setting		*An old river drain is located 128m south of the site.* *The site does not lie within 2000m of a Source Protection Zone or Groundwater Abstraction.* *The nearest surface water abstraction licence is 798m west.*
Pollution Linkage (PL) Assessment	Human Health	*Made Ground is likely to be present beneath the site associated with former ponds, tanks and developments, however due to the proposed commercial end use and hardstanding covering the entire site there is not considered to be a viable pollution linkage.*
	Controlled Waters	*Low risk to groundwater as Unproductive Aquifers beneath the site and entire site to be covered with hardstanding which will restrict downward migration of contaminants.*
	Permanent Ground Gas	*Moderate risk as Made Ground is likely present beneath the site due to the presence of the historic drains, a former pond and previously demolished building.*
Ground Model		
Made Ground Soils		*Made Ground was generally encountered beneath the site to a maximum depth of 0.7m bgl, in CP2 and SuDS2 Made Ground was encountered to a maximum depth of 2.5m and 1.4m respectively.*
Natural Soils		*Very soft to soft gravelly Clay was encountered within all locations between depths of 0.4m and 9.0m bgl. Very clayey very silty Sand, this was encountered within CP1 to CP3 between depths of 5.0m and 16.0m bgl.* *Firm to stiff gravelly Clay was encountered within CP1 to CP3 between depths of 13.8m and 19.7m bgl.*

Bedrock	*Bedrock was encountered during the Ground Investigation within CP1 to CP3 between depths of 18.2m and 25.0m bgl and comprised extremely weak Mudstone completely weathered recovered as stiff gravelly silty clay.*
Groundwater	*Groundwater strikes were observed across the site between depths of 0.8m and 1.5m bgl, this was encountered within all locations.* *A second groundwater strike was observed within CP1 at 9.0m and CP3 at 9.5m bgl.*
Ground Engineering Assessment	
Foundations	*The most suitable solution for the proposed development is considered to be driven piles foundations transferring loads through the underlying Made Ground and Tidal Flat Deposits to the weathered Mudstone strata. For a single square pile 300mm in diameter end bearing in the High strength Clay at 20.0m bgl, a vertical allowable load of 150kN has been calculated.*
SuDS	*The use of SuDS drainage within the natural ground is not considered feasible as poor soil infiltration rates were observed at locations SuDS1 and SuDS2a within the natural cohesive soils and a high groundwater table.*
Constraints	*Further investigation will be required in the footprint of the existing buildings on site to fully characterise the ground conditions and achieve appropriate site coverage.*
GQRA Assessment and Revised (PL) Assessment	
Human Health	*All CoC were recorded at concentrations below the relevant screening values for commercial end use, one elevated concentration of speciated PAHs was encountered within WS01 at 0.2m bgl. No asbestos fibres were detected in any of the samples tested. Asbestos and PAH contamination was recorded by the previous investigation.* *The proposed development will be covered in hardsurfacing this will break the pollution linkage to site end users and so the risk to human health is Low.*
Controlled Waters	*Hydrocarbons across the site have generally been low, free phase was observed in SuDS2 – free phase will require removal. The risk to controlled waters is considered to be Low due Unproductive Aquifers underlying the site.*
Permanent Ground Gas	*At present, gas monitoring places the site in CS2 or CS3 and gas protection measures are currently considered necessary. The classification and level of precautions is will be confirmed on completion of the gas monitoring where a full assessment will be undertaken.*
Final Appraisal	

The following further work is considered necessary to progress the site to construction phase:

- *Completion of gas monitoring programme.*
- *Issue gas assessment.*
- *Intrusive site investigations post demolition of the buildings on site.*
- *Demolition Asbestos survey.*
- *Tree survey by qualified arboriculturist.*
- *Detailed foundation design.*
- *Production of a Remedial Specification.*

- *Production of a Flood Risk Assessment.*
- *Confirmation of remedial recommendations with the Regulators.*
- *Production of a Floor Risk Assessment.*
- *Confirmation of Remedial Strategy with regulators.*

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Project Objectives 1
1.2 Proposed Development 1
1.3 Limitations 1
2.0 SITE SETTING 3
2.1 Location 3
2.2 Site Description 3
3.0 SUMMARY OF PREVIOUS GROUND INVESTIGATION 5
4.0 ENVIRONMENTAL SETTING 7
4.1 Site History 7
4.2 Geology 8
4.3 Hydrogeology 9
4.4 Hydrology 9
4.5 Environmental Consultations 9
4.6 Radon 10
5.0 CONCEPTUAL SITE MODEL AND RISK ASSESSMENT 11
5.1 Introduction 11
5.2 Potential Contamination Sources 11
5.3 Pollution Linkages 13
5.4 Receptors 13
5.5 Preliminary Conceptual Site Model (CSM) 13
6.0 SCOPE OF INVESTIGATION AND RATIONALE 20
6.1 Project Objectives 20
6.2 Scope of Works 20
6.3 Soil Sampling 21
6.4 Geo-Environmental Testing 21
6.5 Gas and Groundwater Monitoring 22
7.0 GROUND MODEL 23
7.1 Made Ground 23
7.2 Natural Ground 24
7.3 Bedrock 24
7.4 Groundwater 24
7.5 Watching Brief 25
7.6 Excavation Stability 25
7.7 Excavation/Borehole Progress 25
8.0 GROUND ENGINEERING 26
8.1 Geotechnical Testing Results 26
8.2 Assessment Background 26
8.3 Geotechnical Parameters 28
8.4 Preliminary Foundation Design 28
8.5 Building Near Trees 29
8.6 Floor Slabs 30
8.7 Construction 31
8.8 Concrete Classification 31
8.9 Highway Design 32

8.10 Sustainable Urban Drainage System (SuDS) 33

9.0 LAND QUALITY 34

9.1 Geo-Environmental Testing Results - Soils 34
9.2 Generic Quantitative Risk Assessment - Soils 36
9.3 Permanent Ground Gases 37
9.4 Revised Pollution Linkage Assessment 39
9.5 Outline Remedial Strategy 47
9.6 Asbestos in Soils 47
9.7 Health and Safety - Construction and Ground Workers 48
9.8 Waste Classification by Assessment 49
9.9 Waste Acceptance Criteria (WAC) Results 49

10.0 FINAL APPRAISAL 51

10.1 Land Quality 51
10.2 Ground Engineering 52
10.3 Required Supplementary Investigation 52

11.0 RELEVANT INDUSTRY REFERENCES 53

APPENDIX 1 - Plans
APPENDIX 2 - Site Photographs
APPENDIX 3 - Historical Plans
APPENDIX 4 - BGS Records
APPENDIX 5 - Groundsure Report
APPENDIX 6 - Risk Assessment Methodology
APPENDIX 7 - Exploratory Hole Logs
APPENDIX 8 - Geo-Environmental Testing Results
APPENDIX 9 - Geotechnical Testing Results
APPENDIX 10 - Permanent Gas Monitoring Results
APPENDIX 11 - Soil Percolation Testing Results
APPENDIX 12 - Screening Values (Commercial End Use)
APPENDIX 13 - JWIG Receptor Tool
APPENDIX 14 - Waste Classification Report
APPENDIX 15 - Contaminated Land Legislative Background
APPENDIX 16 - Limitations

Plans

Plan Reference	*Revision*	*Title*
GRO-21400-P01	-	*Project Location Plan*
GRO-21400-P02	-	*Preliminary Development Constraints Plan*
GRO-21400-P03	-	*Illustrative Preliminary CSM*
GRO-21400-P04	-	*Exploratory Hole Location Plan*
GRO-21400-P05	-	*Revised Development Constraints and Contamination Plan*
GRO-21400-P06A	-	*Generalised Ground Model SPT*
GRO-21400-P06B	-	*Generalised Ground Model Cu*
GRO-21400-P07	-	*Illustrative Revised CSM*

1.0 INTRODUCTION

1.1 Project Objectives

Groundtech Consulting Limited have been instructed by Craddys on behalf of Aldi Stores Limited to undertake a Geo-Environmental Appraisal for a site at Fleet Street in Holbeach.

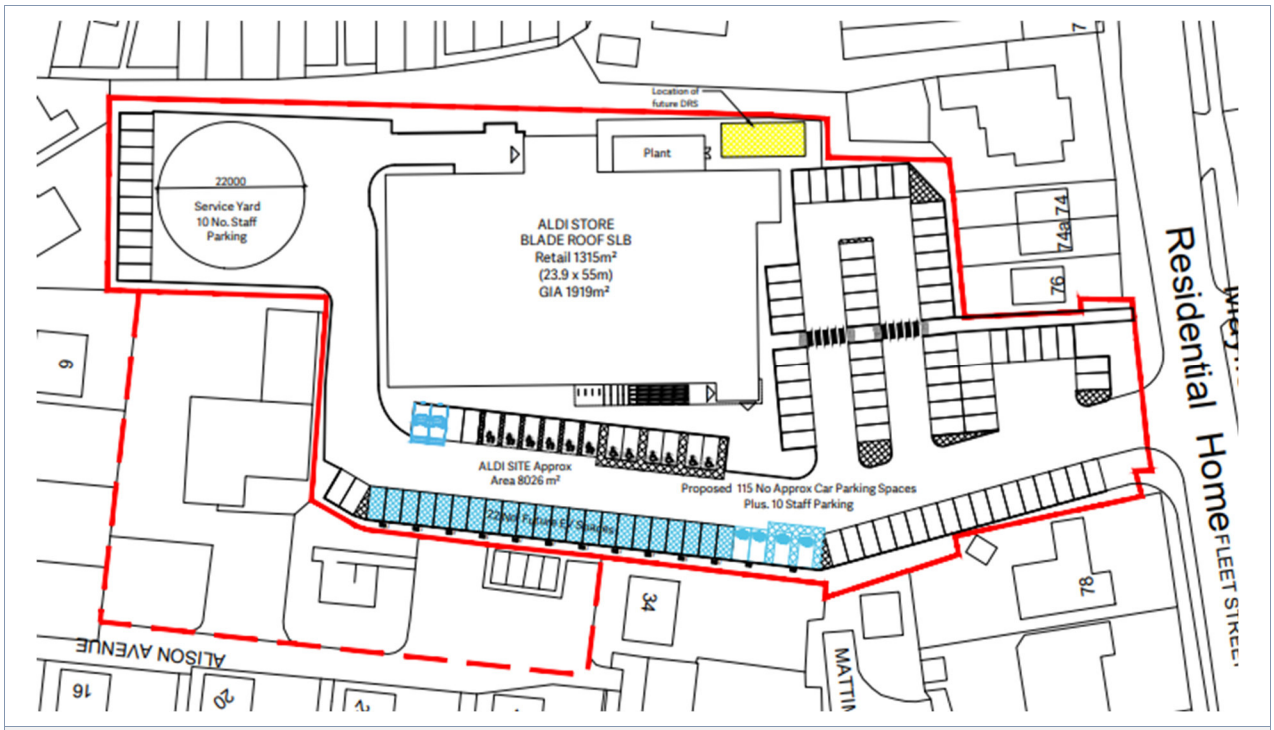
The objectives of the Preliminary Risk Assessment were to establish the sites environmental and geotechnical background in order to generate a Conceptual Site Model to identify any potential constraints and linkages which may affect the redevelopment of the site.

A main investigation was undertaken in accordance with BS 5930:2015, BS 10175:2017, BS 8576:2013 and Eurocode 7 to revise the CSM and quantify the level of risk identified in the PRA. The Appraisal has been prepared in accordance with current UK Legislation and to discharge Land Quality pre-commencement planning conditions.

The report has been undertaken to fulfil the requirements of a preliminary risk assessment in accordance with LCRM (Land Contamination Risk Management).

1.2 Proposed Development

The proposed development is commercial end use comprising of an Aldi store with associated hardstanding and car parking areas.



Proposed Development

1.3 Limitations

This Preliminary Risk Assessment is based on information obtained from a number of sources, and the information is assumed to be correct.

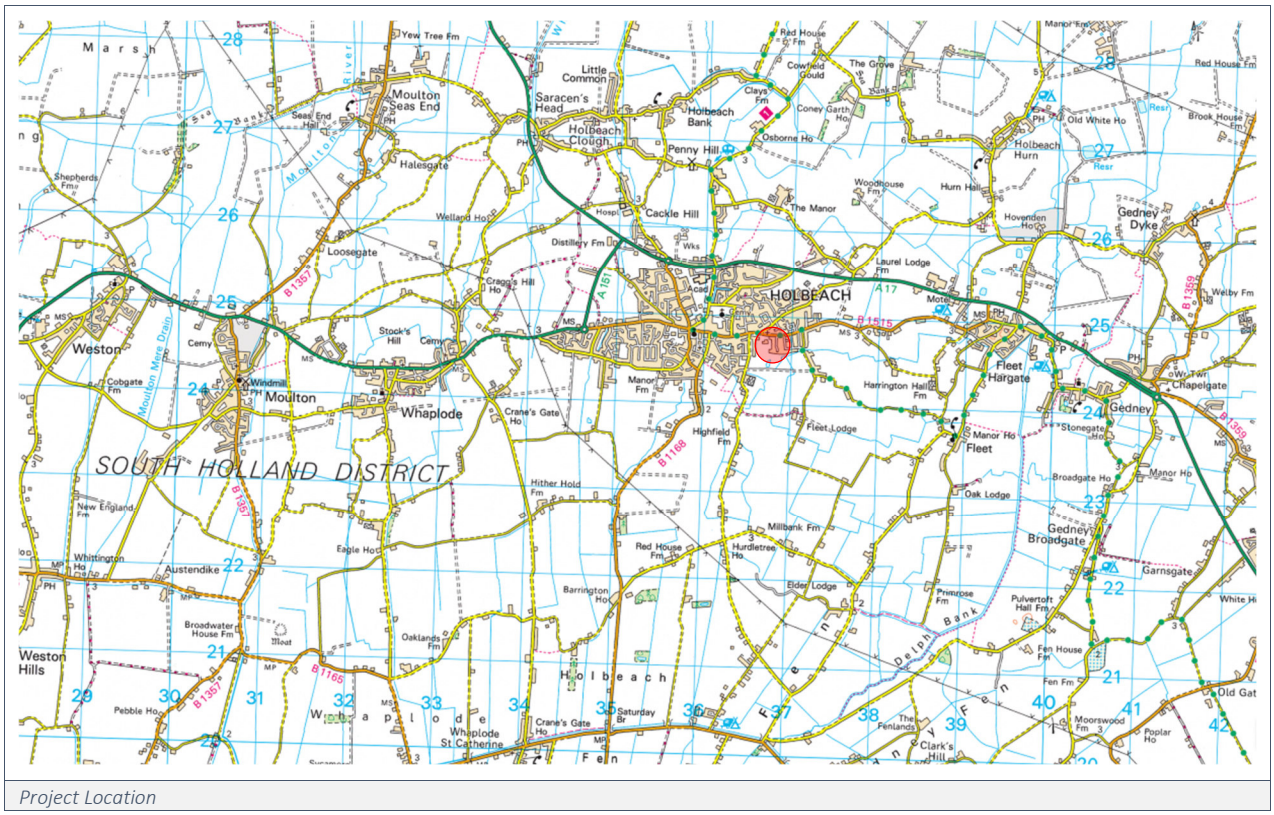
Other conditions may exist on the site that have not been taken into account in this assessment as they are outside the scope of works. Groundtech Consulting are not responsible for these circumstances that are not outlined in the report.

The assessment has been prepared for the exclusive use of the client. No third parties may rely on or reproduce the contents of the report without the written permission of Groundtech Consulting Limited. If any unauthorised third party comes into possession of the report, they rely on it at their own risk and Groundtech Consulting Limited will not be obliged to provide a duty of care.

2.0 SITE SETTING

2.1 Location

The site is located circa 600m east of Holbeach Town Centre, as shown on the Project Location Plan *GRO-21400-P01* and is approximately centred on National Grid Reference 536403, 324719.



Project Location

Access to the site is gained off Fleet Street to the north.

2.2 Site Description

The site is irregular in shape and approximately 0.8 hectares in area. The topography is generally flat lying with no notable sloped/ramped areas.

The site is occupied by two rectangular shaped commercial buildings, one along the western boundary and the other in the eastern area. The buildings within the western area of the site are currently still active whereas the eastern building has been vacant for some time.

Western Area

The western building comprises a row of large warehouse units covering approximately 0.2 hectares in area. Roller shutters are located along the eastern extent of these buildings behind which varying equipment is stored. This includes bin lorries, parade floats and household wastes. There is an office/stores building located within the north western area of the site adjoining the previously mentioned warehouse building. Asbestos roofing tiles are present above these buildings.

Tarmac surfacing is present throughout this section of the site, some vegetation encroaches onto this area of the site comprising small scale bushes and shrubbery.

Eastern Area

A former boxing gym is located within the eastern part of the sitecovering approximately 0.06 hectares in area. This building has been empty for some years and has been hoarded up to prevent vandalism. Asbestos roofing tiles are present above these buildings.

There are two large skips located to the west of this building which have been filled with waste and materials from within the gym. A number of storage containers are present in this area utilised by subcontractors who have access to store equipment.

Two stockpiles of demolition material were located in this area of the site that consist of concrete and brick rubble. It is suspected that this is the internal demolition materials from within the former boxing gym. There are also a number of mattresses in this area and are suspected to have been dumped at the site for disposal purposes.

South Eastern Area

The south eastern part of the site is circa 0.13 hectares in area, roughly square in shape and surfaced entirely by topsoil. A large above ground storage tank is situated in this area with associated concrete ramps adjacent which are possibly for delivery of fuel or oils for the tanks or an access ramp for the former sewage treatment works located on site.

Generally, there is a large quantity of fly tipped materials these include tyres, fridges and washing machines, former parade float steel frames and cages and gas bottles.

No evidence of asbestos or invasive plant species were identified during the site reconnaissance, the latter should be confirmed by a suitable trained ecologist.

Site Boundaries and Surrounding Area

The site boundaries are formed by the previously mentioned warehouses to the west, metal mesh fencing to the south and east and the northern boundary of the site is the location of the entrance gate which comprises palisade fencing. Some mature to semi-mature trees are present along the south eastern boundary and adjacent to the northern entrance of the site.

The site is surrounded by the following features/land uses:

- *North* - *Fleet Street followed by residential land use.*
- *East* - *Residential properties.*
- *South* - *Residential properties.*
- *West* - *Residential properties.*

Site photographs are presented in *Appendix 2* and relevant features are recorded on the Preliminary Development Constraints Plan *GRO-21400-P02.*

3.0 SUMMARY OF PREVIOUS GROUND INVESTIGATION

The Ground Investigation report has previously been produced by Delta-Simons on behalf of South Holland District Council referenced 19-2292.01, dated April 2020.

Site Description and Walkover

The site comprised the former council vehicle depot and toilet block in the western and southern areas of the site with the former South Holland Boxing Academy occupying the north-eastern corner of the site. The surfacing at the site comprised mainly of macadam although concrete hardstanding was present within the former vehicle depot warehouse. Suspected asbestos cement sheet roofing was present on both buildings.

A raised above ground storage tank was identified in the centre of the site noted to be empty and in good condition, no evidence of fuel staining or spills was present on the ground surface below.

Two metal containers were present centrally outside the former South Holland Boxing Academy containing a wide range of waste material. Associated stockpiles of washing machines, cookers, hobs and microwaves were also present.

A small stockpile of masonry, concrete and brick rubble was present in the central area of the site.

Scope of Works

The following scope of works was completed on the 12th December and 13th December 2016:

- *10 No. windowless sample boreholes (DS101 to DS110).*

Ground Model

Made Ground

Made Ground was encountered across the site to a maximum depth of 0.8m bgl and consisted of Macadam hardstanding to a maximum depth of 0.05m bgl underlain by a yellowish brown slightly sandy gravel of sandstone and sand to a maximum depth of 0.8m bgl.

Natural Soils

Natural soils underlying the Made Ground were Tidal Flat Deposits consisting of very soft to soft dark brown and grey Clay and Sand to a maximum depth of 3.0m bgl.

Bedrock

Bedrock was not encountered.

Groundwater

Groundwater was encountered during the Ground Investigation between depths of 0.95m and 2.4m bgl.

Watching Brief

No visual or olfactory evidence of contamination was noted during the investigation.

Generic Quantitative Risk Assessment

Human Health

Nineteen of the samples obtained were analysed for the presence of selected contaminants. The results indicated that marginally elevated concentrations of TPH and speciated PAHs were identified above the most stringent GAC for a residential end use with plant uptake.

Asbestos was detected during the laboratory analysis within two of the samples of Made Ground collected from DS107 at 0.3-0.4m bgl and DS110 at 0.15-0.2m bgl, both identified as Chrysotile quantified as <0.001mass % (i.e. trace).

It was suggested that no action was required in relation to contaminated soils as the elevated concentrations of TPH and PAHs were located beneath proposed roadways breaking any pathway to site end users.

Controlled Waters

Groundwater testing undertaken at the site revealed no elevated concentrations of contaminants and so the risk to controlled waters was considered to be Low.

Permanent Ground Gas

Potential sources of ground gas identified Made Ground including landfill materials in the east, however these were not fully investigated, the degradation of petroleum hydrocarbons and onsite/offsite infilled land.

Monitoring standpipes were installed as part of the works, the site was categorised as CS1 based on no methane detection and a maximum carbon dioxide concentration of 4.7% v/v.

Recommendations

The following recommendations and development abnormals were to be considered:

- *Following demolition or when full access can be gained, additional ground investigation should be undertaken to further assess the shallow soils at the Site. Additional ground investigation, including a ground gas monitoring program, is also considered to be necessary in the south east of the Site in the area of the historical EA recorded landfill and vehicle washdown area.*
- *The existing AST should be suitably decommissioned and further soil samples undertaken to assess the extent of contamination in the vicinity of the AST. Localised soil removal and validation sampling may be required.*
- *A 'hotspot' protocol to be put in place during any sub-surface works for groundworkers to act upon should potential contamination be identified.*
- *Consultation with the Local Water Authority to confirm the requirements for upgraded potable water pipes, although this should be anticipated.*
- *Additional soil testing (WAC) may be required to optimise offsite disposal of soils.*
- *An asbestos survey of the current buildings should be undertaken prior to demolition.*
- *Importation of suitable certified topsoil for any proposed for any proposed landscaped areas.*
- *A Remediation Method Statement (RMS) to support Planning and a subsequent Validation Report.*

4.0 ENVIRONMENTAL SETTING

4.1 Site History

Available historical maps have been obtained, a list of dates and scale are listed in the table below:

Scale	Date
1:1,250	*2003.*
1:2,500	*1888, 1904, 1931, 1969, 1977, 1982/83, 1984, 1986/91, 1995, 1991/95.*
1:10,000/10,560	*1887, 1903, 1929, 1938, 1950, 1955/58, 1970, 1977, 1992, 2001, 2010, 2022.*

The plans were examined and potential issues have been identified and summarised in the table below:

Date	Site	Surrounding Area
1888	*A pond overlaps the south eastern area and a building is located in the central northern area.* *The remaining parts are undeveloped.*	*The **pond** that overlaps the site extends approximately 10m to the south east.* ***Old brick pits** are indicated c.30m south west which are now **marshland**.* ***Old Fish Ponds** c.70m south shown as **marshland.*** *Four small **ponds** c.80 to 150m south east.* *Small **pond** c.230m east.* ***Railway Lines** c.250m south.*
1904	*Minor development to the building on site.* *Suspected **drain** located centrally along a north to south axis.*	***Malthouse** c.100m east.* *Small **pond** c.110m north.* ***Brewery** c.210m north west.* ***Cemetery** c.200m north west.* ***Saw Pit** c.200 north west.*
1931	*Western area shown as an Orchard.*	*Residential development c.100m south.*
1969	*Pond in south east no longer present, assumed to have been **infilled.*** *Building in central northern area of the site **demolished.*** ***Depot** building constructed in the north east of the site.* ***Sewage works** constructed in the south east of the site with associated **tank**.*	***Depot** c.70m south west.* ***Ponds** located over former brick pits c.70m west and c.140m west.* ***Pond** c.160m south.* ***Builders yard** c.80m north.* *Nursery c.100m north and 150m south west.* ***Works** c.120m north west.* ***Works/Depot** c.200m west.* ***Bus Depot** c.130m north east.* ***Electricity substation** c.75m north west.*
1977	***Buildings** constructed along the western boundary in current format.* *Suspected **drain** assumed to have been **infilled** or culverted.*	***Electricity substation** c.120m south east.* *Residential development in the surrounding area.*
1995	*Minor changes to the layout of the site.*	***Pond** c.230m east presumably infilled.* *Pond c.140m west designated as a nature reserve.* *Proportion of pond c.160m south no longer shown, possibly **infilled.*** ***Tank** c.120m north east.*
2003	*No significant change.*	*Residential development to the immediate north east.*
2022	*No significant change.*	*Residential development along the western boundary.*

The historical plans are presented in *Appendix 3.*

4.2 Geology

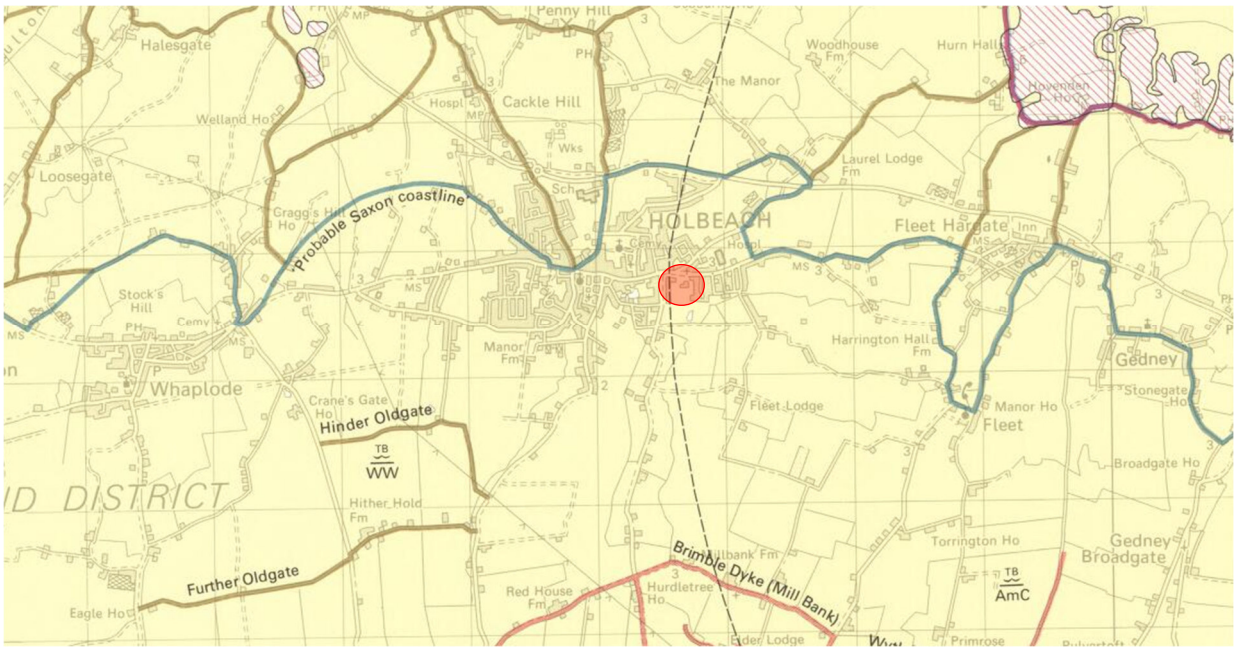
The following British Geological Survey (BGS) records and other available information were inspected to accurately determine the geology underlying the site:

- *1:50,000 Scale Geological Sheet 144, Spalding – Solid and Drift Edition.*
- *BGS Records.*

Made Ground
Made Ground is not indicated to be present beneath the site on the geological records, is although likely to be present.

Superficial Deposits
The site is indicated to be underlain by Tidal Flat Deposits, this stratum characteristically comprises Clay and Silt.

Solid Geology
The site is indicated to be underlain by the West Walton Formation, this stratum typically consists of Mudstone and Siltstone.



Geological Map – Solid Geology

Geological Faults
No faults are shown on or within an influencing distance of the site.

BGS Records
A number of BGS records are located within 250m of the site, the nearest and therefore the most representative is located circa 20m to the west of the site and the following sequence was recorded:

- *Made Ground to a maximum depth of 0.6m bgl.*
- *Very soft to soft peaty Clay between depths of 0.6m and 5.0m bgl.*
- *Very soft Clay interbedded with fine Sand between depths of 5.0m and 9.0m bgl.*

The BGS records are presented in *Appendix 4.*

4.3 Hydrogeology

The superficial and bedrock deposits in this area are classified by the Environment Agency as Unproductive Aquifers. These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The site is not indicated to lie within 2000m of a Source Protection Zone or a groundwater/potable water abstraction licence.

4.4 Hydrology

No named watercourses are present in the vicinity of the site. The nearest unnamed watercourse is an inland river located 128m south east of the site, this is defined as an Old River (Drain).

One surface water abstraction is located 798m west of the site and is associated with spray irrigation at P & L Hayes Farm.

Environment Agency information indicates that the site is within Flood Zone 2 and 3. The Risk of Flooding from Rivers or Seas is stated as *Low*.

The risk from surface water flooding is stated as between 0.1m – 0.3m for a 1 in 30 year flood event, this means that the site is at risk of flooding but a modern drainage system will be able to handle the extra surface waters.

The risk from Groundwater flooding on site is negligible.

4.5 Environmental Consultations

A request has been submitted to the Contaminated Land Officer at South Holland District Council for information pertaining to the site, this will be forwarded on receipt.

An environmental consultation has been conducted through Groundsure, which accesses British Geological Survey and Environment Agency databases. The complete Groundsure Report can be found in *Appendix 5*, a summary of the more relevant points is presented in the table below.

Record	<250m	250 – 500m	Description
Authorised Processes	-	*1*	*One licenced pollutant release 405m west of the site associated with a dry cleaners.*
Pollution Incidents	-	*1*	*One pollution incident located 270m north east and was associated with crude sewage, this had a significant impact to water.*
Landfill and Waste Treatment	*1*	*2*	*On site historic landfill associated with a former historic pond this is suspected to be household waste.*

Record	<250m	250 – 500m	Description
Discharge Consents	*2*	*2*	*The nearest of these with named effluent is located 294m east and is associated with sewage discharges. The nearest unspecified license is located 166m south west.*
Petrol Filling Stations	-	-	-
Current industrial Uses	*7*	-	*A number of industrial land uses within 250m of the site. A number of electrical substations are located 59m west, 72m north west, 146m south east and 157m south. A tank is located 137m north east of the site.*

4.6 Radon

Map 15 Lincolnshire and the Wash, from BRE 211 and HPA were examined which defines areas requiring radon protective measures. The probability is less than 1% and Holbeach is not an area requiring radon precautions in foundations in accordance with BRE Report 211 'Radon – Guidance on protective measures for new dwellings' 2015 Edition.

The radon data in the Groundsure report is supplied by the BGS/Public Health England and is the definitive map of Radon Affected Areas in Great Britain and Northern Ireland, the Groundsure report confirms the classification of less than 1% on the radon maps. The dataset was created using long-term radon measurements in over 479,000 homes across Great Britain and 23,000 homes across Northern Ireland, combined with geological data. The dataset is considered accurate to 50m to allow for the margin of error in geological lines, and the findings of this report supersede any answer given in the less accurate Indicative Atlas of Radon in Great Britain, which simplifies the data to give the highest risk within any given 1km grid square.

5.0 CONCEPTUAL SITE MODEL AND RISK ASSESSMENT

5.1 Introduction

The potential level of risk posed by contaminants in soil and/or groundwater will be influenced by the type and concentration of the contamination at source, the likelihood of exposure occurring, the potential pollution linkages and the likely chronic or acute effects on the receptors.

A contaminant is defined as a substance that has the potential to cause harm, a risk is considered to exist if such a substance is present at sufficient concentrations to cause harm and if a pathway is present a receptor could be exposed to the contaminant.

Section 4.0 compiles the information from the previous sections to assemble a Conceptual Site Model to inform the risk assessment process. The potential sources identified on the site and off the site that are within influencing distance are assessed to determine if pollution linkages exist and an unacceptable risk is posed to human health and controlled waters. The assessment has been carried out on a qualitative basis and aims to produce a complete and comprehensive Preliminary Conceptual Site Model, the potential pollution linkages are displayed on *GRO-21400-P03* Illustrative Preliminary CSM.

Three potential types of impacts exist for a site and all three need to be considered in the qualitative preliminary risk assessment:

- *Impacts from sources on the subject site.*
- *Impacts to the surrounding area from the subject site.*
- *Impacts to the subject site from the surrounding area.*

5.2 Potential Contamination Sources

Onsite Sources and Associated Contaminants of Concern (CoC)
From the information obtained during the preliminary risk assessment, there are a number of sources which may affect the redevelopment of the site for commercial end use.

Due to the varying previous land uses, Made Ground is anticipated within the vicinity of these former buildings and backfilled pond. Associated contamination includes heavy metals, speciated Polycyclic Aromatic Hydrocarbons (PAHs), and asbestos

An above ground storage tank is located within the central part of the site, associated potential Contaminants of Concern (CoC) include fuel derived hydrocarbons or other compounds stored. If this tank was related to the sewage treatment works located onsite, contaminants could include chemicals relating to the works.

Local landfill coverage is present within the south eastern area of the site associated with a former pond which has been infilled. Dependent upon the nature of any backfilled material, this may be a source of ground gas as well as general contaminants associated with Made Ground discussed above.

A former sewage works was located in the south eastern section of the site, the above ground tank is assumed to have been associated with this works. Associated potential CoC include fuel derived hydrocarbons, metals, speciated Polycyclic Aromatic Hydrocarbons (PAHs), sewage sludges, treatment chemicals and ground gases.

The former drain indicated to be present on site is another potential source of deep Made Ground and associated ground gases.

The existing commercial buildings at the site are currently utilised as a council depot for bin wagons and the storage of former parade floats, potential contamination from the fuelling and cleaning of these wagons included Total Petroleum Hydrocarbons (TPH CWG). The roof and guttering of these buildings was potentially constructed from Asbestos Containing Materials (ACMs).

Multiple skips and areas of tipped/demolition rubble are present at the site in the eastern area, potential contaminants identified or associated include asbestos, heavy metals, solvents and paints, TPH and household waste.

The orchard formerly located on site is a potential source of herbicides, pesticides and fertilisers as well as heavy metals and TPH's.

Offsite Sources and Associated Contaminants of Concern (CoC)
A range of potential contaminative sources have been identified within 250m of the site which may affect the redevelopment of the site for commercial end use:

- *Infilled pond/Landfill to the immediate south east of the site.*
- *Old Brick pits/Ponds/Marshland c.30m south west.*
- *Old Fish ponds/Marshland c.70m south.*
- *Depot c.70m south west, c.200m west and c.110m north east.*
- *Electricity substation c.75m north west and c.120m south east.*
- *Builder's Yard c.80m north.*
- *Small ponds c.80 to 150m south east, c.230m east and c.110m north.*
- *Works c.120m and c.200m north west.*
- *Tank c.120m north east.*
- *Cemetery c.200m north west.*
- *Saw Pit c.200m north west.*
- *Railway Lines c.250m south.*

The former fish ponds/numerous small ponds, wells, marshland and cemetery are potential sources of ground gas including methane and carbon dioxide.

The depot/works buildings are a potential source of heavy metals, speciated PAHs, fuels and oils.

Electricity substations are a potential source of Polychlorinated Biphenyls (PCBs) which are used as cooling agents in the transformers.

The builders yard and saw pits formerly located around the site are potential sources of heavy metals, speciated PAHs, asbestos, phenols, solvents, Volatile Organic Compounds (VOCs) and Semi Volatile Organic Compounds (SVOCs).

The unspecified tank identified could be a source of a number of contaminants dependant on what they were used to store. This could include fuels, oils or other chemicals.

The DoE profile for railway land indicates that the railway lines to the south are a potential source of heavy metals, ash, speciated PAHs fuels and oils.

5.3 Pollution Linkages

The definition of a pollution linkage is a medium which allows a contaminant to impact a receptor. Potential pollution linkages have been recognised for the commercial development from the identified contamination sources that exist.

At this stage, the contaminants identified above are considered to potentially pose an unacceptable risk to human health and controlled waters through the following pollution linkages:

- *Direct soil and dust ingestion.*
- *Dermal contact with soil both indoors and outdoors.*
- *Indoor air inhalation from soil and vapour.*
- *Outdoor inhalation of soil and vapour.*
- *Migration and accumulation of ground gas into internal spaces.*
- *Impaction of groundwater from soil contamination (diffuse and point).*
- *Impaction of groundwater from groundwater plume.*
- *Migration of soil and groundwater contamination impacting surface waters.*

5.4 Receptors

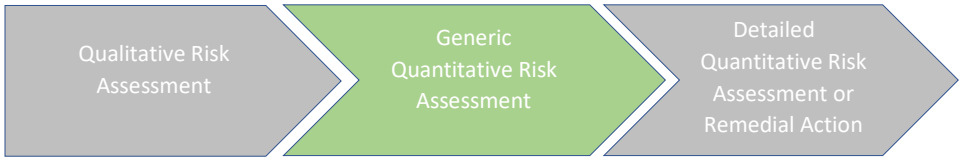
Receptors generally fall into the categories of human health or controlled waters within the river basin system. The recognized receptors are listed below:

- *Site end users.*
- *Unnamed river c.128m south east of the site.*
- *Clean potable water supply pipe.*

5.5 Preliminary Conceptual Site Model (CSM)

The factual information obtained from the consultations and summarised in Section 2.0 and 3.0 has been used to compile a Preliminary CSM. Using Source-Pathway-Receptor assessment criteria that is applicable in the UK, a risk assessment has been completed to determine if a plausible pollution linkage exists between the identified contaminants and receptors. The risk classification has been estimated in accordance with the CIRIA C552 assessment criteria outlined in *Appendix 6.*

Human Health Pollution Linkage Assessment



- The table below represents the second stage in the land quality risk assessment process - **the Generic Quantitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					*Generic Quantitative Risk Assessment*	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
PL1	Contaminated Soils	Ingestion of soil and dust. Dermal contact with soil.	Unlikely	Medium	Low	*Pollution Linkage 1 refers to proposed site users coming into contact with contaminated soils on the site.* *The site is currently separated into two areas, the eastern part contains a former boxing gym and the western area is utilised as an active depot.* *Historic site uses include an above ground tank, pond and associated landfill, depot and a sewage treatment works.* *Made Ground has been recorded to depths of up to 2.5m bgl however, it is generally present to a maximum depth of 0.7m bgl. Visual and olfactory evidence of contamination was noted in the form of free phase contamination within SuDS2 and ash within WS8 and WS12. As a minimum the free phase contamination should be removed.* *One elevated concentration of speciated PAHs was detected within the subbase strata in the southern area of the site. Elevated PAHs were encountered during the previous*

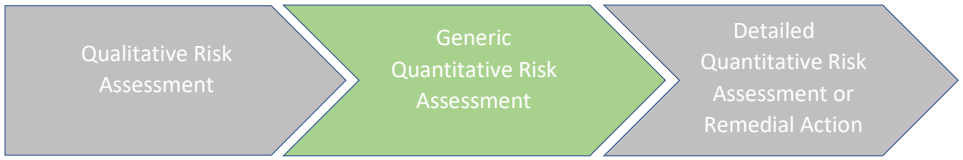
Conceptual Site Model						*Generic Quantitative Risk Assessment*
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
						investigation undertaken and are likely related to the subbase material or tarmac in these locations. *A large above ground tank is located in the central part of the site which was associated with the former sewage works and it is likely that this tank was used to store fuels or other chemicals. From the results of the laboratory testing, it has been determined that the tank has had no notable impact on the surrounding soils. The previous investigation undertaken found moderately impacted soils in vicinity of the tank although this was not elevated for a commercial end use scenario.* *Evidence of backfilled materials associated with the former pond on site was identified within the south eastern corner of the site, this material contained visual and olfactory evidence of contamination in the form of free phase liquids and a moderate hydrocarbon odour. Contamination at this location included hydrocarbon detection related to fuels or oils however this was not elevated compared to commercial screening values. As a minimum the free phase contamination should be removed.* *The historic drainage feature beneath the central area of the site was encountered within CP2 at 2.5m bgl, no elevated contamination has been detected associated with this feature.* *No asbestos has been detected in any of the samples screened from across the site during the Groundtech investigation. However, asbestos was detected during the previous investigation at two locations, DS107 and DS110 both identified Chrysotile at trace concentrations of less than 0.001mass %.*

Conceptual Site Model						*Generic Quantitative Risk Assessment*
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
						The proposed development is for a new Aldi store with associated hardsurfaced car parking areas. The proposed building and car park will effectively remove the pollution linkage to site end users by acting as a cover layer.
PL2	Contaminated Soils	Inhalation of vapour.	Low Likelihood	Medium to Severe	Moderate	*This pollution linkage refers to volatile vapours migrating into confined spaces within the proposed development. Significant hydrocarbon contamination is not present within the shallow Made Ground soils in the vicinity of the former tank as a result of potential spillages/leaks of fuel. However, hydrocarbon concentrations above laboratory detection limits have been detected in other areas of the site.* *Concentrations of heavy end hydrocarbons have been detected above detection limits at locations WS02 and WS08 and this is associated with ashy strata encountered, as these are the heavy fractions these are not considered to be volatile.* *Concentrations of middle to heavy end hydrocarbon fractions recorded above detection limit in SuDS2 and also BTEX. This is possibly associated with fuels and heavy oils associated with landfill/pond where free phase hydrocarbons were observed.* *Vapour saturation limit has been exceeded for Aliphatic bands C10 - C12 in SuDS2 at 0.8m and 1.2m bgl indicating that volatile contamination is present below the footprint of the proposed store and the risk is considered moderate.*

Conceptual Site Model						*Generic Quantitative Risk Assessment*
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
PL3	Contaminated Soils	Inhalation of soil dust by adjacent site users.	Low Likelihood to Likely	Medium	Moderate	*Pollution Linkage 3 relates to contamination on the subject site affecting adjacent site users. Free phase hydrocarbons have been encountered at location SuDS2 associated with moderate concentrations of hydrocarbons in the area of the backfilled pond which extends off site to the east and south. Therefore, the risk to offsite users from mobile contamination is moderate.*
PL4	Contaminated Soils	Attacking potable water supply pipe.	Unlikely to Low Likelihood	Medium	Moderate	*This pollution linkage refers to the possible contaminants permeating potable water pipes and consumption by the future site end users of the tainted water supply. Made Ground is present beneath the entire site. However, it will only be present at installation depths in the vicinity of CP2 and SuDS2. Hydrocarbon concentrations are above laboratory detection limits locally at the site and moderately high concentrations have been recorded in SuDS2.* *Potable water supply pipes will be included as part of the development and a possible pollution linkage is considered to exist, a local water company risk assessment is required prior to construction to advise on the level of protection required for the potable water supply. Depending on the proposed route of the water supply pipe, it may be possible to lay the pipe in natural soils to mitigate the risk.*
PL5	Ground Gas	Migration and accumulation of ground gas in internal spaces.	Likely	Medium to Severe	High	*Made Ground is present beneath the site to a maximum depth of 2.5m bgl. Monitoring standpipes installed at the site have indicated high readings of methane especially within the vicinity of the former drain encountered within CP2.*

Conceptual Site Model						*Generic Quantitative Risk Assessment*
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
						A maximum concentration of carbon dioxide has also been recorded at a concentration of 18.2% v/v and a maximum methane concentration of 60.7% v/v has been recorded. A single positive flow rate of 18.4 l/hr has also been recorded however, this is not considered to be representative as no other positive gas flow rates have been recorded. *The site is not within an area requiring radon precautions within foundations.*

Controlled Waters Pollution Linkage Assessment



- The table below represents the second stage in the land quality risk assessment process – **Generic Quantitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					*Generic Quantitative Risk Assessment*	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	*Rationale*
PL6	Contaminated Soils	Impaction of groundwater from soil contamination (diffuse and point). Impaction of groundwater from groundwater plume.	Unlikely	Medium	Low	*Made Ground is present below the site to a maximum depth of 2.5m bgl. One elevated concentration of speciated PAHs was detected within a sample of subbase material within the southern part of the site related to tarmac surfacing. During the previous investigation, three elevated concentrations of Dibenzo(ah)anthracene were recorded within DS103, DS107 and DS110 and two elevated concentrations of Chrysene were recorded in locations DS107 and DS110.* *Visual and olfactory evidence of mobile contamination was encountered within SuDS2 which included free phase. Hydrocarbons detected at this location were concentrations above laboratory detection limits and potential sources of mobile contamination are present within the vicinity in the form of tanks. As a minimum free phase should be removed from site.* *A significant thickness of natural impermeable clay has been encountered underlying the Made Ground across the entire site which is considered to be the Tidal Flat Deposits which are classified as an Unproductive Aquifer. Although, evidence of mobile*

Conceptual Site Model						*Generic Quantitative Risk Assessment*
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	*Rationale*
						contamination has been identified, the impermeable Tidal Flat Deposits will have pretended downward migration of contaminants. *Furthermore, the proposed development will be completely covered with hardsurfacing and a new drainage system installed. This will considerably reduce infiltration and leaching of potential contaminants, therefore no pollution linkage is considered to exist.*
PL7	Contaminated Soils	Migration of soil and groundwater contamination impacting surface waters.	Unlikely	Low	Low	*Pollution Linkage 7 refers to the impaction of an unnamed watercourse 128m south east of the site from contaminated soils and groundwater. Localised evidence of mobile contamination was encountered in SuDS2 where free phase hydrocarbons were present in the area of the backfilled pond which is predominantly located offsite to the south east. The offsite portion of the pond is likely to be having a more significant impact on the surrounding area.* *Impermeable Clay deposits encountered across the site will have restricted lateral migration of mobile contamination and a sufficient attenuation distance is considered to exist between this watercourse and the site, no realistic pollution linkage is present.*

6.0 SCOPE OF INVESTIGATION AND RATIONALE

6.1 Project Objectives

The aim of the fieldwork was to:

Determine the stratification beneath the site.
Maintain a watching brief for visual and olfactory evidence of contamination.
Obtain samples using methodology in current guidance for contamination analysis.
Identify realistic pollution linkages to groundwater.
Obtain relevant geotechnical parameters for preliminary foundation design to address both ULS and SLS conditions.
Determine if targeted supplementary investigation in areas of concern is required and for remedial design.
Install monitoring standpipes for gas monitoring.
Assess the identified pollution linkages in the CSM.
Calculate soil infiltration rates to determine feasibility of SuDS drainage.

6.2 Scope of Works

The following scope of works was completed between the 24th January and 28th of January 2022:

- *Three Cable Percussive Boreholes (CP1 to CP3) were drilled to 25.0m bgl using a Dando 3000 cable percussive drilling rig.*
- *Fifteen Windowless Samples Boreholes (WS01 to WS15) were drilled to 4.45m bgl using a Dando Terrier Windowless Sampling Rig. An exception to this was WS12 which was terminated at 0.5m bgl due to a concrete obstruction.*
- *Three Soil Percolation Tests (SuDS1, SuDS2 and SuDS2a) were excavated to depths of between 1.8m to 2.7m bgl using a JCB 3CX where soil percolation testing was undertaken.*

The exploratory hole locations are presented on Groundtech Plan *GRO-21400-P04* and the exploratory hole logs are in *Appendix 7.*

The exploratory holes were positioned to establish the stratification beneath the site and target any areas of concern as summarised in the table below:

Location	Target Rationale
CP1, WS12	*Vicinity of Above Ground Tank*
WS13 and SuDS2	*Former Pond/landfill*
CP2	*Former Drainage Feature*
WS01 to WS05, WS11, CP1	*Western Area Coverage*
WS06, WS09, WS10, WS12 to WS15	*Eastern Area Coverage*
CP1 to CP3, WS4, WS5,WS3, WS9	*Proposed Aldi Footprint*
SuDS1 to SuDS2a	*Proposed SuDS drainage*
CP1, WS12, WS13, SuDS2a2	*Former Sewage Works*
WS1 to WS5	*Depot*
WS1, WS2, CP1	*Orchard*

The exploratory holes were logged by a suitably experienced geo-environmental engineer in general accordance with the following current guidance:

- *BS 5930 'Code of Practice for Site Investigations' 2015.*
- *BS EN 14688-1:2002 'Geotechnical Investigation and Testing – Identification and classification of soil'.*
- *BS EN ISO 14689:2002 'Geotechnical investigation and testing – Identification and classification of rock'.*

6.3 Soil Sampling

During the intrusive investigation, representative samples were taken at regular intervals, changes of strata and where evidence of contamination existed. Laboratory analysis was scheduled on the samples taken.

The samples obtained are summarised in the table below:

Soil Sample	Number
Environmental Sample	*29*
Disturbed Sample	*158*
Bulk Sample	*-*
Undisturbed U100 Sample	*10*

The samples have been obtained in accordance with current environmental and geotechnical guidance. The sampling plan has been designed to obtain samples from all required strata using the correct methodology.

Disturbed samples of soil for geo-environmental testing were placed in the correct sampling containers as required by the laboratory in accordance with their MCERTS and UKAS Accreditation. Transportation was arranged in a timely manner and the samples were at the correct temperature.

The sample locations and depths are recorded on the exploratory logs.

6.4 Geo-Environmental Testing

To inform the Generic Quantitative Risk Assessment, the following geo-environmental testing was scheduled to assess the risk from contamination on the site. The testing is based on the potential sources identified in the PRA and observations during the Ground Investigation.

Contaminants of Concern	Matrix	Number
Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Water Soluble Boron, Zinc	*Soil*	*23*
Speciated Polycyclic Aromatic Hydrocarbons (PAHs)	*Soil*	*23*
Phenols, cyanide, organic matter, sulphate and pH	*Soil*	*23*
Hexavalent Chromium	*Soil*	*23*
Total Petroleum Hydrocarbons (TPH CWG)	*Soil*	*9*
Asbestos Screening	*Soil*	*23*
Waste Acceptance Criteria (WAC)	*Solid and Eluate*	*5*

The Geo-Environmental Laboratory Testing Results are presented in *Appendix 8.*

Representative disturbed samples were obtained for all soil types encountered. Selected samples were scheduled for testing at an approved laboratory in accordance with BS 1377 'Method of Test for Soils for Civil Engineering Purposes' 1990. The following tests were scheduled:

BS 1377	Test Method	Number
Part 2	*Water Content*	*7*
Part 2	*Plasticity Index Analysis*	*7*
Part 7	*Quick Undrained Triaxial*	*6*
Part 7	*One Dimensional Consolidation*	*1*
BRE	*BRE Suite D (Pyrite Present)*	*7*

The Geotechnical Laboratory Testing Results are presented in *Appendix 9*.

6.5 Gas and Groundwater Monitoring

Gas and groundwater monitoring installations were constructed in the boreholes. The standpipes consisted of polyvinyl chloride (PVC) and high-density polyethylene (HDPE) pipe - a bentonite seal was placed around the plain pipe and a clean gravel pack was placed around the slotted pipe. A summary of the installation construction is presented in the table below:

Location	Depth (m)	Response Zone (m bgl)	Targeted Strata	Reason
CP1	*6.0*	*3.0 – 6.0*	*Very Soft Clay*	*Ground Gas*
CP2	*6.0*	*3.0 – 6.0*	*Very Soft Clay*	*Ground Gas*
CP3	*6.0*	*3.0 – 6.0*	*Very Soft Clay*	*Ground Gas*
WS01	*4.0*	*1.0 – 4.0*	*Very Soft Clay*	*Ground Gas*
WS06	*4.0*	*1.0 – 4.0*	*Very Soft Clay*	*Ground Gas*
WS08	*4.0*	*1.0 – 4.0*	*Very Soft Clay*	*Ground Gas*
WS13	*4.0*	*1.0 – 4.0*	*Very Soft Clay*	*Ground Gas*
WS14	*4.0*	*1.0 – 4.0*	*Very Soft Clay*	*Ground Gas*

Permanent gas and flow rate monitoring was carried out using a GFM 436 infrared gas monitor with integral electronic flow analyser. The measurements taken are listed below:

- *Oxygen (O_2), carbon dioxide (CO_2) and methane (CH_4) as the percentage volume in air (%v/v).*
- *Hydrogen sulphide (H_2S) and carbon monoxide (CO) as the percentage volume in air (%v/v).*
- *Lower Explosive Limit (%LEL) of methane.*
- *Atmospheric and borehole pressure, including pressure trend.*
- *Flow measurements (l/hr).*
- *Weather and ground surface conditions*.

Both peak and steady state conditions were monitored to understand the behaviour of the permanent ground gas, the steady state conditions were recorded by allowing the gas monitor to run for a minimum of 3 minutes.

Interim permanent gas and groundwater monitoring results are presented in *Appendix 10.*

7.0 GROUND MODEL

7.1 Made Ground

Made Ground was encountered in all locations and was generally present beneath the site to depths between 0.2m and 0.7m bgl, however in CP2 and SuDS2 located within the central and eastern area of the site, Made Ground was observed to a maximum depth of 2.5m and 1.3m respectively.

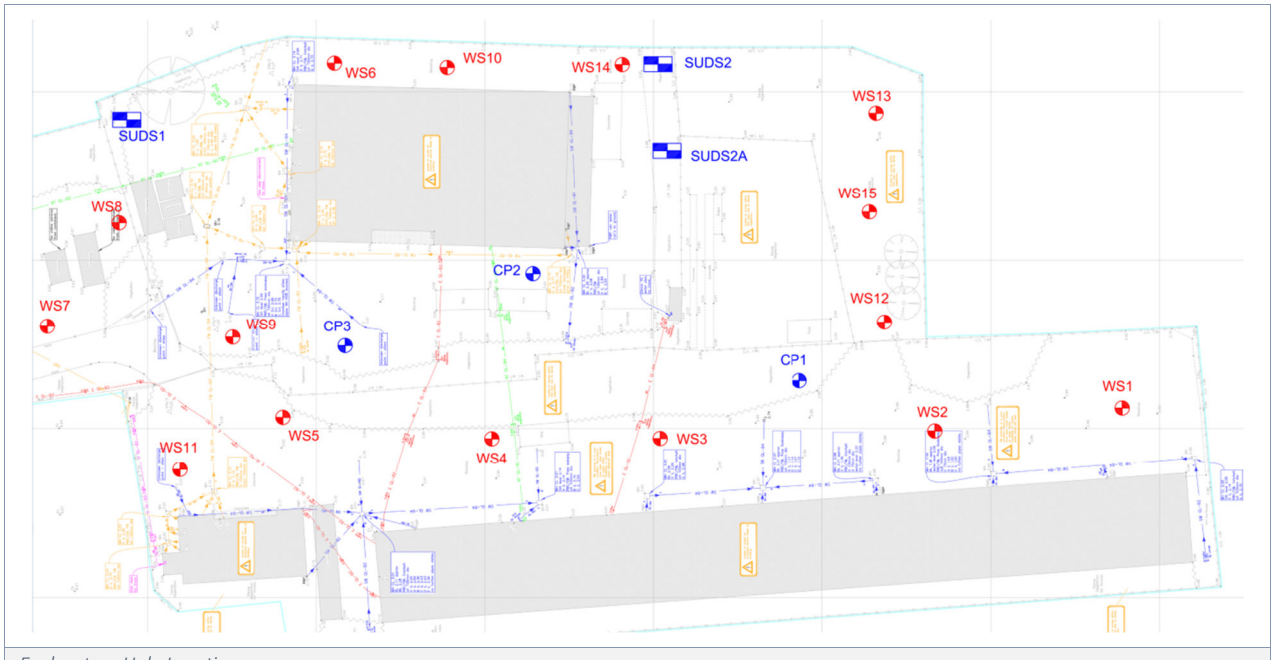
The Made Ground encountered within SuDS2 is anticipated to be associated with the former infilled pond and the Made Ground within CP2 is anticipated to be associated with the former drain.

Surfacing populations encountered at the site consisted of tarmac within the central and western areas, very gravelly sand within the north eastern area and very gravelly sandy topsoil within the south eastern area.

Four main Made Ground populations were identified during the investigation and are described below:

- *Pale brown sandy gravel in all exploratory holes excluding WS12, WS13 and WS15 between depths of 0.05m and 0.7m bgl.*
- *Black ashy gravel in WS8 and WS12 between 0.05m and 0.35m bgl.*
- *Very soft gravelly clay was in CP2 between 0.3m to 2.5m bgl.*
- *Demolition material inclusive of bricks, roof tiles and suspected asbestos sheeting was encountered within SuDS2, which was coated in a black hydrocarbon odorous liquid between depths of 0.5m to 1.3m bgl.*

A number of stockpiles of demolition material was identified during the Ground Investigation within the central area of the site. This comprised of brick and cinder block rubble assumed to be associated with the internal walls of the former gym on site as well as house hold wates including mattress.



Exploratory Hole Locations

Concrete obstructions were encountered within CP1, CP2 and WS12 at depths of 0.2m, 2.5m and 0.5m bgl respectively located within the central/ entral southern areas of the site. Within CP2, the concrete obstruction is suspected to be a historic drain feature indicated on the historic maps for the site.

7.2 Natural Ground

The natural strata encountered generally confirmed the published geological records. Three main natural stratification were present during the investigation and are described below:

- *Very soft to soft gravelly Clay in all of the exploratory holes from a minimum depth of 0.4m to a maximum depth of 9.0m bgl.*
- *Loose to medium dense very clayey very silty Sand in CP1 to CP3 between depths of 5.0m and 16.0m bgl.*
- *Firm to stiff gravelly Clay in CP1 to CP3 between depths of 13.0m and 19.7m bgl.*

7.3 Bedrock

Bedrock was encountered in CP1 to CP3 from depths of between 18.2m and 19.7m bgl and comprised extremely weak Mudstone residually weathered recovered as stiff gravelly silty Clay.

7.4 Groundwater

Shallow groundwater strikes were observed beneath the site between depths of 0.8m and 1.5m bgl, this was encountered within all locations within the Tidal Flat deposits.

A second groundwater strike was observed within CP1 at 9.0m and CP3 at 9.5m bgl within clayey silty Sand.

Location	Depth to base (m)	Depth to Groundwater (m)
CP1	*20.0*	*1.1* *9.0*
CP2	*20.0*	*2.5*
CP3	*20.0*	*1.3* *9.5*
WS01	*4.0*	*1.1*
WS02	*4.0*	*1.2*
WS03	*4.0*	*1.1*
WS04	*4.0*	*1.0*
WS05	*4.0*	*1.5*
WS06	*4.0*	*1.5*
WS07	*4.0*	*0.8*
WS08	*4.0*	*0.9*
WS09	*4.0*	*1.1*
WS10	*4.0*	*1.5*
WS11	*4.0*	*1.0*
WS13	*4.0*	*1.3*

WS14	*4.0*	*0.9*
WS15	*4.0*	*1.0*

7.5 Watching Brief

A watching brief was maintained during the Ground Investigation for visual and olfactory evidence of contamination.

In WS08 between 0.05m and 0.20m bgl and WS12 between 0.2m and 0.35m bgl, a band of ashy material was observed which had a moderate hydrocarbon odour. The locations are in both the northern and southern areas of the site associated with the former sewage works within WS12 and historical developments within WS08.

In SuDS2, demolition material with a hydrocarbon coating comprising free phase liquids was observed with a moderate hydrocarbon odour at depths of between 0.3m to 1.3m bgl. This is assumed to be the backfilled materials associated with the former pond within the south eastern area of the site.

Asbestos is suspected to be present on the site, this was observed within the buildings onsite and within the demolition waste materials stockpiled in the western area.

7.6 Excavation Stability

Evidence of collapse was noted during excavation of the trial pits within the very soft to soft clay stratum which has been encountered site wide between 0.4m and 9.0m bgl.

7.7 Excavation/Borehole Progress

Slow progress while excavating the trial pits was not experienced.

Concrete obstructions were encountered within CP1, CP2 and WS12 at depths of 0.2m, 2.5m and 0.5m bgl respectively located within the central/central southern areas of the site.

8.0 GROUND ENGINEERING

8.1 Geotechnical Testing Results

Comparison of water content and the value of 0.4 times the Liquid Limit in accordance with BRE Digest 412 'Desiccation in Clay Soils' suggests significant desiccation has taken place when 0.4 times the Liquid Limit is greater than the actual water measured water content. This is a rudimentary method but also a good guide.

Results of the plasticity testing and the volume change potential of the Clay is summarised in the table below:

Reference	Depth	Modified PI	Volume Change Potential	Significantly Desiccated
CP1	*1.2*	*56.0*	*High*	*N*
CP2	*2.0*	*29.4*	*Medium*	*N*
CP3	*1.2*	*10.9*	*Low*	*N*
WS03	*2.0*	*17.2*	*Low*	*N*
WS04	*1.0*	*14.8*	*Low*	*N*
WS05	*2.0*	*23.0*	*Medium*	*N*
SUDS2A	*1.0*	*17.0*	*Low*	*N*

Results of the Quick Undrained Triaxial testing are summarised in the table below:

Reference	Depth (m)	Undrained Sheer Strength (kN/m^2)	Relative Strength
CP1	*21.5*	*148*	*High*
CP1	*23.0*	*146*	*High*
CP2	*8.0*	*9*	*Extremely Low*
CP2	*15.5*	*128*	*High*
CP2	*20.0*	*137*	*High*
CP3	*15.5*	*329*	*Extremely High*

Results of the one dimensional consolidation testing are summarised in the table below:

Reference	Depth (m)	Range of Coefficient of Compressibility (Mv) m^2/MN
CP2	*4.0*	*0.437 – 2.966*

8.2 Assessment Background

Background

The ground engineering investigation has been undertaken to formulate an accurate ground model in order to undertake preliminary foundation design. The ground model has been constructed with a moderate to high level of confidence and has evolved from the information obtained by the PRA.

The site is currently occupied by a former boxing gym and a council depot building. Tarmac surfacing occupies the majority of the site, some topsoil is present within the south eastern area and gravel surfacing is present within the northern area. Small scale vegetation is located at the site in the form of bushes and shrubbery, some semi-mature to mature trees are present along the northern boundary. There are also multiple stockpiles of demolition waste present in the eastern area which require removal prior to development, and an above ground storage tank is present in the central southern area.

The proposed development is commercial end use comprising the construction of an Aldi store with associated hardstanding car parking areas and service yard. At this stage, loadings associated with the proposed buildings are not available and the following recommendations area based on existing site levels.

Existing buildings and structures, including the Above ground Storage Tank (AST) and concrete ramp, will require demolishing/removal as part of the enabling works and existing hardstanding will require breaking out and stockpiling. All below ground structures and foundations will also require grubbing up. The AST will require suitable decommissioning as part of the enabling works.

Stockpiled and tipped waste across the site will require removal to a suitably licenced waste disposal facility.

Topsoil is present in the south east of the site and will require stripping and stockpiling separately as part of the enabling works and vegetation will require removal and chipping. Trees that are not to be retained will also require removal prior to the construction phase.

If any invasive species are encountered at the site, these will need to be identified by a suitably trained ecologist and removed by a specialist contractor.

Ground Conditions

Made Ground was generally encountered beneath the site to a maximum depth of 0.7m bgl, however in CP2 and SuDS2 Made Ground was encountered to depths of 2.5m and 1.3m respectively. This is typically underlain by extremely low strength very soft to soft natural Clay to 9.0m bgl followed by loose to medium dense Sand to 14.4m bgl. Mudstone bedrock was recovered as firm becoming stiff Clay from depths of between 18.2m and 19.7m bgl to a final investigation depth of 25.0m bgl. Consistent ground conditions were encountered across the site, which will aid in the overall foundation design.

During the Ground Investigation, groundwater was encountered between depths of 0.8m and 1.5m bgl at all locations. A deeper water strike was observed within CP1 at 9.0m and CP3 at 9.5m bgl.

Limitations

The main limitation at the site is the presence of poor ground conditions comprising extremely low strength clay to a maximum depth of 9.0m bgl underlain by loose to medium dense sand up to 12.0m bgl. These strata are not considered to be a suitable bearing stratum and therefore a deeper foundation solution will be required. Typical SPT N values within these unsuitable strata ranged between 0 and 4 indicating confirming low strength Clay.

A further limitation is the presence of a suspected former drainage feature present in the area of CP2, which contained a concrete and brick obstruction at 2.5m bgl. This suspected former drainage feature is indicated to be present bisecting the site with a north to south trend below the length of the proposed Aldi store and will require grubbing out during the enabling works. A further concrete obstruction was encountered in WS12 which is likely associated with concrete ramps in the southern extent of the site. These are suspected to be associated with the former sewage works present on the site and will also require grubbing out.

A former pond was indicated below the south eastern area of the site which was also recorded as a landfill for household waste historically. The material encountered in SuDS2 on the eastern site boundary is likely to be associated with the infilled pond. Free phase hydrocarbon contaminated material was present within SuDS2 which will require removal as part of the enabling works and voids will need backfilling with suitably engineered fill. Evidence of the backfilled pond was not encountered within WS14 or WS15 and therefore it is not anticipated to extend beyond these locations to the north and west.

Stockpiled waste materials have been identified as a potential limitation to the site for disposal and it is anticipated that the majority of this material will require removal off site. Concrete and brick rubble is present and may be suitable for crushing as part of the enabling works and used as part of the development if it is considered chemically suitable.

Trees are present around the site boundaries, and some will require removal if they are not protected. The influence of trees on foundations in cohesive strata also requires consideration.

The final development levels need to take into consideration the potential for flooding as the site falls within a Flood Risk Zone 2/3, this is potentially subject to flooding of between 0.1m and 0.3m in a 30 year flood event. A Flood Risk Assessment (FRA) is likely required regarding this and should be taken into consideration.

No investigation has been undertaken within the footprint of the existing buildings which cover a significant area of the site. Further investigation is recommended post demolition to characterise the entire site and update the ground model accordingly.

The limitations highlighted are presented within the Revised Development Constraints Plan *GRO-21400-P05.*

8.3 Geotechnical Parameters

The geotechnical test results have been evaluated to derive geotechnical parameters for the soils underlying the site. A '*Depth to SPT N value*' and a '*Depth to C_u*' graph is presented on *GRO-21400-P06A* and *GRO-21400-P06B* to provide a generalised ground model for the site.

Characterisation of the geotechnical parameters above has been undertaken to select a characteristic value, which is a cautious estimate of the value affecting the occurrence of the limit state. The characteristic values for the Ultimate Limit State (ULS) conditions selected are presented in the table below:

Stratum	Parameter	Selected Characteristic Value
Loose Sand	*Drained angle of friction (ϕ')*	*28°*
Medium dense Sand	*Drained angle of friction (ϕ')*	*31°*
Extremely Low Strength Clay	*Undrained Shear Strength (C_u)*	*9kPa*
High Strength Clay	*Undrained Shear Strength (C_u)*	*128kPa*
Mudstone recovered as Extremely High Strength Clay	*Undrained Shear Strength (C_u)*	*329kPa*

For the very soft to soft extremely low strength Clay, a coefficient of compressibility value (m_v) of 2.966m^2/MN has been selected based on laboratory testing results.

8.4 Preliminary Foundation Design

Traditional shallow foundations are not considered suitable for the proposed Aldi store based on the poor natural ground conditions encountered beneath the entire site to a maximum depth of circa 12.0m bgl. At this stage, the loadings of the proposed structure are unknown and designs will need to be confirmed once they are provided.

Pile Foundations

The most suitable solution for the proposed development is considered to be driven pile foundations transferring loads through the underlying Made Ground and Tidal Flat Deposits to the natural high to extremely high strength Clay. Foundations should be deepened through the Made Ground, very soft to soft

extremely low strength Clay and loose to medium dense Sand to found in the residually weathered Mudstone deposits which have been encountered from depths of between 18.2m and 19.7m bgl. Pile caps and a reinforced ring beam should be constructed to span between piles and support loadings from walls.

Pile Solution – Design by Calculation

Preliminary design by calculation has been carried out using due skill and care using the global factor of safety method for pile design, a global factor of safety of 3 has been used to mitigate the risk of settlement in the poor ground conditions in the absence of undertaking static load testing. The preliminary design by calculation is based on combined skin friction/end bearing piles in the high to extremely high strength Clay. The preliminary design by calculation is based on the following ground model:

- *Made Ground to 2.8m bgl.*
- *Extremely low strength Clay to 8.7m bgl.*
- *Low to Medium dense Sand to 14.4m bgl.*
- *High strength Clay to 18.4m bgl.*
- *Mudstone recovered as high to extremely high strength Clay to 20m bgl.*

For a single square 300mm pile end bearing in the high strength Clay at 20.0m bgl, a vertical allowable load of 150kN has been calculated. If greater loads are required, the diameter of the piles should be increased and/or the piles installed in groups. This should be considered once the loadings are confirmed.

The ground conditions and the below ground construction indicate that downdrag should be considered by the detailed design for the construction of the piles due to the extremely low strength Clay encountered. The magnitude of downdrag will be dependent on the finished site levels.

Little lateral support will be provided by the Tidal Flat Deposits and this needs to be considered in the design of the piles to a depth of up to 9.0m bgl. The type of pile should provide sufficient lateral stability due to the poor ground conditions recorded.

An appropriate working platform should be constructed in accordance with BR470 guidance.

Design Validation

The piling type, length, depth of reinforcement and design should be discussed with a specialist piling contractor, it should also be discussed if CFA piles would be feasible. They can then undertake the detailed design including drawings and specifications to provide fitness for purpose design.

The piling works should be carried out in accordance with Execution Standard EN 1536 for Bored Piles or BS EN 12699:2015 'Execution of special geotechnical works. Displacement piles'.

Construction Requirements

If the ground conditions or groundwater regime encountered during the construction phase differ significantly to the conditions encountered during the Ground Investigation, work should cease and Groundtech Consulting contacted for further advice.

During the construction phase, supervision should be on a continuous basis to check the design assumptions are correct and construction conforms to design. Supervision should include inspections, Control Ground Investigations and monitoring. This includes where ground conditions and design situations change due to below ground construction.

8.5 Building Near Trees

There are trees located within the vegetated areas surrounding the site, these are indicated to be semi-mature to mature in age and will require removal as part of the enabling works.

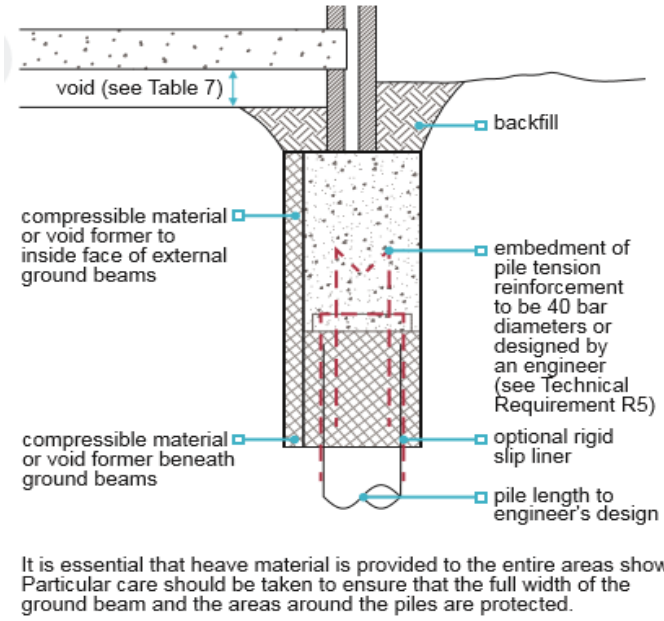
Foundation excavations will encounter cohesive strata in the vicinity of existing, proposed or recently removed trees and foundations should be adjusted in full accordance with current guidance.

All foundations should be deepened below roots of greater than 5mm diameter during excavations for footings. The natural Clay encountered beneath the site is of medium to high volume change potential.

A survey of all trees and hedges on the site and within 30m of the site boundary should be undertaken to identify tree species, locations and heights. This information will be required in order to assess the effects of trees on the cohesive strata and inform a foundation schedule.

Where foundation depths due to trees already present or recently removed exceeds 1.5m there is a possibility for heave to occur on removal of the tree. Where foundations and substructure may be subject to heave, they should be protected by voids, void formers or compressible materials. The void dimension against side of foundation and ground beam is 35mm as the Clay is of low to high volume change potential.

Where heave precautions are deemed necessary, the pile installation design will need to accommodate the following precautions in the design.



Heave precautions for pile and beam foundations

8.6 Floor Slabs

A suspended floor slab is recommended for the proposed development due to the compatibility with the proposed pile foundation solution and also due to the presence of cohesive deposits underlying the site which may be affected by the influence of existing, proposed or recently removed trees. More than 600mm of Made Ground will be present beneath the floor slabs locally which would also dictate the use of suspended slabs.

The Clay at the site is of low to high volume change, therefore the void beneath a suspended in-situ floor slab should be 150mm, or 300mm beneath a suspended precast concrete slab.

8.7 Construction

The trial pits indicate that instability of excavations is anticipated. Collapsing was noted within the trial pits and windowless sample boreholes within the Tidal Flat Deposits comprising very soft clay. Adverse weather conditions and shallow groundwater could also factor into the instability of these soils. Temporary works design should be in place for instability.

Instability of the Made Ground is also a possibility and should be considered in the groundworks method statements. Due to the presence of shallow groundwater at the site, all excavations are likely to require dewatering.

Tracked high specification plant is recommended to maintain the build programme. Breaking equipment will also be required locally to penetrate obstructions identified by the Ground Investigation, these include concrete obstructions encountered within the south eastern extent and the former drain feature encountered within the central area.

8.8 Concrete Classification

Made Ground
Water soluble sulphate testing was undertaken on twenty-three samples of the Made Ground. The range of soluble sulphate (SO_4) recorded is 3.4mg/l to 2370.9mg/l and associated pH values ranged between 7.53 and 11.03 indicating slightly alkaline to alkaline conditions.

In a dataset where there are more than ten results, the mean of the highest 20% of water soluble sulphate results and mean of the lowest 20% of pH values are taken as the characteristic values. Therefore, for the Made Ground, the characteristic water soluble sulphate concentration is 563.36mg/l and the pH value is 7.6.

Natural Strata
Water soluble sulphate testing was also undertaken on seven samples of the natural strata. The range of soluble sulphate (SO_4) recorded is 99.5mg/l to 337.8mg/l and associated pH values ranged between 8.01 and 8.64 indicating slightly alkaline conditions.

In a dataset where there are five to nine results, the mean of the highest two water soluble sulphate results and the lowest two pH values is taken as the characteristic values. The characteristic water soluble sulphate concentration is 323.7mg/l and the pH value is 8.32.

The strata beneath the proposed development areas are predominantly cohesive, therefore the groundwater is considered to be static.

The results of laboratory pH and sulphate content indicate that ACEC Class AC-1s and sulphate class DS-2 conditions prevail in accordance with BRE Special Digest 1 “Concrete in aggressive ground” 2005. The specific concrete mixes (the Design Concrete Class) to be used on site will be determined by the site-specific concrete requirements in terms of the durability and structural performance. These are assessed in terms of the Structural Performance Level (SPL) and any need for Additional Protective Measures (APM) detailed in Part D of BRE Special Digest 1 with further guidance in Pt E and F.

Potentially Pyritic Ground
Seven BRE SD1 Brownfield Pyrite Suites were caried out and a summary of the testing results is present below:

Stratum	Number of Samples	Contaminants of Concern	Range of Results
Natural Strata	*7*	*Acid Soluble Sulphate (% SO_4)*	*0.09 – 0.15*
		Soluble Sulphate (mg/l SO_4)	*99.5 – 337.8*
		Total Sulphur (%)	*0.2 – 1.18*
		Magnesium (g/l)	*0.0299 – 0.0955*
		pH	*8.01 – 8.64*

The amount of oxidisable sulphites (OS % SO_4) in the suspected pyritic ground is determined by subtracting the acid soluble sulphates (AS % SO_4) from the total potential sulphate content:

$$OS\ \%\ SO_4 = TPS\ \%\ SO_4 - AS\ \%\ SO_4$$

The amount of oxidizable sulphates was greater than 0.3% SO_4 in all seven of the natural samples (CP1, CP2, CP3, WS03, WS04 and WS10) therefore, pyrite is potentially present across the site as a whole.

Concrete in pyritic ground which is initially low in soluble sulphate does not have to be designed to withstand a high potential sulphate class unless it is exposed to ground which has been disturbed to the extent that contained pyrite might oxidise and the resultant sulphate ions reach the concrete. This may prompt redesign of the structure or change to the construction process to avoid ground disturbance; for example, by using precast or cast-in-situ piles instead of constructing a spread footing within an excavation.

The sole determination of the acid-soluble sulphate content, as employed in some recent European Standards, will not detect pyrite which might be oxidised to sulphates as a result of ground disturbance.

Where the ground is to be significantly disturbed such as construction of the ring beam, the classification of the concrete should be increased accordingly.

8.9 Highway Design

Cohesive and granular Made Ground soils and natural cohesive Clay is anticipated to be encountered at formation level across the site.

CBR values of less than 2% are likely to be achieved in undisturbed natural cohesive soils for pavement design purposes, unless proven otherwise by in-situ testing at sub-base level by a specialist geotechnical engineer. Some reengineering of the subgrade is required prior to highway construction to achieve the required design CBR value.

Untreated Made Ground should be assumed to have a CBR value of less than 2.5%, unless proven otherwise. Highways Agency document HD25 'Interim Advice Note 73/06 Revision 1' (2009) states that where a subgrade has a CBR value lower than 2.5%, it is considered unsuitable support for a pavement foundation since it would tend to deform under construction traffic and must be improved.

Where highways are proposed in areas underlain by Made Ground, it is recommended that Made Ground to a depth of 1.0m below subgrade level is excavated, sorted and classified in accordance with Series 600 (Earthworks) of the Highways Agency "Specification for Highways Works". Following the above, any suitable

material which can be used as part of highway construction shall be compacted in accordance with the earthworks specification.

Due to the soft low strength strata encountered at the site, it is recommended that the highway design take into consideration the use of a thick construction and install geogrid. The design will be dependent of finished site levels.

The soils are considered to be frost susceptible due to the fines content and highway construction should be a minimum thickness of 450mm to mitigate the risk.

8.10 Sustainable Urban Drainage System (SuDS)

SuDS testing was undertaken in two locations on the site in general accordance with BRE Digest 365 (2016). A summary of the soil percolation test results is given below and the full results are presented in *Appendix 11*.

Location	Test No.	Dimensions of Pit Before Test	Behaviour During Test	Soil Infiltration (m/sec)
SuDS1	*1*	*1800 (L) x800 (W) x 2600 (D)*	*Pit sides unstable*	*6.39×10^{-7}*
SuDS1	*2*	*1800 (L) x800 (W) x 2600 (D)*	*Pit sides unstable*	*8.47×10^{-7}*
SuDS1	*3*	*1800 (L) x800 (W) x 2600 (D)*	*Pit sides unstable*	*1.05×10^{-6}*
SuDS2a	*1*	*1700 (L) x 1000 (W) x 2700 (D)*	*Pit sides unstable*	*1.28×10^{-6}*
SuDS2a	*2*	*1700 (L) x 1000 (W) x 2700 (D)*	*Pit sides unstable*	*1.30×10^{-6}*
SuDS2a	*3*	*1700 (L) x 1000 (W) x 2700 (D)*	*Pit sides unstable*	*1.04×10^{-6}*

Three fills were completed at positions SuDS1 and SuDS2a at depths of 2.6m and 2.7m within the underlying natural Tidal Flat Deposits comprising very soft very sandy silty Clay. Groundwater was encountered below the entire site and was evident within these trial pits at depths of between 1.1m and 1.2m bgl.

The tests conducted at the site calculated drainage rates between *1.13×10^{-6}* and *$1.33 \times 10^{-6} m/s$* which is representative of poor drainage conditions.

SuDS drainage is not considered to be feasible at the site due to the poor soil infiltration rates observed in the natural cohesive deposits which are present across the site and the high groundwater table.

9.0 LAND QUALITY

9.1 Geo-Environmental Testing Results - Soils

Samples of Made Ground have been tested for a range of relevant Contaminants Of Concern. In accordance with LCRM, a Generic Quantitative Risk Assessment (GQRA) has been undertaken to determine the significance of the concentrations as derived through Geo-Environmental analysis.

The GQRA process comprises the comparison of the actual concentrations measured on site with Generic Assessment Criteria (GACs) for the protection of human health.

The GACs used for the assessment of soil concentrations have been derived using the CLEA model. The GACs used and their ranking of importance are listed below:

- *Soil Guideline Values (SGVs) which demonstrate minimal risk.*
- *LQM/CIEH S4ULs which use the same toxicological data as the SGVs but different exposure criteria.*
- *C4SLs which demonstrate low risk.*

In deriving the GACs for use on Brownfield sites, we have assumed a 1% Soil Organic Matter unless the results indicate otherwise.

The proposed end-use for the site is a commercial development comprising an Aldi store with pavements, car parking areas and an access road. We have therefore undertaken the GQRA on the basis that the proposed development site falls under the Commercial land-use scenario as defined in SR3 (EA, 2009b).

The strata or sources of contamination targeted by the laboratory testing scheduled is summarised in the table below:

Strata	Number of Samples Tested	Locations
Made Ground: Subbase Material	*14*	*WS01 to WS07, WS09, WS10, WS15, CP01*
Made Ground: Gravel Surfacing	*1*	*WS08*
Made Ground: Ash	*1*	*WS12*
Made Ground: Topsoil	*3*	*SuDS2, SuDS2a, WS13*
Made Ground: Clay	*2*	*CP2*
Made Ground: Pond fill material	*2*	*SuDS2*

A summary of the Geo-Environmental Testing results is presented below and the GQRA Screening Values are presented in *Appendix 12:*

Metals				
Contaminant	Range (mg/kg)	Screening Value (mg/kg)	Exceedances	Locations
Arsenic	*3.0 - 12.2*	*640*	-	-
Boron	*0.2 – 7.2*	*240000*	-	-
Cadmium	*<0.1 – 0.2*	*230*	-	-
Chromium	*9.0 – 84.6*	*8600*	-	-
Hexavalent Chromium	*<0.3*	*49*	-	-
Copper	*3 – 44*	*68000*	-	-
Lead	*5 – 597*	*2300*	-	-

Mercury	*<0.1*	*26*	-	-
Nickel	*1.3 – 29.4*	*980*	-	-
Selenium	*0.5 – 7.2*	*13000*	-	-
Zinc	*<5 – 156*	*730000*	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)				
Contaminant	Range (mg/kg)	Screening Value (mg/kg)	Exceedances	Locations
Naphthalene	*<0.04 – 0.62*	*190*	-	-
Acenaphthylene	*<0.03 – 1.01*	*83000*	-	-
Acenaphthene	*<0.05 – 3.98*	*84000*	-	-
Fluorene	*<0.04 – 2.18*	*63000*	-	-
Phenanthrene	*<0.03 – 16.07*	*22000*	-	-
Anthracene	*<0.04 – 5.46*	*520000*	-	-
Fluoranthene	*<0.03 – 40.11*	*23000*	-	-
Pyrene	*<0.03 – 42.1*	*54000*	-	-
Benzo(a)anthracene	*<0.03 – 30.31*	*170*	-	-
Chrysene	*<0.02 – 26.69*	*35*	-	-
Benzo(bk)fluoranthene	*<0.07 – 59.95*	*1244*	-	-
Benzo(a)pyrene	*<0.04 – 34.81*	*35*	-	-
Indeno(123cd)pyrene	*<0.04 – 26.38*	*500*	-	-
Dibenzo(ah)anthracene	*<0.04 – 4.38*	*3.5*	*1*	*WS01 at 0.2m*
Benzo(ghi)perylene	*<0.04 – 20.88*	*3900*	-	-
TPH CWG - Aliphatics				
Contaminant	Range (mg/kg)	Screening Value (mg/kg)	Exceedances	Locations
>C5-C6	*<0.10*	*3200*		-
>C6-C8	*<0.10*	*7800*		-
>C8-C10	*<0.10 – 5.5*	*2000*		-
>C10-C12	*<0.20 – 109.7*	*9700*		-
>C12-C16	*<4.00 – 254*	*59000*		-
>C16-C21	*<7.00 – 129*	*1600000*		-
>C21-C35	*<7.00 – 1381*	*3200*		-
Total aliphatics C5-35	*<19.00 – 1401*	-		
TPH CWG - Aromatics				
Contaminant	Range (mg/kg)	Screening Value (mg/kg)	Exceedances	Locations
>C5-EC7	*<0.10*	*26000*	-	-
>EC7-EC8	*<0.10*	*56000*	-	-
>EC8-EC10	*<0.10 – 0.30*	*3500*	-	-
>EC10-EC12	*<0.20 – 59.4*	*16000*	-	-
>EC12-EC16	*<4.00 – 120*	*36000*	-	-
>EC16-EC21	*<7.00 – 968*	*28000*	-	-
>EC21-EC35	*<7.00 – 5939*	*28000*	-	-
Total aromatics C5-35	*<19.00 – 6927*	-	-	-
Total aliphatics and aromatics(C5-35)	*<38.00 – 7560*	-	-	-
MTBE	*<0.005*	*7900*	-	-

Benzene	*<0.005*	*95*	-	-
Toluene	*<0.005 – 0.012*	*4400*	-	-
Ethylbenzene	*<0.005 – 0.014*	*2800*	-	-
m/p-Xylene	*<0.005 – 0.12*	*6700*	-	-
o-Xylene	*<0.05 – 0.073*	*2600*	-	-
Others				
Organic Matter			*0.4 – 0.6%*	
pH			*7.53 – 11.03*	
Moisture Content			*0.1 – 41.6*	
Asbestos Screen				
Result				
None Detected				

Samples screened for PCBs and Total Cyanide concentrations have been detected below laboratory detection limits. This also applies for samples tested for Phenol concentrations with the exception of SuDS2 at 0.8m bgl which recorded a very low concentration of 0.04 mg/kg which is below the commercial screening value of 3200 mg/kg

A high pH level of 11.03 was detected within WS09 at 0.2m bgl.

9.2 Generic Quantitative Risk Assessment - Soils

Made Ground was generally encountered beneath the site to a maximum depth of 0.7m bgl, however in CP2 and SuDS2 Made Ground was encountered to a of 2.5m and 1.4m respectively, this is associated with household waste/landfill material used to backfill a former pond at the site and a former drainage feature identified running along the centre of the site.

Metals

Based on the site being developed commercially, no elevated concentrations of metals have been recorded during either investigation carried out at the site.

Speciated Polycyclic Aromatic Hydrocarbons (PAHs)

One elevated concentration of speciated PAHs was detected throughout the laboratory testing in relation to a commercial end use. This comprised an elevated concentration of Dibenzo(ah)anthracene within WS01 at 0.2m bgl. This borehole is located within the most southern part of the site and contamination is presumed to be associated with tarmac surfacing in this area

During the previous investigation undertaken by Delta Simons, three elevated concentrations of Dibenzo(ah)anthracene were recorded at locations DS104, DS107 and DS110 in the vicinity of the above ground tank and in the central area of the site. The concentrations recorded were between 3.8mg/kg and 11.0mg/kg which are above commercial screening values.

Two elevated concentrations of Chrysene were also recorded at locations DS107 and DS110 with values of 41.0mg/kg and 68.0mg/kg recorded respectively.

The elevated speciated PAHs recorded during the previous investigation are all associated with the tarmac surfacing above the subbase material tested.

Total Petroleum Hydrocarbons (TPH CWG)

Eight samples were tested for TPH CWG, the results for these samples were all generally below the relevant screening values for commercial land use, this is inclusive of locations CP1, CP2, CP3, WS12 and WS14 which are within the vicinity of the above ground storage tank which indicates this has not impacted the soils in this area. Although, no elevated TPH concentrations were detected by the previous investigation when compared to commercial screening values. The highest concentrations were recorded at locations DS104, DS107 and DS110 these are in the vicinity of the former tank and in the central area of the site. It is likely that this is associated with spillages from the tank here however this was not encountered within current investigation.

High concentrations of heavy end hydrocarbon fractions have been recorded within WS02 and WS08 where the observed visual contamination at this site was noted. This relates to the ashy material encountered and is considered to be the source of this contamination. As this exceeded the screening levels as a minimum this should be removed from the site.

Moderate hydrocarbon concentrations recorded at location SuDS2 within the mid to heavy end fractions and also BTEX detected above laboratory detection limits at this location only. This is likely to be associated with free phase hydrocarbons observed in the former pond/landfill. As this exceeded the screening levels as a minimum this should be removed from the site.

Asbestos
No asbestos was detected in the samples of Made Ground that were screened during the Groundtech Consulting investigation. However, asbestos was detected in the previous investigation by Delta Simmons within DS107 at 0.3-0.4m bgl and DS110 at 0.15-0.20m bgl both identified as Chrysotile quantified as <0.001mass % (i.e. trace).

Other Contaminants
The high pH of 11.03 observed within WS09 at 0.2m bgl is considered to be corrosive.

9.3 Permanent Ground Gases

Made Ground was generally encountered beneath the site to a maximum depth of 0.7m bgl, however it was present to a depth of up to 2.5m bgl locally. Visual and olfactory evidence of contamination has been noted during the Ground Investigation within SuDS2 in the form of hydrocarbon odours and oils present within the strata.

Two gas monitoring visits have been undertaken to date on 22nd February and 15th March 2022. A further two visits are scheduled.

Concentrations of methane (CH_4) have been recorded within the majority of the standpipes to a maximum concentration of 60.7% v/v and detectable levels of carbon dioxide (CO_2) were recorded within the standpipes up to a maximum concentration of 18.2% v/v. Associated depleted oxygen (O_2) concentrations with a minimum of 1.2% v/v were recorded. Generally, CO_2 concentrations recorded were less than 2.7% v/v and only elevated at a single location WS14 on a single visit.

A positive gas flow rates of 18.4 l/hr has been recorded during the preliminary monitoring visits within CP02 only during the second visit. Positive borehole pressure recorded in borehole with peak flow – relates to gas trapped within the plain pipe as the groundwater is above response zone. Not representative of site conditions as no other positive flow rates have been recorded.

The atmospheric pressure ranged between 1008mb and 1020mb and the monitoring was carried out during a period of steady and rising barometric pressure.

Groundwater was encountered within all of the standpipes between 0.49m and 1.22m bgl and was present within the response zone of the standpipes with exception to WS14 within the second visit where no groundwater was recorded.

Characterisation of the Gas Screening Value (GSV)
In accordance with CIRIA Report C665, November 2007 it is felt that an adequate risk assessment can be undertaken based on the following limiting factors:

- *The proposed development has been considered as* ***low sensitivity*** *based on the site being a proposed commercial store (Table 5.5 – Typical/Idealised frequency and period of monitoring, after Wilson et al, 2005).*
- *The risk associated with the generation potential of a source is considered as* ***moderate****, (assessment based on the environmental setting).*

Based upon the results recorded, in accordance with CIRIA Report C665, the risk to the site from ground gases has been assessed by converting the results to gas screening values (GSVs), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates. In addition, individual "hazardous gas flow rates" (Qhg) have been derived for each monitoring point.

GSV (l/hr) = max borehole flow rate (l/hr) x max gas concentration (%)

For this assessment, the maximum recorded concentration of carbon dioxide of 18.2%v/v and maximum methane concentration of 60.7%v/v have been used. A positive flow rate of 18.4 l/hr has been detected however this is not representative of the site and so a flow rate of 0.1l/h and has been used to calculate the GSV.

Carbon Dioxide GSV = 0.182 (18.2%) x 18.4 = 0.0182 l/hr

Methane GVS = 0.607 (60.7%) x 18.4 = 0.0607 l/hr

In order to assess the ground gas regime beneath the site and the need to incorporate ground gas precautions, guidance was taken from CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings'. Based on the site being developed for a commercial end use, the Wilson and Card method has been used to carry out the assessment.

When considering the results to date in accordance with CIRIA C665 (Section A Development and Table 8.5 – Modified Wilson and Card Classification), the site is in CS1 but should be increased to CS2 or CS3 based on carbon dioxide/methane concentrations.

Carbon dioxide concentrations recorded are typically less than 3.0%v/v. However, carbon dioxide concentrations have reached 18.2% v/v at a single location (WS14) which is likely associated with the former infilled pond/landfill which was identified as a potential ground gas source and is located immediately south of WS14.

High methane concentrations have been recorded across the development area and may be associated with the natural organic Tidal Flat Deposits encountered across the site or the infilled pond/landfill or drain feature or sewage works.

Characteristic Situation 2 or 3

The proposed development is classified as a Building Type C in accordance with BS 8485 and the site falls in CS2 or 3 in accordance with Table 2 of the above guidance. On completion of the gas monitoring, the requirement for remedial work will be undertaken, particularly in relation to the former drain feature, 1 to 2 points of gas protection measures will be required.

Gas precautions outlined in CIRIA C665 are summarised below:

Structural barrier / Floor slabs

- *Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations – 1.5 points*

Ventilation protection measures

- *Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building) – 0.5 points*
  or
- *Passive sub floor dispersal layer of either good or very good performance – 1.5 to 2.5 points*

Gas resistant membrane

- *Gas resistant membrane (including methane) meeting the criteria outlined in Table 7 of BS 8485:2015 – 2 points.*

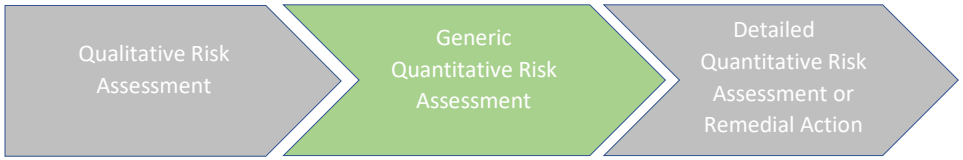
The recommendations will be confirmed or otherwise on completion of the monitoring.

The site is in an area not requiring radon precautions.

9.4 Revised Pollution Linkage Assessment

The CSM has been revised to inform the following pollution linkage assessment based on the Ground Investigation and laboratory testing. Using Source-Pathway-Receptor assessment criteria that is applicable in the UK, the risk assessment has been revised to determine if a plausible pollution linkage exists between the identified contaminants and receptors. The risk classification has been estimated in accordance with the CIRIA C552 assessment criteria and an Illustrative Revised CSM is presented on Groundtech Consulting Plan *GRO-21400-P07*.

Human Health Pollution Linkage Assessment



- The table below represents the second stage in the land quality risk assessment process - **the Generic Quantitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

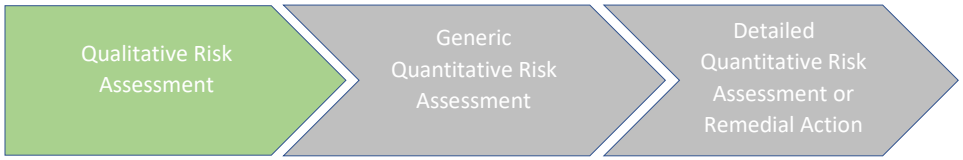
Conceptual Site Model					*Generic Quantitative Risk Assessment*	
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
PL1	Contaminated Soils	Ingestion of soil and dust. Dermal contact with soil.	Unlikely	Medium	Low	*Pollution Linkage 1 refers to proposed site users coming into contact with contaminated soils on the site.* *The site is currently separated into two areas, the eastern area is occupied by a former boxing gym and the western area is utilised as an active depot for the storage of waste removal vehicles including vans and bin lorries. Waste being stored will be removed prior to development.* *Made Ground is anticipated to be present beneath the site due to the historical development. Heavy metals, speciated PAHs and asbestos may be present in the Made Ground soils.* *A large above ground tank is located in the central part of the site and it is likely that it was used to store fuels or potentially chemicals. These contaminants may have impacted the area as a result of potential spillages/leaks, the immediate area is covered by hardsurfacing and no evidence of staining was noted.*

Conceptual Site Model						*Generic Quantitative Risk Assessment*
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
						The former pond located within the south eastern corner of the site and the historic drainage feature beneath the central area are potential sources of deep Made Ground if they have been backfilled historically. The former pond is indicated to be backfilled with landfill materials. The demolished buildings, depot and sewage works formerly on site are also potential sources of contamination as well as the current land uses including the stored waste and fly tipped materials. *Most offsite sources are at a sufficient distance where they will unlikely have impacted the site and the more impactful sources are generally identified on site.* *The proposed development is for a new Aldi store with associated hardstanding car parking areas and service yard. The hardstanding cover and proposed building will act as a cover layer and effectively remove the pollution linkage to site end users.* *There is not considered to be a viable pollution linkage.*
PL2	Contaminated Soils	Inhalation of vapour.	Low likelihood	Medium to Severe	Moderate	*This pollution linkage refers to vapours migrating into confined spaces within the proposed development. Sources of potential volatile contamination may be present within the shallow Made Ground below the site associated with the former tank, depot, drain, sewage works etc. A pollution linkage is considered to exist.*

Conceptual Site Model						*Generic Quantitative Risk Assessment*
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
PL3	Contaminated Soils	Inhalation of soil dust by adjacent site users.	Unlikely	Medium	Low	*Pollution Linkage 3 relates to contamination on the subject site affecting adjacent site users.* *Localised mobile hydrocarbon contamination may be present associated with the former depot and existing AST. However, gross mobile contamination is not anticipated, and all the contaminative sources identified onsite are indicative of the surrounding area, no realistic pollution linkage has been identified.*
PL4	Contaminated Soils	Attacking potable water supply pipe.	Low Likelihood	Medium	Moderate	*Pollution Linkage 4 refers to the possible contaminants permeating potable water pipes and consumption by the future site end users of the tainted water supply. Made Ground is likely to be present beneath the site and may be present at installation depth. Organic contamination may be present.* *Potable water supply pipes will be included as part of the development and a pollution linkage is considered to exist. A local water company risk assessment is recommended prior to construction to advise on the level of protection required for the potable water supply.*
PL5	Ground Gas	Migration and accumulation of ground gas in internal spaces.	Likely	Medium to Severe	Moderate to High	*Made Ground is likely present beneath the site due to the historical development and deep Made Ground may be present associated with the historic drain, former pond/landfill and previously demolished buildings. Depending on the composition of the backfill material, ground gases may be generated. The Sewage treatment works*

Conceptual Site Model						*Generic Quantitative Risk Assessment*
PL	Potential Source	Pollution Linkage	Likelihood	Consequence/ Severity	Risk Rating	*Rationale and Action*
						is also a potential source of ground gas depending on the construction and demolition and the location of the demolished materials. *Offsite sources of ground gas include brick pits, marshland and varying ponds. Tidal Flat Deposits are also indicated around the site and may be a source.* *Due the potential sources of ground gas on and offsite, an intrusive investigation including the installation and monitoring of ground gas wells will be required.* *The site is not within an area requiring radon precautions within foundations.*

Controlled Waters Pollution Linkage Assessment



- The table below represents the first stage in the land quality risk assessment process – **Qualitative Risk Assessment**.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be reduced to an acceptable level - low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional stages of assessment in order to have sufficient confidence to support a risk characterisation or remedial action.

Conceptual Site Model					*Qualitative Risk Assessment*	
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	*Rationale*
PL6	Contaminated Soils	Impaction of groundwater from soil contamination (diffuse and point). Impaction of groundwater from groundwater plume.	Unlikely	Medium	Low	*Made Ground is likely to be present below the site in the vicinity of the infilled pond and drain feature indicated on the historic maps as well as in the formerly developed areas. These may be contaminated with a range of contaminants including heavy metals, speciated PAHs and hydrocarbons.* *Potential sources of mobile contamination may be present at the site relating to the former tank and depot in the form of hydrocarbon contamination.* *Geological maps indicate that the site is underlain by Tidal Flat Deposits. The bedrock underlying the site is the West Walton Formation which comprises Mudstone and Siltstone. Both the Superficial and Bedrock Aquifers are Unproductive and no pathway is considered to exist. The site is not within 500m of a SPZ or potable water abstraction.* *Furthermore, the proposed development will be completely covered with hardsurfacing and a new drainage system installed. This will considerably reduce infiltration and leaching of potential contaminants, no pollution linkage is considered to exist.*

Conceptual Site Model						*Qualitative Risk Assessment*
PL	Potential source	Pollution linkage	Likelihood	Severity	Level of risk	*Rationale*
PL7	Contaminated Soils	Migration of soil and groundwater contamination impacting surface waters.	Unlikely	Low	Low	*Pollution Linkage 7 refers to the impaction of an unnamed watercourse 128m south east of the site from contaminated soils and groundwater.* *A sufficient attenuation distance is considered to exist between this watercourse and the site, and the presence of impermeable Tidal Flat Deposits will reduce lateral migration beneath the site.* *No plausible pollution linkage has been identified.*

9.5 Outline Remedial Strategy

Soils

Based on the site having a commercial end use, one elevated concentration of speciated PAHs was detected as part of the Groundtech Consulting investigation. This comprised an elevated concentration of Dibenzo(ah)anthracene within WS01 at 0.2m bgl. This borehole is located within the most southern part of the site and contamination is presumed to be associated with tarmac materials in this area. No asbestos has been detected by the Groundtech Ground Investigation, however was by the previous investigation. The site will be covered with hardsurfacing which is effectively a cover system and remedial measures are not required.

As a minimum, free phase contamination will require removal offsite and should be disposed at a suitably licensed waste facility. The free phase in SuDS2 is likely present offsite if associated with the former pond located in this area.

In areas of proposed soft landscaping a cover system should be placed it is recommended that a minimum 300mm of "clean" topsoil/subsoil be placed.

Stockpiles identified on the site require removing to a suitably licensed waste disposal facility.

Vapours

Hydrocarbons in the volatile range have been detected at location SuDS2 in the south east of the site where free product was observed during the investigation. Hydrocarbon concentrations have been detected above the vapour saturation limit at this location which is close to or within the footprint of the proposed Aldi store depending on the finalised development layout. Excavation and removal of all free product and hydrocarbon impacted soils in the vicinity of SuDS2 should be carried out and will effectively remove the vapour source. If remediation can be undertaken successfully by excavation and removal, then no further measures will be required with respect to vapour. Alternatively, a vapour resistant membrane may be required.

Ground Gas

Gas monitoring undertaken in relation to the site indicates that the site will fall into CS2 or CS3 in accordance with BS 8485, 1 to 2 points of protection will be required.

In addition, radon precautions are not needed.

Groundwater

Localised mobile contamination has been encountered in the vicinity of SuDS2 and any free phase hydrocarbon contamination should be excavated and removed off site as a minimum.

Watching Brief and Regulatory Compliance

A watching brief should be in place during ground works and construction. If previously unidentified contamination is encountered, work should cease in that area and Groundtech Consulting contacted for advice.

Regulatory compliance should be obtained pre-commencement to avoid delays during the construction phase which will have cost implications.

9.6 Asbestos in Soils

Asbestos has not been identified in the soil samples that have been screened. Asbestos was detected within the previous investigation undertaken by Delta Simmons within two of the samples of Made Ground collected from DS107 at 0.3-0.4m bgl and DS110 at 0.15-0.20m bgl, both identified as Chrysotile quantified as <0.001mass % (i.e. trace).

Where soils will be disturbed as part of the ground works, in accordance with the Joint Industry Working Group (JIWG) decision support tool for CAR2012 work categories, the combined hazard and exposure ranking is low. The work is classified as non-licenced and CAR does not apply, and there is a low to very low risk from asbestos fibres.

The JIWG table is presented in *Appendix 13*. This should be used as an aid to classify risk and recommend the level of protection required, the final decision on how asbestos within the soils should be managed should be made by the contractor.

As there is a low to very low risk from asbestos fibres based on the concentration recorded, the JIWG report recommends the following when groundworkers disturb the subbase materials as part of the enabling works:

- *RPE should be worn (EN140 with P3 filter half mask).*
- *Dust suppression should be carried out to reduce the potential for fibre release.*
- *Localised and enhanced personal decontamination facilities should be provided.*

9.7 Health and Safety - Construction and Ground Workers

During the reclamation and construction phases of the site development, it will be necessary to protect the health and safety of site personnel. The risk to construction and ground workers is assessed in the table below:

PL Ref	Potential Source	Pollution Linkage	Likelihood	Severity	Level of Risk
PL8	*Made Ground*	*Ingestion, direct contact, inhalation of dusts.*	*Unlikely*	*Medium*	***Low***
PL8	*Asbestos*	*Ingestion, direct contact, inhalation of dusts.*	*Unlikely to Low Likelihood*	*Medium*	***Very Low***

Significant contamination has not been identified, the risk from odours, free phase hydrocarbons, speciated PAHs and asbestos should be communicated to ground workers through a site induction and information made available on noticeboards.

General guidance on these matters is given in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land". In summary, the following measures are suggested to provide a minimum level of protection:

- *All ground workers should be issued with the relevant protective clothing, footwear and gloves. These protective items should not be removed from the site and personnel should be instructed as to why and how they are to be used.*
- *Hand-washing and boot-washing facilities should be provided.*
- *Care should be taken to minimise the potential for off-site migration of contamination by the provision of dust suppression control and wheel cleaning equipment during the construction works.*
- *Good practices relating to personal hygiene should be adopted on the site.*

- *The contractor shall satisfy the Health and Safety Executive with regard to any other matters concerning the health, safety and welfare of persons on the site.*

9.8 Waste Classification by Assessment

We have reviewed the testing results and inputted them into the HazWasteOnline model which allows users to code and classify waste as defined in the EWC (European Waste Catalogue 2002) based on EC Regulation 1272/2008 on the Classification, labelling and packaging of substances and mixtures (CLP) and latest Environment Agency guidance (WM3 "Guidance on the classification and assessment of waste (1st edition 2015)-Technical Guidance").

This is a useful tool as waste producers have the legal responsibility to classify any waste they produce.

Twenty-three samples were tested to assess whether they contained any contaminants in the hazardous range when screened against assessment criteria within WM3. The results are in the Waste Classification Report presented in *Appendix 14.*

Reference	Depth (m)	Strata Type	Hazardous Properties
WS02	*0.05*	*Subbase*	*TPH - Carcinogenic and Mutagenic*
WS08	*0.10*	*Subbase*	*TPH - Carcinogenic and Mutagenic*

The Made Ground soils within WS02 and WS08 have been classified as *Hazardous* for waste disposal purposes. The Made Ground soils within WS02 and WS08 have been classified as *Hazardous* based on the sample being Carcinogenic and Mutagenic due to TPH concentrations.

These properties are associated with the hydrocarbon contamination encountered in the subbase materials within WS02 and WS08. It is recommended that the granular Made Ground encountered within WS02 and WS08 is kept on site beneath areas of hardstanding and the free phase contamination encountered within

Based on the HazWasteOnline assessment tool, the remaining Made Ground soils have been classified as *Non-Hazardous* for waste disposal purposes.

Total testing was not undertaken on the natural soils and are assumed to be Non-hazardous.

9.9 Waste Acceptance Criteria (WAC) Results

The Landfill Directive (Directive 1999/31/EC on the landfilling of waste) led to the establishment of a methodology for classifying wastes. Wastes can only be accepted at a landfill if they meet the relevant Waste Acceptance Criteria (WAC) for that type of landfill. There are three different WAC, these are for:

- *Inert waste*
- *Non–Hazardous waste*
- *Hazardous waste*

Wastes should first be classified based on their total concentrations as detailed in the previous section. WAC testing is then required if the end disposal route is a landfill.

Solid and eluate WAC analysis was undertaken on five samples, the findings of which are presented in the table below.

Reference	Depth (m)	Strata Type	Classification	WAC Analysis	Landfill Disposal
WS03	*0.60*	*MG: Subbase*	*Non-Hazardous*	*Inert*	*Inert Landfill*
WS07	*0.40*	*MG: Subbase*	*Non-Hazardous*	*Inert*	*Inert Landfill*
WS12	*0.30*	*MG: Ashy gravel*	*Non-Hazardous*	*Inert*	*Inert Landfill*
WS14	*0.50*	*MG: Topsoil*	*Non-Hazardous*	*Inert*	*Inert Landfill*
SuDS2	*0.80*	*MG: Contaminated Soils*	*Hazardous*	*Inert*	*Hazardous Landfill*

The WAC testing has revealed that if the end disposal route of the Made Ground is landfill, the material would be accepted at an Inert Landfill with the exception of the contaminated soils within SuDS2 located in the eastern part of the site. The soils within SuDS2 would be accepted at a Hazardous Waste Landfill, these materials should be stockpiled separately and placed on a visqueen sheeting to prevent cross contamination of soils prior to removal.

The possibility of automatic inert classification of the natural soils should be explored in accordance with Section 4.3 of the EA guidance document. The Council Decision includes a list of wastes in Section 2.1.1 of the document that are assumed to be inert and therefore acceptable at a landfill for inert waste without testing, this is the case if:

- *They are single stream waste of a single waste type (although different waste types from the list may be accepted together if they are from a single source)*
  and
- *There is no suspicion of material or substances such as metals, asbestos, plastics, chemicals, etc to an extent which increases the risk associated with the waste sufficiently to justify contamination and they do not contain other their disposal in other classes of landfill.*

If any organic contaminated material is encountered during the construction phase, it is possible that this may be classified as Hazardous and testing should be undertaken at that time.

Materials should be segregated and where necessary, sufficient time is allowed to further classify the material properly, including discussion with landfill sites and waste transfer stations to find the best disposal route. It is recommended that where possible, the soils could be recycled at a suitable local waste treatment plant or transfer station rather than a landfill disposal route.

The reuse of soils on the site this should be done in accordance with the CL:AIRE "Development Industry Code of Practice for the Definition of Waste" (CL:AIRE CoP). Any re-use scheme should be designed to minimise disposal costs.

After a cut and fill balance plan/volume calculation has been carried out, a U1 and T5 exemption could be registered. This will allow the use of the following soils without a waste permit or under Dow CoP MMP:

- *1,000 tonnes (c.600m^3) of non-hazardous soil*
- *5,000 tonnes (c.3,000m^3) of natural sand and gravels.*
- *50,000 tonnes (c.25,000m^3) of bituminous material to be used in roadways.*
- *5,000 tonnes (c.3,000m^3) of crushed concrete / stone.*

10.0 FINAL APPRAISAL

10.1 Land Quality

The site has formerly been utilised as a depot, a sewage works, an orchard and a depot. Other features present at the site include a pond and a drain which have been identified during the Ground Investigation.

The site is formed by two adjoined areas with associated large commercial/industrial buildings and tarmac surfacing present over most of the site. Some areas of soft landscaping are present in the south eastern area. An above ground storage tank is located in the central southern area and areas of fly tipped wastes are located within the central areas.

Made Ground was generally encountered beneath the site to depth of 0.7m bgl, however deeper Made Ground was present in CP2 and SuDS2 to a maximum depth of 2.5m associated with the former drain and pond respectively.

Visual and olfactory evidence of contamination was encountered within WS02 and WS08 in the form of an ashy material with a moderate hydrocarbon odour.

Geo-environmental testing has indicated that one elevated contaminant of concern has been detected within the underlying soils based on the site having a commercial end use. This comprises an elevated concentration of Dibenzo(ah)anthracene within WS01 at 0.20m bgl. From the previous investigation elevated concentrations of Dibenzo(ah)anthracene and Chrysene were recorded associated with subbase materials. Asbestos was not encountered during the Ground Investigation however this was encountered during the previous investigation by Delta Simmons within in two of the samples of Made Ground collected from DS107 at 0.3-0.4m bgl and DS110 at 0.15-0.20m bgl, both identified as Chrysotile quantified as <0.001mass % (i.e. trace). The risk to human health from contaminated soils is *Low* as the site will be covered with hardsurfacing.

The risk from vapours identified at location SuDS2 associated with free phase and risk from vapours is *Moderate.* These locally impacted soils are to be excavated which will remove the need for a vapour resistant membrane if remediation by excavation is successful.

Ground gas monitoring to date has indicated that the site classifies as CS2 or 3, the classification and level of precautions will be confirmed by the final assessment. The site is not in an area requiring radon precautions.

Mobile concentration has been encountered locally in SuDS2 associated with the free phase contamination identified at this location. The free phase will be removed and the site is also underlain by a significant thickness of natural Clay deposits which will restrict the lateral and vertical migration of any potential contamination. The risk to controlled waters is considered to be *Low*.

The Made Ground soils within WS02 and WS08 have been classified as *Hazardous* for waste disposal purposes. The remainder of the Made Ground soils have been classified as *Non-Hazardous*.

The areas of fly tipped waste will require removal offsite as part of the enabling works.

The above ground storage tank will require decommissioning in accordance with an approved specification.

Further works are recommended within the areas previously inaccessible, when the site has been demolished this can be undertaken.

10.2 Ground Engineering

The most suitable solution for the proposed development is considered to be driven pile foundations transferring loads through the underlying Made Ground and Tidal Flat Deposits to the natural high to extremely high strength Clay encountered from depths between 18.2m and 19.7m bgl.

The use of SuDS drainage is not feasible at the site due to the cohesive strata and shallow groundwater encountered.

Further Ground Investigation is required within the vicinity of the buildings still present on site to identify any further limitations present at the site.

Flood risk of site should be taken into consideration with respect to final site levels and a FRA will be required.

10.3 Required Supplementary Investigation

The following further work is considered necessary to progress the site to construction phase:

Completion of gas monitoring programme.
Issue gas assessment.
Intrusive site investigations post demolition of the buildings on site.
Demolition Asbestos survey.
Tree survey by qualified arboriculturist.
Detailed foundation design.
Production of a Remedial Specification.
Production of a Flood Risk Assessment.
Confirmation of remedial recommendations with the Regulators.

11.0 RELEVANT INDUSTRY REFERENCES

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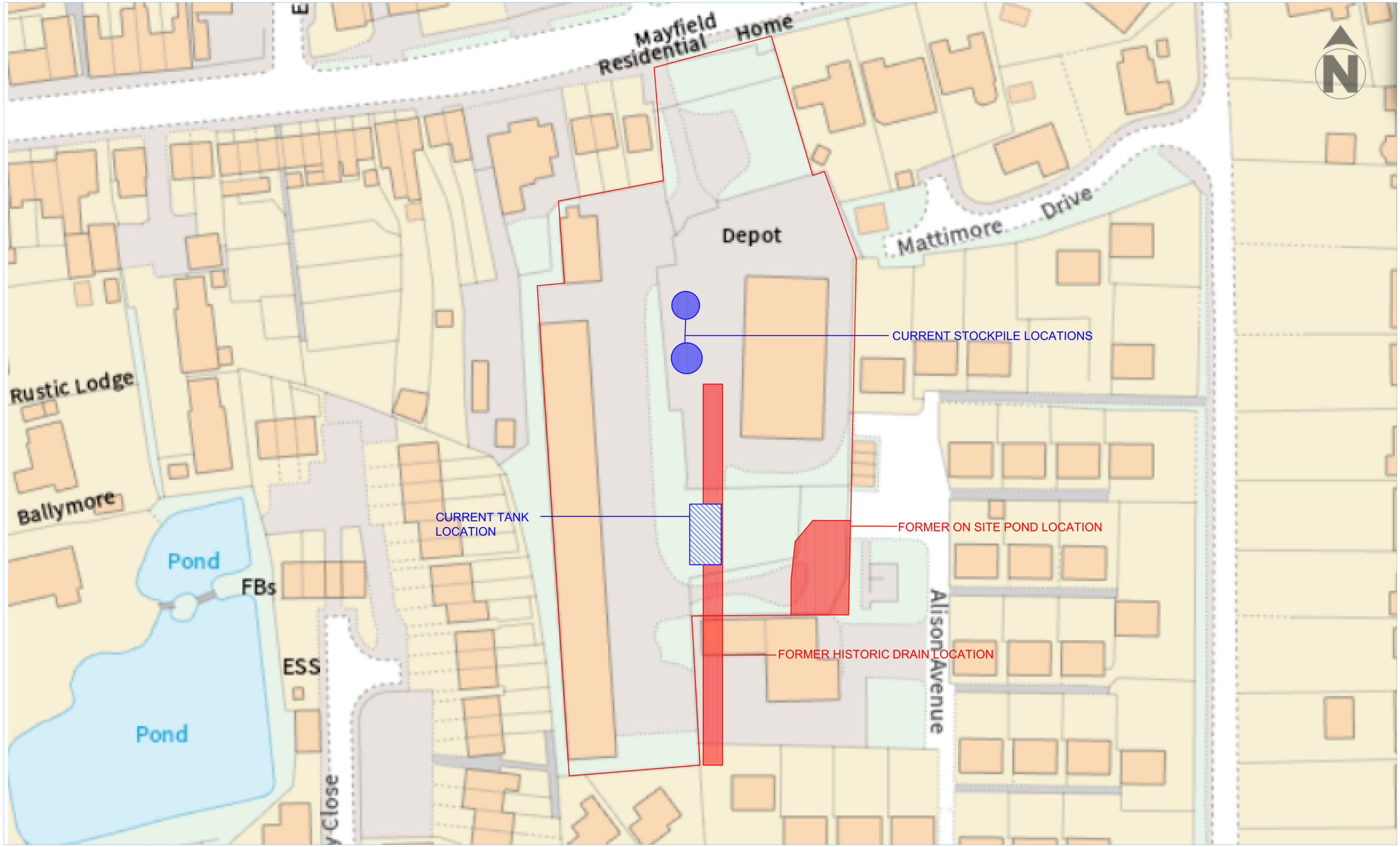
APPENDIX 1 - Plans



GROUNDTECH CONSULTING	CLIENT	ALDI STORES LIMIED	DATE	FEBRUARY 2022			Status
	PROJECT TITLE	ALDI HOLBEACH	SCALE	NTS			Preliminary
	PLAN TITLE	PROJECT LOCATION PLAN	PLAN NUMBER	GRO-21400-P01			Draft
							Issued
							For Comment
							Approved
				Rev.	Details	Date	

Notes

SITE LOCATION



GROUNDTECH CONSULTING

CLIENT	ALDI STORES LIMITED
PROJECT TITLE	HOLBEACH
PLAN TITLE	PRELIMINARY DEVELOPMENT CONSTRAINTS PLAN
DATE	FEBRUARY 2022
SCALE	NTS
PLAN NUMBER	GRO-21400-P02

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

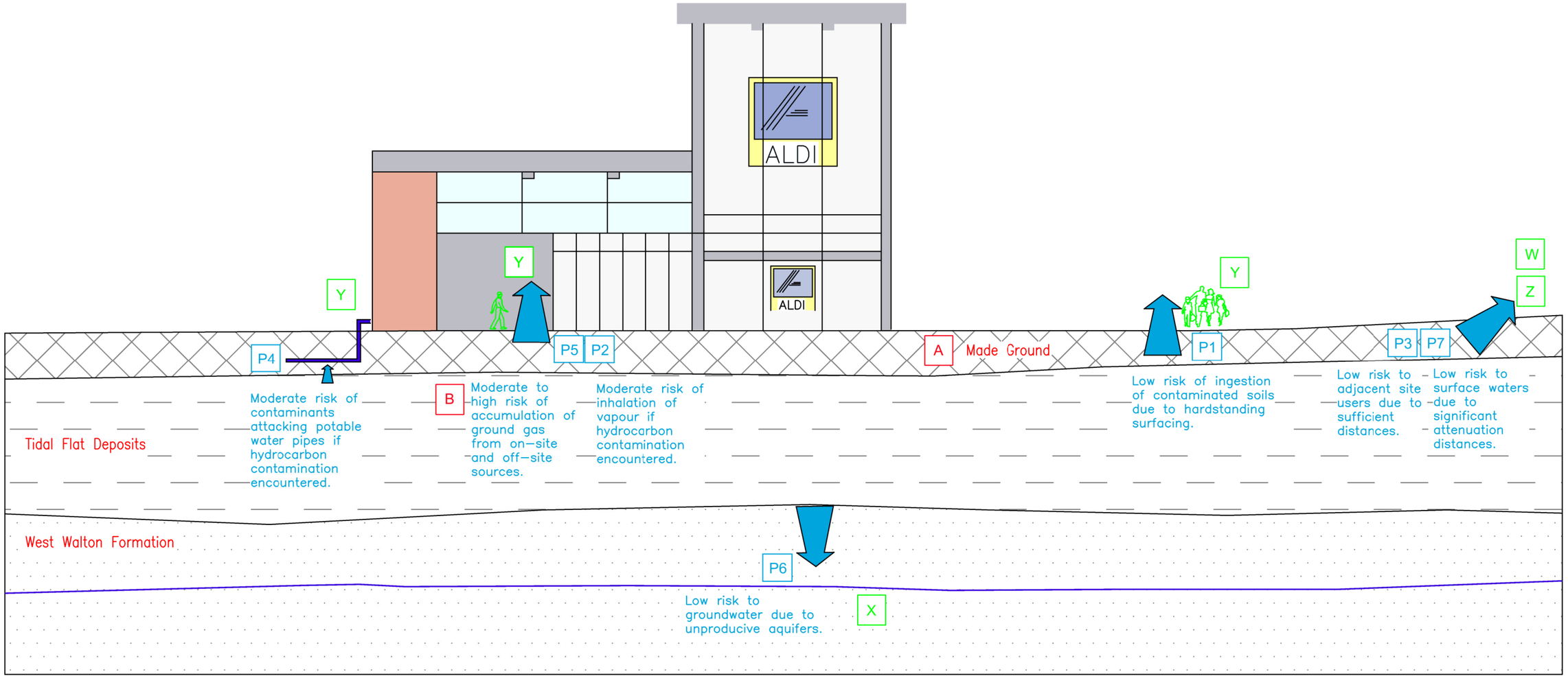
Notes

- CURRENT PRELIMINARY DEVELOPMENT CONSTRAINTS
- SITE BOUNDARY
- HISTORIC PRELIMINARY DEVELOPMENT CONSTRAINTS

SOURCES
A. Contaminated soils / Made ground. B. Ground gas.

POLLUTION LINKAGES
P1. Ingestion of soil and dust. P2. Inhalation of vapour. P3. Inhalation of soil dust by adjacent site users. P4. Attacking of potable water supply pipe. P5. Migration and accumulation of ground gas in internal places. P6. Impaction of groundwater from soil contamination. P7. Migration of soil and groundwater contamination impacting surface waters.

RECEPTORS
W. Unnamed river c. 128m south east of the site. Y. Site end users X. Groundwater within the unproductive bedrock and superficial aquifers. Z. Adjacent site users.



GROUNDTECH CONSULTING

CLIENT	ALDI STORES LIMITED
PROJECT TITLE	HOLBEACH
PLAN TITLE	ILLUSTRATIVE PRELIMINARY CSM
DATE	FEBRUARY 2022
SCALE	NTS
PLAN NUMBER	GRO-21400-P03

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes