Amey

Preliminary Ground Conditions Risk Assessment

New Carrington Ground Investigation – Stage 1
NCGI1 / NCGI1-AMEY-VGT-SWI-RP-GE-000001 / P03

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P01 Initial Issue	Name: Tanya Walsh (Geo-env) Signature: [redacted] Date:04/11/24 Name: Connor Turton(Geotechnical) Signature: Date: 6/11/24	Name: Mathew Rouge (Geo-env) Signature: Date: 08/11/24 Name: Joewin Tsang (Geotechnical) Signature: Date: 11/11/24	Name: Gerry McGarrity (Geo-env) Signature: [redacted] Date: 15/11/24 Name: Ian Taylor (Geotechnical) Signature: Date: 13/11/24	Name: Gerry McGarrity (Geo-env) Signature: Date: 15/11/24 Name: Keith Innes (Geotechnical) Signature: Date 15/11/24
P02 Minor revisions of figures	Name: Tanya Walsh (Geo-env) Signature: [redacted] Date:19/11/24 Name: Connor Turton(Geotechnical) Signature: Date: 19/11/24	Name: Mathew Rouge (Geo-env) Signature: Date: 19/11/24 Name: Joewin Tsang (Geotechnical) Signature: Date: 19/11/24	Name: Gerry McGarrity (Geo-env) Signature: [redacted] Date: 19/11/24 Name: Ian Taylor (Geotechnical) Signature: Date: 19/11/24	Name: Gerry McGarrity (Geo-env) Signature: Date: 19/11/24 Name: Keith Innes (Geotechnical) Signature: Date 19/11/24

P03 Amendments following comments from client	Name: Tanya Walsh (Geo-env) Signature: [redacted] Date: 24/1/25	Name: Mathew Rouge (Geo-env) Signature: Date: 6/2/25	Name: Gerry McGarrity (Geo-env) Signature: [redacted] Date: 11/2/25	Name: Gerry McGarrity (Geo-env) Signature: Date: 11/2/25

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1. Introduction

1.1. General

Amey Consulting was commissioned by Trafford Council (The Client) to prepare a desk study review of pertinent information to provide an initial indication of potential constraints presented from ground conditions that may impact upon the future development of New Carrington (herein referred to as the 'scheme').

New Carrington's Allocation Plan was developed as part of the Places for Everyone strategy - the long-term plan of the Greater Manchester districts for jobs, new homes and sustainable growth. The Allocation Plan covers an area of approximately 1,150 hectares and includes the construction of approximately 5,000 homes and allows for approximately 350,000m^2 of employment floorspace for industry and warehousing. It also incorporates significant areas of retained Green Belt, alongside strategic greenspaces.

The location and boundary of the scheme is shown in Figure 1.1 below and is shown as Drawing NCGI1-AMEY-HGT-SWI-DR-GE-000001 within Appendix A.

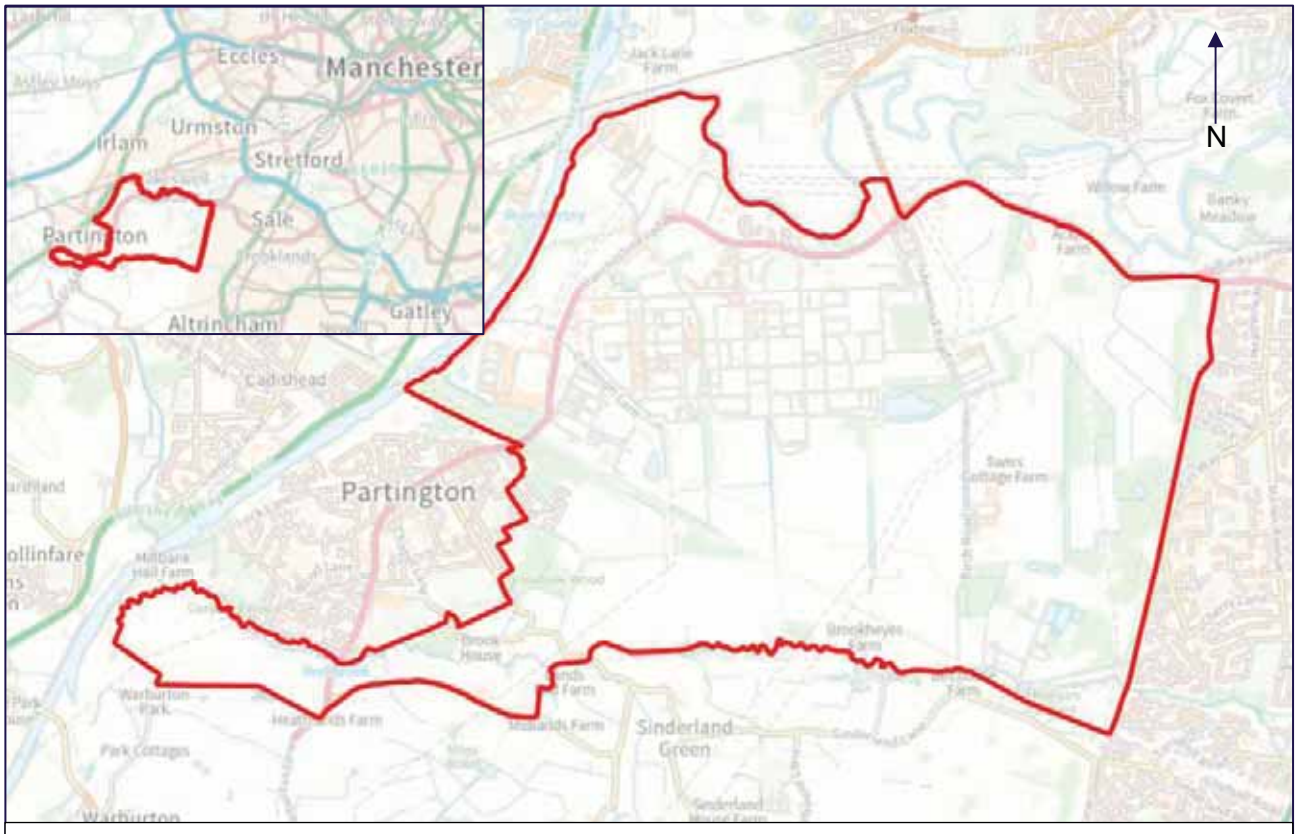

Figure 1.1 Scheme Location and Boundary

As shown in Figure 1.1 the boundary of the scheme is irregular in shape, and is bounded to the west by the Manchester Ship Canal (MSC) and the village of Partington; to the east by the town of Sale; to the north by the River Mersey, and to the south by agricultural land.

The scheme's Indicative Allocation Plan, sourced from Places for Everyone (1), is presented in Figure 1.2 below, and illustrates the general development aspirations, likely land divisions and proposed land uses.

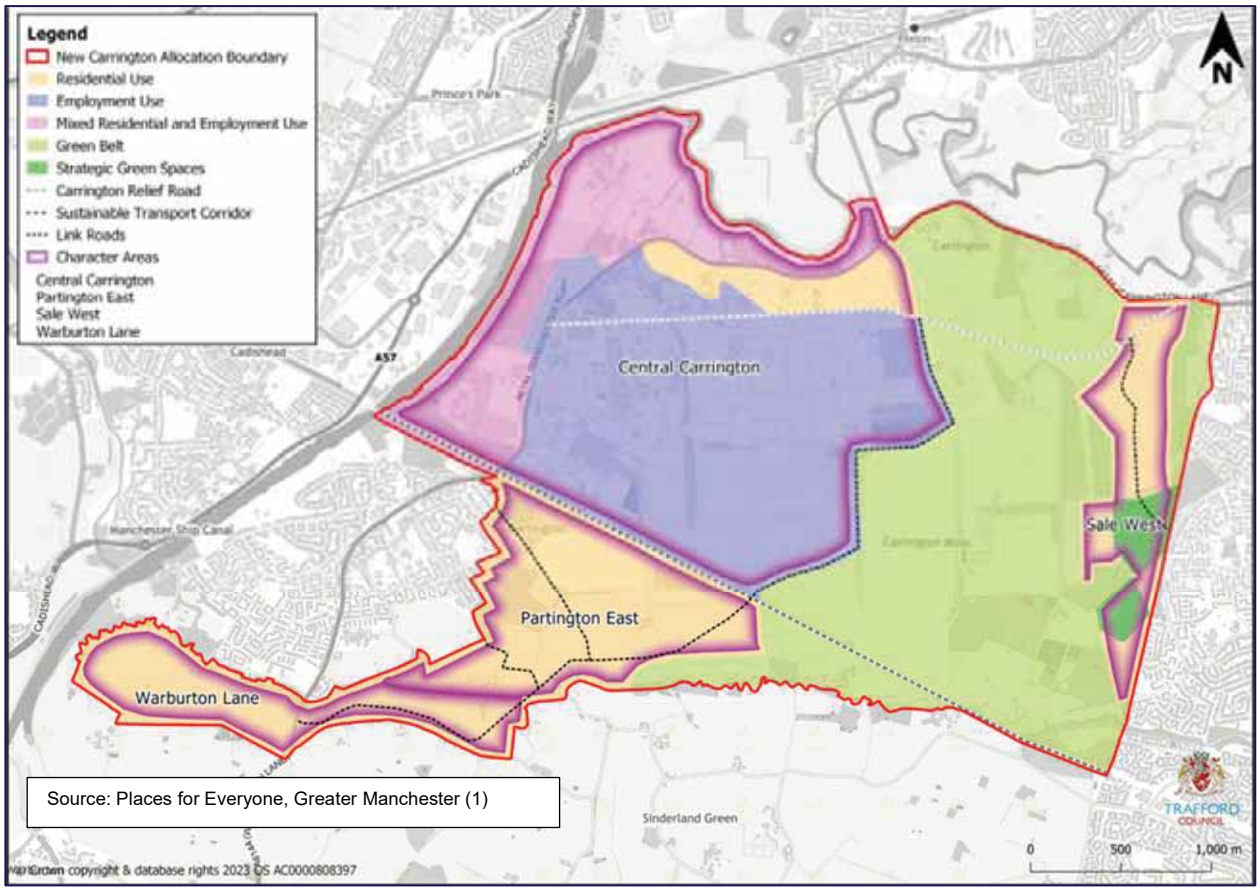

Figure 1.2 New Carrington Indicative Allocation Plan

1.2. Assessment Approach

Due to the size of the area covered by New Carrington, and the various land uses proposed, when undertaking this desk study, the scheme was divided into 12 zones. The zonal division of the scheme was based on a combination of the existing land ownership / promoter / potential developer, and the proposed land-use. The allocated zones are shown in Table 1-1 below, and their location within the Allocation Plan is shown in Figure 1.3 below and Drawing NDGI1-SMEY-HGT-SWI-DR-GE-000002 within Appendix A.

There are areas within the Allocation Plan which have already been developed, and for which further development or redevelopment under the Allocation Plan is considered unlikely. These areas have been greyed out and collectively referred to as Zone 0. However, in Zone 12, the presence of existing land uses which are unlikely to be redeveloped (such as the sewage treatment works operated by United Utilities and substation operated by National Grid) have been considered given the sensitive nature of this zone as Green Belt.

ZONE	EXISTING LAND OWNERSHIP/PROMOTER/POTENTIAL DEVELOPER	CURRENT LAND USE	PROPOSED LAND USE
1	Wain Estates, Peel, Lordstone Developments Ltd (Freehold) Wainstones Energy Ltd (Leasehold)	Woodland, brownfield space, and greenfielld	Employment
2	Predominantly Mr and Mrs Tandy	Woodland and brownfield	Residential
3	BlackRock UK Property Fund	Largely open brownfield space with isolated commercial use	Employment

ZONE	EXISTING LAND OWNERSHIP/PROMOTER/POTENTIAL DEVELOPER	CURRENT LAND USE	PROPOSED LAND USE
4	Vistry Partnerships	Open brownfield space	Residential
5	Redrow	Agricultural	Residential
6	Wain Estates	Largely open brownfield space with isolated commercial use	Employment
7	Predominantly Wain Estates with smaller areas belonging to Manchester United Football Club, United Utilities and private landowner	Predominantly Agricultural	Residential
8	National Trust and Wain Estates	Agricultural	Green Belt
9	Wain Estates	Largely open brownfield space	Mixed Residential and Employment
10	Wain Estates	Agricultural	Employment
11	Wain Estates, National Trust, Trafford Council and other ownership	Agricultural	Residential
12	Predominantly Wain Estates with smaller areas belonging to Manchester United Football Club, National Grid, Trafford Council and United Utilities	Predominantly Agricultural with areas of existing development (sewage works, football training ground etc)	Predominantly Green Belt

Table 1-1 Zonal division of Allocation Plan

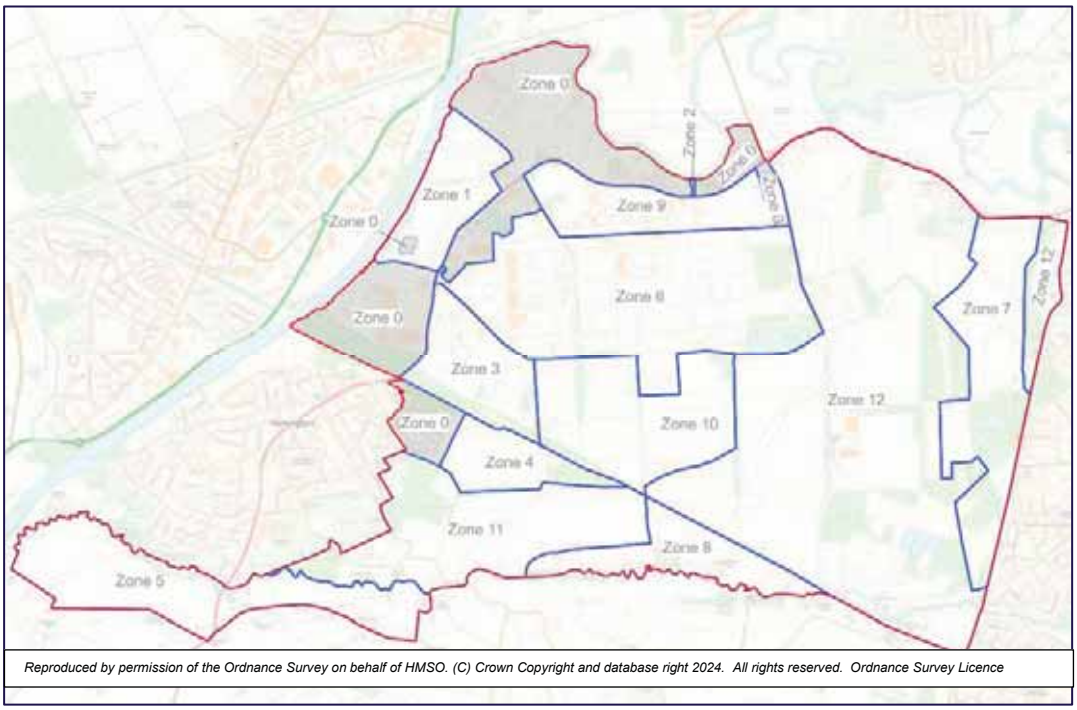

Figure 1.3 Zonal division of the Allocation Plan

This report comprises desk-based reviews of relevant third-party information to provide an initial indication of potential ground condition constraints that may impact on the proposed development within each of the zones. Each zone has been considered separately and is reported as an individual chapter within this report.

The ground condition constraints to development considered within this report are the possible presence of land and groundwater contamination (resulting from existing and historical land uses), and possible geotechnical constraints. In addition, where environmentally sensitive and designated areas such as Sites of Special Scientific Interest (SSSI's) and Sites of Biological Importance (SBI's) have been identified these have been highlighted. These will need to be considered as part of any future development.

For each zone, the chapter has been structured to provide:

- A desk study assessment that presents an introduction to the zone and details all relevant background information that relates to ground conditions, and that has been sourced from third party data providers (see Table 1-2 below)
- A preliminary engineering assessment and geotechnical risk register. This section identifies potential ground engineering/geotechnical constraints to the proposed development and provides a preliminary risk rating of identified potential geotechnical hazards
- A preliminary conceptual site model and risk assessment. This section identifies potential land and groundwater contamination constraints to the proposed development and provides a preliminary risk rating of identified potential contaminant linkages

It should be noted that as part of this report available information relating to historical intrusive ground investigations undertaken across the scheme was not reviewed or included.

A series of drawings presenting the key ground condition and selected environmental information across the scheme are presented in Appendix A, and detail:

- Superficial Geology, Drawing NCGI1-AMEY-HGT-SWI-DR-GE-000003.
- Solid Geology, Drawing NCGI1-AMEY-HGT-SWI-DR-GE-000004.
- Non-Statutory Environmental Designated Sites, Drawing CO00201460-R00-68
- Relative Land Contamination Risk (see chapter 14) Drawing NCGI1-AMEY-HGT-SWI-DR-GE-000005.
- Relative Geotechnical Risk (see chapter 14) Drawing NCGI1-AMEY-HGT-SWI-DR-GE-000006.

1.3. Sources of Information

To support the preparation of the desk study assessments for the scheme a Groundsure Report was procured and is presented within Appendix B. The Groundsure Report provided a series of historical maps which were reviewed to understand the historical development of each of the zones. Copies of the historical maps are presented in Appendix C. The sources of information reviewed in preparation of this report are detailed in Table 1-2 below.

INFORMATION	SOURCE
Historical Maps and Aerial photography	• Groundsure Historical Maps scales 1:500, 1:1,250, 1:2,500, 1: 10,000 and 1:10,560 (Appendix C). • Google Earth™ (2)
Geological	• British Geological Survey (BGS) Onshore GeoIndex Tool (3) • Groundsure report datasheet (Appendix B). (4) • British Geological Survey (BGS) 1:10,560 Sheet SJ79SW Solid and Drift Geology (5) • British Geological Survey (BGS) 1:10,560 Sheet SJ79SE Solid and Drift Geology (6)
Environmental	• Groundsure report datasheet (Appendix B), • MAGIC (7)
Mining	• Coal Authority Interactive Map Viewer (8), • Groundsure Report (4)
Other	• Zetica Unexploded Bomb (UXB) risk assessment maps (9)

Table 1-2 Information Sources

2. Zone 1

2.1. Desk Study Assessment

Zone Location and Current Land Use

Zone 1 is located in the northwestern area of the Allocation Plan, adjacent to the Manchester Ship Canal (MSC). The zone lies between approximately 18 m and 24 m Above Ordnance Datum (AOD), sloping gently downwards towards the MSC. The western half of the zone appears to have had the land raised, with the levels raising from 20 m to 23m AOD, then dropping to 18 m to 19 m AOD at the canal bank. The northern area of the zone comprises ground which has recently been subject to working; with the southeastern area comprising grassland and the southwestern area comprising trees and shrubs occupying a former raised spoil heap. An electricity generating facility is present in the southern area of the zone. The location and current land use of Zone 1 is shown in Figure 2.1 below.

Figure 2.1 Zone 1 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 1 is proposed for employment use.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the earliest mapping available (dated 1848) and 1980, Zone 1 and the surrounding area comprised largely of unoccupied land.

Carrington Wharf was located in the northwestern area of the zone until the 1960s, when the area became covered with a spoil heap associated with Carrington Power Station that had been constructed directly to the north of Zone 1. The spoil heap increased in size over the following decades, occupying the northern and southwestern areas of the zone, and by the 1990s it was shown to be vegetated.

The 1954 mapping shows a petrochemical plant to have developed approximately 800m east of the zone, within Zone 6.

The 1980 mapping shows significant development of the area surrounding the zone, with a construction of a depot to the south and expansion of the petrochemical works to the southeast of the zone, approximately 270m from the zone.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000 (left image in Figure 2.2, below). Within this photograph, the majority of the zone was shown as unoccupied land, with a depot to the south of the zone and Carrington Power Station to the north. Between 2000 and the most recent aerial photograph (2024, right image in Figure 2.2, below) there were only a couple of significant changes shown. An electricity generating facility had been constructed in the southern area of the zone, and the ground within the northern area appeared to have been regraded. The image of 2024 showed the raised nature of the ground in the southwestern and northern areas of the zone.

Figure 2.2 Zone 1 Aerial Photography

Historical Industrial Sites

The Groundsure Report records a number of potentially contaminative historical industrial sites within Zone 1 and the surrounding area. A summary of these land uses is provided in Table 2-1 and Table 2-2 below.

HISTORICAL LAND USE	DATE SHOWN ON HISTORICAL MAPS	LOCATION WITHIN ZONE
Spoil Heap	1981 - 1995	Northern and western area, adjacent to MSC.
Wharf	1894 - 1965	Northwestern area, adjacent to MSC
Laboratory	1981 (only)	Northwestern area, directly south of Carrington Power Station

Table 2-1 Zone 1 Historical industrial sites within zone

HISTORICAL LAND USE WITHIN 250m OF ZONE	DATE SHOWN ON HISTORICAL MAPS	LOCATION
Electricity Substation	1965 to present day	Directly north of zone
Carrington Power Station	1965 to present day	Directly north of zone
Gas Works	1954 - 1990	Zone 3, to the southeast
Petrochemical Works	1954 - 2001	Zone 6, to the southeast
Depot	1981- 2001	Directly south of zone.
Railway and tramway infrastructure (including buildings, sidings etc.)	1897 - 1965	To the south of zone

Table 2-2 Zone 1 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SW Solid and Drift Geology 1:10,560 paper map (5), the Groundsure Report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed, with the findings summarised below.

Artificial Ground

The majority of the western half and northern area of the zone is recorded to be underlain by artificial ground.

Superficial Deposits

Alluvium deposits are indicated to be located across the western half of the zone, with Glaciofluvial Sheet Deposits located predominantly within the eastern area of the zone (and which may also extend beneath the Alluvium). The mapped location of the superficial deposits is shown in

Figure 2.3 below, with strata descriptions presented in Table 2-3.

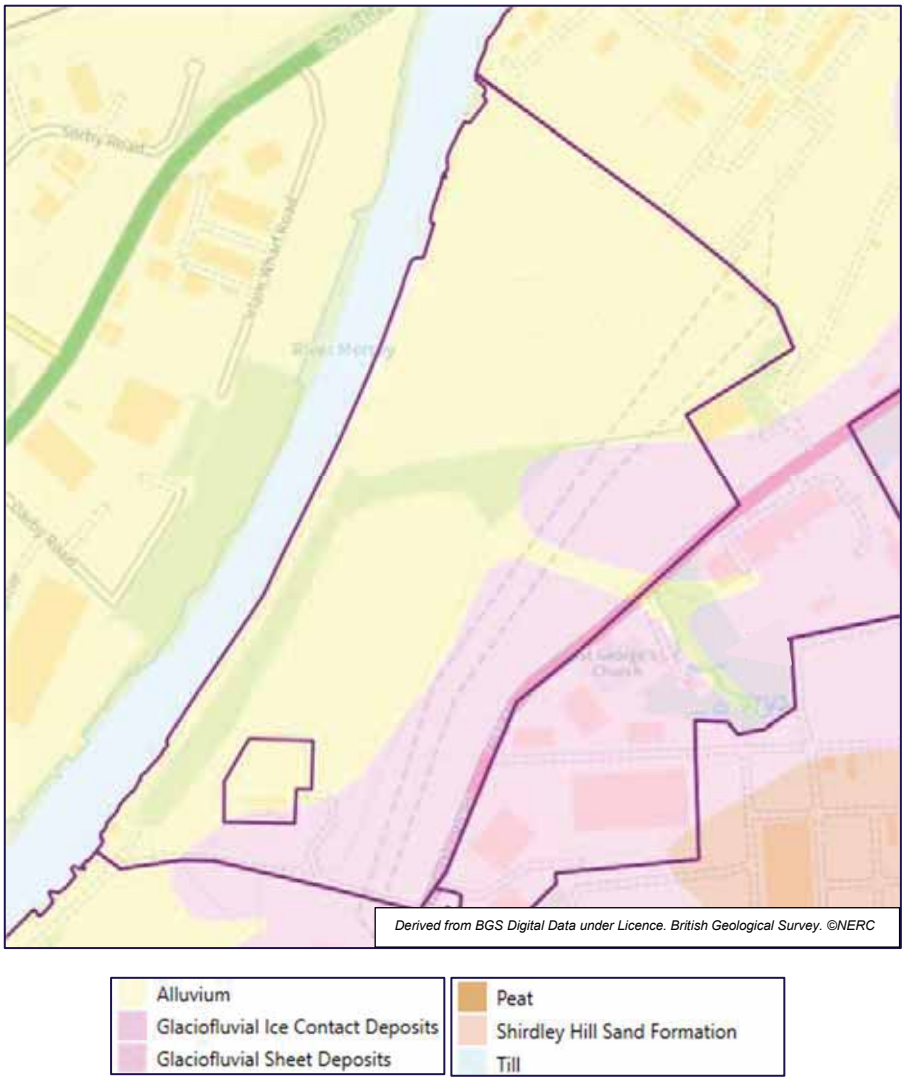

Figure 2.3 Zone 1 Superficial Deposits

DEPOSIT	DESCRIPTION
Alluvium	Clay, silt, sand and gravel, Unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.

Table 2-3 Zone 1 Superficial deposits

Solid Geology

The entire zone is indicated to be underlain by the Wilmslow Sandstone Formation, described by the BGS (3) as '*Red-brown to brick-red, fine to medium grained, generally pebble free, cross bedded sandstones, with sporadic siltstone. The sand grains are well rounded and indicate an aeolian origin*'.

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is shown in Figure 2.4 below.

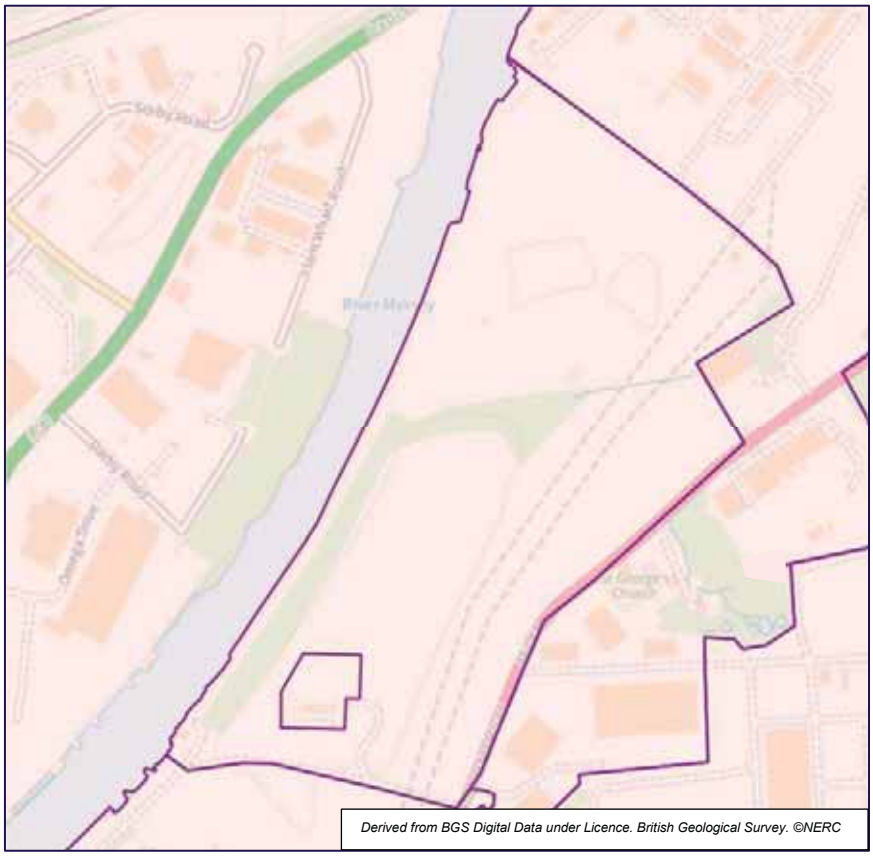

Figure 2.4 Zone 1 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 1 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records the presence of one BritPit within Zone 1, named 'Peak Nooks Deposit Ground', a surface mineral working for sand and gravel.

A number of surface ground workings are recorded within Zone 1, in the locations of the refuse heaps and wharf identified within the historical maps.

No underground workings or non-coal mining records were identified within Zone 1. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 2-4 below.

HAZARD	HAZARD RATING
Shrink swell clays	Very Low to Negligible
Running sands	Low to Very Low
Compressible deposits	Moderate to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Moderate To Very Low
Ground dissolution of soluble rocks	Negligible

Table 2-4 Zone 1 Natural hazards

Hydrogeology

The Wilmslow Sandstone Formation is classified by the Environment Agency (EA) as a Principal Aquifer, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Alluvium and Glaciofluvial Sheet Deposits are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*.

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 1 or the surrounding area, and Zone 1 is not located in a Source Protection Zone.

Groundwater flow is anticipated to be towards the River Mersey and the MSC which are located to the north and west of the zone, respectively.

Surface Water Bodies

The River Mersey is located 300 m north of Zone 1, which flows in a generally southwest direction. The river flows into the MSC which is located directly west of the zone.

The stretch of the River Mersey/MSC in the vicinity of Zone 1 was rated by the EA as having a 'Moderate' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Fail' chemical quality rating and 'Good' ecological rating) in 2019 (the most recent rating available).

Flooding

The area of Zone 1 immediately adjacent to the MSC is indicated to be in Flood Zone 3 and has a High probability of flooding (defined by the EA as greater than or equal to 1 in 30 chance) as a result of its close proximity to this water body. The rest of the zone is at a low risk of flooding from the MSC.

With the exception of small, isolated areas, Zone 1 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records no archaeological records to be present within Zone 1.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 1 or the immediate surrounding area.

A non-statutory Site of Biological Importance (SBI), named Carrington Power Station, is located in the northeastern corner of the zone. This area is also designated as a Site of Importance for Nature Conservation.

Licenses / Permits / Consents

The Groundsure Report identifies the following industrial sites at the zone that hold (or held) environmental licenses, permits or consents:

- The area of the historical spoil heap located in the northern area of the zone adjacent to Carrington Power Station is referred to within the Groundsure Report as “Drying out Ground” (an Historical landfill). The information provided states that this entry was first recorded in 1962 for inert and industrial wastes. No license information is provided in the Groundsure Report.
- The historical spoil heap present in the western area of the zone is identified within the Groundsure Report as Peaks Nook landfill. The landfill was operated by Viridor Wate Management between 1988 and 1996, with the waste type accepted recorded as inert, industrial and commercial. The license was surrendered in 2003.
- The electricity generating facility located in the south of the zone which is referred to as the Carrington Generation Plant has an active Environmental Permit for a Part A1 installation regulated under the Environmental Permitting (England and Wales) Regs 2016 for the release of substances to the environment.

Radon

The Groundsure Report indicates that Zone 1 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required.

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 1 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

2.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Preliminary engineering assessment

Based on the findings of the review of relevant information undertaken in Section 2.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon the assumption for requirements for earthworks, structures, hard standing and road pavement, assessing feasibility and risks for each item.

General

Zone 1 currently hosts a mix of brownfield, greenfield and industrial land usage with an electrical plant itself classified as Zone 0 within the southern side of Zone 1.

Whilst the zone is primarily recorded to be underlain primarily by Alluvium to the west, alongside the Manchester Ship Canal, and Glaciofluvial Sheet Deposits to the east, the majority of site is additionally overlain by Made Ground, including a raised platform adjacent the Canal. Spoil material is located on the northern and southwestern areas (the Made Ground platform) of the zone, on an area historically hosting a wharf associated with the MSC and a historic laboratory.

The Alluvium recorded on the western side of the zone contributes an increase to the risk of shrink and swell clays (very low risk), running sands (low risk), compressible deposits (moderate). Risk of landsliding on the western edge of the zone, adjacent the MSC is low to moderate, as per the Groundsure report. This risk carries into the Made Ground platform due to the uncertainty as to it being engineered or not.

A number of surface ground workings are recorded for the site, in the areas of the spoil on the northern side of the zone at the historic wharf. These pits are likely to have been infilled with Made Ground, otherwise may remain open pits, especially if obscured by vegetation. No other mining related risks are recorded; however, it should be noted Zone 1 falls within the Cheshire Brine Compensation District.

Flooding risk is generally low for the zone, being upon raised topography, with the exception of areas adjacent the MSC designated Flood Zone 3 with a high probability of flooding.

The Allocation Plan indicates Zone 1 is to comprise employment buildings with associated hard standing.

Potential Proposed Development

Earthworks – Cutting

Due to the low to moderate risk of landsliding on the western edge of the zone, cutting on or near these slopes should be avoided. Otherwise, methods for increasing slope stability should be considered, including ground improvement, replacement of material with engineering fill or the implementation of retaining systems.

Much of the zone is recorded to have Made Ground cover. In the case of the raised Made Ground platform, this is likely composed of spoil and/or other historic fill material which may not meet modern engineering standards. It is unknown if the platform of likely spoil material has been engineered into its current morphology or has had no intervention since it was initially dumped. As such, sufficient GI is recommended for geotechnical design.

The Glaciofluvial Sheet are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within this type of deposit, ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

The Alluvium's low risk of running sands and moderate risk of compressible deposits present a risk of stability for a cutting slope, as such ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The bedrock geology is recorded as sandstones of the Wilmslow Sandstone Formation (WLSF). Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, is bedrock cutting is required, it may present a hard dig risk dependent upon extent of weathering.

Earthworks – Embankment

Dependent upon location, Alluvium presents a low to moderate risk of landsliding on the western edge of the zone (along the bank of the MSC), embankment construction/modification on or near these slopes may affect slope stability. The Alluvium covering much of the site presents additional moderate risk as a compressible deposit, which may cause issues with differential settlement, affecting any overlying embankment.

Embankments should be constructed from appropriate imported engineering fill material. Site won material may be too contaminated to use in embankment construction/expansion of the existing even if it meets engineering fill criteria. Testing is required to assess contamination and soil properties to establish adequacy in earthworks construction.

Other site geologies are anticipated to generally be amenable to embankment construction.

Structures

The Allocation Plan indicates employment buildings are to be situated on the eastern side of Zone 1, along the A6144 Manchester Road.

Founding upon geologies within this zone does not present as significant a risk. In general, the zones geology does not present a significant risk of natural ground subsidence. The low risk of running sands may present potential issues for excavation associated with construction. Other consideration for risks associated with Alluvium discussed previously in the Embankment section.

The potential variable nature of Glaciofluvial Sheet Deposits and Made Ground may carry some minor risk of localised instability. In such cases the design should adequately consider variable parameters or the poor material may be subject to ground improvement or removed and replaced by appropriate engineering fill material.

The Allocation Plan does not indicate any structures are to be built upon the Made Ground platform to the west. However, in general this platform of Made Ground is anticipated to be amenable to construction following confirmation via sufficient GI.

Subgrade

The geology of the site does not pose a significant risk to the establishment of hard standing, however sufficient GI is required to confirm ground suitability. Any inadequate underlying material should be considered for appropriate ground improvement, or if issues are more localised: removal and replacement with appropriate engineering fill.

Potential high groundwater levels may present a risk to subgrade stability. Additionally, extensive impermeable hard standing could increase the surface water and river flood risk, which is currently designated as low for the majority of the zone (with the exception of high risk areas on the banks of the MSC). Potential risk may be reduced with a design implementing permeable hard standing and implementation of sustainable drainage systems (SUDS), however the effectivity of the latter may be limited.

Man-Made Obstructions

The most significant consideration for man-made obstructions for this zone are likely to include the foundations associated with the historic area of wharf and laboratory to the north and any potential foundations within or overlain by the Made Ground platform. Additionally, any buried services: gas pipes, electrical and waste pipes, associated with these historic structures. Furthermore, there are 4 No. electrical pylons and their foundations running N-S over the eastern side of the zone.

Historic foundations may require full or partial removal prior to new construction as they could cause obstruction and act as a hard spot leading to differential settlement. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 2-5 below. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity).

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Landsliding risk on the western edge of the zone, slope between the raised (spoil) platform and the Manchester Ship Canal. Any additional construction or cutting upon or near the existing slope may result in destabilisation and failure.	3	5	15	Landsliding of the slopes on the western side of Zone 1, on the bank of the MSC and any associated canal structures such as sheet piled walls. Slope failure will affect any structures being established, with risk to workers.
2	Alluvium identified on the western side of Zone 1. Moderate compressibility risk and risk of bearing capacity failure.	4	3	6	Any construction upon this Alluvium are at risk of instability due to settlement.
3	Localised variability in the Glaciofluvial Sheet Deposits and Made Ground.	4	3	12	Localised variability of ground composition and conditions may lead to settlement issues.
4	Existing foundations: There will be foundations associated with the 4 No. electrical pylons running N-S on the eastern side of site. Presence of other recorded and unrecorded remnant subterranean structures.	5	2	10	Existing foundations may require breakout for new foundation design. Increased time and design considerations.
5	Surface Mining within Zone 1.	4	4	16	Presence of large voids at surface which require infilling with suitable fill material increasing cost and programme. Poorly backfilled surface working which create a risk of voiding and collapse below the proposed development.
6	Risk of high groundwater levels and flooding during construction.	3	2	6	Leading to overly conservative design and delays to programme.
7	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified and the site is underlain by sandstones of the WLSF which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
8	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 2-5 Zone 1 Geotechnical Risk Register

2.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study, a number of current and historical land uses at Zone 1 and the surrounding area have been identified that could have likely led to contamination at the zone.

Therefore, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the current and historical land uses at the zone and the understanding that the proposed development is for employment use.

When considering potential sources of groundwater contamination surrounding Zone 1, it has been assumed that the direction of groundwater flow across the scheme is from southeast to northwest i.e. towards the River Mersey and MSC. Therefore, only existing or historical land uses that are located to the southeast or east of Zone 1 have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 1, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 1 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 1

- Made Ground associated with the former large spoil heap (Peaks Nook landfill) located in the western area, adjacent to the MSC. The Made Ground has the potential for elevated concentrations of soil bound and leachable chemical species, and the potential to generate ground gases and or vapours;
- Existing land uses, notably an electricity generating facility in the southern area
- Historical land uses, notably:
    - Former wharf in the northwestern area, adjacent to MSC
    - Former laboratory in the northern area

Sources and hazards within 250m of Zone 1

- Plume of groundwater contamination within superficial deposits associated with up-gradient existing and historical land uses, notably:
    - Former petrochemical works located to the east (Zone 6)
    - Former gas works located to the southeast within Zone 3
    - Former railway lines and infrastructure located to the south
    - Former depot located to the south

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently the River Mersey and MSC;
- Direct contact of soils and groundwater with foundations and buildings' infrastructure; and,
- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for employment land use the following receptors have been identified (during and following development):

Human Health

- Future users (employees); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed residential and employment properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- River Mersey and MSC; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment (PRA) in Table 2-6 and Table 2-7. The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the likelihood (probability) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define likelihood, severity and risk are described in Appendix F.

In the absence of quantitative data, the likelihood and severity for each potential contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIIKELIHOOD	RISK	COMMENTS
Made Ground associated with the former large spoil heap (Peaks Nook landfill) with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gases and/or vapours	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 1 (employees)	3	2	6	Following development, the majority of the zone will be hardsurfaced and occupied by buildings. The presence of the hardsurfacing and buildings will prevent the direct exposure of the Made Ground to future users. Any areas proposed for soft landscaping may require a suitable thickness of clean cover to provide a suitable growing medium and prevent direct exposure of the Made Ground to future users.
		Construction and maintenance workers	1	3	3	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 1 (employees)	4	2	8	Depending on the composition of the spoil heap/landfill the potential exists for ground gases and/or vapours to be present. The presence and nature of such gases and/or vapours would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	2	8	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	2	8	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	2	6	The potential exists for contaminated wind-blown dust and/or asbestos fibres to be generated during earthworks and construction activities. Measures to mitigate the risk will need to be implemented during these activities.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	1	3	Following development, the majority of the zone will be hardsurfaced and occupied by buildings. A dedicated surface water drainage network will also be constructed. Therefore, it is considered unlikely that there will be rainfall infiltration with the potential to leach contamination from the Made Ground.
	Direct contact	Foundations and Infrastructure	2	3	6	The potential exists for the presence of chemical species that are aggressive towards concrete, and/or which may permeate plastic drinking water supply pipes. Therefore, such materials will need to designed according to the prevailing ground conditions.
Historical land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	River Mersey and MSC	3	3	9	The potential exists for the existing and historical land uses to have led to the contamination of groundwater at the zone. Groundwater within the superficial deposits is expected to be in hydraulic continuity with the River Mersey, and therefore any groundwater contamination has the potential to enter this surface water body. The lining of the MSC, where in a good state of repair, would likely inhibit the recharge of this surface water by groundwater. Therefore, a viable contaminant linkage whereby contaminated groundwater enters the MSC may not be present.

Table 2-6 Zone 1 Preliminary Risk Assessment (sources within Zone 1)

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Existing and historical land uses up groundwater gradient which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	Groundwater within superficial deposits in Zone 1 (and subsequently the River Mersey and MSC)	3	3	9	The historical land uses to the southeast of the zone (i.e. up groundwater gradient) have the potential to have led to groundwater contamination. The expected direction of groundwater flow within the superficial deposits across New Carrington is towards the River Mersey and MSC. Therefore, any contaminated groundwater surrounding the zone has the potential to migrate into the zone and flow towards the River Mersey and MSC.

Table 2-7 Zone 1 Preliminary Risk Assessment (sources within 250m of Zone 1)

3. Zone 2

3.1. Desk Study Assessment

Site Location and Current Land Use

Zone 2 is located in the northern area of the Allocation Plan and is located to the north of Manchester Road. The zone lies between approximately 18 and 20 m Above Ordnance Datum (AOD), sloping gently downwards towards the River Mersey. The majority of the zone comprises rough grassland and trees and shrubs. A former abattoir (now in a state of ruin) is present northern end of the zone. The location and current land use of Zone 2 is shown in Figure 3.1 below.

Figure 3.1 Zone 2 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 2 is proposed for residential use.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the earliest mapping available (1891) and 1980, Zone 2 and the surrounding area largely comprised agricultural land with a residential building in the southern part of the zone.

Between 1980 and 2010, an abattoir was shown on historical mapping to be present in the northern area of the zone, but by 2024 this land use is no longer indicated, despite the building still being shown.

The 1980 mapping shows significant development of the wider Carrington area, with substantial development to the south of Zone 2, in Zone 9

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 3.2 (left image). The majority of the zone is shown as grassland with trees and shrubs, with a residential property in the southern area and the abattoir in the northern area.

Figure 3.2 Zone 2 Aerial Photography

Between 2000 and the most recent aerial photography (2024, image on the right within Figure 3.2) the residential property has been demolished, with possible minor changes to the land use in the northern area (although the quality of the photograph makes this difficult to establish).

Historical Industrial Sites

The Groundsure Report records a limited number of potentially contaminative historical industrial sites within Zone 2 and the surrounding area. A summary of these land uses is provided in Table 3-1 and Table 3-2 below.

HISTORICAL LAND USE	DATE SHOWN ON HISTORICAL MAPS	LOCATION WITHIN ZONE
Abattoir	1980 to 2010	Northern end of Zone 2

Table 3-1 Zone 2 Historical industrial sites within zone

HISTORICAL LAND USE WITHIN 250m OF ZONE	DATE DHOWN ON HISTORICAL MAPS	LOCATION
Haulage company	1980 to present day	Zone 9, south of zone 2

Table 3-2 Zone 2 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SW Solid and Drift Geology 1:10,560 paper map (5), the Groundsure Report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and summarised below.

Artificial Ground

The majority of the western half and northern area of the zone is recorded to be underlain by artificial ground.

Superficial Deposits

Alluvium deposits are shown to be located across the majority of the zone, with Glaciofluvial Sheet Deposits shown to be located in the southwestern corner.

The mapped location of the superficial deposits is shown in Figure 3.3 below and strata descriptions presented in Table 3-3 below.

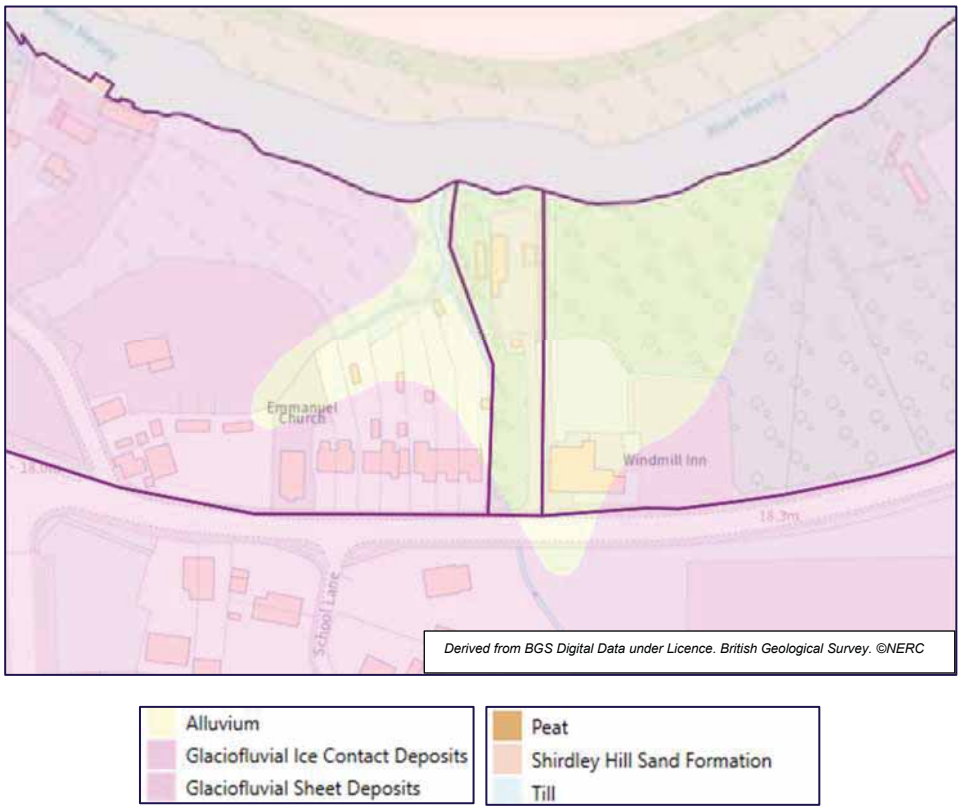

Figure 3.3 Zone 2 Superficial Deposits

DEPOSIT	DESCRIPTION
Alluvium	Clay, silt, sand and gravel, Unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.

Table 3-3 Zone 2 Superficial deposits

Solid Geology

The entire zone is recorded to be underlain by the Wilmslow Sandstone Formation, described by the BGS (3) as '*Red-brown to brick-red, fine to medium grained, generally pebble free, cross bedded sandstones, with sporadic siltstone. The sand grains are well rounded and indicate an aeolian origin*'.

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is presented in Figure 3.4 below.

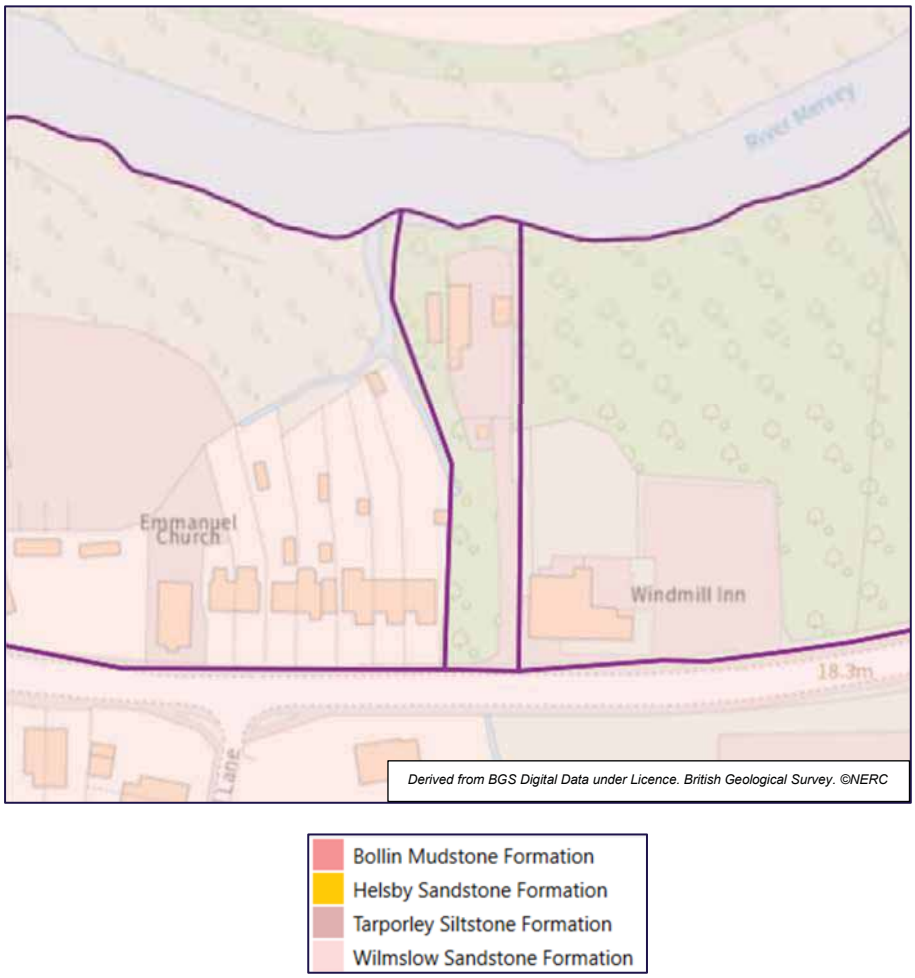

Figure 3.4 Zone 2 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 2 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits within Zone 2

No surface ground workings, underground workings or non-coal mining records were identified within Zone 2. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 2-4 below.

HAZARD	HAZARD RATING
Shrink swell clays	Very Low to Negligible
Running sands	Low to Very Low
Compressible deposits	Moderate to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Moderate To Very Low
Ground dissolution of soluble rocks	Negligible

Table 3-4 Zone 2 Natural hazards

Hydrogeology

The Wilmslow Sandstone Formation is classified by the Environment Agency (EA) as a Principal Aquifer, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Alluvium and Glaciofluvial Sheet Deposits are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*.

Groundwater flow is anticipated to be towards the River Mersey to the north

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 2 or the surrounding area, and Zone 2 is not located in a Source Protection Zone.

Groundwater flow is anticipated to be towards the River Mersey to the north

Surface Water Bodies

The River Mersey is located directly to the north of Zone 2, which flows in a generally southwest direction. The river flows into the MSC which is located approximately 1.5 km west of the zone.

The stretch of the River Mersey/MSC in the vicinity of Zone 2 was rated by the EA as having a 'Moderate' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Fail' chemical quality rating and 'Good' ecological rating) in 2019 (the most recent rating available).

Flooding

The area of Zone 2 immediately adjacent to the River Mersey is indicated to be in Flood Zone 3 and has a High probability of flooding (defined as greater than or equal to 1 in 30 chance) as a result of its close proximity to this water body. The rest of the zone is recorded at a Low risk of flooding from the River Mersey.

With the exception of small, isolated areas, Zone 2 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records no archaeological records to be present within Zone 2.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 2 or the immediate surrounding area.

No Sites of Biological Importance (SBIs) or Sites of Importance for Nature Conservation (both of which are non-statutory environmental designations) were identified within Zone 2 or the immediate surrounding area.

Licenses / Permits / Consents

The Groundsure Report records no premises within Zone 2 to hold (or to have recently held) environmental licenses, permits or consents:

Radon

The Groundsure Report indicates that Zone 2 lies within an area where less than 1% of the properties exceed the Radon Action Level. Therefore, no protection measures are anticipated to be required.

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 2 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

3.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 3.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon the assumption for requirements for earthworks, structures, hard standing and road pavement, assessing feasibility and risks for each item.

General

Zone 2 is the site of a historic abattoir, underlain primarily by Alluvium (according to the Groundsure Report) or Glacial Till (according to GeoIndex), which indicates Till underlies the centre area of the zone. A minor area or Glaciofluvial Sheet Deposits is recorded at the southwestern most corner of the zone.

Of these superficial geologies, Alluvium represents the higher risks.

The majority of Zone 2 has a negligible to very low risk of natural ground subsidence. However, the area of Alluvium is associated with low risk from running sands and moderate risk from compressible deposits.

It should be noted Zone 2 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 2 is proposed for mixed residential and employment use, however the zone has a planning application for just residential properties.

Potential Proposed Development

Earthworks – Cutting

Whilst not recorded as such, much of the zone is covered by hard standing and buildings associated with the historic abattoir. This likely comprises historic fill material which may not meet modern engineering standards, however, should otherwise be amenable to cutting if sufficient GI confirms its suitability.

The Glaciofluvial Sheet Deposits and Till are generally anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within these types of deposit, especially Glaciofluvial Sheet Deposits, ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles.

The Alluvium's low risk of running sands and moderate risk of compressible deposits present a risk of stability for a cutting slope, as such ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The bedrock geology is recorded as sandstones of the Wilmslow Sandstone Formation (WLSF). The WLSF is anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the Wilmslow Sandstone Formation may pose a hard dig risk on site.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material. Site won material will likely be too contaminated to use in embankment construction even if it meets engineering fill criteria.

Superficial and bedrock geologies are anticipated to be generally amenable to embankment construction. Although Alluvium is noted to have a moderate risk as a compressible deposit, thus may result in bearing capacity failure, differential settlement issues. As such sufficient GI will be required to inform adequate design.

Structures

Residential buildings are proposed for Zone 2.

Alluvium presents a moderate risk from compressible deposits and low risk from running sands and the variable nature of Glaciofluvial Sheet Deposits may carry some minor risk of localised instability. In such cases sufficient GI should inform adequate design to account for variability, appropriate ground improvements be implemented or the material may be removed and replaced by appropriate engineering fill material. The same risk should be considered for the Made Ground due to unknown composition.

The Alluvium's low risk of running sands may present potential issues for excavation associated with construction.

Whilst the majority of site is at low risk of river flooding, the banks of the River Mersey are designated as medium risk. The proposed residential area should be adequately designed to reduce flood risk, including the potential implementation of SUDS, however the effectivity of the latter may be limited.

Subgrade

A significant portion of the zone is currently covered by hard standing. Additional/replacement hard standing required for road surfacing or parking is likely.

The geology of the site does not pose a significant risk to the establishment of hard standing, however sufficient GI is required to confirm ground suitability. Any inadequate underlying material should be subject to ground improvement, or removed and replaced with appropriate engineering fill.

Potential high groundwater levels may present a risk to subgrade stability. Any increase to the impermeable hard standing that may be associated with the residential area could increase the surface water flood risk, which is currently designated as low for the majority of the zone and increase the extent of the medium risk of river flooding on the banks of the River Mersey. Development platform level should be high enough to exceed the 1:100yr flood level, and additional risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

Buried services are anticipated to be associated with the historic abattoir.

Historic foundations may require full or partial removal prior to new construction as they could cause obstruction and act as a hard spot leading to differential settlement. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 3-5. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Alluvium identified with uncertain extents from the north end to potentially the majority of site. Moderate compressibility risk and risk of bearing capacity failure.	4	3	12	The Alluvium comprises the northern area and potentially the majority of the zone. Any construction upon this Alluvium are at moderate risk of instability due to compressibility.
2	Localised variability in the Glaciofluvial Sheet Deposits and high likelihood of Made Ground. Glaciofluvial deposits potentially underly alluvium.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
3	Existing foundations: Zone 2 hosts a historic abattoir which is anticipated to be associated with the presence of Made Ground and foundations.	5	2	10	Existing foundations may require breakout for new foundation design. Increased time and design considerations. Uncertainty around foundations depth.
4	Existing and potential increased risk of flooding following development of the zone.	3	3	9	Damage to proposed residential area.
5	Risk of high groundwater levels and flooding during construction.	3	2	6	Leading to overly conservative design and delays to programme.
6	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified and the site is underlain by sandstones of the WLSF which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
7	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 3-5 Zone 2 Geotechnical Risk Register

3.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study a limited number of current or historical land uses at Zone 2 and the surrounding area have been identified that could have likely led to contamination at the zone.

Nevertheless, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone and the understanding that the proposed development is for residential use.

When considering potential sources of groundwater contamination surrounding Zone 2, it has been assumed that the direction of groundwater flow across the scheme is from southeast to northwest i.e. towards the River Mersey and MSC. Therefore, only existing or historical land uses that are located to the southeast or east of Zone 2 have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 2, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 2 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 2

- Made Ground associated with the former development of the zone located in the northern and southern areas. The Made Ground has the potential for elevated concentrations of soil bound and leachable chemical species, and the potential to generate ground gases and or vapours;
- Historical land uses, notably:
    - Former abattoir

Sources and hazards within 250m of Zone 2

- Plume of groundwater contamination within superficial deposits associated with up-gradient existing and historical land uses, notably:
    - Former fire station located to the southeast within Zone 9
    - Former petrochemical plant within Zone 2

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently the River Mersey and MSC;

- Direct contact of soils and groundwater with foundations and buildings' infrastructure; and,
- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for employment land use the following receptors have been identified (during and following development):

Human Health

- Future users (residents); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed residential properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- River Mersey and MSC; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment in Table 3-6 and Table 3-7. The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the probability (likelihood) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define contaminant probability, consequence and risk are described in Appendix F.

In the absence of quantitative data the likelihood and consequence for each contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Made Ground associated with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gases an/or vapours	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 2 (residents)	3	4	12	Following development, the zone will consist of one or more residential properties with gardens and possibly areas of hard and soft landscaping together with access roads. Where buildings and hardsurfacing are present these would be expected to prevent the direct exposure of the Made Ground to future users. However, it is likely that within areas proposed for gardens and soft landscaping a suitable thickness of clean cover will need to be incorporated to provide a growing medium and prevent direct exposure of the Made Ground to future users.
		Construction and maintenance workers	1	3	3	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 2 (residents)	4	1	4	Depending on the composition of the Made Ground the potential exists for ground gases and/or vapours to be present. The presence and nature of such gases and/or vapours would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	1	4	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	2	6	The potential exists for contaminated wind-blown dust and/or asbestos fibres to be generated during earthworks and construction activities. Measures to mitigate the risk will need to be implemented during these activities.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	2	6	Following development, areas of the zone will consist of hardsurfacing and buildings, and a dedicated surface water drainage network will also be constructed. In these locations, it is considered unlikely that there will be rainfall infiltration with the potential to leach contamination from the Made Ground. However, in areas proposed for gardens and soft landscaping the potential exists for rainfall infiltration to lead to the leaching of contamination within the Made Ground.
	Direct contact	Foundations and Infrastructure	2	1	2	The potential exists for the presence of chemical species that are aggressive towards concrete, and/or which may permeate plastic drinking water supply pipes. Therefore, such materials will need to designed according to the prevailing ground conditions.
Historical land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	River Mersey and MSC	3	2	6	The potential exists for the historical and existing land uses to have led to the contamination of groundwater at the zone. Groundwater within the superficial deposits is expected to be in hydraulic continuity with the River Mersey, and therefore any groundwater contamination has the potential to enter this surface water body. The lining of the MSC, where in a good state of repair, would likely inhibit the recharge of this surface water by groundwater. Therefore, a viable pollutant linkage whereby any contaminated groundwater enters the MSC may not be present.

Table 3-6 Zone 2 Preliminary Risk Assessment (sources within Zone 2)

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Existing and historical land uses up groundwater gradient which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	Groundwater within superficial deposits in Zone 2 (and subsequently the River Mersey and MSC)	3	3	9	The historical land uses to the southeast of the zone (i.e. up groundwater gradient) have the potential to have led to groundwater contamination. The expected direction of groundwater flow within the superficial deposits across New Carrington is towards the River Mersey and MSC. Therefore, any contaminated groundwater surrounding the zone has the potential to migrate into the zone and flow towards the River Mersey and MSC. .

Table 3-7 Zone 2 Preliminary Risk Assessment (sources within 250m of Zone 2)

4. Zone 3

4.1. Desk Study Assessment

Zone Location and current Land Use

Zone 3 is located in the central area of the Allocation Plan and is located to the east of Manchester Road and Saica Paper UK. The zone lies between approximately 20 and 21 m AOD. The zone is generally vacant land which has been cleared to ground level, however remnants of the historical land use are present in the southern area of the zone, including above ground pipework and pooled water within historical gasholder locations. The location and current land use of Zone 3 is shown in Figure 4.1 below.

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Figure 4.1 Zone 3 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 3 is proposed for employment use.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the earliest mapping available (1848) and 1952, Zone 3 and the surrounding largely comprised open land, with the Cheshire Lines Railway running along the southern boundary, and with Partington Station located at the southwestern corner.

The 1954 mapping showed a gas works within the southeastern corner of the zone with access routes beneath the railway line to Partington Gas Works located directly south of Zone 3.

The 1980-1985 mapping showed the gas works had expanded and covered the entirety of Zone 3, with the southern half comprising the Gasholder and numerous tanks, and the northern half comprising buildings. The Cheshire Lines Railway was labelled as dismantled.

The 1990-1995 mapping showed a number of the buildings and tanks to no longer be present, however the remaining buildings were labelled as Works, with the Gasholders still in place.

The 1954 and1980 mapping also showed significant development of the wider Carrington area, with a Works (labelled as a petrochemical plant, works and chemical works over time) located directly northeast of Zone 3, and a Depot located directly west of the zone, within Zone 1.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 4.2 (left image). The majority of the zone was shown as a former gas works, with gas holders evident. Between 2000 and the most recent aerial photography (2024, image on the right within Figure 4.2) the gas works' buildings and gas holders were shown to have been demolished.

Figure 4.2 Zone 3 Aerial Photography .

Historical Industrial Sites

The Groundsure Report records a number of potentially contaminative historical industrial sites within Zone 3 and the surrounding area. A summary of these land uses is provided in Table 4-1 and Table 4-2 below.

HISTORICAL LAND USE	DATE DHOWN ON HISTORICAL MAPS	LOCATION WITHIN ZONE
Gas Works	1954 - 2001	Entire zone
Gas Holders	1980 - 2001	Two holders were located close to the southern boundary
Railway and tramway infrastructure (including buildings, sidings etc.)	1894 - 1952	Along the southern boundary

Table 4-1 Zone 3 Historical industrial sites within zone

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HISTORICAL LAND USE WITHIN 250M OF ZONE	DATE DHOWN ON HISTORICAL MAPS	LOCATION
Gas Works	1954 - 2001	Zone 4, to the south
Gas Holders	1954 - 2001	Four gas holders were located in Zone 4, approximately 200m south.
Depot	1980 - 2010	Directly west of zone

Table 4-2 Zone 3 Historical industrial sites within 250m of the zone .

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SW Solid and Drift Geology 1:10,560 paper map (5), the Groundsure report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and summarised below.

Artificial Ground

The majority of the zone is recorded to be underlain by artificial ground, with the very eastern extent of the zone shown to have no artificial ground.

Superficial Deposits

The superficial deposits that are indicated to be present in the zone are Alluvium, Glaciofluvial Sheet Deposits, Glaciofluvial Ice Contact Deposits and Peat.

The Alluvium deposits are located on the western boundary, and are shown to cover a small area. The Glaciofluvial Deposits are located predominantly within the western half of the zone and along the route of the former railway. The Peat deposits are shown to be present within the eastern half of the zone, and the Glaciofluvial Ice Contact Deposits are located in the northwestern corner of the zone, in a kidney shaped deposit. The mapped location of the superficial deposits is shown in Figure 4.3 below.

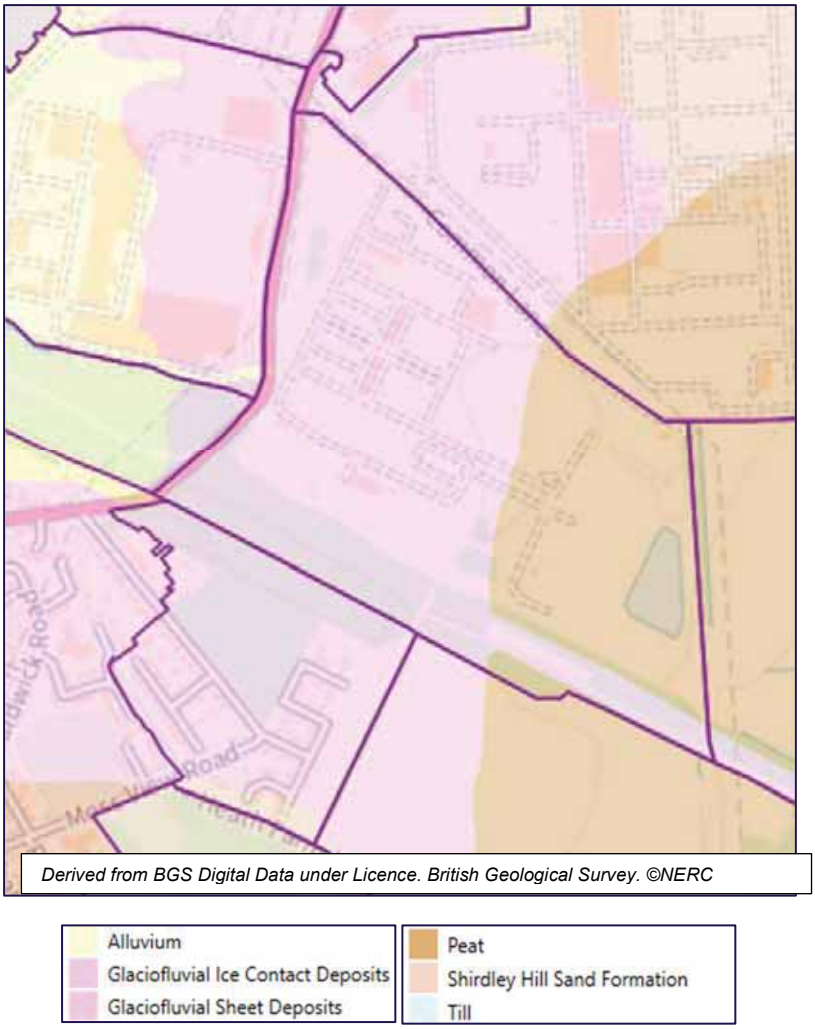

Figure 4.3 Zone 3 Superficial Deposits

The strata descriptions of the superficial deposits are summarised in Table 4-3 below.

DEPOSIT	DESCRIPTION
Alluvium	Alluvium is a general term for clay, silt, sand and gravel. It is the unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream or on its floodplain or delta, or as a cone or fan at the base of a mountain slope
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.
Glaciofluvial Ice Contact Deposits	Stratified sand and gravel and interbedded diamicton deposited by meltwater and ice under, within and at the margins of glaciers. Sand and gravel, locally with lenses of silt, clay and organic material.
Peat	Peat is a partially decomposed mass of semi-carbonised vegetation which has grown under waterlogged, anaerobic conditions.

Table 4-3 Zone 3 Superficial deposits

Solid Geology

The entire zone is indicated to be underlain by the Wilmslow Sandstone Formation, described by the BGS (3) as '*Red-brown to brick-red, fine to medium grained, generally pebble free, cross bedded sandstones, with sporadic siltstone. The sand grains are well rounded and indicate an aeolian origin'.*

The Helsby Sandstone Formation is located directly south of the zone, and therefore may be encountered at depth, and is described as '*Fine to medium grained, locally micaceous, cross-bedded and flat-bedded sandstones, weathering to sand near surface. Sandstones are of fluvial and aeolian facies. Pebbles may be common, particularly near the base of the formation.*'

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is shown in Figure 4.4 below.

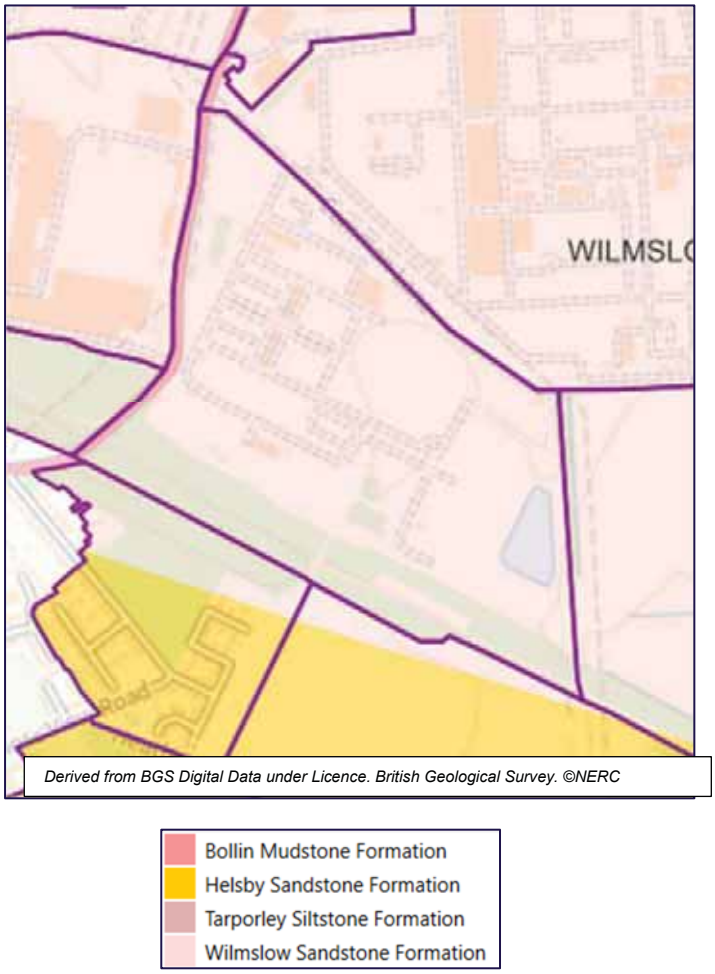

Figure 4.4 Zone 3 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 3 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits within Zone 3.

Two ground workings are noted within Zone 3, in the locations of cuttings associated with the dismantled railway identified within the historical mapping review.

No underground workings or non-coal mining records are identified within Zone 3. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 4-4 below.

HAZARD	HAZARD RATING
Shrink swell clays	Very Low to Negligible
Running sands	Low to Very Low
Compressible deposits	High to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 4-4 Zone 3 Natural hazards

Hydrogeology

The Wilmslow Sandstone Formation is classified by the Environment Agency (EA) as a Principal Aquifer, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Alluvium and Glaciofluvial Sheet Deposits are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*. The Peat deposits are classified by the EA as an Unproductive Aquifer.

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 3 or the surrounding area, and Zone 3 is not located in a Source Protection Zone.

Groundwater flow is anticipated to be towards the MSC to the west.

Surface Water Bodies

The MSC is located approximately 400m west of the zone and was rated by the EA as having a 'Moderate' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Fail' chemical quality rating and 'Good' ecological rating) in 2019 (the most recent rating available).

Flooding

The Groundsure Report indicates no areas within Zone 3 that are subject to flooding from rivers.

With the exception of small isolated areas, Zone 3 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records no archaeological records within Zone 3.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 3 or the immediate surrounding area.

The area of the dismantled railway to the immediate south of Zone 3 is a Site of Importance for Nature Conservation.

A Site of Biological Importance (SBI), named Partington Nature Reserve, is located immediately west of the southern area of Zone 3. This area is also recorded as a Site of Importance for Nature Conservation.

Although not formally designated, Carrington Moss (which is a large area of peat bog) extends across the eastern area of Zone 3, and has local environmental interest.

Licenses / Permits / Consents

The Groundsure Report identifies the following industrial sites at the zone that hold (or held) environmental licenses, permits or consents

- The gas works was a historical NIHHS Site (Notification of Installations Handling Hazardous Substances).
- A Hazardous Substances consent existed for the gas works

Radon

The Groundsure Report indicates that Zone 3 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required.

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 3 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

4.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 4.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon an assumption of requirements for earthworks, structures, hard standing and road pavement, whilst assessing feasibility and risks for each item.

General

Zone 3 is the site of a historic gas works, with the majority of the area being underlain by Made Ground, the exception being the easternmost quarter. Peat underlays the eastern third of the zone and represents a high risk of compressible deposits, as per the Groundsure Report. Historically, this zone comprised an area referred to as 'Carrington Moss', an area of bog land. The present day understood extent of the peat across New Carrington, also known as Carrington Moss, covers a reduced portion of this bog, likely due to historical development across the scheme.

A minor area (roughly 100m^2) of Alluvium is recorded towards the centre of the western boundary of Zone 3, which contributes a minor increase to the risk of shrink and swell clays (very low risk), running sands (low risk), compressible deposits (moderate).

It should be noted Zone 3 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 3 is to be comprised of large employment buildings to the north and hard standing covering most of the rest of the zone to the south.

Potential Proposed Development

Earthworks – Cutting

If cuttings are required within Peat, its poor geotechnical properties must be considered, with it being a high compressibility risk, possessing a low shear strength and high water content. Stabilising a cutting slope in Peat would require ground improvement or localised replacement with engineering fill material or the implementation of a retaining structure, which may require piling.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

Much of the zone is recorded with Made Ground cover. This likely comprises historic fill material which may not meet modern engineering standards, however, should otherwise be amenable to cutting if sufficient GI confirms its suitability.

The Glaciofluvial Sheet and Ice Contact Deposits and Alluvium are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within this type of deposit, ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

The bedrock geology is recorded as sandstones of the Wilmslow Sandstone Formation (WLSF) (with the Helsby Formation overlaying beyond the southern edge of Zone 3). The WLSF is generally anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered Wilmslow Sandstone Formation may pose a hard dig risk on site. However, bedrock may present a hard dig risk dependent upon extent of weathering.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material. Site won material may be too contaminated to use in embankment construction even if it meets engineering fill criteria.

Embankments should not be constructed upon areas of Peat due to high compressibility which would increase the risk of settlement and differential settlement of the embankment. If Embankments are to be constructed in locations with Peat, deep foundations or ground improvement would be required or the Peat would likely need to be removed. However removal is not preferable due to environmental and political pressures.

Other site geologies are anticipated to generally be amenable to embankment construction.

Structures

Employment buildings are proposed for Zone 3.

For structures to be located over any area of Peat, and to avoid removal of Peat, a piled raft foundation will be required to counteract the settlement of the structure and damage to Peat. Construction and piling into the Peat may also damage the Peat environment through vibration driven de-watering and sealing with an impermeable layer, which should be minimised. Piling solutions may also introduce a risk of differential settlement between structures and infrastructure.

Founding upon the other geologies within this zone does not present as significant a risk. In general, the zones geology does not present a significant risk of natural ground subsidence, with risks of shrink swell clays, collapsable deposits, landslides and ground dissolution being negligible to very low. Peat and Alluvium present high and moderate risks as compressible deposits and Alluvium presenting a low risk from running sands.

The small area of Alluvium to the west represents a minor risk due to its size, however, should construction upon the Alluvium be required then sufficient GI is recommended to confirm suitability. If poor conditions are present, material may be subject to ground improvement or removed and replaced by appropriate engineering fill material.

The variable nature of Glaciofluvial Sheet Deposits may carry some risk of localised instability. In such cases the design should adequately account for variability, ground improvement be implemented, or the material may be removed and replaced by appropriate engineering fill material. The same risk should be considered for the Made Ground due to unknown composition.

Subgrade

Approximately 30-40% of the zone is currently covered by hard standing and pavement.

The provisional development plans suggest the majority of the zone will be covered by hard standing, likely for use as vehicle parking. The most significant risk to this is the presence of Peat on the eastern parts of the zone, which present a high compressibility risk. This hard standing presents a risk to the Peat itself, introducing an impermeable layer which may damage the Peat.

Outgassing features may be considered to prevent gaseous build up beneath the hard standing, or a permeable material comprising the hard standing areas should be considered, to ensure Peat is not fully drained.

Potential high groundwater levels may present a risk to subgrade stability. Additionally, extensive impermeable hard standing could increase the surface water flood risk, which is currently designated as low for the majority of the zone. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

The most significant consideration for man-made obstructions for this zone are those associated with the historic gas works, which are likely to include buried services, especially gas pipes, electrical and waste pipes, and potentially buried tanks.

The historic foundations associated with the old gas works may require full or partial removal prior to new construction as they could cause obstruction and act as a hard spot leading to differential settlement. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

The southern end of site currently hosts an abandoned and dismantled railway line, with associated cuttings and embankments. The development Allocation Plan indicates this historic rail line is to host the 'Proposed Trafford Greenway', presumed public footpath. Though marked as dismantled, there may be railway sidings and associated buildings present in this area.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 4-5. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Peat identified on the eastern half of Zone 3. High compressibility risk.	5	4	20	Peat is a highly compressible material, founding upon which could lead to differential settlement and localised structural failures. Gas build up in confined space, such as below solid foundations. Additionally, Peat creates acidic ground conditions, thus may damage concrete foundations.
2	Alluvium identified towards the centre of the western edge of Zone 3. Moderate compressibility risk and risk of bearing capacity failure.	2	3	6	The Alluvium covers a very small area at the western edge of the zone. Any construction upon this Alluvium are at moderate risk of instability due to compressibility.
3	Localised variability in the Glaciofluvial Sheet Deposits and high likelihood of Made Ground.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
4	Existing foundations: Zone 3 is primarily a historic gas works, with the majority of the zone being classified as Made Ground (undivided), Artificial Deposit. Additionally, there will be foundations associated with the 2 No. electrical pylons on the western edge of Zone 3.	5	3	15	Existing foundations may require breakout for new foundation design. Increased time and design considerations. Uncertainty around foundations depth and locations may impact requirements for piled foundations.
5	Undetermined composition and dimensions of existing cuttings and embankments associated with the historic railway line to the south of Zone 3.	4	3	12	Provisional development plans indicate areas of hard standing are to be constructed towards the southern edge of Zone 3, at the approximate boundary with the observed cutting. The cutting may become destabilised by construction over the crest. The 'Trafford Greenway' is planned to run along the route of the historic railway. Embankment may become destabilised with increased surcharge from pedestrians. Presenting a danger to users.
6	Risk of high groundwater levels and flooding during construction.	3	2	6	Leading to overly conservative design and delays to programme.
7	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified, and the site is underlain by sandstones of the WLSF which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
8	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 4-5 Zone 3 Geotechnical Risk Register

4.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study historical land uses at Zone 3 and the surrounding area have been identified that could have likely led to contamination at the zone.

Therefore, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the current and historical land uses at the zone and the understanding that the proposed development is for employment use.

When considering potential sources of groundwater contamination surrounding Zone 3, it has been assumed that the direction of groundwater flow across the scheme is from southeast to northwest i.e. towards the River Mersey and MSC. Therefore, only existing or historical land uses that are located to the southeast or east of Zone 3 have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 3, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 3 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 3

- Made Ground associated with the historical development of the zone. The Made Ground has the potential for elevated concentrations of soil bound and leachable chemical species, and the potential to generate ground gases and or vapours;
- Historical land uses, notably the former gas works; and,
- Deposits of peat are indicated to be present across the eastern area of the zone which could release stored ground gas into excavations during construction activities

Sources and hazards within 250m of Zone 3

- Plume of groundwater contamination within superficial deposits associated with up-gradient existing and historical land uses, most notably the former gas works to the south within Zone 4

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently the River Mersey and MSC;
- Direct contact of soils and groundwater with foundations and buildings' infrastructure; and,

- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for employment land use the following receptors have been identified (during and following development):

Human Health

- Future users (employees); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for employment properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- River Mersey and MSC; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment (PRA) in Table 4-6 and Table 4-7. The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13) (13). As such, risk is considered to be a function of both the likelihood (probability) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define likelihood, severity and risk are described in Appendix F.

In the absence of quantitative data, the likelihood and severity for each potential contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

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SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKLIHOOD	RISK	COMMENTS
Made Ground with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gases and/or vapours	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 3 (employees)	3	2	6	Following development, the majority of the zone will be hardsurfaced and occupied by buildings. The presence of the hardsurfacing and buildings will prevent the direct exposure of Made Ground to future users. Any areas proposed for soft landscaping may require a suitable thickness of clean cover to provide a suitable growing medium and prevent direct exposure with the Made Ground.
		Construction and maintenance workers	1	3	3	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 3 (employees)	4	1	4	Depending on the composition of the Made Ground the potential exists for ground gases and/or vapours to be present. The presence and nature of such gases and/or vapours would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	2	8	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	2	6	The potential exists for contaminated wind-blown dust and/or asbestos fibres to be generated during earthworks and construction activities. Measures to mitigate the risk will need to be implemented during these activities.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	1	3	Following development, the majority of the zone will be hardsurfaced and occupied by buildings. A dedicated surface water drainage network will also be constructed. Therefore, it is considered unlikely that there will be rainfall infiltration with the potential to leach contamination from the Made Ground.
	Direct contact	Foundations and Infrastructure	2	3	6	The potential exists for the presence of chemical species that are aggressive towards concrete, and/or which may permeate plastic drinking water supply pipes. Therefore, such materials will need to designed according to the prevailing ground conditions.
Deposits of peat with the potential to release ground gases	Ingress of ground gas into excavations and confined spaces and subsequent inhalation and/or explosion	Construction and maintenance workers	4	2	8	The potential exists for ground gases released from peat to enter excavations during construction activities. Whilst atmospheric dispersion of such gases would be expected to occur the potential risk to construction workers would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
Historical land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	River Mersey and MSC	3	3	9	The potential exists for the historical land uses to have led to the contamination of groundwater at the zone. Groundwater within the superficial deposits is expected to be in hydraulic continuity with the River Mersey, and therefore any groundwater contamination has the potential to enter this surface water body. The lining of the MSC, where in a good state of repair, would likely inhibit the recharge of this surface water by groundwater. Therefore, a viable pollutant linkage whereby any contaminated groundwater enters the MSC may not be present.

Table 4-6 Zone 3 Preliminary Risk Assessment (sources within Zone 3)

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Existing and historical land uses up groundwater gradient which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	Groundwater within superficial deposits in Zone 3 (and subsequently the River Mersey and MSC)	3	2	6	The historical land uses to the south of the zone (i.e. up groundwater gradient) have the potential to have led to groundwater contamination. The expected direction of groundwater flow within the superficial deposits across New Carrington is towards the River Mersey and MSC. Therefore, any contaminated groundwater surrounding the zone has the potential to migrate into the zone and flow towards the River Mersey and MSC. .

Table 4-7 Zone 3 Preliminary Risk Assessment (sources within 250m of Zone 3)

5. Zone 4

5.1. Desk Study Assessment

Site Location and Current Land Use

Zone 4 is located in the central area of the Allocation Plan and is located to the east of northern Partington. The zone lies between approximately 20 and 26 m AOD. The western area of the zone is currently cleared land which is in the process of undergoing residential development, with the eastern area comprising trees and shrubs. The location and current land use of Zone 4 is shown in Figure 5.1 below.

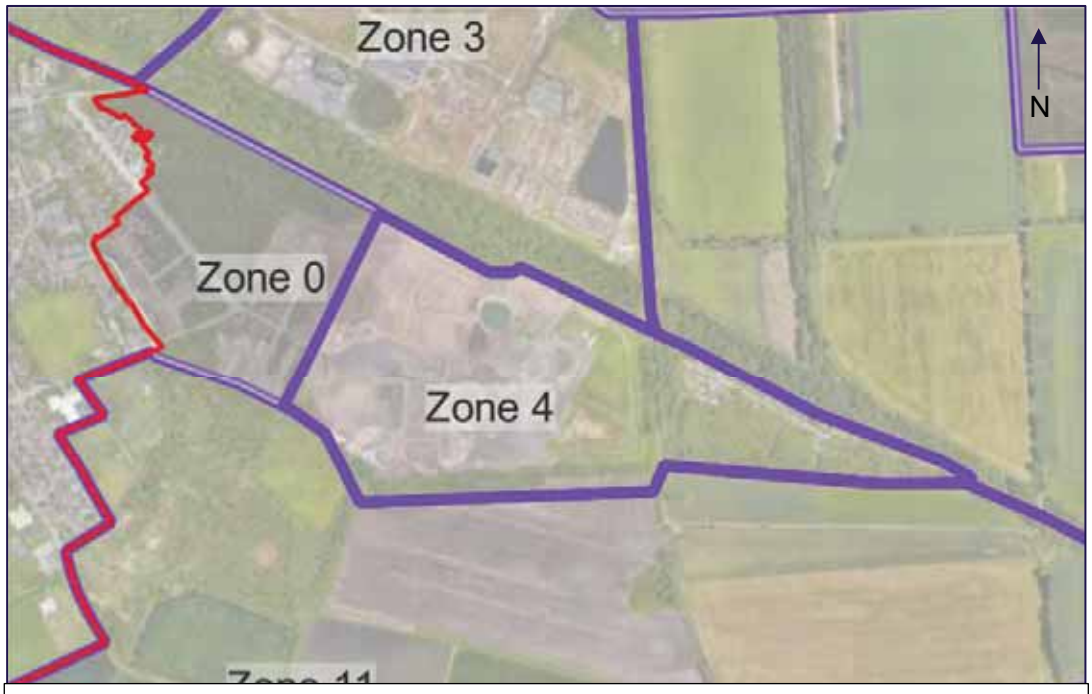

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Figure 5.1 Zone 4 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 4 is proposed for residential land use.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the earliest mapping available (1848) and 1938, Zone 4 and the surrounding area largely comprised agricultural land, labelled as Carrington Moss. The Cheshire Lines Railway ran along the northern boundary, with Partington Station located at the northwestern corner of the zone.

The 1938 mapping showed a number of unnamed buildings to have been built within the centre of the zone. The 1954 mapping showed these buildings to have been replaced by Partington Gas Works, with a gas holder present in the northern area, and railway sidings servicing the gas works. The 1980-1985 mapping showed further gas holders/tanks and a reservoir to be present within the central and eastern areas of the zone.

The 1990-1995 mapping labelled the gas works as a Depot, with the most eastern gas holders/tanks no longer shown. The mapping from 2010 showed the depot to still be present, but the 2024 mapping showed the zone to be vacant.

The 1954 and 1980 mapping also showed significant development of the wider Carrington area, with a Gas Works located directly north of the zone, within Zone 3. To the south of Zone 4, the area has remained largely agricultural, and Partington slowly expands over time to the west of the zone.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 5.2 (first image). The western area of the zone was shown as the former gas works, with the eastern area shown as trees and shrubs. The aerial photography from 2013 showed the gas works to be undergoing demolition, which appeared to have been completed by 2017. The 2024 image presented in Figure 5-2 (second image) shows the redevelopment of the western area of the zone.

Figure 5.2 Zone 4 Aerial Photography

Historical Industrial Sites

The Groundsure Report records a number of potentially contaminative historical industrial sites within Zone 4 and the surrounding area. A summary of these land uses is provided in Table 5-1 and Table 5-2 below.

HISTORICAL LAND USE	DATE SHOWN ON HISTORICAL MAPS	LOCATION WITHIN ZONE
Gas Works	1954 - 2001	Western area
Gasometer	1980 mapping only	Within the central and eastern areas of the zone.
Railway and tramway infrastructure (including buildings, sidings etc.)	1894 - 1952	Along the northern boundary

Table 5-1 Zone 4 Historical industrial sites within zone

HISTORICAL LAND USE WITHIN 250M OF ZONE	DATE SHOWN ON HISTORICAL MAPS	LOCATION
Gas Works	1954 – 2001	Zone 3, to the north
Gas Holders	1954 - 2001	Two gas holders were located in Zone 3, to the north.

Table 5-2 Zone 4 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SW Solid and Drift Geology 1:10,560 paper map (5), the Groundsure Report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and are summarised below.

Artificial Ground

The majority of the zone is recorded to be underlain by artificial ground, with exception of the most eastern area.

Superficial Deposits

Glaciofluvial Sheet Deposits are indicated to be located across the far western area of the zone and along the former railway line on the zone's northern boundary. Peat deposits are indicated to be present across the majority of the zone, covering the central and eastern areas. The mapped location of the superficial deposits is shown in Figure 5.3 below, with the strata descriptions presented in Table 5-3.

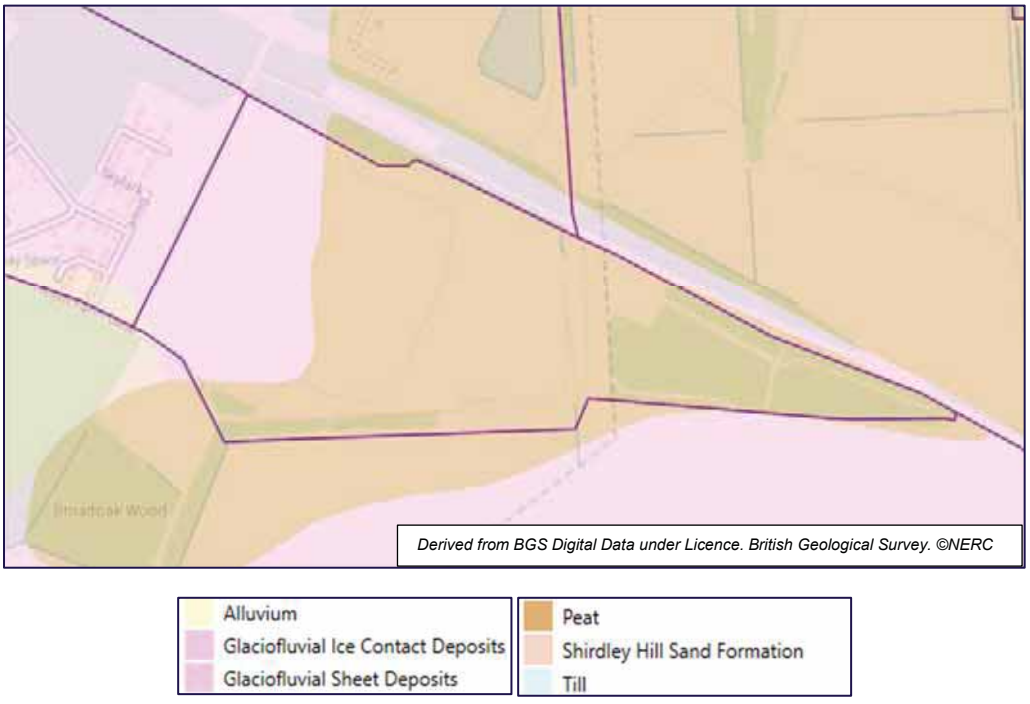

Figure 5.3 Zone 4 Superficial Deposits

STRATA	DESCRIPTION
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.
Peat	Peat is a partially decomposed mass of semi-carbonised vegetation which has grown under waterlogged, anaerobic conditions.

Table 5-3 Zone 4 Superficial Deposits

Solid Geology

The majority of the zone is recorded to be underlain by the Helsby Sandstone Formation, and is described by the BGS (3) as '*Fine to medium grained, locally micaceous, cross-bedded and flat-bedded sandstones, weathering to sand near surface. Sandstones are of fluvial and aeolian facies. Pebbles may be common, particularly near the base of the formation.*'

A small section along the northern boundary is shown to be underlain by the Wilmslow Sandstone Formation, which is described as '*Red-brown to brick-red, fine to medium grained, generally pebble free, cross bedded sandstones, with sporadic siltstone. The sand grains are well rounded and indicate an aeolian origin'.*

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is presented in Figure 5.4 below.

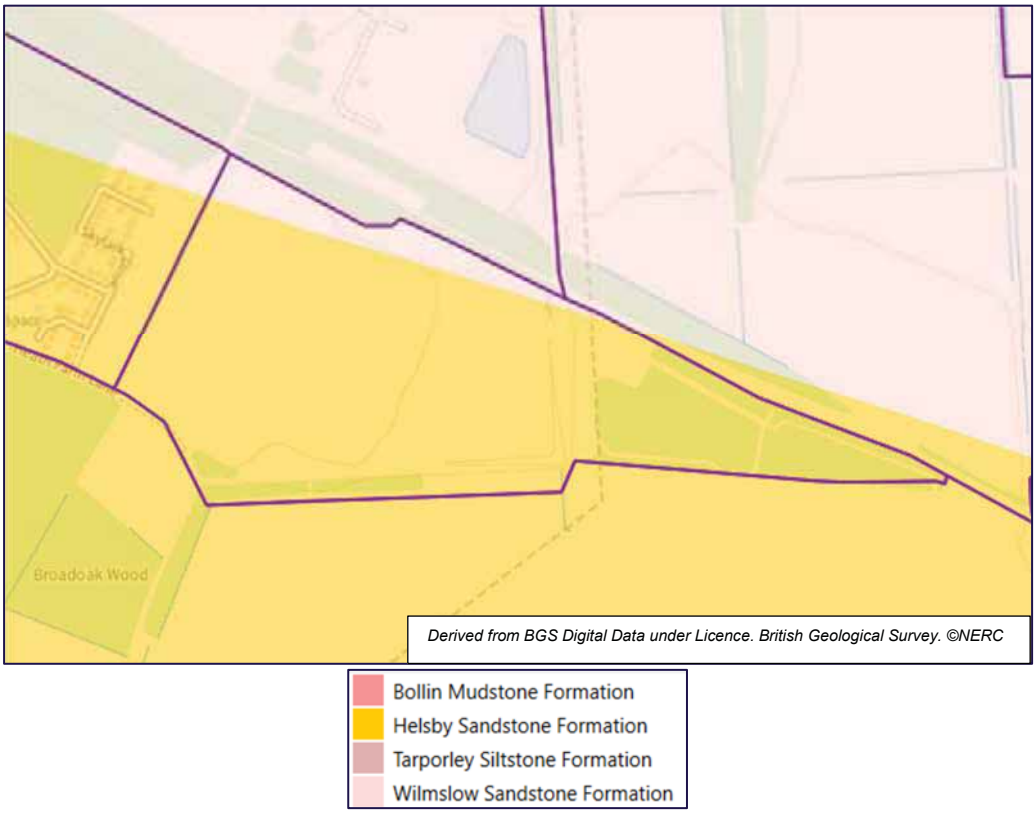

Figure 5.4 Zone 4 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 4 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits within Zone 4.

One ground working is noted within Zone 4, identified as a reservoir located close to the southern boundary within the central area of the zone.

No underground workings or non-coal mining records were identified within Zone 4. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 2-4 below.

HAZARD	HAZARD RATING
Shrink swell clays	Negligible
Running sands	Very Low
Compressible deposits	High to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 5-4 Zone 4 Natural hazards

Hydrogeology

The Wilmslow Sandstone Formation and the Helsby Sandstone Formation are classified by the EA as Principal Aquifers, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Glaciofluvial Sheet Deposits are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*. The Peat deposits are classed as an Unproductive Aquifer.

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 4 or the surrounding area, and Zone 4 is not located in a Source Protection Zone.

Groundwater flow is anticipated to flow towards the Manchester Ship Canal in the west.

Surface Water Bodies

The MSC is located approximately 1.2 km west of the zone, and is rated by the EA as having a 'Moderate' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Fail' chemical quality rating and 'Good' ecological rating) in 2019 (the most recent rating available).

Flooding

The Groundsure Report indicates that no areas within Zone 4 are subject to flooding from rivers.

With the exception of small, isolated areas, Zone 4 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure report records no archaeological records within Zone 4.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 4 or the immediate surrounding area.

The area of the dismantled railway to the immediate north of Zone 4 is a Site of Importance for Nature Conservation.

A Site of Biological Importance (SBI), named Broadoak Wood, is located to the south of Zone 4. This area is also recorded as a Site of Importance for Nature Conservation.

Although not formally designated, Carrington Moss (which is a large area of peat bog) extends across the eastern area of Zone 4, and has local environmental interest.

Licenses / Permits / Consents

The Groundsure report shows the following industrial sites at the zone that hold (or held) environmental licenses, permits or consents:

- The former gas works was a historical NIHHS Site (Notification of Installations Handling Hazardous Substances)
- The former gas works held a license for pollutant release for chemical and acid processes and held licenses for industrial activities (gasification, liquifac. and refining as well as combustion).
- The former gas works also held a Radioactive Substance Authorisation, for the keeping and use of, and disposal of radioactive waste, which was revoked in 2015.

Radon

The Groundsure Report indicates that Zone 4 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required.

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 4 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

5.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 5.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon the assumption for requirements for earthworks, structures, hard standing and road pavement, assessing feasibility and risks for each item.

General

Zone 4 is the site of a historic gas works and later depot with railway sidings to the east. The western side is currently undergoing development into a residential area. The majority of the area except the eastern end is recorded as Made Ground, although hard standing and anticipated Made Ground is associated with the historic railway sidings. Peat is recorded as the superficial geology underlying the vast majority of the zone and represent a high risk of compressible deposits, as per the Groundsure Report. Historically, this zone comprised an area referred to as 'Carrington Moss', an area of bog land. The present day understood extent of the peat across New Carrington, also known as Carrington Moss, covers a reduced portion of this bog, likely due to historical development across the scheme.

Minor areas of Glaciofluvial Sheet Deposits encircle the zone, most significantly to the west and southeast, and represented within the cutting of the historic railway to the north.

It should be noted Zone 4 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 4 is proposed for residential development.

Potential Proposed Development

Earthworks – Cutting

If cuttings are required within Peat, its poor geotechnical properties must be considered, with it being a high compressibility risk, possessing a low shear strength and high water content. Stabilising a cutting slope in Peat would require ground improvement or localised replacement with engineering fill material or the implementation of a retaining structure, which may require piling.

Much of the zone is recorded with Made Ground cover. This likely comprises historic fill material which may not meet modern engineering standards, however, should otherwise be amenable to cutting if sufficient GI confirms its suitability.

The Glaciofluvial Sheet are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within this type of deposit, ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The primary bedrock geology is recorded as sandstones of the Helsby Formation (HEY), overlaying the Wilmslow Sandstone Formation (WLSF), which is present to the northwest of the zone. The HEY and WLSF are anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the Helsby Formation and Wilmslow Sandstone Formation may pose a hard dig risk on site.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material. Site won material may be too contaminated to use in embankment construction even if it meets engineering fill criteria.

Embankments should not be constructed upon areas of Peat due to high compressibility which would risk issues of bearing capacity failure, settlement and differential settlement of the embankment. If Embankments are to be constructed in locations with Peat, deep foundation or ground improvement will be required, or the Peat would likely need to be removed.

Other site geologies are anticipated to generally be amenable to embankment construction.

Structures

Residential buildings are proposed for Zone 4.

For structures to be located over the area of Peat, and to avoid removal of Peat, a piled raft foundation will likely be required to counteract the settlement of the structure and damage to Peat. Construction and piling into the Peat may also damage the Peat environment through vibration driven de-watering and sealing with an impermeable layer which should be minimised. Piling solutions may also introduce a risk of differential settlement between structures and infrastructure.

Aside from the Peat, founding upon the Glaciofluvial Sheet Deposits within this zone does not present as significant a risk. In general, this geology does not present a significant risk of natural ground subsidence, with risks of shrink swell clays, collapsable deposits, running sands, landslides and ground dissolution being negligible to very low.

However, the variable nature of Glaciofluvial Sheet Deposits may carry some risk of localised instability. In such cases the design should adequately account for variability, ground improvement implemented, or the material may be subject to ground improvement or removed and replaced by appropriate engineering fill material. The same risk should be considered for the Made Ground due to unknown composition.

Subgrade

Hard standing, such as road pavement and parking areas are likely to be associated with the planned residential areas. The most significant risk to this is the presence of Peat, which present a high compressibility risk which may result in differential settlement of housing and roads. This hard standing presents a risk to the Peat itself, introducing an impermeable layer which may damage the Peat environment.

Areas of open ground should be considered as part of the housing development design, such that complete cover by hard standing is minimised. Outgassing features may be considered to prevent gaseous build up beneath any large areas of hard standing, or a permeable material comprising the hard standing areas should be considered, to ensure Peat is not fully drained.

Potential high groundwater levels may present a risk to subgrade stability. Additionally, extensive impermeable hard standing could increase the surface water flood risk, which is currently designated as low for the majority of the zone. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

The most significant consideration for man-made obstructions for this zone are those associated with the historic gas works, which are likely to include buried services, especially gas pipes, electrical and waste pipes and potentially buried tanks.

Up-to-date STATS plans will be required to identify the locations of buried services, in addition to on-site surveys for disused services which may not be present on STATS plans.

The historic foundations associated with the old gas works may require full or partial removal prior to new construction. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 5-5. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the

hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Peat identified underlying most of Zone 4. High compressibility risk.	5	4	20	Peat is a highly compressible material, founding upon which could lead to differential settlement and localised structural failures. Gas build up in confined space, such as below solid foundations. Additionally, Peat creates acidic ground conditions, thus may damage concrete foundations.
2	Localised variability in the Glaciofluvial Sheet Deposits and high likelihood of Made Ground.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
3	Existing foundations: Zone 4 is primarily a historic gas works, with the majority of the zone being classified as Made Ground (undivided), Artificial Deposit. Presence of other recorded and unrecorded remnant subterranean structures.	5	3	15	Existing foundations may require breakout for new foundation design. Increased time and design considerations. Uncertainty around foundations depth and locations may impact requirements for piled foundations.
4	Risk of high groundwater levels and flooding during construction.	3	2	6	Leading to overly conservative design and delays to programme.
5	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified, and the site is underlain by sandstones of the HEY and WLSF which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
6	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 5-5 Zone 4 Geotechnical Risk Register

5.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study a number of historical land uses at Zone 4 have been identified that could have likely led to contamination at the zone.

Therefore, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone and the understanding that the proposed development is for residential use.

When considering potential sources of groundwater contamination surrounding Zone 4, it has been assumed that the direction of groundwater flow across the scheme is from southeast to northwest i.e. towards the MSC. Therefore, only existing or historical land uses that are located to the southeast or east of Zone 4 have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 4, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 4 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 4

- Made Ground associated with the historical development of the zone. The Made Ground has the potential for elevated concentrations of soil bound and leachable chemical species, and the potential to generate ground gases and or vapours;
- Historical land uses, notably the former gas works, predominantly in the western area of the zone; and,
- Deposits of peat are indicated to be present across the eastern and central area of the zone which could release stored ground gas into excavations during construction activities

Sources and hazards within 250m of Zone 4

No potential sources of groundwater contamination up gradient of Zone 4 are readily identifiable.

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently the MSC;
- Direct contact of soils and groundwater with foundations and buildings' infrastructure; and,
- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for residential land use the following receptors have been identified (during and following development):

Human Health

- Future users (residents); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed residential properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- MSC; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment (PRA) in Table 2-6.The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the likelihood (probability) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define likelihood, severity and risk are described in Appendix F.

In the absence of quantitative data, the likelihood and severity for each potential contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

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SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Made Ground with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gases and/or vapours	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 4 (residents)	3	4	12	Following development, the zone will be comprised of housing, gardens and areas of hardsurfacing. The presence of the housing and hardsurfacing would be expected to prevent the direct exposure of the Made Ground to future users. However, it is likely that within areas proposed for gardens and soft landscaping a suitable thickness of clean cover will need to be incorporated to provide a growing medium and prevent direct exposure of the Made Ground to future users.
		Construction and maintenance workers	1	4	4	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 4 (residents)	4	2	8	Depending on the composition of the Made Ground the potential exists for ground gases and/or vapours to be present. The presence and nature of such gases and/or vapours would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	2	8	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	2	6	The potential exists for contaminated wind-blown dust and/or asbestos fibres to be generated during earthworks and construction activities. Measures to mitigate the risk will need to be implemented during these activities.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	3	9	Following development, areas of the zone will consist of hardsurfacing and buildings, and a dedicated surface water drainage network will also be constructed. In these locations, it is considered unlikely that there will be rainfall infiltration with the potential to leach contamination from the Made Ground. However, in areas proposed for gardens and soft landscaping the potential exists for rainfall infiltration to lead to the leaching of contamination within the Made Ground.
	Direct contact	Foundations and Infrastructure	2	3	6	The potential exists for the presence of chemical species that are aggressive towards concrete, and/or which may permeate plastic drinking water supply pipes. Therefore, such materials will need to designed according to the prevailing ground conditions.
Deposits of peat with the potential to release ground gases	Ingress of ground gas into excavations and confined spaces and subsequent inhalation and/or explosion	Construction and maintenance workers	4	2	8	The potential exists for ground gases released from peat to enter excavations during construction. Whilst atmospheric dispersion of such gases would be expected to occur the potential risk to construction workers would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
Historical land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	River Mersey and MSC	3	3	9	The potential exists for the historical and existing land uses to have led to the contamination of groundwater at the zone. Groundwater within the superficial deposits is expected to be in hydraulic continuity with the River Mersey, and therefore any groundwater contamination has the potential to enter this surface water body. The lining of the MSC, where in a good state of repair, would likely inhibit the recharge of this surface water by groundwater. Therefore, a viable pollutant linkage whereby any contaminated groundwater enters the MSC may not be present.

Table 5-6 Zone 4 Preliminary Risk Assessment (sources within Zone 4)

6. Zone 5

6.1. Desk Study Assessment

Site Location and Current Land Use

Zone 5 is located in the southwestern corner of the Allocation Plan and is located to the south of Partington. The zone comprises agricultural land and is bisected by Warburton Lane which runs in a north to south direction. The zone lies between approximately 16 and 20 m AOD, and the Red Brook generally forms the zone's northern boundary. The location and current land use of Zone 5 is shown in Figure 6.1 below.

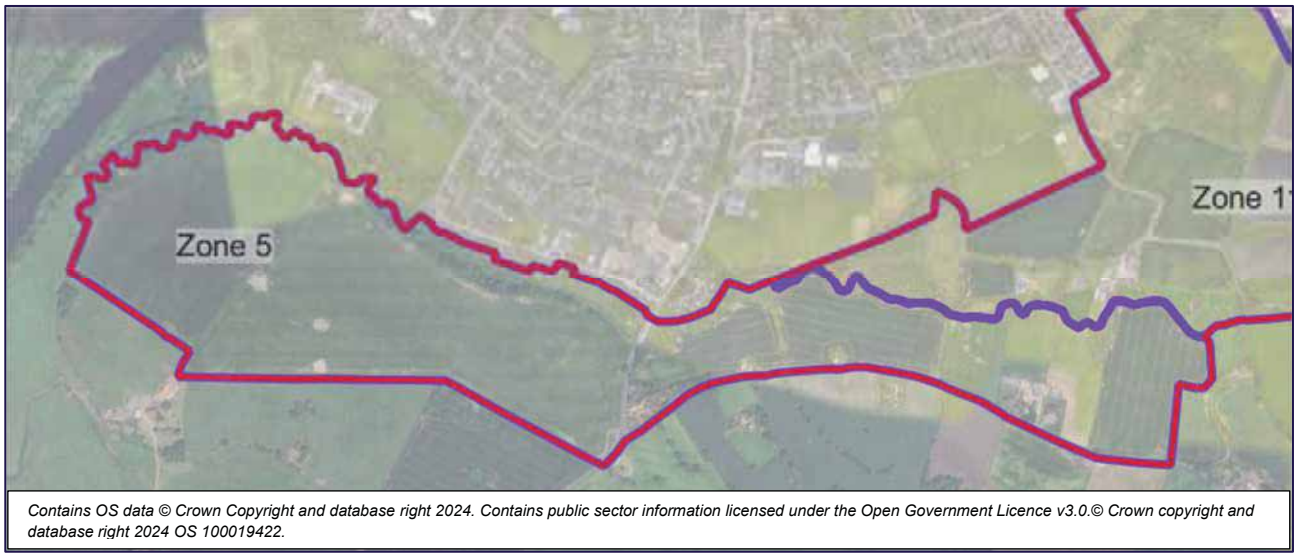

Figure 6.1 Zone 5 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 5 is proposed for residential land use, with a possible High Speed 2 corridor in the western corner.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the earliest mapping available (1891) and 2024, the zone is shown to comprise agricultural land which is bisected by Warburton Lane. The MSC is shown to be approximately 20 m west of the zone throughout the time period mapped, with the surrounding land use comprising agricultural land, and Partington to the north.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 6.2 (top image). The majority of the zone is shown as agricultural land, bisected by the Warburton Lane. No significant changes were noted in the 2024 image.

Figure 6.2 Zone 5 Aerial Photography

Historical Industrial Sites

The Groundsure Report records no potentially contaminative historical industrial sites within Zone 5 or the surrounding area.

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SW Solid and Drift Geology 1:10,560 paper map (5), the Groundsure Report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and are summarised below.

Artificial Ground

No artificial ground is recorded to be present within the zone.

Superficial Deposits

The superficial deposits indicated to be present at the zone comprise Alluvium, Till, Glaciofluvial Sheet Deposits and the Shirdley Hill Sand Formation.

The Shirdley Hill Sand Formation is indicated to be present across most of the zone, with the Alluvium present in the areas adjacent to the Red Brook. The Glaciofluvial Sheet Deposits are shown to be present within the eastern and western areas of the zone. A small area of Till is shown to be present adjacent to the zone's southern boundary. The mapped location of the superficial deposits is shown in Figure 6.3 below, with the strata descriptions presented in Table 6-1.

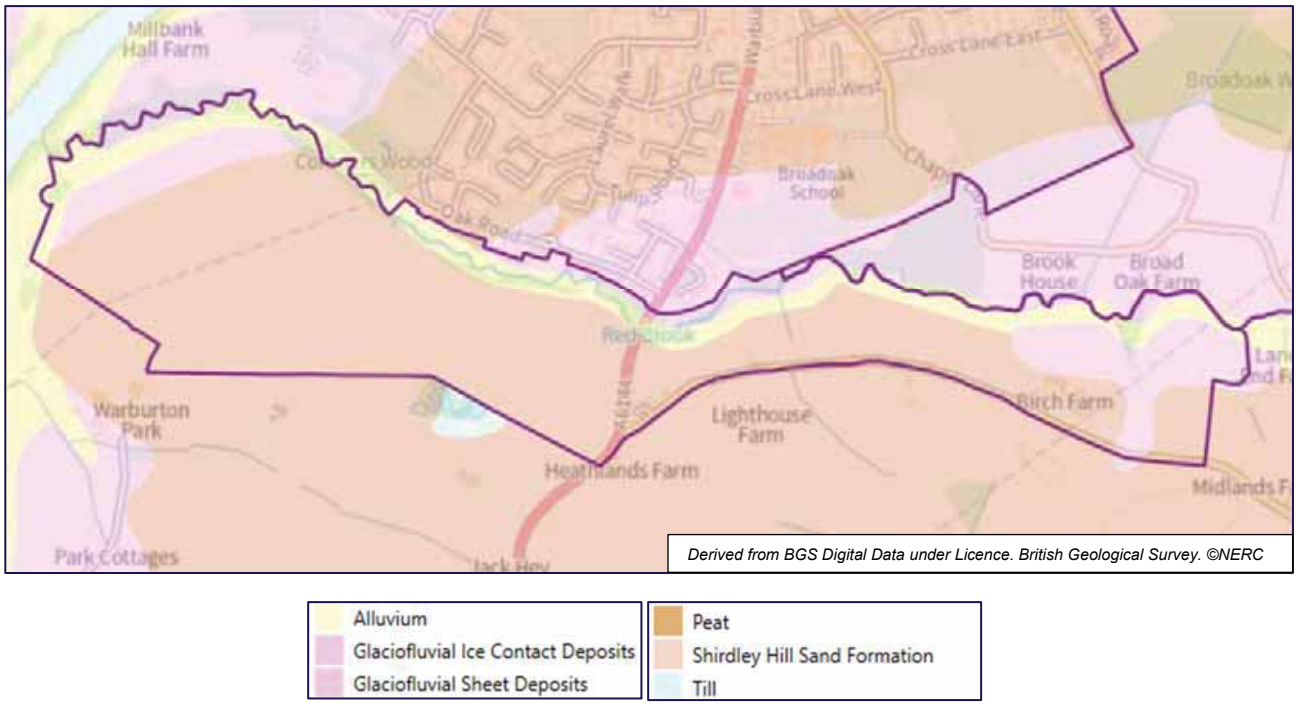

Figure 6.3 Zone 5 Superficial Deposits

DEPOSIT	DESCRIPTION
Alluvium	Clay, silt, sand and gravel, Unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.
Till, Devensian	Unsorted and unstratified drift, generally overconsolidated, deposited directly by and underneath a glacier.
Shirdley Hill Sand Formation	Moderately to well-sorted, fine-grained sand with peat layers in the lower part. Sand grains are dominated by rounded to sub-rounded quartz grains. The formation is divisible into an upper 'white' sand and a lower 'brown' sand that is olive grey and brown.

Table 6-1 Zone 5 Superficial Deposits

Solid Geology

The zone is recorded to be underlain by the Tarporley Siltstone Formation and the Bollin Mudstone Member.' The Tarporley Siltstone Formation is described by the BGS (3) as '*Heterolithic, comprising interlaminated and interbedded siltstones, mudstones and sandstones. Most mudstones and siltstone beds are reddish-brown, though green-grey mottles and laminae are common*' and the Bollin Mudstone Member is described as *'Laminated reddish-brown and greenish0grey mudstone with siltstones. The lower part is structureless and laminated, dominantly reddish-brown mudstone*'.

The BGS Onshore GeoIndex Tool (1:50,000 scale map) indicates two faults to be present within the central area of the zone running in a south to north-northeast direction and in a southeast to northwest direction. The solid geology is shown in Figure 6.4.

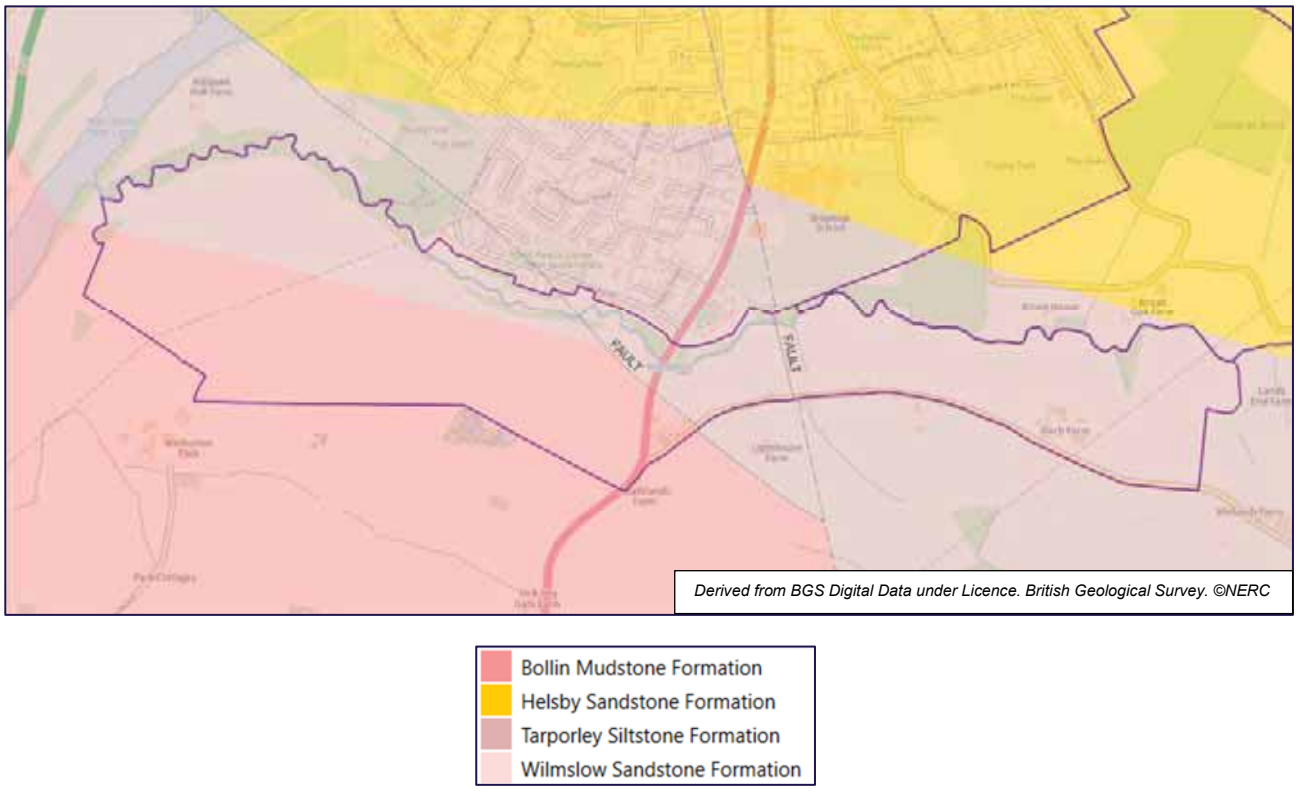

Figure 6.4 Zone 5 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 5 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits within Zone 5.

One ground working entry is noted within Zone 5, an unspecified heap/pit in the location of a historical landfill, directly east of Warburton Lane, on the northern boundary of the zone.

No underground workings or non-coal mining records were identified within Zone 5. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 6-2 below.

HAZARD	HAZARD RATING
Shrink swell clays	Very Low to Negligible
Running sands	Low to Very Low
Compressible deposits	Moderate to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 6-2 Zone 5 Natural hazards

Hydrogeology

The Tarporley Siltstone Member and Bollin Mudstone Member are classified by the EA as Secondary B Aquifers, defined as '*predominantly lower permeability layers which may store/yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering'*.

The Glaciofluvial Sheet Deposits, Till, Alluvium and Shirdley Hill Sand Formation are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*.

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 5 or the surrounding area, and Zone 5 is not located in a Source Protection Zone.

Groundwater flow is anticipated to be towards the Red Brook located at the zone's to the northern boundary, and to the west towards the MSC.

Surface Water Bodies

The Manchester Ship Canal, located directly west of the zone has been rated by the EA as having a 'Moderate' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Fail' chemical quality rating and 'Good' ecological rating) in 2019 (the most recent rating available).

The Red Brook, a tributary of the River Mersey, forms the zone's northern boundary, and has an overall rating of 'Poor' (a combination of 'Fail' rating for chemical quality and 'Poor' ecological rating), assessed in 2019

Flooding

The area of Zone 5 immediately adjacent to the Red Brook is indicated to be in Flood Zone 3 and has a High probability of flooding (defined by the EA as greater than or equal to 1 in 30 chance) as a result of its close proximity to this water body. The rest of the zone is at a low risk of flooding from the Red Brook.

With the exception of small, isolated areas, Zone 5 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records a Grade II listed building within Zone 5, which is located within Birch Farm in the eastern area of the zone.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 5 or the immediate surrounding area.

A Site of Biological Importance (SBI), named Coroners Wood, is located immediately north of the western area of Zone 5. This area is also recorded as a Site of Importance for Nature Conservation.

Red Brook SBI is located immediately north of the eastern area of Zone 5.

A small area located to the immediate south of the central area of the zone is designated as a Site of Importance for Nature Conservation.

Licenses / Permits / Consents

The Groundsure Report shows the following industrial sites at the zone that hold (or held) environmental licenses, permits or consents

- One historical landfill, Brook Farm, located directly to the east of Warburton Lane. No waste types for the landfill are reported. The licence issued date is 1991. It should be noted that Brook Farm landfill is not shown on historical mapping and its exact location and extent is unknown.

Radon

The Groundsure Report indicates that Zone 5 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required.

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 5 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

6.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 6.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon the assumption for requirements for earthworks, structures, hard standing and road pavement, assessing feasibility and risks for each item.

General

Zone 5 consists entirely of arable farmland with scattered residential and farm properties, underlain primarily by the Shirdley Hill Sand Formation. Alluvium is associated with Red Brook, which effectively aligns with the northern boundary of the zone. Relatively small areas or Glaciofluvial Sheet Deposits are located towards the northwestern edge and far east of the zone.

The majority of Zone 5 is at negligible to very low risk of natural ground subsidence. The Shirdley Hill Sand Formation and Alluvium being associated with low risk from running sands and Alluvium being a moderate risk from compressible deposits.

Two faults are located within the central area of the zone, oriented NNW-SSE, and another bisected fault, oriented NW-SE.

It should be noted Zone 5 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 5 is proposed for residential use.

Potential Proposed Development

Earthworks – Cutting

The Glaciofluvial Sheet Deposits are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within these types of deposit, especially Glaciofluvial Sheet Deposits, ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

The low risk of running sands associated with the Shirdley Hill Sand Formation and Alluvium and additional moderate risk of compressible deposits associated with the Alluvium, present a risk of stability for a cutting slope. As such ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The bedrock geology is recorded as interbedded siltstones, mudstones and sandstones of the Tarporley Siltstone Formation (TPSF) to the northeast and the overlying mudstones of the Sidmouth Mudstone Formation (SIM) to the southwest. These are anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the TPSF and SIM may pose a hard dig risk on site.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material. Site won material may be used if it meets engineering fill criteria.

Superficial and bedrock geologies are anticipated to be generally amenable to embankment construction. Although Alluvium is noted to have a moderate risk as a compressible deposit, thus may result in differential settlement issues. As such appropriate GI will be required to inform adequate design.

Structures

Residential buildings are proposed for Zone 5.

On the whole, foundating residential buildings upon geologies within this zone does not present a significant risk. In general, the zones geology does not present a significant risk of natural ground subsidence. The low risk of running sands may present potential issues for excavation associated with construction. Other consideration for risks associated with Alluvium discussed previously in the Embankment section.

The variable nature of Glaciofluvial Sheet Deposits and Alluvium may carry some minor risk of localised instability. Adequate design should account for these variations, alternatively/additionally the material may be subject to ground improvement or removed and replaced by appropriate engineering fill material.

The low risk of running sands from the Shirdley Hill Sand Formation and Alluvium present a stability risk for excavations during construction.

The presence of the aforementioned faults presents a risk to structural stability. Though unlikely, any movement on the fault may result in structural damage due to deflection.

Whilst the majority of site is at low risk of river flooding, the areas in the immediate vicinity of Red Brook should be adequately designed to reduce flood risk, including the potential implementation of SUDS, however the effectivity of the latter may be limited.

Subgrade

The geology of the site does not pose a significant risk to the establishment of hard standing, however sufficient GI is required to confirm ground suitability. Any inadequate underlying material should be subject to ground improvement or removed and replaced with appropriate engineering fill.

Potential high groundwater levels may present a risk to subgrade stability. Additionally, extensive impermeable hard standing associated with the residential areas could increase the surface water flood risk, which is currently designated as low for the majority of the zone, and increase the extent of the high risk of river flooding in the vicinity of Red Brook. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

Buried services likely exist within the zone, associated the existing farm and residential buildings. Any historic foundations may require full or partial removal prior to new construction. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 6-3. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Alluvium identified in association with Red Brook along the northern to northwestern edges of the zone. Moderate compressibility risk and risk of bearing capacity failure.	4	3	12	The Alluvium comprises the northern to northwestern edge of the zone. Any construction upon this Alluvium are at moderate risk of instability due to compressibility.
2	Localised variability in the Glaciofluvial Sheet Deposits and high likelihood of Made Ground. Glaciofluvial deposits potentially underly alluvium.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
3	Potential existing foundations.	2	2	4	Existing foundations may require breakout for new foundation design. Increased time and design considerations. Uncertainty around foundations depth.
4	Presence of fault lines within the zone.	5	2	10	Any construction directly upon fault lines may risk damage due to deflection.
5	Existing and potential increased risk of flooding following development of the zone.	3	3	9	Damage to proposed residential areas.
6	Risk of high groundwater levels and flooding during construction.	3	2	6	Leading to overly conservative design and delays to programme.
7	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified, though halite may be associated with the SIM.	3	3	9	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.

Table 6-3 Zone 5 Geotechnical Risk Register

6.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study a limited number of current and historical land uses at Zone 5 and the surrounding area have been identified that could have likely led to contamination at the zone.

Nevertheless, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone and the understanding that the proposed development is for residential use.

When considering potential sources of groundwater contamination surrounding Zone 5, it has been assumed that the direction of groundwater flow across the zone (and the wider scheme) is from southeast to northwest i.e. towards the Red Brook and MSC. Therefore, only existing or historical land uses that are located to the southeast or east of Zone 5 have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 5, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 5 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 5

With the exception of Brook Farm landfill, no credible sources of contamination within Zone 5 have been identified. The exact location, extent and waste types accepted at the landfill are unknown, and the potential exists for it to be located outside the zone's boundary.

Sources and hazards within 250m of Zone 5

No potential sources of groundwater contamination up gradient of Zone 5 are readily identifiable.

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently the Red Brook and MSC; and
- Direct contact of soils and groundwater with foundations and buildings' infrastructure.
- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for residential land use the following receptors have been identified (during and following development):

Human Health

- Future users (residents predominantly); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed residential properties

Wider Environment

- Groundwater within superficial deposits and solid geology;
- MSC and the Red Brook; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment (PRA) in Table 6-4.The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the likelihood (probability) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define likelihood, severity and risk are described in Appendix F.

In the absence of quantitative data, the likelihood and severity for each potential contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Made Ground associated with wastes deposited at Brook Farm landfill, with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gases and/or vapours	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 5 (residents)	3	1	3	Depending on the nature of the wastes deposited at Brook Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
		Construction and maintenance workers	1	1	1	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 5 (residents)	4	1	4	Depending on the nature of the wastes deposited at Brook Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	1	4	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	1	3	Depending on the nature of the wastes deposited at Brook Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and solid geology	3	1	3	Depending on the nature of the wastes deposited at Brook Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Direct contact	Foundations and Infrastructure	2	1	2	Depending on the nature of the wastes deposited at Brook Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
Historical land uses which have led to plume of groundwater contamination within superficial deposits and solid geology	Lateral migration	Red Brook, River Mersey and MSC	3	1	3	Depending on the nature of the wastes deposited at Brook Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.

Table 6-4 Zone 5 Preliminary Risk Assessment (sources within Zone 5)

7. Zone 6

7.1. Desk Study Assessment

Site Location and Current Land Use

Zone 6 is located in the central area of the Allocation Plan and is located to the south of the existing A1 road, the proposed route of the Carrington Relief Road. The zone lies between approximately 21 m and 25 m AOD. The zone is currently an area of former industrial land use with a significant proportion of the land having been cleared to ground level. Large areas of the zone are vacant with the northern and eastern areas used by haulage companies for vehicle storage. The location and current land use of Zone 6 is shown in Figure 7.1 below.

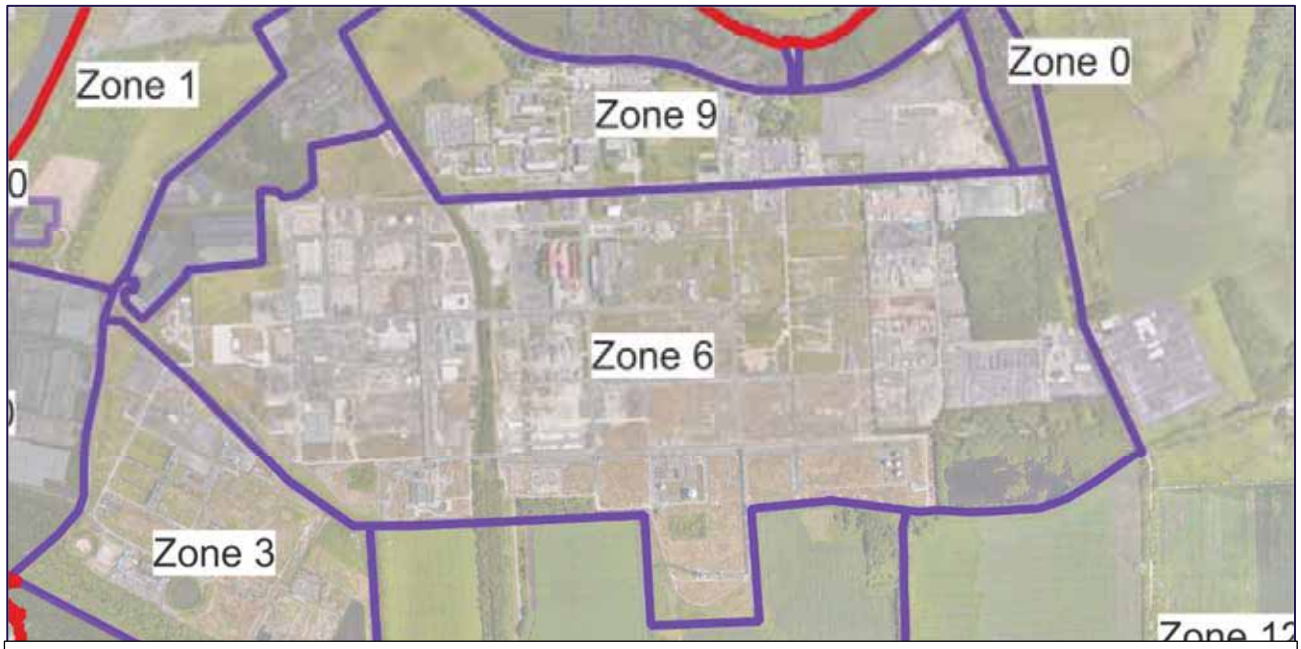

Figure 7.1 Zone 6 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 6 is proposed for employment use.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the earliest mapping available (1891) and 1954, Zone 6 and the surrounding area largely comprised agricultural land.

The 1954 mapping shows the central area of the zone to consist of a Petrochemical plant. From 1965 the petrochemical plant was labelled as a works, and expanded significantly within the zone with numerous buildings and tanks.

By 1980-1985 the works was labelled as a Chemical Works, and had expanded, covering the majority of the zone. A miniature rifle range was also located adjacent to the eastern boundary.

The 1990-1995 mapping showed areas of the Chemical Works to have undergone demolition, with several buildings and tanks no longer shown. The mapping from 2001 onwards showed no significant changes from the 1990-1995 mapping.

The mapping showed the areas to the south and east of the zone to have undergone limited development over time, with the exception of a National Grid substation which was shown to the east of the zone on the 1980 mapping.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 7.2 (first image). A large proportion of the zone comprised cleared former industrial land use. Units consisting of vehicle and haulage storage were noted in the eastern area of the zone.

Between 2000 and the most recent aerial photograph (2024, second image within Figure 7.2) further demolition of buildings had been undertaken, with large of the zone used for storage.

Figure 7.2 Zone 6 Aerial Photography

Historical Industrial Sites

The Groundsure Report records a limited number of potentially contaminative historical industrial sites within Zone 6 and the surrounding area. A summary of these land uses is provided in Table 7-1 and Table 7-2 below.

HISTORICAL LAND USE	DATE SHOWN ON HISTORICAL MAPS	LOCATION WITHIN ZONE
Petrochemical works/chemical works	1954 to 1990	Central area
Road planing / aggregate recycling	2020 to present day	Northeastern area
Haulage companies and vehicle repairs	2020 to present day	Western and eastern areas
Miniature rifle range	1980 to present day	Eastern boundary

Table 7-1 Zone 6 Historical industrial sites within zone

HISTORICAL LAND USE WITHIN 250m OF ZONE	DATE DHOWN ON HISTORICAL MAPS	LOCATION
Haulage company	1980 to present day	Zone 9, to the north
Historical Gas Works	1954 to 2001	Approx. 200m southwest, within Zone 3
Fire Station	1980 to 2010	100m north of the northeastern boundary in Zone 9
Carrington Business Park	1980 to 2024	Zone 9, to the north

Table 7-2 Zone 6 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SW Solid and Drift Geology 1:10,560 paper map (5), the Groundsure Report (3) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and are summarised below.

Artificial Ground

The majority of the western half of the zone is recorded to be underlain by artificial ground.

Superficial Deposits

The superficial deposits at the zone are indicated to comprise the Shirdley Hill Sand Formation, Peat and Glaciofluvial Sheet Deposits. The central area of the zone is predominantly underlain by the Shirdley Hill Sand Formation, with the Glaciofluvial Sheet Deposits present in the eastern, northern and western areas. The Peat deposits are shown to be located in the southwestern area of the zone. The mapped location of the superficial deposits is shown in Table 7-3 below, with the strata descriptions presented in Figure 7.3 below.

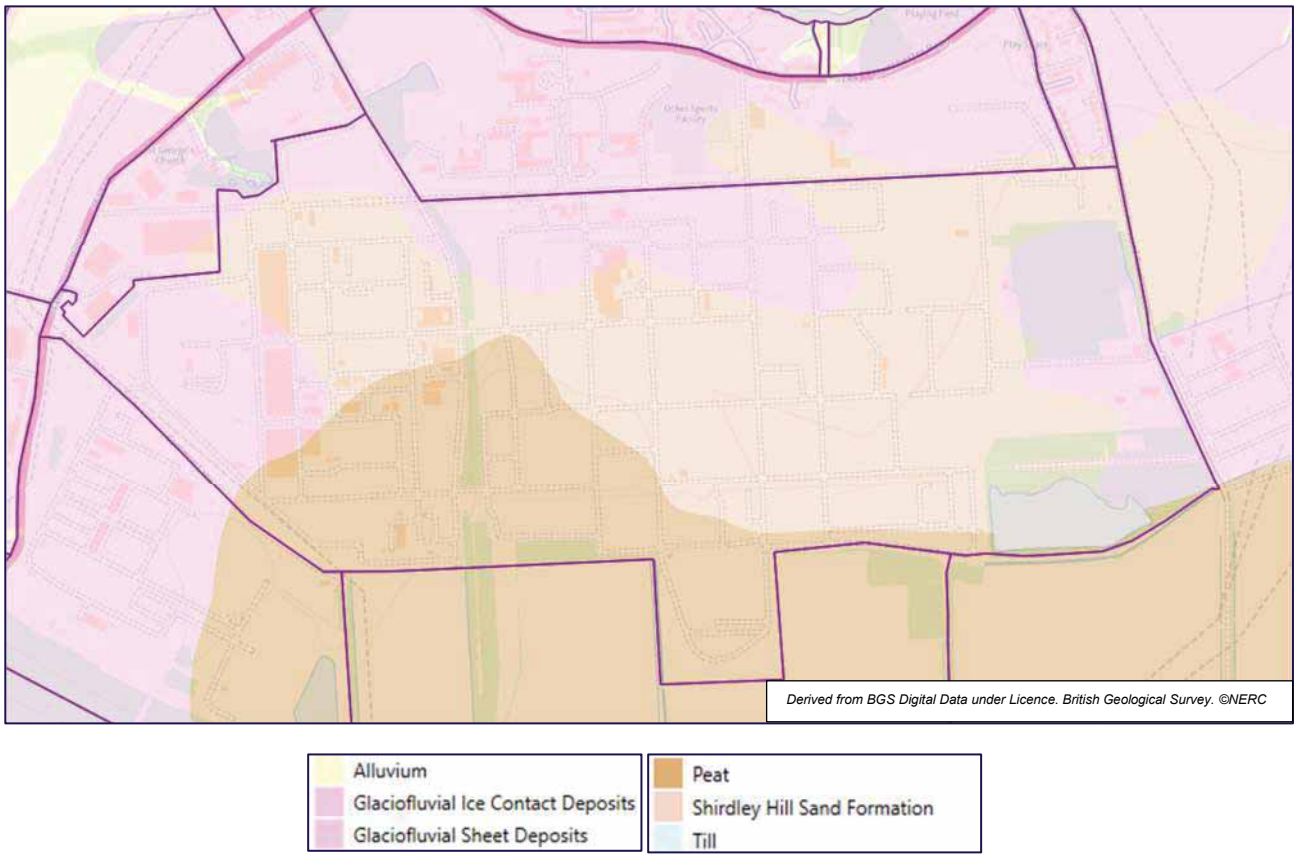

Figure 7.3 Zone 6 Superficial Deposits

DEPOSIT	DESCRIPTION
Alluvium	Clay, silt, sand and gravel, Unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.
Shirdley Hill Sand Formation	Moderately to well-sorted, fine-grained sand with peat layers in the lower part. Sand grains are dominated by rounded to sub-rounded quartz grains. The formation is divisible into an upper ‘white’ sand and a lower ‘brown’ sand that is olive grey and brown.
Peat	Peat is a partially decomposed mass of semi-carbonised vegetation which has grown under waterlogged, anaerobic conditions.

Table 7-3 Zone 6 Superficial Deposits

Solid Geology

The entire zone is indicated to be underlain by the Wilmslow Sandstone Formation, described by the BGS (3) as ‘Red-brown to brick-red, fine to medium grained, generally pebble free, cross bedded sandstones, with sporadic siltstone. The sand grains are well rounded and indicate an aeolian origin’.

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is shown in Figure 7.4 below.

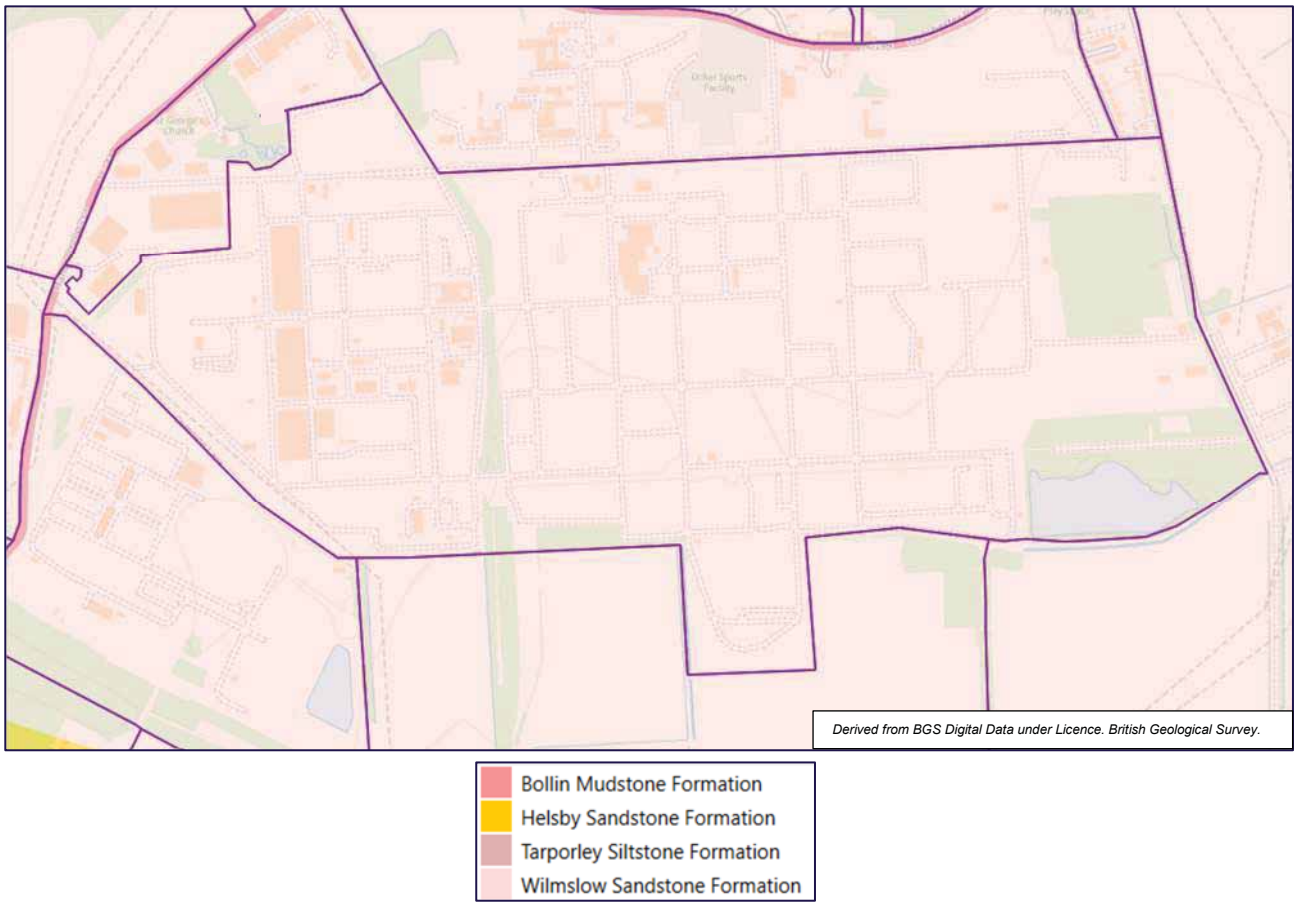

Figure 7.4 Zone 6 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 6 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits within Zone 6.

A number of surface ground working entries are noted within Zone 6, including a pond in the southeastern area of the zone and a number of pits within the south-central area of the zone.

No underground workings or non-coal mining records were identified within Zone 6. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 7-4 below.

HAZARD	HAZARD RATING
Shrink swell clays	Negligible
Running sands	Low to Very Low
Compressible deposits	High to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 7-4 Zone 6 Natural hazards

Hydrogeology

The Wilmslow Sandstone Formation is classified by the EA as a Principal Aquifer, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Shirdley Hill Sand Formation and Glaciofluvial Sheet Deposits are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*. The Peat is classified as an Unproductive Aquifer.

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 6 or the surrounding area, and Zone 6 is not located in a Source Protection Zone.

Groundwater flow is anticipated to flow towards the River Mersey and MSC to the north and west, respectively.

Surface Water Bodies

The River Mersey is located approximately 300m (at its closest point) to the north of Zone 6, which flows in a generally southwest direction, and is classified by the EA as having a 'Moderate' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Fail' chemical quality rating and 'Good' ecological rating) in 2019 (the most recent rating available).

Flooding

The Groundsure Report indicates that no areas within Zone 4 are subject to flooding from rivers.

With the exception of small, isolated areas, Zone 6 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records no archaeological records to be present within Zone 6.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 6 or the immediate surrounding area.

A Site of Biological Importance (SBI), named Wetland at Carrington Moss, is located within the eastern area of the zone. The SBI comprises two areas which are separated by a car park. These areas are also recorded as a Site of Importance for Nature Conservation.

Although not formally designated, Carrington Moss (which is a large area of peat bog) extends across the southern area of Zone 6, and has local environmental interest.

Licenses / Permits / Consents

The Groundsure Report shows the following industrial sites at the zone that hold (or held) environmental licenses, permits or consents

- Basell Polyolefins UK Limited, located within the south and western areas of the zone, is listed as a current COMAH Upper Tier Operator, and has hazardous consent for the presence of methanol, styrene, propylene and propane gas.
- Shell Chemicals UK and Nova Chemicals Europe Ltd also historically held hazardous substances consents for ethylene gas and a 'consent following a change in control of part of the land' respectively within the same area as Basell Polyolefins.
- Numerous historical licensed industrial uses within the west and south of the zone listed for Basell Polyolefins UK Ltd. Bassell Polyolefins is also listed as having List 1 Dangerous Substances (mercury and trichloroethylene)
- Nova Chemicals Europe Ltd held a historical permit for pollutant release, for chemical and acid processes, within close proximity to the northern boundary within the central area of the zone
- J Fisher and Sons Ltd and Wrays Plant Hire Ltd, an aggregate and road planings company and plant hire respectively, have licenses for treatment of waste to produce a soil. Both of which are located close to Isherwood Road, in the eastern area of the zone. Waste exemptions for 'burning of waste as a fuel in a small appliance' and storage of waste in secure containers are also identified for J Fisher and Sons.
- An historical landfill, named East of E1 Road, located in the northeastern corner of the zone and operated by Shell Chemicals UK Limited. The landfill was recorded to accept industrial and liquid sludge waste. The license was issued in 1980; no date was provided for its surrender.

Radon

The Groundsure Report indicates that Zone 6 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 6 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

7.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 7.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon an assumption of requirements for earthworks, structures, hard standing and road pavement, whilst assessing feasibility and risks for each item.

General

Zone 6 is the site of historic petrochemical and chemical works, with the majority of the western and central area of the zone being underlain by Made Ground. Peat underlays a significant portion of the southwestern quarter of the zone and represents a high risk of compressible deposits, as per the Groundsure Report. Historically this zone comprised an area referred to as 'Carrington Moss', an area of bog land. The present day understood extent of the peat (as shown in Figure 7.3), also known as Carrington Moss, covers a reduced portion of this bog, likely due to site wide development.

Aside from the Peat, Glaciofluvial Sheet Deposits and the Shirdley Hill Sand Formation underlies the majority of Zone 6 and present a negligible to very low risk of natural ground subsidence, with the Shirdley Hill Sand Formation being associated with an additional risk of low risk from running sands.

A number of surface ground workings are recorded for Zone 6, including a pond to the southwest and several pits toward the centre of the zone. These pits are likely to have been infilled with Made Ground, otherwise may remain open pits, especially if obscured by vegetation. No other mining related risks are recorded; however, it should be noted Zone 6 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 6 is to be comprised of employment buildings.

Potential Proposed Development

Earthworks – Cutting

If cuttings are required within Peat, its poor geotechnical properties must be considered, with it being a high compressibility risk, possessing a low shear strength and high water content. Stabilising a cutting slope in Peat would require ground improvement, localised replacement with engineering fill material or the implementation of a retaining structure, which may require piling.

Much of the zone is recorded with Made Ground cover. This likely comprises historic fill material which may not meet modern engineering standards, however, should otherwise be amenable to cutting if sufficient GI confirms its suitability.

The Glaciofluvial Sheet Deposits are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within this type of deposit, ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

The low risk of running sands associated with the Shirdley Hill Sand Formation, present a risk of stability for a cutting slope. As such ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The bedrock geology is recorded as sandstones of the Wilmslow Sandstone Formation (WLSF). The WLSF is anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the Wilmslow Sandstone Formation may pose a hard dig risk on site.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material. Site won material may be too contaminated to use in embankment construction even if it meets engineering fill criteria.

Embankments should not be constructed upon areas of Peat due to high compressibility which would increase the risk of bearing capacity failure, settlement and differential settlement of the embankment. If embankments are to be constructed in locations with Peat, deep foundations or ground improvement would be required or the Peat would likely need to be removed.

Other site geologies are anticipated to generally be amenable to embankment construction.

Structures

Employment buildings are proposed for Zone 6.

For structures to be located over any area of Peat, and to avoid removal of Peat, a piled raft foundation will be required to counteract the settlement of the structure and damage to Peat. Construction and piling into the Peat may also damage the Peat environment through vibration driven de-watering and sealing with an impermeable layer, which should be minimised. Piling solutions may also introduce a risk of differential settlement between structures and infrastructure.

Founding upon the other geologies within this zone does not present as significant a risk. In general, the zones geology does not present a significant risk of natural ground subsidence, with risks of shrink swell clays, collapsable deposits, landslides and ground dissolution being negligible to very low. Peat presents high risks as compressible deposits and the Shirdley Hill Sand Formation presents a low risk from running sands. The low risk of running sands may present potential issues for excavation associated with construction.

The variable nature of Glaciofluvial Sheet Deposits may carry some risk of localised instability. In such cases the design should adequately account for variability, ground improvement implemented, or the material may be removed and replaced by appropriate engineering fill material. The same risk should be considered for the Made Ground due to unknown composition.

Subgrade

Approximately 25-35% of the zone is currently covered by hard standing and pavement.

The provisional development plans suggest a significant portion of the northeastern 3rd of the zone will be covered by hard standing, likely for use as vehicle parking. The most significant risk to this is the presence of Peat which present a high compressibility risk. This hard standing presents a risk to the Peat itself, introducing an impermeable layer which may damage the Peat.

Outgassing features may be considered to prevent gaseous build up beneath the hard standing, or a permeable material comprising the hard standing areas should be considered, to ensure Peat is not fully drained.

Potential high groundwater levels may present a risk to subgrade stability. Additionally, extensive impermeable hard standing could increase the surface water flood risk, which is currently designated as low for the majority of the zone. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

The most significant consideration for man-made obstructions for this zone are those associated with the historic petrochemical and chemical works, which are likely to include foundations, buried services, especially gas pipes, electrical and waste pipes, and potentially buried tanks.

The historic foundations associated with the old works may require full or partial removal prior to new construction as they could cause obstruction and act as a hard spot leading to differential settlement. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

An abandoned and dismantled railway line runs N-S through the western 3rd of site. The Allocation Plan indicates this historic rail line is proposed to host a foot/cycle linkage. Though marked as dismantled, there may be railway track, sidings and associated buildings present in this area.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 7-5. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Peat identified in the southwestern of Zone 6. High compressibility risk.	5	4	20	Peat is a highly compressible material, founding upon which could lead to differential settlement and localised structural failures. Gas build up in confined space, such as below solid foundations. Additionally, Peat creates acidic ground conditions, thus may damage concrete foundations.
2	Localised variability in the Glaciofluvial Sheet Deposits and high likelihood of Made Ground.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
3	Existing foundations: Zone 6 is primarily a historic petrochemical and chemical works (with smaller peripheral industry), with the majority of the zone being classified as Made Ground (undivided), Artificial Deposit.	5	3	15	Existing foundations may require breakout for new foundation design. Increased time and design considerations. Uncertainty around foundations depth and locations may impact requirements for piled foundations.
4	Surface Mining within Zone 6.	4	4	16	Presence of large voids at surface which require infilling with suitable fill material increasing cost and programme. Poorly backfilled surface working which create a risk of voiding and collapse below the proposed development.
5	Risk of high groundwater levels and flooding during construction.	3	2	6	Leading to overly conservative design and delays to programme.
6	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified, and the site is underlain by sandstones of the WLSF which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
7	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 7-5 Zone 6 Geotechnical Risk Register

7.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study a number of current and historical land uses at Zone 6 and the surrounding area have been identified that could have likely led to contamination at the zone.

Therefore, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone and the understanding that the proposed development is for employment use.

When considering potential sources of groundwater contamination surrounding Zone 6, it has been assumed that the direction of groundwater flow across the scheme is from southeast to northwest i.e. towards the River Mersey and MSC. Therefore, only existing or historical land uses that are located to the southeast or east of Zone 6 have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 6, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 6 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 6

- Made Ground associated with the historical development of the zone. The Made Ground has the potential for elevated concentrations of soil bound and leachable chemical species, and the potential to generate ground gases and or vapours;
- Historical land uses, notably:
    - Former petrochemical plant/chemical works across the majority of the zone
    - An historical landfill within the northeastern area of the zone
- Deposits of peat are indicated to be present across the southwestern area of the zone which could release stored ground gas into excavations during development

Sources and hazards within 250m of Zone 6

Plume of groundwater contamination within superficial deposits associated with up-gradient existing and historical land uses, notably the existing sub-station located directly east of Zone 6.

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;

- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently the River Mersey and MSC; and
- Direct contact of soils and groundwater with foundations and buildings' infrastructure.
- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for employment land use the following receptors have been identified (during and following development):

Human Health

- Future users (employees); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed employment properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- MSC and the River Mersey; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment (PRA) in Table 2-6 and Table 7.6.The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the likelihood (probability) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define likelihood, severity and risk are described in Appendix F.

In the absence of quantitative data, the likelihood and severity for each potential contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Made Ground with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gases and/or vapours	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 6 (employees)	3	2	6	Following development, the majority of the zone will be hardsurfaced and occupied by buildings. The presence of the hardsurfacing and buildings will prevent the direct exposure of Made Ground to future users. Any areas proposed for soft landscaping may require a suitable thickness of clean cover to provide a suitable growing medium and prevent direct exposure with the Made Ground.
		Construction and maintenance workers	1	3	3	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 6 (employees)	4	1	4	Depending on the composition of the Made Ground the potential exists for ground gases and/or vapours to be present. The presence and nature of such gases and/or vapours would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	2	8	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	2	6	The potential exists for contaminated wind-blown dust and/or asbestos fibres to be generated during earthworks and construction activities. Measures to mitigate the risk will need to be implemented during these activities.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	1	3	Following development, the majority of the zone will be hardsurfaced and occupied by buildings. A dedicated surface water drainage network will also be constructed. Therefore, it is considered unlikely that there will be rainfall infiltration with the potential to leach contamination from the Made Ground.
	Direct contact	Foundations and Infrastructure	2	3	6	The potential exists for the presence of chemical species that are aggressive towards concrete, and/or which may permeate plastic drinking water supply pipes. Therefore, such materials will need to designed according to the prevailing ground conditions.
Deposits of peat with the potential to release ground gases	Ingress of ground gas into excavations and confined spaces and subsequent inhalation and/or explosion	Construction and maintenance workers	4	2	8	The potential exists for ground gases released from peat to enter excavations during construction. Whilst atmospheric dispersion of such gases would be expected to occur the potential risk to construction workers would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
Historical land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	River Mersey and MSC	3	4	12	The potential exists for the historical and existing land uses to have led to the contamination of groundwater at the zone. Groundwater within the superficial deposits is expected to be in hydraulic continuity with the River Mersey, and therefore any groundwater contamination has the potential to enter this surface water body. The lining of the MSC, where in a good state of repair, would likely inhibit the recharge of this surface water by groundwater. Therefore, a viable pollutant linkage whereby any contaminated groundwater enters the MSC may not be present.

Table 7-6 Zone 6 Preliminary Risk Assessment (sources within Zone 6)

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Existing and historical land uses up groundwater gradient which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	Groundwater within superficial deposits in Zone 6 (and subsequently the River Mersey and MSC)	3	1	3	With the exception of a sub-station, no existing or historical land uses have been identified up groundwater gradient that are likely to have resulted in significant groundwater contamination. This is reflected in the risk score that has been assigned to this potential contaminant linkage.

Table 7-7 Zone 6 Preliminary Risk Assessment (sources within 250 m of Zone 6)

8. Zone 7

8.1. Desk Study Assessment

Site Location and Current Land Use

Zone 7 is located in the far eastern area of the Allocation Plan and predominantly comprises agricultural land with an area of shrubs and trees. The zone lies between approximately 20 m and 25 m Above Ordnance Datum (AOD). The land to the east of the zone typically comprises agricultural land with the town of Sale beyond. The area to the west of the zone comprises agricultural land and Manchester United Football Club's training grounds, with the area to the south comprising a sewage treatment works and solar farm. The location and current land use of Zone 7 is presented in Figure 8.1 below.

Figure 8.1 Zone 7 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 7 is proposed to consist of residential development.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the earliest mapping available (1897) and 2024 mapping, Zone 7 and the surrounding area largely comprised agricultural land with areas of trees and shrubs.

Altrincham sewage works is located to the south of the zone between 1969 to the present day, and Manchester United's training grounds are mapped from 2010.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 8.2 (left image). The zone is shown to comprise largely of agricultural land, and there are no apparent changes of land use between the 2000 and 2024 imagery (right image).

Figure 8.2 Zone 7 Aerial Photography

Historical Industrial Sites

The Groundsure Report records no potentially contaminative historical industrial sites within Zone 7, with a single entry provided for the surrounding area as detailed in Table 8-1 below.

HISTORICAL LAND USE WITHIN 250m OF ZONE	DATE SHOWN ON HISTORICAL MAPS	LOCATION
Sewage treatment works	1969 – present	Directly south of the southern end of the zone

Table 8-1 Zone 7 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SE Solid and Drift Geology 1:10,560 paper maps (6) , the Groundsure Report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and summarised below.

Artificial Ground

No artificial ground is recorded to be located within Zone 7.

Superficial Deposits

Peat deposits are indicated to be present across the western area of the zone with Glaciofluvial Sheet Deposits present across the rest of the zone. The mapped location of the superficial deposits is shown in

Figure 8.3 below, with the strata descriptions presented in Table 8-2 below.

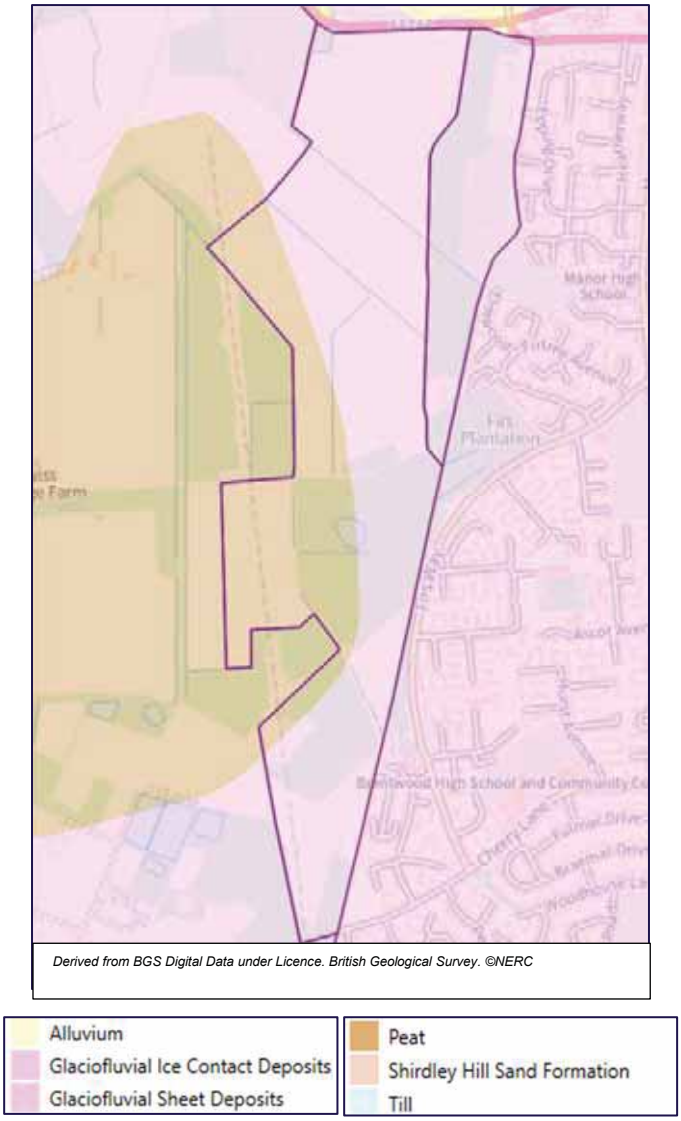

Figure 8.3 Zone 7 Superficial Deposits

DEPOSIT	DESCRIPTION
Peat	Peat is a partially decomposed mass of semi-carbonised vegetation which has grown under waterlogged, anaerobic conditions.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.

Table 8-2 Zone 7 Superficial Deposits

Solid Geology

The majority of the zone is recorded to be underlain by the Wilmslow Sandstone Formation, described by the BGS (3) as '*Red-brown to brick-red, fine to medium grained, generally pebble free, cross bedded sandstones, with sporadic siltstone. The sand grains are well rounded and indicate an aeolian origin'*.

The extreme southern area of the zone is underlain by the Helsby Sandstone Formation, described as '*Fine to medium grained, locally micaceous, cross-bedded and flat-bedded sandstones, weathering to sand near surface. Sandstones are of fluvial and aeolian facies. Pebbles may be common, particularly near the base of the formation*'.

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is shown in Figure 8.4.

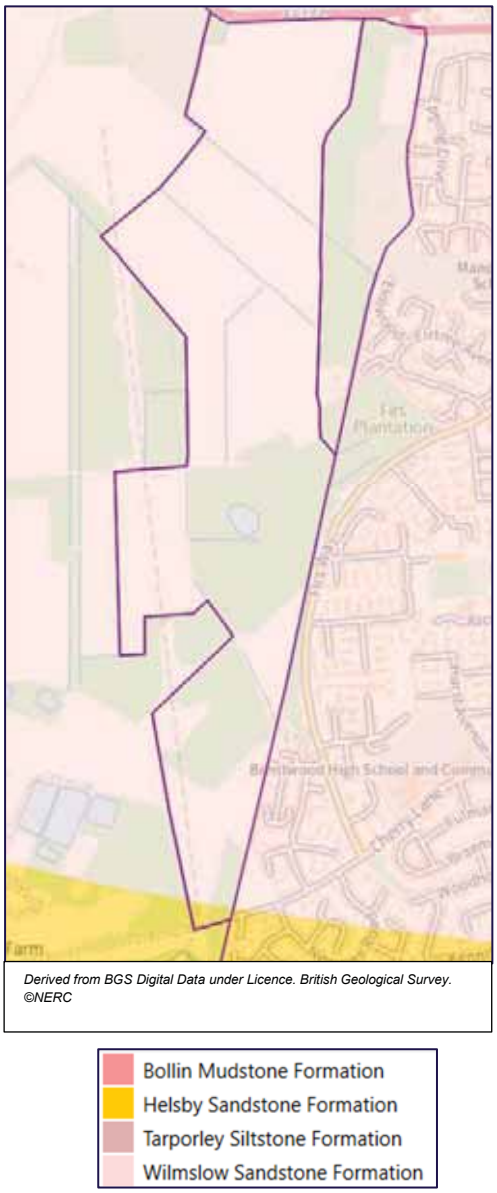

Figure 8.4 Zone 7 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 7 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits within Zone 7.

One area of surface ground workings is recorded in the southern area of the zone, identified as a Refuse Heap and historical landfill.

No underground workings or non-coal mining records were identified within Zone 7. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 8-3 below.

HAZARD	HAZARD RATING
Shrink swell clays	Negligible
Running sands	Very Low
Compressible deposits	High to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 8-3 Zone 7 Natural hazards

Hydrogeology

The Wilmslow Sandstone Formation and Helsby Sandstone Formations are classified by the EA as Principal Aquifers, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Glaciofluvial Sheet Deposits are classified by the EA as a Secondary A Aquifer, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*. The Peat is classified as an Unproductive Aquifer

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 7 or the surrounding area, and Zone 7 is not located in a Source Protection Zone.

Groundwater flow is anticipated to be towards both Sinderland Brook (a tributary of the River Mersey) to the south of the zone, and the River Mersey located to the north of the zone.

Surface Water Bodies

The River Mersey is located approximately 80m north of the zone, and is classified by the EA as having a 'Moderate' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Fail' chemical quality rating and 'Good' ecological rating) in 2019 (the most recent rating available).

The Sinderland Brook is located approximately 20m south of the zone, flowing east to west towards the River Mersey, and has an overall rating of 'Poor' (a combination of 'Fail' rating for chemical quality and 'Poor' ecological rating), assessed in 2019

Flooding

The Groundsure Report indicates that Zone 7 is not subject to flooding risk from rivers.

With the exception of small, isolated areas, Zone 7 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records no archaeological records to be present within Zone 7.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 7 or the immediate surrounding area.

No Sites of Biological Importance (SBIs) or Sites of Importance for Nature Conservation (both of which are non-statutory environmental designations) were identified within Zone 7. A Site of Importance for Nature Conservation is present immediately east of the zone.

Although not formally designated, Carrington Moss (which is a large area of peat bog) extends across the western area of Zone 7, and has local environmental interest.

Licenses / Permits / Consents

The Groundsure Report shows the following industrial sites at the zone that hold (or held) environmental licenses, permits or consents

- Woodcote Farm landfill, located within the southern area of the zone. Recorded to have accepted. industrial and commercial wastes between 1945 and 1972. It should be noted that Brook Farm landfill is not shown on historical mapping and its exact location and extent is unknown.

Radon

The Groundsure report indicates Zone 7 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a medium potential for UXB to be present in the southern area of Zone 7 due to WWII bombardment. The remaining area of Zone 7 is shown to have a low risk of encountering UXB. The risk map from Zetica is presented in Appendix D.

8.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 8.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon an assumption of requirements for earthworks, structures, hard standing and road pavement, whilst assessing feasibility and risks for each item.

General

Zone 7 is host to open farmland and vegetated land, with historic buildings identified. The majority of the area is underlain by Glaciofluvial Sheet Deposits, with the exception of the central western edge. Peat underlays the western side of the zone and represents a high risk of compressible deposits, as per the Groundsure Report. Historically, this zone comprised an area referred to as 'Carrington Moss', an area of bog land. The present day understood extent of the peat across New Carrington, also known as Carrington Moss, covers a reduced portion of this bog, likely due to historical development across the scheme.

A historic surface working identified as a refuse heap and landfill is located in the southern area of the zone. No other related surface working or mining risks are recorded. However, it should be noted Zone 7 falls within the Cheshire Brine Compensation District.

Zone 7 carries a medium risk of UXB presence in its southern area, as such a pre-desk study should be requested from Zetica, and any recommendations provided therein be adhered to, such as a detailed desk study and supervision during construction. The rest of the zone is at low risk.

The Allocation Plan indicates Zone 7 is to be comprised of residential areas with Carrington Relief Road crossing the northern area of the zone.

Potential Proposed Development

Earthworks – Cutting

Cutting within the area of the historic landfill should be avoid due to unknown nature of the refuse fill material. If cuttings are to be excavated within the landfill area, removal of refuse material will be required and replacement by engineered fill material.

If cuttings are required within Peat, its poor geotechnical properties must be considered, with it being a high compressibility risk, possessing a low shear strength and high water content. Stabilising a cutting slope in Peat would require localised replacement with engineering fill material or the implementation of a retaining structure, which may require piling.

The Glaciofluvial Sheet Deposits are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within this type of deposit, localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The bedrock geology is recorded as sandstones of the Wilmslow Sandstone Formation (WLSF), with the Helsby Formation (HEY) overlaying at the southernmost end of the zone. Both bedrock geologies are anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the Helsby Formation and Wilmslow Sandstone Formation may pose a hard dig risk on site.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material.

Embankments should not be constructed upon areas of Peat due to high compressibility which would increase the risk of bearing capacity failure, settlement and differential settlement of the embankment. If embankments are to be constructed in locations with Peat, deep foundations or ground improvement would be required, or the Peat would likely need to be removed.

Other site geologies are anticipated to generally be amenable to embankment construction.

Structures

Residential buildings and a single lane relief road are proposed for Zone 7.

Building upon historic landfill may present stability risks.

For structures to be located over any area of Peat, and to avoid removal of Peat, a piled raft foundation will be required to counteract the settlement of the structure and damage to Peat. Construction and piling into the Peat may also damage the Peat environment through vibration driven de-watering and sealing with an impermeable layer, which should be minimised. Piling solutions may also introduce a risk of differential settlement between structures and infrastructure.

Founding upon the Glaciofluvial Sheet Deposits within this zone does not present as significant a risk. In general, the zones geology does not present a significant risk of natural ground subsidence, with risks of shrink swell clays, collapsable deposits, landslides, running sands and ground dissolution being negligible to very low. The exception being Peat, which presents a high risk as a compressible deposit.

The variable nature of Glaciofluvial Sheet Deposits may carry some risk of localised instability. In such cases the design should adequately account for variability, ground improvement implemented, or the material may be subject to ground improvement or removed and replaced by appropriate engineering fill material.

Subgrade

Hard standing, road pavement and parking areas are likely to be associated with the planned residential areas. The most significant risk to this is the presence of Peat, which present a high compressibility risk which may result in differential settlement of housing and roads. This hard standing presents a risk to the Peat itself, introducing an impermeable layer which may damage the Peat environment.

Areas of open ground should be considered as part of the housing development design, such that complete cover by hard standing is minimised. Outgassing features may be considered to prevent gaseous build up beneath any large areas of hard standing, or a permeable material comprising the hard standing areas should be considered, to ensure Peat is not fully drained.

Establishing hard standing upon historic landfill may present stability risks.

Potential high groundwater levels may present a risk to subgrade stability. Additionally, extensive impermeable hard standing could increase the surface water flood risk, which is currently designated as low for the majority of the zone. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

Buried services likely exist within the zone, likely running through to connections outside of the zone boundaries. Though not anticipated, any historic foundations may require full or partial removal prior to new construction. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 8-4. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk =

Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Peat identified on the eastern half of Zone 7. High compressibility risk.	5	4	20	Peat is a highly compressible material, founding upon which could lead to differential settlement and localised structural failures. Gas build up in confined space, such as below solid foundations. Additionally, Peat creates acidic ground conditions, thus may damage concrete foundations.
2	Localised variability in the Glaciofluvial Sheet Deposits.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
3	Potential existing foundations.	2	2	4	Existing foundations may require breakout for new foundation design. Increased time and design considerations. Uncertainty around foundations depth.
4	Risk of high groundwater levels and flooding during construction.	3	2	6	Leading to overly conservative design and delays to programme.
5	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified, and the site is underlain by sandstones of the HEY and WLSF which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
6	Unexploded Ordnance (UXO).	3	5	15	Detonation of historic UXO leading to catastrophic damage of structures and surrounding area. Potential for fatalities on site due to UXO detonation.
7	Presence of historic refuse heap/landfill.	4	3	12	Ground conditions and nature of the refuse material and potential presence of voids may lead to differential settlement or subsidence due following construction.
8	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 8-4 Zone 7 Geotechnical Risk Register

8.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study a limited number of current and historical land uses at Zone 7 and the surrounding area have been identified that could have likely led to contamination at the zone.

Nevertheless, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone and the understanding that the proposed development is for residential use.

When considering potential sources of groundwater contamination surrounding Zone 7, it has been assumed that the direction of groundwater flow across the northern area of the zone is from south to north i.e. towards the River Mersey, and across the southern area of the zone is from north to south i.e. towards the Sinderland Brook. Therefore, only existing or historical land uses that are located up groundwater gradient of these water bodies have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 7, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 7 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 7

- With the exception of the historical Woodcote Farm landfill, no credible sources of contamination within Zone 7 have been identified. The exact location and extent of the landfill are unknown, and the potential exists for it to be located outside the zone's boundary.
- Deposits of peat are indicated to be present across the western area of the zone which could release stored ground gas into excavations during development

Sources and hazards within 250m of Zone 7

No potential sources of groundwater contamination up gradient of Zone 7 are readily identifiable.

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently the River Mersey, Sinderland Brook and MSC;
- Direct contact of soils and groundwater with foundations and buildings' infrastructure; and,
- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for residential land use the following receptors have been identified (during and following development):

Human Health

- Future users (residents); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed residential properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- River Mersey, MSC and the Sinderland Brook; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment (PRA) in Table 8-5.The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the likelihood (probability) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define likelihood, severity and risk are described in Appendix F.

In the absence of quantitative data, the likelihood and severity for each potential contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

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SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Made Ground associated with wastes deposited at Woodcote Farm landfill, with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gases and/or vapours	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 7 (residents)	3	1	3	Depending on the nature of the wastes deposited at Woodcote Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
		Construction and maintenance workers	1	1	1	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 7 (residents)	4	1	4	Depending on the nature of the wastes deposited at Woodcote Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	1	4	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	1	3	Depending on the nature of the wastes deposited at Woodcote Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	1	3	Depending on the nature of the wastes deposited at Woodcote Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Direct contact	Foundations and Infrastructure	2	1	2	Depending on the nature of the wastes deposited at Woodcote Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
Deposits of peat with the potential to release ground gases	Ingress of ground gas into excavations and confined spaces and subsequent inhalation and/or explosion	Construction and maintenance workers	4	1	4	Depending on the nature of the wastes deposited at Woodcote Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.
Historical land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	Sinderland Brook, River Mersey and MSC	3	1	3	Depending on the nature of the wastes deposited at Woodcote Farm landfill the potential exists for localised contamination to be present. However, with the exception of this former landfill, it is considered unlikely that potentially contaminated Made Ground will be present across the rest of the zone, and this is reflected in the risk score that has been assigned.

Table 8-5 Zone 7 Preliminary Risk Assessment (sources within Zone 7)

9. Zone 8

9.1. Desk Study Assessment

Site Location

Zone 8 is located along the southern boundary of the Allocation Plan and comprises predominantly agricultural land. The zone lies between approximately 16 and 24 m Above Ordnance Datum (AOD), gently sloping to the west. The location and current land use of Zone 8 is shown in Figure 9.1 below.

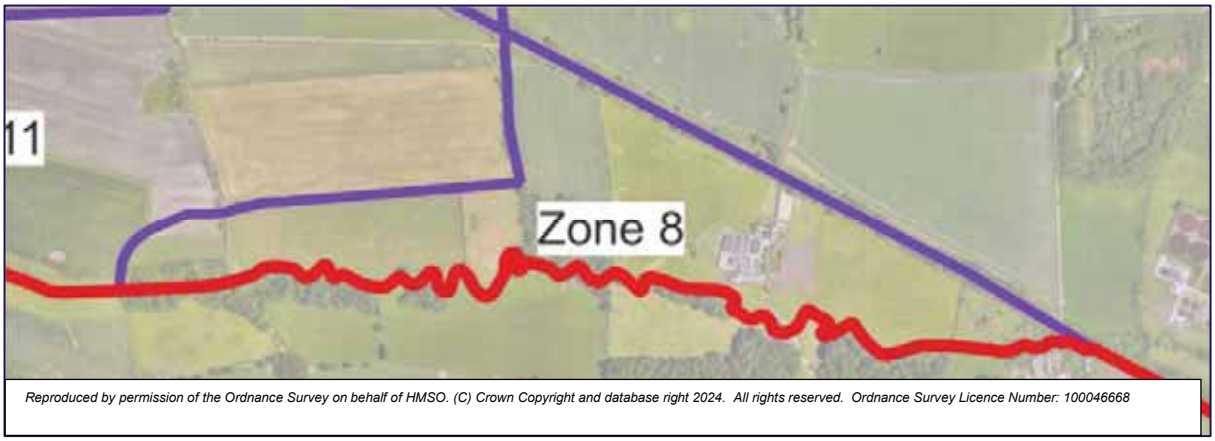

Figure 9.1 Zone 8 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 8 is proposed to remain as green belt with no development proposed.

Historical Development

A review of the historical mapping provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

With the exception of a small sewage disposal works located within the centre of the zone between the end of the nineteenth century and the 1960s, the zone has remained as agricultural land. The area of the former sewage works is currently occupied by woodland.

The surrounding areas, Zones 11 and 12, have shown no significant development over time, with the exception of a large sewage works located approximately 200m to the northeast of the eastern boundary which was constructed in the 1960s.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 9.2 (first image). The entire zone is shown as agricultural land with small areas of woodland.

Between 2000 and the most recent aerial photography (2024, the second image within Figure 9.2) no significant change in land use was noted.

Figure 9.2 Zone 8 Aerial Photography

Historical Industrial Sites

The Groundsure Report records a limited number of potentially contaminative historical industrial sites within Zone 8 and the surrounding area. A summary of these land uses is provided in Table 9-1 and Table 9-2.

HISTORICAL LAND USE WITHIN ZONE	DATE SHOWN ON HISTORICAL MAPS	LOCATION
Sewage Disposal Works	1900 - 1965	Centre of Zone 8, in the area of woodland. .

Table 9-1 Zone 8 Historical industrial sites within zone

HISTORICAL LAND USE WITHIN 250m OF ZONE	DATE SHOWN ON HISTORICAL MAPS	LOCATION
Altrincham Sewage Works	1969 to present	Within Zone 12 to the east of Zone 8

Table 9-2 Zone 8 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SW and 79SE Solid and Drift Geology 1:10,560 paper maps (5) (6), the Groundsure report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and summarised below.

Artificial Ground

One area of artificial ground is identified within the zone, located in the central area in the area of the former sewage disposal works.

Superficial Deposits

Alluvium deposits are indicated to be located across the southern boundary adjacent to the course of Sinderland Brook. Glaciofluvial Sheet Deposits are indicated to be located across the remaining areas of the zone. The mapped location of the superficial deposits is shown in

Figure 9.3 below, with the strata descriptions presented in Table 9-3 below

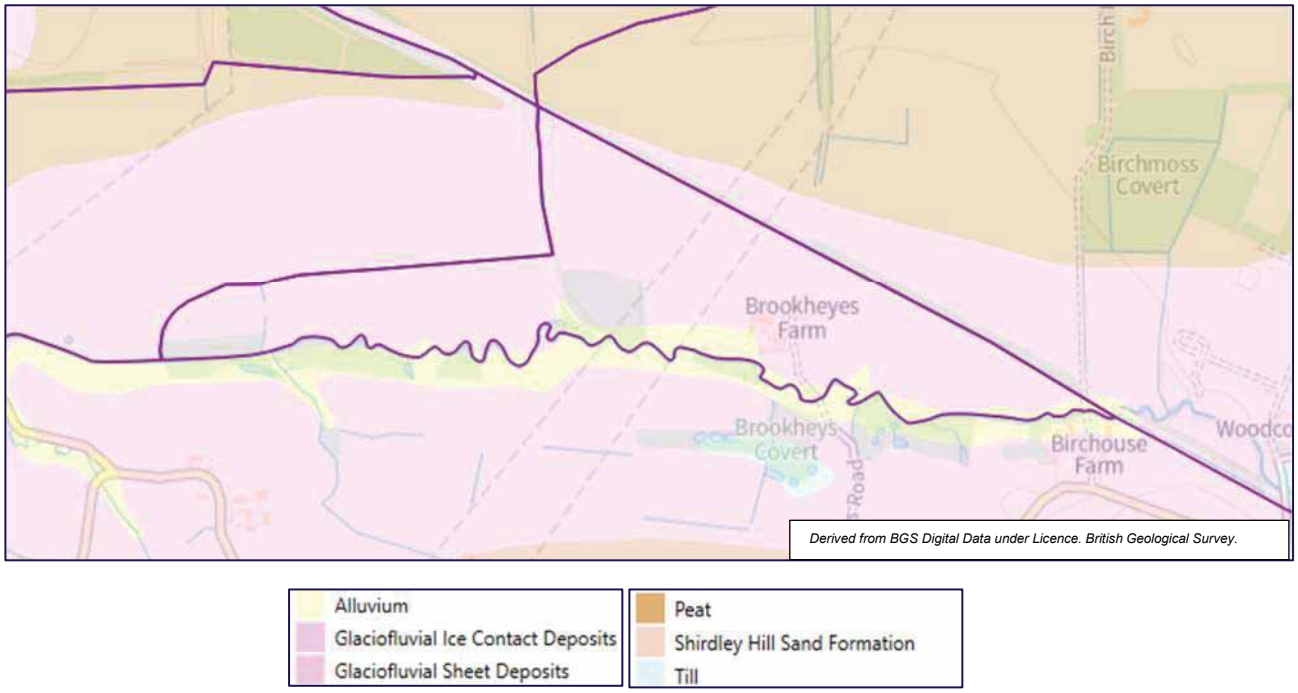

Figure 9.3 Zone 8 Superficial Deposits

DEPOSIT	DESCRIPTION
Alluvium	Clay, silt, sand and gravel, Unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.

Table 9-3 Zone 8 Superficial Deposits

Solid Geology

The zone is recorded to be underlain by the Helsby Sandstone Formation, described by the BGS (3) as '*Fine to medium grained, locally micaceous, cross-bedded and flat-bedded sandstones, weathering to sand near surface. Sandstones are of fluvial and aeolian facies. Pebbles may be common, particularly near the base of the formation.*'.

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is presented in Figure 9.4.

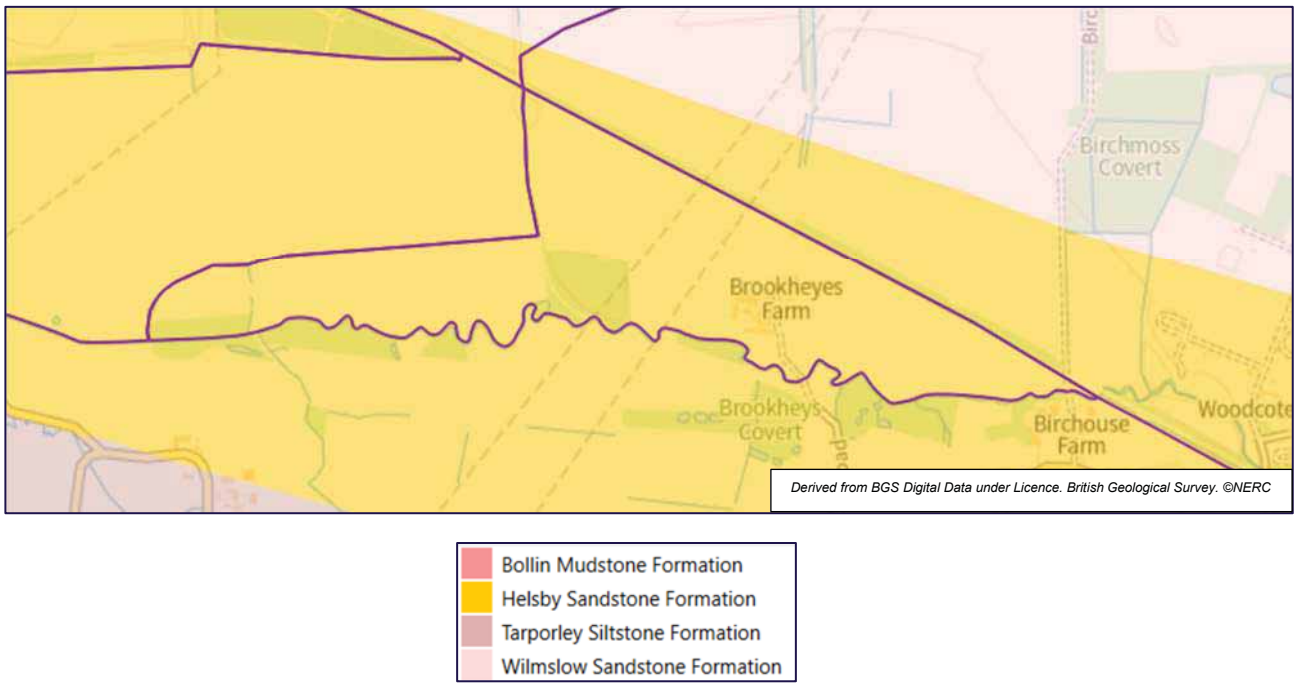

Figure 9.4 Zone 8 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 8 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records one BritPit to be present within Zone 8, Brookheys Farm Sand Pit.

Two surface ground workings were recorded within Zone 8, a sludge bed and a refuse heap, located in the central area of the zone.

No underground workings, non-coal mining records were identified within Zone 8. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 9-4.

HAZARD	HAZARD RATING
Shrink swell clays	Very Low to Negligible
Running sands	Low to Very Low
Compressible deposits	Moderate to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 9-4 Zone 8 Natural hazards

Hydrogeology

The Helsby Sandstone Formation is classified by the EA as a Principal Aquifer, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Alluvium and Glaciofluvial Sheet Deposits are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*.

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 8 or the surrounding area, and Zone 8 is not located in a Source Protection Zone.

Groundwater flow is anticipated to be towards Sinderland Brook located at the zone's southern boundary.

Surface Water Bodies

The Sinderland Brook forms the southern boundary of Zone 8, and flows in a generally westerly direction. The Brook is a tributary of the River Mersey, and is classified by the EA as having a 'Poor' (as defined in the Water Framework Directive (10) (a combination of 'Fail' rating for chemical quality and 'Poor' ecological rating), in 2019 (the most recent rating available).

Flooding

The Groundsure Report indicates that Flood Zones 2 and 3 are present adjacent to Sinderland Brook, with Flood Zone 2 being very limited in the extent.

With the exception of small, isolated areas, Zone 8 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records no archaeological records to be present within Zone 8.

Environmental Designations

An Ancient Woodland was identified within the Groundsure Report to the south of Zone 8 at Brookheys Covert. The zone also lies within an SSSI Impact Risk Zone for Brookheys Covert, which is located approximately 20m south of the zone's southern boundary. The zone also lies within an area designated as Green Belt.

A Site of Biological Importance (SBI), named Sinderland Green Wood, is located within, and to immediate south of the western area of Zone 8.

Brookheys Covert SBI and Hogswood Covert SBI are located immediately south of the eastern area of Zone 8. These areas are also recorded as Sites of Importance for Nature Conservation.

An area within the central area of the zone is designated as a Site of Importance for Nature Conservation.

Licenses / Permits / Consents

The Groundsure Report shows the following industrial sites at the zone that hold (or recently held) environmental licenses, permits or consents:

- Dark Lane historical landfill, located in the same location as the former sewage disposal works and recorded to have accepted household waste and liquid sludge. No dates of operation are provided.

- Sewage tanks and sewage disposal works located in the central area of the zone, noted in the historical mapping.

Radon

The Groundsure Report indicates that Zone 8 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required.

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 8 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

9.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 9.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon the assumption for requirements for earthworks, structures, hard standing and road pavement, assessing feasibility and risks for each item.

General

Zone 8 consists entirely of agricultural land, with a historic sewage work formerly located at the centre of the zone and an existing farm to the central east. Zone 8 is underlain primarily by Glaciofluvial Sheet Deposits and secondarily by Alluvium associated with Sinderland Brook, which defines the southern border of the zone.

The majority of Zone 8 is at negligible to very low risk of natural ground subsidence, with Alluvium being associated with additional risks, such as low risk from running sands and a moderate risk from compressible deposits.

Two historic surface workings are identified for Zone 8, a sludge bed and a refuse heap, at the central area of the zone. No other related surface working or mining risks are recorded. However, it should be noted Zone 8 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 8 is to remain as greenbelt with no proposed development.

Potential Proposed Development

Earthworks – Cutting

Cutting within the area of the historic sludge bed or refuse heap should be avoid due to unknown nature of the fill material. If cuttings are to be excavated within the landfill area, removal of refuse material will likely be required and replacement by engineered fill material.

The Glaciofluvial Sheet Deposits are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within these types of deposit, especially Glaciofluvial Sheet Deposits, ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

The low risk of running sands associated with the Alluvium, present a risk of stability for a cutting slope. As such ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The primary bedrock geology is recorded as sandstones of the Helsby Formation (HEY). The HEY and is anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the Helsby Formation may pose a hard dig risk on site.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material.

Superficial and bedrock geologies are anticipated to be generally amenable to embankment construction. Although Alluvium is noted to have a moderate risk as a compressible deposit, thus may result in differential settlement issues. As such sufficient GI will be required to inform adequate design.

Structures

No structures are proposed for Zone 8, however for potential future considerations:

Building upon the historic sludge bed and refuse heap may present stability risks.

Founding upon geologies within this zone does not present as significant a risk. In general, the zones geology does not present a significant risk of natural ground subsidence. The low risk of running sands may present potential issues for excavation associated with construction. Other consideration for risks associated with Alluvium discussed previously in the Embankment section.

The variable nature of Glaciofluvial Sheet Deposits and Alluvium may carry some minor risk of localised instability. Adequate design should account for these variations, alternatively/additionally the material may be subject to ground improvement or removed and replaced by appropriate engineering fill material.

The low risk of running sands from the Alluvium presents a stability risk for excavations during construction.

Whilst the majority of site is at low risk of river flooding, the areas in the immediate vicinity of Sinderland Brook represent a medium to high risk of river flooding. Any proposed structures should consider adequate drainage design.

Subgrade

No additional subgrade is proposed for Zone 8, however for potential future considerations:

Establishing hard standing upon historic the sludge bed and refuse heap may present stability risks.

The geology of the site does not pose a significant risk to the establishment of hard standing, however localised sufficient GI is required to confirm ground suitability. Any inadequate underlying material should be subject to ground improvement or removed and replaced with appropriate engineering fill.

Potential high groundwater levels may present a risk to subgrade stability. Additionally, extensive impermeable hard standing could increase the surface water flood risk, which is currently designated as low for the majority of the zone, and increase the extent of the high risk of river flooding in the vicinity of Sinderland Brook. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

Buried services likely exist within the zone, associated with the existing farm, in addition to passing through to other zones. Any historic foundations, such as those potentially remnant form the old sewage works, may require full or partial removal prior to new construction. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 9-5. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Alluvium identified along the southern edge of the zone. Moderate compressibility risk and risk of bearing capacity failure.	4	3	12	The Alluvium comprises the southern edge and potentially the majority of the zone. Any future proposed construction of structures upon this Alluvium are at moderate risk of instability due to compressibility.
2	Localised variability in the Glaciofluvial Sheet Deposits. Glaciofluvial deposits potentially underly alluvium.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
3	Potential existing foundations, associated with the historic sewage works.	3	2	6	Existing foundations may require breakout for new foundation design. Increased time and design considerations. Uncertainty around foundations depth.
4	Existing and potential increased risk of flooding following development of the zone.	2	3	6	Damage to potential future development.
5	Risk of high groundwater levels and flooding during construction.	3	2	6	Leading to overly conservative design and delays to programme.
6	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified, and the site is underlain by sandstones of the HEY which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
7	Presence of historic refuse heap and sludge bed.	4	3	12	Ground conditions and nature of the sludge and refuse material and potential presence of voids may lead to differential settlement or subsidence due following construction.
8	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 9-5 Zone 8 Geotechnical Risk Register

9.3. Preliminary Conceptual Site Model and Risk Assessment

No development within Zone 8 is proposed as part of the Allocation Plan, with the zone remaining as undeveloped green belt. However, to provide context as to the risks presented from contamination in the event that the zone is developed a conceptual site model (CSM) and preliminary risk assessment in accordance with LCRM (12) have been prepared nevertheless.

Based on the findings of the desk study a limited number of current or historical land uses at Zone 8 and the surrounding area have been identified that could have likely led to contamination at the zone.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone.

When considering potential sources of groundwater contamination surrounding Zone 8, it has been assumed that the direction of groundwater flow across the locality is towards Sinderland Brook. Therefore, only existing or historical land uses that are located to the northeast or east of Zone 8 have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 8, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 8 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 8

With the exception of the historical sewage disposal works and the Dark Lane historical landfill (located in the same location) no credible sources of contamination within Zone 8 have been identified.

Sources and hazards within 250m of Zone 8

Plume of groundwater contamination within superficial deposits associated with up-gradient existing and historical land uses, notably the sewage treatment works, located approximately 50m east within Zone 12

Pathways

The key viable migratory and exposure pathways (in the event that the zone is redeveloped) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently Sinderland Brook, the River Mersey and MSC;
- Direct contact of soils and groundwater with foundations and buildings' infrastructure; and,
- Lateral migration of contaminated groundwater

Receptors

Based on the theoretical development of the zone the following receptors have been identified (during and following development):

Human Health

- Future users; and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- Sinderland Brook, River Mersey and MSC; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment (PRA) in Table 8-5.The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the likelihood (probability) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define likelihood, severity and risk are described in Appendix F.

In the absence of quantitative data, the likelihood and severity for each potential contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

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SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Isolated areas of Made Ground with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 8	3	1	3	Isolated areas of Made Ground may be present within the vicinity of historical sewage disposal works and historical landfill (Dark Lane). However, there is unlikely to areas of contaminated Made Ground across the rest of the zone, and this is reflected in the risk score that has been assigned.
		Construction and maintenance workers	1	1	1	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	1	3	Isolated areas of Made Ground may be present within the vicinity of historical sewage disposal works and historical landfill. However, there is unlikely to areas of contaminated Made Ground across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	1	3	Isolated areas of Made Ground may be present within the vicinity of historical sewage disposal works and historical landfill. However, there is unlikely to areas of contaminated Made Ground across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Direct contact	Foundations and Infrastructure	2	1	2	Isolated areas of Made Ground may be present within the vicinity of historical sewage disposal works and historical landfill. However, there is unlikely to areas of contaminated Made Ground across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 8	4	1	4	Isolated areas of Made Ground may be present within the vicinity of historical sewage disposal works and historical landfill. However, there is unlikely to areas of contaminated Made Ground across the rest of the zone, and this is reflected in the risk score that has been assigned.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	1	4	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
Historical and existing land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	River Mersey and Sinderland Brook/Red Brook	3	1	3	Isolated areas of Made Ground may be present within the vicinity of historical sewage disposal works and historical landfill. However, there is unlikely to areas of contaminated Made Ground across the rest of the zone, and this is reflected in the risk score that has been assigned.

Table 9-6 Zone 8 Preliminary Risk Assessment (sources within Zone 8)

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Existing and historical land uses up groundwater gradient which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	Groundwater within superficial deposits in Zone 8 (and subsequently the Sinderland Brook, River Mersey and MSC)	3	2	6	Although considered relatively unlikely, the potential exists for the sewage works located to the east of the zone (i.e. up groundwater gradient) to have led to groundwater contamination. .

Table 9-7 Zone 8 Preliminary Risk Assessment (sources within 250m of Zone 8)

10. Zone 9

10.1. Desk Study Assessment

Site Location and Current Land Use

Zone 9 is located within the northwestern area of the Allocation Plan, to the south of Manchester Road and to the north of the A1. The zone lies between approximately 18 and 22 m Above Ordnance Datum (AOD). The majority of the zone currently comprises vacant land with the recent demolition of a former business park. The northwestern area of the zone comprises undeveloped greenfield. The location and recent land use of Zone 9 is shown in Figure 10.1 below.

Figure 10.1 Zone 9 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 9 is proposed for residential and employment use.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between 1891-1894 mapping and 1954 the zone largely comprised agricultural land, with the southern half of Carrington village located within the eastern half of the zone. A blacksmith was located within Carrington village (between 1891 and 1938), located within the northern area of the zone. The northern boundary generally followed the alignment of Manchester Road.

The 1954 mapping showed a number of buildings and a reservoir in the western half of the zone, and a petrochemical plant directly south of the western half of Zone 9.

Between 1965 and 1980, the zone developed substantially, with laboratories at the western end of the zone, a leisure area in the central area, including tennis courts and bowling green, and unnamed buildings within the eastern half of the zone.

The 1990-1995 mapping showed no significant changes within Zone 9, however the petrochemical plant to the south appeared partially cleared.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 10.2 (first image). The western end of the zone comprises Carrington Business Park with green open space to the northwest. A sports field was present in the central area, whilst the eastern area of the zone comprised unnamed buildings and appears to be occupied with storage containers.

Between 2000 and the most recent aerial photography (2024, the second image), Carrington Business Park and the fire station appear to have been demolished.

Figure 10.2 Zone 9 Aerial Photography

Historical Industrial Sites

The Groundsure Report records a number of potentially contaminative historical industrial sites within Zone 9 and the surrounding area. A summary of these land uses is provided in Table 10-1 and Table 10-2 below.

HISTORICAL LAND USE	DATE SHOWN ON HISTORICAL MAPS	LOCATION WITHIN ZONE
Laboratories	1965 - 1980	Western area
Business Park/industrial area	1980 - 2024	Western half
Vehicle repair, distribution and haulage	1990 to present	Western half, towards the northern boundary

Table 10-1 Zone 9 Historical industrial sites within zone

HISTORICAL LAND USE WITHIN 250m OF ZONE	DATE SHOWN ON HISTORICAL MAPS	LOCATION
Petrochemical works/chemical works (including associated tanks)	1954 - 1995	Directly south of zone, within Zone 6

Table 10-2 Zone 9 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SW Solid and Drift Geology 1:10,560 paper maps (5), the Groundsure Report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and summarised below.

Artificial Ground

One area of artificial ground is identified within the zone, located beneath the western area of the zone.

Superficial Deposits

Alluvium deposits are indicated to be limited to a small area located on the northern boundary in the central area of the zone. The Glaciofluvial Sheet Deposits are indicated to be located across the majority of the zone, with the Shirdley Hill Sand Formation located within the central southern area. The mapped location of the superficial deposits is shown in

Figure 10.3 below, with strata descriptions presented in Table 10-3.

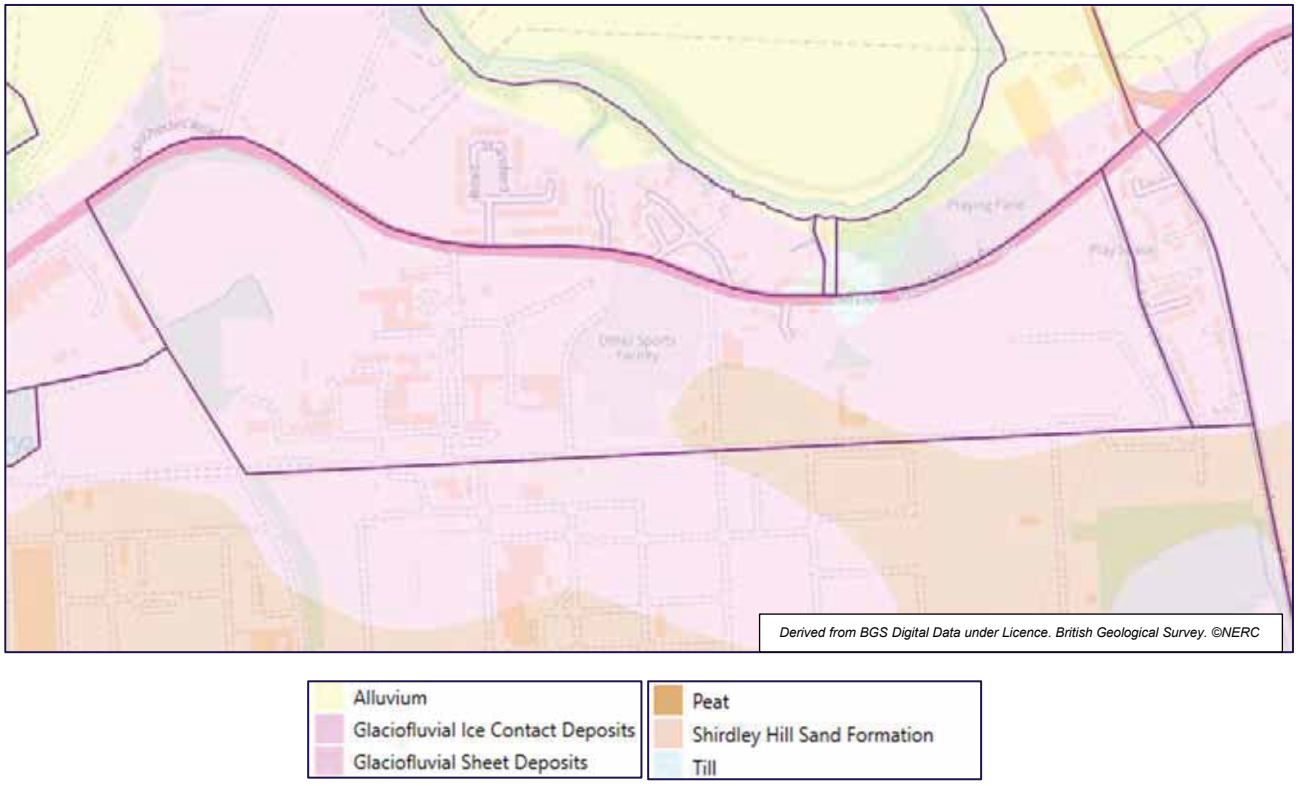

Figure 10.3 Zone 9 Superficial Deposits

DEPOSIT	DESCRIPTION
Alluvium	Clay, silt, sand and gravel, Unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.
Shirdley Hill Sand Formation	Moderately to well-sorted, fine-grained sand with peat layers in the lower part. Sand grains are dominated by rounded to sub-rounded quartz grains. The formation is divisible into an upper ‘white’ sand and a lower ‘brown’ sand that is olive grey and brown.

Table 10-3 Zone 9 Superficial Deposits

Solid Geology

The entire zone is indicated to be underlain by the Wilmslow Sandstone Formation, described by the BGS (3) as 'Red-brown to brick-red, fine to medium grained, generally pebble free, cross bedded sandstones, with sporadic siltstone. The sand grains are well rounded and indicate an aeolian origin'.

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is presented in

Figure 10.4 below.

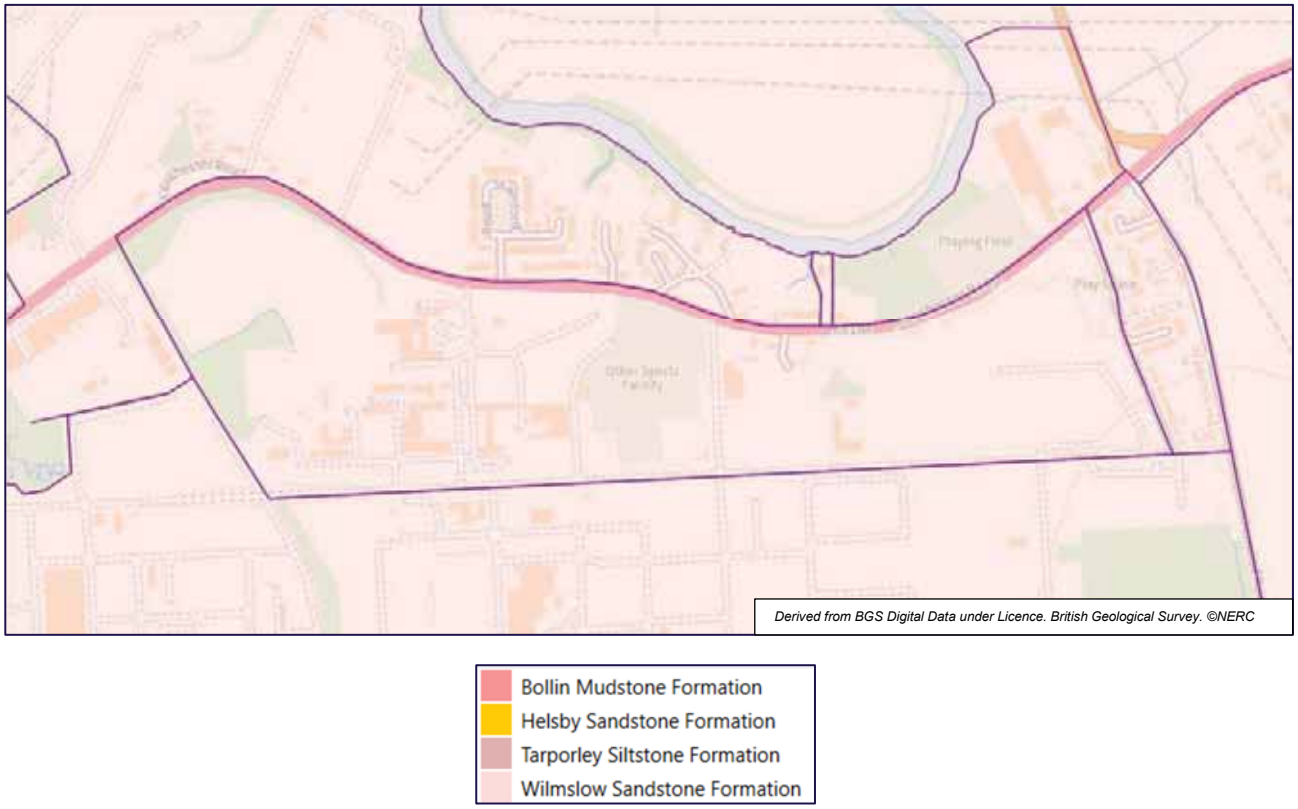

Figure 10.4 Zone 9 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 9 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits to be present within Zone 9.

No surface ground workings, underground workings, or non-coal mining records were identified within Zone 9. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 10-4 below.

HAZARD	HAZARD RATING
Shrink swell clays	Negligible
Running sands	Low to Very Low
Compressible deposits	Negligible
Collapsible deposits	Very Low
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 10-4 Zone 9 Natural hazards

Hydrogeology

The Wilmslow Sandstone Formation is classified by the EA as a Principal Aquifer, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Alluvium, Shirdley Hill Sand Formation, Glaciofluvial Sheet Deposits are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*.

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 9 or the surrounding area, and Zone 9 is not located in a Source Protection Zone.

Groundwater flow is anticipated to flow towards the River Mersey and MSC to the north and west, respectively.

Surface Water Bodies

The River Mersey is located approximately 150m to the north of the zone (at its closest point) and flows in a generally westerly direction. The river is classified by the EA as having a 'Moderate' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Fail' chemical quality rating and 'Good' ecological rating) in 2019 (the most recent rating available).

Flooding

The Groundsure Report indicated no risk of river flooding to exist within Zone 9.

With the exception of small, isolated areas, Zone 9 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure report records no archaeological records to be present within Zone 9.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 9 or the immediate surrounding area.

No Sites of Biological Importance (SBIs) or Sites of Importance for Nature Conservation (both of which are non-statutory environmental designations) were identified within Zone 9 or the immediate surrounding area.

Licenses / Permits / Consents

The Groundsure Report shows the following industrial sites at the zone that hold (or recently held) environmental licenses, permits or consents:

- A Licensed waste site was present within the zone, Carrington Oil Recovery Installation (part of Grosvenor Power Station Ltd), within Carrington Business Park, which treated oil. Carrington Oil Recovery was also listed as a licensed industrial activity.
- J1 Technologies Ltd was also listed as a licensed industrial activity, dealing with organic chemicals
- A Pollution inventory waste transfer was identified in the central area of the zone for Carrington Polyolefins Plant for organic chemicals.
- A waste exemption was also recorded within the Carrington Business Park, at Encore Buildings, for treating waste for use of waste in construction, and screening and blending waste, as well as storage of waste in a secure place.
- A number of licensed pollutant releases were identified within the zone, all of which were historical for various chemical works for petrochemical processes, combustion and incineration and waste oil burner.
- One sewage discharge into a tributary of the River Mersey was identified in the central area of the zone.

Radon

The Groundsure Report indicates Zone 9 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required.

Unexploded Ordnance

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 9 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

10.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 10.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon an assumption of requirements for earthworks, structures, hard standing and road pavement, whilst assessing feasibility and risks for each item.

General

Zone 9 is the site of present day and historic commercial buildings with an infilled reservoir on the western end of the zone.

The majority of the zone is underlain by Glaciofluvial Sheet Deposits with an area recorded as Made Ground underlying the active commercial area on the western side of site and a relatively small area (approximately 0.02km^2) of the Shirdley Hill Sand Formation to the central south of the zone. These geologies present a negligible to very low risk of natural ground subsidence, with the Shirdley Hill Sand Formation being associated with an additional risk of low risk from running sands.

It should be noted Zone 9 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 9 is to be comprised of employment and residential buildings, with the proposed Carrington Relief Road (the present day A1) defining the southern boundary of the zone.

Potential Proposed Development

Earthworks – Cutting

Approximately 15-25% of the western side of the zone is recorded with Made Ground cover, including both the recorded Made Ground and the anticipated Made Ground infill of the historic reservoir. This likely comprises historic fill material which may not meet modern engineering standards, however, should otherwise be amenable to cutting if sufficient GI confirms its suitability.

The Glaciofluvial Sheet and the Shirdley Hill Sand Formation are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within the Glaciofluvial Sheet Deposits, ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

The low risk of running sands associated with the Shirdley Hill Sand Formation, present a risk of stability for a cutting slope. As such ground improvement or localised replacement with engineering fill may be required to achieve stable slope angles.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The bedrock geology is recorded as sandstones of the Wilmslow Sandstone Formation (WLSF). The WLSF is anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the Wilmslow Sandstone Formation may pose a hard dig risk on site.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material. Site won material may be too contaminated to use in embankment construction even if it meets engineering fill criteria.

Other site geologies are anticipated to generally be amenable to embankment construction.

Structures

Employment and residential buildings are proposed for Zone 9, with a relief road along the southern boundary.

Founding upon the geologies within this zone does not present a significant risk of natural ground subsidence, with risks of shrink swell clays, collapsable deposits, compressible deposits, landslides and ground dissolution being negligible to very low. The low risk of running sands from the Shirdley Hill Sand Formation presents a stability risk for excavations during construction.

The variable nature of Glaciofluvial Sheet Deposits may carry some risk of localised instability. In such cases the design should adequately account for variability, ground improvement implemented, or the material may be removed and replaced by appropriate engineering fill material. The same risk should be considered for the Made Ground due to unknown composition.

Subgrade

Approximately 35-45% of the zone is currently covered by hard standing and pavement.

Potential high groundwater levels may present a risk to subgrade stability. Additionally, extensive impermeable hard standing associated with the residential developments, and more significantly with the employment areas and associated parking, could increase the surface water flood risk. This is currently designated as low for the majority of the zone. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

The most significant consideration for man-made obstructions for this zone are those associated with the historic commercial buildings across the zone, including buried services and foundations. Increased density of buried services may be present in association with the historic petrochemical and chemical works to the south in Zone 6.

The historic foundations associated with the historic buildings may require full or partial removal prior to new construction as they could cause obstruction and act as a hard spot leading to differential settlement. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

An infilled reservoir exists on the northwestern end of the zone, which may be associated with concrete, geogrid or other liners.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 10-5. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Localised variability in the Glaciofluvial Sheet Deposits and Made Ground.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
2	Existing foundations: Zone 9 is primarily comprised of historic commercial and industrial areas, with a portion of the western side of the zone being classified as Made Ground (undivided), Artificial Deposit. Concrete, geo grids and/or other liner material may be associated with the infilled reservoir on the northwestern end of site.	5	3	15	Existing foundations may require breakout for new foundation design. Increased time and design considerations. Uncertainty around foundations depth and locations may impact requirements for piled foundations.
3	Risk of high groundwater levels and flooding during construction.	3	2	6	Leading to overly conservative design and delays to programme.
4	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified, and the site is underlain by sandstones of the WLSF which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
5	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 10-5 Zone 9 Geotechnical Risk Register

10.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study a number of current or historical land uses at Zone 9 and the surrounding area have been identified that could have likely led to contamination at the zone.

Therefore, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone and the understanding that the proposed development is for residential and employment use.

When considering potential sources of groundwater contamination surrounding Zone 9, it has been assumed that the direction of groundwater flow across the scheme is from south/southeast to north/northwest i.e. towards the River Mersey and MSC. Therefore, only existing or historical land uses that are located to the south or southeast of Zone 9 have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 9, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 9 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 9

- Made Ground associated with the historical development of the zone. The Made Ground has the potential for elevated concentrations of soil bound and leachable chemical species, and the potential to generate ground gases and or vapours;
- Historical land uses, notably the former Carrington Business Park, including historical laboratories located in the western area of the zone

Sources and hazards within 250m of Zone 9

Plume of groundwater contamination within superficial deposits associated with up-gradient existing and historical land uses, notably the former petrochemical/chemical works to the south within Zone 6

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently the River Mersey and MSC;
- Direct contact of soils and groundwater with foundations and buildings' infrastructure; and,
- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for residential land use the following receptors have been identified (during and following development):

Human Health

- Future users (residents and employees); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed residential and employment properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- MSC and the River Mersey; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment in Table 10-6 and Table 10-7. The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the probability (likelihood) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define contaminant probability, consequence and risk are described in Appendix F.

In the absence of quantitative data the likelihood and consequence for each contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Made Ground associated with the former development, has the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gases and/or vapours	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 9 (employees and residents)	3	4	12	Following development, the zone will be comprised of housing, employment buildings, gardens and areas of hardsurfacing. The presence of the housing, buildings and hardsurfacing would be expected to prevent the direct exposure of the Made Ground to future users. However, it is likely that within areas proposed for gardens and soft landscaping a suitable thickness of clean cover will need to be incorporated to provide a growing medium and prevent direct exposure of the Made Ground to future users.
		Construction and maintenance workers	1	4	4	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 9 (employees and residents)	4	1	4	Depending on the composition of the Made Ground the potential exists for ground gases and/or vapours to be present. The presence and nature of such gases and/or vapours would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	1	4	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	2	6	The potential exists for contaminated wind-blown dust and/or asbestos fibres to be generated during earthworks and construction activities. Measures to mitigate the risk will need to be implemented during these activities.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	3	9	Following development, a large proportion of the zone will consist of hardsurfacing and buildings, and a dedicated surface water drainage network will also be constructed. In these locations, it is considered unlikely that there will be rainfall infiltration with the potential to leach contamination from the Made Ground. However, in areas proposed for gardens and soft landscaping the potential exists for rainfall infiltration to lead to the leaching of contamination within the Made Ground.
	Direct contact	Foundations and Infrastructure	2	2	4	The potential exists for the presence of chemical species that are aggressive towards concrete, and/or which may permeate plastic drinking water supply pipes. Therefore, such materials will need to designed according to the prevailing ground conditions.
Historical land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	River Mersey and MSC	3	3	9	The potential exists for the historical and existing land uses to have led to the contamination of groundwater at the zone. Groundwater within the superficial deposits is expected to be in hydraulic continuity with the River Mersey, and therefore any groundwater contamination has the potential to enter this surface water body. The lining of the MSC, where in a good state of repair, would likely inhibit the recharge of this surface water by groundwater. Therefore, a viable pollutant linkage whereby any contaminated groundwater enters the MSC may not be present.

Table 10-6 Zone 9 Preliminary Risk Assessment (sources within Zone 9)

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Existing and historical land uses up groundwater gradient which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	Groundwater within superficial deposits in Zone 9 (and subsequently the River Mersey and MSC)	3	3	9	The historical land uses to the south of the zone (i.e. up groundwater gradient) have the potential to have led to groundwater contamination. The expected direction of groundwater flow within the superficial deposits across New Carrington is towards the River Mersey and MSC. Therefore, any contaminated groundwater surrounding the zone has the potential to migrate into the zone and flow towards the River Mersey and MSC. .

Table 10-7 Zone 9 Preliminary Risk Assessment (sources within 250m of Zone 9)

11. Zone 10

11.1. Desk Study Assessment

Site Location and Current Land Use

Zone 10 is located in the central area of the Allocation Plan, located to the south of the former petrochemical plant. The zone lies between approximately 21 m and 23 m Above Ordnance Datum (AOD) and comprises agricultural land. The location and current land use of Zone 10 is shown in Figure 11.1 below.

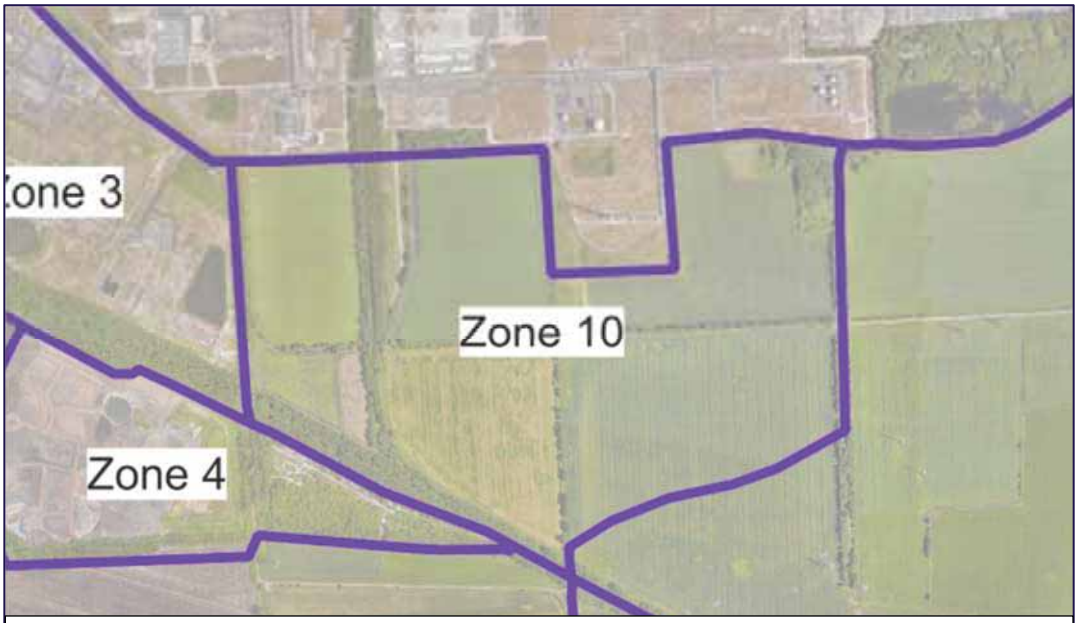

Figure 11.1 Zone 10 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 10 is proposed to be used for employment use.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the earliest mapping available (1891) and 2024 mapping, Zone 10 and the surrounding area is shown to largely comprise agricultural land.

From 1897 three parallel tramways ran from north to south across the zone. Two of the tramways formed the eastern and western boundaries of the zone and the other tramway ran through the central area of the zone. Additionally, two tramways crossed the zone in an east to west direction, one of which formed the zone's northern boundary, with the other crossing the central area. By the 1950s the tramways were no longer labelled as such.

By the 1950s and following the construction of the petrochemical plant to the north, railway sidings orientated north to south was constructed in the western area of the zone. The siding connected with the Cheshire Lines Railway (which formed the zone's southern boundary) at Partington Junction. The sidings remained until 2010 and were labelled as a Mineral railway. The Cheshire Lines Railway was dismantled from the 1980s onwards.

To the north of Zone 10, significant development occurred between 1954 and 1980, with a petrochemical plant/works expanding over time. To the southwest and directly west of Zone 10, a gas works was present over the same time period.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 11.2 (left image). The entire zone is shown to comprise agricultural land and an area of trees and shrubs where the former railway sidings were located.

No significant changes were noted between the 2000 and 2024 imagery for the zone (image on the right). Outside of the zone, structures to the north, west and southwest have been demolished.

Figure 11.2 Zone 10 Aerial Photography

Historical Industrial Sites

The Groundsure Report records a limited number of potentially contaminative historical industrial sites within Zone 10 and in the surrounding area. A summary of these land uses is provided in Table 11-1 and Table 11-2 below.

HISTORICAL LAND USE	DATE SHOWN ON HISTORICAL MAPS	LOCATION WITHIN ZONE
Historical railway and tramway infrastructure	1891 to 2010	Across zone boundaries and central areas (currently field boundaries).

Table 11-1 Zone 10 Historical industrial sites within zone

HISTORICAL LAND USE WITHIN 250m OF ZONE	DATE SHOWN ON HISTORICAL MAPS	LOCATION
Gas Works	1954 to 1995	To the west in Zone 3 and southwest in Zone 4

Table 11-2 Zone 10 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SE and 79SW Solid and Drift Geology 1:10,560 paper maps (6) (5), the Groundsure Report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and summarised below.

Artificial Ground

An area of artificial ground is recorded to be located beneath the historical railway sidings within the western area of Zone 10.

Superficial Deposits

Peat deposits are indicated to present across the majority of the zone, which are anticipated to be underlain by Glaciofluvial Sheet Deposits, which are also shown to present at the near surface along the southern boundary. The mapped location of the superficial deposits is shown in Figure 11.3 below, with the strata descriptions presented in Table 11-3 below.

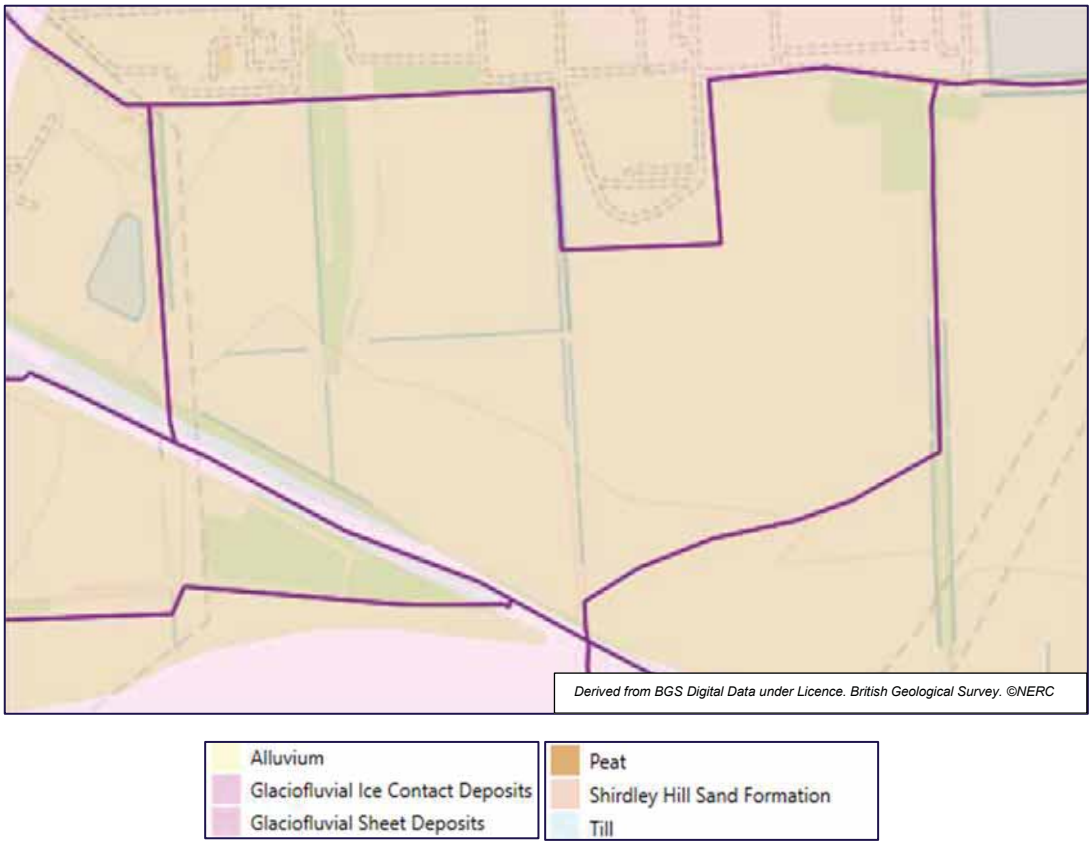

Figure 11.3 Zone 10 Superficial Deposits

DEPOSIT	DESCRIPTION
Peat	Peat is a partially decomposed mass of semi-carbonised vegetation which has grown under waterlogged, anaerobic conditions.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.

Table 11-3 Zone 10 Superficial Deposits

Solid Geology

The majority of the zone to be underlain by the Wilmslow Sandstone Formation, described by the BGS (3) as '*Red-brown to brick-red, fine to medium grained, generally pebble free, cross bedded sandstones, with sporadic siltstone. The sand grains are well rounded and indicate an aeolian origin'*.

The southern extent of the zone is underlain by the Helsby Sandstone Formation, and may be encountered beneath the Wilmslow Sandstone Formation at depth. Described by the BGS (3) as '*Fine to medium grained, locally micaceous, cross-bedded and flat-bedded sandstones, weathering to sand near surface. Sandstones are of fluvial and aeolian facies. Pebbles may be common, particularly near the base of the formation.*'

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is presented in Figure 11.4 below.

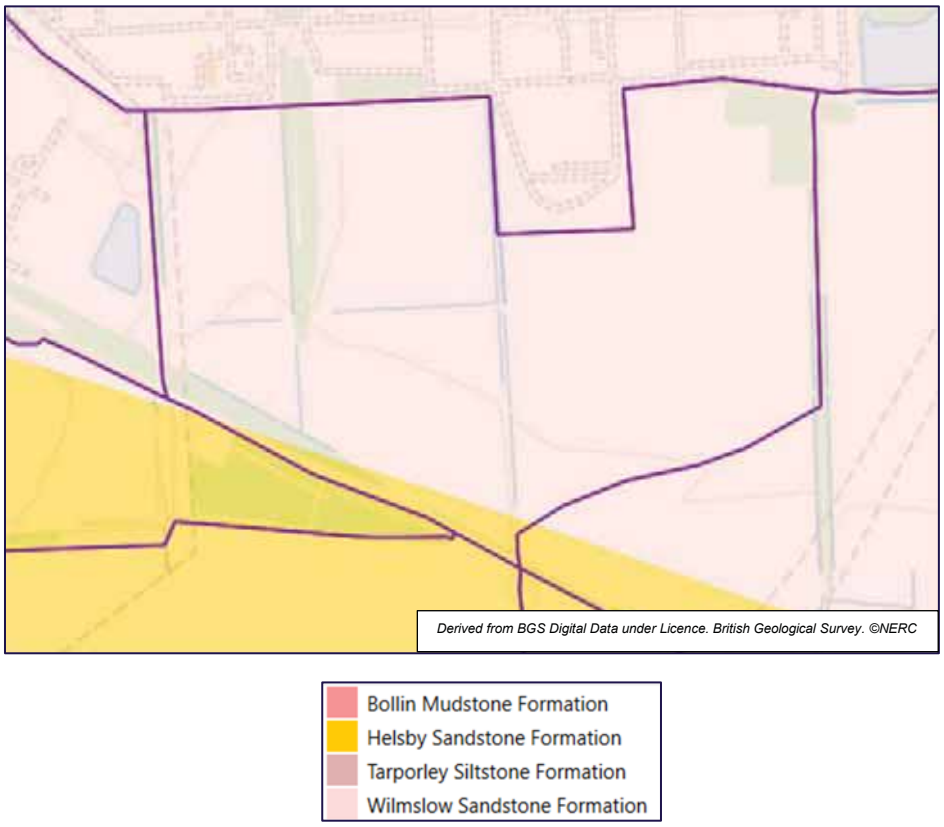

Figure 11.4 Zone 10 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 10 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits within Zone 10.

Surface ground workings are recorded on the southern boundary of the zone, cuttings associated with the historical railway.

No underground workings or non-coal mining records were identified within Zone 10. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 9-4.

HAZARD	HAZARD RATING
Shrink swell clays	Negligible
Running sands	Very Low
Compressible deposits	High to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 11-4 Zone 10 Natural hazards

Hydrogeology

The Wilmslow Sandstone Formation and Helsby Sandstone Formations are classified by the EA as Principal Aquifers, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Glaciofluvial Sheet Deposits are classified by the EA as a Secondary A Aquifer, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*. The Peat is classified as an Unproductive Aquifer

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 10 or the surrounding area, and Zone 10 is not located in a Source Protection Zone.

Groundwater flow is anticipated to be towards the MSC located to the west of the zone and potentially towards Sinderland Brook, a tributary of the River Mersey, located to the south of the zone.

Surface Water Bodies

Sinderland Brook is located approximately 400m south of the zone, flowing east to west towards the MSC, and is classified by the EA as having a 'Poor' (as defined in the Water Framework Directive (10) (a combination of 'Fail' rating for chemical quality and 'Poor' ecological rating), in 2019 (the most recent rating available).

Flooding

The Groundsure Report indicates no risk of river flooding to exist within Zone 10.

With the exception of small, isolated areas, Zone 10 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records no archaeological records to be present within Zone 10.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 10 or the immediate surrounding area.

No Sites of Biological Importance (SBIs) are present with Zone 10.

The eastern areas of the zone which were formerly occupied by tramways are Sites of Importance for Nature Conservation. Additionally, the area of the dismantled railway to the immediate south of Zone 10 is a Site of Importance for Nature Conservation.

Although not formally designated, Carrington Moss (which is a large area of peat bog) extends across Zone 10, and has local environmental interest.

Licenses / Permits / Consents

The Groundsure Report did not identify any existing or historical land uses within Zone 10 that hold (or held) licenses, permits or consents.

Radon

The Groundsure report indicates Zone 10 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required.

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 10 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

11.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 11.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon the assumption for requirements for earthworks, structures, hard standing and road pavement, assessing feasibility and risks for each item.

General

Zone 10 is currently the site of several fields which are undeveloped. Peat is recorded as the superficial geology underlying the entire zone, as part of the historically designated area 'Carrington Moss' and represent a high risk of compressible deposits, as per the Groundsure Report. Historical maps indicate that a historic tramway/ railway passed through the zone, as a result it is likely that some Made Ground associated with the historic sidings are present within the zone.

As noted above, the Peat underlying most of the zone and represents a high risk of compressible deposits, as per the Groundsure Report. The zone is generally at low risk from other geotechnical risks including shrink and swell clays (negligible risk), running sands (very low risk), collapsible deposits (negligible risk) and landslides (very low risk).

It should be noted Zone 10 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 10 is to be comprise employment use.

Potential Proposed Development

Earthworks – Cutting

If cuttings are required within Peat, its poor geotechnical properties must be considered, with it being a high compressibility risk, possessing a low shear strength and high water content. Stabilising a cutting slope in Peat would require localise replacement with engineering fill material or the implementation of a retaining structure, which may require piling.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

There is the potential for Made Ground associated with the historic tramway/railway sidings to be present below the zone. This likely comprises historic fill material and may be highly variable which may not meet modern engineering standards, however, should otherwise be amenable to cutting if sufficient GI confirms its suitability.

Whilst the materials themselves may be amenable to cutting, the materials are considered likely to be contaminated, with potential chemical contaminants originating from the historic tramway/railway line. Any excavated material must be appropriately categorised and disposed of by appropriate means. Additionally, consideration should be given to whether the construction of the cutting will expose contaminants within the Made Ground unit.

The primary bedrock geology is recorded as sandstones of the Helsby Formation (HEY), overlaying the Wilmslow Sandstone Formation (WLSF), which is present to the northwest of the zone. The HEY and WLSF are anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the Helsby Formation and Wilmslow Sandstone Formation may pose a hard dig risk on site.

Earthworks – Embankment

Embankments should not be constructed upon areas of Peat due to high compressibility which would risk issues of settlement and differential settlement of the embankment. If embankments are to be constructed in locations with Peat, deep foundation will be required, or the Peat would likely need to be removed. A possible alternative to the above options is to undertake ground improvement in affected areas to avoid the need for large scale excavations or support structures.

It is possible that Made Ground is present below areas of proposed embankments within the zone. This likely comprises historic fill material and may be highly variable which may not meet modern engineering standards, however, should otherwise be amenable to supporting an embankment if sufficient GI confirms its suitability.

Structures

Employment buildings are proposed for Zone 10, with a Greenway along the southern boundary.

The Peat deposits on site are noted to be high risk compressible deposits. As the proposed structures will be located over areas of Peat, and to avoid removal of Peat, a piled foundation solution such as a raft or alternative stabilisation method such as ground improvement will be required to counteract the settlement of the structure and damage to Peat. However, construction and piling into the Peat may also damage the Peat environment through vibration driven de-watering and sealing with an impermeable layer, which should be minimised.

The potential variable nature of the Made Ground may carry some minor risk of localised instability. In such cases the design should adequately consider variable parameters or the poor material may be removed and replaced by appropriate engineering fill material.

Subgrade

Hard standing, such as road pavement will be required for the proposed employment buildings. The most significant risk to this is the presence of Peat, which present a high compressibility risk which may result in differential settlement of the roads and car parks. This hard standing presents a risk to the Peat itself, introducing an impermeable layer which may damage the Peat environment.

Outgassing features may be considered to prevent gaseous build up beneath any large areas of hard standing, or a permeable material comprising the hard standing areas should be considered, to ensure Peat is not fully drained.

The potential variable nature of the Made Ground may carry some minor risk of localised instability. In such cases the design should adequately consider variable parameters, or the poor material may be removed and replaced by appropriate engineering fill material.

Potential high groundwater levels may present a risk to subgrade and excavation stability. Additionally, extensive impermeable hard standing could increase the surface water flood risk, which is currently designated as low for the majority of the zone. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

The most significant consideration for man-made obstructions for this zone are likely to include the buried sidings associated with the historic tramway/railway previously located within the western section of the zones, in addition to the buried services: gas pipes, electrical and waste pipes.

The historic sidings may require full or partial removal prior to new construction as they could cause obstruction and act as a hard spot leading to differential settlement. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

Up-to-date STATS plans will be required to identify the locations of buried services, in addition to on-site surveys for disused services which may not be present on STATS plans.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 11-5. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Peat identified underlying Zone 10. High compressibility risk.	5	4	20	Peat is a highly compressible material, founding upon which could lead to differential settlement and localised structural failures. Gas build up in confined space, such as below solid foundations. Additionally, Peat creates acidic ground conditions, thus may damage concrete foundations.
2	Existing and potential increased risk of flooding following development of the zone.	2	3	6	Damage to potential future development.
3	Risk of groundwater flooding during construction and potential high groundwater level.	3	4	12	Over conservative design increasing cost and programme.
4	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified, and the site is underlain by sandstones of the HEY and WLSF which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
5	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.
6	Buried Obstructions due to historic tram/railway	3	3	9	Historic buried obstructions may require breakout in order to allow for the construction of new foundations. Increased time and design considerations. Constructability issues. Uncertainty around foundations depth.

Table 11-5 Zone 10 Geotechnical Risk Register

11.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study a limited number of current or historical land uses at Zone 10 and the surrounding area have been identified that could have likely led to contamination at the zone.

Nevertheless, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone and the understanding that the zone will be developed for employment use.

When considering potential sources of groundwater contamination surrounding Zone 10, it has been assumed that the direction of groundwater flow across the scheme is from east to west i.e. towards the MSC. Therefore, only existing or historical land uses that are located to the southeast or east of Zone 10 have been considered as potential sources of contamination.

For potential sources of groundwater contamination surrounding Zone 10, a distance of 250m was considered appropriate as this would capture the most likely sources of groundwater contamination. However, it is acknowledged that a plume of contamination generated within the surrounding area does have the potential to travel distances that are greater than 250m.

Sources

The potential sources of ground contamination identified within Zone 10 (and within 250m for potential sources of groundwater contamination) are summarised below.

Sources and hazards within Zone 10

- With the exception of possible localised Made Ground in the area of the former tramways and railway, no credible sources of contamination within Zone 10 have been identified.
- Deposits of peat are indicated to be present across the majority of the zone which could release stored ground gas into excavations during development

Sources and hazards within 250m of Zone 10

No potential sources of groundwater contamination up gradient of Zone 10 are readily identifiable.

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently Sinderland Brook, the River Mersey and MSC;
- Direct contact of soils and groundwater with foundations and buildings' infrastructure; and,
- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for employment land use the following receptors have been identified (during and following development):

Human Health

- Future users (employees); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed employment properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- Sinderland Brook, MSC and the River Mersey; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment (PRA) in Table 8-5.The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the likelihood (probability) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define likelihood, severity and risk are described in Appendix F.

In the absence of quantitative data, the likelihood and severity for each potential contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

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SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Made Ground associated with the historical railway and tramways with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gases and/or vapours	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 10 (employees)	3	1	3	Following development, the majority of the zone will be hardsurfaced and occupied by buildings. The presence of the hardsurfacing and buildings will prevent the direct exposure of Made Ground to future users. Any areas proposed for soft landscaping may require a suitable thickness of clean cover to provide a suitable growing medium and prevent direct exposure with the Made Ground.
		Construction and maintenance workers	1	1	1	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 10 (employees)	4	1	4	Isolated areas of Made Ground may be present within the vicinity of the historical railway and tramways. However, given the limited extent of such deposits it is unlikely that they would be able to generate significant volumes of ground gas and/or vapours.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	1	4	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	1	3	Given the likely limited extent of Made Ground it is considered unlikely that significant amounts of contaminated wind-blown dust and/or asbestos fibres would be generated during earthworks and construction activities. However, measures to mitigate the risk may need to be implemented during these activities.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	1	3	Following development, the majority of the zone will be hardsurfaced and occupied by buildings. A dedicated surface water drainage network will also be constructed. Therefore, it is considered unlikely that there will be rainfall infiltration with the potential to leach contamination from the Made Ground.
	Direct contact	Foundations and Infrastructure	2	1	2	Given the likely limited extent of Made Ground it is considered unlikely that chemical species that are aggressive towards concrete, and/or which may permeate plastic drinking water supply pipes will be present.
Deposits of peat with the potential to release ground gases	Ingress of ground gas into excavations and confined spaces and subsequent inhalation and/or explosion	Construction and maintenance workers	4	2	8	The potential exists for ground gases released from peat to enter excavations during construction. Whilst atmospheric dispersion of such gases would be expected to occur the potential risk to construction workers would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
Historical land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	Sinderland Brook, River Mersey and MSC	3	1	3	Isolated areas of Made Ground may be present within the vicinity of the historical railway and tramways. However, the historical land uses at the zone are unlikely to have led to significant groundwater contamination.

Table 11-6 Zone 10 Preliminary Risk Assessment (sources within Zone 10)

12. Zone 11

12.1. Desk Study Assessment

Site Location and Current Land Use

Zone 11 is located in the southwestern corner of the Allocation Plan, and is located to the east of Partington. The zone lies between approximately 18 and 24 m Above Ordnance Datum (AOD), gently sloping to the west. The zone currently comprises agricultural land and a small area of woodland (Broadoak Wood). The location and current land use of Zone 11 is shown in Figure 12.1 below.

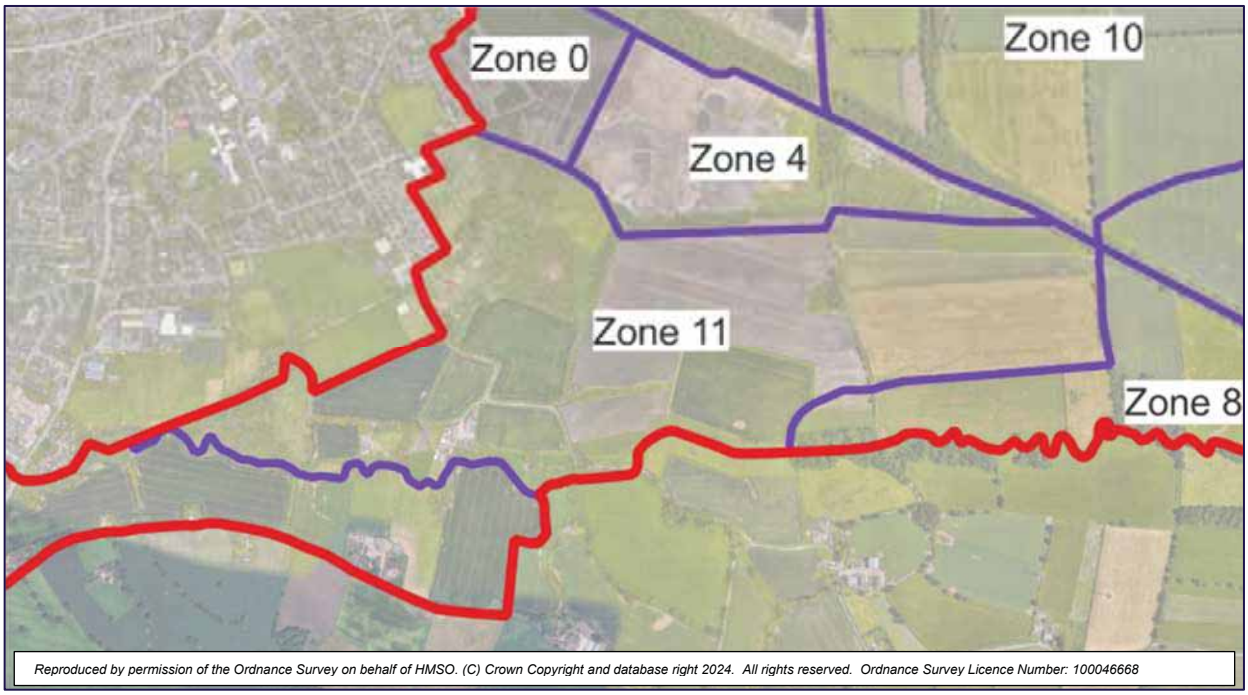

Figure 12.1 Zone 11 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 11 is proposed for residential use.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the 1890s (earliest viewed map) and 2024 the zone comprised agricultural land.

The surrounding area underwent limited development over time with the exception of Partington to the west and the historical gas works (mapped between 1954 and 1990) directly north of the zone, in Zone 4.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 12.2 (top image). The entire zone was shown as agricultural land, with a historical gas works directly north of the zone, and Partington to the west.

Between 2000 and the most recent aerial photography (2024, the second image) the only significant change was demolition of the historical gas works which is in the process of being redeveloped.

Figure 12.2 Zone 11 Aerial Photography

Historical Industrial Sites

The Groundsure Report records no potentially contaminative historical industrial sites within Zone 11, whilst only the former gas works is identified in the surrounding area (as detailed in Table 12-1 below).

HISTORICAL LAND USE WITHIN 250m OF ZONE	DATE SHOWN ON HISTORICAL MAPS	LOCATION
Gas Works	1954 - 1990	Zone 4, directly north of the northern boundary

Table 12-1 Zone 11 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SW Solid and Drift Geology 1:10,560 paper map (5), the Groundsure Report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and summarised below.

Artificial Ground

No artificial ground is recorded within the zone.

Superficial Deposits

The superficial deposits indicated to be present within the zone are Alluvium, Glaciofluvial Sheet Deposits, Peat and Shirdley Hill Sand Formation. The Alluvium deposits are located across the southern boundary adjacent to Red Brook, with the Shirdley Hill Sand Formation recorded to be present in the northwestern corner of the zone. The Glaciofluvial Sheet Deposits are shown across the majority of the zone, with the Peat present in the central and northern areas of the zone. The mapped location of the superficial deposits is shown in Figure 12.3 below, with the strata descriptions presented in Table 11-3 below.

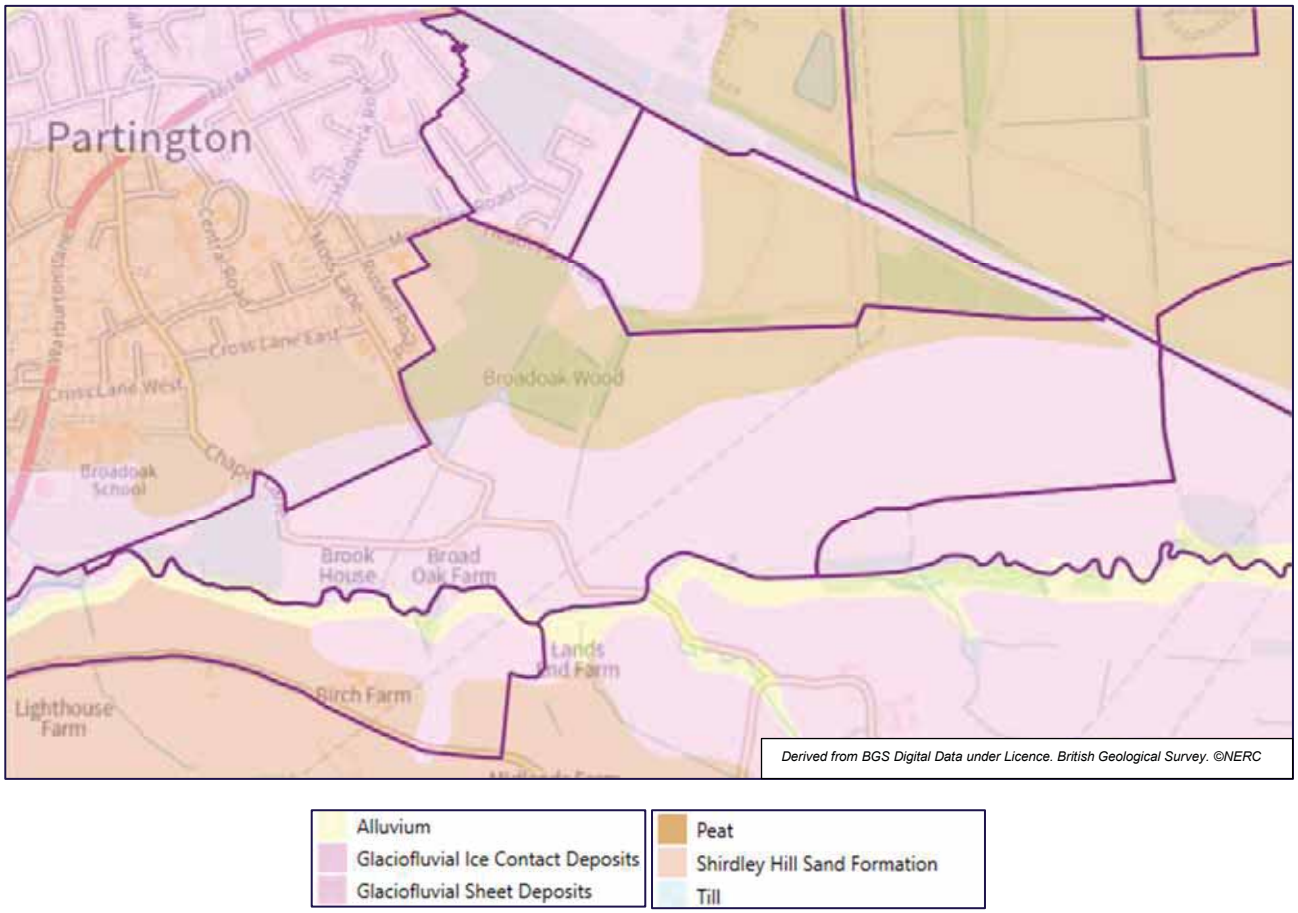

Figure 12.3 Zone 11 Superficial Deposits

DEPOSIT	DESCRIPTION
Alluvium	Clay, silt, sand and gravel, Unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.
Peat	Peat is a partially decomposed mass of semi-carbonised vegetation which has grown under waterlogged, anaerobic conditions.
Shirdley Hill Sand Formation	Moderately to well-sorted, fine-grained sand with peat layers in the lower part. Sand grains are dominated by rounded to sub-rounded quartz grains. The formation is divisible into an upper ‘white’ sand and a lower ‘brown’ sand that is olive grey and brown.

Table 12-2 Zone 11 Superficial Deposits

Solid Geology

The majority of the zone to be underlain by the Helsby Sandstone Formation, with the Tarporley Siltstone Formation underlaying the southern extent of the zone. The Helsby Sandstone Formation is described by the

BGS (3) as '*Fine to medium grained, locally micaceous, cross-bedded and flat-bedded sandstones, weathering to sand near surface. Sandstones are of fluvial and aeolian facies. Pebbles may be common, particularly near the base of the formation.*' The Tarporley Siltstone Formation is described as '*Heterolithic, comprising interlaminated and interbedded siltstones, mudstones and sandstones. Most mudstones and siltstone beds are reddish-brown, though green-grey mottles and laminae are common*'.

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is presented in Figure 12.4 below.

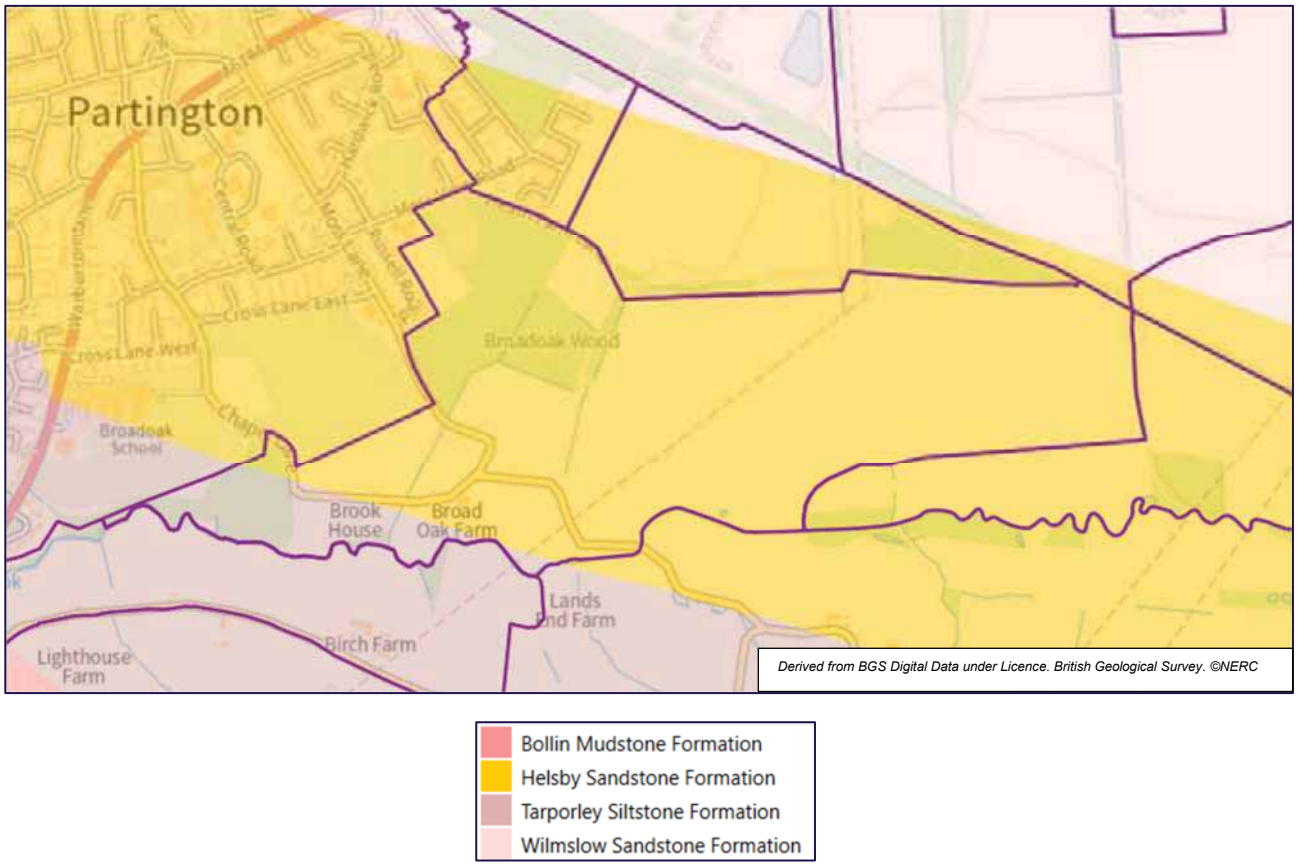

Figure 12.4 Zone 11 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 11 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits to be present within Zone 11

No surface ground workings, underground workings, non-coal mining records were identified within Zone 11. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 12-3.

HAZARD	HAZARD RATING
Shrink swell clays	Very Low to Negligible
Running sands	Low to Very Low
Compressible deposits	Moderate to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 12-3 Zone 11 Natural hazards

Hydrogeology

The Helsby Sandstone Formation is classified by the EA as a Principal Aquifer, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*. The Tarporley Siltstone Formation is classified by the EA as a Secondary B Aquifer, defined as '*predominantly lower permeability layers which may store/yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering'*

The Alluvium, Glaciofluvial Sheet Deposits and Shirdley Hill Sand Formation are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*. The Peat is classified as an Unproductive Aquifer.

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 11 or the surrounding area, and Zone 11 is not located in a Source Protection Zone.

Groundwater flow is anticipated to be towards the Red Brook which forms the zone's southern boundary.

Surface Water Bodies

The Red Brook is located directly south of Zone 11, which flows in a generally westerly direction. The Brook is a tributary of the River Mersey, and is classified by the EA as having a 'Poor' (as defined in the Water Framework Directive (10) (a combination of 'Fail' rating for chemical quality and 'Poor' ecological rating), in 2019 (the most recent rating available).

Flooding

The area of Zone 11 immediately adjacent to the Red Brook is indicated to be in Flood Zone 3, and has a High probability of flooding (defined as greater than or equal to 1 in 30 chance) as a result of its close proximity to this water body.

With the exception of small isolated areas, Zone 11 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records no archaeological records to be present within Zone 11.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 11 or the immediate surrounding area.

A non-statutory Site of Biological Importance (SBI), named Broadoak Wood, is located in the northwestern area of the zone. This area is also designated as a Site of Importance for Nature Conservation.

An additional Site of Importance for nature Conservation is located within the eastern area of the zone.

Licenses / Permits / Consents

The Groundsure Report shows the following industrial sites at the zone that hold (or recently held) environmental licenses, permits or consents:

- Dark Lane historical landfill (located in the same location as the former sewage disposal works) located to the south of the eastern area of Zone 11, within Zone 8. The landfill is recorded to have accepted household waste and liquid sludge, although no dates for its operation are provided.

Radon

The Groundsure Report indicates that Zone 11 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required.

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that there is a low potential for UXB to be present in Zone 11 due to WWII bombardment. The risk map from Zetica is presented in Appendix D.

12.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 12.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon the assumption for requirements for earthworks, structures, hard standing and road pavement, assessing feasibility and risks for each item.

General

Zone 11 is the site of a several undeveloped fields with the only development within Zone 11 being Broad Oak Farm located within the southwestern section of the zone.

Peat is recorded as the superficial geology underlying minor areas in the north of the zone and represent a high risk of compressible deposits, as per the Groundsure Report. Historically, this zone comprised an area referred to as 'Carrington Moss', an area of bog land. The present day understood extent of the peat across New Carrington, also known as Carrington Moss, covers a reduced portion of this bog, likely due to historical development across the scheme.

The majority of Zone 11 is underlain by Glaciofluvial Sheet Deposits generally in the south of the zone. Additionally, a small section to the west of the Peat is underlain by the Shirdley Hill Sand Formation. The zone is generally at low risk from other geotechnical risks including shrink and swell clays (negligible risk), running sands (very low risk), collapsible deposits (negligible risk) and landslides (very low risk).

It should be noted Zone 11 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 11 is to be comprised of a residential area.

Potential Proposed Development

Earthworks – Cutting

If cuttings are required within Peat, its poor geotechnical properties must be considered, with it being a high compressibility risk, possessing a low shear strength and high water content. Stabilising a cutting slope in Peat would require localise replacement with engineering fill material or the implementation of a retaining structure, which may require piling.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The Glaciofluvial Sheet and Shirdley Hill Sands deposits are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within this type of deposit, localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

The primary bedrock geology is recorded as sandstones of the Helsby Formation (HEY), overlaying the Wilmslow Sandstone Formation (WLSF), which is present to the northwest of the zone. The HEY and WLSF are anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the Helsby Formation and Wilmslow Sandstone Formation may pose a hard dig risk on site.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material. As Zone 11 is generally undeveloped, site won material is not anticipated to be contaminated. However, site won material around the Broad Oak Farm may be too contaminated to use in embankment construction due to the agricultural history of the specific area, even if it meets engineering fill criteria.

Embankments should not be constructed upon areas of Peat due to high compressibility which would risk issues of settlement and differential settlement of the embankment. If embankments are to be constructed

in locations with Peat, deep foundation will be required, or the Peat would likely need to be removed. A possible alternative to the above options is to undertake ground improvement in affected areas to avoid the need for large scale excavations or support structures.

Other site geologies are anticipated to generally be amenable to embankment construction.

Structures

Residential buildings are currently proposed for Zone 11.

For structures to be located over any area of Peat, and to avoid removal of Peat, a piled foundation solution such as a raft or alternative stabilisation method such as ground improvement will be required to counteract the settlement of the structure and damage to Peat. Construction and piling into the Peat may also damage the Peat environment through vibration driven de-watering and sealing with an impermeable layer, which should be minimised.

Founding upon the Glaciofluvial Sheet and Shirdley Hill Sands Deposits within this zone does not present as significant a risk. In general, the zones geology does not present a significant risk of natural ground subsidence, with risks of shrink swell clays, collapsable deposits, landslides, running sands and ground dissolution being negligible to very low.

The variable nature of Glaciofluvial Sheet and Shirdley Hill Sands Deposits may carry some risk of localised instability. In such cases the sufficient GI for adequate design should account for variability, or the material may be removed and replaced by appropriate engineering fill material. An alternative method may be to undertake ground improvement within these areas to prevent the transportation of imported material and reduce waste on site.

Subgrade

Hard standing, such as road pavement and parking areas are likely to be associated with the planned residential areas. The most significant risk to this is the presence of Peat, which present a high compressibility risk which may result in differential settlement of housing and roads. This hard standing presents a risk to the Peat itself, introducing an impermeable layer which may damage the Peat environment.

Areas of open ground should be considered as part of the housing development design, such that complete cover by hard standing is minimised. Outgassing features may be considered to prevent gaseous build up beneath any large areas of hard standing, or a permeable material comprising the hard standing areas should be considered, to ensure Peat is not fully drained. There is a potential for future residents to undertake adjustments to their properties such as driveway extensions and grass replacement which may increase the amount of non-permeable and hardstanding areas.

Potential high groundwater levels may present a risk to subgrade and excavation stability. Extensive impermeable hard standing associated with the residential areas could increase the surface water flood risk, which is currently designated as low for the majority of the zone and increase the extent of the high risk of river flooding in the vicinity of Red Brook. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Man-Made Obstructions

As the Zone is generally agricultural in nature the risk to the developments within Zone 11 from manmade obstructions is low. Any historic foundations associated with Broad Oak Farm may require full or partial removal prior to new construction. Buried services likely exist within the zone, associated the existing farm, in addition to feeding into passing through to other zones.

Any historic foundations may require full or partial removal prior to new construction. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

Up-to-date STATS plans will be required to identify the locations of buried services, in addition to on-site surveys for disused services which may not be present on STATS plans.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 12-4. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Peat identified underlying a large section of Zone 11. High compressibility risk.	5	4	20	Peat is a highly compressible material, founding upon which could lead to differential settlement and localised structural failures. Gas build up in confined space, such as below solid foundations. Additionally, Peat creates acidic ground conditions, thus may damage concrete foundations.
2	Localised variability in the Glaciofluvial Sheet Deposits.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
3	Existing and potential increased risk of flooding following development of the zone.	2	3	6	Damage to potential future development.
4	Existing foundations associated with the farm development in Zone 11	5	3	15	Existing foundations may require breakout for new foundation design. Increased time and design considerations. Uncertainty around foundations depth and locations may impact requirements for piled foundations.
5	Risk of flooding during construction and potential high groundwater level.	3	4	12	Over conservative design increasing cost and programme.
6	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified, and the site is underlain by sandstones of the HEY and WLSF which are known to not be halite bearing.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
7	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 12-4 Zone 11 Geotechnical Risk Register

12.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study no existing or historical land uses at Zone 11 and the surrounding area have been identified that could have led to contamination at the zone.

However, Made Ground (potentially contaminated) may be present in isolated areas where existing infrastructure is present. Therefore, in accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone and the understanding that the zone will be developed for residential use.

Sources

No readily identifiable potential sources of contamination are present within Zone 11. The only possible known sources of contamination are restricted to potentially isolated areas of Made Ground associated with existing infrastructure.

No significant up groundwater gradient existing or historical land uses with the potential to have led to groundwater contamination that could migrate into the zone have been identified.

Deposits of peat are expected to be present across the northern area of the zone which could release stored ground gas into excavations during development

Pathways

The key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas and/or vapours into excavations and buildings, and subsequent inhalation and/or explosion;
- Inhalation of wind-blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater and subsequently the River Mersey and MSC;
- Direct contact of soils and groundwater with foundations and buildings' infrastructure; and,
- Lateral migration of contaminated groundwater

Receptors

Based on the development of the zone for residential land use the following receptors have been identified (during and following development):

Human Health

- Future users (residents); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for proposed residential properties

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- Red Brook, MSC; and,
- Members of public in surrounding areas.

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment (PRA) in Table 8-54.The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the likelihood (probability) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define likelihood, severity and risk are described in Appendix F.

In the absence of quantitative data, the likelihood and severity for each potential contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Isolated areas of Made Ground with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 11 (residents)	3	1	3	Whilst isolated areas of Made Ground may be present, it is considered unlikely that these will be widespread and are unlikely to be present at the near surface within areas proposed for back gardens.
		Construction and maintenance workers	1	1	1	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas and/or vapours into buildings and subsequent inhalation	Future users of Zone 11 (employees)	4	1	4	It is considered unlikely that isolated areas of Made Ground would have the potential to generate sufficient volumes of ground gas and/or vapours that would present unacceptable risks.
	Ingress of ground gas and/or vapours into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	1	4	
	Ingress of ground gas and/or vapours into buildings and subsequent explosion	Building Infrastructure	4	1	4	
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	1	3	The potential exists for contaminated wind-blown dust and/or asbestos fibres to be generated during earthworks and construction activities. However, as any Made Ground present is likely to be minimal it is unlikely that significant amounts of contaminated dust and asbestos fibres would be generated.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	1	3	The potential exists for rainfall infiltration to leach any contamination present within Made Ground into the underlying groundwater. However, since any Made Ground is likely to be of limited extent it is unlikely that that this would lead to a plume of contamination.
	Direct contact	Foundations and Infrastructure	2	1	2	Given the likely limited extent of Made Ground it is considered unlikely that chemical species that are aggressive towards concrete, and/or which may permeate plastic drinking water supply pipes will be present.
Deposits of peat with the potential to release ground gases	Ingress of ground gas into excavations and confined spaces and subsequent inhalation and/or explosion	Construction and maintenance workers	4	1	4	The potential exists for ground gases released from peat to enter excavations during construction. Whilst atmospheric dispersion of such gases would be expected to occur the potential risk to construction workers would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
Historical and existing land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	Sinderland Brook/Red Brook and MSC	3	1	3	No current or historical land uses have been identified at the zone. Therefore, it is considered unlikely that a plume of groundwater contamination is present at the zone.

Table 12-5 Zone 11 Preliminary Risk Assessment (sources within Zone 11)

13. Zone 12

13.1. Desk Study Assessment

Site Location and Current Land Use

Zone 12 is located within the eastern half of the Allocation Plan, and generally comprises agricultural land. The zone also includes the small area of woodland and parkland that is located to the east of Zone 7. The zone lies between approximately 20 m and 25 m Above Ordnance Datum (AOD).

Within Zone 12 there are a small number of commercial and industrial land uses, notably the National Grid electricity substation located within the northern half of the zone; Manchester United Football Club's training ground in the central area; and Altrincham Sewage Treatment Works in the southeastern area. The location and current land use of Zone 12 is shown in Figure 13.1 below.

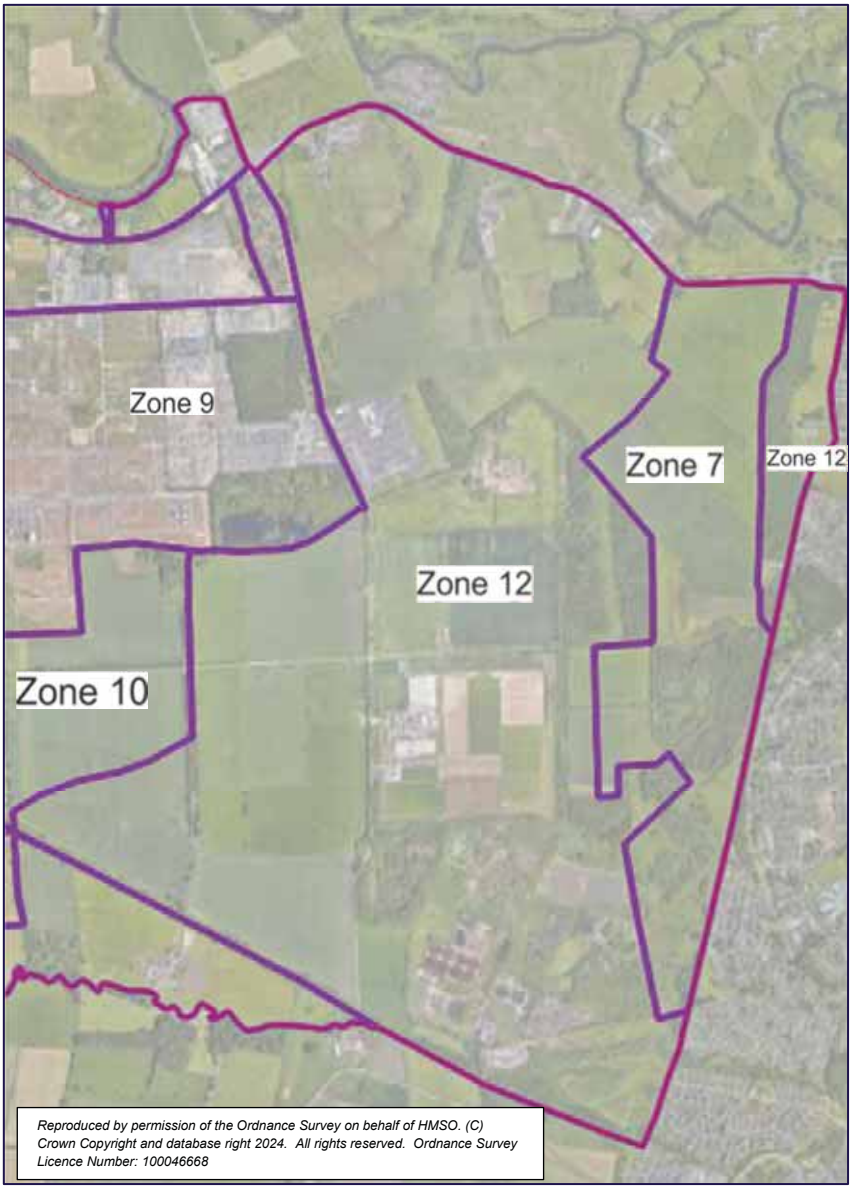

Figure 13.1 Zone 12 Location Plan

Proposed Land Use

Within the Allocation Plan, Zone 12 is proposed to remain as part of the Green Belt.

Historical Development

A review of the historical map data provided in the Groundsure Report (4) is summarised below, with the historical maps provided in Appendix C.

Between the earliest mapping available (1897) and 2024 mapping, Zone 12 and the surrounding land largely consisted of farmland and associated farm buildings.

The Cheshire Lines Railway formed the zone's southern boundary until it was recorded as dismantled within the 1980-1985 mapping.

Altrincham sewage works has been located in the southeastern area of the zone since the 1960s, and an electricity substation has been located in the northwestern area of the zone since the 1970s.

Aerial Photography

Google Earth™ (2) was reviewed to obtain historical imagery for the zone. The earliest available, and legible, aerial photograph is for the year 2000, presented in Figure 13.2 (left image). The majority of the zone comprises agricultural land, with the commercial and industrial uses noted within the historical development section (above) also shown. No significant changes to the land uses within the zone are indicated between the 2000 and 2024 imagery (right image).

Figure 13.2 Zone 12 Aerial Photography

Historical Industrial Sites

The Groundsure Report records a limited number of potentially contaminative historical industrial sites within Zone 12 and in the surrounding area. A summary of these land uses is provided in Table 3-1 and Table 3-2 below.

HISTORICAL LAND USE	DATE SHOWN ON HISTORICAL MAPS	LOCATION WITHIN ZONE
Historical railway infrastructure	1891 to 2010	Southern boundary
Sewage treatment works	1969 – present	Southeastern area
National Grid Substation	1978 – present	Northwestern area

Table 13-1 Zone 12 Historical industrial sites within zone

HISTORICAL LAND USE WITHIN 250m OF ZONE	DATE SHOWN ON HISTORICAL MAPS	LOCATION
Former petrochemical plant	1954 – 1990s	To the west of the northern area (Zone 6)

Table 13-2 Zone 12 Historical industrial sites within 250m of the zone

Geology

Existing information sourced from the British Geological Survey (BGS) Sheet 79SE Solid and Drift Geology 1:10,560 paper maps (6), the Groundsure Report (4) and the British Geological Survey (BGS) Onshore GeoIndex Tool (3) were reviewed and summarised below.

Artificial Ground

No artificial ground is recorded to be located beneath the majority of Zone 12, with a small area shown in the southern area, associated with the former railway.

Superficial Deposits

Peat deposits are shown to be located across the central area of the zone, and are indicated to be underlain by Glaciofluvial Sheet Deposits which underlie the majority of the zone. Small areas of Alluvium are located at both the north and southern boundaries, and an area of the Shirdley Hill Sand Formation is shown in the northwestern area. The mapped location of the superficial deposits is shown in Figure 12.3 below, with the strata descriptions presented in Table 11-33 below.

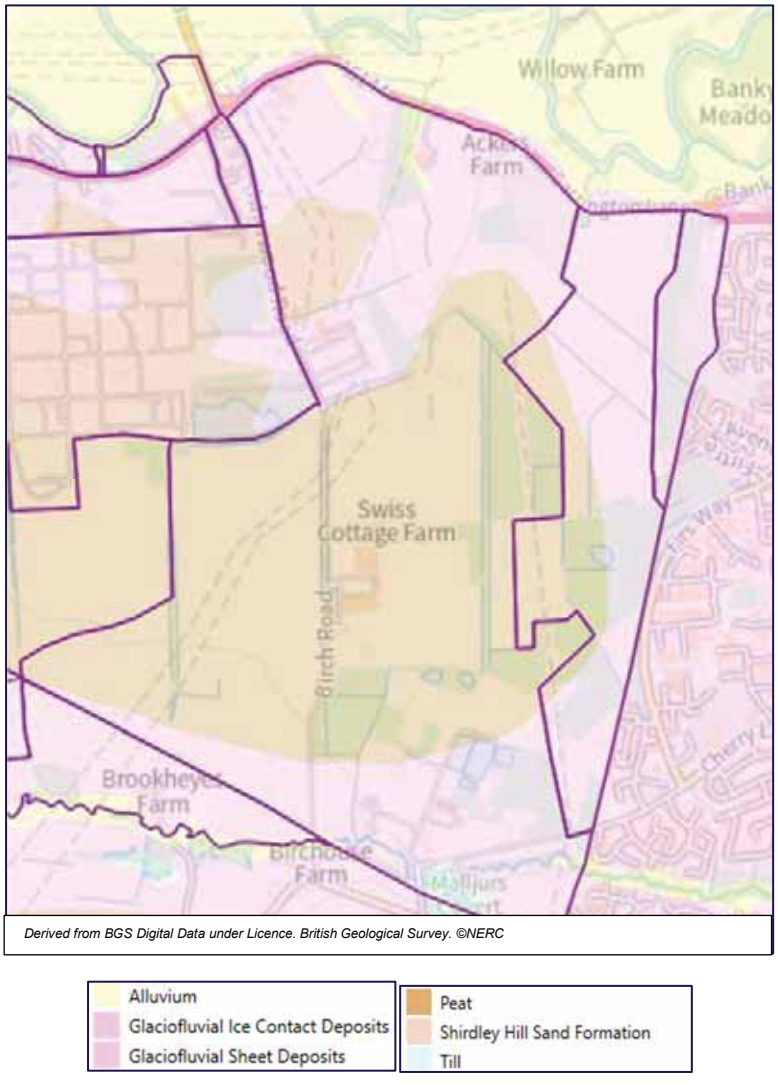

Figure 13.3 Zone 12 Superficial Deposits

DEPOSIT	DESCRIPTION
Peat	Peat is a partially decomposed mass of semi-carbonised vegetation which has grown under waterlogged, anaerobic conditions.
Glaciofluvial Sheet Deposits	Sand and gravel, locally with lenses of silt, clay or organic material; characteristic 'sandur' (sheet) and valley train form; of glaciofluvial origin.
Shirdley Hill Sandstone Formation	Moderately to well-sorted, fine-grained sand with peat layers in the lower part. Sand grains are dominated by rounded to sub-rounded quartz grains. The formation is divisible into an upper 'white' sand and a lower 'brown' sand that is olive grey and brown.
Alluvium	Clay, silt, sand and gravel, Unconsolidated detrital material deposited by a river, stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream.

Table 13-3 Zone 12 Superficial Deposits

Solid Geology

The majority of the zone is shown by the BGS (3) to be underlain by the Wilmslow Sandstone Formation, described as 'Red-brown to brick-red, fine to medium grained, generally pebble free, cross bedded sandstones, with sporadic siltstone. The sand grains are well rounded and indicate an aeolian origin' by the. The southern area of the zone is shown to be underlain by the Helsby Sandstone Formation, described as 'Fine to medium grained, locally micaceous, cross-bedded and flat-bedded sandstones, weathering to sand near surface. Sandstones are of fluvial and aeolian facies. Pebbles may be common, particularly near the base of the formation'.

The BGS Onshore GeoIndex Tool (1:50,000 scale map) does not indicate any faults to be present within the zone. The solid geology is presented in Figure 13.4 below

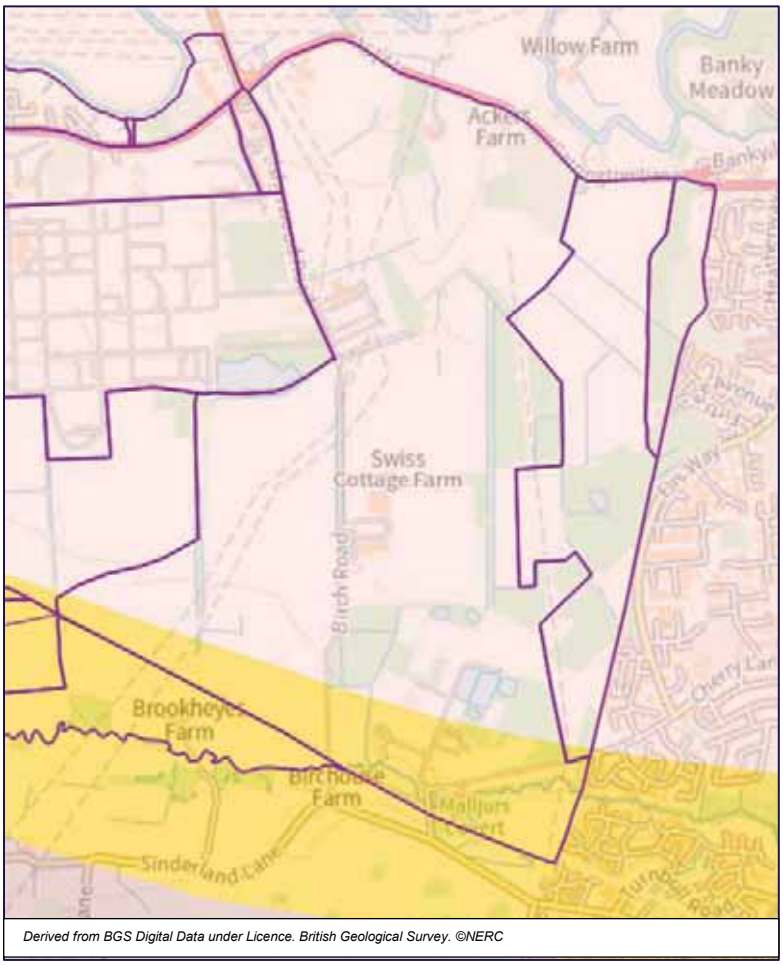

Figure 13.4 Zone 12 Solid Geology

Coal Mining

The Coal Authority Interactive Map (8) indicates that Zone 12 does not lie within a coal mining reporting area.

Non-Coal Mining, Brit Pits and Ground Works

The Groundsure Report records no BritPits within Zone 12.

One area of surface ground workings is recorded, which comprises sludge beds within the southeastern area of the zone, associated with the sewage treatment plant.

No underground workings or non-coal mining records were identified within Zone 12. It should be noted that the zone lies within The Cheshire Brine Compensation District.

Natural Ground Subsidence

The ratings for potential natural hazards provided within the Groundsure Report are summarised in Table 13-4 below.

HAZARD	HAZARD RATING
Shrink swell clays	Very Low to Negligible
Running sands	Low to Very Low
Compressible deposits	High to Negligible
Collapsible deposits	Very Low to Negligible
Landslides	Very Low
Ground dissolution of soluble rocks	Negligible

Table 13-4 Zone 12 Natural hazards

Hydrogeology

The Wilmslow Sandstone Formation and Helsby Sandstone Formations are classified by the EA as Principal Aquifers, defined as '*rocks that provide significant quantities of water and can support water supply and/or baseflow to rivers on a strategic level'*.

The Glaciofluvial Sheet Deposits, Alluvium and the Shirdley Hill Sand Formation are classified by the EA as Secondary A Aquifers, defined as '*permeable layers that can support local water supplies, and may form an important source of base flow to rivers'*. The Peat is classified as an Unproductive Aquifer

The Groundwater Bodies which underlie the zone are the Weaver and Dane Quaternary Sand and Gravel Aquifers (ID:GB41202G991700), and the Manchester and East Cheshire Permo-Triassic Sandstone Aquifers (ID:GB41201G101100). Both of these bodies were rated by the EA as having a 'Poor' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Poor' chemical quality rating and 'Good' quantitative rating) in 2019 (the most recent rating available).

There are no licensed groundwater abstraction licenses in Zone 12 or the surrounding area, and Zone 12 is not located in a Source Protection Zone.

Groundwater flow is anticipated to be towards the Sinderland Brook (a tributary of the River Mersey) to the south of the zone, and the River Mersey to the north of the zone.

Surface Water Bodies

The River Mersey, located approximately 80m north of Zone 12, has been rated by the EA as having a 'Moderate' (as defined in the Water Framework Directive (10)) overall rating (which is a combination of the 'Fail' chemical quality rating and 'Good' ecological rating) in 2019 (the most recent rating available).

The Sinderland Brook has an overall rating of 'Poor' (a combination of 'Fail' rating for chemical quality and 'Poor' ecological rating), assessed in 2019

Flooding

The area of Zone 1 immediately adjacent to Sinderland Brook is indicated to be in Flood Zone 3 and has a High probability of flooding (defined as greater than or equal to 1 in 30 chance) as a result of its close proximity to this water body. The rest of the zone is at a low risk of flooding from Sinderland Brook and the River Mersey.

With the exception of small, isolated areas, Zone 12 is at a low risk of surface water and groundwater flooding.

Archaeology

The Groundsure Report records no archaeological records to be present within Zone 12.

Environmental Designations

No statutory environmental designations were identified within the Groundsure Report within Zone 12, with the exception of the majority of the zone lying within the Green Belt designation. However, the zone lies within an SSSI Impact Risk Zone for Brookheys Covert (an ancient woodland), located approximately 20m south of the zone.

Three non-statutory Sites of Biological Importance (SBI) are located within Zone 12, all of which are located within the southern area of the zone. These SBIs are named Altrincham Sewage Works, Birchmoss Covert and Malljurs Covert. These areas are also designated Sites of Importance for Nature Conservation.

Additional Sites of Importance for Nature Conservation are the footpaths (and hedgerows) that run in a north to south direction either side of Manchester United Football Club's training ground.

Although not formally designated, Carrington Moss (which is a large area of peat bog) extends across the central and southern areas of Zone 12, and has local environmental interest.

Licenses / Permits / Consents

The Groundsure Report shows the following industrial sites at the zone that hold (or recently held) environmental licenses, permits or consents:

- Altrincham Sewage Works Landfill, in the southeastern corner of the zone. The landfill is recorded to have accepted industrial, commercial, household, special waste, liquid sludge and inert wastes, operational between 1967 and 1972
- South of Askers Farm Landfill is indicated to be present in the northeastern corner of Zone 12, recorded to accept industrial and liquid sludge (no dates of operation are provided).

Radon

The Groundsure report indicates Zone 12 lies within an area where less than 1% of the properties exceed the Radon Action Level, therefore no protection measures are anticipated to be required.

Unexploded Bombs (UXB)

The Zetica UXB Online Risk Map (9) indicates that for the majority of Zone 12 there is a low potential for UXB to be present due to WWII bombardment. Within the southeastern corner of the zone there is a moderate potential for UXB to be present. The risk map from Zetica is presented in Appendix D.

13.2. Preliminary Engineering Assessment and Geotechnical Risk Register

Based on the findings of the review of relevant information undertaken in Section 13.1 together with an understanding of the potential proposed development a preliminary engineering assessment to identify possible constraints to development is presented below.

In absence of detailed design plans, preliminary engineering assessments are based upon the assumption for requirements for earthworks, structures, hard standing and road pavement, assessing feasibility and risks for each item.

General

Zone 12 is the site of a several undeveloped fields with what appears to be a water treatment plant located along the southern boundary of Zone 12. The Carrington Training Centre is located within the centre of Zone 12. A large National Grid installation is present within the north of the zone. Peat is recorded as the superficial geology underlying the vast majority of the zone and represent a high risk of compressible deposits, as per the Groundsure Report. Historically, this zone comprised an area referred to as 'Carrington Moss', an area of bog land. The present day understood extent of the peat across New Carrington, also known as Carrington Moss, covers a reduced portion of this bog, likely due to historical development across the scheme.

Minor areas of Glaciofluvial Sheet Deposits encircle the zone, most significantly to the north and south. Additionally, a small section Shirdley Hill Sand Formation is located to the north of the Peat. The zone is generally at low risk from other geotechnical risks including shrink and swell clays (negligible risk), running sands (very low risk), collapsible deposits (negligible) and landslides (very low risk). It is also likely that Made Ground will be present within the zone associated with the Carrington Training Centre, the large National Grid Installation in the north of the zone and existing road constructions.

An area of sludge beds surface ground workings is recorded within the southeastern area of the zone, to the north of the existing sewage treatment plant. This may or may not have been filled in as a result there is potential for a large pit to be present.

A review of the available Unexploded Ordnance, UXO, risk maps has indicated that sections of Zone 12 are at moderate risk from UXO. A detailed UXO Risk Assessment should be acquired for proposed developments within Zone 12.

The Groundsure report indicates there is an area of historic surface mining within the southeastern section of Zone 12. No developments are proposed for this area and so it is not considered an exceptional risk to the scheme.

It should be noted Zone 12 falls within the Cheshire Brine Compensation District.

The Allocation Plan indicates Zone 12 is to remain largely unchanged with the construction of Carrington Relief Road across the northern area of the zone.

Potential Proposed Development

Earthworks – Cutting

If cuttings are required within Peat, its poor geotechnical properties must be considered, with it being a high compressibility risk, possessing a low shear strength and high water content. Stabilising a cutting slope in Peat would require localise replacement with engineering fill material or the implementation of a retaining structure, which may require piling.

Potential high groundwater levels may present a risk to cutting stability and increase risk of surface flooding within cutting area.

The Glaciofluvial Sheet and Shirdley Sands Deposits are anticipated to be amenable to cuttings, with parameters from GI supporting cutting design. However, due to the large potential for local variation within this type of deposit, localised replacement with engineering fill may be required to achieve stable slope angles. This material does not present a significant risk to potential cuttings.

There is the potential for Made Ground associated with the Carrington Training Centre, the National Grid installation, sludge beds and existing road constructions to be present below the zone. This likely comprises historic fill material and may be highly variable which may not meet modern engineering standards, however, should otherwise be amenable to cutting if sufficient GI confirms its suitability. Additionally, consideration should be given to whether the construction of the cutting will expose contaminants within the Made Ground unit.

The primary bedrock geology is recorded as sandstones of the Helsby Formation (HEY), overlaying the Wilmslow Sandstone Formation (WLSF), which is present to the northwest of the zone. The HEY and WLSF are anticipated to be amenable to cuttings with parameters from GI supporting cutting design. Due to the anticipated depth of bedrock in this zone, direct interaction via cutting is unlikely. However, if encountered the Helsby Formation and Wilmslow Sandstone Formation may pose a hard dig risk on site.

Whilst the materials themselves may be amenable to cutting, the materials are considered to be potentially contaminated, with potential chemical contaminants originating from the National Grid installation. Any excavated material must be appropriately categorised and disposed of by appropriate means.

Risk maps indicate a moderate risk of UXO is present across Zone 12 which poses a risk during the construction of cuttings due to the required excavation of material.

Earthworks – Embankment

Embankments should be constructed from appropriate imported engineering fill material. As Zone 12 is generally undeveloped, site won material is generally not anticipated to be contaminated. However, site won material around the Carrington Training Centre, National Grid installation and roads may be too contaminated to use in embankment construction, even if it meets engineering fill criteria.

Embankments should not be constructed upon areas of Peat due to high compressibility which would risk issues of settlement and differential settlement of the embankment. If embankments are to be constructed in locations with Peat, deep foundation will be required, or the Peat would likely need to be removed. A possible alternative to the above options is to undertake ground improvement in affected areas to avoid the need for large scale excavations or support structures.

It is possible that Made Ground is present below areas of proposed embankments within the zone. This likely comprises historic fill material and may be highly variable which may not meet modern engineering standards, however, should otherwise be amenable to supporting an embankment if sufficient GI confirms its suitability.

Other site geologies are anticipated to generally be amenable to embankment construction.

Structures

A single lane relief road and several commercial buildings are proposed for Zone 12.

Where the relief road is likely to be located over the area of Peat, it is recommended that the Peat be excavated to remove the risk of excessive settlement.

The Peat deposits on site are noted to be high risk compressible deposits.

Aside from the Peat, construction of the relief road upon the other geologies within this zone does not present as significant a risk. In general, these geologies do not present a significant risk of natural ground subsidence, with risks of shrink swell clays, collapsable deposits, running sands, landslides and ground dissolution being negligible to very low.

For structures to be located over any area of Peat, and to avoid removal of Peat, a piled foundation solution such as a raft or alternative stabilisation method such as ground improvement will be required to counteract the settlement of the structure and damage to Peat. Construction and piling into the Peat may also damage the Peat environment through vibration driven de-watering and sealing with an impermeable layer, which should be minimised.

Founding upon the Glaciofluvial Sheet and Shirdley Hill Sands Deposits within this zone does not present as significant a risk. In general, the zones geology does not present a significant risk of natural ground

subsidence, with risks of shrink swell clays, collapsable deposits, landslides, running sands and ground dissolution being negligible to very low.

The variable nature of Glaciofluvial Sheet and Shirdley Hill Sands Deposits may carry some risk of localised instability. In such cases the sufficient GI for adequate design should account for variability, or the material may be removed and replaced by appropriate engineering fill material. An alternative method may be to undertake ground improvement within these areas to prevent the transportation of imprted material and reduce waste on site.

The potential variable nature of the Made Ground may carry some minor risk of localised instability. In such cases the design should adequately consider variable parameters or the poor material may be removed and replaced by appropriate engineering fill material. AS with the Glasciofluvial deposits above it is possible that ground improvement would be a suitable alternative to excavation and replacement in these areas.

Risk maps indicate a moderate risk of UXO is present across Zone 12 which poses a risk during the construction of structures due to the required excavation of material. Additionally, potential disturbed UXO could severely damage structures following construction if additional works occur in future.

Subgrade

The most significant risk to this is the presence of Peat, which present a high compressibility risk which may result in differential settlement of the commercial buildings, roads and car parks. This hard standing presents a risk to the Peat itself, introducing an impermeable layer which may damage the Peat environment.

Outgassing features may be considered to prevent gaseous build up beneath any large areas of hard standing, or a permeable material comprising the hard standing areas should be considered, to ensure Peat is not fully drained.

Potential high groundwater levels may present a risk to subgrade and excavation stability. Extensive impermeable hard standing associated with the commercial areas in the west of the zone could increase the surface water flood risk, which is currently designated as low for the majority of the zone. Potential risk may be reduced with a design implementing permeable hard standing and adequate drainage design.

Risk maps indicate a moderate risk of UXO is present across Zone 12 which poses a risk subgrade.

Man-Made Obstructions

Due to the largely undeveloped nature of Zone 12 man-made obstructions are unlikely to be present across the zone. However, a number of buried services are known to be located along the proposed path of the relief road which include jet fuel pipe, gas pipes, electrical and waste pipes and potentially buried tanks.

Any historic foundations may require full or partial removal prior to new construction. The voids left by these foundations will require backfilling with appropriate fill material or be subject to appropriate ground improvement.

Up-to-date STATS plans will be required to identify the locations of buried services, in addition to on-site surveys for disused services which may not be present on STATS plans.

Preliminary geotechnical risk register

The potential geotechnical hazards to the proposed development within this zone during the feasibility, design and construction phases that have been identified are presented within Table 13-5. A qualitative assessment of the potential risks presented by each hazard has been made in accordance with the approach outlined in CD 622 Revision 1 (11). Risk is considered to be a function of the likelihood of the hazard occurring and the potential severity of impact should the hazard occur. Both likelihood and severity are scored 1 to 5, and the product of these two variables provides a risk rating score (i.e. Risk = Likelihood x Severity). For each potential hazard identified a risk rating is assigned before and after mitigation.

The risk classification system used to define likelihood, severity and risk are described in Appendix E.

RISK NO	HAZARD	RISK RATING BEFORE MITIGATION			CONSEQUENCE
		LIKELIHOOD	SEVERITY	RISK	
1	Peat identified underlying a large section of Zone 12. High compressibility risk.	5	4	20	Peat is a highly compressible material, founding upon which could lead to differential settlement and localised structural failures. Gas build up in confined space, such as below solid foundations. Additionally, Peat creates acidic ground conditions, thus may damage concrete foundations.
2	Localised variability in the Glaciofluvial Sheet Deposits.	4	3	12	Localised variability of ground composition and conditions may affect local stability.
4	Existing and potential increased risk of flooding following development of the zone.	2	3	6	Damage to potential future development.
5	Risk of flooding during construction and potential high groundwater level.	3	4	12	Over conservative design increasing cost and programme.
6	Surface Mining within Zone 12.	4	4	16	Presence of large voids at surface which require infilling with suitable fill material increasing cost and programme. Poorly backfilled surface working which create a risk of voiding and collapse below the proposed development.
7	Unexploded Ordnance (UXO)	3	5	15	Detonation of historic UXO leading to catastrophic damage of structures and surrounding area. Potential for fatalities on site due to UXO detonation.
8	Zone within the Cheshire Brine Compensation District. However no historic brine extraction identified.	2	3	6	Historic extraction of brine may result in ground subsidence, damaging any structures and hard standing built upon the affected area.
9	Reuse of site won materials.	3	3	9	Site won materials may not meet engineering standards.

Table 13-5 Zone 12 Geotechnical Risk Register

13.3. Preliminary Conceptual Site Model and Risk Assessment

Based on the findings of the desk study no existing or historical land uses at Zone 12 and the surrounding area have been identified that could have led to contamination at the zone. It is understood that no dedicated development is proposed for Zone 12 other than the construction of the relief road and other minor foot and cycle pathways. There are some existing industrial land uses at the zone such as the sewage treatment works and substation; however, as stated in Section 1.2 of this report development of these areas under the Allocation Plan is considered unlikely. Therefore, the risk to construction workers and future site users in the areas already developed has not been considered.

In accordance with LCRM (12) a conceptual site model (CSM) and preliminary risk assessment have been prepared, acknowledging that isolated areas of contamination may be encountered.

The preliminary risk assessment provides a qualitative assessment of the risks that may occur during and following the zone's development.

Preliminary conceptual site model

The sources of potential ground contamination, possible migratory and exposure pathways, and relevant receptors that have been identified in the zone are detailed below. The CSM reflects the historical and current land uses at the zone and the understanding that the zone will remain largely as undeveloped green belt.

Sources

No readily identifiable potential sources of contamination (within the undeveloped areas) are present in Zone 12. The only possible known sources of contamination are restricted to potentially isolated areas of Made Ground associated with existing infrastructure.

The existing industrial land uses in Zone 12 have the potential to have led to localised groundwater contamination. However, no significant up groundwater gradient existing or historical land uses with the potential to have led to groundwater contamination that could migrate into the zone have been identified.

Substantial deposits of peat are expected to be present across the zone which could release stored ground gas into excavations during development

Pathways

In the event that isolated areas of Made Ground are encountered the key viable migratory and exposure pathways (during and following development) are outlined as follows:

- Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres;
- Ingress of ground gas into excavations and subsequent inhalation and/or explosion
- Direct contact of soils and groundwater with building infrastructure;
- Inhalation of wind blown dust and asbestos fibres during construction activities;
- Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater
- Lateral migration of contaminated groundwater

Receptors

Based on the fact that the only proposed development within the zone is the construction of the relief road and foot and cycle paths the following receptors have been identified:

<u>Human Health</u>

- Future users (farmers, cyclists/pedestrians and users of the relief road); and,
- Construction workers.

Proposed Structures

- Foundations and infrastructure for the proposed relief road

Wider Environment

- Groundwater within superficial deposits and Principal Aquifer;
- River Mersey (to the north) and Sinderland Brook (to the south); and,
- Members of public in surrounding areas

Preliminary risk assessment

The potential contaminant sources, pathways and receptors (i.e. potential contaminant linkages) identified above are presented in a preliminary risk assessment in Table 13-6. The qualitative assessment of the potential risks presented to identified receptors in relation to the proposed development has been made in accordance with the methodology outlined in CIRIA C552 (13). As such, risk is considered to be a function of both the probability (likelihood) of contamination occurring at the zone and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define contaminant probability, consequence and risk are described in Appendix F.

In the absence of quantitative data the likelihood and consequence for each contaminant linkage has been assessed based on the definitions provided in CIRIA C552 and professional judgement.

To enable the level of risk to be assessed relatively between zones (and to ensure consistency with the approach for evaluating geotechnical risk), a modification to the approach outlined in CIRIA C552 was adopted, whilst maintaining the overall philosophy of the risk assessment approach. Both the various likelihood and severity categories provided within CIRIA C552 were given a score rating from 1 to 4, with 4 being equal to a highly likely event and also to an event which has a severe consequence. The risk rating score for each contaminant linkage was subsequently calculated as a product of these two variables (i.e. Risk = Likelihood x Severity). Further details of the scoring system are provided in Appendix F.

SOURCE & HAZARD	PATHWAY	RECEPTOR	SEVERITY	LIKELIHOOD	RISK	COMMENTS
Isolated areas of Made Ground with the potential for elevated concentrations of soil bound and leachable concentrations of chemical species, and the potential to generate ground gas	Accidental dermal contact and ingestion of soil, inhalation of contaminated dust and asbestos fibres	Future users of Zone 12	3	1	3	Whilst isolated areas of Made Ground may be present at or the near the surface following development, there is unlikely to be significant exposure duration to future users. Therefore, the risk is considered to be low.
		Construction and maintenance workers	1	1	1	The low level of risk presented to construction workers may be mitigated through the provision of appropriate PPE and adopting safe methods of working as is standard on construction schemes.
	Ingress of ground gas into excavations and confined spaces and subsequent inhalation	Construction and maintenance workers	4	1	4	It is considered unlikely that isolated areas of Made Ground would have the potential to generate sufficient volumes of ground gas that would present unacceptable risks.
	Inhalation of wind-blown dust and asbestos fibres during construction activities	Members of public in surrounding areas	3	1	3	The potential exists for contaminated wind-blown dust and/or asbestos fibres to be generated during earthworks and construction activities. However, as development within Zone 12 is likely to be minimal it is unlikely that significant amounts of contaminated dust and asbestos fibres would be generated.
	Rainfall infiltration and subsequent vertical migration of leached contamination into groundwater (resulting in plume of contamination)	Groundwater within superficial deposits and Principal Aquifer	3	1	3	The potential exists for rainfall infiltration to leach any contamination present within Made Ground into the underlying groundwater. However, since any Made Ground is likely to be of limited extent it is unlikely that that this would lead to a plume of contamination.
	Direct contact	Foundations and Infrastructure	2	1	2	The potential exists for the presence of chemical species within Made Ground that are aggressive towards concrete. However, since any Made Ground is likely to be limited in extent the risk is considered to be very low.
Deposits of peat with the potential to release ground gases	Ingress of ground gas into excavations and confined spaces and subsequent inhalation and/or explosion	Construction and maintenance workers	4	2	8	The potential exists for ground gases released from peat to enter excavations during construction. Whilst atmospheric dispersion of such gases would be expected to occur the potential risk to construction workers would need to be established as part of a ground investigation. The findings of the investigation would enable an assessment of the risks to the identified receptors to be made.
Historical and existing land uses which have led to plume of groundwater contamination within superficial deposits and Principal Aquifer	Lateral migration	River Mersey and Sinderland Brook	3	1	3	The potential exists for the historical and existing land uses to have led to the contamination of groundwater at the zone. Groundwater within the superficial deposits is expected to be in hydraulic continuity with the River Mersey and Sinderland Brook, and therefore any groundwater contamination has the potential to enter these surface water bodies. However, with the possible exception of the sewage treatment works, it is considered unlikely that the land uses across the zone will have led to a plume of contamination that could adversely impact upon the surface water bodies.

Table 13-6 Zone 12 Preliminary Risks Assessment (sources within Zone 12)

14. Summary of Land Contamination and Geotechnical Risk Assessments

14.1. Findings of Preliminary Risk Assessments

To enable a preliminary assessment of the risk presented from land contamination at each of the zones relative to one another, the range of risk ratings (and highest individual risk rating encountered) for all the potential contaminant linkages identified within a zone have been tabulated in Table 14-2 below.

Similarly, to provide a preliminary assessment of the geotechnical risk presented at each of the zones relative to one another, the range of risk ratings (and highest individual risk rating encountered) for all the potential hazards identified within a zone have also been tabulated within Table 14-2 below.

For each zone the highest risk rating obtained for both land contamination and geotechnical risks has been calculated as a percentage (%) of the maximum risk rating that could be obtained. It is important to understand the maximum risk rating for a potential contaminant linkage (16 out of 16) is different to that for a potential geotechnical hazard (25 out of 25). This is a consequence of the different approaches advocated in the relevant guidance documents used for assessing risks from land contamination and geotechnical hazards, as detailed below.

For evaluating risks from land contamination, CIRIA C552 (13), prescribes the methodology, which is based on four categories of likelihood and four categories of severity as summarised in Appendix F. This results in a scoring matrix with 16 possible outcomes, and a maximum risk rating of 16. Therefore, for example, a land contamination risk rating of 12 would be expressed in percentage terms as 12/16 x 100% = 75%

For evaluating risks from geotechnical hazards, CD622 (11), prescribes the methodology, which is based on five categories of likelihood and five categories of severity as summarised in Appendix E. This results in a scoring matrix with 25 possible outcomes, and a maximum risk rating of 25. Therefore, for example, a geotechnical risk rating of 15 would be expressed in percentage terms as 15/25 x 100% = 60%

For ease of reference, the highest risk rating (expressed as a percentage rating) for both land contamination and geotechnical risks within each zone have been allocated a colour in accordance with the colour scheme provided in Table 14-1 below.

HIGHEST RISK RATING %			
0-25	26-50	51-74	75+

Table 14-1 Risk rating colour scheme

ZONE	LAND CONTAMINATION RISKS			GEOTECHNICAL RISKS		
	RANGE OF RISK RATINGS	HIGHEST RISK RATING	HIGHEST RISK RATING AS %	RANGE OF RISK RATINGS	HIGHEST RISK RATING	HIGHEST RISK RATING AS %
1	3-9	9	56	6-15	15	60
2	2-9	9	56	6-12	12	48
3	3-9	9	56	6-20	20	80
4	4-12	12	75	6-20	20	80
5	1-4	4	25	4-12	12	48
6	3-12	12	75	6-20	20	80
7	1-4	4	25	4-20	20	80
8	1-6	6	38	6-12	12	48
9	4-12	12	75	6-15	15	60
10	1-8	8	50	6-20	20	80
11	1-4	4	25	6-20	20	80
12	1-8	8	50	6-20	20	80

Table 14-2 Summary of land contamination and geotechnical risk ratings

Drawings showing the colouration of the zones according to their highest risk rating (expressed as a percentage) for land contamination risks and geotechnical risks are presented in Appendix A.

It is important to note that the highest risk rating (expressed as a percentage) should not be viewed as an indicator of the absolute level of risk. The risk ratings only provide a preliminary indication of the potential risks presented within each zone relative to one another and should be viewed qualitatively rather than quantitatively. The risk ratings achieved (and the risk ratings expressed as a percentage) are a function of the size of the matrices, and the possible risk ratings that can be obtained (with not all numerical values being able to be obtained from the matrices used).

As stated above, the size of the matrices used for initially evaluating risks from land contamination and geotechnical hazards are different. Therefore, the risk ratings (and the risk ratings expressed as a percentage) obtained for land contamination and geotechnical risks within a zone are not directly comparable and should not be interpreted as providing an indication of the level of risk from land contamination relative to the level of risk from geotechnical hazards.

14.2. Summary and Conclusions

The zones with the highest risk ratings for potential land contamination risks are **Zone 4, Zone 6** and **Zone 9**.

The higher risks associated with these zones are reflective of the fact they were formerly occupied by significant contaminative former industrial land uses and therefore have an increased likelihood for the presence of contamination being a significant impediment to development. Additionally, in the case of Zone 4 and Zone 9, these are earmarked for residential development within the Allocation Plan. Residential developments are considered to be a more sensitive land use and are likely to require more stringent remediation targets than those required for employment land or where the land use remains as green belt. Zone 6 represents the former petrochemical plant which, as a result of its size and the significant contamination potential associated with its former land use, has an increased likelihood for the presence of contamination being a significant impediment to development.

The zones with the highest average risk ratings for geotechnical risks are **Zones 3, 4, 6, 7, 10, 11 and 12.**

This is due to the potential presence of peat within these zones which is a highly compressible material. Founding upon peat could lead to differential settlements and localised structural failures.

To refine the evaluation of land contamination and geotechnical hazard risk ratings, and to support a quantitative assessment of the risks, it will be necessary to obtain actual data relating to the presence or absence of contamination, and the geotechnical properties of the superficial deposits and stratum across the scheme.

Such information can be obtained through the undertaking of an intrusive ground investigation and appropriate laboratory analysis of soil, rock and groundwater samples collected as part of the investigation. However, where records for existing ground investigations are available these should be reviewed to assess the degree to which it enables refinement of the preliminary risk assessments or whether there are data gaps which will require further information to be obtained. Should further ground investigations be required they should focus on the zones where the highest land contamination and geotechnical risks have been identified or where developer phasing priority dictates

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15. References

1. **Greater Manchester Combined Authority.** *Places for Everyone.* 2021.

2. **Google.** Google Earth. *Google.* [Online] https://earth.google.com/web/@0,-2.56240015,0a,22251752.77375655d,35y,0h,0t,0r.

3. **British Geological Survey.** Onshore GeoIndex Tool. *British Geological Survey.* [Online] http://mapapps2.bgs.ac.uk/geoindex/home.html.

4. **Groundsure Location Intelligence.** *Enviro + Geo Insight, New Carrington, AME-UDU-2PD-F8F-3GA.* 2024.

5. **British Geological Survey.** *Map Sheet SJ79SW, 1:10,560, Solid and Drift.* s.l. : British Geological Survey, 1964. https://largeimages.bgs.ac.uk/iip/mapsportal.html?id=13460447.

6. —. *Map Sheet SJ79SE, 1:10,560 , Solid and Drift.* s.l. : British Geological Survey, 1962.

7. **DEFRA.** MAGIC Map Viewer. *MAGIC Map Viewer.* [Online] 2024. https://magic.defra.gov.uk/home.htm.

8. **The Coal Authority.** Interactive Map Viewer. [Online] British Geological Survey. https://mapapps2.bgs.ac.uk/coalauthority/home.html.

9. **Zetica UXO.** Risk Maps. [Online] https://zeticauxo.com/downloads-and-resources/risk-maps/.

10. **HM Government.** *The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.* s.l. : HMSO, 2015.

11. **Highways England.** *CD 622 Managing geotechnical risk.* 2020.

12. **Environment Agency.** *Land Contamination Risk Management.* London : Environment Agency, 2020.

13. **CIRIA.** *Contaminated land risk assessment. A guide to good practice (C552).* London : Construction Industry Research and Information Association, 2001.