



Greater Cambridge Partnership

CAMBOURNE TO CAMBRIDGE

Environmental Statement

Technical Report 11, Appendix TR11.1: Mott
MacDonald Geotechnical and Geo-environmental
Preliminary Risk Assessment





Cambourne to Cambridge

Geotechnical and Geo-environmental Preliminary
Risk Assessment

5 May 2020

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Cambourne to Cambridge

Geotechnical and Geo-environmental Preliminary Risk Assessment

5 May 2020

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	05/05/2020	P Fitt E Jeffrey	M Gipson J Southall A Jackson	J Baker	Draft for comment

Document reference: 392438-MMD-HWA-XX-RP-GE-0001

Information class: Standard

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Executive summary

Mott MacDonald has been commissioned by Greater Cambridge Partnership (GCP) to undertake a Geotechnical and Geo-environmental Preliminary Risk Assessment for the Cambourne to Cambridge Better Public Transport Project (C2C).

GCP are proposing to construct infrastructure required to enable a Public Transport Route (PTR) service to operate between Cambourne to Cambridge. The C2C scheme aims to provide a dedicated public transport corridor for people travelling to Cambridge from towns and villages to its west, while providing additional transport capacity for developments proposed and planned within Greater Cambridge to alleviate the impact of future growth along the corridor. The scheme comprises of three key elements including a new public transport route or bus lanes/priority measures between Cambourne and Cambridge, a new Park and Ride site off of the A428 / A1303, and new cycling/walking facilities along the route.

GCP will be applying for a Transport and Works Act Order (TWAO), which would provide the relevant powers for the construction, maintenance and operation of the C2C Scheme.

Historic maps indicate that the majority of the study area has been used as agricultural land with the development of several villages, Bourn Airfield, and major roads (A428, M11) present adjacent to or bisecting the route.

No Artificial Ground is recorded on the BGS mapping at the site or within the immediate surrounding area. BGS mapping only indicates artificial deposits where they occur at thicknesses greater than 2.5m. However, Artificial Ground may be present within the site and surrounding area associated with historic mining / extractive industry sites, and the industrial / infrastructure development associated with road construction present at the site. It is highly likely to be present below the footprint of Bourn airfield towards the western end of the scheme.

Previous ground investigations and geological records indicate that the superficial geology underlying the majority of the site comprises the glacial till of the Oadby Member, this is usually 20m thick or more and thins to the east before petering out to the west of the village of Coton.

The bedrock geology varies across the site from west to east. The Kimmeridge Clay Formation is shown as present at the very western extremity of the route whilst the Woburn Sands Formation is recorded east of this below the footprint of the airfield and is replaced by the Gault Formation in the region of Highfields Road and underlies the remainder of the proposed route, this is recorded as potentially being up to c.39m thick. One of a few outliers of the West Melbury Marly Chalk Formation is present above the Gault Formation near Coton, with the unit indicated to only be up to c. 12m in thickness, which is physically separate to the main body of Chalk present beyond the western end of the proposed scheme.

There are a number of potential geotechnical hazards associated with the geological units that are likely to be present below the site. However, this report concludes that most of the risk associated with these is low to moderate, the most significant risks of which are likely to be associated with areas of key structures and/or significant earthworks. A summary of the high-level geotechnical risks based on the proposed scheme is provided below.

Superficial Deposits of the Oadby Member are likely to be encountered across the majority of the site. This unit is likely to be moisture sensitive and ground conditions may deteriorate if the material becomes wet. The deposit is likely to be variable which may lead to differential / long-term consolidation settlement of embankments and may contain cobbles / boulders which may

pose as obstructions to structures. Periglacial features such as shallow shear-surfaces and perched water in granular beds may be encountered which could lead to instability of slopes.

The West Melbury Marly Chalk Formation is likely to be susceptible to frost, and pavement over this material will need to be founded below the frost susceptible zone. The Chalk may have a variable weathering zone, contain natural dissolution and man-made cavities which could lead to subsidence, and the potential presence of low strength, compressible material at foundation level. It is possible that at its boundary with the Oadby Member, this may have been reworked by glacial processes resulting in variable, low strength and potentially compressible material.

The Gault Formation is likely to be encountered east of Coton. This deposit may have a variable strength / weathering profile which may lead to differential settlement between elements, and long-term consolidation settlement of embankments. The unit is susceptible to shrink/swell and may contain periglacial shallow shear surfaces, which may lead to instability. Obstructions to deep foundation construction such as limestone bands may also be present.

The Preliminary Unexploded Ordnance (UXO) Threat & Risk Assessment indicates that UXO encounter is likely at the western extent of the scheme between Cambourne and Childerley Lodge. East of Childerley Lodge, UXO encounter is recorded as unlikely. A detailed assessment of UXO has not yet been undertaken however, and it is recommended that this is completed prior to any intrusive works in the western area of the scheme.

The most significant sources of contamination were identified to have a potential impact on the western to central area of the scheme, with potentially contaminated made ground associated with Bourn Airfield, and an active fuel station with underground tanks (to the north-east of Bourn Airfield). Other potential minor sources were identified, associated with contemporary trade, infrastructure development, agricultural practices and historical/current land use.

The risk assessment identified a very low to moderate risk to human health and controlled waters. This is primarily due to the lack of significant on-site contamination sources along the majority of the scheme. The increase in hardstanding across the route will act as a barrier between the soil and site users, as well as reducing infiltration and migration of contaminants to the sensitive groundwater receptors. There are numerous land drains and surface water features along the route, however, that may be impacted via increased surface run-off.

The following recommendations have been made to help further assess geotechnical and contaminated land risks:

- A ground investigation should be designed to identify variability of the ground and groundwater conditions at the scheme location. Geotechnical and geo-environmental testing should also be undertaken to assess variations in the geotechnical properties of the units likely to be encountered at the scheme and the levels of contamination present;
- It is recommended that a natural and man-made cavity search is completed for the site based on a number of man-made (and potential presence of natural cavities) recorded in close proximity to the site;
- If material re-use is proposed, this should be done under an appropriate regulatory regime (e.g. waste exemption, environmental permit or a Materials Management Plan). If disposal of excess material is required, this should be discussed with a waste carrier; and,
- Carry out an Agricultural Land Classification (ALC) and Soil Resource Survey (SRS) in order to understand the impact of works upon the current Topsoil resource.

The above should be read in conjunction with the specific recommendations made in the relevant geotechnical and contaminated land sections of this report.

1 Introduction

1.1 Background

Greater Cambridge Partnership (GCP) are proposing to construct infrastructure required to enable a Public Transport Route (PTR) service to operate between Cambourne to Cambridge. This scheme is known as the Cambourne to Cambridge Better Public Transport Project (C2C).

The scheme aims to provide a dedicated public transport corridor for people travelling to Cambridge from towns and villages to its west, while providing additional transport capacity for developments proposed and planned within Greater Cambridge to alleviate the impact of future growth along the corridor.

The scheme comprises of three key elements including a new busway or bus lanes/priority measures between Cambourne and Cambridge, a new Park and Ride site off of the A428 / A1303, and new cycling/walking facilities along the route.

GCP will be applying for a Transport and Works Act Order (TWAO), which would provide the relevant powers for the construction, maintenance and operation of the C2C Scheme.

1.2 Proposed Works

The currently proposed works for the scheme are listed below. It should be noted that the exact route alignment is yet to be confirmed, however the below represents the anticipated proposed works based on the Outline Business Case (OBC) alignment. Should these change, this section should be updated accordingly:

- A new Public Transport Route (PTR) c. 7.3m wide between Cambourne and Cambridge, the majority of which is to be an off road segregated route, utilising existing roads along Charles Babbage road and Adam's Road on the outskirts of Cambridge;
- Earthworks to form the PTR between Cambourne and Cambridge, including cuttings / embankments along the PTR alignment.
- A bridge crossing over the M11 in the east of the scheme with associated earthworks;
- Potential retaining structures including a retaining wall up to c. 3m high north of Childerley Lodge, and a potential retaining structure between St Neots Road / A428 north of Long Road;
- Potential modifications to existing ponds present along the scheme;
- Extension of an existing culvert west of Scotland Road Roundabout to accommodate the route;
- A new Park and Ride site at Scotland Road, off of the A428 / A1303 and associated ancillary infrastructure;
- Construction of a new non-motorised route for cycling/walking facilities, running adjacent to or in close proximity of the PTR, as well as a proposed non-motorised route between Scotland Road Roundabout and Dry Drayton; and,
- Ancillary works including signal controlled junctions, junction upgrades, tie-ins to existing infrastructure, lighting and landscaping.

1.3 Objectives

The purpose of this report is to summarise available ground related information for the site and identify potential geotechnical and/or geo-environmental hazards which may place a constraint upon the proposed development, in support of the TWAO application.

These hazards may pose a risk to the proposed development itself, human health, or the environment. By identifying these risks at an early stage, opportunity is provided to consider them whilst undertaking the optioneering process and thereby minimise or take into account abnormal development costs associated with ground related risks. This report will also help inform planned intrusive works, as well as beginning to understand the site with respect to pavement and foundation requirements.

Recommendations are provided at the end of this report to aid management of the identified ground related risks.

1.4 Scope of Works

The scope of work associated with this report includes:

- A review of readily available environmental records including those contained within an Envirocheck report for the site, and those from the British Geological Survey (BGS);
- Review of available historical maps of the area;
- A review of available ground investigation data local to the site;
- Preparation of a geotechnical and geo-environmental preliminary risk assessment providing conclusions on likely ground related risks; and,
- Recommendations for the proposed works based on a high-level review of likely geotechnical risks along the route.

1.5 Report Layout

Due to the size of the overall scheme / route alignment and the Park and Ride, the report has been laid out in the following format:

- Section 2 – Scheme Description: In this section the overall scheme footprint is described, and the location of the proposed Park and Ride site. The use of route zones is detailed, with each of the route zones described in Section 2. The proposed key earthworks and structures are outlined in this section.
- Section 3 – Overview of Entire Study Area: The geography, geology, hydrogeology and hydrology, are presented for the overall scheme footprint, along with the risk of radon and UXO.
- Section 4 – Route Zone Desk Study Findings: The geology, hydrogeology, hydrology, environmental records and historical development are presented for each of the route zones. The route has been split into zones to cover areas of differing geology or the location of key structures. To present the geotechnical and geo-environmental information appropriately, these zones are discussed separately. Further details are provided in Section 2. A summary of the route zones is then presented at the end of the section to allow comparison along the route in terms of indicated geology, hydrogeology, hydrology and environmental records;
- Section 5 – Geotechnical Risk Assessment: This section presents the geotechnical risks of the likely anticipated strata across the site, as well as potential risks associated with structures and earthworks within each of the Zones.

- Section 6 – Contaminated Land Qualitative Risk Assessment: The qualitative risk assessment presented assesses potential contaminant sources, pathways and receptors for each of the Route Zones.
- Section 7 – Conclusions and Recommendations: The geotechnical and geo-environmental findings of the report are summarised, along with a summary of the initial engineering proposed for the scheme. A series of recommendations are then presented for the proposed scheme.

1.6 Sources of Information

The information in this report has been taken from the following sources of information, which are listed in Section 8 of this report:

- Landmark PLC (Envirocheck Report), Ref. 236185287_1_1, February 2020 – Referred to herein as Envirocheck Report 1.
- Landmark PLC (Envirocheck Report), Ref. 236185392_1_1, February 2020 – Referred to herein as Envirocheck Report 2.
- British Geological Survey Lexicon of Named Rock Units, accessed from <http://www.bgs.ac.uk/lexicon/> on 17/03/2020;
- British Geological Survey Geology of Britain Viewer, accessed from <http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html> on 17/03/20;
- British Geological Survey Borehole Scans Database, accessed from <http://www.bgs.ac.uk/data/boreholescans/home.html> on 01/05/2019;
- British Geological Survey, 1975, Huntingdon. England and Wales Sheet 187, Drift Geology.
- British Geological Survey, 1984, 1:100,000 Hydrogeological Map of the Area Between Cambridge and Maidenhead Sheet 14.
- British Geological Survey, 1981, Cambridge. England and Wales Sheet 188, Solid and Drift Geology.
- Department for Environment Industry Profiles (1995);
- Environment Agency Technical Guidance on Special Sites (2001);
- Worssam, B. C., Taylor, J. H., 1969. Geology of the country around Cambridge. Explanation of Sheet 188.
- Edmonds, E. A., Dinham, C. H., Casey, R., Day, J.B.W., 1965. Geology of the country around Huntingdon and Biggleswade. Explanation of Sheets 187 and 204.
- 6 Alpha Associates, Preliminary Unexploded Ordnance (UXO) Threat Assessment, Project Number 8028, March 2020.

It should be noted that a preliminary geotechnical assessment was undertaken by Capita on behalf of Skanska in 2018:

- Cambourne to Cambridge Guided Busway, Preliminary Geotechnical Route Assessment, Capita, June 2018.

The report listed above provides a high-level assessment of the likely anticipated geology and geotechnical risks across the broad area of the site, and presents a preliminary geotechnical risk register for the scheme proposed at the time. The Capita report has not been used in the production of this report and has been referenced for completeness.

2 Scheme Description

2.1 Overall Site Description

The main proposed route runs between Cambourne and Cambridge, Cambridgeshire, and comprises a roughly east to west orientated alignment approximately 11.5km long. An indicative site location plan is provided in Figure 2.1. Several villages are located adjacent to the south of the site including Highfields Caldecote, Hardwick and Coton, with the city of Cambridge and its commercial/ residential areas present towards the eastern ends of the site.

Immediately east of Cambourne the site passes around the perimeter of Bourn Airfield and is orientated east to west broadly parallel to the south of the A428 along c. half of its length, with several key features such as balancing ponds, a culvert and some surface water features including drains adjacent to it. Towards the eastern end of the site, the M11 crosses the site in a north to south orientation.

Several land drains and brooks drain the area surrounding the site, with Callow Brook crossing the site north of Hardwick in between St Neots Road and the A428, orientated north-east. A series of land drains which appear to lead to Bin Brook, located c. 450m south of the site, are located to the east of Hardwick, and two springs are also recorded in Coton (one within the town and another immediately west of Whitwell Farm). Bin Brook is orientated broadly east to west between Hardwick and Cambridge, where it joins the River Cam.

Within the surrounding area, agricultural land forms the dominant land-use to the north and south, with occasional patches/strips of woodland and plantations, and Coton Countryside Reserve present west of the M11. The town of Cambourne extends to the west of the site, and the City of Cambridge to the eastern end of the site, forming the wider areas to the east.

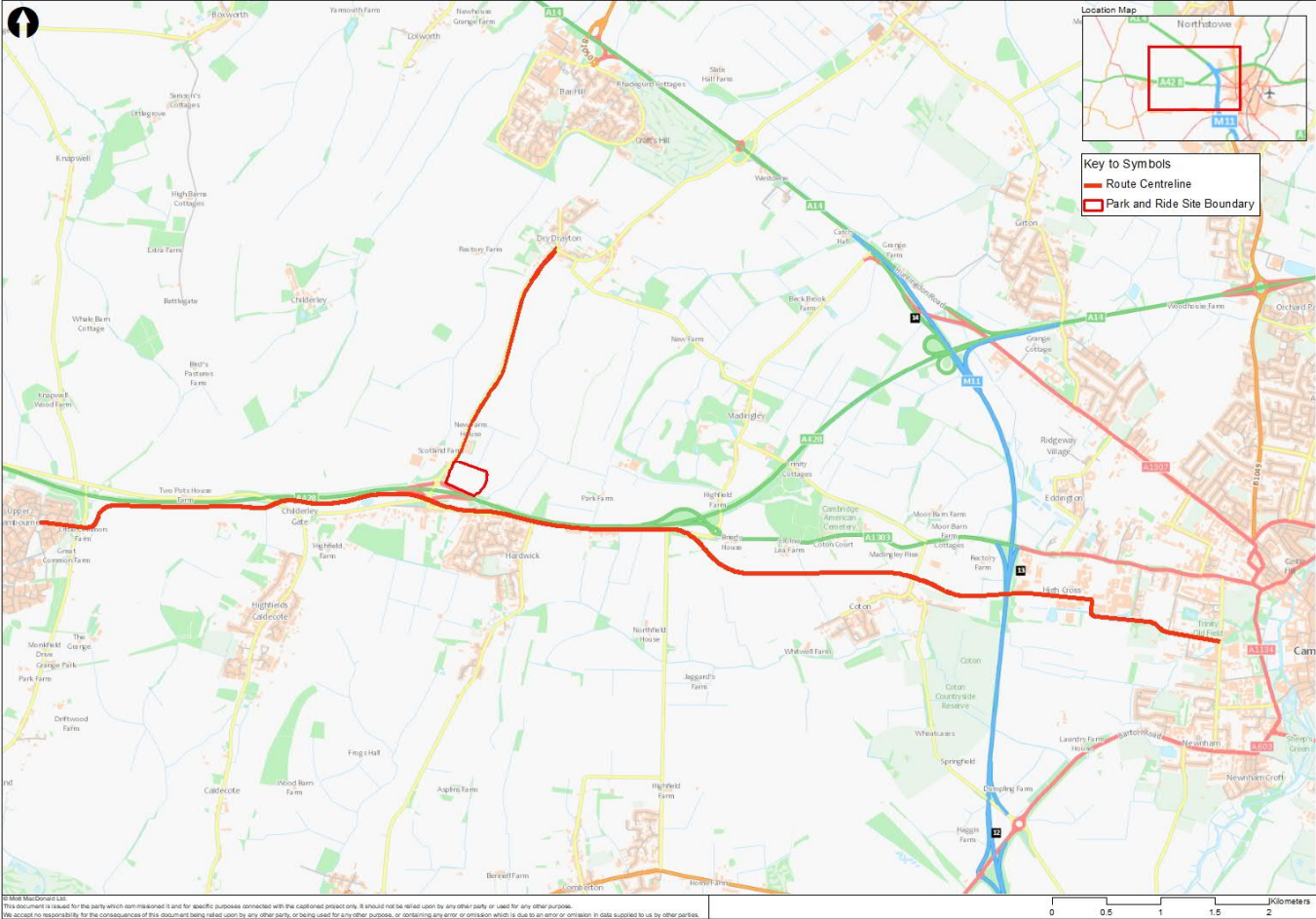
A full site topographic survey has not yet been undertaken. However, a review of the topography along the route has been completed based on available ordnance survey mapping. Following receipt of the topographic survey results, this section should be updated.

The western half of the site sits between c. 60 – 75m AOD, sloping very gently to the east, and forms a slightly elevated area. Ground levels slope more steeply east of Hardwick in the centre of the site from c. 60 to 30m AOD, where the landscape is dissected by a small stream valley of Bin Brook. East of this valley, ground levels decrease gently toward the eastern site boundary at approximately 10 – 15m AOD within the city of Cambridge.

The proposed Park and Ride site is located within an agricultural field adjacent to Scotland Road Roundabout, and a spur circa. 2.5km long of the proposed NMU route runs adjacent to Scotland Road orientated north/north-east towards Dry Drayton, predominantly along the perimeter of agricultural fields and past some residential houses and a business park.

Ground levels also decrease to the north / north-east from c. 60m AOD at Scotland Road Roundabout at the proposed Park and Ride, to c. 45m AOD at Dry Drayton at the northern end of the proposed NMU route.

Figure 2.1: Indicative Site Location Plan



Source: Contains OS data © Crown copyright and database right (2019)

2.2 Field Studies

2.2.1 Site Walkover

A site walkover has yet to be undertaken due to restrictions in place at present as a result of COVID-19. A walkover is however planned and the report will be finalised when a walkover is complete.

2.2.2 Other Field Studies

Several environmental, aboricultural and archaeological surveys have been completed at the site between c. 2017 - 2019, with a summary provided within the following technical note. It should be noted that several surveys such as Hedgerow surveys are also yet to be undertaken:

- 392438-MMD-ENV-XX-TN-EN-0010, Cambourne to Cambridge, GCP C2C Survey Technical Note, November 2019.

2.3 Overview of Route Options

The review contained in this report assesses the alignment recommended in the OBC. It is understood that route options in some areas of the site may be further developed at a later stage. Should other options be developed this report should be updated accordingly.

Due to presence of key structures and varying geology across the route, and to present the geotechnical and geo-environmental information appropriately, these routes have been split into zones and are presented in Table 2.1. An overall sketch of the site is presented in Figure 2.1, and the below sections provide a description of each of the route zones and are also presented in Figure 2.2.

The approximate chainages referred to in the below sections have been assessed based on the Outline Business Case alignment from west to east. A chainage has also been provided based on the current information available for the proposed NMU route between Scotland Road Roundabout and Dry Drayton. These chainages have been used to inform description of features along the route and assist in dividing the site into a series of route zones.

The below section provides:

- A description of each of the Route Zones, along with the start and end chainage and associated drawings.
- Assessment of the anticipated earthworks and key structures present in each of the route zones. The approximate lengths of earthworks have been derived based on the existing topographical survey data and/or LIDAR data for the site provided in the drawings listed below. It should be noted that at the time of writing not all survey information has been received and the vertical alignments are still to be confirmed, therefore the approximate height of earthworks should be treated with caution and this report should be updated upon receipt of the full site topographic information and to capture any development of the design drawings. Areas where no topographic information is currently available is detailed in the following drawings within Appendix A:
 - 392438-MMD-XX-C-SK-0020 and 0021. Mott MacDonald Limited, Cambourne To Cambridge (C2C), Topographic Risk Plan, March 2020.
- An assessment has also been undertaken to determine whether any further retaining features could be required due to the width requirement for earthworks and space restrictions along some areas of the route. This has been assessed on the basis of an assumed requirement for slope gradient of 1:3 for embankments and cuttings.

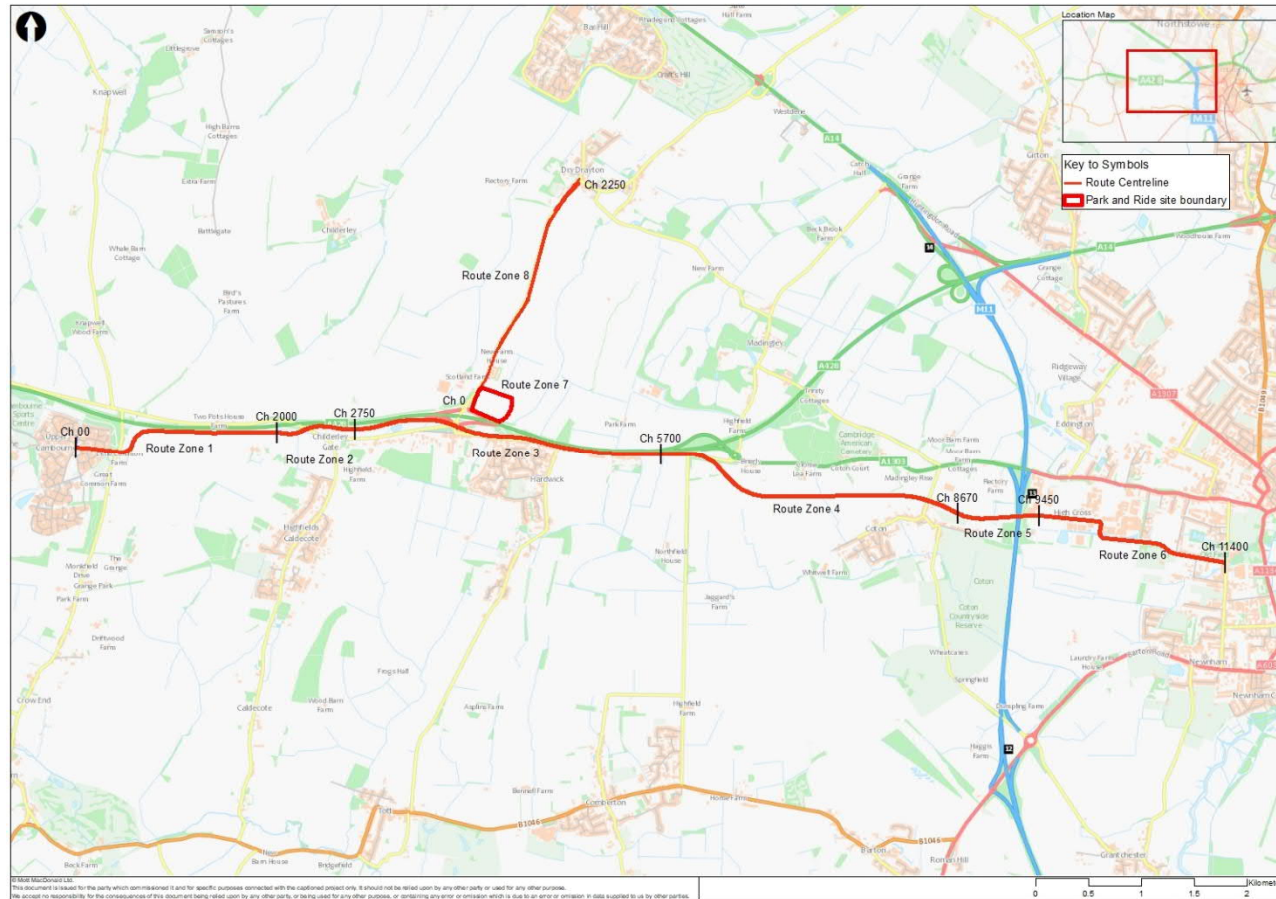
It should also be noted that the route is currently being designed, and therefore the below zones and/or routes assessed in this report may be subject to change throughout the design process.

Table 2.1: Route Zones and Approximate Chainages

Zone	Start Chainage*	End Chainage*	Brief Description	Drawings
Zone 1	Ch 0	Ch 2000	Cambourne to Wellington Way	392438-MMD-00-XX-DR-C-025 392438-MMD-TC-TR-M2-CV-0001
Zone 2	Ch 2000	Ch 2750	Wellington Way and Childerley Lodge	392438-MMD-00-XX-DR-C-025 392438-MMD-TC-TR-M2-CV-0001
Zone 3	Ch 2750	Ch 5700	Childerley Gate to Long Road / Madingley Mulch Roundabout	392438-MMD-00-XX-DR-C-026 – 27 392438-MMD-TC-TR-M2-CV-0001
Zone 4	Ch 5700	Ch 8670	Long Road / Madingley Mulch Roundabout to Coton Orchard	392438-MMD-00-XX-DR-C-027 – 28 392438-MMD-TC-TR-M2-CV-0001
Zone 5	Ch 8670	Ch 9450	Coton Orchard to Ada Lovelace Road	392438-MMD-00-XX-DR-C-028
Zone 6	Ch 9450	Ch 11400	Ada Lovelace Road to Adam's Road	392438-MMD-00-XX-DR-C-028 – 29 392438-MMD-TC-TR-M2-CV-0001
Zone 7	N/A – Park and Ride site	N/A – Park and Ride site	Agricultural field northeast of Scotland Road Roundabout	At the time of writing, no drawing is currently available. This should be updated upon its receipt
Zone 8	Ch 0	Ch 2256	Scotland Farm to Dry Drayton	At the time of writing, no drawing is currently available. This should be updated upon its receipt.

* It should be noted that the chainages presented are approximate only and should not be relied upon.

Figure 2.2: Indicative Site Location Plan and Route Zones



Source: Contains OS data © Crown copyright and database right (2019)

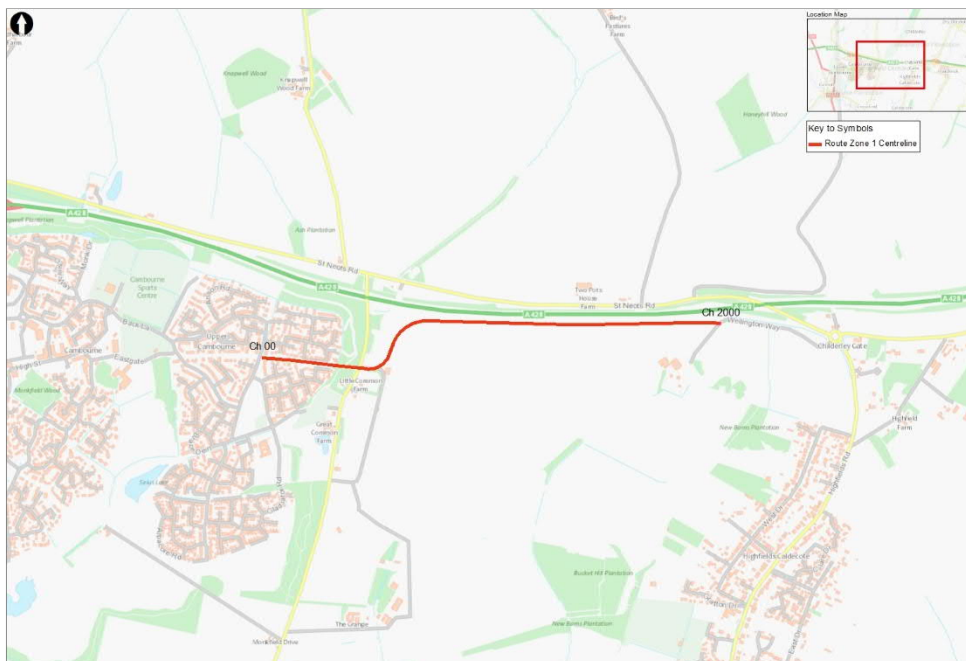
2.3.1 Route Zone 1 (Ch. 0 – 2000)

Zone 1 is positioned at the western end of the scheme and forms a c. 2000m long route between Sterling Way in Cambourne to Wellington Way, adjacent to Bourn Roundabout. Along Sterling Way, the route is orientated east to west before bisecting Broadway at Ch 400. The route then passes around the perimeter of the Bourn Airfield site through land adjacent to taxiways, bearing north, and then east (from Ch 400 – 2000), to run broadly parallel to the A428 which is present c. 20m north from Ch 800. The route crosses two disused taxiways associated with the airfield between approximate Ch. 730 – 810, and 1785 – 1880. This zone ends at the approximate location of Wellington Way at Ch. 2000, a road which connects Bourn Works (present c. 200m south) to Bourn Roundabout to the east (Zone 2).

A location plan for Zone 1 is presented in Figure 2.3.

It should be noted that as part of the South Cambridgeshire Local Plan (2018), Bourn Airfield is a Strategic Site which has been outlined for development of c. 3500 new dwellings. An existing planning application has been submitted, and the South Cambridgeshire District Council has developed a Supplementary Planning Document, with further consultation ongoing.

Figure 2.3: Location Plan – Zone 1



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2.3.1.1 Route Zone 1 Proposed Earthworks

Potential earthworks over c. 0.5m in height or depth are summarised below.

Within Zone 1, the majority of the route appears to be in cut which is generally less than 1.5m and is locally shown to be up to 2.5m between approximate Ch 1860 – 2000. It should be noted that limited topographic information is available between Ch 1860 – 2000, and the current assessment of earthworks is based on lower resolution LiDAR data.

Areas of embankment are present at the western end of the Zone and along the northern side of Bourn Airfield, and are shown to be between approximately 0.5 – 1.5m in height.

The below table summarises the proposed earthworks in this zone. This section should be updated upon receipt of the site-specific topographic information.

Table 2.2: Summary of Proposed Earthworks – Zone 1

Earthwork Type	Maximum Height / depth (m)*	Length (m)*	Start Chainage*	End Chainage*	Underlying Geology
Embankment	1.0	100	100	250	Oadby Member
	1.5	320	980	1300	
Cutting	1.0	150	250	400	Oadby Member
	1.5	400	480	880	
	1.5	550	1300	1850	
	2.5	150	1850	2000	
At Grade	-	150	0	150	Oadby Member
	-	80	400	480	
	-	100	880	980	

*Dimensions and Chainages are approximate

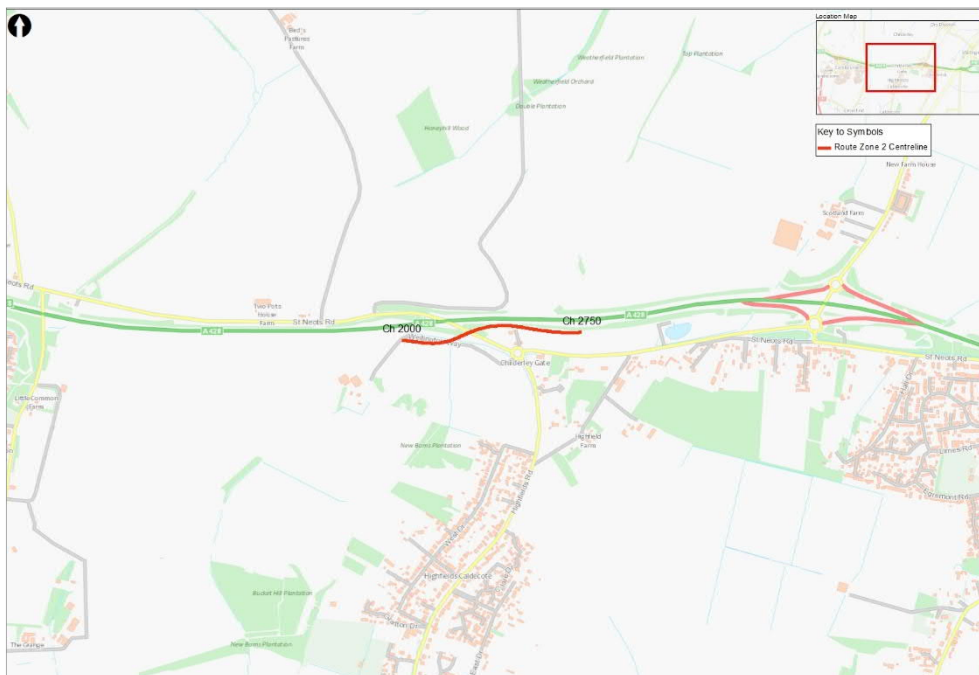
2.3.1.2 Route Zone 1 Proposed Structures

It is understood that no significant structures are proposed within this Zone.

2.3.2 Route Zone 2 (Ch 2000 – 2750)

Zone 2 is c. 750m in length and is located along the north-east boundary of Bourn Airfield, between Wellington Way and the outskirts of Highfields Caldecote, to the east of Childerley Lodge. The route zone commences at Ch 2000 adjacent to Wellington Way in an agricultural field heading roughly east, before bearing north-east from Ch 2150 and crosses Wellington Way at approximate Ch 2190, it then passes through a field, over a drain before meeting and crossing St Neots Road (which is present upon an embankment) at approximate Ch 2280 – 2290. East of this, the OBC route trends east past Childerley Lodge and runs broadly east to west parallel to the south of the A428 (Ch 2350 – 2750). A location plan for Zone 2 is presented in Figure 2.4.

Figure 2.4: Location Plan – Zone 2



Source: Contains OS data © Crown copyright and database right (2019)

2.3.2.1 Route Zone 2 Proposed Earthworks

Potential earthworks over c. 0.5m in height or depth are summarised below.

Within the OBC alignment, an embankment up to c. 4.5m high would be required for the proposed PTR to meet and cross St Neots Road, which is present on an existing embankment.

For the remainder of this zone, cuttings are present and are shown to be between up to 1m, and locally up to 3m deep along the south side of the A428. Further cut may be required to form a potential retaining structure along the north of Childerley Lodge, this is discussed in section 2.3.2.2 below.

The below table summarises the proposed earthworks in this zone.

Table 2.3: Summary of Proposed Earthworks – Zone 2

Earthwork Type	Maximum Height (m)*	Length (m)*	Start Chainage*	End Chainage*	Underlying Geology
Embankment	4.5	380	2000	2380	Oadby Member
Cutting	3.0	370	2380	2750	Oadby Member

*Dimensions and Chainages are approximate

2.3.2.2 Route Zone 2 Proposed Structures

The OBC alignment may require a retaining structure up to c. 3m high to be constructed between approximate Ch. 2380 – 2520 due to restricted space where Childerley Lodge is located adjacent the A428 due to restricted space.

Based on current topographic information, a cutting up to a maximum of c. 3m deep may be required between approximate Ch 2600 – 2750, where the proposed alignment runs adjacent to the south of the A428. However, it is possible that a retaining structure may be required within this area as the design could encroach onto the side slopes of existing earthworks associated with the A428.

2.3.3 Route Zone 3 (Ch 2750 – 5700)

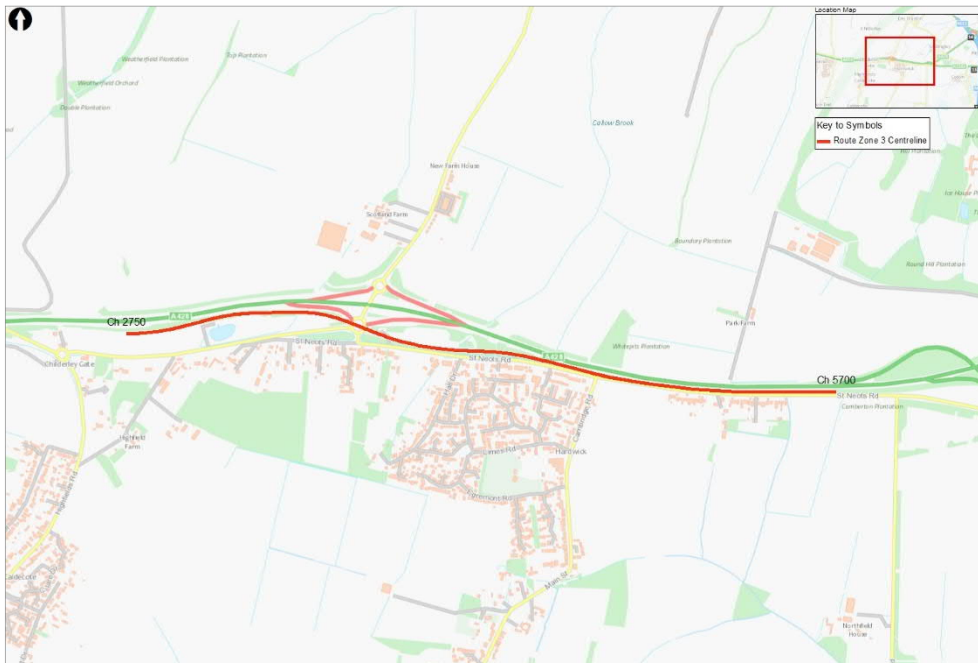
This route zone commences east of Bourn Bridge Roundabout where the PTR is runs c. 30m south of the A428 from Ch. 2750. From Ch 2920, the proposed route passes through areas of semi-mature trees/vegetation adjacent to the A428 until it reaches Scotland Roundabout. It passes adjacent to the north of an existing balancing pond (Ch 3070 – 3190), and over an existing culvert (approximate Ch 3450).

The OBC alignment approaches Scotland Road Roundabout (Ch 3720) and the PTR crosses directly through the roundabout in a south-easterly direction. The PTR route then bears east running c. 25m north of St Neots Road, passing along the southern side of an existing drainage pond at Ch 4000, which connects to Callow Brook via a culvert at approximate Ch 4200 (c. 50m north of the route), and then crosses a drain feature at Ch 4350. From approximate Ch 4350 the alignment runs on a strip of land currently populated by trees / vegetation between St Neots Road and the A428, with limited room either side of it until the end of this Zone at approximate Ch. 5700, west of Madingley Mulch Roundabout.

West of Scotland Road Roundabout the NMU separates from the PTR and bears south before joining St Neots Road. The NMU is shown to run adjacent to St Neots Road for the remainder of this zone.

A location plan for Zone 3 is presented in Figure 2.5.

Figure 2.5: Location Plan – Zone 3



Source: Contains OS data © Crown copyright and database right (2019)

2.3.3.1 Route Zone 3 Proposed Earthworks

Proposed earthworks over c. 0.5m in height or depth are summarised below.

Within Zone 3, the majority of the route is shown to comprise of cut or fill of up to c. 1.5m in height. However, where the route passes to the north of an existing balancing pond at approximate Ch. 3050 – 3200 embankments up to c. 2.5m may be required. Significant cut is also currently anticipated on approach to Scotland Road Roundabout within the OBC alignment. The below table summarises the proposed earthworks in this zone.

Table 2.4: Summary of Proposed Earthworks – Zone 3

Earthwork Type	Maximum Height (m)*	Length (m)*	Start Chainage*	End Chainage*	Underlying Geology
Embankment	2.5	700	2750	3450	Oadby Member
	1.0	10	3810	3820	
	1.0	10	4290	4300	
	1.5	1100	4400	5500	
Cutting	2.5	150	3600	3750	Oadby Member
	2.0	430	3860	4290	
	1.0	100	4300	4400	
	2.5	150	5550	5700	
At Grade	-	40	3750	3810	Oadby Member
		40	3820	3860	
		50	5500	5550	

*Dimensions and Chainages are approximate

2.3.3.2 Route Zone 3 Proposed Structures

It is understood that no significant structures are currently proposed within this Zone. However, where areas of significant embankment/cut up to c. 2.5 are recorded, a structure could potentially be required e.g. between approximate Ch 2700 - 2850.

A potential retaining structure may be also required between Ch 5700 – 6100 where the required height of embankment / cut increases between St Neot's Road and the A428.

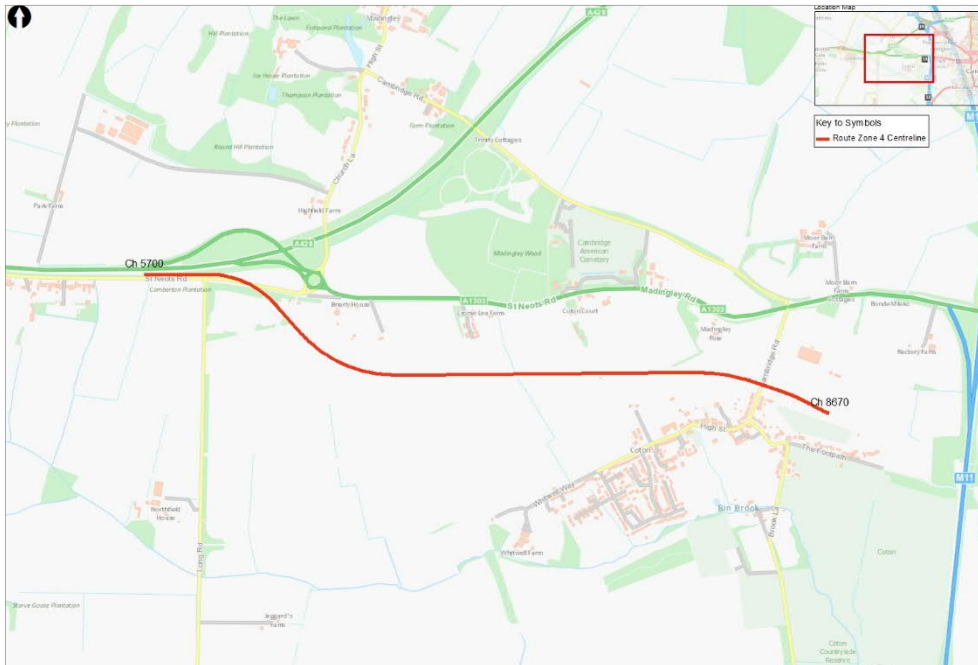
2.3.4 Route Zone 4 (Ch 5700 – 8670)

This zone commences at approximate Ch 5700 on a narrow strip of land between St Neots Road and the A428, which is populated by semi-mature trees/ vegetation west of Madingley Mulch Roundabout. Between Ch 5700 – 6100 the alignment trends east between St Neots Road to the south, and the A428 to the north (c. 8 – 10m north). It should be noted that the A428 appears to be in cut along some of this length with the proposed route apparently located over some of the existing cut slopes.

The route begins to bear south-east at Ch. 6100 and crosses St Neots Road (Ch 6150) into a series of agricultural fields, continuing south-east to Ch. 6700, before then bearing east until Ch. 8200. Through this area the route predominantly passes through agricultural fields (except a small area of semi-mature trees at Ch 6350) and passes several features including a Waterworks site 150m west (with covered reservoir) at Ch 6300 and water tower/radio masts 70m north-east of Ch 6325; 150m south of Crome Lea Business Park at Ch 7200, and 60m north of two further covered water reservoirs at Ch 7800. A water main also runs from the Waterworks site to the two covered reservoirs orientated south-east, crossing the route at approximate Ch 6450 and Ch 7260. The village of Coton is present south of the alignment from

approximate Ch 7800, with the PTR and NMU crossing Cambridge Road, 40m north-east of the properties in the village at approximate Ch 8375. From Ch 8375 – 8670 the route passes through Coton Orchard. A location plan for Zone 4 is presented in Figure 2.6.

Figure 2.6: Location Plan – Zone 4



Source: Contains OS data © Crown copyright and database right (2019)

2.3.4.1 Route Zone 4 Proposed Earthworks

Proposed earthworks over c. 0.5m in height or depth in this Zone are summarised below.

Between approximate Ch 5700 – 6100 this zone runs adjacent to the south of the A428, where areas of side long embankment up to c. maybe up to c. 2.5m may be required. Due to the width restrictions from the proposed route and the A428 present directly north, and St Neots Road to the south it is possible that a retaining feature may be required (See 2.1.4.2).

The remainder of this route between Ch 6200 – 8700 is predominantly shown to be upon embankment, with embankment heights up to c. 2.5m expected. Areas of cut may also be required along some sections, which are shown to be up to c. 1.5m deep.

It should be noted that no topographic information is currently available between approximate Ch 6200 – 6800 and this section should be updated upon receipt of this information. A summary of the proposed earthworks is presented in the Table below.

Table 2.5: Summary of Proposed Earthworks – Zone 4

Earthwork Type	Maximum Height (m)*	Length (m)*	Start Chainage*	End Chainage*	Underlying Geology
Embankment	1.0**	600	6300	6900	Oadby Member
	1.5	400	7530	7930	Oadby Member
	1.0**	460	8210	8670	Chalk

Earthwork Type	Maximum Height (m)*	Length (m)*	Start Chainage*	End Chainage*	Underlying Geology
Cutting	2.5	600	5700	6300	Oadby Member
	1.5	750	6900	7400	
	1.0	90	8060	8150	
At Grade	-	150	7000	7150	Oadby Member
		130	7400	7530	
		130	7930	8060	
		70	8150	8210	

*Dimensions and Chainages are approximate

**No long-section topographic information is available between Ch 6200 – 6900, therefore this section should be updated upon its receipt and the above estimated heights should be treated with caution. LIDAR data has also been utilised within this assessment due to limited topographic survey coverage. Potential variability in the LIDAR data which may impact the proposed assessment is recorded between Ch 8300 – 8670, and as a result this should be treated with caution.

2.3.4.2 Route Zone 4 Proposed Structures

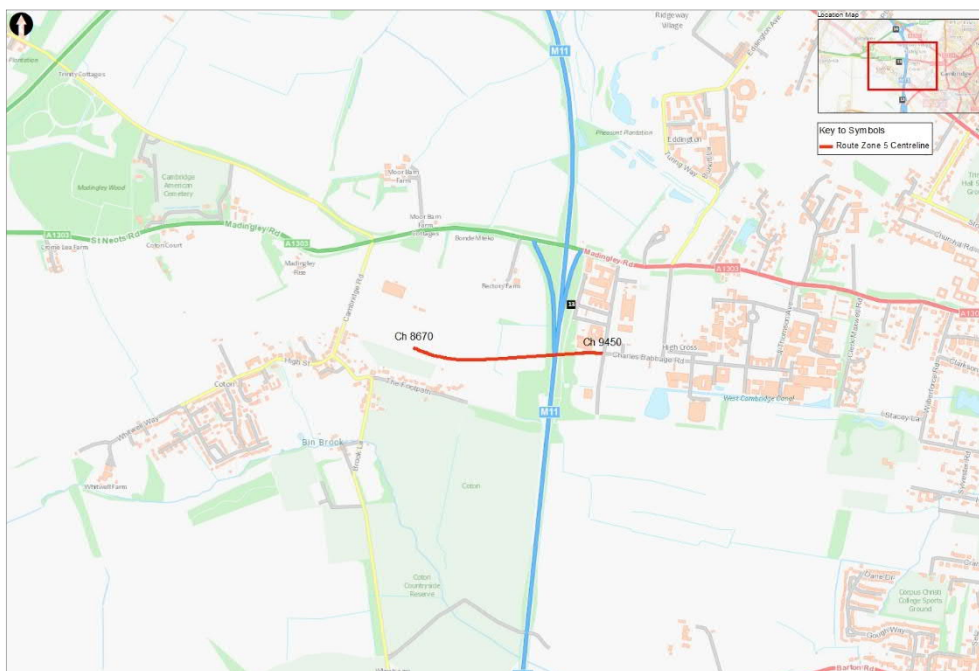
It is understood that no significant structures are currently proposed within this Zone. However, it is possible that a retaining structure may be required between approximate Ch 5700 – 6100 due to the proposed site passing over an existing cutting associated with the A428.

2.3.5 Route Zone 5 (Ch 8670 – 9450)

Route Zone 5 commences on the OBC alignment at approximate Ch 8670, within Coton Orchard. The route then bears south-east to Ch 8800, before bearing east, passing into an agricultural field at Ch 9000. The M11 and its earthworks, orientated north to south, are present between approximate Ch 9230 – 9390, where the proposed route crosses over it from west to east. Immediately east of the M11 (approximate Ch 9300 – 9400), the zone passes through an area of semi mature trees, beyond which the zone enters the West Cambridge Site of the University of Cambridge. The proposed NMU diverges from the PTR at approximate Ch 9425, and an NMU spur trends west, connecting to an existing cycle/footway adjacent to the east of the M11. From Ch 9400 the route enters the West Cambridge Site, a developed area, and Ada Lovelace Road is present at approximate Ch 9450, beyond which is assessed within Zone 6.

A location plan for Zone 5 is presented in Figure 2.7.

Figure 2.7: Location Plan – Zone 5



Source: Contains OS data © Crown copyright and database right (2019)

2.3.5.1 Route Zone 5 Proposed Earthworks

Proposed earthworks over c. 0.5m in height or depth in this Zone are summarised below.

The main earthworks for this section are predominantly associated with the approach embankments for the proposed bridge over the M11. No topographic information is currently available for the proposed heights of this therefore the below has been estimated based on LiDAR data and height of other significant earthworks on the scheme (overpass over the A428 in Zone 2). This section should be updated upon receipt of this information.

Minor areas of cut up to c. 1m are also likely to be required west of the approach embankments.

A summary of the proposed earthworks is presented in the Table below.

Table 2.6: Summary of Proposed Earthworks – Zone 5

Earthwork Type	Maximum Height (m)*	Length (m)*	Start Chainage*	End Chainage*	Underlying Geology
Embankment	1.0m* **	80	8670	8750	Gault Formation
	5.0* **	180	9050	9230	
	5.0* **	110	9290	9400	
Cutting	1.5* **	300	8750	9050	Gault Formation
At Grade	-	50	9400	9450	Gault Formation

*Dimensions and Chainages are approximate

**No long-section topographic information is available within this Zone; therefore, this section should be updated upon its receipt and the above estimated heights should be treated with caution. LIDAR data has been utilised within this assessment due to limited topographic survey coverage. Potential variability in the LIDAR data which may impact the proposed assessment is recorded across the zone, and as a result this should be treated with caution.

2.3.5.2 Route Zone 5 Proposed Structures

A bridge over the M11 is proposed within the eastern section of this zone (centred at approximate Ch 9260). Based on current proposals this may comprise a 7.3m carriageway and 3.5m NMU facility which will cross the M11, with bridge design currently ongoing. The approach embankments (discussed above) are expected to form part of the design for this and are present between Ch 9100 – 9400 either side of the structure.

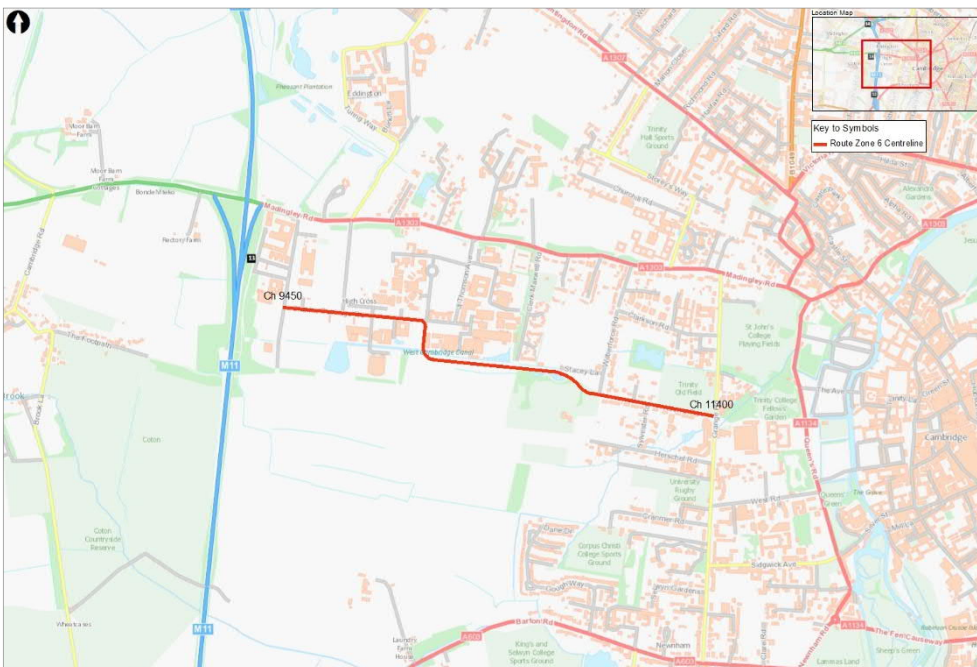
2.3.6 Route Zone 6 (Ch 9450 – 11400)

Zone 6 commences from OBC alignment Ch 9450 at Ava Lovelace Road. It trends east with the proposed PTR alignment running along Charles Babbage Road through the West Cambridge Site (Cambridge University), which is bordered by business/ residential/ educational buildings. The existing shared-use facility is to be improved within this zone as part of the proposed NMU works at approximate Ch 10000. The proposed PTR bears south at Ch 10020 and proceeds to cross through an existing car park adjacent to a residence structure, over grass verges and an existing shared-use facility and into an agricultural field.

The alignment crosses over an existing water feature at approximate Ch 10180 (Cambridge West Canal) and bears east from Ch 10200 running through an agricultural field adjacent to the West Cambridge Campus. Several ponds which are bordered by semi-mature trees are located directly adjacent to the route at Ch 10600 and from Ch 10625 – 10700, to the south of which is the Cambridge University Sports Ground. The route joins Adam's Road at approximate Ch 10900, where it is proposed to utilise existing infrastructure, terminating at approximate Ch 11400.

A location plan for Zone 6 is presented in Figure 2.8.

Figure 2.8: Location Plan – Zone 6



Source: Contains OS data © Crown copyright and database right (2019)

2.3.6.1 Route Zone 6 Proposed Earthworks

It is understood at this stage that no significant earthworks are expected within this Zone. Should this change following development of design, this section should be updated accordingly.

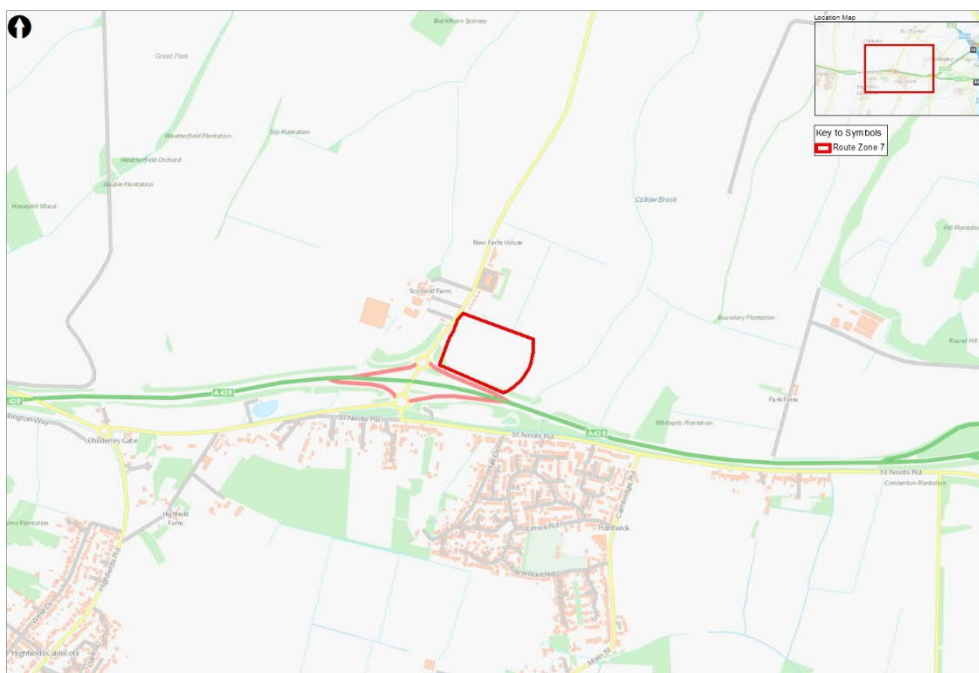
2.3.6.2 Route Zone 6 Proposed Structures

It is understood that no significant structures are proposed within this Zone. Should this change following development of design, this section should be updated accordingly.

2.3.7 Route Zone 7 (Park and Ride)

Zone 7 is positioned in the central area of the scheme and comprises a broadly rectangular area c. 325m x 230m to the north-east of the A428 adjacent to the north-east of Scotland Road roundabout. The zone is located within an agricultural field, with a field boundary / verge on to the A428 located along its southern boundary. The Zone is located at approximately 60m AOD, and a location plan for Zone 7 is presented in Figure 2.9.

Figure 2.9: Location Plan – Zone 7



Source: Contains OS data © Crown copyright and database right (2019)

2.3.7.1 Route Zone 7 Proposed Earthworks

It is understood at this stage that no significant earthworks are expected within this Zone. Should this change following development of design, this section should be updated accordingly.

2.3.7.2 Route Zone 7 Proposed Structures

It is understood that no significant structures such as bridges or retaining structures are proposed within this Zone, with the Zone comprising a proposed Park & Ride with associated ancillary infrastructure.

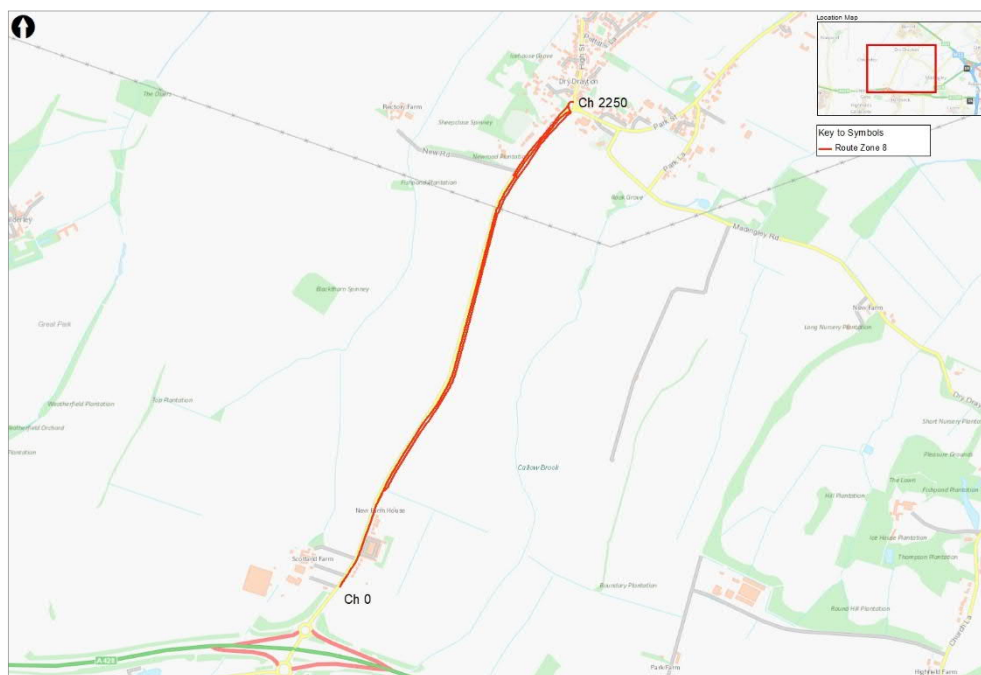
At the time of writing, the current proposed drainage solution will comprise of surface run-off collection in a holding pond, which will be discharged into the adjacent watercourse. It should be noted that this high-level design is not confirmed and is subject to change.

2.3.8 Route Zone 8 (Ch 0 – 2250)

Zone 8 comprises a proposed NMU route along Scotland Road from the proposed Scotland Road Park and Ride to Dry Drayton, and is c. 2250m long. It is understood that the route is a combination of on-road and off-road sections. The proposed NMU route utilises existing footway adjacent to Scotland Road at its southern end, before becoming off-road behind hedgerow east of Scotland Road through a series of agricultural fields for the vast majority of its length. On approach to Dry Drayton, the proposed NMU crosses from east to west at existing traffic calming measures at the Dry Drayton village entrance. From this crossing, the proposed route proceeds along the west of Scotland Road for the remainder of the route, with associated tie-ins in to existing footpaths at its northern end.

A location plan for Zone 8 is presented in Figure 2.10.

Figure 2.10: Location Plan – Zone 8



Source: Contains OS data © Crown copyright and database right (2019)

2.3.8.1 Route Zone 8 Proposed Earthworks

It is understood at this stage that no significant earthworks are expected within this Zone. Should this change following development of design, this section should be updated accordingly.

2.3.8.2 Route Zone 8 Proposed Structures

It is understood that no significant structures are proposed within this Zone.

3 Overview of Entire Study Area

This section provides an overview of the scheme footprint of the proposed routes and location of the Park and Ride.

3.1 Published Geology

A schematic of the superficial, bedrock and combined geology is presented in Figure 3.1 and 3.2.

3.1.1 Artificial Ground

The British Geological Survey (BGS) 1:50,000 Series mapping, the Landmark Envirocheck Report, and the BGS Geology of Britain Online Viewer do not indicate artificial ground within the scheme footprint. However, Artificial Ground is only recorded where it occurs in excess of 2.5m. Though it should be noted that it is likely that this unit will be encountered due to the developed nature of some areas of the site and the surrounding adjacent infrastructure including, for example, adjacent villages and the city of Cambridge, St Neots Road, and the A428/M11.

3.1.2 Superficial Geology

The BGS 1:50,000 mapping indicates the majority of the site is underlain by the Oadby Member (Wolston Glaciogenic Formation), with no superficial deposits recorded in the eastern area of the site.

The Oadby Member (formerly known as Boulder Clay) was formed up to 3 million years ago in the Quaternary Period, in an environment previously dominated by ice age conditions. This unit extensively covers the bedrock geology within the site and wider surrounding area to the west

The unit is described as a sandy silty clay with abundant fragments of chalk and flint, as well as farther travelled erratics of various lithologies. Layers, lenses and pockets of sand and gravel are also common. The base of the unit is sharp, and the uppermost area of this unit is commonly decalcified. The thickness of this unit is noted to be variable, and may be up to 20 – 25m thick.

Other superficial deposits including River Terrace Deposits, Alluvium and Head Deposits are recorded within the wider area, however these are not expected to be encountered.

A sketch of the superficial geology is presented in Figure 3.1.

3.1.3 Bedrock Geology

The BGS mapping indicates that the site is likely to be underlain by several different bedrock units, including the Kimmeridge Clay, Woburn Sand Formation (formerly the Lower Greensand), Gault Formation and the Lower Chalk (West Melbury Marly Chalk Formation). A sketch of the bedrock geology is presented in Figure 3.2.

It should be noted that much of the bedrock geology appears to be obscured at surface and is overlain by the Oadby Member (Figure 3.1). Table 3.1 describes the deposits indicated and presents a typical description, age and thickness.

Based on the BGS mapping the outcrop of Chalk at the site appears to be an outlier which is separated from the main outcrop of Chalk in the district

Table 3.1: Summary of Bedrock Geology

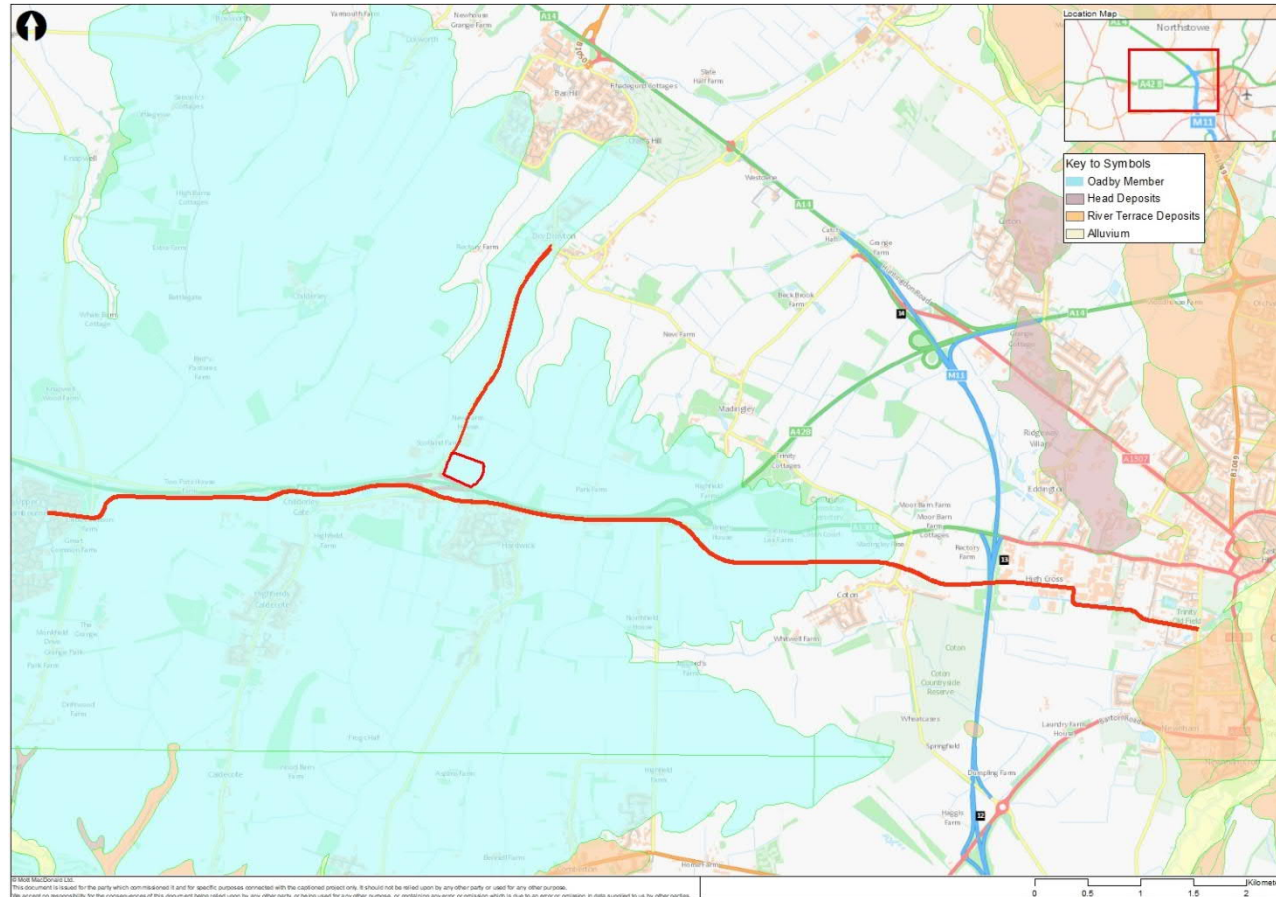
Unit	Typical Description	Age (Ma)	Typical thickness
Kimmeridge Clay	Dark to pale grey clay and calcareous clays with thin beds of oil shale. Tabular beds and septarian nodules of argillaceous limestone (cementstone) are common in the calcareous clays. Abundant ammonites are present. The top of this unit is well marked by the Woburn Sands Formation and the presence of springs.	152 – 157	up to 27m
Woburn Sands Formation	Fossiliferous loosely cemented glauconitic sandstones or unconsolidated pebbly sands. Common basal pebble bed containing phosphatized material from older Jurassic / cretaceous deposits (known as 'coprolite'). Thin layers of silty clay are seen locally.	101 – 126	up to 12m
Gault Formation	Grey clay/mudstone or marl. Basal beds commonly glauconitic, sandy and pebbly with phosphatic nodules. Upper part is highly calcareous and rich in fossils (foreshadowing the deposition of the Chalk). Occasional pyritic / calcareous nodules.	101 - 113	up to 40m
West Melbury Marly Chalk Formation (Grey Chalk Subgroup)	<p>Buff, grey and off-white, interbedded soft marl and hard grey limestone. The lower beds of the unit are blue-grey marls which bear resemblance to the mudstones of the Gault Formation below, passing upwards in to blocky greyish white marly chalk with occasional pyritic nodules.</p> <p>The erosional base of this unit is marked by the Cambridge Greensand Member, described as a glauconitic sandy marl with abundant phosphatic nodules. Angular blocks of igneous/metamorphic rocks have also been encountered in this unit in the Cambridge area.</p> <p>The upper surface is conformable and marked by the erosional surface of either the overlying Zig Zag Chalk Formation or Totterhoe Stone Member (Grey Chalk Subgroup).</p> <p>Where this unit is overlain by the Oadby Member, the uppermost few metres of the Chalk is commonly softened and brecciated with infillings of flint fragments and argillaceous material.</p>	94 – 101	15 to 25m

3.1.4 Structural Geology

Worssam & Taylor (1969) states that two main episodes of folding are recorded within the rocks of the Cambridge district. The first episode occurred post-deposition of the Kimmeridge Clay Formation, but pre-deposition of the Lower Greensand Formation. The second episode of folding, affected all units, including the Late Cretaceous rocks of the Chalk Group. Intermittent vertical movements of the underlying faulted block within this area during the Upper Jurassic and Lower Cretaceous are evident from the condensed / non-sequences, and the presence of phosphate nodule beds.

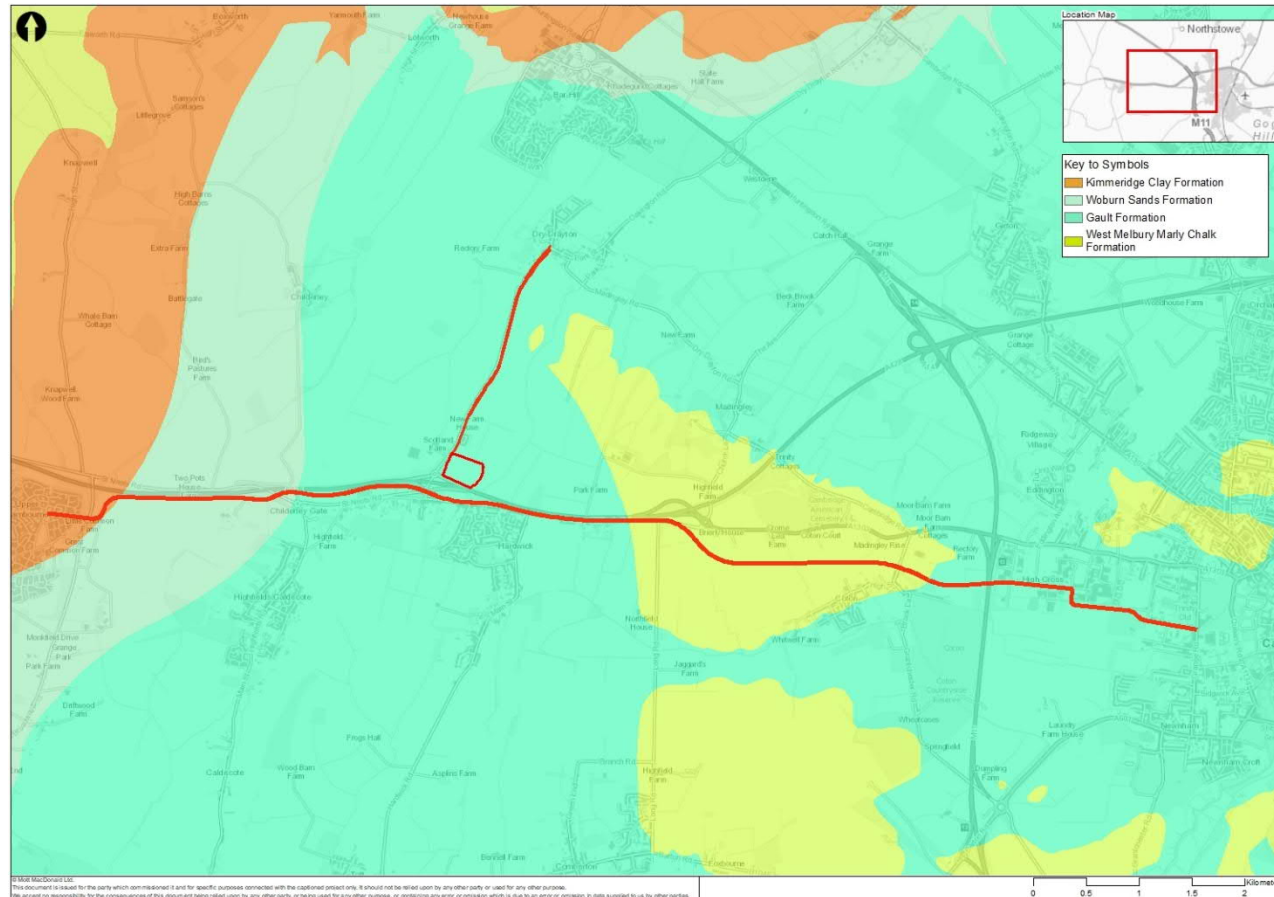
The most prominent fold within the region is called the Upware Anticline, which strikes NWE-SSW. The Haddenham Axis, which is the least well-developed of the axes, crosses the eastern area of the site approximately in the region of Coton. Regional dips of exposed strata are very gentle, and local steep dips of up to 10° degrees may be present in the Woburn Sands Formation.

Figure 3.1: Sketch of Superficial Geology



Source: Contains OS data © Crown copyright and database right (2019), British Geological Survey

Figure 3.2: Sketch of Bedrock Geology



Source: Contains OS data © Crown copyright and database right (2019), British Geological Survey

3.2 Hydrogeology and Hydrology

3.2.1 Hydrogeology

The Envirocheck Report records the following deposits, aquifer classifications and groundwater vulnerabilities at the site (Table 3.2).

Table 3.2: Summary of Hydrogeology

Strata	Aquifer Classification	Groundwater Vulnerability
Oadby Member	Secondary undifferentiated)	Medium
Kimmeridge Clay Formation	Unproductive Strata	Low
Woburn Sands Formation	Principal Aquifer	Medium
Gault Clay Formation	Unproductive Strata	Unproductive
West Melbury Marly Chalk Formation	Principal Aquifer	Medium to High (Soluble Rock Risk)

A Secondary Undifferentiated Aquifer is defined as an aquifer which has previously been designated as a minor and non-aquifer in different locations, due to the variable characteristics of the unit.

Principal Aquifers are deposits that have a high intergranular and/or fracture permeability and can provide a high level of water storage as well as supplying river base flow on a strategic scale.

Unproductive Strata are deposits with low permeability that have negligible significance for water supply or river base flow.

The Envirocheck report indicates that the site is not located within a Source Protection Zone (SPZ). The nearest SPZ to the site is indicated to be c. 630m south of the site boundary, to the west of Highfields Caldecote. The BGS 1:100,000 Hydrogeological map (Cambridge to Maidenhead) indicates that groundwater levels within the Lower Greensand (Woburn Sands Formation) range from c. 30m AOD in the west to c. 10m AOD in the east near the village of Coton.

A series of springs are also recorded within Coton, which appear to be located broadly at the boundary between the Oadby Member and the underlying Chalk. This may suggest the presence of groundwater within the Chalk, which has been confined by the Oadby Member overlying it to the west.

3.2.2 Hydrology

Along the site, there are many land drains which appear to be associated with the existing road infrastructure. Several small valley streams are recorded, including Callow Brook which transects the site north of Hardwick and appears to run under the A428 through a culvert orientated north-east to south-west.

Bin Brook is present at its closest c. 200m south of the site orientated approximately north-west to south-east. Several land drains south of the site lead to this, forming a tributary to the River Cam c. 1.1km east of the site.

In the eastern area of the site between Charles Babbage Road and Adam's Road, several ponds and land drains are present. The site also crosses over the West Cambridge Canal, a water feature (non-navigational) which is orientated east to west within the West Cambridge Site (Cambridge University).

The Envirocheck Report shows that the site is not within an area at risk of flooding from rivers or the sea (Flood zone 1 – 3), which correlates with the Flood Map for Planning. The nearest area shown to be at risk of flooding is Bin Brook, c. 20m east of the site at Ch. 11400.

3.3 Radon

The UKradon Interactive Map and Envirocheck Report suggest that the site is either in the lowest, or Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level), with the Envirocheck Report stating no radon protection measures are necessary in the construction of new dwellings or extensions. Some areas adjacent to the north of the site within the outskirts of Cambridge have a maximum radon potential of 1 – 3%.

3.4 Unexploded Ordnance

The Preliminary UXO Threat Assessment completed by 6 Alpha Associates recorded the potential for unexploded WWI and WWII ordnance to exist at the western quarter of the site, notably around Bourn Airfield, (approximate Ch 0 – 2400) to be Likely, with no further action required in the eastern area of the site (approximate Ch 2400 – 11400). For further details, please refer to Appendix E.

3.5 Environment

A series of environmental surveys have already been completed at the site, with some surveys yet to be completed. These are summarised in a separate document produced by Mott MacDonald.

Surveys undertaken to date have identified the presence of badger setts within 250m of the proposed scheme, mostly occurring in the area between the M11 and Grange Road. The grassland habitat at the Waterworks site at Madingley Mulch is considered to be of most conservation significance and a site of high value for invertebrates. For further details, reference should be made to the Environmental Impact Assessment Scoping Report produced by Mott MacDonald.

There are also historic surveys which have been undertaken assessing Tree Preservation Orders (TPOs) and root protection zones across the site. Further surveys are proposed to be undertaken and this report should be updated upon their completion.

3.6 Archaeology and Heritage

An Environmental Impact Assessment Scoping Report is currently being produced by Mott MacDonald Limited which summarises the archaeological and heritage information present at the site. Furthermore, a series of archaeological surveys have been undertaken, including geophysical surveys, and trial trenches that have been undertaken across the wider site in 2018. The assessments undertaken to date record several archaeological features ranging from the Lower/Middle Palaeolithic to Medieval, including Iron Age/Roman settlements. These are summarised in EIA Scoping Report produced by Mott MacDonald.

Areas of known buried archaeology which may be impacted by the currently proposed scheme include for example archaeological remains associated with an Iron Age Roman settlement in Bourn Airfield, Iron Age Enclosures at Scotland Farm, middle Iron Age quarry pits which were recorded during construction of Hardwick Junction, and Iron Age/Roman settlements and enclosure remains west of Cambridge. For further details, please refer to the report listed above.

4 Route Zone Desk Study Findings

This section of the report provides a detailed geotechnical and geo-environmental desk study assessment of each of the proposed zones described in Section 2.3 that the study area has been split into (Figure 4-1). It also provides a commentary of how each feature identified relates to each of the proposed route options in each zone.

Section 4.1 – 4.8 provides a summary of the desk study findings for each of the zones and route options contained within each, and a summary is presented in Section 4.9.

4.1 Zone 1

4.1.1 Site Geology

4.1.1.1 Published Geology

Table 4.1 presents the geology likely to be present directly beneath and in the surrounding area of Zone 1 as recorded by the 1:50,000 BGS mapping. For a description of the strata indicated, along with the age and thickness information please refer to Section 3.1.

Table 4.1: Summary of geology indicated on BGS mapping – Zone 1

Artificial Ground	Superficial Geology	Bedrock Geology
<p>Onsite None indicated. However, Artificial Ground may be present on-site as a result of existing road infrastructure, residential housing and Bourn Airfield.</p> <p>Offsite None indicated. However, Artificial Ground may be present on-site as a result of existing road infrastructure, residential housing and Bourn Airfield.</p>	<p>Onsite Oadby Member.</p> <p>Offsite Oadby Member.</p>	<p>Onsite Kimmeridge Clay Formation to the west from Ch. 0 to Ch. 830. Not anticipated to be encountered. Woburn Sands Formation to the east from Ch. 830 to Ch. 2000. Not anticipated to be encountered.</p> <p>Offsite Gault Formation (east of Zone 1). West Walton Formation and Amptill Clay Formation (west of Zone 1). Not anticipated to be encountered.</p>

4.1.1.2 Encountered Geology

The BGS Geindex indicates that there are several boreholes located along the length of Zone 1, which are mostly adjacent to or within the immediate surrounding area of the site boundary. The logs for these boreholes can be found in Appendix C, and a summary of the borehole records is presented in Table 4.2.

Table 4.2: Summary of historical BGS Boreholes – Zone 1

Borehole ID	Eastings	Northings	Distance / Compass Direction	Chainage	Depth (m bgl)
TL35NW57	533690	259790	50m NW	Ch 700	18.0
TL35NW75	533520	259580	20m N	Ch 400	3.0
TL35NW79	533660	259710	10m NW	Ch 650	4.2

Borehole ID	Eastings	Northings	Distance / Compass Direction	Chainage	Depth (m bgl)
TL35NW59	534000	259790	40m N	Ch 1100	5.0
TL35NW87	534300	259760	20m N	Ch 400	3.0
TL35NW88	534480	259770	30m N	Ch 1450	3.0
TL35NW90	534660	259760	20m N	Ch 1550	3.0

It should be noted there are further historic boreholes adjacent to the route and within the surrounding area. However, the selected records are thought to be representative of the ground conditions likely to be present at this Zone.

All records recorded a veneer of topsoil (approximately 0.3m thick), which overlays the Oadby Member, described as a firm to very stiff fissured silty gravelly CLAY, with gravel comprising fine to coarse gravel of flint and chalk, and occasional pockets of sand and gravel. Occasional cobbles of flint and chalk, and boulders of siltstone have been encountered. It is also described locally as being fissured. The thickness of the Oadby Member was not proven in these historic boreholes.

4.1.2 Hydrogeology and Hydrology

4.1.2.1 Hydrogeology

The Envirocheck Report indicates that the Oadby Member is a Secondary Undifferentiated Aquifer, recorded as having medium groundwater vulnerability. The strata are considered to be “*both minor and non-aquifer in different locations due to the variable characteristics of the rock type*” (Environment Agency, 2018).

The Kimmeridge Clay to the west is recorded as Unproductive Strata (low permeability, negligible significance for water supply) and the Woburn Sands Formation to the east is recorded as a Principal Aquifer (high permeability and high levels of water storage).

Groundwater was encountered in the historical BGS borehole TL35NW57 at 17.8m (53.55m AOD, within the Oadby Member), rising to 17.7mbgl (53.65m AOD) after 20 minutes. Groundwater monitoring in this historic borehole indicated that the groundwater level range lies between 16.99 – 4.09mbgl (54.36 – 67.26m AOD). A groundwater seepage was also encountered in TL35NW88 at 1.7m within a granular bed. These results suggest that the groundwater level may be variable within the Oadby Member, and perched groundwater may be encountered.

An area between 500m – 1km south/south-west of the zone is within a Source Protection Zone (SPZ) 3, defined by the Environment Agency (2018) as “*the area around a source within which all groundwater recharge is presumed to be discharged at the source*”.

4.1.2.2 Hydrology

A series of drains are present within the wider surrounding area and are present north of Ch. 0, Ch. 400 and south of Ch. 1750. Sirius Lake, a possible man-made lake to the south-west of Upper Cambourne is located c. 650m south-west of Ch. 0. Two other small ponds lie c. 315m and 120m south of the route (at Great Common Farm and Little Common Farm, respectively).

The Envirocheck Report shows that there is no risk of flooding from surface water for the majority of the Zone 1 footprint.

The Envirocheck Report also records that there is potential for groundwater flooding of property below ground level across the western half of this zone, with limited potential to occur within the eastern half.

4.1.3 Environmental Records

The following section presents any environmental records detailed in the Landmark Envirocheck Report. In order to avoid repetition, where numerous records were deemed to be similar, only one of them has been included. For further details, please refer to the Landmark Envirocheck Report in Appendix C and drawing 403394-MMD-XX-00-GIS-YG-0003 in Appendix A.

4.1.3.1 Soil Geochemistry

The maximum recorded concentrations of metals within the soils at this Zone and in the immediate surrounding area, as reported in the Landmark Envirocheck Report, are presented in Table 4.3.

Table 4.3: Summary of Soil Geochemistry – Zone 1

Chemical	Concentration (mg/kg)
Arsenic	15 – 25
Cadmium	< 1.8
Chromium	60 - 90
Lead	<100
Nickel	30 – 45

4.1.3.2 Groundwater and Surface Water Abstraction

The Envirocheck Report indicates that there are no records of groundwater or surface water abstractions within 1km of Zone 1.

4.1.3.3 Discharge Consents

The Envirocheck Report indicates that there are seven discharge consents within 500m of Zone 1, in the eastern are of the zone. The consents are summarised in Table 4.4.

Table 4.4: Summary of discharge consents – Zone 1

Name	Easting	Northing	Distance / Compass Direction	Chainage	Discharge Type	Receiving Body
Thyssenkrupp Tallent Limited	534900	259800	60m N	Ch. 1900	Trade Discharge – Process Water	Tributary of Bourn Brook
Pre-Star Limited	534900	259800	60m N	Ch. 1900	Trade Discharge – Process Water	Tributary of Bourn Brook
David Ball Group Public Limited Company	534800	259500	240m SW	Ch. 1800	Sewage Discharges – Final/Treated Effluent – Not Water Company	Tributary of Bourn Brook
Rotortech Ltd	534800	259500	240m SW	Ch. 1800	Sewage Discharges – Final/Treated Effluent – Not Water Company	Tributary of Bourn Brook

Name	Easting	Northing	Distance / Compass Direction	Chainage	Discharge Type	Receiving Body
Martin Jenkins	535439	259807	495m E	Ch. 2000	Sewage Discharges - Final/Treated Effluent – Not Water Company	Unnamed ditch
Martin Jenkins	535439	259807	495m E	Ch. 2000	Sewage Discharges - Final/Treated Effluent – Not Water Company	Unnamed ditch
J Jenkins	535510	259750	495m E	Ch. 2000	Sewage Discharges - Final/Treated Effluent – Not Water Company	Ditch Tributary Cottenham Lode

4.1.3.4 Enforcement and Prohibition Notices

No Enforcement and Prohibition Notices are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.1.3.5 Pollution Incidents to Controlled Waters

Three pollution incidents to controlled waters are recorded in the Envirocheck Report within 500m of Zone 1, summarised in Table 4.5. Two of the incidents are related to industries at Bourn Works, on land which is believed to be historically associated with Bourn Airfield.

Table 4.5 Summary of pollution incidents to controlled waters – Zone 1

Type	National Grid Reference	Distance / Compass Direction	Chainage (OBC)	Pollutant	Receiving Body
Metal industry	534900 259600	145m S	Ch. 1900	Chemicals – Unknown	Tributary of Bourn Brook
Industrial: Other	534900 259500	240m S	Ch. 1900	Oils – Other Oil	Tributary of Bourn Brook
Domestic/Residential	534800 259400	340m S	Ch. 1775	Sewage – Septic Tank Effluent	Tributary of Bourn Brook

4.1.3.6 BGS Mineral Sites

No BGS Mineral Sites are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

4.1.3.7 Waste Activities

No landfill sites are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

One record of Extractive Industries or Potential Excavations from 1950 – 1980 is recorded within the Landmark Envirocheck Report, summarised in Table 4.6.

Table 4.6: Summary of extractive industries or potential excavations from 1950 – 1980 – Zone 1

Use	Easting	Northing	Chainage	Distance / Compass Direction
Pond	533528	259439	Ch. 425	100m, S

This record appears to relate to a pond which is present adjacent to Broadway Farm.

4.1.3.8 Hazardous Substances

No Control of Major Accident Hazards Sites or Planning Hazardous Substances Consents / Enforcements are recorded within 500m of this Zone within the Landmark Envirocheck Report.

One Notification of Installations Handling Hazardous Substances (NIHHS), although currently inactive, is recorded c. 410m south from Ch. 1750, and is associated with the Bourn Works.

4.1.3.9 Registered Radioactive Substances

The Landmark Envirocheck Report records no registered radioactive substances within 500m of route Zone 1.

4.1.3.10 Contemporary Trade Directory Entries

The Envirocheck Report identified nine contemporary trade directory entries within 500m of Zone 1, which are summarised in Table 4.7.

Table 4.7: Summary of contemporary trade directory entries – Zone 1

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
New Star	532931	259892	Ch. 0	350m NW	Ventilators & Ventilation Systems	
Allclean Enterprises	532963	259488	Ch. 0	190m SW	Cleaning Services – Domestic	Active
David Ball Plc	534829	259570	Ch. 1800	170m S	Waterproof Material Manufacturers	Inactive
D B Group	534829	259568	Ch. 1800	170m S	Engineering Materials	Active
David Ball Group	534829	259568	Ch. 1800	170m S	Engineering Materials	Inactive
D B Group	534829	259568	Ch. 1750	200m S	Builders' Merchants	Active
Filcris Ltd	533424	259136	Ch. 350	430m S	Machine Shops	Active
Thyssenkrupp Automotive Tallent Chassis Ltd	534950	259419	Ch. 1850	320m S	Car Component Manufacturers	Inactive
Cambourne Car Clinic	534877	259422	Ch. 1925	320m S	Car Body Repairs	Inactive

4.1.3.11 Sensitive Land Uses

The Zone is located within a Nitrate Vulnerable Zone.

No further sensitive land uses are recorded within 500m of the site within the Landmark Envirocheck Report.

4.1.3.12 Archaeology and Heritage

Please refer to Section 3.6 for further details.

4.1.3.13 Historical Development

A summary of the historical development of Zone 1 and the surrounding area within 500m is detailed in Table 4.8, highlighting the major changes observed in the historical maps.

It should be noted that where no significant changes and/or no coverage of the site or its surrounding area is provided, these records have not been included in the summary below.

Zone 1 and the immediate surrounding area are covered in slices A (A7, A8 and A12) and B (B5, B6, B9 and B10) of Envirocheck Report 1.

Table 4.8: Historic map review – Zone 1

Year of Publication	Scale	On-site	Off-site
1886 - 1887	1:10,560	Agricultural fields form the dominant land-use across the site. A road crosses the site at Ch . 450 and a lane leading up to Grange Farm crosses the site at Ch. 1700.	A road is orientated north-west to south-east c. 80m north. Pond located c. 100m south adjacent to Broadway Farm, and c. 280m south adjacent to Great Common Farm. Surrounding land-use comprises agricultural land and a series of farms.
1903	1:10,560	No significant change.	Water tank c. 230m north of Ch. 700 (labelled as Water Works)
1927	1:10,560	School on-site at Ch. 1700.	Development of housing (Highfields) along Highfields Road from c. 530m to the south/south-east of Ch 2000. A pond is located adjacent to Grange Farm c. 250m south of Ch 1800.
1960	1:10,560	Bourn Airfield present on-site (between Ch. 500 - 2000). Route mainly covering sections of runway/taxiways and small ancillary buildings. Airfield labelled as disused. Tracks and unknown buildings surrounding Grange Farm (Ch. 1400 - 1700).	A new rectangular structure with earthworks appears to be present near the waterworks, c. 220m NW of Ch 700. Development associated with bourn airfield is recorded up to c. 900m south of the site, west of Highfields. The road to the north of the site is labelled as A45 (T)
1976	1:2,500	No significant change.	A tank is recorded c. 40m NE of the site at Ch 0, and an aerial mast recorded 50m S of Ch 350. The rectangular structure near the waterworks is labelled as a Reservoir (covered) and a series of additional tanks are present adjacent to St Neots Road (c. 230m north-west from Ch. 700).

1980 – 1983	1:10,000	A structure is recorded on the site on the footprint of the airfield c. 30m south-east of Ch. 520.	Grange Farm is now labelled as two Works, with several additional structures recorded at the eastern footprint of Bourn Airfield (c. 200 – 400m south of Ch 1800). Further development of Highfields south/southeast of the site is recorded
2000	1:10,000	No significant change	The A45 is relabelled as A428 and has a series of drains adjacent to it c. 200m east of Ch 2000.
2006	1:10,000	No significant change.	The village of Cambourne has been constructed, including a new road, balancing pond and additional land drains present between c. 0.3 – 1km west of the site. A drain is recorded c. 50m NE of Ch 2000, running parallel to the A428 A roundabout is present along the A428 c. 450m E of Ch 2000
2020	1:10,000	The site comprises of a footpath and a small patch of wooded vegetation. Building recorded in 1980-1982 now labelled as Gofers House. The village of Upper Cambourne is now present and forms a large residential area (between Ch. 0 – 450). The village extends into the surrounding area west / southwest of the site, towards Cambourne.	The A428 has been upgraded and widened, and the new road runs parallel to the north of the site (between Ch. 0 – 2000), c. 30m north from Ch. 800 – 2000, including a flyover present c. 220m NE of Ch 2000. Sewage Pumping Station located c. 750m north-west of the site (Ch. 0). Map suggests large building in the south-eastern side of the Bourn Works has now been demolished.

4.1.3.14 Site History: Bourn Airfield

Constructed in 1940, RAF Bourn was originally intended as a satellite station for RAF Oakington (Bourn.org, 2013). It was used for training purposes from 1941 and was subjected to at least six air raids/strategic bombing between 1941 and 1944. Numerous aircraft were destroyed on the site during its operational years.

The airfield was given to the RAF Maintenance Command in 1947 and was closed in 1948; some of the land was sold off for agricultural use. Currently, the site is used for light aircraft and small industrial developments and other recreational uses (Bourn Airfield.co.uk, n.d.).

The airfield is now the subject of a Planning Application for redevelopment. As such potential concerns such as contaminants may be addressed by the developer.

4.1.3.15 Contaminants of Concern

Based on information obtained on the site and surrounding area, the Department for Environment (1995) Industry Profiles and Environment Agency Technical Guidance on Special Sites (2001), several contaminants of concern may be present. Those potentially present within 250m of the site have been summarised in Table 4.9.

Mott MacDonald is not insured to advise on risk arising from asbestos or radioactive substances, and therefore will not give advice relating to risks associated with them. It is recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos and/or radioactive substances at the site.

Table 4.9: Contaminants of concern – Zone 1

Potential Contaminant Source	Location	Contaminants of Concern
Building labelled 'Gofers House', (potentially to be demolished)	Western edge of the disused Bourn Airfield c. 30m south-east of Ch. 520.	Asbestos.
Highways / roads	A428 and St Neots Road located north of the site.	Organic compounds e.g. petrol, diesel, MTBE, hydrocarbons; heavy metals.
Bourn Airfield	Approximately between Ch. 0 – 1800, within and immediately south of the route.	Asbestos, UXO, acids, pesticides, herbicides, fungicides, solvents, paints, chemical warfare agents, metal powders, heavy metals, fuel and lubricating oils, de-icers, detergents, wastes reflective of site operations, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs).

4.1.4 Utilities

A high-level review of the main C2 utility return data indicates that electricity (high voltage) and water services are present adjacent to and parallel to Broadway which the proposed PTR crosses, these utilities pass around the western outskirts of Bourn Airfield adjacent to the A428. A different water main runs along the northern outskirts of Bourn Airfield between Ch 1250-2000. Several services are recorded running adjacent to and crossing Wellington Way, one of which appears to be a medium pressure gas main leading to an area of historic industry c. 250m south of the site at Ch 2000. It is understood that a series of drawings recording the approximate location of the C2 utility returns are being produced by Mott MacDonald, and these should be referred to for further information.

4.2 Zone 2

4.2.1 Site Geology

4.2.1.1 Published Geology

Table 4.10 presents the geology likely to be present directly beneath and in the surrounding area of Zone 2 as recorded by the 1:50,000 BGS mapping. For a description of the strata indicated, along with the age and thickness information please refer to Section 3.1.

Table 4.10: Summary of geology indicated on BGS mapping – Zone 2

Artificial Ground	Superficial Geology	Bedrock Geology
Onsite None indicated. However, Artificial Ground may be present as a result of existing road infrastructure.	Onsite Oadby Member.	Onsite Woburn Sands Formation (Ch. 2000 to Ch. 2300).
Offsite None indicated.	Offsite Oadby Member.	Gault Formation (Ch. 2300 to Ch. 2750).
		Offsite Kimmeridge Clay (to the west)

4.2.1.2 Encountered Geology

The BGS Geoindex indicates that there are several boreholes located along the length of Zone 2, which are mostly adjacent to or within the immediate surrounding area of the site footprint. The logs for these boreholes can be found in Appendix C, and a summary of the borehole records is presented in Table 4.11.

It should be noted there are many further historic boreholes within the surrounding area, however, the selected records are thought to be representative of the ground conditions likely to be present at this Zone.

All records recorded a veneer of topsoil (up to approximately 0.4m thick) overlying the Oadby Member, which was typically described as a firm to very stiff fissured silty gravelly CLAY, with gravel comprising fine to coarse gravel of flint and chalk, and occasional pockets of sand and gravel. Occasional cobbles/boulders were also recorded. The thickness of the Oadby Member was not proven in these historic boreholes.

Table 4.11: Summary of historical BGS Boreholes – Zone 2

Borehole ID	Eastings	Northings	Distance / Compass Direction	Chainage	Depth (m bgl)
TL35NE78	535080	259800	60m N	Ch. 2050	18.0
TL35NE82	535180	259790	40m N	Ch. 2200	18.0
TL35NE101	535290	259820	30m N	Ch. 2325	4.5
TL35NE105	535620	259790	On-site	Ch. 2550	4.2
TL35NE85	535850	259790	50m E	Ch. 2750	6.0

Although not recorded in these historic boreholes, it is possible that Made Ground and/or engineered fill may be encountered within this zone due to the presence of the A428 and any associated earthworks on and adjacent to the site.

4.2.2 Hydrogeology and Hydrology

4.2.2.1 Hydrogeology

The Envirocheck Report indicates that the Oadby Member is a Secondary Undifferentiated Aquifer, recorded as having medium groundwater vulnerability.

The Woburn Sands Formation on the western side of the Zone is recorded as a Principal Aquifer (high permeability and high levels of water storage). The Gault Formation to the east is classified as Unproductive Strata (no sensitive groundwater).

Groundwater was encountered in the historical BGS boreholes TL35NE78 and TL35NE82 within the Oadby Member at 0.35 – 0.72m bgl (71.1 – 70.73m AOD) and 1.03 – 1.06m bgl (70.37 – 70.34m AOD), respectively. This information suggests that the groundwater level may be relatively close to surface, and that perched groundwater is likely to be encountered.

Land between 500m – 1km south-west of the site is within a Source Protection Zone (SPZ) 3.

4.2.2.2 Hydrology

A number of drains are present on-site between Ch. 2000 and 2450 adjacent to the A428, with further drains recorded within the wider surrounding area which appear to drain agricultural land.

The Envirocheck Report shows that there is largely no risk of flooding from surface water for the majority of the Zone 2 footprint. There is, however, a medium/high risk of surface water flooding on Wellington Way, leading up to the Bourn Roundabout.

The Envirocheck Report also records limited potential for groundwater flooding of property below ground level across the western portion of this zone (Ch 2000 – 2300), with some potential for it to occur within the eastern area (Ch 2300 – 2750).

4.2.3 Environmental Records

4.2.3.1 Soil Geochemistry

The maximum recorded concentrations of metals within the soils at this Zone and in the immediate surrounding area, as reported in the Landmark Envirocheck Report, are presented in Table 4.12.

Table 4.12: Summary of Soil Geochemistry – Zone 2

Chemical	Concentration (mg/kg)
Arsenic	15 – 25
Cadmium	< 1.8
Chromium	60 - 120
Lead	<100
Nickel	30 – 45

4.2.3.2 Groundwater and Surface Water Abstractions

The Envirocheck Report indicates that there are no records of groundwater or surface water abstractions within 1km of Zone 2.

4.2.3.3 Discharge Consents

The Envirocheck Report indicates that there are seven discharge consents within 500m of Zone 2, three of which are within the proposed development boundaries. The consents are summarised in Table 4.13.

Table 4.13: Summary of discharge consents – Zone 2

Name	Easting	Northing	Distance / Compass Direction	Chainage	Discharge Type	Receiving Body
Thyssenkrupp Tallent Limited	534900	259800	60m N	Ch. 1900	Trade Discharge – Process Water	Tributary of Bourn Brook
Pre-Star Limited	534900	259800	60m N	Ch. 1900	Trade Discharge – Process Water	Tributary of Bourn Brook
J Jenkins	535510	259750	40m S	Ch 2500	Sewage Discharges - Final/Treated Effluent – Not Water Company	Ditch Tributary Cottenham Lode
Martin Jenkins	535439	259807	10m N	Ch 2450	Sewage Discharges - Final/Treated Effluent – Not Water Company	Unnamed ditch
Martin Jenkins	535439	259807	10m N	Ch 2450	Sewage Discharges - Final/Treated Effluent – Not Water Company	Unnamed ditch
Robin Martlew	535565	259568	220m S	Ch 2575	Sewage Discharges - Final/Treated Effluent – Not Water Company	Tributary of Callow Brook
Mr & Mrs R B Scurll	535600	259400	380m S	Ch 2600	Sewage Discharges - Final/Treated Effluent – Not Water Company	Land

4.2.3.4 Enforcement and Prohibition Notices

No Enforcement and Prohibition Notices are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.2.3.5 Pollution Incidents to Controlled Waters

Three pollution incidents to controlled waters are recorded in the Envirocheck Report within 500m of Zone 2, which have previously been summarised in Table 4.5. Two of the incidents are related to industries at Bourn Works, on land which is believed to be historically associated with Bourn Airfield.

4.2.3.6 BGS Mineral Sites

No BGS Mineral Sites are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

4.2.3.7 Waste Activities

No landfill sites or Extractive Industries or Potential Excavations (1950 – 1980) are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

4.2.3.8 Hazardous Substances

No Control of Major Accident Hazards Sites or Planning Hazardous Substances Consents / Enforcements are recorded within 500m of this Zone within the Landmark Envirocheck Report.

One Notification of Installations Handling Hazardous Substances (NIHHS), although currently inactive, is recorded approximately 450m south-west of Ch 2000, and is associated with the Bourn Works.

4.2.3.9 Registered Radioactive Substances

The Landmark Envirocheck Report records no registered radioactive substances within 500m of route Zone 2.

4.2.3.10 Contemporary Trade Directory Entries

The Envirocheck Report identified ten contemporary trade directory entry within 500m of Zone 2, which is summarised in Table 4.14.

Table 4.14: Summary of contemporary trade directory entries – Zone 2

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
David Ball Plc	534829	259570	Ch. 2000	260m SW	Waterproof Material Manufacturers	Inactive
D B Group	534829	259568	Ch. 2000	260m SW	Engineering Materials	Active
David Ball Group	534829	259568	Ch. 2000	260m SW	Engineering Materials	Inactive
D B Group	534829	259568	Ch. 2000	260m SW	Builders' Merchants	Active
Thyssenkrupp Automotive Tallent Chassis Ltd	534950	259419	Ch. 2000	325m SW	Car Component Manufacturers	Inactive
Cambourne Car Clinic	534877	259422	Ch. 2000	350m SW	Car Body Repairs	Inactive
McCulloch Direct Ltd	535382	259311	2200	470m SE	Electrical Goods Sales, Manufacturers & Wholesalers	Inactive
BP Express Shopping	535574	259669	Ch. 2600	110m S	Petrol Filling Stations	Inactive
Liquatek	536196	259644	Ch. 2750	470m SE	Damp and Dry Rot Control	Active
B P Service Station	536073	259647	Ch. 2750	360m SE	Petrol Filling Stations	Active

4.2.3.11 Sensitive Land Uses

The Zone is located within a Nitrate Vulnerable Zone.

No further sensitive land uses are recorded within 500m of the site within the Landmark Envirocheck Report.

4.2.3.12 Archaeology and Heritage

Please refer to Section 3.6 for further details.

4.2.3.13 Historical Development

A summary of the historical development of Zone 2 and the surrounding area within 500m is detailed in Table 4.15, highlighting the major changes observed in the historical maps.

It should be noted that where no significant changes and/or no coverage of the site or its surrounding area is provided, these records have not been included in the summary below.

Zone 2 and the immediate surrounding area are covered in Slice B (B6, B7, B10 and B11) of Envirocheck Report 1.

Table 4.15: Historic map review – Zone 2

Year of Publication	Scale	On-site	Off-site
1886	1:10,560	A road crosses the site orientated east to west at Ch. 2200. Another lane joins this road from the south at Ch. 2470. A building (Gate House) is present at the junction of these two roads at approximate Ch. 2470.	The surrounding land is predominantly comprised of agricultural land, farms and plantations, with Grange Farm (c. 200m south of Ch 2000, containing a pond) and Highfield Farm (c. 370m south of Ch 2500.)
1903	1:10,560	Methodist Chapel now labelled adjacent to the Gate House building at Ch. 2470.	Some small dwellings are now present to the south of the site (>250m south/south-east).
1927	1:10,560	An Iron age coin find is recorded adjacent to the Methodist Chapel.	Continued development south of the site (now labelled Highfields). A tank is labelled at Highfield Farm (c. 400m south-east of Ch. 2550).
1938 – 1953	1:10,560	No significant change.	Continued residential development in Highfields. Some buildings added to the south-east of the site (c. 500m from Ch. 2550)
1960	1:10,000	The road crossing the site is labelled as A45 (T)	Bourn Airfield (disused) now mapped, c. 250m south-west from Ch. 2100.
1960 – 1968	1:10,000	No significant change.	No significant change.
1976	1:2,500	A45 (T) is also labelled as St Neots Road A new building is present (Childerley Lodge) c. 60m north-west from the Methodist Chapel at Ch. 2470.	Grange Farm is no longer recorded, and several Works and tanks are present at its former location between c. 200 – 400m south of Ch 2000 (Bourn Works). Further tanks are recorded c. 250m south of the site on the outskirts of Highfields (c. 350m SE of Ch 2200)
1979 – 1986	1:2,500	No significant change	A petrol station is labelled directly adjacent to the site boundary, c. 80m south of Ch 2550.
1980 – 1983	1:10,000	No significant change	Continued development in Highfields with large buildings on the northern boundary of the village, and development along the southern side of St Neots Road c. 200m south-east from Ch 2750.

			A caravan Park is recorded c. 200m south of Ch 2600.
2000	1:10,000	A field drain crosses the site orientated north to south at Ch, 2200 and connects to a drain running adjacent to the south side of St Neots Road.	No significant change.
2006	1:10,000	St Neots Road junction is now a roundabout (100m south of Ch 2500. The Methodist Chapel, Childerley Lodge and Gate House remain at the northern facing exit of the roundabout along an unnamed lane. The drain adjacent to the south of St Neots Road now extends to Ch 2000.	No significant change.
2020	1:10,000	An overpass (and associated earthworks) connects the existing roundabout to the new A428, and crosses the site orientated north-west to south-east at Ch 2300. Wellington Way (small road) is now present, connecting Bourn Works/disused airfield to the roundabout at Ch. 2000 – 2450.	A large building at Bourn Works appears to have been demolished. The A428 is constructed, which passes east to west c. 100m north of St Neots Road. This comprises two carriageways which is located adjacent to the northern site boundary orientated east to west (c. 20 – 40m north from Ch 2400).

4.2.3.14 Contaminants of Concern

Based on information obtained on the site and surrounding area, the Department for Environment (1995) Industry Profiles, several contaminants of concern may be present. Those potentially present within 250m of the site have been summarised in Table 4.16.

Mott MacDonald is not insured to advise on risk arising from asbestos or radioactive substances, and therefore will not give advice relating to risks associated with them. It is recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos and/or radioactive substances at the site.

Table 4.16: Contaminants of concern – Zone 2

Potential Contaminant Source	Location	Contaminants of Concern
Agricultural land / farms	Zone surrounded by agricultural land e.g. south of the route, between Ch. 2000 and 2400 (OBC)/ Ch. 1980 – 2420 (Wellington Way).	Metals, nitr-compounds from organic waste and fertilisers, fuel oil, pesticides, animal slurry and silage effluent
Highways / roads	Entire Zone - between Ch. 2000 and 2750 (OBC/Wellington Way).	Organic compounds e.g. petrol, diesel, MTBE, hydrocarbons; heavy metals.
Fuel station	Approximately 140m S of Ch. 2550 (OBC), 60m E of Ch. 2500 (Wellington Way).	Alcohols, ethers, organo-lead compounds, benzene, branched olefins, long-chain aliphatic compounds, naphthalene, polycyclic aromatic hydrocarbons, petrol additives, diesel, metals and metal

Potential Contaminant Source	Location	Contaminants of Concern
		compounds, waste oil, anti-freeze, brake fluids, solvents (chlorinated and non-chlorinated), paints, glycol ethers, asbestos, isocyanates, battery acids, detergents.

4.2.4 Utilities

A high-level review of the main C2 utility return information indicates that water services and a medium pressure gas main run adjacent to and through Wellington Way. These cross Wellington Way Roundabout and continue along St Neots Road. A high-voltage service is present along St Neots Road at the petrol station, and a water mains hub is present c. 80m east of Childerley Lodge, where a water service crosses the proposed scheme towards the A428, orientated north to south. Gas and water services also run adjacent to the northern spur of Wellington Way Roundabout.. It is understood that a series of drawings recording the approximate location of the C2 utility returns are being produced by Mott MacDonald, and these should be referred to for further information.

4.3 Zone 3

4.3.1 Site Geology

4.3.1.1 Published Geology

Table 4.17 presents the geology likely to be present directly beneath and in the surrounding area of Zone 3 as recorded by the 1:50,000 BGS mapping. For a description of the strata indicated, along with the age and thickness information please refer to Section 3.1.

Table 4.17: Summary of geology indicated on BGS mapping – Zone 3

Artificial Ground	Superficial Geology	Bedrock Geology
<p>Onsite None indicated. However, Artificial Ground may be present on-site as a result of existing road infrastructure, residential housing.</p> <p>Offsite None indicated. However, Artificial Ground may be present on-site as a result of existing road infrastructure, residential housing and Bourn Airfield.</p>	<p>Onsite Oadby Member.</p> <p>Offsite Oadby Member.</p>	<p>Onsite Gault Formation</p> <p>Offsite West Melbury Marly Chalk Formation (north and east).</p>

4.3.1.2 Encountered Geology

The BGS Geoindex indicates that there are several boreholes located along the length of Zone 3, which are mostly adjacent to or within the immediate surrounding area of the zone footprint. The logs for these boreholes can be found in Appendix C, and a summary of the borehole records is presented in Table 4.18.

It should be noted there are further historic boreholes within the surrounding area however the selected records are thought to be representative of the ground conditions likely to be present at this Zone.

Table 4.18: Summary of historical BGS Boreholes – Zone 3

Borehole ID	Eastings	Northings	Distance / Compass Direction	Chainage (OBC)	Depth (m bgl)
TL35NE85	535850	259790	50m E	Ch. 2800	6.0
TL35NE28	536100	259880	60m N	Ch. 3125	24.0
TL35NE113	536290	259880	10m N	Ch. 3325	4.1
TL35NE88	536570	259860	15m NE	Ch. 3575	10.0
TL35NE24	536720	259750	20m S / N	Ch. 3775	1.0
TL35NE124	537040	259790	70m N	Ch. 4200	2.5
TL35NE128	537260	259710	10m N	Ch. 4300	3.1
TL35NE95	537490	259680	25m N	Ch. 4550	15.0
TL35NE33	538600	259540	On site	Ch. 5650	3.0

All records recorded a veneer of topsoil (up to approximately 0.4m thick), and Made Ground was recorded in two locations c. 1m in thickness (TL35NE113 and TL35NE24) comprising of

firm to stiff fissured sandy CLAY with gravel of chalk and flint, pieces of tarmac; or boulders and cobbles with pockets of clay. The Oadby Member was encountered beneath topsoil / Made Ground and was typically described as a firm to very stiff silty gravelly CLAY, with gravel described as fine to coarse flint and chalk, and occasional pockets of sand and gravel. The thickness of the Oadby Member was not proven in these historic boreholes.

Siltstone boulders were also encountered in TL35NE124 at 2.4m bgl, and siltstone erratic/boulders present between 2.1 – 3.1m bgl in TL35NE128, suggesting the possible presence of below ground obstructions.

Although not recorded in most historic boreholes, it is possible that Made Ground and/or engineered fill may be encountered within this zone associated with the A428 and its earthworks.

4.3.2 Hydrogeology and Hydrology

4.3.2.1 Hydrogeology

The Envirocheck Report indicates that the Oadby Member is a Secondary Undifferentiated Aquifer, recorded as having medium groundwater vulnerability.

The Gault Formation is classified as Unproductive Strata (no sensitive groundwater). The West Melbury Marly Chalk Formation to the north/east of the zone is classified as a Principal Aquifer.

Groundwater was encountered in the historical BGS boreholes TL35NE28 (a seepage at 17mbgl i.e. 44.30m AOD) and TL35NE95 (monitored between 1.76 – 4.57mbgl i.e. 56.21 – 59.02m AOD) in the Oadby Member. This suggests groundwater may be encountered at reasonably shallow depths within the Oadby Member and that perched groundwater may be encountered.

4.3.2.2 Hydrology

An extensive network of drains is present on-site (between Ch. 2750 and 5700) and within the wider surrounding area. Callow Brook crosses the route zone at approximately Ch. 4200 orientated north-east to south-west, and runs beneath the A428 via an underpass. There are two balancing ponds approximately 540m west and 270m east of the Scotland Road roundabout (at Ch. 3100 and Ch. 4000, respectively), which are present directly adjacent to the route alignment.

The Envirocheck Report shows that there is largely no risk of flooding from surface water for the majority of the Zone 3 footprint. There are bands of high risk (30-year return) surface water flooding at Ch. 3000 – 3500 and a low-medium risk (100-1000-year return) at Ch. 5700.

There is also potential for groundwater flooding at the surface at these chainages, according to the Envirocheck Report. The rest of Zone 3 mainly has the potential for groundwater flooding in property situated below ground level.

4.3.3 Environmental Records

4.3.3.1 Soil Geochemistry

The maximum recorded concentrations of metals within the soils at this Zone and in the immediate surrounding area, as reported in the Landmark Envirocheck Report, are presented in Table 4.19.

Table 4.19: Summary of Soil Geochemistry – Zone 3

Chemical	Concentration (mg/kg)
Arsenic	15 – 25
Cadmium	< 1.8
Chromium	90 – 120
Lead	<100
Nickel	30 – 45

4.3.3.2 Groundwater and Surface Water Abstractions

The Envirocheck Report indicates that there are no records of groundwater or surface water abstractions within 500m of Zone 3.

4.3.3.3 Discharge Consents

The Envirocheck Report indicates that there are ten discharge consents within 500m of Zone 3. The consents are summarised in Table 4.20.

Table 4.20: Summary of discharge consents – Zone 3

Name	Easting	Northing	Distance / Compass Direction	Chainage	Discharge Type	Receiving Body
J Jenkins	535510	259750	240m W	Ch 2750	Sewage Discharges - Final/Treated Effluent – Not Water Company	Ditch Tributary Cottenham Lode
Martin Jenkins	535439	259807	320m W	Ch 2750	Sewage Discharges - Final/Treated Effluent – Not Water Company	Unnamed Ditch
Martin Jenkins	535439	259807	320m W	Ch 2750	Sewage Discharges - Final/Treated Effluent – Not Water Company	Unnamed Ditch
Robin Martlew	535565	259568	280m SW	Ch 2750	Sewage Discharges - Final/Treated Effluent – Not Water Company	Tributary of Callow Brook
Anglian Water Services Limited	536390	259740	150m S	Ch 3350	Sewage Discharges – Pumping Station – Water Company	Unnamed Culverted Watercourse
Anglian Water Services Limited	536390	259740	150m S	Ch 3350	Sewage Discharges – Pumping Station – Water Company	Unnamed Culverted Watercourse

Name	Easting	Northing	Distance / Compass Direction	Chainage	Discharge Type	Receiving Body
Anglian Water Services Limited	536390	259740	150m S	Ch 3350	Storm/emergen cy overflow	Unnamed Culverted Watercourse
Anglian Water Services Limited	538450	259490	25m S	Ch 5550	Public Sewage – Storm Sewage Overflow	Tributary of Bin Brook
Anglian Water Services Limited	538450	259490	25m S	Ch 5550	Sewage Discharges – Final/Treated Effluent – Water Company	Tributary of Bin Brook
W T Burden, Civil Engineering/ Building Materials	538380	259350	180m SW	Ch 5550	Sewage Discharges – Final/Treated Effluent – Not Water Company	Tributary of Bin Brook

4.3.3.4 Enforcement and Prohibition Notices

No Enforcement and Prohibition Notices are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.3.3.5 Pollution Incidents to Controlled Waters

No Pollution Incidents to Controlled Waters are recorded within 500m of this Zone within the Landmark Envirocheck Report.

There is, however, one reported incident on the Substantiated Pollution Incident Register within 500m of Zone 3. This is summarised in Table 4.21.

Table 4.21 Summary of substantiated pollution incidents – Zone 3

Authority	Easting	Northing	Distance / Compass Direction	Pollutant	Impact
Environment Agency – Anglian Region	537970	260039	450m N (Ch. 5050)	Agricultural Materials and Wastes: Slurry and Dilute Slurry	Category 2: Significant Incident (Water)

4.3.3.6 BGS Mineral Sites / Mining

No BGS Mineral Sites are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

4.3.3.7 Waste Activities

No landfill sites or Extractive Industries or Potential Excavations (1950 – 1980) are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

One Licensed Waste Management Facility (licence surrendered) is located approximately 250m south-east of Ch. 3350. The facility was in the Household, Commercial and Industrial Transfer Stations category.

4.3.3.8 Hazardous Substances

No Hazardous Substances are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.3.3.9 Registered Radioactive Substances

The Landmark Envirocheck Report records no registered radioactive substances within 500m of route Zone 3.

4.3.3.10 Contemporary Trade Directory Entries

The Envirocheck Report identified twenty-nine contemporary trade directory entries within 500m of Zone 3, one of which is within the site boundary. These are summarised in Table 4.22.

Further contemporary trade directory entries are recorded within the wider surrounding area and are detailed within the Envirocheck Report.

Table 4.22: Summary of contemporary trade directory entries – Zone 3

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
BP Express Shopping	535574	259669	Ch. 2750	200m SW	Petrol Filling Stations	Inactive
The Tavistock Press (Cambridge) Ltd	537209	259637	Ch. 4250	280m S	Printers	Inactive
CSC Automotive	537184	259637	Ch. 4250	50m S	Garage Services	Active
CSC Vehicle Service and Repair Centre	537184	259637	Ch. 4250	50m S	Mot Testing Centres	Inactive
Cambridgeshire Sports Cars	537185	259635	Ch. 4250	50m S	Garage Services	Inactive
CSC Vehicle Service and Repair Ltd	537185	259635	Ch. 4250	50m S	Garage Services	Inactive
Helix Continuing Care	537065	259651	Ch. 4000	20m S	Stairlifts – Manufacturers and Installers	Inactive
Mark Weatherhead	537014	259645	Ch. 4000	75m SW	Agricultural Engineers	Inactive
3 Counties Cleaning	536705	259703	Ch. 3700	70m S	Commercial Cleaning Services	Inactive
3 Counties Cleaning	536705	259703	Ch. 3700	70m S	Commercial Cleaning Services	Inactive

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
S L Pallets	536670	259705	Ch. 3700	70m S	Pallets, Crates and Packing Services	Inactive
Nakitas Wholesale Paints	536394	259714	Ch. 3350	180m S	Do It Yourself Wholesalers	Inactive
Curtis Surfacing Contractors and Plant Hire	536394	259714	Ch. 3350	180m S	Asphalt and Coated Macadam Laying Contractors	Inactive
Mark Weatherhead Ltd	536367	259716	Ch. 3350	180m S	Agricultural Machinery – Sales and Service	Active
Liquatek	536196	259644	Ch. 3050	200m S	Damp and Dry Rot Control	Active
B P Service Station	536973	259647	Ch. 3200	270m S	Petrol Filling Stations	Active
Adawall Construction Chemicals Ltd	538247	259519	Ch. 5300	0m	Builders' Merchants	Inactive
Silver Star Chauffeur Service	538423	259487	Ch. 5400	75m SE	Car Engine Tuning and Diagnostic Services	Inactive
Anatune Ltd	537592	259616	Ch. 4600	25m S	Laboratory Equipment, Instruments and Supplies	Inactive
Technisol	537402	559616	Ch. 4450	50m S	Electrical Goods Sales, Manufacturers and Wholesalers	Active
Burdens	538289	259385	Ch. 5350	135m S	Builders' Merchants	Inactive
Blue Rose Cars	537591	259422	Ch. 4600	185m SE	Car Engine Tuning and Diagnostic Services	Active
Silo & Storage Systems Ltd	537048	259260	Ch 4100	445m S	Agricultural Machinery - Sales & Service	Inactive
Tiptop Cleaning	536196	259644	Ch 3170	200m S	Cleaning Services - Domestic	Active

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
Cambridge Mobile Mechanics	537360	259369	Ch 4480	500m S	Garage Services	Inactive
Eve'S Homeserve & Commercial	536793	260241	Ch 3650	200m N	Cleaning Services - Domestic	Inactive
Eve'S Homeserve	536793	260241	Ch 3650	200m N	Cleaning Services - Domestic	Inactive
Cambio Ltd	536802	260295	Ch 3650	200m N	Chemicals & Allied Products	Inactive

4.3.3.11 Sensitive Land Uses

The Zone is located entirely within a Nitrate Vulnerable Zone. The eastern side of Zone 3 (Ch. 3800 – 5700) from Scotland Road to Hardwick is classified as Area of Adopted Green Belt.

No further sensitive land uses are recorded within 500m of the site within the Landmark Envirocheck Report.

4.3.3.12 Archaeology and Heritage

Please refer to Section 3.6 for further details.

4.3.3.13 Historical Development

A summary of the historical development of Zone 3 and the surrounding area within 500m is detailed in Table 4.23, highlighting the major changes observed in the historical maps.

It should be noted that where no significant changes and/or no coverage of the site or its surrounding area is provided, these records have not been included in the summary below.

Zone 3 and the immediate surrounding area are covered in Slice B (B7, B8, B11 and B12) and C (C5) of Envirocheck Report 1 and Slice C (C12) and D (D5, D6, D7, D9, D10 and D11) of Envirocheck Report 2.

Table 4.23: Historic map review – Zone 3

Year of Publication	Scale	On-site	Off-site
1886 – 1886	1:10,560 1:2,500	A road (St Neots Road) is present orientated approximately east to west through agricultural land and is present within the site footprint from Ch 3700 (OBC).	St Neots Road is present c. 50 – 80m south of the site between Ch 2750 – 3700 (OBC). There is a collection of buildings/a farm adjacent to St Neots Road, south of the proposed route at Ch. 4200. Scotland Road crosses the route at approximately Ch. 3700. Two more farms (Park Farm and Redhouse Farm) are labelled to the north and south of the route (Ch. 5200), respectively. Highfield Farm present to the south-west of Ch. 2800.

			Scotland Farm present to the north (Ch. 3800), along Scotland Road.
1902 -1903	1:10,560 1:2,500	No significant change.	Collection of buildings at Ch. 4200 is now labelled as Hardwick Hall.
1926 - 1927	1:10,560 1:2,500	A field drain crosses the site orientated NE / SW, at approximate Ch 3450.	Tank labelled at Highfield Farm. New Farm and residential housing adjacent to Scotland Farm.
1938 – 1953	1:10,560 1:2,500	New lane crosses the route at Ch. 4150.	Development of residential/commercial buildings along St Neots Road (Hardwick) adjacent to the site, and new dwellings south of St Neots Road c. 100m south between Ch 2750 – 3450 (OBC).
1952	1:10,560 (Partial coverage)	No significant change.	Continued residential development in the eastern side of Zone 3
1960	1:10,000	Callow Brook crosses the site at Ch 4350, orientated northeast to southwest adjacent to Hardwick Hall.	No significant change.
1960 – 1968	1:10,000	No significant change.	No significant change.
1975	1:2,500	No significant change.	A depot is labelled c. 120m south of Ch. 5400, and a silo c. 140m south of Ch 5350.
1976 - 1977	1:2,500	No significant change.	A Sewage pumping station is recorded at Ch. 3400 (c. 150m south), and a filter bed is recorded c. 200m SW of Ch 3700. Caravan park c. 250m south-west of Ch. 2800.
1979 - 1984	1:2,500	Earthworks associated with new road construction (labelled as the A45) are shown along the northern boundary of St Neots Road from approximate Ch 5600 – 5700 (continuing to the east)	Pond c. 190m south of Ch. 2800. A Sewage pumping station is recorded at Ch. 3400 (c. 200m south) and at Ch. 5500 (50m south). A new roundabout has been constructed c. 700m east of Ch 5700, with associated slip roads, earthworks (significant cuttings shown c. 250m east) and overpasses.
1980 – 1983	1:10,000 1:2,500	A roundabout with associated earthworks has constructed along at Scotland Road. The road has been widened towards the east, with an additional slip road connecting to a roundabout east of this zone (Zone 4). A series of drains also run adjacent to the new roundabout. It appears that significant earthworks may have been undertaken from Ch. 5550 associated with the new road construction.	Continued residential and industrial development of Hardwick, with new areas of housing under construction. The filter bed is no longer labelled south of the site. Agricultural Engineering Works is labelled at Ch. 4000, replacing Hardwick Hall. Pump house labelled as Park Farm. An additional structure is present adjacent to the Depot at Ch 5400. Many land drains are recorded within the wider surrounding area draining agricultural land towards Bin or Callow Brook.

		<p>A drain is recorded within the site footprint at Ch 4150. This appears to connect to Callow Brook, flowing north-east from the site.</p> <p>More minor earthworks associated with the road upgrades are shown between Ch 5300 – 5700.</p>	
1994	1:2,500	No significant change.	No significant change.
2000	1:10,000	<p>A series of drains are recorded adjacent to St Neots Road, which is labelled as the A428. These are present between approximate Ch 3300 – 4900.</p> <p>Earthworks are recorded adjacent to the A428 between Ch 4800 – 5050</p>	<p>Housing estate developed to the south of St Neots road in the eastern part of Zone 3 (east of Scotland Road).</p> <p>New Farm now labelled as Dry Drayton Industries.</p> <p>Two artificial water bodies located at Ch. 4200 – 4300: unknown use.</p>
2006	1:10,000	No significant change.	No significant change.
2020	1:10,000	<p>A new road (A428) has been constructed parallel to St Neots Road to the north and is present adjacent to the site throughout much of this zone.</p> <p>The drain which crosses the OBC alignment at Ch 3450, and Callow Brook at Ch 4150 both appear to pass through culverts under the A428.</p> <p>Earthworks associated with the new A428 construction are present within the OBC alignment between Ch 2700 – 4700 including two balancing ponds (at Ch. 3100 and 4000.</p> <p>The drains adjacent to St Neots Road have altered slightly due to the construction of the A428.</p>	<p>A substation is labelled to the east of Scotland Road roundabout c. 25m north-east of the route at (Ch. 3800). A pumping station also appears to be present adjacent to this.</p> <p>Scotland Farm has also expanded to include Electrical Substation.</p> <p>A second roundabout is added at Scotland Road.</p> <p>A covered reservoir is present c. 425m east of Ch 5700.</p>

4.3.3.14 Contaminants of Concern

Based on information obtained on the site and surrounding area, the Department for Environment (1995) Industry Profiles, several contaminants of concern may be present. Those potentially present within 250m of the site have been summarised in Table 4.24.

Mott MacDonald is not insured to advise on risk arising from asbestos or radioactive substances, and therefore will not give advice relating to risks associated with them. It is recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos and/or radioactive substances at the site.

Table 4.24: Contaminants of concern – Zone 3

Potential Contaminant Source	Location	Contaminants of Concern
Agricultural land / farms	Zone surrounded by agricultural land	Metals, nitr-compounds from organic waste and fertilisers, fuel oil, pesticides, animal slurry and silage effluent.

Potential Contaminant Source	Location	Contaminants of Concern
Highways / roads	Entire Zone (Ch. 2750 – 5700)	Organic compounds e.g. petrol, diesel, MTBE, hydrocarbons; heavy metals.
Fuel station	250m south-west of Ch. 2800.	Alcohols, ethers, organo-lead compounds, benzene, branched olefins, long-chain aliphatic compounds, naphthalene, polycyclic aromatic hydrocarbons, petrol additives, diesel, metals and metal compounds, waste oil, anti-freeze, brake fluids, solvents (chlorinated and non-chlorinated), paints, glycol ethers, asbestos, isocyanates, battery acids, detergents.
Electrical substation	25m north of Ch. 3800.	Copper, copper alloys, cadmium, chromium, silver, beryllium, aluminium, lead, tin, iron, nickel, cobalt, manganese, bitumen, polychlorinated biphenyls, fire retardants, conductors/semi-conductors, polychlorinated naphthalene, mineral oil, capacitor impregnates, cleaning solvents, transformer oils.
Contemporary trade directory entries	The majority are located along southern side of St Neots Road.	<p><u>Electrical goods</u></p> <p>Metals and metalloids, asbestos, polychlorinated biphenyls, inorganic compounds, acids, alkalis, organic solvents, halogenated compounds and mineral oils.</p> <p><u>Garages</u></p> <p>Metals and metal compounds, waste oil, polycyclic aromatic compounds, heavy metals, anti-freeze, brake fluids, non-chlorinated solvents, chlorinated solvents, paints, thinners, inorganic compounds and detergents.</p> <p><u>Printers</u></p> <p>Inorganic pigments, organic pigments, organic dyes, asbestos, barium sulphate, hydrocarbon resins, oils, phenol formaldehyde, amino compounds, alkyds, organic solvents, alcohols and glycol ethers, ketones, esters, dimethylformamide, 1-nitropropane, plasticisers, lubricants, driers and catalysts.</p> <p><u>Asphalt contractors</u></p> <p>Bitumen, phenols, polycyclic aromatic hydrocarbons, ketones, kerosene, creosote oil, solvents, tar, hydrochloric acid, quaternary ammonium compounds, fuel oils, coal, waste solvents, lubricating oils, ash, polychlorinated biphenyls, asbestos.</p>

4.3.4 Utilities

A high-level review of the main C2 utility return information indicates that a water service and medium pressure gas main cross the scheme orientated north to south at approximate Ch 3350. Electricity services are shown to pass along the west side of Scotland Road Roundabout, which continue south before traversing east along St Neots road terminating just past the junction with Hall Drive. Water utilities run parallel to St Neots Road and the A428 on the northern and southern side and a water main crosses the A428 and proposed PTR at Ch 5520. A medium pressure gas main runs along the south side of St Neots Road between Scotland Road roundabout and the sewage pumping station. Foul water services appear present on the south side of St Neots road connecting to the sewage pumping station present at approximate Ch 5550. It is understood that a series of drawings recording the approximate location of the C2 utility returns are being produced by Mott MacDonald, and these should be referred to for further information.

4.4 Zone 4

4.4.1 Site Geology

4.4.1.1 Published Geology

Table 4.25 presents the geology likely to be present directly beneath and in the surrounding area of Zone 4 as recorded by the 1:50,000 BGS mapping. For a description of the strata indicated, along with the age and thickness information please refer to Section 3.1.

Table 4.25: Summary of geology indicated on BGS mapping – Zone 4

Artificial Ground	Superficial Geology	Bedrock Geology
Onsite None indicated. However, Artificial Ground may be present on-site as a result of existing road infrastructure, residential housing.	Onsite Oadby Member (Ch. 5700 – 8260)	Onsite West Melbury Marly Chalk Formation (Ch. 8260 – 8700).
Offsite None indicated. However, Artificial Ground may be present on-site as a result of existing road infrastructure, residential housing	Offsite Oadby Member (west of zone)	Offsite Gault Formation (east, west)

4.4.1.2 Encountered Geology

The BGS Geindex indicates that there are several boreholes located within the surrounding area of Zone 4. The logs for these boreholes can be found in Appendix C, and a summary of the borehole records is presented in Table 4.26.

It should be noted there are further historic boreholes within the wider surrounding area however the selected records are thought to be representative of the ground conditions likely to be present in this Zone.

Table 4.26: Summary of historical BGS Boreholes – Zone 4

Borehole ID	Eastings	Northings	Distance / Compass Direction	Chainage	Depth (m bgl)
TL35NE53	539300	259600	220m NE	Ch 6150	24.0
TL35NE162	539370	259370	140m E	Ch 6375	74.5
TL35NE1	539510	258860	240m SW	Ch 6650	23.0
TL45NW138	540510	258720	320m S	Ch 7700	44.9
TL45NW119	541200	258800	280m S	Ch 8400	39.9

All records recorded a veneer of topsoil (up to approximately 0.3m thick) overlying the Oadby Member in the western half of this zone. The Oadby Member was described as a firm to very stiff silty CLAY with gravel of chalk and was up to c. 20m thick, and broadly shown thin to the east towards its margins.

In the central and eastern areas of the site, the West Melbury Marly Chalk Formation was recorded at surface and ranged in thickness between 3.7 – 12.5m. This was described as a marly CHALK with hard bands, or clayey / hard block CHALK which was locally disturbed by coprolite digging.

The Gault Clay Formation was encountered beneath the Chalk as a stiff CLAY and was found to be between 36.4 – 39.0m in thickness. However, limited engineering descriptions were available of this unit within this zone.

4.4.2 Hydrogeology and Hydrology

4.4.2.1 Hydrogeology

The Envirocheck Report indicates that the Oadby Member is a Secondary Undifferentiated Aquifer, recorded as having medium groundwater vulnerability.

The West Melbury Marly Chalk Formation which underlies the entire footprint of this zone, and is likely to be encountered at surface in the central to eastern area, is classified as a Principal Aquifer.

The Gault Formation to the west and east of the zone is classified as Unproductive Strata (no sensitive groundwater).

Zone 4 is not located within a groundwater Source Protection Zone.

4.4.2.2 Hydrology

An extensive network of drains is present within the wider surrounding area of Zone 4 (Ch. 5700 – 8700), some of which cross the route (at Ch. 5700 and 7350). The drains to the south feed into Bin Brook c. 580m south of Ch. 8100.

Two Springs are also recorded in Coton and west of Whitwell Farm, and appear to be associated with the underlying Chalk within this area of the site between c. 220m and 650m south of the site respectively. These both drain southwards towards Bin Brook.

The Envirocheck Report shows that there is generally a low risk of surface water flooding to the route in Zone 4, with bands of low risk (i.e. 1000-year return) where drains cross the route e.g. Ch. 5700 and to the south-east of the Zone where the drains feed into Bin Brook.

The risk of groundwater flooding is generally limited across Zone but is greater at Ch. 5700.

4.4.3 Environmental Records

4.4.3.1 Soil Geochemistry

The maximum recorded concentrations of metals within the soils at this Zone and in the immediate surrounding area, as reported in the Landmark Envirocheck Report, are presented in Table 4.27.

Table 4.27: Summary of Soil Geochemistry – Zone 4

Chemical	Concentration (mg/kg)
Arsenic	< 15 – 25
Cadmium	< 1.8
Chromium	60 - 90

Chemical	Concentration (mg/kg)
Lead	<100
Nickel	30 - 60

4.4.3.2 Groundwater and Surface Water Abstractions

The Envirocheck Report indicates that there is one record of groundwater abstraction and no records of surface water abstraction within 500m of Zone 4, summarised in Table 4.28.

Table 4.28: Summary of water abstractions – Zone 4

Name	Easting	Northing	Distance / Compass Direction	Abstraction Type	Source
N B Blow Ltd	541000	259300	200m N (Ch. 8200)	General Farming and Domestic	Groundwater (borehole)

4.4.3.3 Discharge Consents

The Envirocheck Report indicates that there are eleven discharge consents within 500m of Zone 4. The consents are summarised in Table 4.29.

Table 4.29: Summary of discharge consents – Zone 4

Name	Easting	Northing	Distance / Compass Direction	Chainage	Discharge Type	Receiving Body
L Webster & Sons	539350	259200	0m E	Ch 6550	Trade Discharge - Agricultural and Surface	Groundwater
Anglian Water Services Limited	538450	259490	200m W	Ch 5700	Public Sewage: Storm Sewage Overflow	Tributary of Bin Brook
Anglian Water Services Ltd.	538450	259490	200m W	Ch 5700	Sewage Discharges - Final/Treated Effluent - Water Company	Tributary of Bin Brook
Dr Basile Kalogerakis	539542	259425	190m N	Ch 6570	Sewage Discharges - Final/Treated Effluent - Not Water Company	Tributary of Bin Brook
W T Burden, Civil Engineering/Building Materials	538380	259350	180m SW	Ch 5430	Sewage Discharges - Final/Treated Effluent - Not Water Company	Tributary of Bin Brook

Name	Easting	Northing	Distance / Compass Direction	Chainage	Discharge Type	Receiving Body
Chancellor Masters & Scholars Of*	538280	259810	460m NW	Ch 5700	Sewage Discharges - Final/Treated Effluent - Not Water Company	Tributary of Bin Brook
Avlar Boiventures	539350	259860	450m N	Ch 6150	Sewage Discharges - Final/Treated Effluent - Not Water Company	Tributary of Beck Brook
M Walker- Smith	539390	259830	450m N	Ch 6200	Discharge Of Other Matter- Surface Water	Tributary of Beck Brook
Ridgeon Mr	541808	259065	370m NE	Ch 8760	Sewage Discharges - Final/Treated Effluent - Not Water Company	Ground & Unnamed Ditch via Soak
Anglia Marketing Communicatio ns	540100	259400	275m N	Ch 7300	Unknown	Land
Dr & Mrs J B Hickling	540700	259500	370m N	Ch 7900	Sewage Discharges - Final/Treated Effluent - Not Water Company	Unnamed Drainage Ditch

*Potentially incomplete record information

4.4.3.4 Enforcement and Prohibition Notices

No Enforcement and Prohibition Notices are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.4.3.5 Pollution Incidents to Controlled Waters

Five pollution incidents to controlled waters are recorded in the Envirocheck Report within 500m of Zone 4, summarised in Table 4.30.

Table 4.30: Summary of pollution incidents to controlled waters – Zone 4

Type	National Grid Reference	Distance / Compass Direction	Chainage	Pollutant	Receiving Body
Not Given	539400 259500	300m E	Ch. 6150	Unknown	Ditch at Low Road Comberton
Not Given	539200 259800	305m NE	Ch. 6150	Unknown	Ditch Tributary of Rhee
Road	541200 259000	35m S	Ch. 8400	Chemicals – Fertiliser, Solid	Bin Brook

Type	National Grid Reference	Distance / Compass Direction	Chainage	Pollutant	Receiving Body
Not Applicable	540800 258900	220m S	Ch. 7950	Miscellaneous – Natural	Pond
Water Company Sewage: Sewage Treatment Works	541400 258400	500m S/SW	Ch. 8700	Sewage – Treated Effluent	Bin Brook

4.4.3.6 BGS Mineral Sites / Mining

One BGS Recorded Mineral Site is present within 500m of this zone, summarised in Table 4.31. One further record is presented within the Envirocheck report within 1km of the site. For further details, please refer to the Envirocheck Report.

Table 4.31: Summary of BGS Recorded Mineral Sites – Zone 4

Site	Easting	Northing	Chainage	Distance / Compass Direction	Commodity	Type / Status
Coton Chalk Pit	540849	258964	Ch. 8100	150m S	Chalk	Opencast, Ceased

Three records of man-made mining cavities are also recorded within 500m of the site, summarised in Table 4.32. Three further records are present within 1km of the site, summarised within the Envirocheck Report.

Table 4.32: Summary of Man Made Mining Cavities – Zone 4

Cavity Type	Easting	Northing	Chainage	Distance / Compass Direction	Commodity
Coprolite Mining – Details unknown	539800	259200	Ch. 7000	75m N	Coprolite
Coprolite Mining – Details unknown	539500	258800	Ch. 6700	360m S	Coprolite
Coprolite Mining – Details unknown	540100	258800	Ch. 7300	330m S	Coprolite

The above record of coprolite mining broadly correlates with descriptions on the historic borehole logs, which suggest that the Chalk is disturbed by mining within this zone.

4.4.3.7 Waste Activities

No landfill sites are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

One record of Extractive Industries or Potential Excavations (1950 – 1980) is recorded within the Landmark Envirocheck Report, summarised in Table 4.33.

Table 4.33: Summary of extractive industries or potential excavations from 1950 – 1980 – Zone 1

Use	Easting	Northing	Chainage (OBC)	Distance / Compass Direction
Reservoir (Covered)	540627	25904	Ch 7800	50m S

4.4.3.8 Hazardous Substances

No Hazardous Substances are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.4.3.9 Registered Radioactive Substances

The Landmark Envirocheck Report records no registered radioactive substances within 500m of route Zone 4.

4.4.3.10 Contemporary Trade Directory Entries

The Envirocheck Report identified thirteen contemporary trade directory entry within 250m of Zone 4, which are summarised in Table 4.34.

Table 4.34: Summary of contemporary trade directory entries – Zone 4

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
Adawall Construction Chemicals Ltd	538247	259519	Ch 5700	400m W	Builders' Merchants	Inactive
Silver Star Chauffeur Service	538423	259487	Ch 5700	230m W	Car Engine Tuning & Diagnostic Services	Inactive
American Battle Monuments Commission	539623	259271	Ch. 6850	35m N	Cemeteries and Crematoria	Inactive
Digital Healthcare Ltd	539964	259326	Ch. 7150	170m N	Medical Equipment Manufacturers	Inactive
Digital Healthcare Ltd	539964	259327	Ch. 7150	170m N	Medical Equipment Manufacturers	Inactive
Burdens	538289	259385	Ch 5700	360m W	Builders' Merchants	Inactive
East Anglian Haulage Ltd Within Madingley Garage	539440	259375	Ch. 6350	100m E	Road Haulage Services	Active
Think Thorne	541522	258805	Ch. 8700	170m S	Office Furniture & Equipment	Active
Aclardian	539374	259830	Ch 6200	440m N	Chemists' & Pharmacists' Suppliers & Wholesalers	Active
Desira Ltd	541204	258882	Ch. 8370	180m S	Car Dealers	Inactive

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
Altone	540983	258921	Ch. 8200	200m S	Printers	Inactive
Vetquip	540964	258910	Ch. 8200	200m S	Laboratory Equipment, Instruments & Supplies	Inactive
Martin Hardy Contract Services	540787	258769	Ch 7970	360m S	Horticultural Equipment Maintenance & Repair	Inactive

4.4.3.11 Sensitive Land Uses

The entire zone is located within an Area of Adopted Greenbelt and a Nitrate Vulnerable Zone.

Madingley Wood, an Ancient Woodland and Site of Special Scientific Interest, is present c. 280m north of the OBC alignment at Ch 7400.

No further sensitive land uses are recorded within the Envirocheck Report within 500m of the zone.

4.4.3.12 Archaeology and Heritage

Please refer to Section 3.6 for further details.

4.4.3.13 Historical Development

A summary of the historical development of Zone 4 and the surrounding area within 500m is detailed in Table 4.35, highlighting the major changes observed in the historical maps.

It should be noted that where no significant changes and/or no coverage of the site or its surrounding area is provided, these records have not been included in the summary below.

Zone 4 and the immediate surrounding area are covered in Slice D (D7, D8 and D11) and E (E5, E6, E7 and E8) from Envirocheck Report 2.

Table 4.35: Historic Map Review – Zone 4

Year of Publication	Scale	On-site	Off-site
1886	1:10,560	<p>St Neots Road is already established and is present in the site footprint between Ch 5700 – c. 6000, orientated approximately east to west.</p> <p>Long Road branches off from St Neots Road, crossing the route at Ch. 5950</p> <p>After Ch. 6000, the route lies on open fields/agricultural land.</p> <p>An unnamed lane crosses the route at approximately Ch. 8400</p>	<p>Agricultural land and woodland surround the route. The village of Coton lies c. 250m south of Ch. 8100.</p> <p>Madingley Hall estate lies c. 950m north of Ch. 6200/.</p> <p>Old Clunch (Chalk) pit labelled c. 575m north of Ch. 7450.</p> <p>A windmill and mill house (corn) is located c. 320m north of Ch. 7900.</p>

1903	1:10,560	No significant change.	Another old chalk pit is labelled in the village of Coton, c. 150m south of Ch. 7950.
1927	1:10,560	An Orchard associated with Crome Lea Farm crosses the route at approximately Ch. 7200 – 7350 .	Residential expansion of Coton. A pump house is now located c. 175m north of Ch. 8150. Coton Court labelled c. 260m north of Ch. 7600. Crome Lea Farm, along with a pump house, have been added, c. 200m north of Ch. 7200. Wind pump and tank located c. 620m north of Ch. 6800. Unspecified earthworks labelled at Madingley Wood, 300m north of Ch. 7200.
1938 – 1953	1:10,560	No significant change.	Some buildings are added 200m north of Ch. 7000.
1952	1:10,560	No significant change.	Land to the east of Madingley Wood is now the American Military Cemetery. New building added c. 130m north of Ch. 8600.
1972 – 1973 (partial)	1:10,000	The Orchard is no longer present and is now shown to be agricultural fields.	Covered reservoir works and pump house c. 100m south of Ch. 7850. Allotment gardens immediately to the south of Ch. 8700.
1980 – 1983	1:10,000	No significant change.	Road to the north of Ch. 5700 altered – additional slip road and Madingley Mulch Roundabout added to the east (north of Ch. 6400). Water tower also labelled adjacent to Ch. 6400. Significant development of Cambridge Road to the east of Zone 4.
2006	1:10,000	Covered reservoir between Ch. 6000 – 6200.	Crome Lea Farm expanded and now includes Crome Lea Business Park.
2020	1:10,000	Unlabelled land-use change at Ch. 7700 – 7800. Small building present, potentially related to the covered reservoirs or agricultural activities.	Electrical substation c. 150m south of Ch. 7800

4.4.3.14 Contaminants of Concern

Based on information obtained on the site and surrounding area, the Department for Environment (1995) Industry Profiles, several contaminants of concern may be present. Those potentially present within 250m of the site have been summarised in Table 4.36.

Mott MacDonald is not insured to advise on risk arising from asbestos or radioactive substances, and therefore will not give advice relating to risks associated with them. It is recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos and/or radioactive substances at the site.

Table 4.36: Contaminants of concern – Zone 4

Potential Contaminant Source	Location	Contaminants of Concern
Agricultural land	Zone surrounded by agricultural land. Discharge of agricultural waste to groundwater - 0m E (Ch 6550).	Metals, nitr-compounds from organic waste and fertilisers, fuel oil, pesticides, animal slurry and silage effluent
Potentially infilled land (non-water) and extractive industries	Chalk pit c. 150m south of Ch. 7950. Covered reservoir c. 50m south of Ch. 7800	Unknown infill material (potential source of ground gas and organic contaminants)
Highways / roads	On-site Ch. 5700 – 6200 Off-site Ch. 6200 – 8700	Organic compounds e.g. petrol, diesel, MTBE, hydrocarbons; heavy metals.
Contemporary trade directory entries e.g. printers, laboratory equipment, car/tyre dealers, electrical substation.	<250m west of Ch. 5700, north of Ch. 6600 – 6800 (around Madingley Mulch roundabout) and south of Ch. 7700 – 8700 (Coton)	<u>Electrical goods</u> Metals and metalloids, asbestos, polychlorinated biphenyls, inorganic compounds, acids, alkalis, organic solvents, halogenated compounds and mineral oils. <u>Garages</u> Metals and metal compounds, waste oil, polycyclic aromatic compounds, heavy metals, anti-freeze, brake fluids, non-chlorinated solvents, chlorinated solvents, paints, thinners, inorganic compounds and detergents. <u>Printers</u> Inorganic pigments, organic pigments, organic dyes, asbestos, barium sulphate, hydrocarbon resins, oils, phenol formaldehyde, amino compounds, alkyds, organic solvents, alcohols and glycol ethers, ketones, esters, dimethylformamide, 1-nitropropane, plasticisers, lubricants, driers and catalysts.
Unspecified works	Coton (c. 250m south-east of Ch. 7800)	Potentially a range of contaminants, not limited to: Metals and metal compounds, oils/fuels, polycyclic aromatic compounds, heavy metals, solvents, paints, inorganic compounds, acids, asbestos, polychlorinated biphenyls.

4.4.4 Utilities

A high-level review of the main C2 utility return information indicates that the scheme passes a Waterworks site 150m west (containing a covered reservoir) at Ch 6300 and water tower/radio masts 70m north-east of Ch 6325; two further covered water reservoirs are found 60m south at Ch 7800. A water main also runs from the Waterworks site to the two covered reservoirs orientated south-east, crossing the route at approximate Ch 6300, Ch 6450 and Ch 7260. A high-voltage electricity service crosses the site orientated north-west to south-east crossing the proposed PTR at Ch 6290 and passing adjacent to the west of the two covered reservoirs. A low pressure gas main runs adjacent to Cambridge Road, where the route passes c. 40m north of Coton. It is understood that a series of drawings recording the approximate location of the C2 utility returns are being produced by Mott MacDonald, and these should be referred to for further information.

4.5 Zone 5

4.5.1 Site Geology

4.5.1.1 Published Geology

Table 4.37 presents the geology likely to be present directly beneath and in the surrounding area of Zone 5 as recorded by the 1:50,000 BGS mapping. For a description of the strata indicated, along with the age and thickness information please refer to Section 3.1.

Table 4.37: Summary of geology indicated on BGS mapping – Zone 5

Artificial Ground	Superficial Geology	Bedrock Geology
<p>Onsite None indicated. However, Artificial Ground may be present on-site as a result of existing road infrastructure with earthworks shown adjacent to the M11.</p> <p>Offsite None indicated. However, Artificial Ground may be present on-site as a result of existing road infrastructure, residential housing and surrounding commercial areas east of the M11.</p>	<p>Onsite None recorded.</p> <p>Offsite None recorded within immediate surrounding area</p>	<p>Onsite Gault Formation (Ch 8670 – 9450)</p> <p>Offsite Gault Formation West Melbury Marly Chalk Formation (adjacent to the west of the zone)</p>

4.5.1.2 Encountered Geology

The BGS Geoindex indicates that there are several boreholes located adjacent to the site and within the surrounding area of Zone 5. The logs for these boreholes can be found in Appendix C, and a summary of the borehole records is presented in Table 4.38.

It should be noted there are further historic boreholes within the wider surrounding area however the selected records are thought to be representative of the ground conditions likely to be present in this Zone.

Table 4.38: Summary of historical BGS Boreholes – Zone 5

Borehole ID	Eastings	Northings	Distance / Compass Direction	Chainage	Depth (m bgl)
TL45NW119	541200	258800	350m SW	Ch 8700	39.9
TL45NW110	541990	258650	300m S	Ch 9200	15.2
TL45NW89	542060	258960	20m N	Ch 9350	3.1
TL45NW197	542240	259080	130m N	Ch 9450	20.0

All except one historic borehole recorded a veneer of topsoil (up to approximately 0.45m thick) overlying the Gault Formation. The Gault Formation was described as a firm to stiff slightly to very sandy fissured silty CLAY with occasional gravel and roots near surface. The unit typically lost its sand content with depth and had occasional gravel sized mudstone lithorelics. The thickness of this unit was only proven in one borehole west of the site (TL45NW119) at c. 36.6m.

It should be noted that TL45NW119 records the Chalk present at surface, however this exploratory hole is located c. 350m south-west of this zone and the Chalk is not expected to be encountered in this zone.

4.5.2 Hydrogeology and Hydrology

4.5.2.1 Hydrogeology

The Envirocheck Report indicates that the Gault Formation is classified as Unproductive Strata (no sensitive groundwater).

No superficial deposits are recorded within this zone or the immediate surrounding area.

The West Melbury Marly Chalk Formation present to the west of this zone is classified as a Principal Aquifer.

Groundwater was recorded as a seepage in the Gault Formation at 1.7m bgl in TL45NW197, which may suggest the possible presence of perched groundwater within this unit.

The site is not located within a groundwater Source Protection Zone.

4.5.2.2 Hydrology

An extensive network of drains is present within the wider surrounding area of Zone 5 (Ch. 8700 – 9450), one of which crosses the route at Ch. 9100. The drains to the south feed into Bin Brook (c. 700m south of Ch. 8700).

The Envirocheck Report shows that there is generally a very low risk of surface water flooding to the route in Zone 5, with pockets of low-high risk (i.e. 1000-year to 30-year return) crossing the route between Ch. 8700 – 9100.

The risk of groundwater flooding is limited in the western side of the Zone (Ch. 8700 – 9000), with no reported risk of groundwater flooding thereafter (i.e. moving east towards end of Zone 5 – Ch. 9450).

4.5.3 Environmental Records

4.5.3.1 Soil Geochemistry

The maximum recorded concentrations of metals within the soils at this Zone and in the immediate surrounding area, as reported in the Landmark Envirocheck Report, are presented in Table 4.39.

Table 4.39: Summary of Soil Geochemistry – Zone 5

Chemical	Concentration (mg/kg)
Arsenic	<15
Cadmium	<1.8
Chromium	60 – 90
Lead	<100
Nickel	30 - 60

4.5.3.2 Groundwater and Surface Water Abstractions

The Envirocheck Report indicates that there is one record of groundwater abstraction and no records of surface water abstraction within 500m of Zone 5, summarised in Table 4.40.

Table 4.40: Summary of water abstractions – Zone 5

Name	Easting	Northing	Distance / Compass Direction	Abstraction Type	Source
Natural Environmental Research	542200	259170	225m N (Ch. 9400)	Industrial Processing (Misc.)	Well and borehole

4.5.3.3 Discharge Consents

The Envirocheck Report indicates that there is one discharge consent within 500m of Zone 5, summarised in Table 4.41.

A further 10 discharge consents are present up to 1km from the site, for further details please refer to the Envirocheck Report.

Table 4.41: Summary of discharge consents – Zone 5

Name	Easting	Northing	Distance / Compass Direction	Discharge Type	Receiving Body
Ridgeon Mr	541808	259065	125m N (Ch. 9100)	Sewage Discharges – Final/Treated Effluent – Not Water Company	Ground & Unnamed Ditch via Soak

4.5.3.4 Enforcement and Prohibition Notices

No Enforcement and Prohibition Notices are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.5.3.5 Pollution Incidents to Controlled Waters

One pollution incident to controlled waters is recorded in the Envirocheck Report within 500m of Zone 5, summarised in Table 4.42.

Table 4.42: Summary of pollution incidents to controlled waters – Zone 5

Type	National Grid Reference	Distance / Compass Direction	Chainage (OBC)	Pollutant	Receiving Body
Road	541200 259000	400m W	Ch. 8700	Chemicals – Fertilizer, Solid	Bin Brook

4.5.3.6 BGS Mineral Sites / Mining

No BGS Mineral Sites / mines or quarries are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

4.5.3.7 Waste Activities

No landfill sites, Extractive Industries or Potential Excavations (1950 – 1980), or areas of Potentially Infilled Land are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

4.5.3.8 Hazardous Substances

No Hazardous Substances are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.5.3.9 Registered Radioactive Substances

12 records of Registered Radioactive Substances within 500m of Zone 5 (Ch. 9450) were identified in the Landmark Envirocheck Report. They are associated with the University of Cambridge and British Antarctic Survey for the storage, use and disposal of radioactive substances.

4.5.3.10 Contemporary Trade Directory Entries

The Envirocheck Report identified five contemporary trade directory entries within 500m of Zone 5. These are summarised in Table 4.62Table 4.22 4.43. Further contemporary trade directory entries are recorded within the wider surrounding area and are detailed within the Envirocheck Report.

Table 4.43: Summary of contemporary trade directory entries – Zone 5

Name	Easting	Northing	Chainage (OBC)	Distance / Compass Direction	Classification	Status
Desira Ltd	541204	258882	Ch. 8670	250m SW	Car Dealers	Inactive
Think Thorne	541522	258805	Ch. 8670	130m S	Office Furniture & Equipment	Active
Altone	540983	258921	Ch. 8670	475m, W	Printers	Inactive
Vetquip	540964	258910	Ch. 8670	480m W	Laboratory Equipment, Instruments & Supplies	Inactive
Polysolar	542207	259234	Ch 9450	300m N	Builders' Merchants	Active

4.5.3.11 Sensitive Land Uses

The majority of this zone is within an Area of Adopted Greenbelt, and the entire zone is within a Nitrate Vulnerable Zone. No further sensitive land uses, apart from areas of Adopted Greenbelt within the surrounding area, are recorded within 500m of the site within the Envirocheck Report.

4.5.3.12 Archaeology and Heritage

Please refer to Section 3.6 for further details.

4.5.3.13 Historical Development

A summary of the historical development of Zone 5 and the surrounding area within 500m is detailed in Table 4.44, highlighting the major changes observed in the historical maps.

It should be noted that where no significant changes and/or no coverage of the site or its surrounding area is provided, these records have not been included in the summary below.

Zone 5 and the immediate surrounding area are covered in Slice E (E3, E4, E7 and E8) from Envirocheck Report 2.

Table 4.44: Historic map review – Zone 5

Year of Publication	Scale	On-site	Off-site
1886 – 1888	1:10,560 1:2,500	Site entirely comprises of agricultural land (between Ch. 8670 – 9450).	St Neots Road is present c. 425m north of Ch. 8800.
1902 – 1904	1:10,560 1:2,500	No significant change.	Rectory Farm c. 320m north of Ch. 9000.
1938 – 1953	1:10,560	Marked ground (potentially a car park or storage yard) crosses route at Ch. 9400, associated with unlabelled works c. 200m north.	Unlabelled works c. 200m north of Ch. 9400, comprising two large buildings, small ancillary buildings and tracks. Two large buildings c. 200m south-east of Ch. 9450.
1970 – 1973	1:10,000 1:2,500	No significant change.	Unlabelled works demolished, replaced with small laboratory building (c. 250m north) and Atlas Centre (c. 70m north) – Ch. 9400. Chimney and tank identified at Depot c. 200m south-east of Ch. 9450. University of Cambridge School of Veterinary Medicine established c. 550m north-east of Ch. 9400. Allotment gardens c. 100m south-west of Ch. 8800.
1983	1:10,000	M11 crosses the route at Ch. 9250, with significant earthworks identified (cutting/embankments).	Atlas Centre now larger building. British Antarctic Survey building c. 300m north of Ch. 9400. Pumping station c. 590m north-east of Ch. 9450. Atlas Centre now labelled Design Centre, which is a larger building that borders the route at Ch. 9400.
2000	1:10,000	No significant change.	Design Centre now labelled Computer Aided Design Centre. British Antarctic Survey building expanded. New laboratory (High Cross), with outdoor structures, c. 100m north-east of Ch. 9450.
2006	1:10,000	No significant change.	Small changes to the layout of Computer Aided Design Centre. Park and Ride added in Bradbush Fields c. 500m north-east of Ch. 9450.
2020	1:10,000	No significant change.	Significant expansion of University of Cambridge campus south-east of Ch. 9450. Charles Babbage Road runs east-west along the route (Zone 6, from Ch. 9450).

Potential excavation related to expansion of University of Cambridge campus immediately to the east of Ch. 9450.

Small building c. 170m south of Ch. 9400.

Department of Materials Science and Metallurgy c. 280m south-east of Ch. 9450.

Department of Chemical Engineering and Biotechnology c. 415m south-east of Ch. 9450.

Sports Centre c. 420m south-east of Ch. 9450.

Artificial pond/lake c. 260m south-east of Ch. 9450.

Electrical substation c. 70m north of Ch. 9400.

4.5.3.14 Contaminants of Concern

Based on information obtained on the site and surrounding area, the Department for Environment (1995) Industry Profiles, several contaminants of concern may be present. Those potentially present within 250m of the site have been summarised in Table 4.45.

Mott MacDonald is not insured to advise on risk arising from asbestos or radioactive substances, and therefore will not give advice relating to risks associated with them. It is recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos and/or radioactive substances at the site.

Table 4.45: Contaminants of concern – Zone 5

Potential Contaminant Source	Location	Contaminants of Concern
Highways / roads e.g. M11	A1303 c. 450m north of Ch. 9100. M11 crosses the route at Ch. 9250.	Organic compounds e.g. petrol, diesel, MTBE, hydrocarbons; heavy metals.
Agricultural land/allotment gardens	Allotments c. 130m south-west of Ch. 8700. Agricultural land surrounds the route between Ch. 8700 – 9200.	Metals, nitr-compounds from organic waste and fertilisers, fuel oil, pesticides, animal slurry and silage effluent.
On-site and off-site historical and current industrial/commercial activity e.g. electrical substation, laboratory, depots, car dealers, etc.	Construction of buildings has crossed the route at Ch. 9400. Laboratories, British Antarctic Survey and University buildings within 250m of Ch. 9450 (north and north-east). Unspecified historical depot 200m south/south-east of Ch. 9450.	<u>Car dealers</u> Metals and metal compounds, waste oil, polycyclic aromatic compounds, heavy metals, anti-freeze, brake fluids, non-chlorinated solvents, chlorinated solvents, paints, thinners, inorganic compounds and detergents. <u>Other</u> Potentially a range of contaminants, not limited to: Metals and metal compounds, oils/fuels, polycyclic aromatic compounds, heavy metals, solvents, paints, inorganic compounds, acids, asbestos, polychlorinated biphenyls, radionuclides.

Potential Contaminant Source	Location	Contaminants of Concern
Registered Radioactive Substances	Two records within 250m of Ch. 9400 (north/north-east).	Potentially any radionuclide (principal ones of concern include radium species, tritium and carbon-14).

4.5.4 Utilities

A high-level review of the main C2 utility return information indicates that the scheme does not encounter significant services along the majority of this zone. Foul and surface water, and a low to high pressure gas main are present along / adjacent to Ada Lovelace Road, at approximate Ch 9450, orientated broadly north to south, running parallel with the road. It is understood that a series of drawings recording the approximate location of the C2 utility returns are being produced by Mott MacDonald, and these should be referred to for further information.

4.6 Zone 6

4.6.1 Site Geology

4.6.1.1 Published Geology

Table 4.46 presents the geology likely to be present directly beneath and in the surrounding area of Zone 6 as recorded by the 1:50,000 BGS mapping. For a description of the strata indicated, along with the age and thickness information please refer to Section 3.1.

Table 4.46: Summary of geology indicated on BGS mapping – Zone 6

Artificial Ground	Superficial Geology	Bedrock Geology
<p>Onsite None indicated. However, Artificial Ground may be present associated with the West Cambridge Site (Cambridge University)</p> <p>Offsite None indicated. However, Artificial Ground may be present associated with the educational/ commercial areas of the West Cambridge Site (Cambridge University), and residential areas along Adam's Road.</p>	<p>Onsite None recorded</p> <p>Offsite River Terrace Deposits c. 100m SE of Ch 11400.</p>	<p>Onsite Gault Formation.</p> <p>Offsite West Melbury Marly Chalk Formation (west)</p>

4.6.1.2 Encountered Geology

The BGS Geindex indicates that there are several boreholes adjacent to or within the immediate surrounding area of Zone 6. The logs for these boreholes can be found in Appendix D, and a summary of the borehole records is presented in Table 4.47.

It should be noted there are further historic boreholes within the wider surrounding area however the selected records are thought to be representative of the ground conditions likely to be present in this Zone.

Table 4.47: Summary of historical BGS Boreholes – Zone 6

Borehole ID	Eastings	Northings	Distance / Compass Direction	Chainage (OBC)	Depth (m bgl)
TL45NW197	542240	259080	130m N	Ch. 9450	20.0
TL45NW180	543210	258690	10m S	Ch. 10575	3.2
TL45NW258	543490	258500	100m S	Ch. 10900	3.5
TL45NW37	544070	258410	110m SE	Ch. 11400	24.8

Topsoil was generally encountered at surface between 0.2 – 0.3m thick, and in TL45NW37 this was recorded to c. 1.1m bgl. In two exploratory holes, a possible weathered deposit of Gault Formation was recorded to 1.4 – 1.9m bgl comprising a firm to stiff fissured sandy (gravelly) clay with occasional pockets of silty sand, and a thin bed of sand and gravel with clay. Beneath this, the Gault Formation was recorded as a stiff silty fissured clay with occasional pockets of selenite crystals and calcareous nodules at depth. The thickness of this unit was not proven.

In TL45NW37 110m SE of Ch 11400, River Terrace Deposits were recorded as a medium to very dense sand and gravel of flint beneath topsoil to 3.0m bgl and overlaid the Gault Formation. These deposits are not expected to be encountered within the site footprint.

4.6.2 Hydrogeology and Hydrology

4.6.2.1 Hydrogeology

The Envirocheck Report indicates that the Gault Formation is classified as Unproductive Strata (no sensitive groundwater).

Superficial Deposits of River Terrace Deposits are recorded c. 100m south-east of the site. These deposits are classified as a Secondary A Aquifer with High Vulnerability. However, these deposits are not expected to be encountered within the site footprint.

The site is not located within a groundwater Source Protection Zone.

No superficial deposits are recorded within this zone. River Terrace Deposits (Sand and Gravel) are recorded c. 100m south-east of Ch. 11400, and are designated as a Secondary A aquifer, which are described as “*permeable layers capable of supporting water supplies at a local scale*” (Environment Agency, 2018).

Groundwater was struck in borehole TL45NW180 at 1.2m bgl (Gault Formation), which may suggest the possible presence of perched groundwater within this unit.

4.6.2.2 Hydrology

A network of drains are recorded within the wider surrounding area leading to the River Cam, present c. 1.1km east of the site.

The West Cambridge Canal, orientated east to west, enters the site at approximate Ch 10150 within the West Cambridge Site (Cambridge University). This appears to run parallel to the route until approximate Ch. 10750 where it enters a culvert and is directed east, towards the River Cam. Further small drains appear to run broadly parallel to this and drain the surrounding area. Two ponds are located directly adjacent to the site between approximate Ch. 10575 – 10775.

Bin Brook passes c. 60m south-east of the site at Ch 11400, orientated north-east to south-west and joins the River Cam east of the site.

The Envirocheck Report shows that there is no risk of flooding from Rivers or the Sea within the site footprint. A minor area c. 10m east of Ch. 11400 associated with Bin Brook is shown as being at risk of Extreme Flooding from Rivers or Sea without Defences (Zone 2 – 3).

The Envirocheck Report suggests that minor areas are at low risk of surface water flooding along Charles Babbage Road (Ch 9450 – 10050). Areas adjacent to the ponds and Cambridge West Canal/drains are shown to be at low to high risk between approximate Ch. 10150 – 10750.

There is also potential for groundwater flooding at the surface at these chainages, according to the Envirocheck Report. The rest of Zone 3 mainly has the potential for groundwater flooding in property situated below ground level.

The zone is not shown to be at risk of groundwater flooding. However, areas from approximately 40m south-east of Ch. 11400 have potential for groundwater flooding to occur at surface.

4.6.3 Environmental Records

4.6.3.1 Soil Geochemistry

The maximum recorded concentrations of metals within the soils at this Zone and in the immediate surrounding area, as reported in the Landmark Envirocheck Report, are presented in Table 4.48.

Table 4.48: Summary of Soil Geochemistry – Zone 6

Chemical	Concentration (mg/kg)
Arsenic	<15
Cadmium	<1.8
Chromium	60 – 90
Lead	<100
Nickel	30 - 45

4.6.3.2 Groundwater and Surface Water Abstractions

The Envirocheck Report indicates that there are three records of groundwater or surface water abstraction within 500m of Zone 6, summarised in Table 4.49.

Table 4.49: Summary of Water Abstractions – Zone 6

Name	Easting	Northing	Distance / Compass Direction	Abstraction Type	Source
Natural Environmental Research	542200	259170	260m NW (Ch. 9450)	Industrial Processing (Misc.)	Well and borehole
Robinson College, Cambridge	543956	258445	25m SE (Ch. 11400)	Other Industrial/Commer cial/Public Services: Heat Pump	Surface
Masters and Fellows of Clare College	544500	258500	500m E (Ch. 11400)	General Farming and Domestic	Surface

4.6.3.3 Discharge Consents

The Envirocheck Report indicates that there are eight discharge consents within 500m of Zone 6. The consents are summarised in Table 4.50.

A further seven discharge consents are present up to 1km from the site, for further details please refer to the Envirocheck Report.

Table 4.50: Summary of discharge consents – Zone 6

Name	Easting	Northing	Distance / Compass Direction	Chainage	Discharge Type	Receiving Body
The University of Cambridge	543270	258680	10m S	Ch 10650	Discharge of Other Matter – Surface Water	Tributary of Bin Brook
Wimpey Homes Holdings Ltd	543240	258730	40m N	Ch 10600	Discharge of Other Matter – Surface Water	Tributary of Bin Brook
Robinson College, Cambridge	543956	258445	50m S	Ch 11350	Trade Discharges – Cooling Water	Bin Brook
The Needham Research Institute	543700	258380	170m S	Ch 11050	Discharge of Other Matter – Surface Water	Bin Brook
Clare College	544430	258470	420m E	Ch 11400	Sewage Discharges - Final/Treated Effluent - Not Water Company	Land
St Johns College	544348	258770	430m NE	Ch 11400	Sewage Discharges - Final/Treated Effluent - Not Water Company	Tributary Of Bin Brook
St Johns College	544348	258770	430m NE	Ch 11400	Sewage Discharges - Final/Treated Effluent - Not Water Company	Tributary Of Bin Brook
Anglian Water Services Limited	544340	258780	430m NE	Ch 11400	Discharge Of Other Matter- Surface Water	Bin Brook

4.6.3.4 Enforcement and Prohibition Notices

No Enforcement and Prohibition Notices are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.6.3.5 Pollution Incidents to Controlled Waters

Seven pollution incidents to controlled waters are recorded in the Envirocheck Report within 500m of Zone 6, summarised in Table 4.51.

Table 4.51: Summary of pollution incidents to controlled waters – Zone 6

Type	National Grid Reference	Distance / Compass Direction	Chainage (OBC)	Pollutant	Receiving Body
Cattle (Dairy) Farming: Other	543700 258695	190m NE	Ch. 11100	Organic Wastes: Yard Washings	Tributary of River Cam
Cattle (Dairy) Farming	543700 258700	190m NE	Ch. 11100	Organic Wastes: Yard Washings	Tributary of River Cam
Not Given	543200 258900	200m N	Ch. 10500	Unknown	Ditch Tributary of Cam
Not Given	543000 259000	270m N	Ch. 10300	Unknown	Tributary of Cam
Not Given	544300 258700	360m NE	Ch. 11400	Oils – Other Oil	Bin Brook
Other Transport	544000 259000	500m N	Ch. 11400	Oils – Petrol	Drain
Sewerage: Other	544500 258495	500m E	Ch. 11400	Oils – Other Oil	Hobsons Brook

In addition, two records of Substantiated Pollution Incidents were identified in the Envirocheck Report, summarised in Table 4.52.

Table 4.52: Summary of substantiated pollution incidents – Zone 6

Authority	Easting	Northing	Distance / Compass Direction	Pollutant	Impact
Environment Agency – Anglian Region	543928	258437	45m S (Ch. 11400)	Contaminated Water: Other Contaminated Water	Category 2: Significant Incident (Water)
Environment Agency – Anglian Region	544345	258771	425m NE (Ch. 11400)	Crude Sewage	Category 2: Significant Incident (Water)

4.6.3.6 BGS Mineral Sites / Mining

No BGS Mineral Sites / mines or quarries are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

4.6.3.7 Waste Activities

No landfill sites, Extractive Industries or Potential Excavations (1950 – 1980), or areas of Potentially Infilled Land are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

4.6.3.8 Hazardous Substances

One record of Explosive Sites is recorded within 500m of the site, summarised in Table 4.53.

No other Hazardous Substances are recorded within 500m of the zone within the Envirocheck Report.

Table 4.53: Summary of Explosive Sites – Zone 6

Name	Easting	Northing	Chainage	Distance / Compass Direction	Type / Status
Cambridge / Mr J Deaken (University of Cambridge)	543094	258824	Ch 10450	110m N	Active

The explosive site appears to be associated with Cavendish Laboratory in the West Cambridge Site (Cambridge University).

4.6.3.9 Registered Radioactive Substances

In addition to the 12 Registered Radioactive Substances identified in 4.5.3.8, six additional records have been identified (18 in total) within 500m of Zone 6, which are all associated with the University of Cambridge regarding the storage, use and disposal of radioactive materials.

4.6.3.10 Contemporary Trade Directory Entries

The Envirocheck Report identified six contemporary trade directory entries within 250m of Zone 6. These are summarised in Table 4.62Table 4.22 4.54. Further contemporary trade directory entries are recorded within the wider surrounding area and are detailed within the Envirocheck Report.

Table 4.54: Summary of contemporary trade directory entries – Zone 6

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
Polysolar	542207	259234	Ch 9450	320m N	Builder's Merchants	Active
Ideaspace	542898	258790	Ch. 10300	40m N	Flow Measurement Systems – Manufacturers	Active
Base 4 Ltd	542932	258790	Ch. 10300	40m N	Laboratories	Active
Cavendish Laboratory	543094	258824	Ch. 10500	110m N	Laboratories	Inactive
Hitachi	543069	259144	Ch 10450	350m N	Laboratories	Active
Isaac Newton Institute For Mathematical Sciences	543779	258918	Ch 10750	370m N	Laboratories	Inactive

4.6.3.11 Sensitive Land Uses

The zone between approximate Ch 10150 – 11000 is located at the edge of an Area of Adopted Greenbelt, and the entire zone is classified as a Nitrate Vulnerable Zone.

Except from areas of Adopted Greenbelt within the wider area, no further sensitive land uses are recorded within 500m of the site within the Envirocheck Report.

4.6.3.12 Archaeology and Heritage

Please refer to Section 3.6 for further details.

4.6.3.13 Historical Development

A summary of the historical development of Zone 6 and the surrounding area within 500m is detailed in Table 4.55, highlighting the major changes observed in the historical maps.

It should be noted that where no significant changes and/or no coverage of the site or its surrounding area is provided, these records have not been included in the summary below.

Zone 6 and the immediate surrounding area are covered in Slice E (E4 and E8) and F (F1, F2 and F5) from Envirocheck Report 2.

Table 4.55: Historic map review – Zone 6

Year of Publication	Scale	On-site	Off-site
1888	1:10,560 1:2,500	The site comprises agricultural land between Ch. 9450 – 10000. An unnamed track runs from approximately Ch. 10000 – 10900, joining Love Lane which continues east along the route from approximately Ch. 10900 - 11400.	Grange Farm is present c. 200m south of Ch. 10800. University Bicycle Path is recorded c. 180m north of Ch. 11200. Trinity College Cricket Ground and Pavilion is present c. 100m north of Ch. 11400. Tennis Court and Cricket Grounds are present 150m south-east of Ch. 11400. Bin Brook south of the route c. 60m south of Ch. 11400 (point where it is closest to the route). University Rifle Range c. 320m south of Ch. 10800.
1903 – 1904	1:10,560 1:2,500	Love Lane (Ch. 10900 – 11400) is now called Adams Road.	Development of housing immediately south of Ch. 11200 – 11400. University Football Ground and Trinity College Tennis Ground c. 300m south of Ch. 11400.
1927	1:10,560	No significant change.	More housing added immediately to the south of Adams Road (Ch. 10900 – 11400). Kings and Clare Colleges Cricket Ground now housing/accommodation/large building complex c. 150m south-east of Ch. 11400. Anglo-Saxon burial ground c. 375m north-east of Ch. 11400.
1938	1:10,560	No significant change.	Building complex now demolished – University Library established c. 150m south-east of Ch. 11400.

1952 – 1953	1:10.560	No significant change.	Rosemary Cottages and Merton Hall Cottages c. 350m north of Ch. 10000. Two large warehouse buildings c. 130m south-west of Ch. 9950. Unlabelled buildings associated ancillary buildings and tracks c. 200m north-west of Ch. 9500. Residential development in surrounding area.
1966 – 1967	1:2,500	A Roman Road crosses route at Ch. 11100.	The Eastern side of Rifle Range is now labelled as University Army Officers Training Centre A radio Astronomy Observatory is present c. 320m south/south-west of Ch. 10800. A bird sanctuary, lake and sluice are recorded c. 175m north of Ch. 11100.
1967 – 1970	1:2,500	No significant change.	Additional University buildings/ residential properties are present south of Adams Road. Rifle and Revolver Range has two artificial ponds c. 250m south of Ch. 10900. Merton Hall Farm significantly developed (lots of small buildings) c. 275m north-east of Ch. 10000.
1972 – 1974	1:10,000	Small track crosses route at Ch. 10200.	Atlas Centre c. 100m north-west of Ch. 9500. Small laboratory c. 250m north-west of Ch. 9500. University of Cambridge School of Veterinary Medicine established immediately north of Ch. 9800 – 10000. Warehouses to the south labelled as Depot. Chimney and tank labelled.
1976 – 1977	1:2,500	No significant change.	Small pond and earthworks c. 25m north of Ch. 10500.
1982 - 1985	1:10,000 1:2,500	Two areas of minor earthworks are recorded adjacent to the School of Veterinary Medicine	Atlas Centre developed, now labelled Design Centre. British Antarctic Survey building c. 300m north-west of Ch. 9500. Depot demolished. M11 (with significant earthworks e.g. cutting/embankments) c. 250m west of Ch. 9500. Large laboratory complex c. 100m north of Ch. 10500. Another laboratory building c. 420m north of Ch. 10500.

			Earthworks identified c. 25 – 400m north of Ch. 10550. Robinson College buildings established immediately south of Ch. 11400, replacing some previous buildings.
2000	1:10,000	Two ponds cross route at Ch. 10600 and 10700. Cycle track/path crosses route at Ch. 10600, 10800 and 10900.	British Antarctic Survey building expanded. Laboratory c. 100m north of Ch. 9500. Unknown building and tank c. 60m south of Ch. 9900. University Sports Ground c. 50m south of Ch. 10700.
2006	1:10,000	Unnamed road Ch. 10000 – 10200. Unknown building crosses the route at Ch. 10100.	Additional buildings to University of Cambridge campus immediately to the north of Ch. 9900. Unknown building demolished. Isaac Newton Institute of Mathematics expanded c. 375m north of Ch. 11100. Expansion of laboratory complex c. 275m north of Ch. 10350.
2020	1:10,000	Charles Babbage Road runs east-west along the route (from Ch. 9450). Arts centre and car park crosses the route at Ch. 10100.	Significant expansion of University of Cambridge campus south of Ch. 9800. Small building c. 340m south-west of Ch. 9700. Department of Materials Science and Metallurgy c. 90m south-east of Ch. 9700. Department of Chemical Engineering and Biotechnology c. 100m south-east of Ch. 9800. Sports Centre c. 200m south-east of Ch. 9800. Artificial pond/lake c. 160m south-east of Ch. 9700. Cryogenics substation c. 20m north of Ch. 10350. Electrical substation c. 190m north-west of Ch. 9450.

4.6.3.14 Contaminants of Concern

Based on information obtained on the site and surrounding area, the Department for Environment (1995) Industry Profiles, several contaminants of concern may be present. Those potentially present within 250m of the site have been summarised in Table 4.56.

Mott MacDonald is not insured to advise on risk arising from asbestos or radioactive substances, and therefore will not give advice relating to risks associated with them. It is

recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos and/or radioactive substances at the site.

Table 4.56: Contaminants of concern – Zone 6

Potential Contaminant Source	Location	Contaminants of Concern
Highways / roads	M11 and associated earthworks c. 250m west of Ch. 9500.	Organic compounds e.g. petrol, diesel, MTBE, hydrocarbons; heavy metals.
Agricultural land	South and west (within 250m) of Zone 6.	Metals, nitr-compounds from organic waste and fertilisers, fuel oil, pesticides, animal slurry and silage effluent.
Registered Radioactive Substances	>250m north of Ch. 9450 - 10050	Potentially any radionuclide (principal ones of concern include radium species, tritium and carbon-14).
University of Cambridge Campus Buildings and Laboratories	Throughout Zone 5, but mainly clustered between Ch. 9450 – 10600.	Asbestos, metals and metal compounds, inorganic compounds, explosives, acids, alkalis, organic solvents, organic compounds, fuels, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, dioxins.
Other historical and current industrial/commercial activity e.g. demolished depot, electrical substations.	Contemporary trade between Ch. 10300 – 10500. Depot 130m south-west of Ch. 9950.	Potentially a range of contaminants, not limited to: Metals and metal compounds, oils/fuels, polycyclic aromatic compounds, heavy metals, solvents, paints, inorganic compounds, acids, asbestos, polychlorinated biphenyls, radionuclides.

4.6.4 Utilities

A high-level review of the main C2 utility return information indicates that the scheme passes a series of low to medium pressure gas mains and high voltage electric cables within the West Cambridge Site, which appear to run parallel / perpendicular to Charles Babbage Road which the PTR crosses when changing course south at Ch 10000. Surface and foul water services cross the site at approximate Ch 10550, adjacent to existing ponds, with the foul water service running parallel to Stacey Lane. A low pressure gas main, foul and surface water utilities run parallel along Adam's Road at the eastern end of the zone. It is understood that a series of drawings recording the approximate location of the C2 utility returns are being produced by Mott MacDonald, and these should be referred to for further information.

4.7 Zone 7 – Park and Ride – Scotland Road

4.7.1 Site Geology

4.7.1.1 Published Geology

Table 4.57 presents the geology likely to be present directly beneath and in the surrounding area of Zone 7 as recorded by the 1:50,000 BGS mapping. For a description of the strata indicated, along with the age and thickness information please refer to Section 3.1.

Table 4.57: Summary of geology indicated on BGS mapping – Zone 7

Artificial Ground	Superficial Geology	Bedrock Geology
Onsite None indicated.	Onsite Oadby Member.	Onsite Gault Formation (not anticipated to be encountered).
Offsite None indicated. However, Artificial Ground may be present c. 20m south of the site associated with Scotland Road Roundabout as earthworks appear to be shown on historic mapping.	Offsite Oadby Member.	Offsite Gault Formation.

4.7.1.2 Encountered Geology

The BGS Geoindex indicates that there are several boreholes within the footprint and directly adjacent to Zone 7. These include historical boreholes including TL35NE29, TL36SE1, and TL36SE2 (Cable Percussive boreholes), and also TL36SE57 and TL35NE123 (machine excavated trial pits). These were advanced to depths of 1.0 – 24.0m bgl. It should be noted there are further historic boreholes within the surrounding area however the selected records are thought to be representative of the ground conditions likely to be present at this Zone.

All records recorded a veneer of topsoil (0.15 – 0.5m thick), which overlays the Oadby Member, described as a firm to very stiff fissured silty CLAY with much fine to coarse gravel of flint and chalk, and occasional pockets of sand and gravel. Occasional boulder / cobble sized ironstone was recorded in TL35NE123. The thickness of the Oadby Member was not proven in these historic boreholes.

A groundwater strike was recorded at 6.4m bgl in TL36SE2, however the value this rose to is not recorded on the engineering log.

4.7.2 Hydrogeology and Hydrology

4.7.2.1 Hydrogeology

The Envirocheck Report indicates that the Oadby Member is classified as a Secondary Undifferentiated aquifer, and the underlying Gault Formation is classified as Unproductive Strata.

The Oadby Member is recorded as having medium groundwater vulnerability, and the Envirocheck Report indicates that the site is not located within a groundwater Source Protection Zone.

Groundwater was encountered in historical BGS borehole TL36SE2 at 6.4m bgl (48.8m AOD), in the Oadby Member. It is possible that this may represent perched water, however limited further information is available to determine this.

4.7.2.2 Hydrology

A small stream, Callow Brook, is recorded approximately 80m south-east of the Zone, flowing to the north-east. A land drain is also recorded c. 15m north-east of the site, with further land drains in the wider area around the site either draining the agricultural land or the A428 south of the site.

The Envirocheck Report shows that only a very minor area along the eastern boundary of the Zone is at low risk of flooding from surface water. Within the surrounding area, areas at risk from surface water flooding broadly follow the valley of Callow Brook or the land drains.

The Envirocheck Report also records that there is potential for groundwater flooding of property situated below ground level to occur for the majority of the zone, and potential for this to occur at surface for a minor area along the eastern boundary of the zone.

4.7.3 Environmental Records

4.7.3.1 Soil Geochemistry

The maximum recorded concentrations of chemical within the soils at this Zone and in the immediate surrounding area, as reported in the Landmark Envirocheck Report, are presented in Table 4.58

Table 4.58: Summary of Soil Geochemistry – Zone 7

Chemical	Concentration (mg/kg)
Arsenic	15 – 25
Cadmium	< 1.8
Chromium	60 – 120
Lead	<100
Nickel	30 – 45

4.7.3.2 Groundwater and Surface Water Abstraction

No groundwater or surface water abstractions are recorded within approximately 500m of this Zone, with two records located between 500 – 2000m from the site. These are detailed in the Landmark Envirocheck Report, which can be found in Appendix B.

4.7.3.3 Discharge Consents

The Landmark Envirocheck Report records one discharge consent within 250m of the site, presented in Table 4.59.

Table 4.59: Summary of discharge consents – Zone 7

Name	Easting	Northing	Distance / Compass Direction	Discharge Type	Receiving Body
Bushel & Co Ltd	536900	260460	158m NW	Sewage Discharges - Final/Treated Effluent	Tributary Callow Brook

4.7.3.4 Enforcement and Prohibition Notices

No Enforcement and Prohibition Notices are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.7.3.5 Pollution Incidents to Controlled Waters

The Landmark Envirocheck Report records one pollution incident to controlled waters within 500m of the route zone, summarised in Table 4.60.

Table 4.60: Summary of pollution incidents to controlled waters

Type	Easting	Northing	Distance / Compass Direction	Pollutant	Receiving Body
Private Sewage (Non-PLC): Sewage Treatment Works	536800	260300	200m W	Sewage – Treated Effluent	Freshwater Stream / River

4.7.3.6 BGS Mineral Sites

No BGS Mineral Sites are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

4.7.3.7 Waste Activities

No landfill sites are recorded within approximately 500m of this Zone within the Landmark Envirocheck Report.

One record of Extractive Industries or Potential Excavations from 1950 – 1980 is recorded within the Landmark Envirocheck Report, summarised in Table 4.61.

Table 4.61: Summary of extractive industries or potential excavations from 1950 – 1980 – Zone 7

Use	Easting	Northing	Distance / Compass Direction
Pond	537159	260101	10m, N

This record appears to relate to a pond which is present adjacent to the northern site boundary and based on historical mapping connects to land drains adjacent to the site which flow to Callow Brook.

4.7.3.8 Hazardous Substances

No Hazardous Substances are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.7.3.9 Registered Radioactive Substances

The Landmark Envirocheck Report records no registered radioactive substances within 500m of route Zone 7.

4.7.3.10 Contemporary Trade Directory Entries

A summary of the recorded contemporary trade directory entries within approximately 250m of the Zone, as reported in the Landmark Envirocheck Report, can be found in Table 4.62. The majority of these appear to be present within Dry Drayton Industries, a business park located north of this Zone, with several records along St Neots Road, c. 200m south of the site.

Table 4.62: Summary of contemporary trade directory entries – Zone 7

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
Green Solar World Ltd	537034	260326	N/A	6m SE	Electricity Generating & Distributing Equipment	Active
Eve's Home Serve	537034	260326	N/A	6m SE	Commercial Cleaning Services	Inactive
Eve's Homeserve & Commercial Ltd	537034	260326	N/A	6m SE	Laundries & Launderettes	Inactive
Admiral Kleencare	537055	260342	N/A	20m SE	Carpet, Curtain & Upholstery Cleaners	Inactive
Outside In (Cambridge) Ltd	537053	260322	N/A	25m SE	Medical Equipment Manufacturers	Inactive
Copytrax Technologies UK Ltd	537043	260289	N/A	28m SE	Manufacturers	Inactive
Hilton Heating Components	537066	260316	N/A	39m SE	Central Heating Supplies & Equipment	Active
Thecdproducer .Org	537063	260307	N/A	39m SE	Screen Process Printers	Inactive
Shelford Golf Co	537052	260277	N/A	40m SE	Printers	Inactive
Ice Components	537101 260329	537101 260329	N/A	67m SE	Electronic Component Manufacturers & Distributors	Inactive
Print Absolute	537082	260280	N/A	67m SE	Office Equipment Servicing & Maintenance	Active
Autoclean Services Ltd	537053	260260	N/A	47m SE	Commercial Cleaning Services	Inactive
Sharpe Business System	537061	260258	N/A	56m SE	Photocopiers	Active
T M C Specialist Cleaning Ltd	537072	260253	N/A	68m SE	Carpet, Curtain & Upholstery Cleaners	Active
Mark Weatherhead	537014	259645	N/A	174m S	Agricultural Engineers	Inactive

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
Helix Continuing Care	537065	259651	N/A	198m S	Stairlifts - Manufacturers & Installers	Inactive
C S C Automotive	537184	259637	N/A	215m SE	Garage Services	Active
C S C Vehicle Service & Repair Centre	537184	259637	N/A	215m SE	Mot Testing Centres	Inactive
Cambridgeshire Sports Cars	537185	259635	N/A	218m SE	Garage Services	Inactive
Csc Vehicle Service & Repair Ltd	537185	259635	N/A	218m SE	Garage Services	Inactive
The Tavistock Press (Cambridge) Ltd	537209	259637	N/A	224m S	Printers	Inactive
Eve's Homeserve	536793	260241	N/A	149m W	Cleaning Services - Domestic	Inactive
Eve's Homeserve & Commercial	536793	260241	N/A	149m W	Cleaning Services - Domestic	Inactive

Further contemporary trade directory entries are recorded in the surrounding area, detailed within the Envirocheck Report.

4.7.3.11 Sensitive Land Uses

The majority of this Zone is located within an area of Adopted Green Belt, and the entire zone is shown to be within a Nitrate Vulnerable Zone.

No further sensitive land uses are recorded within 500m of the site within the Landmark Envirocheck Report.

4.7.3.12 Archaeology and Heritage

Please refer to Section 3.6 for further details.

4.7.3.13 Historical Development

A summary of the historical development of Zone 7 and the surrounding area within 500m is detailed in Table 4.63, highlighting the major changes observed in the historical maps.

It should be noted that where no significant changes and/or no coverage of the site or its surrounding area is provided, these records have not been included in the summary below.

Zone 7 and the immediate surrounding area are covered in slices B (B8 and B12) and C (C5 and C9) of Envirocheck Report 1.

Table 4.63: Historic Map Review – Zone 7

Year of Publication	Scale	On-site	Off-site
1886	1:10,560	The site is located within an agricultural field, bounded along its western boundary by Scotland Road.	<p>Scotland Farm is located immediately west of the site</p> <p>Callow Brook is present c. 200m south-east of the site and is orientated to the north/north-east.</p> <p>A road runs east to west c. 200m south of the site.</p> <p>The village of Hardwick is located c. 1km south of the site.</p> <p>The wider surrounding area comprises predominantly of agricultural land with strips/pockets of woodland and plantations.</p>
1886	1:10,560	No coverage of site.	A series of ponds, a sluice and a spring are recorded at Scotland Farm, c. 180m west of the site
1926	1:2,500	No significant changes	<p>A pond is located adjacent to the northern side boundary.</p> <p>A row of residential houses, and New Farm is present immediately adjacent to the north site boundary between c. 5 – 250m north of the site.</p> <p>A possible pit is recorded c. 150m north of the site adjacent to New Farm.</p>
1976 – 1977	1:2,500	No significant changes	<p>New track joins Scotland Road opposite the site from Scotland Farm.</p> <p>A track and drain run adjacent to the northern site boundary, orientated south-east, which connect to the existing pond. The drains within this area appear to flow towards Callow Brook.</p>
1994	1:2,500	No significant changes.	The area labelled as New Farm is renamed as Dry Drayton Industries and the buildings appears to be split into several units (possible business park).
1926	1:2,500	No significant changes.	Hardwick Hall and residential properties run adjacent to a road (east to west) c. 200m south of the site.
1938	1:2,500	No significant changes.	Further properties now line the road 200m south of the site.
1977	1:2,500	No significant changes.	<p>The road 200m south is labelled St Neots Road. Drains run adjacent to the northern side of the road.</p> <p>The village located along St Neots Road is labelled as Hardwick</p>

Year of Publication	Scale	On-site	Off-site
			An agricultural engineering works is present c. 220m south of the site
1979	1:2,500	No significant changes	<p>A new road runs adjacent to the north of St Neots Road, with areas of embankment shown to be present c. 70m south of the site. Drains appear to be present along the base of the new embankment.</p> <p>Two small water reservoirs bounded by earthworks are located c. 220m south of the site in Hardwick.</p> <p>Hardwick village has seen further development.</p>
1994	1:2,500	No significant changes.	The road north of St Neots Road is labelled as the A45.
1976 – 1977	1:2,500	No coverage of site.	Scotland Farm has expanded slightly with a few additional structures, including two tanks
1979	1:2,500	No coverage of site.	A roundabout with areas of embankment are present c. 220m south-west of the site
1994	1:2,500	No coverage of site.	Minor changes to footprint of Scotland Farm
1980 – 1983	1:10,000	No coverage of site.	<p>A roundabout and new road are constructed to the north of St Neots Road, connecting to Scotland Road, with several drains adjacent to the road.</p> <p>A Sewage Pumping Station is located c. 650m south-west of the site</p>
2020	1:10,000	No coverage of site.	<p>A new bridge and roundabout connect Scotland Road to Hardwick, with the roundabout present c. 60m south-west of the site.</p> <p>The A428 is present orientated east-west north of St Neots Road, c. 150m south-west of the site.</p> <p>A balancing pond is located to the south of the A428 c. 600m south-west of the site.</p> <p>Further structures are located in the footprint of Scotland Farm.</p>
2020	1:10,000	An area of wooded vegetation is recorded along the southern boundary of the site.	<p>The A428 has been constructed and is present with its associated slip roads from c. 20m south of the site.</p> <p>A balancing pond is located south of the A428 approximately 100m south.</p>

Year of Publication	Scale	On-site	Off-site
			Callow Brook appears to pass beneath the A428 through a culvert approximately 100m south-east.

4.7.3.14 Contaminants of Concern

Based on information obtained on the site and surrounding area and the Department for Environment (1995) Industry Profiles, limited contaminants of concern are likely to be present. Those potentially present within 250m of the site has been summarised in Table 4.64.

Mott MacDonald is not insured to advise on risk arising from asbestos or radioactive substances, and therefore will not give advice relating to risks associated with them. It is recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos and/or radioactive substances at the site.

Table 4.64: Contaminants of concern - Zone 7

Potential Contaminant Source	Location	Contaminants of Concern
Agricultural land / farms	Zone comprises of an agricultural field	Metals, nitr-compounds from organic waste and fertilisers, fuel oil, pesticides, animal slurry and silage effluent
Highways / roads	Scotland Road adjacent to the site, and the A428 located south of the site.	Organic compounds e.g. petrol, diesel, MTBE, hydrocarbons; heavy metals.

4.7.4 Utilities

A high-level review of the main C2 utility return information indicates that a medium pressure gas main and water utility services run parallel to Scotland Road, adjacent to the site. Water utilities are also recorded along the southern half of the site, and run parallel to the A428 adjacent towards the edge of the agricultural field. It is understood that a series of drawings recording the approximate location of the C2 utility returns are being produced by Mott MacDonald, and these should be referred to for further information.

4.8 Zone 8 – NMU Route (Scotland Road Roundabout to Dry Drayton)

4.8.1 Site Geology

4.8.1.1 Published Geology

Table 4.65 presents the geology likely to be present directly beneath and in the surrounding area of Zone 8 as recorded by 1:50,000 BGS mapping. For a description of the strata indicated, along with age and thickness information please refer to Section 3.1.

Table 4.65: Summary of geology indicated on BGS mapping – Zone 8

Artificial Ground	Superficial Geology	Bedrock Geology
<p>Onsite None indicated.</p> <p>Offsite None indicated. However, Artificial Ground may be present c. 20m south of the site associated with Scotland Road and proximal to development in Dry Drayton.</p>	<p>Onsite Oadby Member.</p> <p>Offsite Oadby Member. No superficial deposits recorded along some areas of small stream valleys</p>	<p>Onsite Gault Formation (not anticipated to be encountered).</p> <p>Offsite Gault Formation. West Melbury Marly Chalk Formation (c. 200m east)</p>

4.8.1.2 Encountered Geology

The BGS GeoIndex indicates that there are few usable borehole scans along the footprint of the Zone. In the southern area of the Zone, Historical BGS boreholes TL36SE57, TL36SE1 are located adjacent to / 20m east of the Zone. North of the Zone, TL36SE38/51 is present approximately 130m north of the Zone (both of these records present the same information).

These records indicate the presence of the Oadby Member overlying the Gault Formation, with the Oadby Member thinning to the north where the ground levels decrease from c. 60m to c. 40m AOD. Its thickness was recorded in one historic borehole (TL36SE38/51) as 7.6m, however, it should be noted that this thickness also includes Made Ground and as these two units were not separated on the historic records. The thickness of the Gault Formation was also proven in this location, recorded as c. 21m thick.

Groundwater was recorded at 19.2m bgl in the well record TL36SE38/51, however it is not stated what strata this originated in.

Three historic well records TL36SE30 and TL36SE54 are located between c. 180 – 250m west of the site, and TL36SE52 approximately 130m north, however, they do not provide sufficient engineering information or thicknesses of the deposits encountered.

4.8.2 Hydrogeology and Hydrology

4.8.2.1 Hydrogeology

The Envirocheck Report indicates that the Oadby Member is classified as a Secondary Undifferentiated aquifer, this is defined as an aquifer which has previously been designated as a minor and non-aquifer in different locations due to the variable characteristics of the unit. The underlying Gault Formation is classified as Unproductive Strata. The West Melbury Marly Chalk Formation is recorded c. 200m east of the site in the valley of Callow Brook and is classified as a Principal Aquifer. It should be noted that this unit is not expected to be encountered.

The Oadby Member is recorded as having medium groundwater vulnerability, and the Envirocheck Report indicates that the site is not located within a Source Protection Zone.

Groundwater was encountered in historical BGS borehole TL36SE2 at 6.4m bgl. It is possible that this may represent perched water, however limited further information is available to determine this.

4.8.2.2 Hydrology

A small stream, Callow Brook, is recorded approximately 275m east of the site, and runs broadly parallel to the eastern boundary of the site, orientated north/north-east. On approach to Dry Drayton, Callow Brook flows east along Madingley Road and joins Beck Brook c. 1km east.

Several land drains and unnamed valley streams are recorded within 500m of the site, typically along field boundaries.

Within Dry Drayton, several small ponds are present c. 20 – 50m from the site, with further ponds present within the wider area. These ponds may potentially be associated with historic sand pits within the Oadby Member.

The Envirocheck Report shows that the site is not at risk of flooding from rivers or the sea. Only minor and discrete areas along the site are shown to be at a low risk of flooding from surface water. In the surrounding area, areas at risk broadly correlate with the land drains and stream valleys.

The Envirocheck Report also records that there is limited potential for groundwater flooding to occur in the vast majority of the site, with an area in the southern end of the site near Scotland Farm Roundabout having potential for groundwater flooding of property situated below ground level.

4.8.3 Environmental Records

4.8.3.1 Soil Geochemistry

The maximum recorded concentrations of chemical within the soils at this Zone and in the immediate surrounding area, as reported in the Landmark Envirocheck Report, are presented in Table 4.66.

Table 4.66: Summary of soil geochemistry – Zone 8

Chemical	Concentration (mg/kg)
Arsenic	15 – 25
Cadmium	< 1.8
Chromium	60 – 120
Lead	<100 – 200
Nickel	30 – 45

A slightly greater concentration of Lead is recorded around Dry Drayton, with the remaining range of concentrations broadly representing the presence of the Oadby Member.

4.8.3.2 Groundwater and Surface Water Abstraction

The Envirocheck Report records no groundwater or surface water abstractions within 500m of the site.

4.8.3.3 Discharge Consents

A summary of the discharge consents within approximately 250m of Zone 8, as reported in the Landmark Envirocheck Report, can be found in Table 4.67.

Table 4.67: Summary of discharge consents – Zone 8

Name	Eastings	Northings	Distance / Compass Direction	Discharge Type	Receiving Body
Bushel & Co Ltd	536900	260460	160m NW (Ch. 2250)	Sewage Discharges - Final/Treated Effluent	Tributary Callow Brook

4.8.3.4 Enforcement and Prohibition Notices

The Landmark Envirocheck Report does not indicate any records of enforcement and prohibition notices within approximately 500m of route Zone 8.

4.8.3.5 Pollution Incidents to Controlled Waters

The Landmark Envirocheck Report records one pollution incident to controlled waters within approximately 500m of route Zone 8, summarised in Table 4.68.

Table 4.68: Summary of pollution incidents to controlled waters – Zone 8

Type	Eastings	Northings	Distance / Compass Direction	Chainage	Pollutant	Receiving Body
Private Sewage (Non-PLC): Sewage Treatment Works	536800	260300	190m, W	Ch. 0	Sewage – Treated Effluent	Freshwater Stream / River

4.8.3.6 BGS Mineral Sites

The Landmark Envirocheck Report records no BGS mineral sites within 500m of Zone 8.

4.8.3.7 Waste Activities

The Landmark Envirocheck Report records one licensed waste management facility and one registered waste transfer site within 500m of Zone 8, summarised in Table 4.69.

Table 4.69: Summary of waste activities - Zone 8

Type	Operator Name	Category	Eastings	Northings	Chainage	Distance / Compass Direction	Authorised Waste
Licensed Waste Management Facility	Richard Van George Jupp	Household, Commercial And Industrial Transfer Stations	536500	259700	Ch. 0	425m SE	-
Registered Waste Transfer Site	Richard Van George Jupp	Transfer	536420	259700	Ch. 0	480m, SE	Cambs Cat 1, 2a,2B: (Inert, Household,

Type	Operator Name	Category	Eastings	Northings	Chainage	Distance / Compass Direction	Authorised Waste
							Demolition, some Contam)

A summary of the potentially infilled land within approximately 500m of Zone 8, as reported in the Landmark Envirocheck Report, can be found in Table 4.70.

Table 4.70: Summary of potentially infilled land – Zone 8

Type	Use	Eastings	Northings	Chainage	Distance / Compass Direction
Water	Unknown Filled Ground (Pond, marsh, river, stream, dock etc)	537753	261803	Ch. 1750	90m, SE
Water	Unknown Filled Ground (Pond, marsh, river, stream, dock etc)	537833	261922	Ch. 1900	100m, SE
Water	Unknown Filled Ground (Pond, marsh, river, stream, dock etc)	537901	262370	Ch. 2250	230m, N
Water	Unknown Filled Ground (Pond, marsh, river, stream, dock etc)	538081	262337	Ch. 2250	280m, NE

A summary of the extractive land uses or potential excavations from 1950 – 1980 within approximately 500m of the site from the Landmark Envirocheck Report for Zone 8 are presented in Table 4.71.

Table 4.71: Summary of extractive industries or potential excavations from 1950 – 1980 – Zone 8

Use	Easting	Northing	Chainage	Distance / Compass Direction
Pond	537159	260101	Ch. 0	225m, SE
Pond	537763	262012	Ch. 1900	7m, W
Pond	537794	262095	Ch. 2000	36m, NW
Pond	537969	262163	Ch. 2250	88m, NE

4.8.3.8 Hazardous Substances

No Hazardous Substances are recorded within 500m of this Zone within the Landmark Envirocheck Report.

4.8.3.9 Registered Radioactive Substances

The Landmark Envirocheck Report records no registered radioactive substances within 500m of route Zone 8.

4.8.3.10 Contemporary Trade Directory Entries

A summary of the recorded contemporary trade directory entries within approximately 250m of the Zone, as reported in the Landmark Envirocheck Report, can be found in Table 4.72. Several of these are present within Dry Drayton Industries, a business park located adjacent to the east of this Zone, and Scotland Farm.

Table 4.72: Summary of contemporary trade directory entries – Zone 8

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
Justin Hawkes Conservation	537732	262168	Ch. 2150	130m, NW	Art Restoration & Picture Cleaning	Active
Green Solar World Ltd	537034	260326	Ch. 250	6m SE	Electricity Generating & Distributing Equipment	Active
Eves Home Serve	537034	260326	Ch. 250	6m SE	Commercial Cleaning Services	Inactive
Eve's Homeserve & Commercial Ltd	537034	260326	Ch. 250	6m SE	Laundries & Launderettes	Inactive
Admiral Kleencare	537055	260342	Ch. 250	20m SE	Carpet, Curtain & Upholstery Cleaners	Inactive
Outside In (Cambridge) Ltd	537053	260322	Ch. 250	25m SE	Medical Equipment Manufacturers	Inactive
Copytrax Technologies Uk Ltd	537043	260289	Ch. 250	28m SE	Manufacturers	Inactive
Hilton Heating Components	537066	260316	Ch. 250	39m SE	Central Heating Supplies & Equipment	Active
Thecdproduce r.Org	537063	260307	Ch. 250	39m SE	Screen Process Printers	Inactive
Shelford Golf Co	537052	260277	Ch. 250	40m SE	Printers	Inactive
Ice Components	537101 260329	537101 260329	Ch. 250	67m SE	Electronic Component Manufacturers & Distributors	Inactive

Name	Easting	Northing	Chainage	Distance / Compass Direction	Classification	Status
Print Absolute	537082	260280	Ch. 250	67m SE	Office Equipment Servicing & Maintenance	Active
Autoclean Services Ltd	537053	260260	Ch. 200	47m SE	Commercial Cleaning Services	Inactive
Sharpe Business System	537061	260258	Ch. 200	56m SE	Photocopiers	Active
T M C Specialist Cleaning Ltd	537072	260253	Ch. 200	68m SE	Carpet, Curtain & Upholstery Cleaners	Active
Eve's Homeserve	536793	260241	Ch. 200	149m E	Cleaning Services - Domestic	Inactive
Eve's Homeserve & Commercial	536793	260241	Ch. 200	149m E	Cleaning Services - Domestic	Inactive
Cambio Ltd	536802	260295	Ch. 200	185m, W	Chemicals & Allied Products	Inactive

4.8.3.11 Ecological Designation of Land and Other Sensitive Land Uses

This Zone is located along the perimeter of an area of Adopted Green Belt, which extends to the east of the site towards Cambridge, and also is within a Nitrate Vulnerable Zone.

No further sensitive land uses are recorded within 500m of the site within the Landmark Envirocheck Report.

4.8.3.12 Archaeology and Heritage

Please refer to Section 3.6 for further details.

4.8.3.13 Historical Development

A summary of the historical development of Zone 8 and the surrounding area within 500m is detailed in Table 4.73, highlighting the major changes observed in the historical maps.

It should be noted that where no significant changes and/or no coverage of the site or its surrounding area is provided, these records have not been included in the summary below.

Zone 8 and the immediate surrounding area are covered in Slice B (B8, B12 and B16), C (C5, C9, C13 and C14) and E (E1, E2, E5 and E6) from Envirocheck Report 1.

Table 4.73: Historic Map Review – Zone 8

Year of Publication	Scale	On-site	Off-site
1886 - 1887	1:10,560 1:2,500	Scotland Road exists in a similar position to its current route. The land surrounding the road is predominantly agricultural land.	<p>Scotland Farm comprising of farm buildings, a sluice, pond and spring are present from c. 100m west of the site at Ch. 100.</p> <p>A track runs north-west/south-east next to Ch. 0. Several further tracks are present adjacent to the route at the margins of agricultural fields.</p> <p>Wooded areas, two small ponds and unlabelled tracks/drains are indicated in the north-eastern side of the Zone (Ch. 1500 – 1900).</p> <p>Village of Dry Drayton to the north of the route (Ch. 2000 – 2200). Notable structures such as a rectory, public house, pond, farm, woodland and houses within 250m of the route boundary.</p> <p>A Reservoir (Dry Drayton Parish Council) is labelled c. 400m east of Ch 1800.</p>
1902	1:10,560 1:2,500	No significant change.	<p>Small changes to Scotland Farm including expansion of small farm buildings.</p> <p>Ash Plantation, a thin strip of woodland, is labelled c. 250m west of Scotland Road (Ch. 600).</p>
1926 - 1927	1:10,560 1:2,500	No significant change.	<p>Small changes to Scotland Farm - removal of small farm buildings.</p> <p>New Farm constructed directly adjacent to the site on the eastern side of Scotland Road, along with some residential dwellings (Ch 0 – 350)</p> <p>A pump house is labelled to the north of Scotland Farm c. 150m west (Ch. 150).</p> <p>A small building is indicated c. 20m west of Ch. 100.</p> <p>A possible Clay Pit is recorded east of New Farm at approximate Ch 150.</p>
1938 - 1953	1:10,560	No significant change.	No significant change.
1958	1:10,000	No significant change.	No significant change.
1976 – 1977	1:2,500	No significant change.	<p>Drains are now labelled on agricultural land, orientated parallel to the southern end of Scotland Road, within 500m of the zone.</p> <p>Small expansion of building on Scotland Farm; two tanks are also labelled on the site.</p> <p>Significant residential expansion of Dry Drayton to the north of the zone.</p>

Year of Publication	Scale	On-site	Off-site
1979	1:2,500	Route of Scotland Road altered slightly at junction with newly constructed roundabout (Wellington Way Roundabout) to the south (Zone 3).	No significant change.
1980 – 1983	1:10,000 1:2,500	No significant change.	Two new tracks labelled (orientated north-west/south-east from approximate Ch. 150 and Ch. 400). Single dwelling added to the north of New Farm (Ch. 380). Drain network labelled to the east of New Farm, connected to Callow Brook further east. A roundabout and new junction are present from c. 450m south of Ch. 0.
1988	1:2,500	No significant change	Dry Drayton continuing to expand, no significant change to historical buildings in the village. Electrical Substation labelled. A cutting is labelled on the western side of the altered Scotland Road route next to Wellington Way Roundabout, c. 200m south of Ch. 0.
1994	1:2,500	No significant change.	No significant changes at Scotland Farm. A new unnamed track leads north-west from the farm and ends in the agricultural land.
2000	1:10,000 1:2,500	No significant change.	New Farm now labelled Dry Drayton Industries.
2006	1:10,000 1:2,500	No significant change.	Additional structure present within the Scotland Farm area c. 180m west of the site (Ch. 0).
2020	1:10,000 1:2,500	No significant change.	A further roundabout and the A428 is now present with associated earthworks (cutting/embankments) orientated east to west from c. 270m south of Ch 0. A large rectangular structure (labelled Electrical Substation) and small circular structures are now present adjacent to Scotland Farm c. 300m west of Ch 0.

4.8.3.14 Contaminants of Concern

Based on information obtained on the site and surrounding area and the Department for Environment (1995) Industry Profiles, limited contaminants of concern are likely to be present. Those potentially present within 250m of the site have been summarised in Table 4.74

Mott MacDonald is not insured to advise on risk arising from asbestos or radioactive substances, and therefore will not give advice relating to risks associated with them. It is recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos and/or radioactive substances at the site.

Table 4.74: Contaminants of concern - Zone 8

Potential Contaminant Source	Location	Contaminants of Concern
Agricultural land / farms	Agricultural land to the east and west of Scotland Road.	Metals, nitr-compounds from organic waste and fertilisers, fuel oil, pesticides, animal slurry and silage effluent
Highways / roads	OBC alignment runs along route of Scotland Road. A428, roundabouts and St Neots Road immediately to the south of Ch. 0.	Organic compounds e.g. petrol, diesel, MTBE, hydrocarbons; heavy metals.
Contemporary trade directory entries	Mainly within 250m of Ch. 200 – 250. One entry 130m NW of Ch. 2150.	<p><u>Cleaning / launderette</u></p> <p>Oils, acids, soaps, polycyclic aromatic hydrocarbons, triglyceride, phenol, alkylbenzene sulphonates, sodium hydroxide, sodium tripolyphosphate, potassium hydroxide, sodium chloride solution, titanium dioxide, dyes, antioxidants, sulphate, sodium/magnesium silicate, aluminium borate, magnesium phosphate, sodium carbonate, zinc oxide, asbestos, hydrocarbon fuels.</p> <p><u>Electronic equipment</u></p> <p>Metals and metalloids, asbestos, polychlorinated biphenyls, inorganic compounds, acids, alkalis, organic solvents, halogenated compounds and mineral oils.</p> <p><u>Printers</u></p> <p>Inorganic pigments, organic pigments, organic dyes, asbestos, barium sulphate, hydrocarbon resins, oils, phenol formaldehyde, amino compounds, alkyds, organic solvents, alcohols and glycol ethers, ketones, esters, dimethylformamide, 1-nitropropane, plasticisers, lubricants, driers and catalysts.</p> <p><u>Chemical products</u></p> <p>Solvents, inorganic compounds, organic compounds (e.g. benzene, toluene, xylenes, phenols, cresols, acids, polycyclic aromatic hydrocarbons, halogenated compounds, organo-sulphur and organo-nitrogen compounds), metals and metalloids, fuel, asbestos, dioxins, polychlorinated biphenyls.</p>
Extractive industries / potentially infilled land	Mainly within 250m of Ch. 1750 – 2250. One entry 225m SE of Ch. 0.	Unknown infill material (potential source of ground gas and organic contaminants)
Electrical substation	Scotland Farm	Metals and metalloids, polychlorinated biphenyls, inorganic compounds, acids, alkalis, organic solvents, halogenated compounds and mineral oils.

4.8.4 Utilities

A high-level review of the main C2 utility return information indicates that a medium pressure gas main and water utility run parallel to the west and east of Scotland Road (respectively) for approximately the entire length of the zone. A high voltage cable runs adjacent to the water utility for the majority of the zone, from approximate Ch 400. It is understood that a series of drawings recording the approximate location of the C2 utility returns are being produced by Mott MacDonald, and these should be referred to for further information.

4.9 Summary of Route Option Desk Study Findings

This section presents an overall summary of the key desk study findings for Route Zones 1 – 8. This allows comparison between each of these zones and therefore comparison of the areas in terms of the geotechnical and geo-environmental risks that may be encountered.

4.9.1 Site Geology

A comparison of the site geology for Route Zones 1 – 8 is presented in Table 4.75. It should be noted that although no Artificial Ground is recorded on the BGS mapping, it is possible this may be present on-site due to the developed nature of some areas of the site and the adjacent infrastructure / earthworks associated with the A428 / M11.

Table 4.75: Comparison of site Geology – Route Zones

Route Zone	Artificial Ground	Superficial Geology	Bedrock Geology
Zone 1	None indicated	Oadby Member	Kimmeridge Clay Formation Woburn Sands Formation
Zone 2	None indicated	Oadby Member	Woburn Sands Formation Gault Formation
Zone 3	None indicated		Gault Formation
Zone 4	None indicated	Oadby Member (Partial coverage)	Gault Formation West Melbury Marly Chalk Formation
Zone 5	None indicated	None indicated	Gault Formation
Zone 6	None indicated	None indicated	Gault Formation
Zone 7	None indicated	Oadby Member	Gault Formation
Zone 8	None indicated	Oadby Member	Gault Formation

4.9.2 Hydrogeology and Hydrology

4.9.2.1 Hydrogeology

A comparison of the hydrogeology for Route Zones 1 – 8 is presented in Table 4.76.

Table 4.76: Comparison of site Hydrogeology – Route Zones

Route Zone	Summary of Hydrogeology
Zone 1	<ul style="list-style-type: none"> ● Oadby Member is classified as a Secondary Undifferentiated Aquifer with medium groundwater vulnerability. ● Kimmeridge Clay to the western area is classified as Unproductive Strata. ● Woburn Sands Formation is classified as a Principal Aquifer. ● Groundwater was encountered in the Oadby Member between 1.7 – 17.7m bgl.
Zone 2	<ul style="list-style-type: none"> ● Oadby Member is classified as a Secondary Undifferentiated Aquifer with medium groundwater vulnerability. ● Woburn Sands Formation in the western area of the site is classified as a Principal Aquifer. ● Gault Formation in the eastern area is classified as Unproductive strata. ● Groundwater was encountered between 0.35 – 1.06m bgl within the Oadby member.
Zone 3	<ul style="list-style-type: none"> ● Oadby Member is classified as a Secondary Undifferentiated Aquifer with medium groundwater vulnerability. ● Gault Formation is classified as Unproductive strata. ● West Melbury Marly Chalk Formation to the east is classified as a Principal Aquifer ● Groundwater was recorded in the Oadby Member between 1.76 – 17m bgl.

Route Zone	Summary of Hydrogeology
Zone 4	<ul style="list-style-type: none"> • Oadby Member is classified as a Secondary Undifferentiated Aquifer with medium groundwater vulnerability. • West Melbury Marly Chalk Formation is classified as a Principal Aquifer • Gault Formation present east and west of the site is classified as Unproductive strata
Zone 5	<ul style="list-style-type: none"> • No superficial deposits recorded in this zone. • Gault Formation is classified as Unproductive strata. • West Melbury Marly Chalk Formation to the west is classified as a Principal Aquifer. • Groundwater seepage recorded in the Gault Formation at 1.7m bgl.
Zone 6	<ul style="list-style-type: none"> • No superficial deposits recorded in this zone. River Terrace Deposits c. 100m SE of Ch 11400 are classified as Secondary A Aquifer, however these are not anticipated to be encountered. • Gault Formation is classified as Unproductive strata. • Groundwater recorded in the Gault Formation at 1.2m bgl
Zone 7	<ul style="list-style-type: none"> • Oadby Member is classified as a Secondary Undifferentiated Aquifer with medium groundwater vulnerability. • Gault Formation is classified as Unproductive strata. • Groundwater recorded in the Oadby Member at 6.4m bgl.
Zone 8	<ul style="list-style-type: none"> • Oadby Member is classified as a Secondary Undifferentiated Aquifer with medium groundwater vulnerability. • Gault Formation is classified as Unproductive strata. • West Melbury Marly Chalk Formation to the east is classified as a Principal Aquifer. • Groundwater recorded in the Oadby Member at 6.4m bgl.

4.9.2.2 Hydrology

A comparison of the hydrology for Route Zones 1 – 8 is presented in Table 4.77. It should be noted that in general, a series of land drains are recorded within the wider area surrounding the site and this has not been presented in the below comparison.

Table 4.77: Comparison of site Hydrogeology – Route Zones

Route Zone	Summary of Hydrogeology
Zone 1	<ul style="list-style-type: none"> • Sirius Lake present 650m SW of Ch 0. • Two small ponds c. 315 / 120m south of the route along Sterling Way • No risk of flooding from surface water for the majority of the site footprint • Potential for groundwater flooding of property below ground level across the western half of the zone, limited potential for this to occur within the eastern half of the site.
Zone 2	<ul style="list-style-type: none"> • A number of drains are recorded between Ch 200 – 2450 adjacent to the A428. • Largely no risk of flooding from surface water for the majority of the site footprint. There is a medium/high risk of surface water flooding on Wellington Way. • Limited potential for groundwater flooding of property below ground level (Ch 2000 – 2300), with potential for it to occur between Ch 2300 – 2750.
Zone 3	<ul style="list-style-type: none"> • Extensive network of drains recorded within/adjacent to the site between Ch 2750 – 5700. • Callow brook crosses the site at Ch 4200 orientated north-east to south-west • Two balancing ponds present directly adjacent to the route at Ch 3100 and Ch 4000 • Largely no risk of flooding from surface water for the majority of the site footprint. However, there are bands of high risk at Ch 3000 – 3500, and a low to medium risk at Ch 5700. • Potential for groundwater flooding to occur at surface at the chainages mentioned above. The remainder of the zone has potential for groundwater flooding to occur in property below ground level
Zone 4	<ul style="list-style-type: none"> • Drains cross the route at Ch. 5700 and 7350). • The drains to the south feed into Bin Brook c. 580m south of Ch. 8100.

Route Zone	Summary of Hydrogeology
	<ul style="list-style-type: none"> • Springs located in Coton area associated with the underlying Chalk (Coton and Whitwell Farm). • Low risk of surface water flooding along the route, with bands of higher risk where the drains cross the route at the chainages mentioned above. • Limited potential for groundwater flooding to occur across the majority of the site, but potential for groundwater flooding below ground level at Ch 5700
Zone 5	<ul style="list-style-type: none"> • A drain crosses the route at Ch. 9100. • The drains to the south of the site feed into Bin Brook (c. 700m south of Ch. 8700). • Very low risk of surface water flooding to the site, with pockets of low – high risk crossing the route between Ch 86700 – 9100. • Limited potential for groundwater flooding to occur between Ch 867000 – 9000, with no reported risk of groundwater flooding for the remainder of the zone
Zone 6	<ul style="list-style-type: none"> • The River Cam is present c. 1.1km east of the site. • The West Cambridge Canal, orientated east to west, enters the site at approximate Ch 10150 within the West Cambridge Site (Cambridge University). This appears to run parallel to the route until approximate Ch. 10750 where it enters a culvert and is directed east, towards the River Cam. Further small drains appear to run broadly parallel to this and drain the surrounding area. • Two ponds are located directly adjacent to the site between approximate Ch. 10575 – 10775. • Bin Brook passes c. 60m south-east of the site at Ch 11400, orientated north-east to south-west and joins the River Cam east of the site. • No risk of flooding from Rivers or the Sea within the site footprint. • Minor areas are recorded at low risk of surface water flooding along Charles Babbage Road (Ch 9450 – 10050). Areas adjacent to the ponds and Cambridge West Canal are low to high risk (Ch 10150 – 10750). • No reported risk of groundwater flooding to occur in the site. Areas 40m SE of Ch 11400 have potential for groundwater flooding to occur at surface.
Zone 7	<ul style="list-style-type: none"> • A land drain is also recorded c. 15m north-east of the site. • Callow Brook is recorded approximately 80m south-east of the site. • Only a minor area along the eastern site boundary is at low risk of surface water flooding. Areas at risk in the wider area broadly follow the valley of Callow Brook or the land drains. • Potential for groundwater flooding of property below ground level to occur in the majority of the site, and potential for this to occur at surface along the eastern boundary.
Zone 8	<ul style="list-style-type: none"> • Callow Brook recorded approximately 275m east running parallel to the site • Several small ponds recorded within Dry Drayton (c. 20 – 50m from the site). • Only minor and discrete areas along the site are at low risk of flooding from surface water. • Limited potential for groundwater flooding to occur across the majority of the site. Potential for groundwater flooding of property below ground level around Ch 0 near Scotland Farm.

4.9.3 Environmental Records

A comparison of the environmental records within c. 500m of Route Zones 1 – 8 are presented in Table 4.78.

Table 4.78: Summary of Environmental Records

Environmental Records (No.)		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Soil Geochemistry Concentrations (mg/kg)	Arsenic	15 – 25	15 – 25	15 – 25	<15 – 25	15 – 25	<15	15 – 25	15 – 25
	Cadmium	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
	Chromium	60 – 90	60 – 120	60 – 120	60 – 90	60 – 90	60 – 90	60 – 120	60 – 120
	Lead	<100	<100	<100	<100	<100	<100	<100	<100 - 120
	Nickel	30 - 45	30 - 45	30 - 45	30 – 60	30 - 60	30 - 45	30 - 45	30 - 45
Groundwater and Surface Water Abstraction	N/A	N/A	N/A	1	1	3	N/A	N/A	
Discharge Consents	7	7	10	11	8	4	1	1	
Enforcement and Prohibition Notices	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Pollution Incidents to Controlled Waters	2	3	1	5	1	9	1	1	
BGS Mineral Sites	N/A	N/A	N/A	1	N/A	N/A	N/A	N/A	
Waste Activities	1	N/A	1	1	N/A	N/A	1	10	
Hazardous Substances	1	1	N/A	N/A	N/A	1	N/A	N/A	
Registered Radioactive Substances	N/A	N/A	N/A	N/A	12	18	N/A	N/A	
Contemporary Trade Directories	9	10	29	13	6	3	23	18	
Sensitive Land Uses	1	1	2	4	2	2	2	2	

5 Geotechnical Risk Assessment

In this section the geotechnical risks have been identified and assessed is based on the information presented for the route options in Section 4 and for the Travel Hub location options in Section 5. The overarching geotechnical risk register for the entire scheme can be found in Appendix F.

The section below presents a preliminary assessment of the geotechnical risks associated with the indicated underlying strata; the risk of geohazards within the site footprint; any geotechnical risks associated with proposes structures and embankments; and, any additional risks within the route zones and Travel Hub sites.

5.1 Preliminary Geotechnical Assessment

In order to understand the potential geotechnical risks associated with the in-situ geology, a preliminary geotechnical assessment has been undertaken. What follows is an overview of the geotechnical risks associated with each of the units indicated along the route / route options, and underlying the footprint of the location for the Park and Ride.

Table 5.1 outlines the geological units which are present within each of the route zones, along with the distance and percentage where each of the units occurs at or close to surface.

It should be noted that although the Kimmeridge Clay and Woburn Sands Formation are recorded beneath the site footprint, these deposits are not expected to be encountered during the proposed works due to the significant thickness of the Oadby Member expected in the west of the site.

Although Made Ground is not recorded on BGS mapping, it is possible that this may be encountered across the site in variable thickness due to the developed nature of some areas of the site, particularly in Zones 1 – 5 where the route runs adjacent to the A428 and major structures.

Table 5.1: Presence of strata within each route zone

Route Area	Unit	Distance/Area of route area where unit occurs at / close to surface*	Percentage of route area where unit occurs at / close to surface
Zone 1	Oadby Member	2000m (Entire Zone)	100%
Zone 2	Oadby Member	750m (Entire Zone)	100%
Zone 3	Oadby Member	2950m (Entire Zone)	100%
Zone 4	Oadby Member Chalk	2350m 440m	85.2% 14.8%
Zone 5	Gault Formation	750m (Entire Zone)	100%
Zone 6	Gault Formation	1950m (Entire Zone)	100%
Zone 7 (Park and Ride)	Oadby Member	0.07km ²	100%
Zone 8 (NMU)	Oadby Member	2250m (Entire Zone)	100%

*Values presented are approximate only

5.1.1 Artificial Ground

The 1:50,000 scale BGS mapping does not record Artificial Ground within the site footprint or immediate surrounding area. It should be noted that artificial deposits of less than 2.5m thickness are not recorded on the 1:50,000 BGS mapping.

However, it is likely that artificial ground will be encountered along the scheme associated with the developed state of some areas and in particular associated with the adjacent roads including the A428 and M11, with areas of significant earthworks identified from historic mapping records.

Below is a geotechnical assessment of the potential risks that could be encountered:

It is possible that significant thicknesses of this material may be encountered;

- The composition of the material may be variable;
- Contamination may be present within the material;
- It may not be suitable as a founding stratum as it could be of low strength and highly compressible;
- The possible presence of organic material may lead to long-term settlement;
- Due to variable density and material which may be encountered, differential settlement may occur both within the unit and in any surrounding units;
- Due to the variability of the deposit, it may have variable permeability;
- There is potential for elevated or perched groundwater within these deposits;
- There is a potential risk for concrete to be attacked by aggressive ground conditions;
- It is possible that ground gas could be generated by the deposits; and,
- Excavations or slopes in this material may be unstable.

5.1.2 Oadby Member (Wolston Glacigenic Formation)

The Oadby Member is likely to be encountered at surface across the majority of the site and is generally described as a firm to very stiff silty gravelly clay with occasional beds of sand/gravel and occasional cobbles/boulders. This unit thins to the east and is not recorded in Zone 5 and 6. The unit may be up to 20 – 25m in thickness.

Below is a geotechnical assessment of the potential risks that could be encountered:

- It is possible that variable founding and settlement conditions may occur due to the variable lithology/ nature of this deposit;
- This deposit may contain periglacial features including for example shallow shear surfaces;
- The strength and compressibility of this deposit may vary with depth;
- The unit may have dilatancy and be sensitive to moisture content change; therefore, there is a risk that ground conditions on site may deteriorate if the material becomes wet;
- Lenses and/or bands of sands and gravels possibly present may lead to perched water being present;
- This unit has the potential to contain cobbles and boulders which may act as obstructions for foundations; and,
- It is possible that sulphate bearing minerals may be present within the unit leading to a potential risk of buried structural elements to be attacked by aggressive ground.

5.1.3 Kimmeridge Clay

The Kimmeridge Clay is likely to be encountered beneath the Oadby Member east of Cambourne. No historic borehole information is available within close proximity of the site which encounters this material, but this unit has been described by the BGS as a dark grey clay / calcareous fossiliferous clay with thin beds of oil shale, and tabular beds and septarian nodules of argillaceous limestone (cementstone).

This deposit is considered unlikely to be encountered based on the currently proposed works. Therefore, geotechnical risks have not been presented in this section. Should the proposed works change, this section should be updated accordingly.

5.1.4 Woburn Sands Formation

The Woburn Sands Formation is likely to be encountered beneath the Oadby Member between Cambourne and Childerley Gate / Highfields Caldecote. This deposit was not encountered in historical boreholes within the immediate surrounding area of the site, but can be described as a fossiliferous loosely cemented glauconitic sandstone / pebbly sand with local thin beds of silty clay and phosphatic nodules/beds at its base. This unit may be up to 12m in thickness.

This deposit is considered unlikely to be encountered based on the currently proposed works due to the significant thickness of the overlying Oadby Member in this area of the site. Therefore, geotechnical risks have not been presented in this section. Should the proposed works change, this section should be updated accordingly.

5.1.5 Gault Formation

The Gault Formation is likely to be encountered beneath the Oadby Member between Childerley Gate / Highfields Caldecote to c. 250m west of Long Road, and again c. 300m east of Coton for the remainder of the site east of this. This unit was encountered in historic boreholes within the immediate surrounding area of the site and was described as a firm to stiff slightly to very sandy fissured silty clay with occasional gravel and selenite crystals. This unit may be up to 40m in thickness.

Below is a geotechnical assessment of the potential risks that could be encountered:

- The unit is likely to be of moderate to high strength and have moderate to low compressibility, however this may vary;
- This deposit may contain periglacial features including for example shallow shear surfaces;
- The strength and compressibility of this deposit may vary with depth;
- The unit has a potential to be affected by shrink/swell;
- This unit may contain pyritic nodules, and there is a potential risk that concrete may be attacked by aggressive ground conditions;
- The unit has the potential to contain limestone bands or nodules which may act as obstructions for foundations; and,
- Perched groundwater may be encountered within beds of silt/ fine-grained sand within the unit.

5.1.6 West Melbury Marly Chalk Formation

The West Melbury Marly Chalk Formation is likely to be encountered along an area c. 440m long north of Coton in the eastern half of the site.

This unit was encountered in historic boreholes within the immediate surrounding area of the site, and was described as a marly chalk with hard bands, or clayey / hard block chalk which was locally disturbed by coprolite digging. This unit may be up to 15 – 25m in thickness.

Below is a geotechnical assessment of the potential risks that could be encountered:

- Chalk units are highly susceptible to frost; therefore, foundations and pavements may be liable to frost heave;
- In the upper weathered zone, it is possible that this material could be of low strength or have variable density characteristics;
- It is possible that differential settlement may occur as a result of the likely variable weathering profile;
- Carbonate rocks such as Chalk are susceptible to dissolution and the formation of karst, e.g. sink holes, cave systems and tapering pipes;
- The subsidence or collapse of material above dissolution derived voids may result in an infill of any overlying deposits. These features can vary in size and will result in variable geotechnical conditions across the site;
- Chalk has the potential to contain flint or cobbles which may act as obstructions for foundations; and,
- It is possible that sulphate bearing minerals/nodules may be present within the West Melbury Marly Chalk Formation, leading to a potential risk of buried structural elements to be attacked by aggressive ground.

5.1.7 Groundwater

Where encountered, groundwater was recorded as being between 1.76 – 17.8m bgl. This was predominantly encountered within the Oadby Member and is likely to be associated with the presence of perched water.

Limited BGS borehole records which indicated the presence of groundwater were recorded proximal to the site within the West Melbury Marly Chalk Formation and the Gault Formation.

For preliminary design, it is recommended that groundwater is assumed as being 1m below ground level to remain conservative subject to the confirmation during a site-specific ground investigation.

5.1.8 Drainage

A drainage strategy is currently under development by Mott MacDonald and is investigating drainage options across the scheme, with the drainage solutions to be installed along the route to be confirmed. There is potential for sustainable drainage systems to be utilised including infiltration, soakaways, filter strips, filter drains and swales.

The Oadby Member overlies the majority of the site footprint (Zones 1 – 4, 7 8). Based on the historic engineering log descriptions it is unlikely to form a suitable medium for infiltration drainage. The West Melbury Marly Chalk Formation is likely to be encountered in some areas of Zone 4, and this deposit could potentially form a suitable medium for infiltration depending on the thickness of the zone of weathered material. The Gault Formation, recorded in Zones 5 and 6, is unlikely to comprise a suitable medium for infiltration drainage based on the review of available BGS information.

It is recommended that the suitability of the above deposits for infiltration drainage is confirmed following completion of site-specific ground investigation and testing.

5.2 Geotechnical Hazards

The Envirocheck Report presents the locations and the hazard potential of geological hazards along the length of the overall scheme footprint.

Table 5.2 presents the hazard potential of geological hazards for the route zones within c. 250m of the centreline.

Table 5.2: Summary of Geotechnical Hazards for Route Zones

Route Zone	Geotechnical Hazard	Hazard Potential	Associated Strata
Zone 1, Zone 2, Zone 3, Zone 7	Collapsible Ground	Very Low	Oadby Member
	Compressible Ground	Very Low	Oadby Member
	Ground Dissolution	No Hazard	Oadby Member
	Landslide	Very Low	Oadby Member
	Running Sand	Very Low	Oadby Member
	Shrinking or swelling clay	Low	Oadby Member
Zone 4	Collapsible Ground	Very Low	Oadby Member
	Compressible Ground	Very Low	Oadby Member
	Ground Dissolution	Very Low	West Melbury Marly Chalk Formation
	Landslide	Very Low to Low	Oadby Member / West Melbury Marly Chalk Formation
	Running Sand	Very Low No Hazard	Oadby Member West Melbury Marly Chalk Formation
	Shrinking or swelling clay	Low No Hazard	Oadby Member West Melbury Marly Chalk Formation
Zone 5	Collapsible Ground	Very Low	Gault Formation
	Compressible Ground	Very Low	Gault Formation
	Ground Dissolution	No Hazard	Gault Formation
	Landslide	Very Low	Gault Formation
	Running Sand	No hazard	Gault Formation
	Shrinking or swelling clay	Moderate	Gault Formation
Zone 6	Collapsible Ground	Very Low	Gault Formation
	Compressible Ground	Very Low	Gault Formation
	Ground Dissolution	No Hazard	Gault Formation
	Landslide	Very Low	Gault Formation
	Running Sand	No Hazard Very Low	Gault Formation River Terrace Deposits
	Shrinking or swelling clay	Moderate	Gault Formation / River Terrace Deposits
Zone 8	Collapsible Ground	Very Low	Oadby Member
	Compressible Ground	No Hazard	Oadby Member
	Ground Dissolution	Very Low	West Melbury Marly Chalk Formation
		N/A	Oadby Member

Route Zone	Geotechnical Hazard	Hazard Potential	Associated Strata
	Landslide	Very Low	Oadby Member / West Melbury Marly Chalk Formation
	Running Sand	Very Low	Oadby Member
	Shrinking or swelling clay	Low Moderate	Oadby Member Gault Formation

Source: Landmark Envirocheck Report

5.3 Geotechnical Risks Associated with Earthworks

Table 5.3 summarises the proposed earthworks over c. 0.5m in height along the various zones of the route, detailing the indicated founding strata and their associated high-level geotechnical risks, along with the likely foundation method that would be utilised. For further details of the earthworks proposed along the routes, please refer to Section 4.

It should be noted that some areas have limited topographic survey coverage and/or LiDAR information (e.g. Zone 4 – 5), and as a result not necessarily all of the potential embankment/cuttings will be listed in the below table. Upon completion of a full site topographic survey, this section should be updated accordingly.

No significant earthworks are currently expected in Zone 6 – 8, therefore these are not assessed in the below table. However, high-level risks associated with the Gault Formation (Zone 6) and Oadby Member (Zone 7, 8) are expected to apply to these zones.

Table 5.3: Geotechnical Risks Associated with Earthworks

Route Zone	Earthwork Type	Start Chainage	End Chainage	Founding Unit	Possible Foundation Solutions	High Level Geotechnical Risks
Route Zone 1	Embankment	100	250	Oadby Member	Soft/loose spots may be encountered below embankment founding level which may require excavation and replacement / ground improvement	The risk of founding an embankment on the Oadby Member are that it is likely to be a variable deposit leading to differential and long-term consolidation settlement, and is likely to be moisture sensitive therefore ground conditions may deteriorate if the material becomes wet. Periglacial conditions may have also arisen in shallow shear surfaces which may cause slope instability.
		980	1300			
	At Grade	0	150	Oadby Member	Pavement likely to be founded onto Oadby Member	The Oadby Member is likely to be a variable deposit leading to differential and long-term consolidation settlement and is likely to be moisture sensitive therefore ground conditions may deteriorate if the material becomes wet.
		400	480			
		880	980			

Route Zone	Earthwork Type	Start Chainage	End Chainage	Founding Unit	Possible Foundation Solutions	High Level Geotechnical Risks
	Cutting	250 480 1300	400 880 2000	Oadby Member	Soft/loose spots may be encountered at sub-formation; therefore, excavation and replacement / ground improvement may be required	The risk of cuts within the Oadby Member are that obstructions such as boulders may be present. Periglacial conditions may have also arisen in shallow shear surfaces which may cause slope instability, as well as potential perched water in granular beds. The unit is likely to be sensitive to changes in moisture content which may lead to deterioration of the material if it becomes wet.
Route Zone 2	Embankment	2000	2380	Oadby Member	Soft/loose spots may be encountered below embankment founding level which may require excavation and replacement / ground improvement	The risk of founding an embankment on the Oadby Member are that it is likely to be a variable deposit leading to differential and long-term consolidation settlement, and is likely to be moisture sensitive therefore ground conditions may deteriorate if the material becomes wet. Periglacial conditions may have also arisen in shallow shear surfaces which may cause slope instability.
	Cutting	2380	2750	Oadby Member	Soft/loose spots may be encountered at sub-formation; therefore, excavation and replacement / ground improvement may be required	The risk of cuts within the Oadby Member are that obstructions such as boulders may be present. Periglacial conditions may have also arisen in shallow shear surfaces which may cause slope instability, as well as potential perched water in granular beds. The unit is likely to be sensitive to changes in moisture content which may lead to deterioration of the material if it becomes wet.
Route Zone 3	Embankment	2750 3810 4290 4400	3450 3820 4300 5500	Oadby Member	Soft/loose spots may be encountered below embankment founding level which may require excavation and replacement / ground improvement	The risk of founding an embankment on the Oadby Member are that it is likely to be a variable deposit leading to differential and long-term consolidation settlement, and is likely to be moisture sensitive

Route Zone	Earthwork Type	Start Chainage	End Chainage	Founding Unit	Possible Foundation Solutions	High Level Geotechnical Risks
		4975	5700			therefore ground conditions may deteriorate if the material becomes wet. Periglacial conditions may have also arisen in shallow shear surfaces which may cause slope instability.
	Cutting	3600 3860 4300 5550	3750 4290 4400 5700	Oadby Member	Soft/loose spots may be encountered at sub-formation; therefore, excavation and replacement / ground improvement may be required	The risk of cuts within the Oadby Member are that obstructions such as boulders may be present. Periglacial conditions may have also arisen in shallow shear surfaces which may cause slope instability, as well as potential perched water in granular beds. The unit is likely to be sensitive to changes in moisture content which may lead to deterioration of the material if it becomes wet.
Route Zone 4	Embankment	6300 7650 7530	6900 8060 7930	Oadby Member	Soft/loose spots may be encountered below embankment founding level which may require excavation and replacement / ground improvement	The risk of founding an embankment on the Oadby Member are that it is likely to be a variable deposit leading to differential and long-term consolidation settlement, and is likely to be moisture sensitive therefore ground conditions may deteriorate if the material becomes wet. Periglacial conditions may have also arisen in shallow shear surfaces which may cause slope instability.
	Embankment	8230	8670	Chalk	Likely to be founded onto Chalk assuming removal of any weathered material	The risks of founding an embankment on Chalk are that it is highly susceptible to frost and moisture ingress, which may lead to heave and deterioration of ground conditions. Dissolution features may be present which could lead to presence of low strength material, subsidence or excessive settlement, and weathered Chalk may be of variable density leading to differential settlement.

Route Zone	Earthwork Type	Start Chainage	End Chainage	Founding Unit	Possible Foundation Solutions	High Level Geotechnical Risks
						The risks of forming cuts within Chalk are that its sensitive to frost, weathered Chalk may be of low strength, and there is potential to encounter perched water.
	Cutting	6900 5700 8060	7400 6300 8150	Oadby Member	Soft/loose spots may be encountered at sub-formation; therefore, excavation and replacement / ground improvement may be required	The risk of cuts within the Oadby Member are that obstructions such as boulders may be present. Periglacial conditions may have also arisen in shallow shear surfaces which may cause slope instability, as well as potential perched water in granular beds. The unit is likely to be sensitive to changes in moisture content.
Route Zone 5	Embankment	8670 9050 9290	8750 9230 9400	Gault Formation	Likely to be founded onto Gault Formation assuming removal of any soft/loose or weathered material.	The risk of embankments within the Gault Clay Formation are that it may experience long-term / differential settlement. The unit is likely to experience shrink/swell behaviour. Variable weathering profile may lead to soft/loose deposits at founding level.
	Cutting	8750	9050	Gault Formation	Likely to be founded onto Gault Formation assuming removal of any soft/loose or weathered material.	The risk of cuttings within the Gault Clay Formation are that the deposit may require reasonably shallow angles (c. 1:3.5) to ensure long-term stability due to the geotechnical properties of this unit. This unit is likely to experience shrink/swell behaviour. Perched water may potentially be encountered which may lead to cut instability.
	At Grade	9400	9450	Gault Formation	Likely to be founded onto Gault Formation assuming removal of any soft/loose or weathered material.	The risk of founding on the Gault Clay Formation are that it is susceptible to shrink/swell behaviour, and may be subject to long-term / differential settlement.

5.4 Geotechnical Risks Associated with Structures

Table 5.4 summarises the proposed structures along the route, the indicated founding strata and their associated high-level geotechnical risks, along with the likely foundation method that would be utilised. Locations where additional structures may also be required due to narrow corridors between existing infrastructure have also been considered in the below assessment. For further details of the structures, please refer to Section 4.

It should be noted that some areas have limited topographic survey coverage and/or LiDAR information (e.g. Zone 4 – 5), and the below table should be updated upon receipt of this information. Upon completion of a full site topographic survey, this section should be updated accordingly.

No significant structures are currently expected in Zones 1, 4, 6, 7, and 8, therefore these are not assessed in the below table. Should the proposed design change, this should be reassessed.

Table 5.4: Geotechnical Risks Associated with Structures

Route Zone	Structure Type	Start Chainage*	End Chainage*	Founding Unit	Possible Foundation Solutions	High Level Geotechnical Risks
Route Zone 2	Retaining Wall	Ch 2380	Ch 2520	Oadby Member	It is possible that shallow foundations may be utilised within the Oadby Member. However, this is dependent on loading conditions and the strength characteristics of the Oadby Member. If the unit is not suitable for shallow foundations, then a deep foundation solution such as piles may be required.	The Oadby Member is likely to be a variable deposit leading to differential and long-term consolidation settlement, and is likely to be moisture sensitive therefore ground conditions may deteriorate if the material becomes wet. Periglacial features such as shallow shear surfaces may be present and perched water may potentially be encountered, which may present a risk of instability during construction. The Oadby Member may contain obstructions to retaining wall construction (specifically embedded walls such as sheet piles) such as cobbles / boulders.
Route Zone 3	Culvert extension	Ch 3455	Ch 3475	Oadby Member	It is possible that shallow foundations may be utilised within the Oadby Member. However, this is dependent on loading conditions and the strength characteristics of the Oadby Member. If the unit is not suitable for shallow foundations, then a deep	If placed on a shallow foundation, it should be noted that the Oadby Member is likely to be a variable deposit leading to differential settlement between the culvert and the road, and long-term consolidation settlement. The unit is likely to be moisture sensitive therefore ground

Route Zone	Structure Type	Start Chainage*	End Chainage*	Founding Unit	Possible Foundation Solutions	High Level Geotechnical Risks
					foundation solution such as piles may be required.	conditions may deteriorate if the material becomes wet. Perched water may potentially be encountered which may lead to instability during construction. Additionally if a deep foundation solution is proposed, the Oadby Member may contain obstructions to possible solutions such as driven piles due to the presence of cobbles / boulders.
	Potential Minor Retaining Structures	Ch 2700 Ch 3050	Ch 2850 Ch 3200	Oadby Member	<p>It is possible that a minor retaining structure may be required throughout some of these chainages due to the adjacent A428 and St Neot's Road, with the presence of existing infrastructure / cuttings, and limited room to construct earthworks.</p> <p>It is possible that shallow foundations may be utilised within the Oadby Member. However, this is dependent on loading conditions and the strength characteristics of the Oadby Member. If the unit is not suitable for shallow foundations, then a deep foundation solution such as piles may be required.</p>	<p>The Oadby Member is likely to be a variable deposit leading to differential and long-term consolidation settlement, and is likely to be moisture sensitive therefore ground conditions may deteriorate if the material becomes wet. Periglacial features such as shallow shear surfaces may be present and perched water may potentially be encountered, which may present a risk of instability during construction.</p> <p>The Oadby Member may contain obstructions to retaining wall construction (specifically embedded walls such as sheet piles) such as cobbles / boulders.</p>
Route Zone 4	Potential Retaining Structure	Ch 5700	Ch 6100	Oadby Member	<p>It is possible that a retaining structure may be required within this area due to the nearby presence of adjacent road infrastructure / cutting (A428 and St Neot's Road, and limited room to construct earthworks.</p> <p>It is possible that shallow foundations may be utilised within the Chalk, assuming removal of any weathered material. Dependent on the strength / weathering profile and loading scenarios, it is possible that ground improvement or a deep</p>	<p>The Oadby Member is likely to be a variable deposit leading to differential and long-term consolidation settlement, and is likely to be moisture sensitive therefore ground conditions may deteriorate if the material becomes wet. Periglacial features such as shallow shear surfaces may be present and perched water may potentially be encountered, which may present a risk of instability during construction.</p> <p>The Oadby Member may contain obstructions to retaining wall construction</p>

Route Zone	Structure Type	Start Chainage*	End Chainage*	Founding Unit	Possible Foundation Solutions	High Level Geotechnical Risks
					foundation solution such as piles could be required.	<p>(specifically embedded walls such as sheet piles) such as cobbles / boulders.</p> <p>The Oadby Member may be thin within this area of the site, therefore it is possible that the underlying West Melbury Marly Chalk formation may be encountered.</p> <p>It is possible that at its boundary with the Chalk, this unit may have be reworked by glacial processes resulting in variable, low strength and potentially compressible material.</p> <p>If encountered, the Chalk is likely to be sensitive to frost / moisture ingress and may contain a variable weathering profile. It may contain perched groundwater which may lead to instability during construction.</p> <p>There is a risk of dissolution features within this deposit which may lead to subsidence/instability and presence of low strength, compressible material at foundation level. Although no natural cavities are recorded within the Envirocheck Report, several man made mining cavities are recorded adjacent to the site and in the wider area around Zone 4.</p>
Zone 5	Bridge	Ch 9230	Ch 9290	Gault Formation	It is possible that shallow and deep foundations may be utilised within the Gault Formation, dependent on the loading conditions and the strength characteristics of the unit. A deep foundation such as piles is likely to be required for large structures.	The Gault Formation may have a variable strength / weathering profile leading to long-term consolidation of the approach embankments and differential settlement between bridge elements and the associated approach embankments. The unit is also susceptible to shrink/swell which may lead to differential settlement of earthworks. Perched water may also

Route Zone	Structure Type	Start Chainage*	End Chainage*	Founding Unit	Possible Foundation Solutions	High Level Geotechnical Risks
						potentially be encountered. The unit may contain periglacial features near-surface such as shear surfaces, which may lead to slope instability. The unit may contain obstructions to construction such as limestone bands which may impact on deep foundation solutions such as piles, and the required pile lengths may vary dependent on the strength and weathering profile.

*Chainages are approximate only

5.5 Additional Geotechnical Risks

This section outlines any other applicable risks that have not been covered in the sections above. These are as follows:

- Agricultural land – site likely to affect topsoil. An agricultural land classification and/or Soil Resource Survey (SRS) may be required:
- Hedgerows and trees – removal of trees and hedgerow may be required within some areas, particularly between Zone 3 and 4 (approximate Ch. 4500 – 5900) and in discrete areas elsewhere on the site, which could affect construction.

6 Contaminated Land Qualitative Risk Assessment

6.1 Environmental Protection Act 1990, Part 11A

The primary legislative regime under which historic contaminated land is managed in the UK is Part IIA of the Environmental Protection Act (EPA), 1990. The framework for the assessment of potential land contamination adopted in this report is based on current guidance documents regarding the implementation of Part IIA of the EPA and the assessment of potentially contaminated land, with particular reference to:

- Department of the Environment Food and Rural Affairs (DEFRA) (2012): “Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance”, April 2012;
- Environment Agency (2008): “Human Health Toxicological Assessment of Contaminants in Soil”, Science Report – SC050021/SR2;
- Environment Agency (2008): “Updated Technical Background to the CLEA Model”, Science Report - SC050021/SR3;
- Construction Industry Research and Information Association (2001): “Contaminated land risk assessment: A guide to good Practice”, CIRIA C552;
- British Standard Institution (2002): “Characterisation of waste. Leaching. Compliance test for leaching of granular waste materials and sludges. One stage batch test at a liquid to solid ratio of 10 l/kg for materials with particle size below 4 mm (without or with size reduction)”, ref. BS EN 12457-2:2002;
- British Standard (BS) 10175:2011(+A2:2017), “Investigation of Potentially Contaminated Sites; Department for Communities and Local Government (2018): “National Planning Policy Framework”.

Part IIA principally deals with sites where individual historic contamination linkages present a “Significant Possibility of Significant Harm” (SPOSH) or a Significant Possibility of Significant Pollution to Controlled Waters (SPOSPCOW) representing an unacceptable level of contamination risk for each linkage. The Part IIA clean-up is the minimum which can be done on a cost basis to make and keep the site in a “just safe” condition for an existing or planned change of use.

Elimination of liability under Part IIA is not always achievable largely because of the inherent risk basis of the statutory regime, the technical difficulty in establishing levels of contamination that are likely to represent SPOSH, and the variable distribution of contamination at many sites. Statutory guidance on Part IIA (DEFRA, 2012) recognises that sites require prioritisation by Local Authorities under the statutory Part IIA site inspection programme to ensure that only those sites likely to present the greatest risks are identified. However, it should be recognised that considerable investigation is often required to establish whether sites are likely to meet the definition of contaminated land under Part IIA. Such investigation may be beyond the scope of project budgets for nominally “low risk sites” necessitating judgement on an acceptable level of investigation, and the likelihood of meeting SPOSH / SPOSPCOW criteria based on incomplete data. Since the designation of Contaminated Land is the responsibility of the local Authority, it is advised that consensus is sought on any recommendations regarding the significance of contaminated land risks and remedial measures through consultation with the Regulator(s).

6.2 Planning Policy Context

The EPA is designed to ensure that risks are considered only in relation to the current use of the site. There are no obligations placed by the EPA for management or mitigation of risks relating to future uses which would require a change in planning permission. Planning policy guidance is available at the national and strategic levels. The relevant policies are considered below:

6.2.1 National Planning Policy Guidance

The National Planning Policy Framework (Department for Communities and Local Government, 2019) includes the following policies in relation to contaminated land:

Policy 170:

“Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and,

f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.”

Policy 178:

“Planning policies and decisions should ensure that:

a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and,

c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.

Policy 180:

“Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.”

The glossary states the following relation to “site investigation information”:

“Site investigation information: Includes a risk assessment of land potentially affected by contamination, or ground stability and slope stability reports, as appropriate. All investigations of land potentially affected by contamination should be carried out in accordance with established procedures (such as BS10175 Investigation of Potentially Contaminated Sites Code of Practice).”

6.3 Qualitative Risk Assessment Framework

Preliminary qualitative risk assessment is part of a phased approach as set out in UK guidance including CIRIA C552 (2001) and DEFRA LCRM (2019) , the first stage requires development of a conceptual model that takes consideration of the environmental site setting and identifies potential contaminant sources, pathways and receptors, this allows potential pollutant linkages to be identified. The qualitative risk assessment follows on from this and is presented in the sections below.

6.4 Conceptual Model

6.4.1 Hazard Identification

For the proposed development, the potential sources, pathways and receptors of contamination have been identified in the conceptual site models below.

It is assumed that a robust environmental management plan will be adopted during the construction works and as a result, no contamination will occur as a result of leaks and spills during construction.

6.4.2 Risk Estimation and Risk Evaluation

The term risk is widely used in different contexts and circumstances, often with differing definitions. In UK Government publications about the environment, the standard definition is that “Risk is a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence” (LCRM).

Following the development of the conceptual model and the identification and assessment of potential pollutant linkages, a preliminary assessment can be made of risk estimation and risk evaluation, as discussed in LCRM and CIRIA C552, to determine whether an unacceptable contamination risk is likely to exist.

LCRM defines risk estimation as predicting the magnitude (or consequence) and probability of the risk occurring that may arise as a result of that hazard. This is also identified in CIRIA C552 in which the risk assessment methodology uses qualitative descriptors of consequence, probability and thus risk. These descriptors are adopted for the purposes of this risk assessment. A description of the risk assessment methodology adopted is given in Appendix G.

6.4.3 Process of Developing Conceptual Model

A key element of an environmental risk assessment is the development of a conceptual model which is done by undertaking a Source –Pathway – Receptor analysis of the Site:

Sources (S) are potential or known contaminant sources e.g. a former land use;

Pathways (P) are environmental systems through which a contaminant could migrate e.g. air, groundwater;

Receptors (R) are sensitive environmental receptors that could be adversely affected by a contaminant e.g. Site occupiers, groundwater resources.

Where a source, relevant pathway and receptor are present, a pollutant linkage is considered to exist whereby there is a circumstance through which environmental harm could occur and a potential environmental liability is considered to exist. The sources, pathways and receptors expected on the route (for each separate zone) are summarised in the following section.

6.5 Preliminary Qualitative Risk Assessment

For each potential pollutant linkage identified within the conceptual model, the potential risk has been evaluated for ecological receptors, construction/maintenance workers and the final end users using a Preliminary Qualitative Risk Assessment. This is based on the probability of the pollution event, and the severity it may have on site users and the environment.

The contaminated land risk assessments and drawn conceptual site models are presented in Appendix G and should be updated upon receipt of further information. The methodology for the assessment is presented in Appendix H.

Mott MacDonald is not insured to advise on risk arising from asbestos, and therefore will not assess risk or give advice relating to risks associated with it. It is recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos at the site.

6.5.1 Sources

Sources of contamination identified across the proposed route zones are presented below.

6.5.1.1 On-site sources

1. Potentially contaminated artificial ground from historical and current land uses at Bourn Airfield.
2. Potentially contaminated artificial ground associated with the construction and operation of the British Antarctic Survey and University of Cambridge campus buildings.
3. Artificial ground and associated contamination from past and current infrastructure i.e. roads / highways.
4. Vehicles using existing infrastructure may have resulted in fuel / oil spillages and airborne particulates.
5. Potential contamination from the application of pesticides and sewage sludge to the ground (agricultural land), and localised fuel / oil spillages from agricultural machinery.

6.5.1.2 Off-site sources

6. Potentially contaminated artificial ground from historical and current land uses at Bourn Airfield.
7. Potentially contaminated ground from the presence of an active fuel station i.e. fuel/oil spillages and airborne particulates.
8. Potentially contaminated artificial ground from historical extractive industries and potentially infilled land within 250m of the Zone.
9. Potentially contaminated artificial ground associated with the construction and operation of the British Antarctic Survey and University of Cambridge campus buildings and nearby historical industrial activity.
10. Artificial ground and associated contamination from past and current infrastructure i.e. roads / highways.
11. Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.
12. Potentially contaminative contemporary trade directory entries within 250m of the site.
13. Potential contamination from the application of pesticides and sewage sludge to the ground (agricultural land), and localised fuel / oil spillages from agricultural machinery.

6.5.1.3 Sources in relation to Route Zones

Table 6.1 summarises which of the aforementioned sources of contamination are likely to be encountered at each of the zones. It should be noted that detailed zone-specific sources are presented in their respective contaminated land risk assessment and conceptual site model (Appendix G).

Table 6.1: Sources in relation to Route Zones

	Zone							
	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
On-site sources								
1	X	-	-	-	-	-	-	-
2	-	-	-	-	X	-	-	-
3	-	X	X	X	X	X	-	X
4	-	X	X	X	X	X	-	X
5	-	-	-	X	X	X	X	-
Off-site sources								
6	X	-	-	-	-	-	-	-
7	-	X	-	-	-	-	-	-
8	-	-	-	X	-	-	-	X
9	-	-	-	-	-	X	-	-
10	-	-	-	X	-	X	X	-
11	X	-	-	X	-	X	X	-
12	X	-	X	X	X	-	X	X
13	-	X	X	-	X	X	-	X

Note: 'X' indicates where a source is present, '-' indicates where a source is not present/not applicable.

6.5.2 Pathways

Contamination pathways identified across the proposed route zones are presented below.

1. Human uptake pathways
 - Direct soil and dust ingestion (outdoors)
 - Skin contact with soils and dust
 - Inhalation of outdoor vapours
2. Horizontal and vertical migration of any volatile vapours resulting from potential on/off-site fuel spillages and / or off-site artificial ground.
3. Horizontal and vertical migration of any ground gas resulting from potential on/off-site fuel spillages and / or off-site artificial ground.
4. Horizontal and vertical migration of contaminants in the unsaturated zone.
5. Horizontal and vertical migration of contaminants in the saturated zone.
6. Migration of contaminants along engineered preferential pathways.
7. Surface run-off along roads, pavements, and other surfaces e.g. soil.

6.5.2.1 Pathways in relation to Route Zones

The geology (both superficial and bedrock geology) below the proposed route varies between zones (detailed in Section 4); due to this, some pathways may be more significant than others in each zone. A summary of the potential pollutant pathways are presented in Table 6.2.

Detailed zone-specific source-pathway-receptor relationships are presented in their respective contaminated land risk assessment and conceptual site model (Appendix G).

Table 6.2: Pathways in relation to Route Zones

Pathways	Zone							
	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
1	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X
3	-	-	-	X	-	-	X	X
4	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X

Note: 'X' indicates where a pathway is present, '-' indicates where a pathway is not present/not applicable.

6.5.3 Receptors

Contamination receptors identified across the proposed route zones are presented below.

1. Construction workers.
2. Final end users (on-site bus route users, road users).
3. Final end users (off-site residential / commercial / recreational).
4. Groundwater in the Oadby Member (Secondary Undifferentiated aquifer).
5. Groundwater in the Woburn Sands Formation (Principal aquifer).
6. Groundwater in the West Melbury Marly Chalk Formation (Principal aquifer).
7. Surface water features.
8. Flora and fauna.

6.5.3.1 Receptors in relation to Route Zones

Table 6.3 summarises the relevant receptors identified at each zone. Detailed zone-specific receptors are presented in their respective contaminated land risk assessment and conceptual site model (Appendix G).

Table 6.3: Receptors in relation to Route Zones

Receptors	Zone							
	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8
1	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X
3	-	X	X	X	-	X	-	X

4	X	X	X	X	-	-	X	X
5	X	X	-	-	-	-	-	-
6	-	-	X	X	X	-	-	X
7	X	X	X	X	X	X	X	X
8	-	-	-	-	-	X	-	-

Note: 'X' indicates where a receptor is present, '-' indicates where a receptor is not present/not applicable.

7 Conclusions and Recommendations

7.1 Geotechnical and Geo-environmental Summary

Table 7.1 summarises both the geotechnical and geo-environmental findings of this report for each of the proposed route zones, along with a summary of the initial engineering proposed.

The BGS 1:50,000 mapping and Envirocheck Report record superficial deposits of the Oadby Member to be present across the majority of the site footprint. The solid geology which may be encountered at surface includes the West Melbury Marly Chalk Formation and the Gault Formation, which are anticipated to be encountered around Coton and to its east towards Cambridge. A summary of the geotechnical risks associated with these deposits to the proposed scheme is provided below, with the relevant deposits referred to within Table 7.1.

Superficial Deposits of the Oadby Member are likely to be encountered across the majority of the site (Zones 1 – 4, 7 and 8). The Oadby Member is likely to be moisture sensitive therefore ground conditions may deteriorate if the material becomes wet. This is likely to be a variable deposit which may lead to variable and long-term consolidation settlement of embankments. Periglacial shear-surfaces and perched water in granular beds may be encountered which can lead to instability of slopes during construction. Obstructions such as cobbles and boulders which may also pose as obstructions to embedded walls requiring removal and replacement.

The West Melbury Marly Chalk Formation is likely to be encountered in Zone 4 around the Coton area. Pavement over this material is likely to be susceptible to frost and will need to be founded below the frost susceptible zone. The Chalk may have a variable weathering zone which could lead to differential settlement and low strength material present at foundation level. This unit may contain natural and man-made cavities / dissolution features which could lead to subsidence and the presence of low strength compressible material at foundation level. It is possible that at its boundary with the Oadby Member, this unit may have been reworked by glacial processes resulting in variable, low strength and potentially compressible material.

The Gault Formation is likely to be encountered east of Coton. This deposit may have a variable strength / weathering profile which may lead to differential settlement between elements, and long-term consolidation settlement of embankments. The unit is susceptible to shrink/swell and may contain periglacial features such as shallow shear surfaces, which may lead to instability. Obstructions to deep foundation construction such as limestone bands may be present in this unit.

The geo-environmental risks identified have generally been assessed as moderate to low. The proposed route requires significant earthworks in some areas (up to c. 5m of embankment), along with structures, all requiring below ground excavation. A reasonable area of the route passes through areas of agricultural land therefore a significant source of contamination is not anticipated within these areas.

It has been determined that potentially contaminated artificial ground may be present at particular locations along the route, particularly around Bourn Airfield, Wellington Way Roundabout fuel station and the University of Cambridge campus where notable construction / demolition / earthworks have previously occurred. Further assessment and

appropriate management (i.e. Materials Management Plan) is required if the material in these areas is to be re-used or disposed of during the works.

A drainage strategy is currently under development by Mott MacDonald and is investigating drainage options across the scheme, with the drainage solutions to be installed along the route to be confirmed. There is potential for sustainable drainage systems to be utilised including infiltration, soakaways, filter strips, filter drains and swales. The drainage solutions chosen could potentially impact infiltration into the unsaturated zone and/or the quality of surface water bodies, and therefore the risk assessment should be updated upon completion of the drainage strategy.

The assessment assumes the following mitigation measures will be in place:

- Use of a Construction Environmental Management Plan (CEMP) to ensure control of dust emissions, surface run-off and suitable storage of oils and fuels during the construction works to prevent new sources of contamination; and
- Use of personal protective equipment and good hygiene practice by construction workers.

Table 7.1: Geotechnical and Geo-environmental Summary of Route Zones

Route Zone	Geotechnical Summary	Geo-environmental Summary	Initial Engineering Summary
Zone 1	<p>Traverses agricultural land therefore may affect topsoil.</p> <p>The superficial geology recorded at the site consists of the Oadby Member.</p> <p>The risks associated with the Oadby Member include being a variable deposit leading to differential settlement, likely to be moisture sensitive, potential to contain granular beds and perched water, contain obstructions such as cobbles/boulders, and may potentially be aggressive to buried infrastructure.</p> <p>The solid geology is recorded as the Kimmeridge Clay Formation, and Woburn Sands Formation. Geotechnical risks are summarised in Section 5, with these deposits not expected to be encountered due to the significant thickness of the Oadby Member.</p>	<p>The most significant contamination source on the site is Bourn Airfield, which covers the majority of Zone 1. There is the potential for hazardous contaminants / made ground to be present within 250m of the proposed route, which could be encountered during works.</p> <p>All risks have been assessed as low, assuming standard mitigation. This is due to the nature of the works (proposed earthworks and increased hardstanding cover along the route) and the significant thickness of the Oadby Member (Secondary Undifferentiated).</p> <p>Further risk assessment based on material testing will be required if material is proposed for reuse from this area.</p>	<p>Embankments <1.5m, and Cuttings up to c. 2.5m within the Oadby Member. At grade areas and pavements are also expected to be found directly on to the Oadby Member.</p> <p>Pavement within cut may be founded directly on the Oadby Member.</p> <p>The Oadby Member, recorded beneath the entire zone footprint, is unlikely to form a suitable medium for infiltration drainage.</p>
Zone 2	<p>Traverses minor areas of agricultural land therefore may affect topsoil.</p> <p>The superficial geology recorded at the site consists of the Oadby Member</p> <p>The risks associated with the Oadby Member include being a variable deposit leading to differential settlement, likely to be moisture sensitive, potential to contain granular beds and perched water, contain obstructions such as cobbles/boulders, and may potentially be aggressive to buried infrastructure.</p> <p>The solid geology is recorded as the Woburn Sands Formation and Gault Formation. Geotechnical risks are summarised in Section 5, these deposits are not expected to be encountered due to the significant thickness of the Oadby Member.</p>	<p>The most significant source identified on the site is the active fuel station, a potential source for leaks, spills and associated vapours from underground fuel tanks. There is the potential for hazardous contaminants / made ground to be present within 250m of the proposed route which could be encountered during works.</p> <p>All risks have been assessed as low to moderate, assuming standard mitigation. This due to the nature of the works (proposed earthworks and increased hardstanding cover along the route) and the significant thickness of the Oadby Member (Secondary Undifferentiated).</p> <p>Further risk assessment based on material testing will be required particularly if any made ground is proposed for reuse from this area.</p>	<p>Embankments up to c. 4.5m, and cuttings up to 3.0m in height underlain by the Oadby Member or possible engineered fill associated with existing earthworks along the A428.</p> <p>Potential structures within this area include a potential retaining wall north of Childerley Lodge, the east of this where the route runs adjacent to the south of the A428 (See Section 5.4). These are likely to be found in the Oadby Member.</p> <p>Pavement within cut may be founded directly on the Oadby Member.</p> <p>The Oadby Member, recorded beneath the entire zone footprint, is unlikely to form a suitable medium for infiltration drainage.</p>
Zone 3	<p>Traverses adjacent to the A428 therefore Artificial Ground may be encountered, and runs along a thin wooded area adjacent to St Neot's Road therefore trees/vegetation may require removal</p> <p>The superficial geology recorded at the site consists of the Oadby Member. Risks associated with the Oadby Member</p>	<p>The active fuel station, off-site but within 250m of Zone 3, was identified as a potential source for leaks, spills and associated vapours from underground fuel tanks. There is therefore the potential for hazardous contaminants / made ground to be encountered during works.</p>	<p>Embankments up to c. 2.5m in height, and cuttings up to 2.5m in height, expected to be found on/in the Oadby Member. At grade areas are also expected to be found on the Oadby Member.</p>

Route Zone	Geotechnical Summary	Geo-environmental Summary	Initial Engineering Summary
	<p>include being a variable deposit leading to differential settlement, likely to be moisture sensitive, potential to contain granular beds and perched water, contain obstructions such as cobbles/boulders, and may potentially be aggressive to buried infrastructure. The unit may contain periglacial features such as shallow shear surfaces.</p> <p>The solid geology recorded at the site consists of the Gault Formation, with the West Melbury Marly Chalk Formation recorded directly adjacent to the east. Geotechnical risks are summarised in Section 5, these deposits are not expected to be encountered due to the significant thickness of the Oadby Member.</p>	<p>All risks have been assessed as low to moderate, assuming standard mitigation. This due to the nature of the works (proposed earthworks and increased hardstanding cover along the route) and the significant thickness of the Oadby Member (Secondary Undifferentiated).</p>	<p>Potential structures within this area include an extension to an existing culvert. This is likely to found in the Oadby Member. Potential retaining structures may be required where earthworks extend into the adjacent A428 or St Neots Road. These are likely to found on to the Oadby Member and may encounter the Chalk dependent on the foundation requirements. Pavement within cut may be founded directly on the Oadby Member.</p> <p>The Oadby Member, recorded beneath the entire zone footprint, is unlikely to form a suitable medium for infiltration drainage.</p>
Zone 4	<p>Traverses agricultural land therefore may affect topsoil. The superficial geology recorded at the site consists of the Oadby Member. Risks associated with the Oadby Member include being a variable deposit leading to differential settlement, likely to be moisture sensitive, potential to contain granular beds and perched water, contain obstructions such as cobbles/boulders, and may potentially be aggressive to buried infrastructure. The unit may contain periglacial features such as shallow shear surfaces.</p> <p>The solid geology is recorded as the West Melbury Marly Chalk Formation. Potential significant risks associated with this unit include solution features, high frost susceptibility, variable weathered zone and flint obstructions.</p>	<p>All risks have been assessed as low to moderate, assuming standard mitigation. Increased hardstanding cover and no enclosed spaces are proposed along the route. Although no significant source of contamination was identified along the route, the Principal Chalk aquifer underlying the Oadby Member is a significant and sensitive receptor and is closer to the surface than in other zones (Oadby Member gradually thins to the east).</p>	<p>Embankments up to 2.0m, and cuttings up to 2.5m. These are expected to encounter the Oadby Member in the western area of this zone, and Chalk in the east. Minor areas at grade may also encounter either of these deposits.</p> <p>Where embankments found on more than one unit along their length, a load transfer platform / ground improvement may be required to prevent differential settlement.</p> <p>Potential structures within this area include a possible retaining structure required between St Neot's Road and the A428. This is likely to found on to the Oadby Member and may encounter the Chalk dependent on the foundation requirements.</p> <p>Pavements within cut may found directly on to the Oadby Member or Chalk.</p> <p>The Oadby Member, recorded beneath the majority of the zone footprint, is unlikely to form a suitable medium for infiltration drainage. The West Melbury Marly Chalk Formation may potentially form a suitable medium for infiltration drainage.</p>

Route Zone	Geotechnical Summary	Geo-environmental Summary	Initial Engineering Summary
Zone 5	<p>Traverses agricultural land therefore may affect topsoil. No superficial geology is recorded at the site.</p> <p>The solid geology at the site consists of the Gault Formation. Potential significant risks include long term settlement / differential settlement, shrink / swell behaviour, potential aggressive ground, periglacial processes (such as shallow shear surfaces), and potential below ground obstructions such as limestone bands.</p>	<p>All risks have been assessed as low, assuming standard mitigation. This is due to the lack of significant contamination source, the nature of the works (proposed earthworks and increased hardstanding cover along the route) and the presence of the Gault Formation (Unproductive Strata) below the site.</p>	<p>Embankments up to c. 5.0m, and cuttings up to c. 1.5m in height are these will be founded on to the Gault formation.</p> <p>A bridge is required to cross the M11. It is likely that this will be founded on deep foundations in the Gault Formation (with associated approach embankments)</p> <p>Pavements are expected to encounter the Gault Formation. However, the Chalk may be encountered in the west of this zone. Embankments which cross the boundary between these units may require a load transfer platform / ground improvement to prevent differential settlement.</p> <p>Pavements within cut may be founded directly onto the Gault Formation.</p> <p>The Gault Formation, recorded beneath the entire zone footprint, is unlikely to form a suitable medium for infiltration drainage.</p>
Zone 6	<p>Traverses the West Cambridge Site (Cambridge University), therefore Artificial Ground may be encountered. Utilises existing infrastructure along Adam's Road.</p> <p>No superficial geology is recorded at the site</p> <p>The solid geology recorded at the site consists of the Gault Formation. Potential significant risks include long term settlement / differential settlement, shrink / swell behaviour, potential aggressive ground, periglacial processes (such as shallow shear surfaces), and potential below ground obstructions such as limestone bands.</p>	<p>All risks have been assessed as very low to low, assuming standard mitigation. This is due to the lack of significant contamination source, the nature of the works (proposed earthworks and increased hardstanding cover along the route) and the presence of the Gault Formation (Unproductive Strata) below the site.</p>	<p>No significant structures or earthworks are currently proposed within this area.</p> <p>Pavements are expected to be underlain by the Gault Formation.</p> <p>The Gault Formation, recorded beneath the entire zone footprint, is unlikely to form a suitable medium for infiltration drainage.</p>
Zone 7	<p>Traverses agricultural land therefore may affect topsoil.</p> <p>The superficial geology recorded at the site consists of the Oadby Member. Risks associated with the Oadby Member include being a variable deposit leading to differential settlement, likely to be moisture sensitive, potential to contain granular beds and perched water, contain obstructions such as cobbles/boulders, and may potentially be aggressive to buried</p>	<p>All risks have been assessed as low, assuming standard mitigation. No significant sources of contamination were identified and there are no earthworks or enclosed spaces are currently proposed as part of the Park and Ride scheme (at the time of writing).</p>	<p>No significant structures or earthworks are currently proposed within this area.</p> <p>Pavements are expected to be underlain by the Oadby Member.</p> <p>Structures for the park and ride are likely to be suitable for shallow foundations in the Oadby Member.</p>

Route Zone	Geotechnical Summary	Geo-environmental Summary	Initial Engineering Summary
	infrastructure. The unit may contain periglacial features such as shallow shear surfaces.		The Oadby Member, recorded beneath the majority of the zone footprint, is unlikely to form a suitable medium for infiltration drainage
Zone 8	Traverses agricultural land therefore may affect topsoil. The superficial geology recorded at the site consists of the Oadby Member. Risks associated with the Oadby Member include being a variable deposit leading to differential settlement, likely to be moisture sensitive, potential to contain granular beds and perched water, contain obstructions such as cobbles/boulders, and may potentially be aggressive to buried infrastructure. The unit may contain periglacial features such as shallow shear surfaces.	All risks have been assessed as low, assuming standard mitigation. No significant sources of contamination were identified and there are no earthworks or enclosed spaces proposed along the route.	No significant structures or earthworks expected Pavements are expected to be underlain by the Oadby member. The Oadby Member, recorded beneath the majority of the zone footprint, is unlikely to form a suitable medium for infiltration drainage.

7.1.1 Recommendations

The following recommendations have been made with regards to the requirement for further mitigation measures based on the risks identified for both the route zones and the Park and Ride location option.

- A ground investigation should be designed to identify the variability in the ground and groundwater conditions. Geotechnical testing should also be undertaken to assess variations in the geotechnical properties of the units likely to be encountered. This should be completed prior to design. It is key to ascertain the presence, thickness properties of any Made Ground, the properties of which are unknown. The variability, weathering profile and properties of the Oadby Member, as well as the West Melbury Marly Chalk Formation and Gault Formation should also be determined;
- It is recommended that a natural and man-made cavity search is completed for the site based on a number of man-made (and potential presence of natural cavities) recorded in close proximity to the site;
- An assessment on the presence of contamination within the soils and groundwater at the site should be undertaken as part of any GI works specifically in zones where contamination sources have been identified. This will confirm the findings of the risk assessment and provide information on the potential for material re-use within the scheme;
- Monitoring of groundwater levels during and after GI should be undertaken in order to determine whether dewatering and drainage will be necessary;
- Gas monitoring should be undertaken if enclosed structures are proposed, such as the Park and Ride site;
- Chemical testing should be conducted as part of the GI to understand how aggressive the ground conditions are. Where the ground is found to be aggressive, lime treatment may be needed to reduce the pH of the soil and reduce the sulphate concentrations;
- If material reuse is proposed, this should be done under an appropriate regulatory regime which may include a waste exemption, environmental permit or Materials Management Plan. If disposal of excess material is required, this should be discussed with a waste carrier.
- Carry out a Detailed UXO Risk Assessment for Zones 1 – 2 (area identified as High risk), to better quantify the risk to the proposed works and any proposed ground investigation works; and,
- Carry out an Agricultural Land Classification (ALC) and Soil Resource Survey (SRS) to understand the impact of works upon the current Topsoil resource.

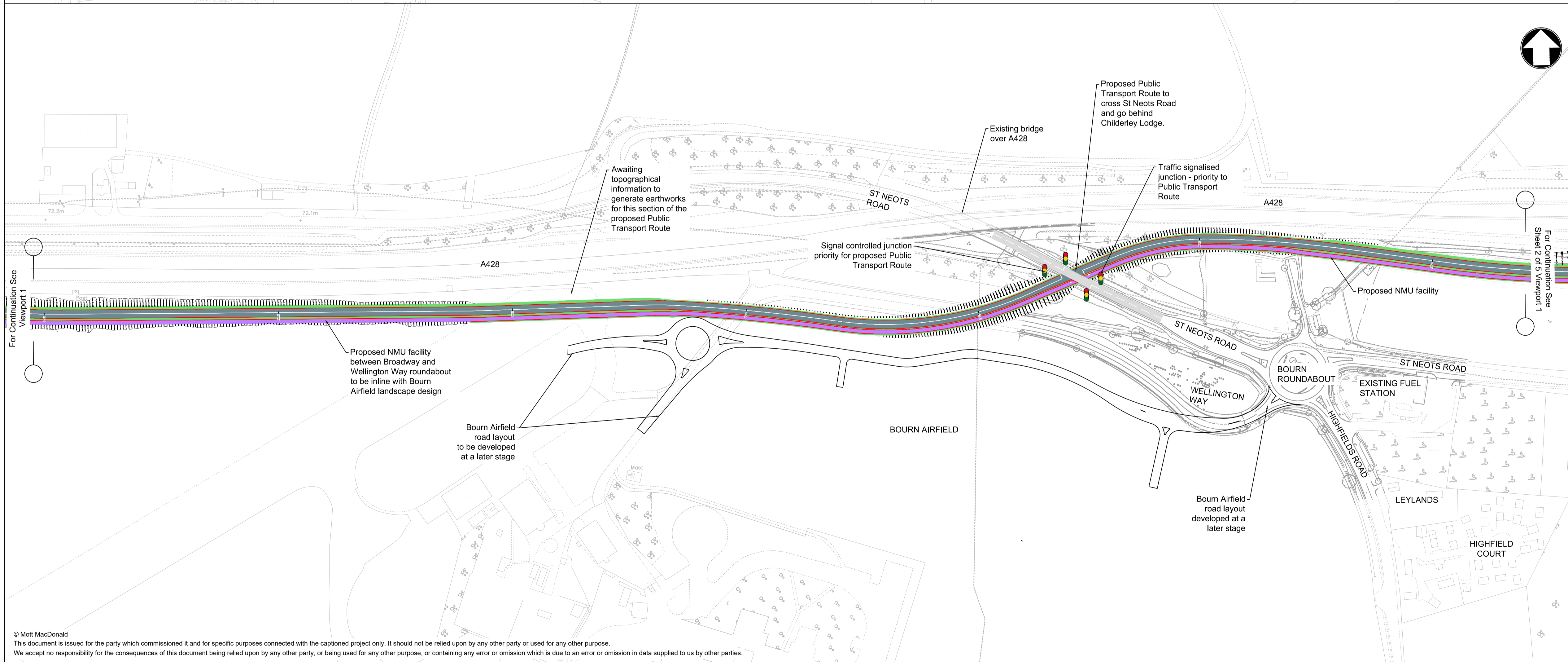
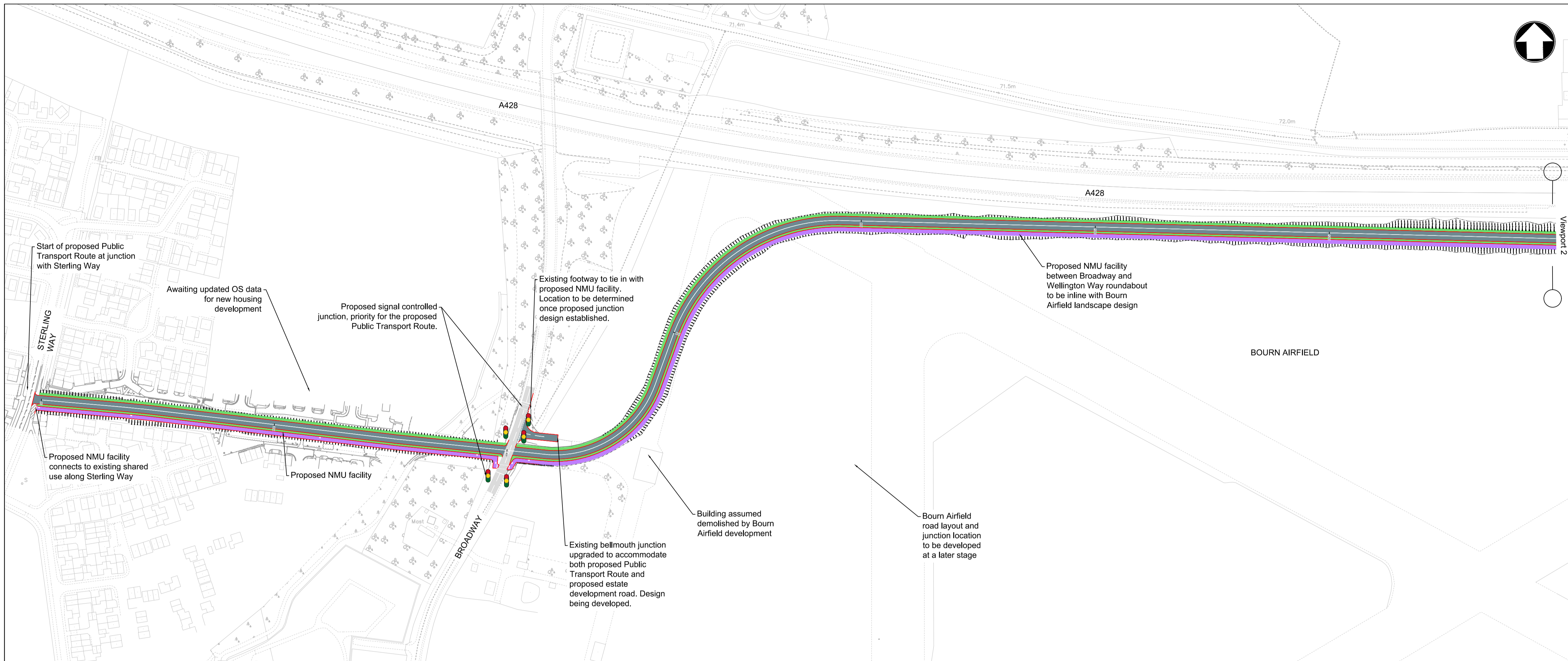
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Appendices

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A. Overall Scheme Drawings



Notes

- Route options shown indicatively and subject to further design.
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- Dimensions are in metres unless stated otherwise.
- These drawings are solely for the purpose of an Outline Business Case submission and not for construction.

Key to Symbols

- Proposed 3.0 - 3.5m non motorised user (NMU) facility
- Proposed 7.3m wide Public Transport Route (PTR)
- Kerbline
- Existing cycle/footpath (segregated from carriageway)
- Existing carriageway
- Existing shared use facility
- Proposed verge
- Proposed traffic signals
- Existing Footway only

Scale: 1:2000

Reference drawings

- This drawing is based on survey data 1378_P_3_Site from 40-7 Ltd. Survey date 03 / 2018

Rev	Date	Drawn	Description	SJ	AJ
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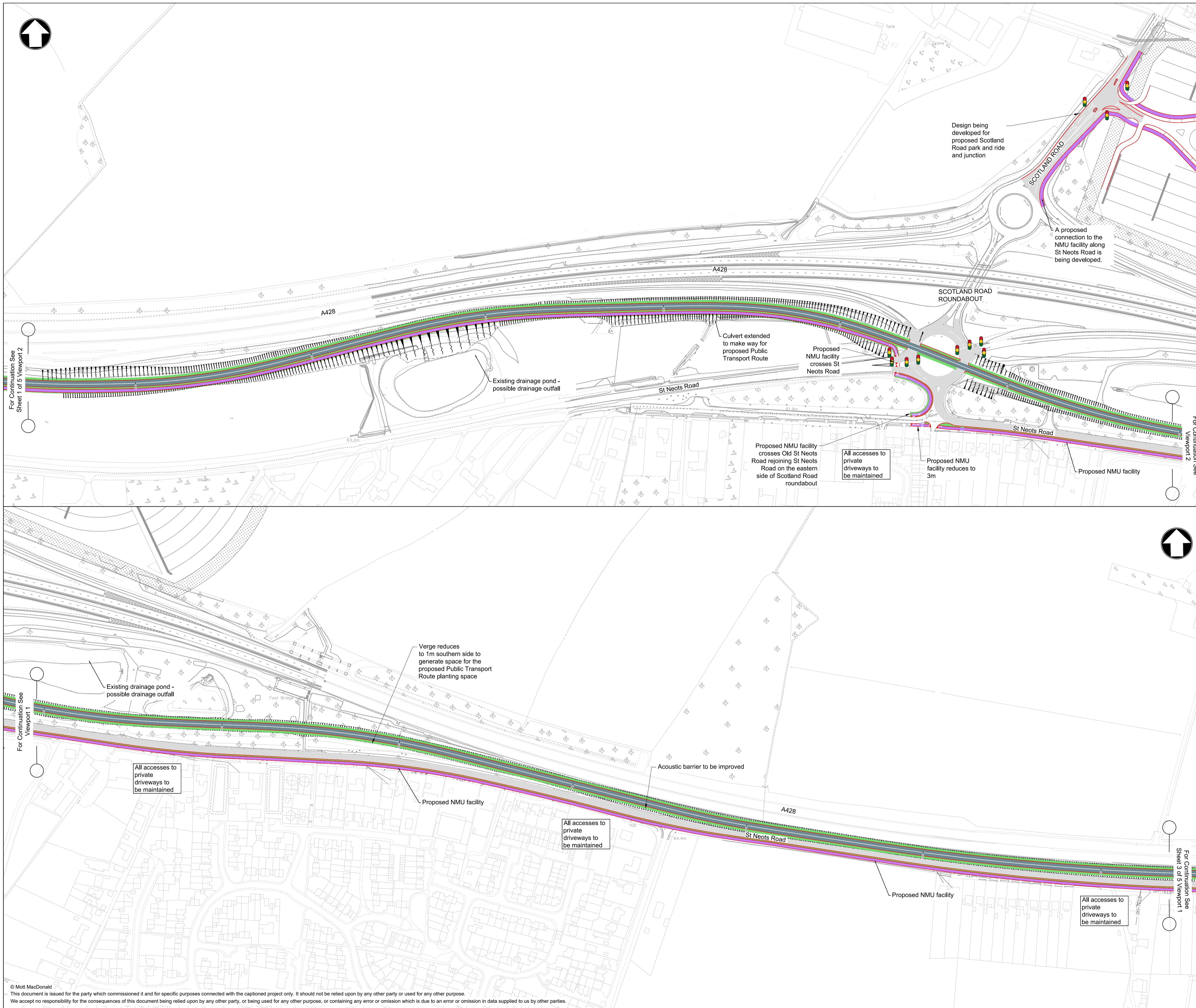
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Title

**Cambridge to Cambridge (C2C)
Outline Business Case (OBC)
General Arrangement
Sheet 1 of 5**

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Dwg check	S Jarvis	09/19	Approved	A Jackson	09/19
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- Existing carriageway
- Existing shared use facility
- Proposed verge
- Proposed traffic signals
- Existing Footway only

Reference drawings

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General Arrangement
Sheet 2 of 5

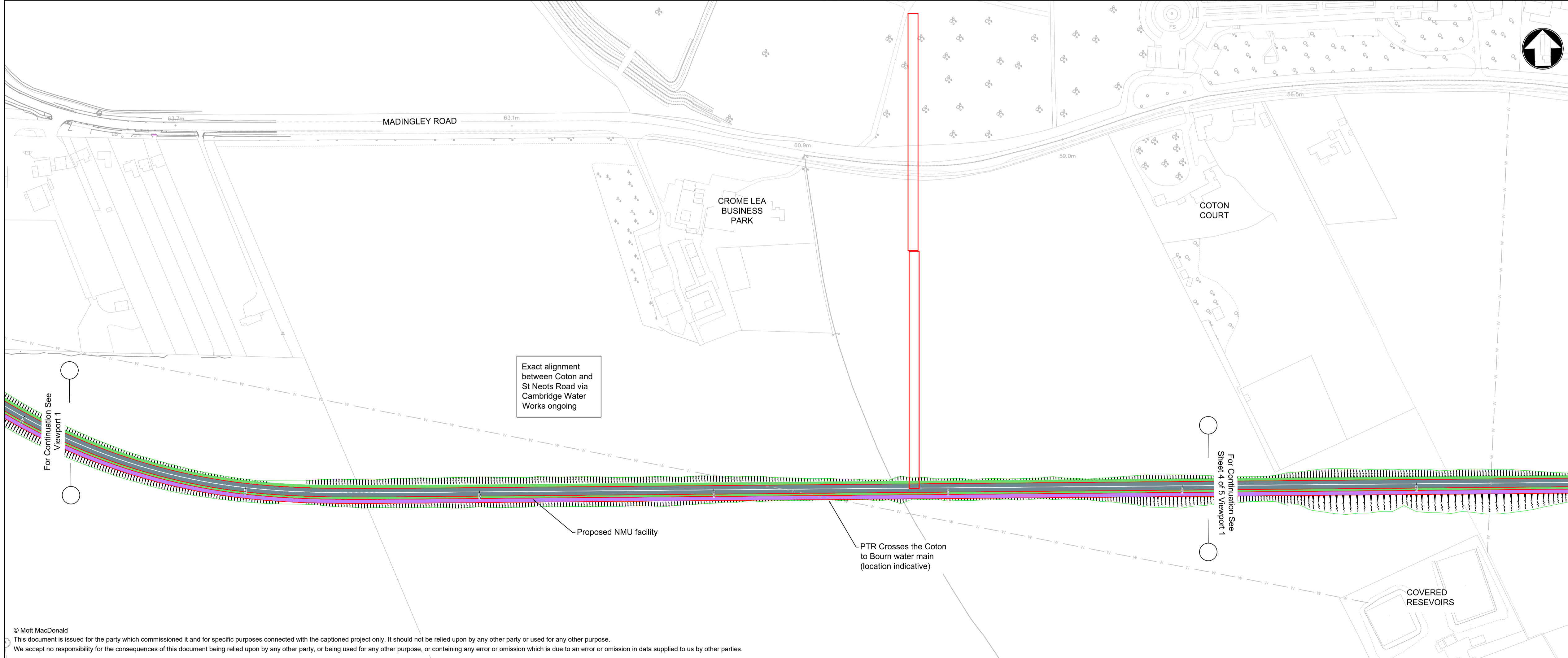
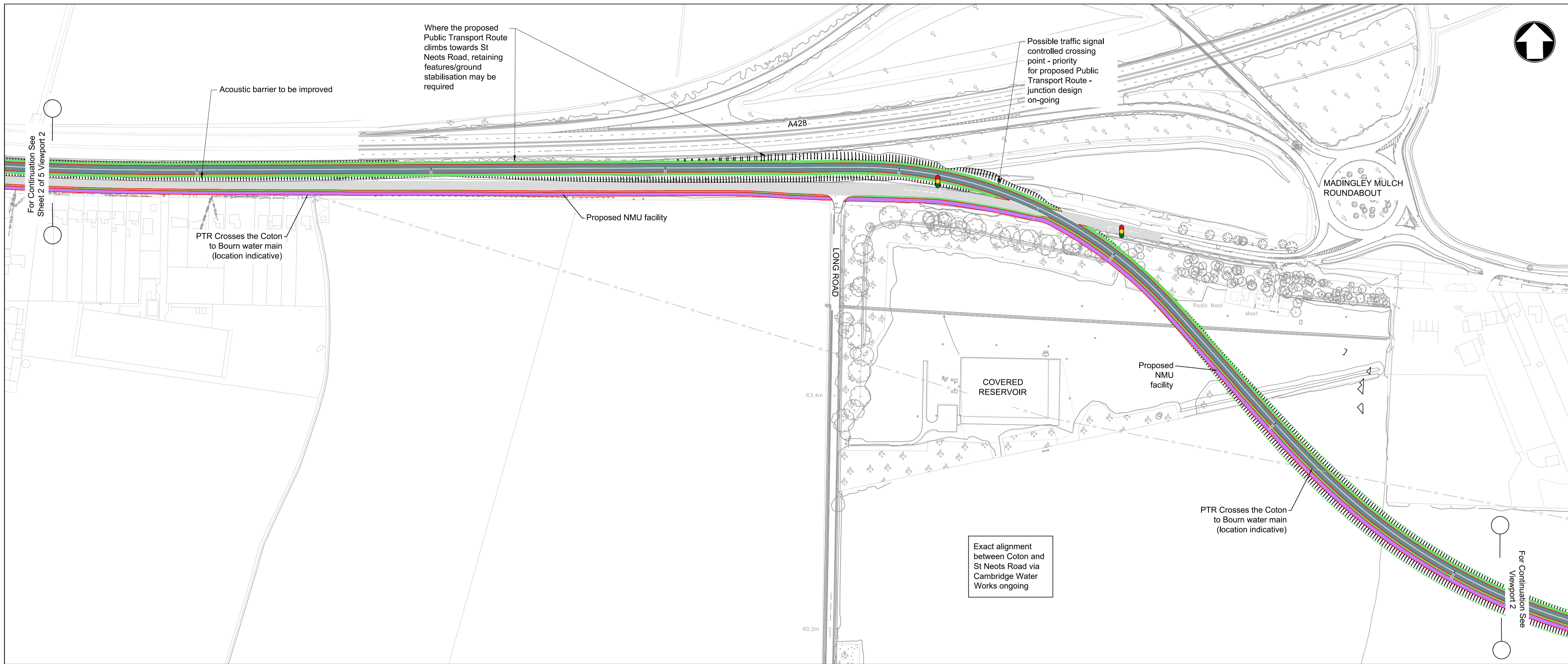
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- Existing carriageway
- Existing shared use facility
- Proposed verge
- Proposed traffic signals
- Existing Footway only
- Existing services - water main

1:2000 0 100m 200m

Reference drawings

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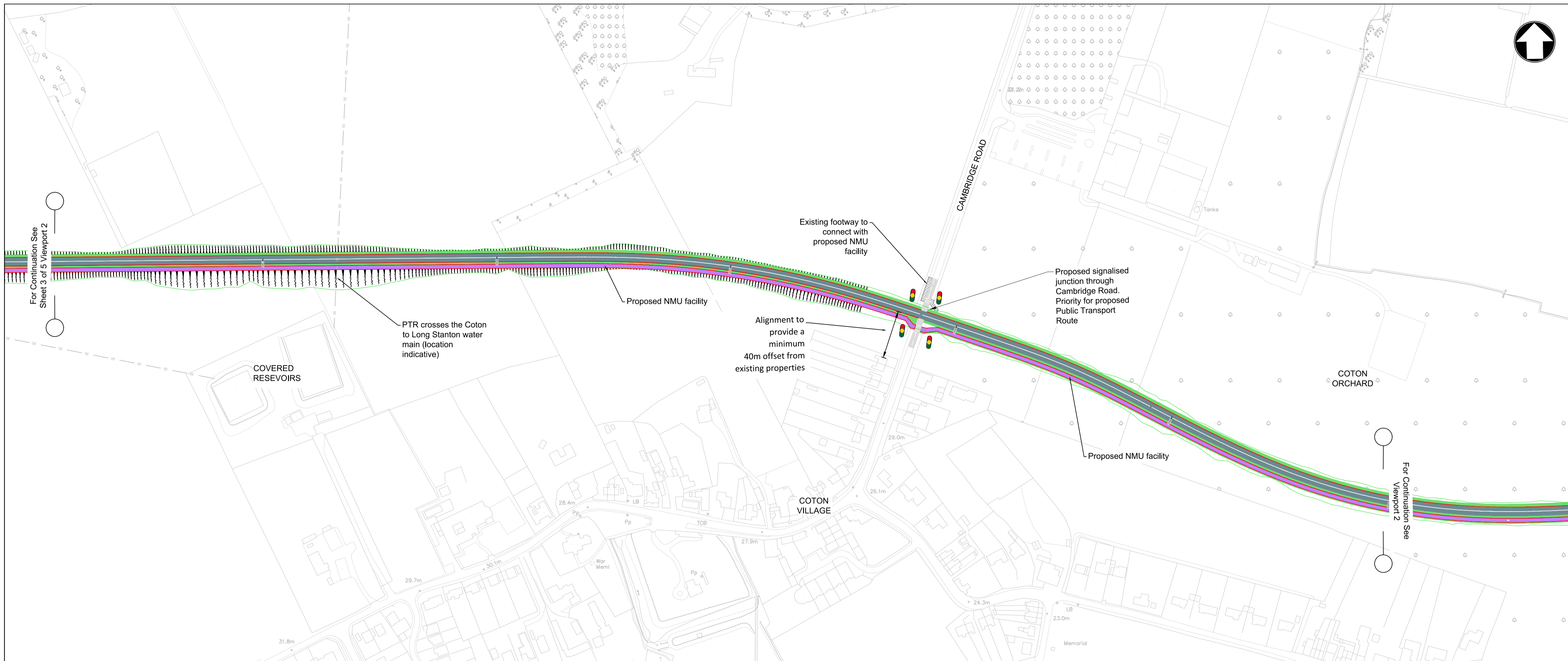
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 General Arrangement
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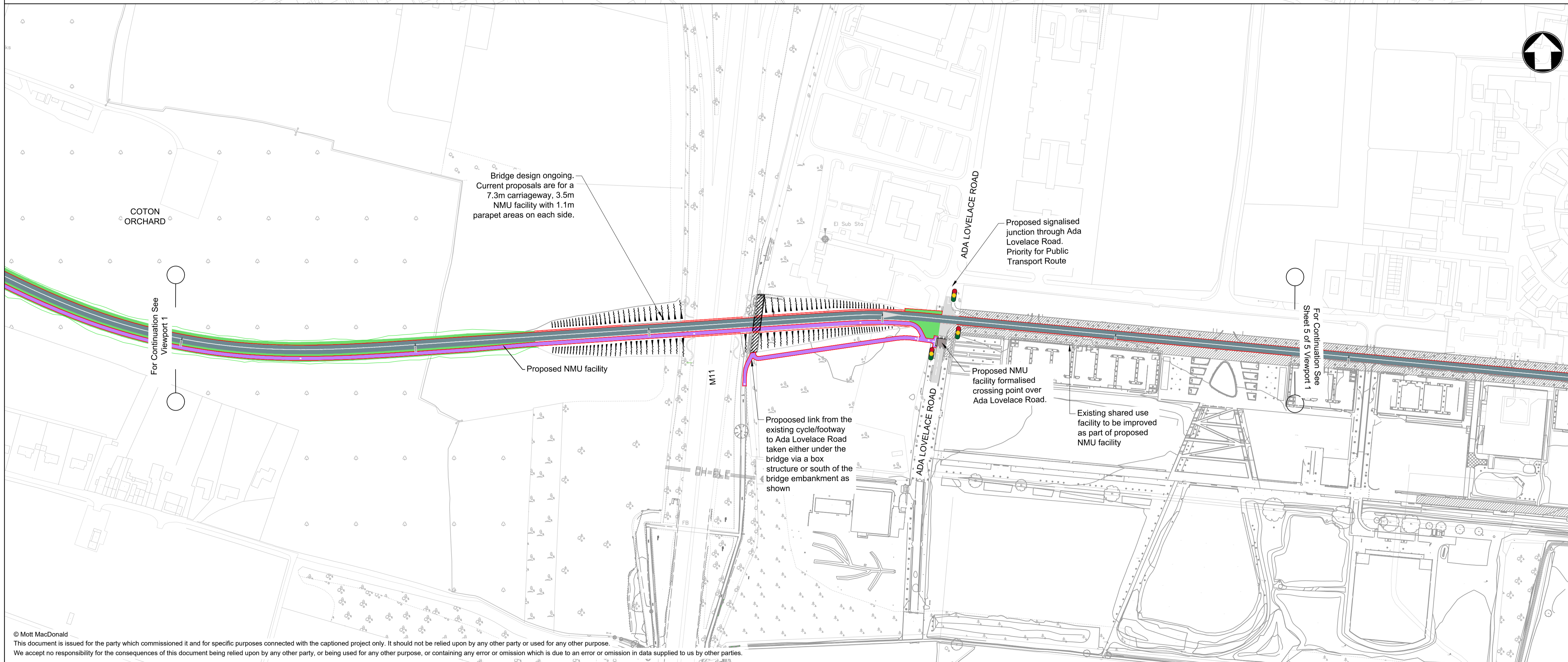
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- Proposed 7.3m wide Public Transport Route (PTR)
- Kerbline
- Existing cycle/footpath (segregated from carriageway)
- Existing carriageway
- Existing shared use facility
- Proposed verge
- Proposed traffic signals
- Existing Footway only
- Existing services - water main

Reference drawings

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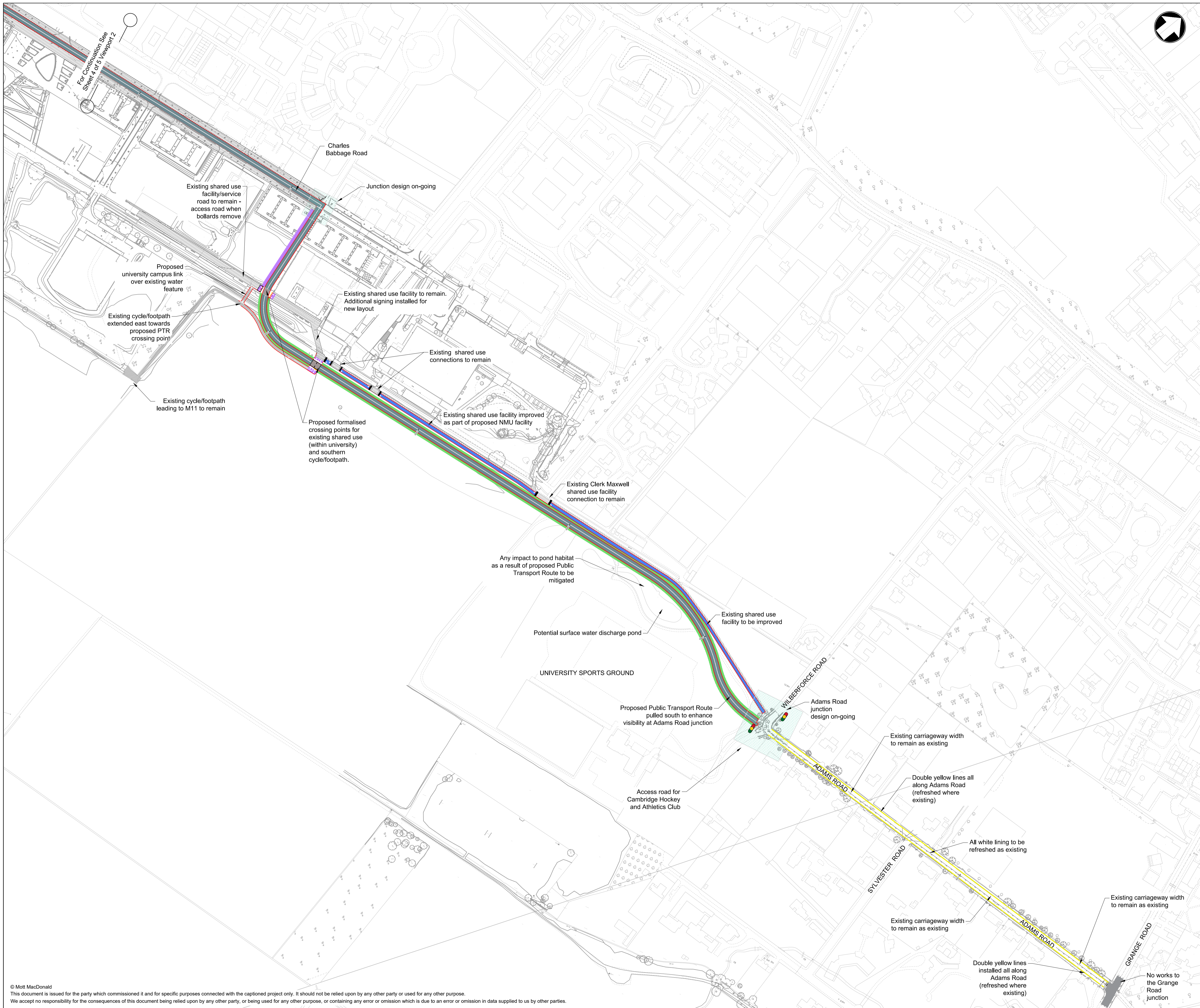
**Camborne To Cambridge (C2C)
Outline Business Case (OBC)
General Arrangement
Sheet 4 of 5**

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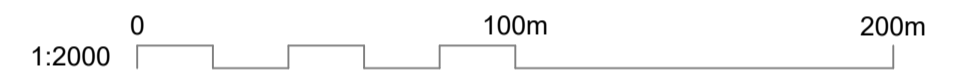
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- Key to Symbols
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 - Proposed 7.3m wide Public Transport Route (PTR)
 - Kerbline
 - Existing cycle/footpath (segregated from carriageway)
 - Existing carriageway
 - Existing shared use facility
 - Proposed verge
 - Proposed traffic signals
 - Proposed/existing yellow lining
 - Junction to be confirmed once all options have been assessed.
 - Existing cycle lane only
 - Existing Footway only (adjacent carriageway)



Reference drawings

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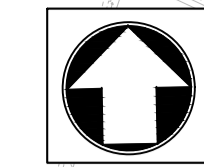
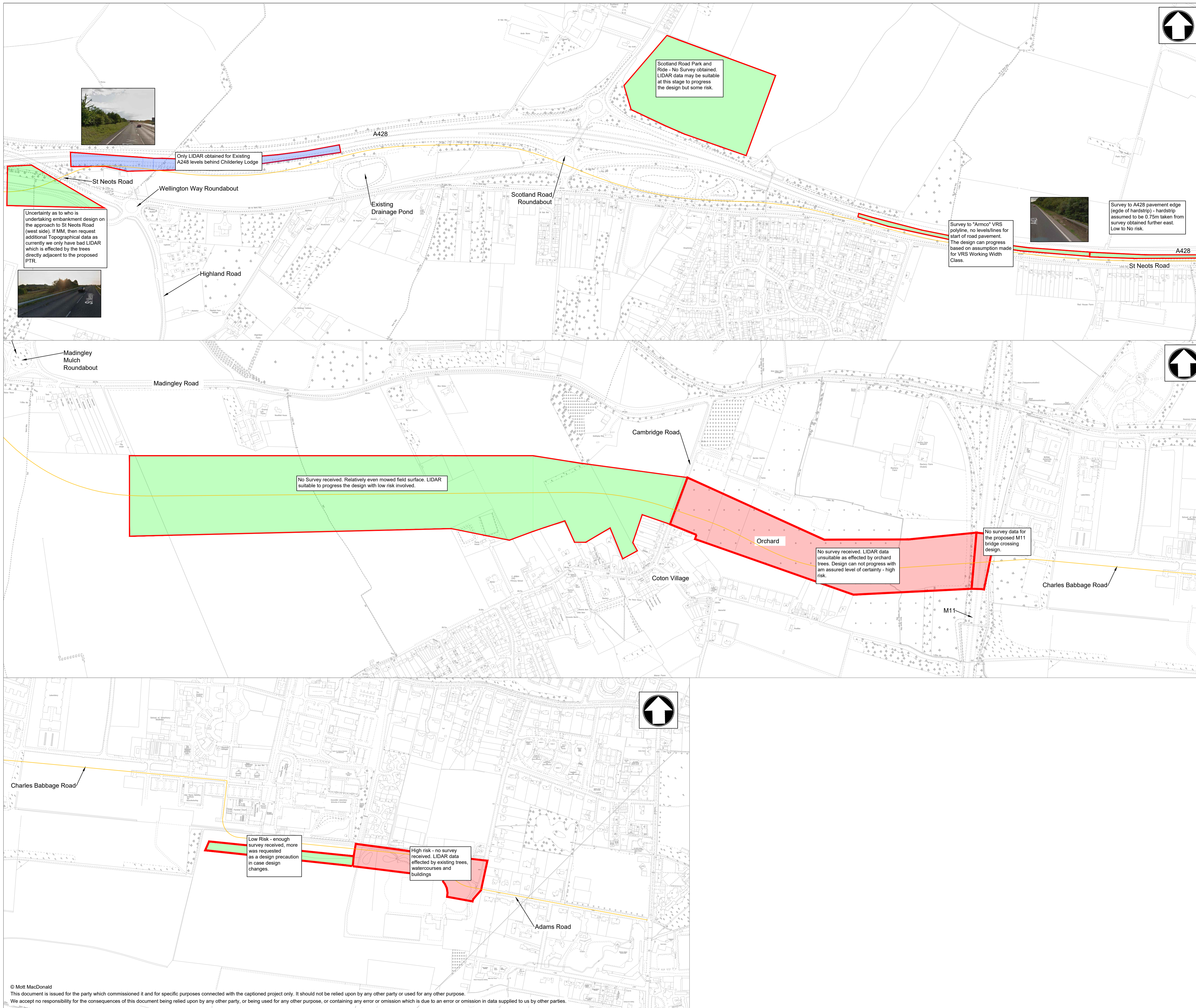
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Title
**Camborne To Cambridge (C2C)
Outline Business Case (OBC)
General Arrangement
Sheet 5 of 5**

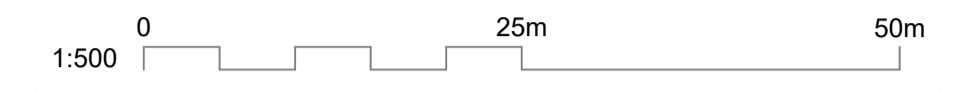
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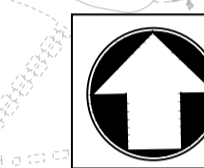
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3. These drawings are not for construction.
4. Where no hatching is shown then the designer feels adequate survey has been obtained to safely progress the design.



Key to symbols

- High Risk - lack of topographical data preventing design from progressing
- Medium Risk - Design ok to proceed with medium risk involved.
- Low Risk - Design ok to proceed with low risk involved.
- Proposed public transport route (PTR)



Reference drawings

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Title
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 Topographical Risk Plan

Designed	J Reeve	JR	Eng check	S Jarvis	SJ
Drawn	J Reeve	JR	Coordination	A Jackson	AJ
Dwg check	S Jarvis	SJ	Approved	A Jackson	AJ
Scale at A1	Status	Rev	Security		
1:500	SK	P1	STD		

Drawing Number
392438-MMD-XX-C-SK-0020



Scotland Road - Survey received from client only within highway boundary. No survey obtained in the farmers field where the NMU is currently proposed. LIDAR data may be suitable at this stage to progress the design but likely effected by the field boundary vegetation.

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0 25m 50m
1:500

Key to symbols

- High Risk - lack of topographical data preventing design from progressing
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- Low Risk - Design ok to proceed with low risk involved.
- Proposed public transport route (PTR)

Reference drawings

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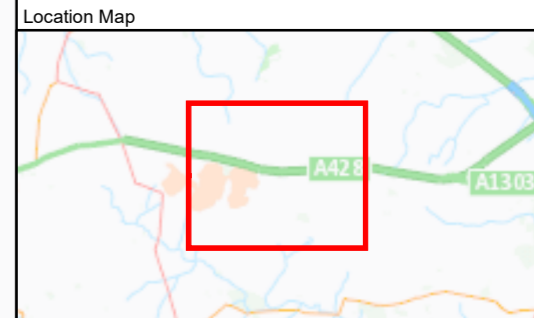
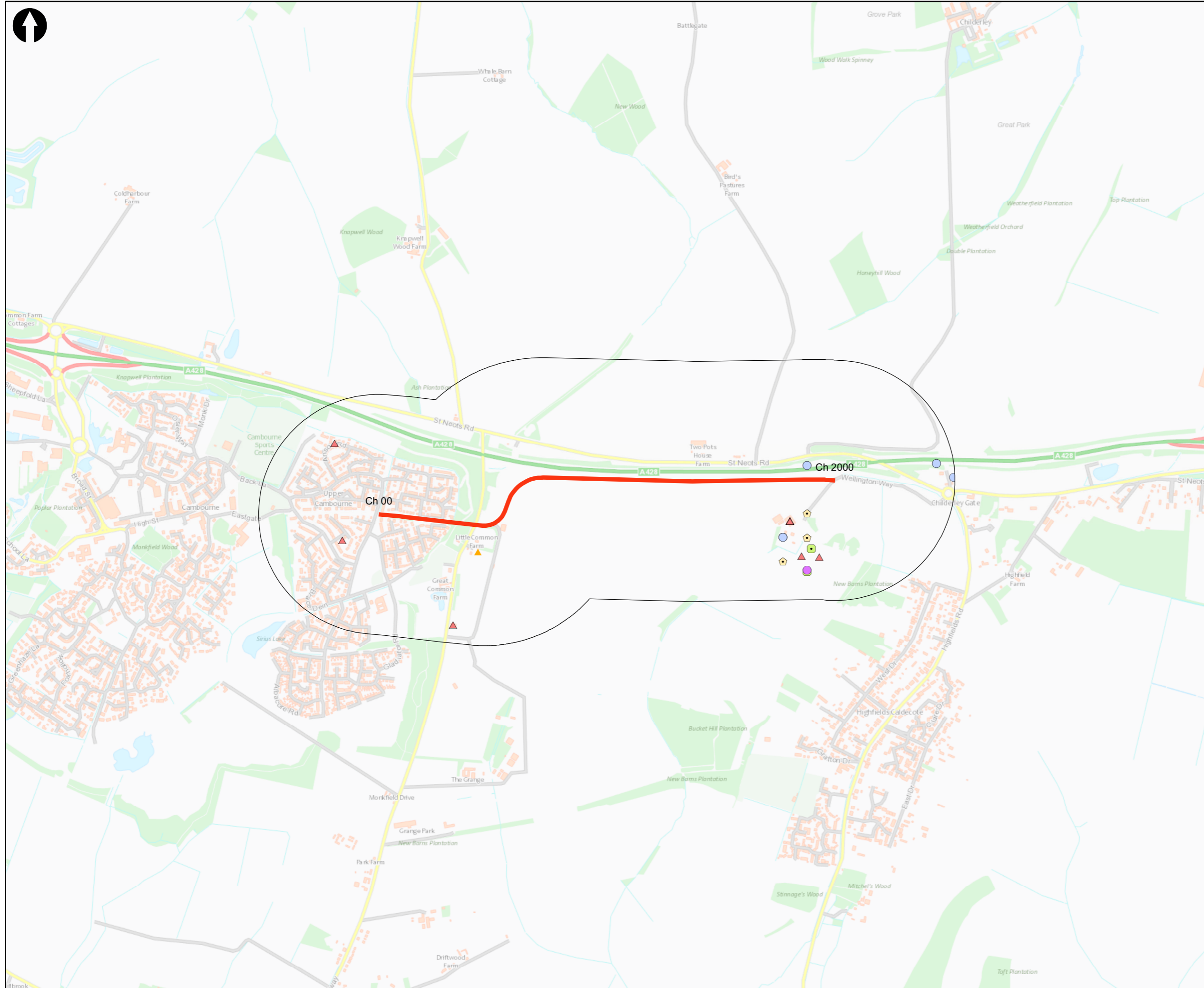
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**Camborne To Cambridge (C2C)
Topographical Survey Risk Plan
Sheet 2 of 2**

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Dwg check	S Jarvis	SJ	Approved	A Jackson	AJ
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				Security	STD

Drawing Number
392438-MMD-XX-C-SK-0021

B. Environmental Record Drawings



Key to Symbols

- Route Zone 1 Centreline
- Route Zone 1 Centreline 500m Buffer
- Registered radioactive substances
- Explosive sites
- Substantiated pollution incident register
- Potentially infilled land
- Pollution incidents to controlled waters
- Notification of installations handling hazardous substances
- ▲ Man made mining activities
- Local nature reserves
- Local authority pollution prevention and controls
- ▲ Liscensed waste management facilities
- Groundwater and surface water abstractions
- Fuel station entries
- ▲ Extractive industries
- Discharge consents
- ▲ Contemporary trade directory entries
- BGS Mineral Sites

Notes

Location of features shown is approximate only.

Contains data extracted from Landmark Envirocheck Report Refs 236185287_1_1, and 236185392_1_1.

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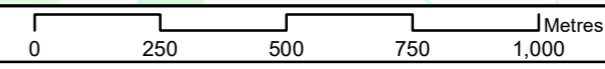
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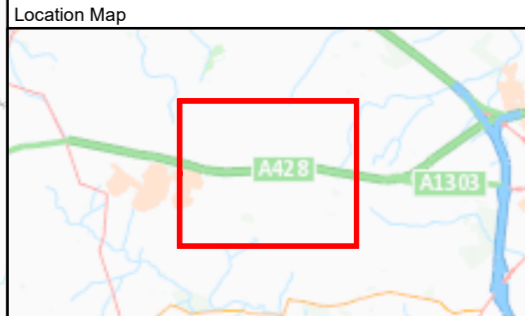
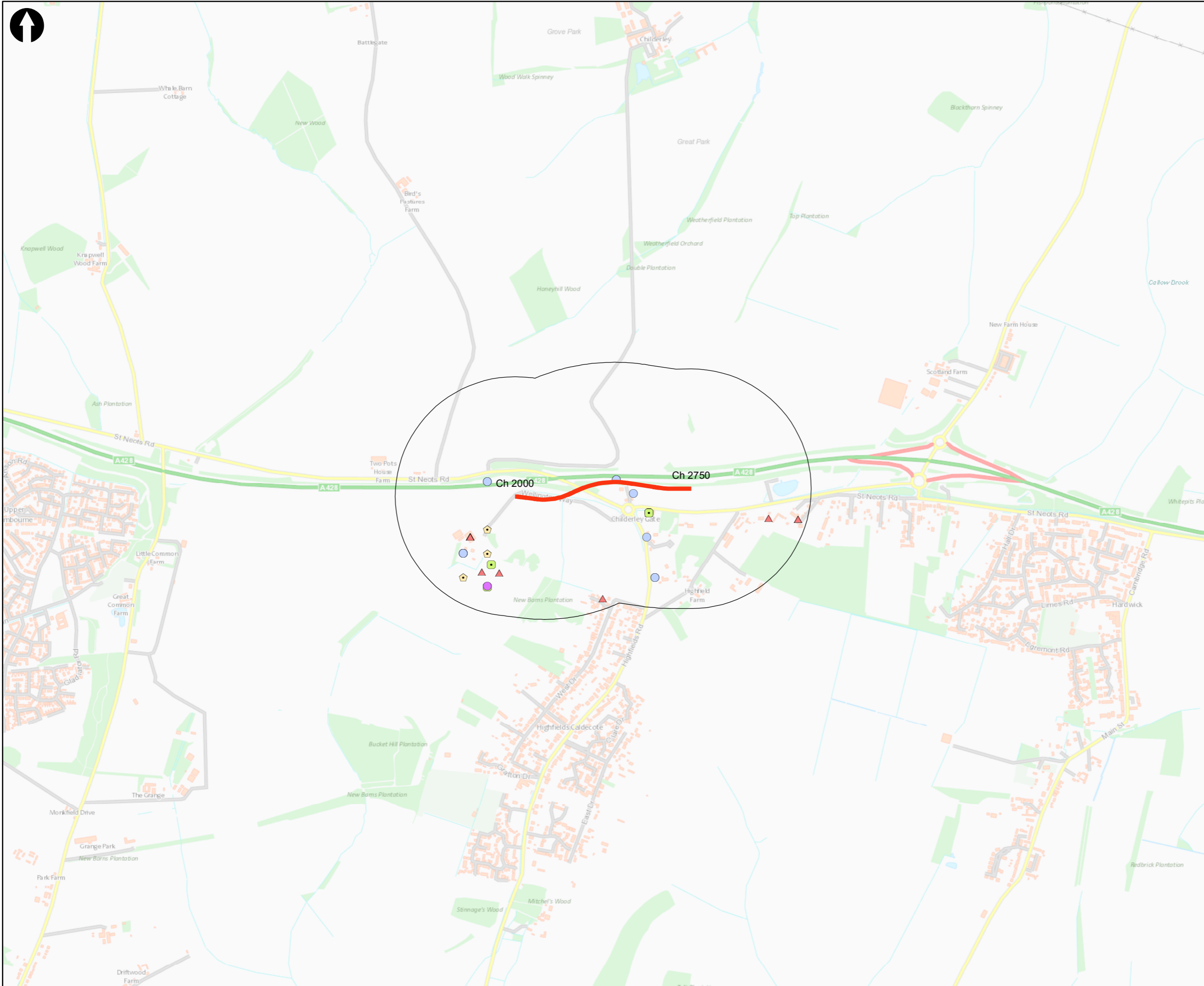
Title
Cambourne to Cambridge
Geotechnical and Geo-environmental
Preliminary Risk Assessment
Route Zone 1
Environmental Constraints Plan

Designed	P Fitt	Eng Check	M Gipson	
Drawn	P Fitt	Coordination	-	
GIS Check	T Graham	Approved	-	
Scale at A3	Status	Rev	Security	
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Drawing Number
392438-MMD-GIS-XX-DR-GEO-0001



Key to Symbols

- Route Zone 2 Centreline
- Route Zone 2 Centreline 500m Buffer
- Pollution incidents to controlled waters
- Notification of installations handling hazardous substances
- Local authority pollution prevention and controls
- Fuel station entries
- Discharge consents
- Contemporary trade directory entries

Notes

Location of features shown is approximate only.

Contains data extracted from Landmark Envirocheck Report Refs 236185287_1_1, and 236185392_1_1.

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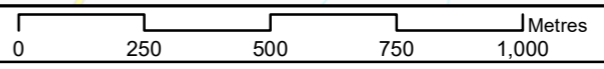
Client

GREATER CAMBRIDGE PARTNERSHIP

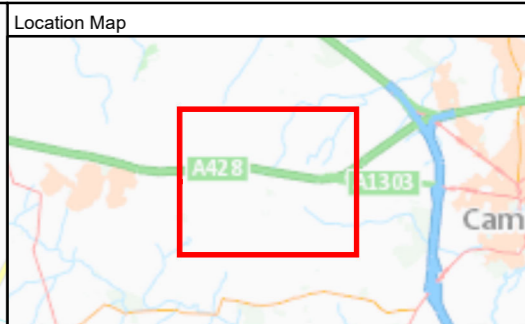
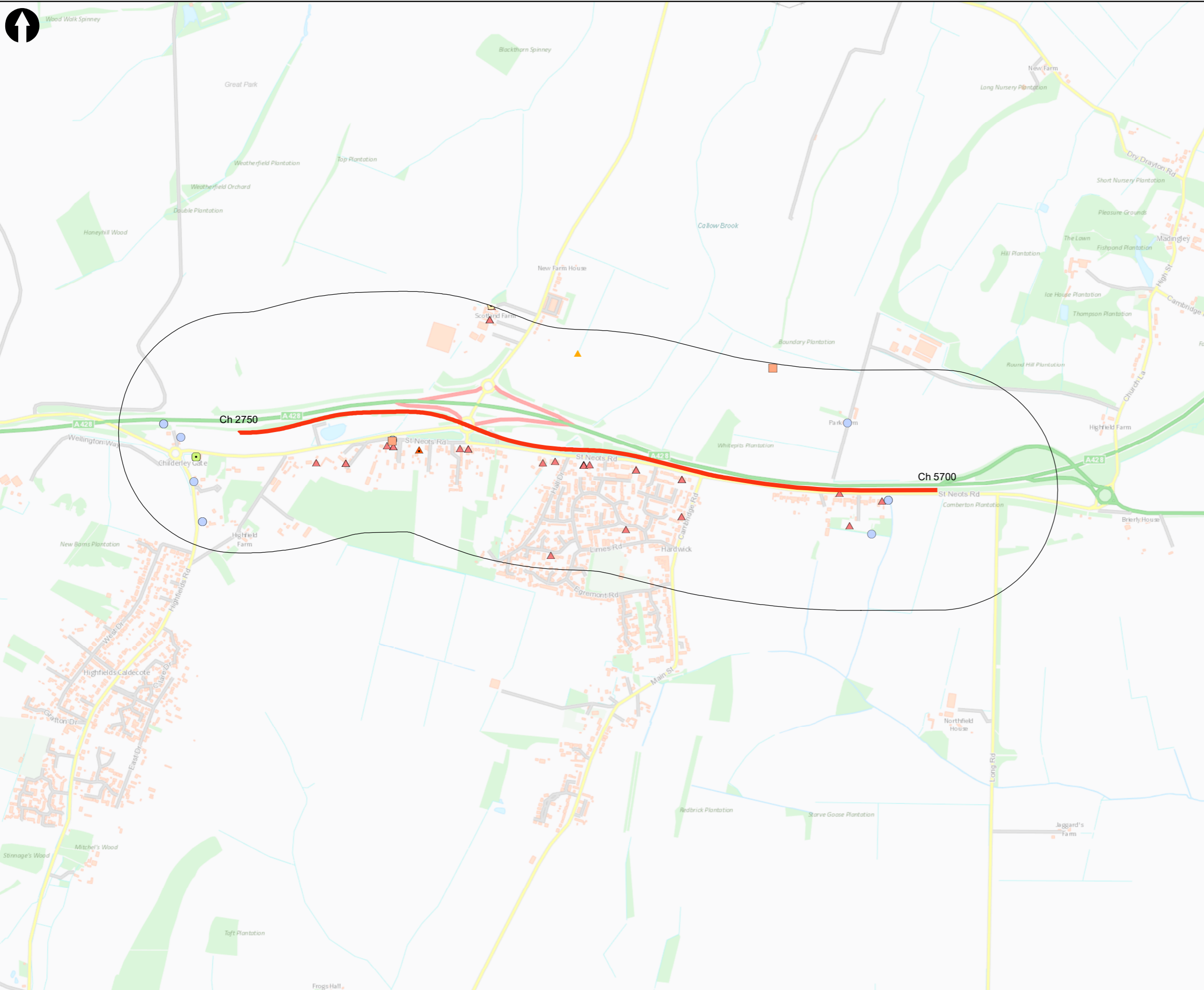
Title
**Cambourne to Cambridge
Geotechnical and Geo-environmental
Preliminary Risk Assessment
Route Zone 2
Environmental Constraints Plan**

Designed	P Fitt	Eng Check	M Gipson
Drawn	P Fitt	Coordination	-
GIS Check	T Graham	Approved	-
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Drawing Number
392438-MMD-GIS-XX-DR-GEO-0002



Key to Symbols

- Route Zone 3 Centreline
- Route Zone 3 Centreline 500m Buffer
- Substantiated pollution incident register
- Pollution incidents to controlled waters
- Local authority pollution prevention and controls
- ▲ Licenced waste management facilities
- Fuel station entries
- ▲ Extractive industries
- Discharge consents
- ▲ Contemporary trade directory entries

Notes

Location of features shown is approximate only.

Contains data extracted from Landmark Envirocheck Report Refs 236185287_1_1, and 236185392_1_1.

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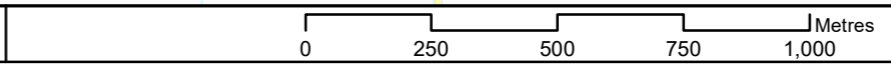
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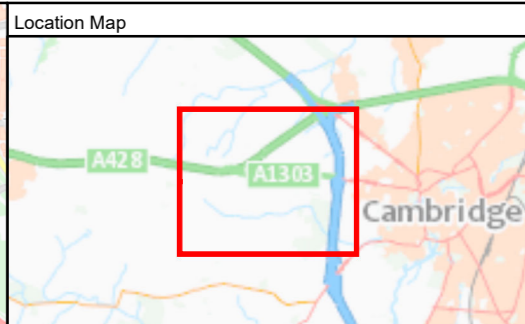
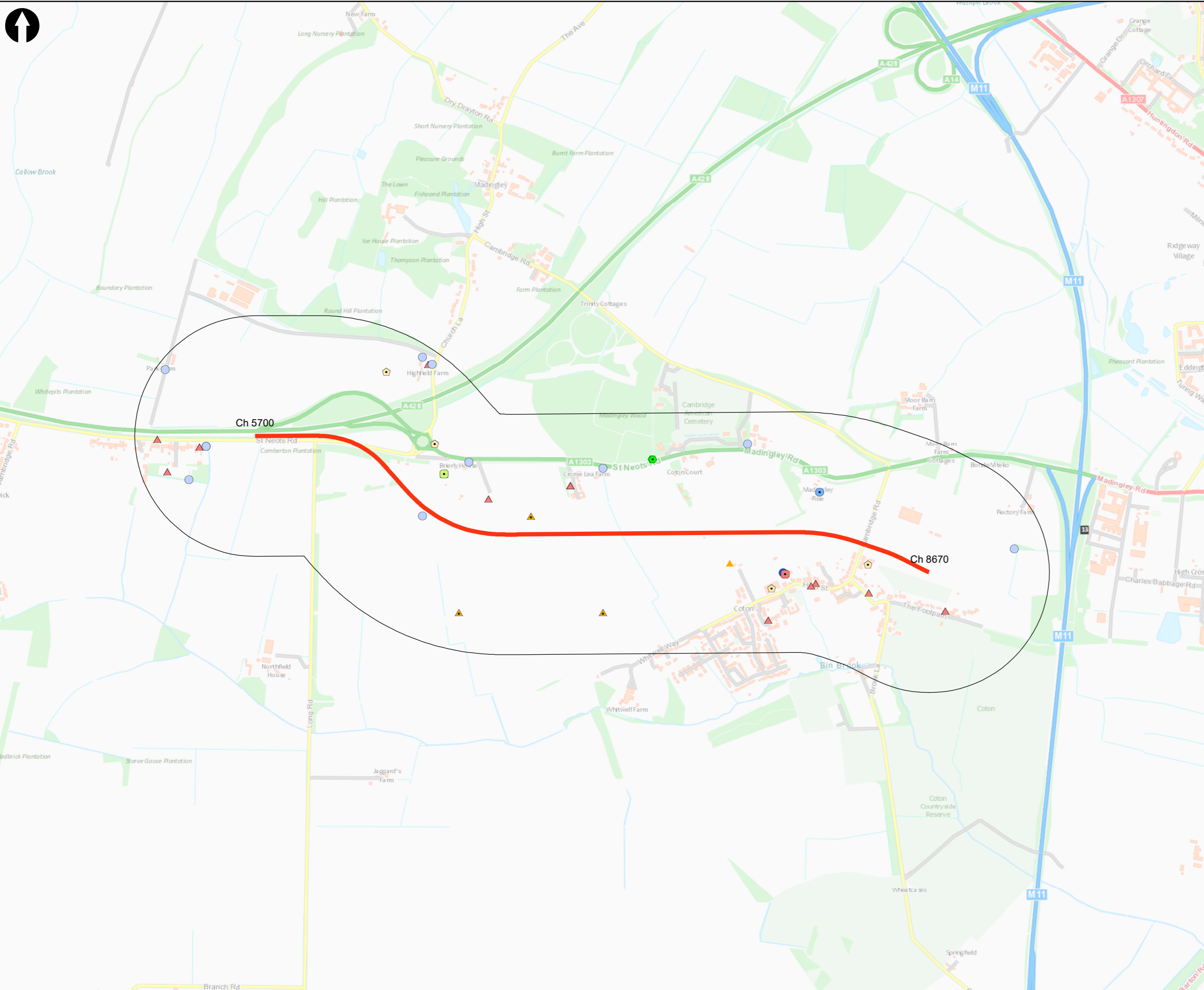
Title
 Cambourne to Cambridge
 Geotechnical and Geo-environmental
 Preliminary Risk Assessment
 Route Zone 3
 Environmental Constraints Plan

Designed	P Fitt	Eng Check	M Gipson		
Drawn	P Fitt	Coordination	-		
GIS Check	T Graham	Approved	-		
Scale at A3	Status	Rev	Security		
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Drawing Number
392438-MMD-GIS-XX-DR-GEO-0003



Key to Symbols

- Potentially infilled land
- ⬠ Pollution incidents to controlled waters
- ▲ Man made mining activities
- Local nature reserves
- Local authority pollution prevention and controls
- Groundwater and surface water abstractions
- ▲ Extractive industries
- Discharge consents
- ▲ Contemporary trade directory entries
- BGS Mineral Sites

Notes

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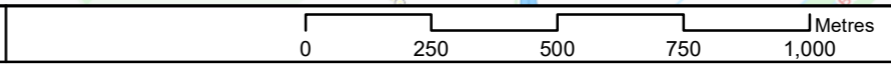
GREATER CAMBRIDGE PARTNERSHIP

Title

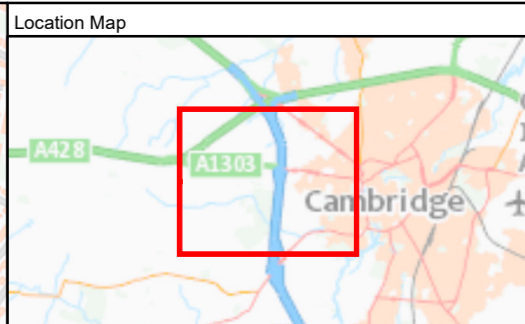
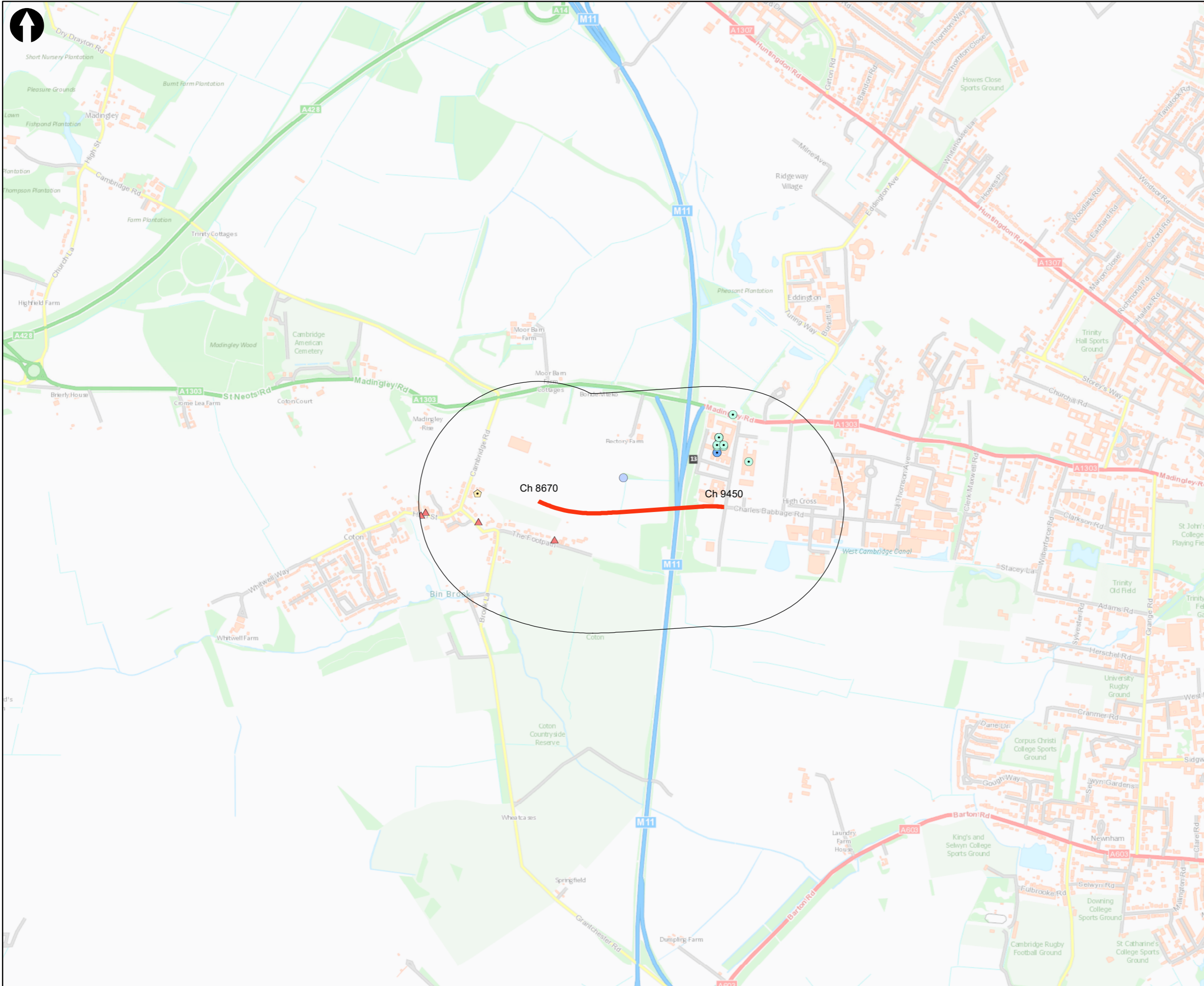
Cambourne to Cambridge
 Geotechnical and Geo-environmental
 Preliminary Risk Assessment
 Route Zone 4
 Environmental Constraints Plan

Designed	P Fitt	Eng Check	M Gipson
Drawn	P Fitt	Coordination	-
GIS Check	T Graham	Approved	-
Scale at A3	Status	Rev	Security
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Drawing Number
392438-MMD-GIS-XX-DR-GEO-0002



Key to Symbols

- Route Zone 5 Centreline
- Route Zone 5 Centreline 500m Buffer
- Registered radioactive substances
- ⬠ Pollution incidents to controlled waters
- Groundwater and surface water abstractions
- Discharge consents
- ▲ Contemporary trade directory entries

Notes

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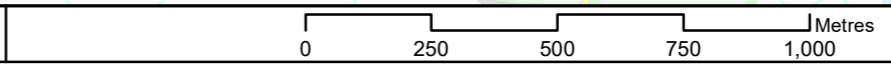
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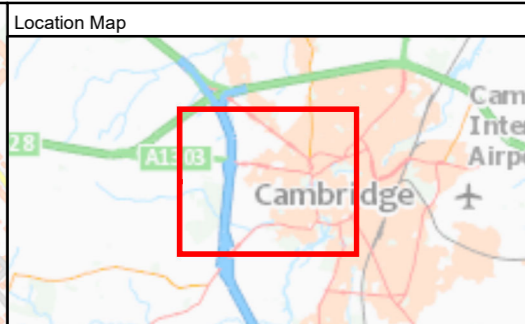
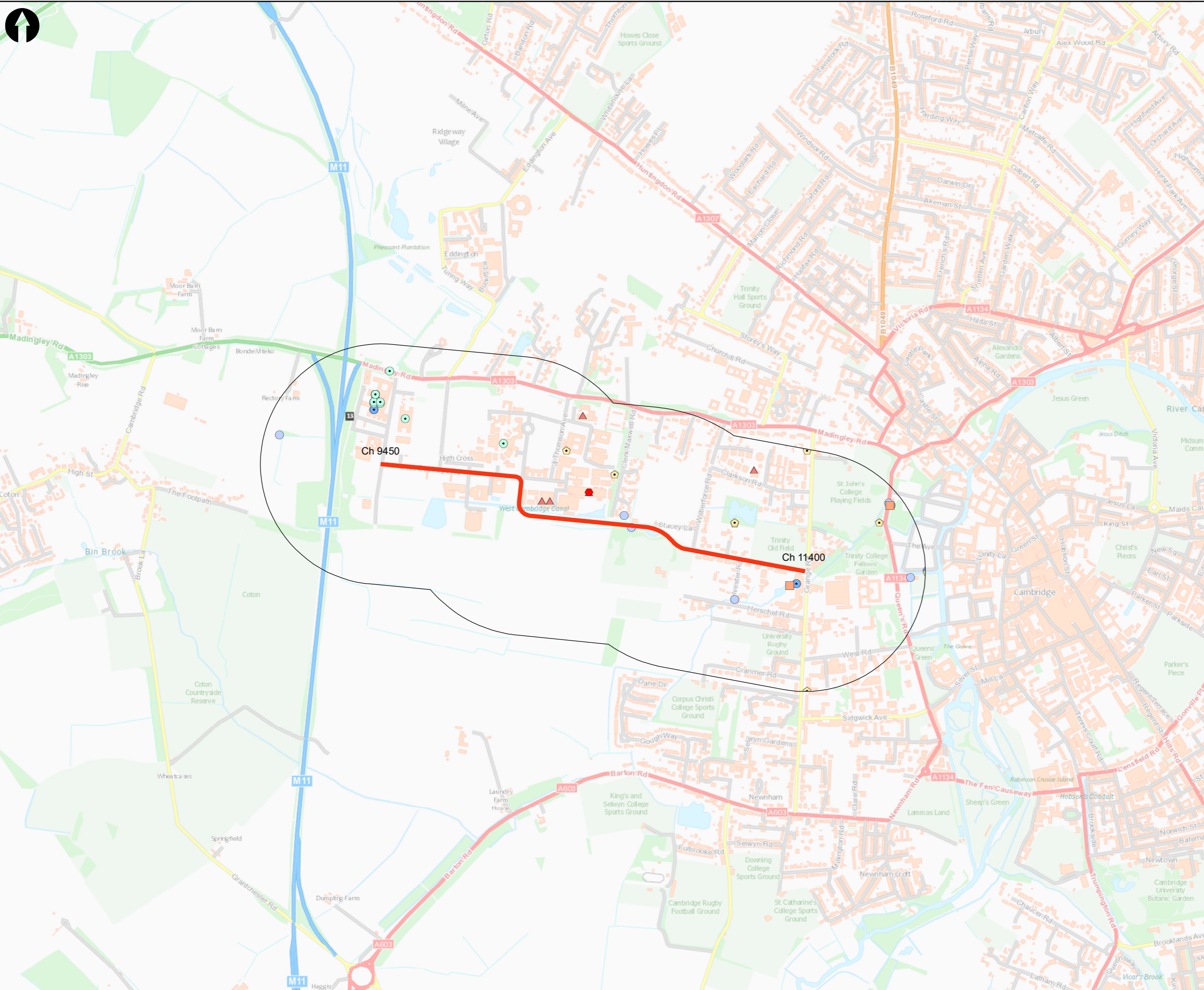
Title
 Cambourne to Cambridge
 Geotechnical and Geo-environmental
 Preliminary Risk Assessment
 Route Zone 5
 Environmental Constraints Plan

Designed	P Fitt	Eng Check	M Gipson
Drawn	P Fitt	Coordination	-
GIS Check	T Graham	Approved	-
Scale at A3	Status	Rev	Security
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Drawing Number
 392438-MMD-GIS-XX-DR-GEO-0005



Key to Symbols

- Route Zone 6 Centreline
- Route Zone 6 Centreline 500m Buffer
- Registered radioactive substances
- Explosive sites
- Substantiated pollution incident register
- Pollution incidents to controlled waters
- Groundwater and surface water abstractions
- Discharge consents
- ▲ Contemporary trade directory entries

Notes

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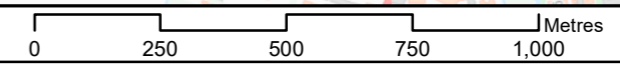


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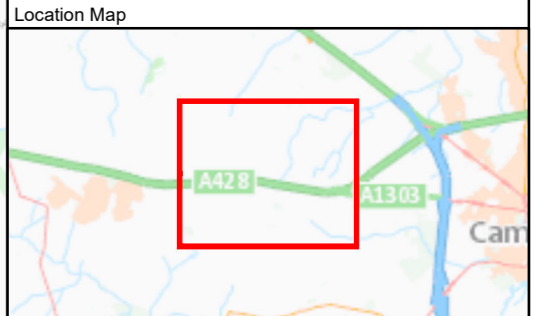
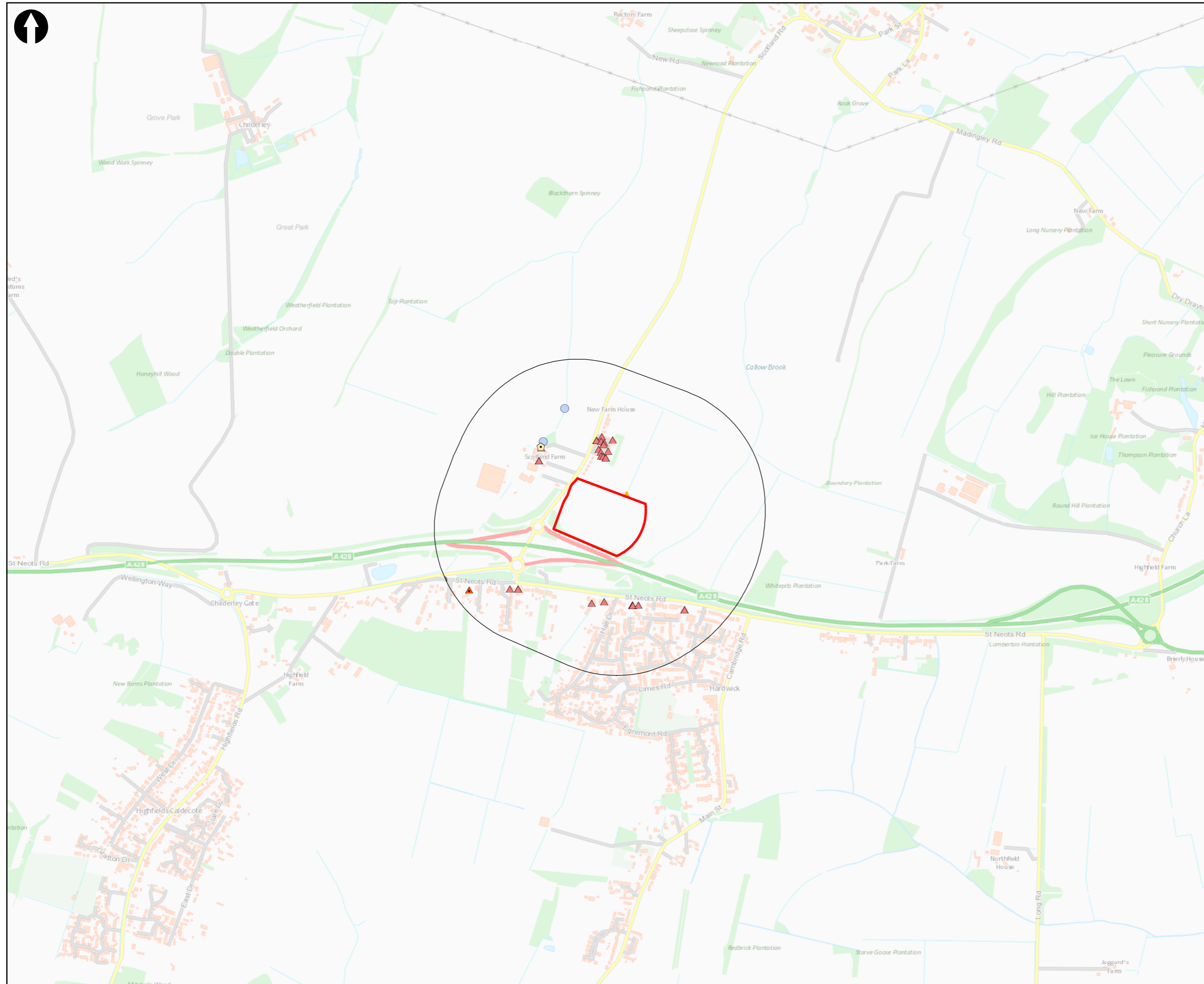
Cambridge to Cambridge
 Geotechnical and Geo-environmental
 Preliminary Risk Assessment
 Route Zone 6
 Environmental Constraints Plan

Designed	P Fitt	Eng Check	M Gipson
Drawn	P Fitt	Coordination	-
GIS Check	T Graham	Approved	-
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Drawing Number
 392438-MMD-GIS-XX-DR-GEO-0006



Key to Symbols

- Route Zone 7
- Route Zone 7 500m Buffer
- Substantiated pollution incident register
- Pollution incidents to controlled waters
- Licenced waste management facilities
- Extractive industries
- Discharge consents
- Contemporary trade directory entries

Notes

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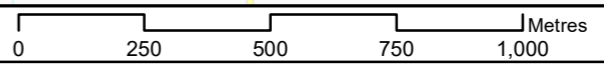


Title

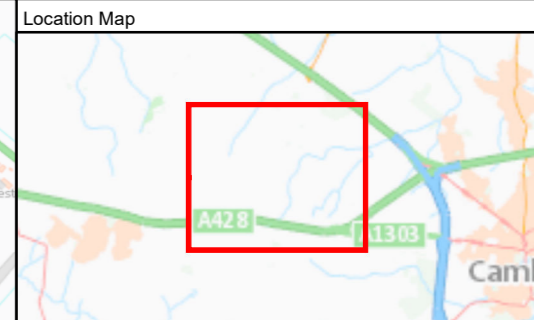
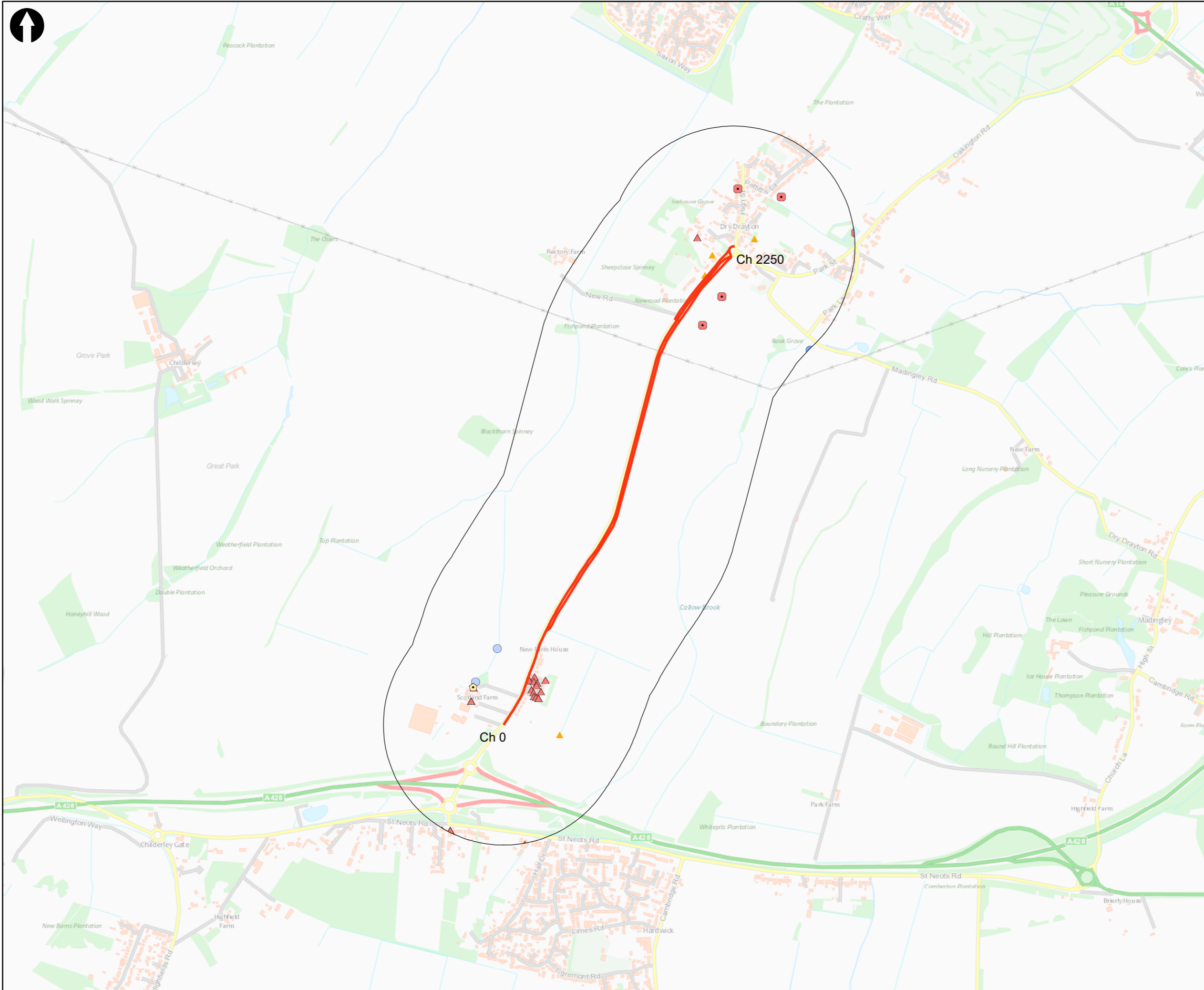
Camborne to Cambridge
Geotechnical and Geo-environmental
Preliminary Risk Assessment
Route Zone 7
Environmental Constraints Plan

Designed	P Fitt	Eng Check	M Gipson
Drawn	P Fitt	Coordination	-
GIS Check	T Graham	Approved	-
Scale at A3	Status	Rev	Security
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Drawing Number
392438-MMD-GIS-XX-DR-GEO-0007



Key to Symbols

- Route Zone 8
- Route Zone 8 Centreline 500m Buffer
- Potentially infilled land
- ⬢ Pollution incidents to controlled waters
- Groundwater and surface water abstractions
- ▲ Extractive industries
- Discharge consents
- ▲ Contemporary trade directory entries

Notes

Location of features shown is approximate only.

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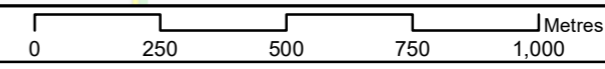
GREATER CAMBRIDGE PARTNERSHIP

Title

Cambourne to Cambridge
Geotechnical and Geo-environmental
Preliminary Risk Assessment
Route Zone 8
Environmental Constraints Plan

Designed	P Fitt	Eng Check	M Gipson
Drawn	P Fitt	Coordination	-
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Scale at A3	Status	Rev	Security
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Drawing Number
392438-MMD-GIS-XX-DR-GEO-0008

C. Landmark Envirocheck Report

To be provided on request.

D. Historical BGS Boreholes

IAN FARMER ASSOCIATES Geotechnical and Environmental Investigations						Site A428 Caxton Common to Hardwick Improvement		Borehole Number 5/16	
Boring Method Cable Percussion		Diameter 150mm Cased to 1.50m		Ground Level (mOD) 71.35		Client Highways Agency		Job Number 2203	
		Location 533690 E 259796 N		Dates 13/09/01 - 13/09/01		Engineer Parsons Brinckerhoff		Sheet 1/2	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.50	B1				71.05	(0.30) 0.30	TOPSPOIL		
0.75-1.25	U1			100 blows			Stiff, mottled blue grey and brown, sandy gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded of flint and chalk		
1.25	D1					(1.80)			
1.50-1.95	CPT N=24			3,7/4,5,7,8					
1.50-2.00	B2								
2.25-2.70	U2			100 blows	69.25	2.10	Stiff, blue grey mottled brown, gravelly CLAY. Gravel is fine to coarse of flint and chalk		
2.70	D2					(1.40)			
3.00-3.45	SPT N=21			2,4/4,5,6,6					
3.00	D3				67.85	3.50	Stiff becoming very stiff with depth, blue grey, gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded of flint and chalk		
3.75-4.20	U3			100 blows					
4.20	D4								
4.50-4.95	SPT N=26			3,5/7,5,7,7					
4.50	D5								
5.50-5.95	U4			100 blows			Very stiff below 6.50m		
5.90	D6								
6.00-6.50	B3								
6.50-6.95	SPT N=35			7,12/12,8,7,8					
6.50	D7								
7.50-7.85	U5			100 blows					
7.85	D8								
8.50-8.95	SPT N=42			13,15/12,10,10,10					
8.50	D9								
9.50-9.95	U6			100 blows					

Remarks	Scale (approx)	Logged By
	1:50	JG
	Figure No.	
2203.5/16		

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>					Site A428 Caxton Common to Hardwick Improvement		Borehole Number 5/16		
Boring Method Cable Percussion		Diameter 150mm Cased to 1.50m		Ground Level (mOD) 71.35		Client Highways Agency		Job Number 2203	
Location 533690 E 259796 N		Dates 13/09/01 - 13/09/01		Engineer Parsons Brinckerhoff		Sheet 2/2			
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50-10.95 10.50	SPT N=43 D10			7,11/10,10,11,12			See previous description.		
11.50-11.95	U7			100 blows					
11.95	D11								
12.50-12.85 12.50	SPT 50*/200 D12			9,13/18,21,11					
13.50-14.00 13.50-13.90	B4 U8			100 blows					
13.90	D13					(14.50)			
14.50-14.88 14.50	SPT 47*/225 D14			5,12/14,14,19					
15.50-15.90	U9			100 blows					
15.90	D15								
16.50-16.88 16.50	SPT 55*/225 D16			11,16/19,19,17					
17.50-17.90	U10			100 blows					
17.90	D17			Slow(1) at 17.80m, rose to 17.70m in 20 mins.	53.35	18.00			
							Complete at 17.90m		
Remarks Piezo at 17.5							Scale (approx) 1:50	Logged By JG	Figure No. 2203.5/16

IAN FARMER ASSOCIATES Geotechnical and Environmental Investigations				Site A428 Caxton Common to Hardwick Improvement				Borehole Number 5/16								
Installation Type Water Monitoring		Dimensions Internal Diameter of Tube [A] = 19 mm Diameter of Filter Zone = 150 mm			Client Highways Agency			Job Number 2203								
Location 533690 E 259796 N		Ground Level (mOD) 71.35		Engineer Parsons Brinckerhoff			Sheet 1/1									
Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description	Groundwater Strikes During Drilling										
						Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)	
			70.85	0.50	Concrete	13/09/01		17.80	17.50	Slow				17.70		
					Topfill											
						Groundwater Observations During Drilling										
						Start of Shift					End of Shift					
						Date	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
						Instrument Groundwater Observations										
						Inst. [A] Type : Piezometer										
						Instrument [A]				Remarks						
						Date	Time	Depth (m)	Level (mOD)							
						14/09/01		DRY	54.36	Borehole not accessible Borehole not accessible						
						21/09/01		16.99								
						02/10/01		4.09								
						09/10/01		NA								
						18/10/01		NA								
			56.35	15.00	Bentonite Seal											
			55.35	16.00	Sand Filter											
			54.15	17.20	Piezometer Tip											
			53.85	17.50												
Remarks Cover fitted.																

IAN FARMER ASSOCIATES Geotechnical and Environmental Investigations						Site A428 Caxton Common to Hardwick Improvement	Trial Pit Number TP5/9
Excavation Method JCB 3CX		Dimensions 2.6 x 0.7	Ground Level (mOD) 71.99	Client Highways Agency		Job Number 2203	
Location 533525 E 259584 N		Dates 17/09/01 - 17/09/01	Engineer Parsons Brinckerhoff		Sheet 1/1		
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend
0.50	J1			71.69	(0.30) 0.30	Grass over TOPSOIL	
					(0.40) 0.70	Firm brown CLAY	
1.00	B1			71.29		Stiff grey and brown CLAY with much sub-angular to sub-rounded fine to coarse gravel of flint and chalk, occasional boulders of siltstone. Light blue grey mottled brown from 1.3m BGL.	
1.50	J2		180,190,220/Av. 196.7		(1.90)		
2.00	B2						
2.50	J3		Hand vane failed due to fissures	69.39	2.60	Stiff blue grey mottled brown CLAY with much fine to coarse gravel and cobbles of flint and chalk and occasional sand lenses.	
3.00	B3			68.99	(0.40) 3.00		
						Complete at 3.00m	
Plan						Remarks Pit dry and stable	
Scale (approx)						1:40	
Logged By						JG	
Figure No.						2203.TP5/9	

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>					Site A428 Caxton Common to Hardwick Improvement		Trial Pit Number TP5/13				
Excavation Method JCB 3CX		Dimensions 2.6 x 0.7		Ground Level (mOD) 71.55		Client Highways Agency		Job Number 2203			
Location 533661 E 259713 N		Dates 12/09/01 - 12/09/01		Engineer Parsons Brinckerhoff		Sheet 1/1					
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water			
0.50	J1			71.25	0.30	TOPSOIL					
				71.05	0.30	Firm brown sandy CLAY					
1.00	B1				0.20	Stiff grey mottled light brown CLAY with occasional to much fine to coarse sub-angular to sub-rounded gravel of flint and chalk and large pockets of light brown clayey sand becoming blue grey mottled brown and damp from 1.5m BGL, becoming blue grey very stiff below 3.9m BGL.					
1.50	J2				0.50						
2.00	B2										
2.50	J3				(3.70)						
3.00	B3										
3.50	J4										
4.00	B4			67.35	4.20	Complete at 4.20m					
Plan						Remarks Pit dry and stable					
						Scale (approx) 1:40		Logged By JG		Figure No. 2203.TP5/13	

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>						Site A428 Caxton Common to Hardwick Improvement		Borehole Number 5/22	
Boring Method Cable Percussion <small>British Geological Survey</small>		Diameter 150mm Cased to 1.50m <small>British Geological Survey</small>		Ground Level (mOD) 71.11 <small>British Geological Survey</small>		Client Highways Agency <small>British Geological Survey</small>		Job Number 2203	
		Location 534005 E 259793 N		Dates 12/09/01 - 12/09/01		Engineer Parsons Brinckerhoff		Sheet 1/1	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20-0.50	B1				70.91	0.20	TOPSOIL		
0.50-0.90	U1			30 blows			Firm, light brown, slightly sandy gravelly CLAY. Gravel is fine to coarse, angular to rounded, of chalk and flint		
0.90	J1					(1.80)			
1.50-1.95	U2			40 blows					
1.95	J2				69.11	2.00	Firm to stiff, dark grey brown / dark grey mottled, slightly sandy, slightly gravelly to gravelly CLAY. Gravel is fine to coarse, angular to rounded, of chalk and flint		
2.00-2.50	B2								
2.50-2.90	U3			40 blows		(1.20)			
2.90	J3								
3.50-3.90	U4			45 blows	67.91	3.20	Stiff, fissured grey slightly gravelly to gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded, of chalk and occasional flint		
3.90	J4								
4.00-4.50	B3					(1.80)			
4.55-5.00	U5			45 blows					
5.00	J5			12/09/01:DRY	66.11	5.00			
							Complete at 5.00m		
Remarks DRY								Scale (approx) 1:50	Logged By PB
								Figure No. 2203.5/22	

IAN FARMER ASSOCIATES
Geotechnical and Environmental Investigations

Site
A428 Caxton Common to Hardwick Improvement
Borehole Number
5/22

Installation Type Water Monitoring <i>British Geological Survey</i>	Dimensions Internal Diameter of Tube [A] = 19 mm Diameter of Filter Zone = 150 mm <i>British Geological Survey</i>	Client Highways Agency <i>British Geological Survey</i>	Job Number 2203
	Location 534005 E 259793 N	Ground Level (mOD) 71.11	Engineer Parsons Brinckerhoff
			Sheet 1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description	Groundwater Strikes During Drilling															
						Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)						
						Groundwater Observations During Drilling															
						Date	Start of Shift				End of Shift										
						Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)						
			70.61	0.50	Concrete																
			69.11	2.00	Cement/Bentonite Grout	12/09/01						5.00	1.50	DRY							
			68.11	3.00	Bentonite Seal	Instrument Groundwater Observations															
					Inst. [A] Type : Piezometer																
						Instrument [A]				Remarks											
						Date	Time	Depth (m)	Level (mOD)												
						14/09/01		4.18	66.93												
						21/09/01		2.35	68.76												
						02/10/01		1.94	69.17												
						09/10/01		NA		Borehole not accessible											
						18/10/01		NA		Borehole not accessible											
										Sand Filter											
			66.61	4.50																	
			66.31	4.80	Piezometer Tip																
			66.11	5.00	Sand Filter																

Remarks
Cover fitted.

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>					Site A428 Caxton Common to Hardwick Improvement		Trialpit Number TP5/25		
Excavation Method JCB 3CX		Dimensions 2.6 x 0.7		Ground Level (mOD) 71.80		Client Highways Agency		Job Number 2203	
		Location 534300 E 259762 N		Dates 17/09/01 - 17/09/01		Engineer Parsons Brinckerhoff		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50	J1			71.30	(0.30) 0.30	TOPSOIL			
1.00	B1					Stiff fissured blue grey mottled brown CLAY with sub-angular to sub-rounded fine to coarse gravel of flint and chalk. With some cobbles.			
1.50	J2				(1.80)				
2.10	B2			69.50	2.10 (0.30)	Fine to coarse brown SAND.			
2.50	J3			69.20	2.40 (0.60)	Very stiff fissured blue grey gravelly CLAY. Gravel is subangular to subrounded fine to coarse of flint and chalk. With some cobbles. Clay is hard in places.			
3.00	B3			68.60	3.00	Complete at 3.00m			
Plan						Remarks Material too stiff for hand vane Pit dry and stable			
						Scale (approx) 1:40		Logged By JG	
						Figure No. 2203.TP5/25			

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>					Site A428 Caxton Common to Hardwick Improvement		Trialpit Number TP6/2		
Excavation Method JCB 3CX <small>British Geological Survey</small>		Dimensions 2.6 x 0.7 <small>British Geological Survey</small>		Ground Level (mOD) 71.58 <small>British Geological Survey</small>		Client Highways Agency <small>British Geological Survey</small>		Job Number 2203	
		Location 534486 E 259777 N		Dates 13/09/01 - 13/09/01		Engineer Parsons Brinckerhoff		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
					(0.30)	TOPSOIL			
				71.28	0.30	Firm brown, CLAY with some fine to coarse chalk and flint gravel.			
0.50	J1				(0.30)				
0.60	CBR1			70.98	0.60	Stiff grey mottled brown CLAY with much sub-angular to sub-rounded fine to coarse gravel flint and chalk, occasional sand pockets. Some cobbles present.			
1.00	B1				(1.10)				
1.50	J2								
1.70	240.0kPa		240, 240/Av. 240.0 Seepage(1) at 1.70m.	69.88	1.70	Light brown silty SAND.		Σ1	
2.00	B2			69.48	2.10	Stiff grey mottled brown CLAY with much sub-angular to sub-rounded fine to coarse gravel flint and chalk, occasional sand pocket.			
2.50	J3				(0.70)				
3.00	B3			68.78	2.80	Stiff dark brown CLAY with rounded gravel and weakly cemented silty sand.			
				68.58	3.00	Complete at 3.00m			
Plan						Remarks In-situ CBR determined by TRL penetrometer Pit stable			
<small>British Geological Survey</small>						<small>British Geological Survey</small>			
						Scale (approx) 1:40		Logged By JG	
						Figure No. 2203,TP6/2			

IAN FARMER ASSOCIATES
Geotechnical and Environmental Investigations

Site
A428 Caxton Common to Hardwick Improvement
Trialpit Number
TP6/4

Excavation Method JCB 3CX <i>British Geological Survey</i>	Dimensions 2.6 x 0.7 <i>British Geological Survey</i>	Ground Level (mOD) 71.36 <i>British Geological Survey</i>	Client Highways Agency <i>British Geological Survey</i>	Job Number 2203
	Location 534667 E 259768 N	Dates 13/09/01 - 13/09/01	Engineer Parsons Brinckerhoff	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL		
0.50	J1			71.06	0.30	Firm brown CLAY		
0.60	CBR1			70.76	0.60			
1.00	B1				(1.20)	Stiff fissured light blue grey CLAY with much sub-angular to sub-rounded fine to coarse gravel of chalk and flint.		
1.50	J2			69.56	1.80	Brown slightly clayey SAND with much fine to medium rounded gravel of varying lithologies.		
2.00	B2			69.16	2.20			
2.50	J3				(0.80)	Stiff blue grey mottled brown CLAY with much sub-angular to sub-rounded fine to coarse gravel of flint and chalk.		
3.00	B3			68.36	3.00	Complete at 3.00m		

Plan <i>British Geological Survey</i>	Remarks In-situ CBR determined by TRL penetrometer Pit dry and stable <i>British Geological Survey</i>					
		<table border="1"> <tr> <td>Scale (approx)</td> <td>Logged By</td> <td>Figure No.</td> </tr> <tr> <td>1:40</td> <td>JG</td> <td>2203.TP6/4</td> </tr> </table>	Scale (approx)	Logged By	Figure No.	1:40
Scale (approx)	Logged By	Figure No.				
1:40	JG	2203.TP6/4				

IAN FARMER ASSOCIATES Geotechnical and Environmental Investigations						Site A428 Caxton Common to Hardwick Improvement		Borehole Number 6/11	
Boring Method Cable Percussion <small>British Geological Survey</small>		Diameter 150mm Cased to 1.50m		Ground Level (mOD) 71.45 <small>British Geological Survey</small>		Client Highways Agency <small>British Geological Survey</small>		Job Number 2203	
		Location 535083 E 259801 N		Dates 18/09/01 - 18/09/01		Engineer Parsons Brinckerhoff		Sheet 1/2	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.50	B1				71.15	(0.30) 0.30	TOPSOIL		
					70.65	(0.50) 0.80	Firm, brown, slightly sandy, gravelly to very gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded of flint and chalk		
1.50-1.80	SPT 55*/150			5,7/26,29					
1.50-1.95	B2								
2.25-2.70	U1 N/R			100 blows		(2.70)			
2.70	J1								
3.00-3.45	SPT N=26			4,6/6,6,7,7					
3.00	J2				67.95	3.50	Very stiff, fissured blue grey gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded flint and chalk		
3.75-4.15	U2			100 blows					
4.15	J3								
4.50-4.95	SPT N=28			5,6/8,7,6,7					
4.50	J4								
5.50-6.00	B3			100 blows					
5.50-5.95	U3 N/R								
6.50-6.61	SPT 50*/110			36,14/					
6.50	0*/0 J5								
7.50-7.90	U4			100 blows					
7.90	J6								
8.50-8.95	SPT N=39			7,9/9,10,10,10					
8.50	J7								
9.50-9.95	U5			100 blows					

Remarks DRY Chiselling from 0.00m to 1.00m for 1.5 hours.	Scale (approx) 1:50	Logged By PB
	Figure No. 2203.6/11	

IAN FARMER ASSOCIATES Geotechnical and Environmental Investigations						Site A428 Caxton Common to Hardwick Improvement		Borehole Number 6/11	
Boring Method Cable Percussion		Diameter 150mm Cased to 1.50m		Ground Level (mOD) 71.45		Client Highways Agency		Job Number 2203	
		Location 535083 E 259801 N		Dates 18/09/01 - 18/09/01		Engineer Parsons Brinckerhoff		Sheet 2/2	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50-10.95 10.50	SPT N=40 J8			6,8,8,9,11,12			See previous description.		
11.50-11.85	U6			100 blows					
11.85 12.00-12.50	J9 B4								
12.50-12.95 12.50	SPT N=52 J10			8,10/11,14,13,14					
13.50-13.85	U7			100 blows					
13.85	J11					(14.50)			
14.50-14.87 14.50	SPT 51*/220 J12			8,10/16,17,18					
15.50-15.85	U8			100 blows					
15.85	J13								
16.50-16.87 16.50	SPT 61*/220 J14			12,17/19,19,23					
17.50-17.85	U9			100 blows					
17.85	J15				53.45	18.00	Complete at 18.00m		
Remarks DRY								Scale (approx) 1:50	Logged By PB
								Figure No. 2203.6/11	

IAN FARMER ASSOCIATES
Geotechnical and Environmental Investigations

Site
A428 Caxton Common to Hardwick Improvement
Borehole Number
6/11

Installation Type Water Monitoring British Geological Survey	Dimensions Internal Diameter of Tube [A] = 19 mm Diameter of Filter Zone = 150 mm British Geological Survey	Client Highways Agency British Geological Survey	Job Number 2203
	Location 535083 E 259801 N	Ground Level (mOD) 71.45	Engineer Parsons Brinckerhoff

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description	Groundwater Strikes During Drilling									
						Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
						Groundwater Observations During Drilling									
						Date	Start of Shift				End of Shift				
						Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
			70.95	0.50	Concrete										
					Topfill										
			65.45	6.00	Bentonite Seal										
			64.45	7.00	Sand Filter										
			63.25	8.20	Piezometer Tip										
			62.95	8.50	Sand Filter										
			62.45	9.00	Bentonite Seal										
			61.45	10.00	Bentonite Seal										
					General Backfill										
			53.45	18.00											

Remarks
Cover fitted.

IAN FARMER ASSOCIATES Geotechnical and Environmental Investigations						Site A428 Caxton Common to Hardwick Improvement		Borehole Number 6/16A	
Boring Method Cable Percussion		Diameter 150mm Cased to 1.50m		Ground Level (mOD) 71.40		Client Highways Agency		Job Number 2203	
Location 535186 E 259793 N		Dates 20/09/01 - 21/09/01		Engineer Parsons Brinckerhoff		Sheet 1/2			
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.75	B1				71.20	0.20	TOPSOIL		
0.75-1.20	U1			60 blows	70.50	(0.70)	Firm, brown, with a little grey brown mottling, gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded of flint and chalk		
1.25	J1								
1.50-1.95	SPT N=14			2,4/3,3,4,4					
1.50	J2					(2.00)			
2.25-2.70	U2			80 blows					
2.75	J3								
3.00-3.45	SPT N=19			2,4/4,4,5,6	68.50	2.90	Stiff becoming very stiff with depth, fissured blue grey gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded flint and chalk		
3.00	J4								
3.75-4.20	U3			80 blows					
4.25	J5								
4.50-4.95	SPT N=21			4,5/5,5,5,6					
4.50	J6								
5.50-5.95	U4			85 blows					
5.95	J7								
6.50-6.95	SPT N=26			3,5/6,6,7,7					
6.50	J8								
7.50-7.95	U5			100 blows					
7.95	J9								
8.50-8.95	SPT N=26			5,6/6,6,7,7					
8.50	J10								
9.50-9.95	U6			100 blows					
9.95	J11								
Remarks DRY								Scale (approx) 1:50	Logged By PB
								Figure No. 2203.6/16A	

IAN FARMER ASSOCIATES
Geotechnical and Environmental Investigations

Site
A426 Caxton Common to Hardwick Improvement
Borehole Number
6/16A

Boring Method Cable Percussion	Diameter 150mm Cased to 1.50m	Ground Level (mOD) 71.40	Client Highways Agency	Job Number 2203
	Location 535186 E 259793 N	Dates 20/09/01 - 21/09/01	Engineer Parsons Brinckerhoff	Sheet 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50-10.95 10.50	SPT N=31 J12			5,8/7,8,8,8			See previous description. Below 10.50m: Very stiff		
11.50-11.90	U7			100 blows					
11.90	J13								
12.50-12.95 12.50	SPT N=39 J14			8,8/9,9,10,11					
13.50-13.90	U8			100 blows					
13.90	J15					(15.10)			
14.50-14.95 14.50	SPT N=48 J16			7,9/12,11,11,14					
15.50-15.85 15.85	U9 J17			100 blows					
16.50-16.88 16.50	SPT 48*/225 J18			10,13/15,15,18					
17.50-17.90	U10			100 blows					
17.90	J19				53.40	18.00	Complete at 18.00m		

Remarks DRY	Scale (approx)	Logged By
	1:50	PB
	Figure No. 2203.6/16A	

IAN FARMER ASSOCIATES
Geotechnical and Environmental Investigations

Site
A428 Caxton Common to Hardwick Improvement

Borehole Number
6/16A

Installation Type
Water Monitoring

Dimensions
Internal Diameter of Tube [A] = 19 mm
Diameter of Filter Zone = 150 mm

Client
Highways Agency

Job Number
2203

Location
535186 E 259793 N

Ground Level (mOD)
71.4

Engineer
Parsons Brinckerhoff

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description	Groundwater Strikes During Drilling										
						Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)	
			70.90	0.50	Concrete						6 min	10 min	15 min	20 min		
						Groundwater Observations During Drilling										
						Start of Shift					End of Shift					
						Date	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
						Instrument Groundwater Observations										
						Inst. [A] Type : Piezometer										
						Instrument [A]				Remarks						
						Date	Time	Depth (m)	Level (mOD)							
						24/10/01		1.03	70.37							
						06/11/01		1.03	70.37							
						13/11/01		1.06	70.34							
						56.40	15.00	Bentonite Seal								
						55.40	16.00	Sand Filter								
						54.20	17.20	Piezometer Tip								
						53.90	17.50	Sand Filter								
						53.40	18.00									

Remarks
Cover fitted.

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>					Site A428 Caxton Common to Hardwick Improvement		Trialpit Number TP6/18				
Excavation Method Komatsu tracked excavator		Dimensions 2.5 x 0.6		Ground Level (mOD) 71.16		Client Highways Agency		Job Number 2203			
		Location 535292 E 259829 N		Dates 17/09/01 - 17/09/01		Engineer Parsons Brinckerhoff		Sheet 1/1			
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water			
1.00	B1			70.76	(0.40)	TOPSOIL					
					(0.50)	Firm brown gravelly CLAY					
2.00	B2			70.26	0.90	Stiff grey mottled brown gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded chalk and flint.					
					(0.60)	Stiff fissured dark grey brown / grey mottled gravelly CLAY of chalk and flint.					
3.30	B3			69.66	1.50	Stiff fissured dark grey brown / grey mottled gravelly CLAY of chalk and flint.					
					(2.30)	Large orange brown sand and gravel pocket at 2.6. Some large pckets of dark grey brown silty fine sand below 3.0m					
4.00	B4			67.36	3.80	Very stiff fissured grey gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded chalk and flint with some cobbles and some small boulders.					
4.50	J1			66.66	4.50	Complete at 4.50m					
Plan						Remarks Pit dry and stable					
						Scale (approx) 1:40		Logged By PB		Figure No. 2203.TP6/18	

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>					Site A428 Caxton Common to Hardwick Improvement		Trialpit Number TP7/5	
Excavation Method JCB 3CX		Dimensions 2.6 x 0.7		Ground Level (mOD) 70.46	Client Highways Agency		Job Number 2203	
Location 535622 E 259795 N		Dates 10/09/01 - 10/09/01		Engineer Parsons Brinckerhoff		Sheet 1/1		
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50	J1			70.16	(0.30) 0.30 (0.30)	TOPSOIL Firm brown CLAY		
1.00	B1			69.86	0.60	Stiff fissured brown and grey mottled brown CLAY with much subangular to subrounded fine to coarse gravel of flint and chalk with occasional 500mm pockets of brown sand and green silt.		
1.50	J2							
2.00	B2				(3.10)			
2.50	J3							
3.00	B3							
3.50	J4			66.76	3.70 (0.50)	Stiff to very stiff blue grey CLAY with much subangular to subrounded gravels of fine to coarse flint and chalk.		
4.00	B4			66.26	4.20	Complete at 4.20m		
Plan				Remarks Pit dry and stable				
				Scale (approx) 1:40		Logged By JG	Figure No. 2203.TP7/5	

IAN FARMER ASSOCIATES Geotechnical and Environmental Investigations						Site A428 Caxton Common to Hardwick Improvement		Borehole Number 7/8	
Boring Method Cable Percussion		Diameter 150mm Cased to 1.50m		Ground Level (mOD) 68.00		Client Highways Agency		Job Number 2203	
Location 535857 E 259795 N		Dates 10/09/01 - 10/09/01		Engineer Parsons Brinckerhoff		Sheet 1/1			
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30-0.60	B1				67.70	(0.30)	TOPSOIL		
0.60-1.00	U1			40 blows		0.30	Stiff, brown / grey mottled, gravelly CLAY. Gravel is fine to coarse, angular to sub-rounded, with occasional small chalk cobble		
1.00	J1								
1.50-1.95	U2			40 blows					
1.95	J2					(3.50)			
2.50-2.95	U3			40 blows					
2.95	J3						Dark grey brown / grey mottled below 2.95m		
3.50-3.95	U4			50 blows					
3.95	J4				64.20	3.80	Stiff, fissured grey gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded chalk		
4.00-4.50	B2								
4.50-4.95	U5			50 blows					
4.95	J5					(2.20)			
5.55-6.00	U6			50 blows					
6.00	J6				62.00	6.00	Complete at 6.00m		
Remarks DRY								Scale (approx) 1:50	Logged By PB
								Figure No. 2203.7/8	

SMD 621

Cementation Ground Engineering **soil mechanics department** **BOREHOLE No. B.1008**

CONTRACT Cambridge Northern By-Phase. **REPORT No.** 8639/SEQ

Client Eastern Road Construction Unit. **Ground Level** 61.30m. O.D

Site Address Girton - Milton, Cambridgeshire. **Boring Commenced** 17.5.71
Boring Completed 18.5.71

Type and Dia. of Boring Shell and Auger 200 mm. diameter. **TLSSNE/28**
3610.5988

Water Strikes		Water Levels Recorded During Boring m					
1.	17.00	Hole Depth	24.00				
2.	(seepage)	Casing Depth	2.00				
3.		Water Level	17.20				

Remarks Chiseling on boulder from 6.40 m. to 7.00 m.

Description	Scale 20mm = 1 m.		Samples		Depth m	S.P.T. N
	Depth	Legend	Ref. No.	Type		
Topsoil	0.10	XXXX				
Stiff to very stiff brown and grey mottled boulder clay with chalk (CI to CH)		○	2144	J	0.30	
		○	2145	J	0.70	
		○	2146	U	1.00-1.45	
		○	2147	J	1.75	
		○	2148	U	2.50-2.95	
		○	2149	J	3.25	
		○	2150	J	4.10	
Very stiff dark grey silty boulder clay (CI)	4.00	○	2151	U	4.30-4.75	
		○	2152	J	5.00	
		○	2153	U	5.80-6.25	
		○	2154	J	6.50	
Hard dark grey silty boulder clay, with very occasional veins of sand (CI to CH)	7.00	○	2155	U	7.30-7.75	
		○	2156	J	8.00	
		○	2157	U	8.80-9.25	

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

SHEET No

SMD 622

**Cementation
Ground Engineering**

soil mechanics department

B.1008

Continuation Sheet No. 11.

CONTRACT Cambridge Northern By-Pass.

REPORT No. 8639/SEQ

7135 NE 123

Description	Scale 20mm = 1.0m		Samples		S.P.T. N blows/ft
	Depth	Legend	Ref.No.	Type	
Hard dark grey silty boulder clay, with very occasional veins of sand (CI to CH) (Cont'd.)			2158	J	9.50
			2159	U	10.30-10.75
			2160	J	11.00
			2161	U	11.80-12.25
			2162	J	12.50
			2163	U	13.30-13.75
			2178	J	14.00
			2164	U	14.80-15.25
			2165	J	15.50
			2166	U	16.30-16.75
			2167	J	17.10
			2168	J	17.75
			2169	J	18.30
			2170	U	18.50-18.95
		2171	J	19.25	
		2172	U	20.00-20.45	
		2173	J	20.75	

Code: U—Undisturbed Sample

D—Large Disturbed Sample

J—Jar Sample



W—Water Sample

SHEET NO

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>						Site A428 Caxton Common to Hardwick Improvement	Trialpit Number TP7/15	
Excavation Method JCB 3CX		Dimensions 2.6 x 0.7	Ground Level (mOD) 61.89		Client Highways Agency	Job Number 2203		
		Location 536297 E 259889 N	Dates 11/09/01 - 11/09/01	Engineer Parsons Brinckerhoff	Sheet 1/1			
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50	J1			61.59	0.30	TOPSOIL		
0.60	CBR			61.29	0.30	MADE GROUND: Firm to stiff, fissured, brown CLAY with some fine to coarse sub-angular to sub-rounded chalk and flint.		
1.00	B1				0.60	MADE GROUND: BOULDERS AND COBBLES with clayey pockets.		
1.50	J2			60.49	1.40	Stiff, fissured, blue grey mottled brown CLAY with a little to some fine to coarse gravel of subangular to subrounded, flint and chalk.		
2.00	B2							
2.50	J3				(2.70)			
3.00	B3							
3.50	J4							
4.00	B4			57.79	4.10	Very stiff at 4.0		
						Complete at 4.10m		
Plan						Remarks Trial pit was dry and stable. In-situ CBR determined by TRL Penetrometer.		
						Scale (approx) 1:40	Logged By JG	Figure No. 2203.TP7/15

IAN FARMER ASSOCIATES Geotechnical and Environmental Investigations					Site A428 Caxton Common to Hardwick Improvement		Borehole Number 8/3		
Boring Method Cable Percussion		Diameter 150mm Cased to 1.50m		Ground Level (mOD) 58.59		Client Highways Agency	Job Number 2203		
		Location 536570 E 259867 N		Dates 06/09/01 - 06/09/01		Engineer Parsons Brinckerhoff	Sheet 1/1		
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30-0.60	B1				58.29	(0.30)	TOPSOIL		
0.60-1.05	U1			80 blows		0.30	Firm to stiff, slightly fissured brown/grey mottled gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded of flint and chalk		
1.05	J1								
1.50-1.95	U2			60 blows					
1.95	J2					(3.70)			
2.50-2.95	U3			75 blows					
2.95	J3								
3.50-3.95	U4			75 blows					
3.95	J4				54.59	4.00	Stiff, fissured grey gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded of flint and chalk, with occasional cobbles		
4.00-4.50	B2								
4.50-4.95	U5			100 blows					
4.60-4.80	B3								
5.00-5.45	U6			80 blows			4.60 to 4.80m: Rock layer (Driller's description)		
5.45	J5								
6.00-6.45	U7			80 blows					
6.45	J6								
7.00-7.45	U8			75 blows		(6.00)			
7.45	J7								
8.00-8.45	U9			80 blows					
8.45	J8								
9.00	J9								
9.55-10.00	U10			80 blows					
10.00	J10				48.59	10.00	Complete at 10.00m.		
Remarks DRY Chiselling from 4.60m to 4.80m for 0.5 hours.							Scale (approx) 1:50	Logged By JG	
							Figure No. 2203.8/3		

SMD 621

Cementation Ground Engineering		soil mechanics department			BOREHOLE No. D.1003.	
CONTRACT Cambridge Northern By-Pass.				REPORT No. 8639/SFO		
Client Eastern Road Construction Unit.				Ground Level 63.50 m. O.D.		
Site Address Girton - Milton, Cambridgeshire.				Boring Commenced 11.6.71 Boring Completed 11.6.71		
Type and Dia. of Boring Hand Auger 200 mm. diameter.				7235NE/29 3672.5975		
Water Strikes		Water Levels Recorded During Boring m				
1. None	Hole Depth					
2.	Casing Depth					
3.	Water Level					
Remarks						
Description		Scale 20mm = 1 in		Samples		S.P.T.
		Depth	Legend	Ref. No.	Type	Depth m
Made ground (grey-brown sandy clay, gravel, topsoil and pieces of tarmac).				5556	J	0.75
Firm brown and grey mottled boulder clay with specks of chalk. (CI to CH)		1.00				
		1.50		5557	J	1.50

British Geological Survey





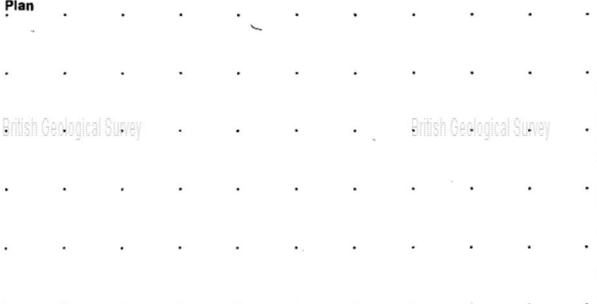
British Geological Survey

British Geological Survey

British Geological Survey

SHEET No

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>					Site A428 Caxton Common to Hardwick Improvement		Trial Pit Number TP8/25		
Excavation Method JCB 3CX <i>British Geological Survey</i>		Dimensions 2.6 x 0.7 <i>British Geological Survey</i>		Ground Level (mOD) 58.38 <i>British Geological Survey</i>		Client Highways Agency <i>British Geological Survey</i>		Job Number 2203	
Location 537265 E 259716 N		Dates 06/09/01 - 06/09/01		Engineer Parsons Brinckerhoff		Sheet 1/4			
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.50	J1			58.08	(0.30) 0.30 (0.30)	TOPSOIL Firm brown CLAY with some fine to coarse subrounded to subangular gravels of flint and chalk.			
1.00	B1			57.78	0.60	Stiff fissured blue grey mottled brown CLAY with much fine to coarse subangular to subrounded gravels of flint and chalk.			
1.40	J2		No penetration/Av.		(2.50)				
1.50									
2.00	B2					From 2.10 - 3.10m - large siltstone erratics encountered.			
2.40	205.3kPa		180,220,216/Av. 205.3						
2.50	J3								
3.00	B3			55.28	3.10	At 2.90m - large siltstone boulder encountered at base of pit. Complete at 3.10m			
Plan					Remarks Pit dry and stable				
									
					Scale (approx) 1:40		Logged By JG		Figure No. 2203.TP8/25

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>							Site A428 Caxton Common to Hardwick Improvement		Borehole Number 9/1
Boring Method Cable Percussion <small>British Geological Survey</small>		Diameter 150mm Cased to 1.50m		Ground Level (mOD) 60.78 <small>British Geological Survey</small>		Client Highways Agency <small>British Geological Survey</small>		Job Number 2203	
		Location 537484 E 259680 N		Dates 05/09/01 - 05/09/01		Engineer Parsons Brinckerhoff		Sheet 1/2	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30-0.70	B1				60.48	(0.30) 0.30	TOPSOIL Firm/stiff, slightly fissured grey mottled brown gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded chalk, flint		
0.75-1.20	U1			30 blows					
1.20	J1								
1.50-1.95	SPT N=14			3,2/3,3,4,4					
1.95	J2								
2.25-2.70	U2			45 blows					
2.70	J3					(4.50)			
3.00-3.45	SPT N=19			3,3/4,5,4,6					
3.45	J4								
3.75-4.15	U3			50 blows					
4.15	J5								
4.50-4.95	SPT N=23			3,4/5,6,6,6					
4.95	J6				55.98	4.80			
5.00-5.50	B2						Stiff becoming very stiff with depth, blue grey, gravelly CLAY. Gravel is fine to coarse, sub-angular to sub-rounded chalk, flint		
5.50-5.95	U4			50 blows					
5.95	J7								
6.50-6.95	SPT N=33			5,6/8,7,9,9			Below 6.50m: Very stiff		
6.95	J8								
7.50-7.95	U5			60 blows					
7.95	J9								
8.50-8.95	SPT N=44			6,6/10,11,11,12					
8.95	J10								
9.50-9.90	U6			75 blows					
9.90	J11					(10.20)			
Remarks DRY								Scale (approx) 1:50	Logged By JG
								Figure No. 2203.9/1	

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>							Site A428 Caxton Common to Hardwick Improvement		Borehole Number 9/1	
Boring Method Cable Percussion British Geological Survey		Diameter 150mm Cased to 1.50m		Ground Level (mOD) 60.78		Client Highways Agency		Job Number 2203		
		Location 537494 E 259680 N		Dates 05/09/01 - 05/09/01		Engineer Parsons Brinckerhoff		Sheet 2/2		
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
10.50-10.95	SPT N=52			7,8/11,12,14,15			See previous description.			
10.95	J12									
11.50-11.95	U7			80 blows						
11.95	J13									
12.50-12.95	SPT N=64			11,10/14,15,16,19		(10.20)				
12.95	J14									
13.50-13.95	U8			80 blows						
13.95	J15									
14.55-15.00	SPT N=70			10,11/15,17,18,20						
15.00	J16				45.78	15.00	Complete at 15.00m			
Remarks DRY								Scale (approx) 1:50	Logged By JG	
								Figure No. 2203.9/1		

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>				Site A428 Caxton Common to Hardwick Improvement		Borehole Number 9/1											
Installation Type Water Monitoring		Dimensions Internal Diameter of Tube [A] = 19 mm Diameter of Filter Zone = 150 mm		Client Highways Agency		Job Number 2203											
Location 537494 E 259680 N		Ground Level (mOD) 60.78		Engineer Parsons Brinckerhoff		Sheet 1/1											
Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description	Groundwater Strikes During Drilling											
						Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)		
			60.28	0.50	Concrete												
					Cement/Bentonite Grout												
						Groundwater Observations During Drilling											
			57.28	3.50	Bentonite Seal	Start of Shift			End of Shift								
			56.28	4.50		Date	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	
					Sand Filter												
			54.78	6.00	Piezometer Tip												
			54.48	6.30	Sand Filter												
			54.28	6.50													
					Bentonite Seal	Instrument Groundwater Observations											
			53.28	7.50		Inst. [A] Type : Piezometer											
						Instrument [A]				Remarks							
						Date	Time	Depth (m)	Level (mOD)								
					General Backfill	14/09/01		DRY									
						21/09/01		DRY									
						02/10/01		DRY									
						09/10/01		DRY									
						18/10/01		DRY									
						24/10/01		4.57	56.21								
						06/11/01		2.97	57.81								
						13/11/01		1.76	59.02								
			45.78	15.00													
Remarks Cover fitted.																	

3860 547

Cementation soil mechanics department BOREHOLE NO. A. 5009
Ground Engineering

CONTRACT Cambridge Northern Works	REPORT No. 4100
Client Eastern Deep Construction Ltd.	Ground Level 61.8 m O D
Site Address Gilton - Milton, Cambridge area.	Boring Commenced 10.6.71 Boring Completed 11.6.71

Type and Dia of Boring Shell and Auger 200 mm diameter
TL35NE/3
3860-5454

Water Strikes	Water Levels Recorded During Boring m					
1. None	Hole Depth					
2.	Casing Depth					
3.	Water Level					

Remarks

Description	Scale 20mm		Samples		Depth m	S.P.T N
	Depth	Legend	Ref. No.	Type		
Topsoil.	0.45					
Stiff light grey and yellow-brown boulder clay with chalk. (CL to CI)			5548	J	0.75	
			5549	U	1.05-1.5	
			5550	J	2.0	
Stiff brown and grey mottled boulder clay with chalk. (CI to CH)	2.6		5551	U	2.6-3.05	
	3.1		5552	J	3.1	

SHEET No

Borehole record form



British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL



Environment Agency

British Geological Survey
Water Resources Act 1991 (as amended by the Water Act 2003)

British Geological Survey

A Site details

Borehole drilled for PRIVATE WATER SUPPLY
 Location MADINGLEY MULCH, MADINGLEY ROAD, COTON, CAMBS CB23 7PH
 NGR (ten digits) TL 3937 5937 Please attach site plan
 Ground level (if known) _____ metres Above Ordnance Datum
 Drilling company A G BROWN DRILLING
 Date drilling commenced 24/07/2016 (DD/MM/YYYY) Completed 12/08/2016 (DD/MM/YYYY)

B Construction details

Borehole datum (if not ground level) _____ metres (m). Please tick if this is above or below ground level.
 (point from which all measurements of depth are taken, for example, flange, edge of chamber)

Borehole drilled diameter
200 mm from 0 to 25.0 m/depth
150 mm from 25.0 to 74.5 m/depth
 _____ mm from _____ to _____ m/depth
 _____ mm from _____ to _____ m/depth

Casing material _____ diameter _____ mm from _____ to _____ m/depth
 and type (for example, if plain steel, plastic slotted). Please record permanent casing details, not temporary casing.

Casing material PVC PLAIN diameter 125 mm from 0 to 71.0 m/depth
 Casing material PVC SLOTTED diameter 125 mm from 71.0 to 74.5 m/depth
 Casing material _____ diameter _____ mm from _____ to _____ m/depth
 Grouting details GL - 20.0 METRES - BENTONITE

Water struck at 1. 40.9 m (depth below datum – mbd) 2. _____ m (mbd)
 3. _____ m (mbd) 4. _____ m (mbd)

C Test pumping summary (Please supply full details on form WR39)

Test pumping datum _____ m. Please tick if this is above or below ground level.
 (if different from borehole datum)

Pump suction depth _____ mbd
 Water level (start of test) 37.0 mbd
 Water level (end of test) 37.0 mbd

Type of test (for example, bailer, step, constant rate)
TO BE CARRIED OUT BY OTHERS, WATER LEVEL AT 37M bgl

Pumping rate 0 m³/hour or litres/second . Please tick as appropriate.
 _____ for _____ days, _____ hours, _____ mins

Recovery to _____ mbd in _____ days, _____ hours, _____ mins
 (from end of pumping)

Date(s) of measurements Pump started 12/08/2016 (DD/MM/YYYY)
 Pump stopped _____ (DD/MM/YYYY)

Please supply chemical analysis if available. If you have included this please tick this box

D Strata log

Geological classification (BGS only)	Description of strata	Thickness m	Depth (to base of strata) m
	GREY BOULDER CLAY	27.0	27.0
	GREY CLAYEY CHALK	5.0	32.0
	STIFF GREY GAULT CLAY	39.0	71.0
	GREY/ GREEN DENSE SAND	3.4	74.4
	SANDSTONE	0.1	74.5
(continue on separate page if necessary)			
Other comments (for example, gas encountered, saline water intercepted)			

E Completing this form

How long did it take you to fill in this form? _____

For Official use only

Date received (DD/MM/YYYY)	File	Consent number	BGS reference number
_____	_____	_____	_____
Accession number	Wellmaster number	SOBI number	NGR
_____	_____	_____	_____
LIC NO	Purpose	EA reference number	
_____	_____	_____	
Copy number	Entered by		
_____	_____		

/MRC

TL/35NE/1

10th September, 1947.

SUPPLY FROM OUSE VALLEY

MISC.

Record of Borings for Reservoir Site near Coton.

British Geological Survey

British Geological Survey

British Geological Survey

Boring No. 1. N.Q.R. 3951-5886

187

Taken on 170 ft. contour line due south of Meddingley Hall, 500 yds. west of line of dam proposed by Messrs. Binnie, Deacon & Gourley, slightly to the west of Whitwell Farm.

<u>Descriptions of Strata</u>	<u>Levels of top of Strata above O.D.</u>	<u>Thickness of Strata.</u>
Surface	170.00	
Top soil		6"
Top of mottled clay	169.50	
Mottled clay		4' 6"
Top of brown clay	165.00	
Brown clay and flints		6' 6"
Top of blue clay	158.50	
Blue clay, flints, and particles of chalk		35' 6"
Top of grey clay	123.00	
Grey clay		2' 6"
Top of grey chalk	120.50	
Grey chalk		2' 6"
Top of hard block chalk	118.00	
The level of the gault	98.50	
The thickness of the chalk		19' 6"
Penetrated 4' into gault		4' 0"
		<hr/>
Total depth of boring.		75' 6"

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

TL 45 NW/119 or 120.
412588

188
20

Coton.
Ordnance Map 188, new ser. (Cambridgeshire 39, S.E., 46 N.E.)
Geologic Map 51 S.W.

1. Communicated by Mr. FLAVELL.

Lck	[Chalk Marl] Soil and white clay	11	} 131 feet+.
G	[Gault] Blue clay	120	
LGS	[Lower Greensand] Rocks and sand	-	

mjs/11

not traced 19.8.60 GOW

Water Supply of
Hants.
and Rutland.
page 68

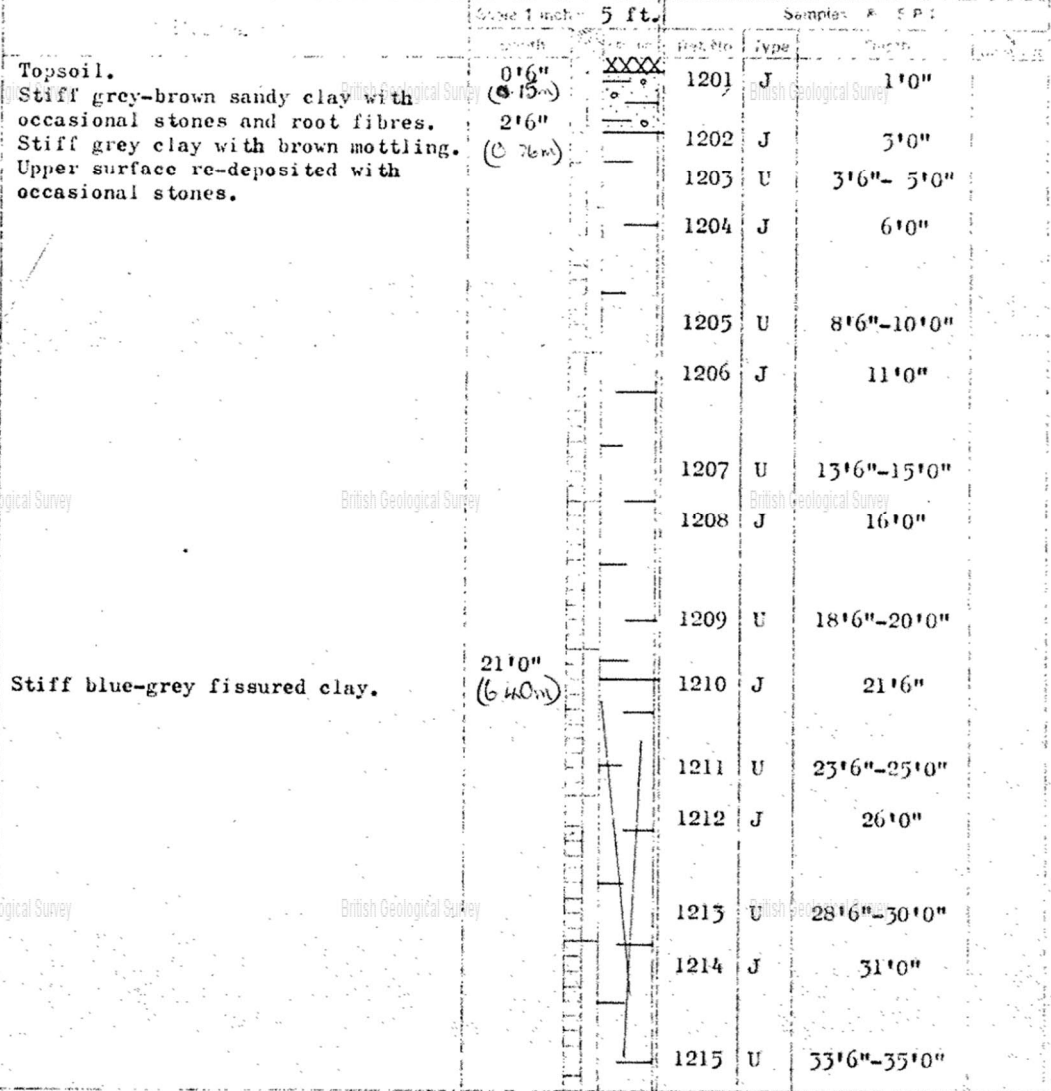
CONTRACT **Cambridge Western By-Pass** REPORT No. **7562/LT/JH**
 Eastern Road Construction Unit
 Ground Level **55.3 O.D. (16.8m)**
 Site Address **Accommodation Bridge - Crossing 12**
 Boring Commenced **10.11.69.**
 Boring Completed **10.11.69.**

Type and dia. of Boring **Shell and Auger 8 ins. dia.**

Water Tables

1. None									
2.									
3.									

Remarks



Code: C—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

NOTE—Unless stated otherwise, all samples are retained in their original state and are not to be used for any other purpose without the agreement of the British Geological Survey. The British Geological Survey is not responsible for any loss or damage to samples or for any delay in the return of samples to the client.

CONTRACT Cambridge Western By-Pass	REPORT No. 7562/LT/JH
------------------------------------	-----------------------

Description	Scale 1 inch = 5 ft.		Samples & S.P.T.		
	Depth	Leg. No.	Ret. No.	Type	Depth
Stiff blue-grey fissured clay. (continued)			1216	J	36'0"
			1217	U	38'6"-40'0"
			1218	J	41'0"
			1219	U	43'6"-45'0"
			1220	J	46'0"
			1221	U	48'6"-50'0"
	50'0" (15.24m)				

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

Note.—Unless classification tests have been made and the results are included in this Report, the descriptions of strata given above have been obtained by inspection in accordance with British Standard Code of Practice CP 2001 (1957) Site Investigations. To ensure agreement as to interpretation, clients are requested to check the descriptions against the samples submitted.

	soil mechanics department	FORM No. TL45 NW/89 189
		4206.5896

CONTRACT Cambridge Western By-Pass.	REPORT No. 7562/LT/JH
--	------------------------------

Bored for Eastern Road Construction Unit.	Ground Level 63.7 O.D. (19.8m)
--	---------------------------------------

Site Address A45 Cut	Boring Commenced 22.10.69 Boring Completed 22.10.69
-----------------------------	--

Type and Size of Borehole Rotary, Flight Auger, 6 ins. diameter.

Water Strikes		Water Levels Recorded During Boring					
1. None	True Depth						
2.	Chart Depth						
3.	Water Level						

Remarks

Description	Scale 1 inch = 5ft.		Samples & S.P.T.			
	Depth	Ground	Ref. No.	Type	Depth	S.P.T.
Topsoil. Firm-stiff grey/brown mottled silty clay.	1'6"		560	J	1'0"	
	(0.46m)		561	J	2'0"	
			562	D	4'0"	
			563	J	6'0"	
			564	D	8'0"	
			565	J	10'0"	
	10'0"					
	(3.05m)					

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

Note.—Unless classification tests have been made and the results are included in this Report, the descriptions of strata given above have been prepared in accordance with British Standard Code of Practice CP 2001 (1957) Site Investigations. To ensure agreement as to interpretation, on the part of the client, the descriptions should be submitted to the client for their approval.

Norwest Holst Soil Engineering Ltd.

Borehole No.

2

Contract No. F9081
 Location: Schlumberger Cambridge
 Client: Buro Happold
 Method of Boring: Cable Percussion
 Diameter of Borehole: 150mm

BOREHOLE LOG

4224
 5908

Sheet 1 of 2
 Chainage
 Ground Level: 21.16 m.A.O.D.
 Date: 28/2/91

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/R.O.D. %	Daily Progress
Firm brownish grey silty CLAY with a little fine rounded gravel.		0.30	20.86		0.00-0.10 0.30-0.40		
Firm to stiff grey brown silty slightly sandy CLAY with a little fine to coarse sub-angular to sub-rounded gravel.		1.20	19.96		1.00-1.20 (60) 1.20-1.30 1.40-1.50 1.50-1.95	"8"	
Soft to firm orange brown very sandy CLAY with much fine to medium subrounded to rounded gravel.		2.10	19.06		s		
Firm blue grey mottled light grey sandy CLAY with a little subangular gravel of chalk.					2.50-2.80 (75) 2.80-2.90		
Stiff blue grey fissured silty CLAY					3.50-3.95 s	"17"	
					4.50-4.90 (80) 4.90-5.00		
					6.00-6.45 s	"17"	
					7.50-7.80 (85) 7.80-7.90		
					9.00-9.45 s	"26"	

Type of Sample

- Is S.P.T. Undisturbed
- Ic C.P.T. Vane
- 0 Jar Water
- Bulk Piezometer

Remarks (Observations of Ground Water etc.) () U100 Blows

Water levels are subject to seasonal or tidal variations and should not be taken as constant

Norwest Holst Soil Engineering Ltd.

Borehole No.

2

Contract No. F9081
 Location Schlumberger Cambridge
 Client Buro Happold
 Method of Boring Cable Percussion
 Diameter of Borehole 150mm

BOREHOLE LOG

TC45NW 197

Sheet 2 of 2
 Chainage
 Ground Level 21.16 m.A.O.D.
 Date 28/2/91

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/R.O.D. %	Daily Progress
Stiff to very stiff blue grey fissured silty CLAY					10.50-10.80 (85)		
					10.80-10.90		
					12.00-12.45		
					13.50-13.80 (90)		
					13.80-13.90		
					14.00-15.00		
					15.00-15.45		
					16.50-16.90 (90)		
					16.90-17.00		
					below 16.90m - with occasional fine to coarse gravel sized mudstone lithorelicts.		
19.50-19.80 (90)							
19.80-19.90							
20.00							

Type of Sample	Remarks (Observations of Ground Water etc.)
Is S.P.T. Undisturbed Ic C.P.T. Vane O Jar Water ● Bulk Piezometer	() U100 Blows Groundwater: Seepage at 1.30m. No inflow. Standpipe piezometer installed to 20.0m depth Gravel filter installed between 1.0m and 20.0m depth Water levels are subject to seasonal or tidal variations and should not be taken as constant

TL45NW 180
4321 5889

HOLST & CO. LTD.
SITE INVESTIGATION DEPT.



PARKSIDE LANE
LEEDS LS115SX.

Contract No. W.3307/F1502.

Borehole No. 4a.

Location Cambridge.

Ground Level.

Client Cambridge City Engineer.

Date.

BOREHOLE LOG

STRATA	Legend	Depth below Ground Level	Thickness of Strata	Type of Sample	c kN/sq.m	φ deg.	m.c. %	γ kg/cu.m.	N
Top Soil.		0.23m	0.23m						
Firm brown sandy stony clay.			1.45m						
		1.68m							
Sand & Gravel with clay.		1.91m	0.23m						
Stiff grey weathered clay. silty, fissured.			1.30m						
		3.20m.							

Water Struck at 1.22m Maximum Observed Water Level 1.22m

- Undisturbed Sample
 - Disturbed Sample
 - Water Sample
 - Penetration Test
- c = Cohesion
 - φ = Angle of Internal Friction
 - m.c. = Moisture Content
 - γ = Bulk Density
 - N = Standard Penetration Value

Water levels are subject to seasonal or tidal variation and should not be taken as constant

T R I A L P I T N

Depth -m	Strata Description
	TOPSOIL
G.L. - 0.25	Dark brown silty clay TOPSOIL with live rootlets and occasional gravel.
	SUPERFICIAL DEPOSITS
0.25 - 1.40	Firm to stiff light brown and light grey mottled CLAY, fissured in places. Occasional gravel and nodules. A few pockets of orange brown gravelly silty sand. Live rootlets.
	GAULT CLAY
1.40 - 3.50	Stiff light grey mottled olive, and dark grey with depth, fissured CLAY. Occasional pockets of small selenite crystals. Traces of decayed roots below 2.50m depth.

Remarks

1. Trial pit dug by JCB 3CX hydraulic excavator on 15.08.1988.
2. Trial pit dimensions 0.75 x 2.50 x 3.50m deep.
3. Sides stable.
4. No water encountered.
5. Disturbed samples taken at 0.50, 1.00, 1.50, 2.00, 2.50, 3.00m depths.
6. Vane Tests.

Depth m	Readings kN/m ²	Average Shear Strength kN/m ²
0.5	110, 110, 170, 88, 162, 155	130
1.00	135, 147, 167, 147	150
1.50	160, 155, 147, 152, 152	155
2.00	165, 157, 152, 152	155

Date . August 1988	TRIAL PIT LOG TYRONE	Report No . S.1086
-----------------------	-------------------------	-----------------------

page 2 of 2 T445 NW/37

RECORD OF BOREHOLE NO. 4

N. GR 4407.5841

Ground level: 30.8ft. above O.D. Newlyn (9.40m) Dia. of boring: 10in. and 8in.
 Type of boring: Shell and Auger Lining tubes: 10in. and 8in. to 15ft.

Daily Progress	Samples		Change of Strata			Description of Strata
	Depth	Type	Legend	Depth	O.D. Level	
				3'6"	27.3	TOPSOIL
	4'0" - 5'0"	C(16)		10'0"		Medium dense to very dense brown coarse SAND and medium to fine flint GRAVEL
	9'0"	C(17)		10'0"	20.8	Stiff brown CLAY with fine flint gravel
25.2.63	10'6" - 12'0"	U(17)		13'0"	17.6	Firm fissured grey CLAY with occasional fine flint gravel
	15'0"	D				
British Geological Survey	20'0" - 21'6"	U(18)				Clay samples taken at 20ft level & submitted for analysis of mineralogy. Refs 28-284.
	21'6"	D				
	25'0"	D				
	30'0" - 31'6"	U(19)				
	31'6"	D				
	35'0"	D				
	40'0" - 41'6"	U(20)				
	41'6"	D				
27.2.63	45'0"	D				Stiff to very stiff fissured grey CLAY becoming hard below about 30ft.; occasional shell fragments below about 35ft.
British Geological Survey	50'0" - 51'6"	U(21)				
	51'6"	D				
	55'0"	D				
	60'0" - 61'6"	U(22)				
	61'6"	D				
	65'0"	C				
	70'0" - 71'6"	U(23)				
	71'6"	D				
27.2.63	75'0"	D				
British Geological Survey	80'0" - 81'6"	U(24)		81'6"	-50.7	
	81'6"	D				
Amount of Material Available (1025)						
Key to type of sample: U (4) - 4 in. dia. undisturbed sample. U (1 1/2) - 1 1/2 in. dia. " " D - disturbed sample. BD - bulk disturbed sample. W - water sample. S () - standard penetration test. C () - dynamic cone penetration test. No. in brackets gives No. of blows/12 in. penetration.			Remarks: (Observations on ground-water, etc.) Water was added to assist boring through sand and gravel deposit. No ground-water was encountered during boring. On withdrawing lining tubes and backfilling to 10ft. depth there was a slight seepage of water into the hole.			
CAMBRIDGE, LIBRARY EXTENSION						Soils No: S/3529
GEORGE WIMPEY & CO., LTD.						FIG. 4
CENTRAL LABORATORY			HAYES			

SMD 621

Cementation soil mechanics department
Ground Engineering BOREHOLE No. D.1005.

CONTRACT **Cambridge Northern By-Pass.** REPORT No. 8639/SEQ




Client **Eastern Road Construction Unit.** Ground Level 60.40 m. O.D.

Site Address **Girton - Milton, Cambridgeshire.** Boring Commenced 10.6.71
Boring Completed 10.6.71

Type and Dia. of Boring **Shell and Auger 200 mm. diameter.** TL36SE/1
3698.6018

Water Strikes	Water Levels Recorded During Boring m						
	Hole Depth	Casing Depth	Water Level				
1. None							
2.							
3.							

Remarks

Description	Scale 20mm = 1m		Samples		Depth m	S.P.T. N
	Depth	Legend	Ref. No.	Type		
Topsoil	0.45		5539	J	0.60	
Very stiff brown and grey mottled boulder clay with chalk (CI to CH).			5540	U	0.75-1.20	
	1.50		5541	J	1.50	

Code: U—Undisturbed Sample D—Lama Disturbed Sample I—In Situ W—Water

SHEET No

SMD 621

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

SHEET No

Cementation soil mechanics department		BOREHOLE No.			
Ground Engineering		D.1010			
CONTRACT Cambridge Northern Hy-Pass.		REPORT No. 8639/SEQ			
Client Eastern Road Construction Unit.		Ground Level 55.2 m. O.D			
Site Address Girton - Milton, Cambridgeshire.		Boring Commenced 21.5.71 Boring Completed 21.5.71			
Type and Dia. of Boring Shell and Auger 200 mm. diameter.		TL36SE/2 5731.6002			
Water Strikes		Water Levels Recorded During Boring m			
1. 6.40	Hole Depth 7.50				
2. (medium)	Casing Depth 7.30				
3.	Water Level None				
Remarks					
Description	Scale 20mm = 1m		Samples	Depth m	S.P.T. N
	Depth	Legend			
Topsoil.	0.15		7729	J	0.30
Stiff brown sandy boulder clay with specks of chalk (CL to CI)	0.50		7730	J	0.60
Very stiff brown and grey mottled boulder clay with chalk (CI to CH)			7731	U	1.50-1.95
			7732	J	2.25
			7733	J	2.70
			7734	U	2.80-3.25
			7735	J	3.50
			7736	J	4.20
			7737	U	4.50-4.95
			7738	J	5.25
			7739	J	6.90
			7740	J	7.30
Very stiff dark grey silty boulder clay with chalk, with occasional small pockets of sand and gravel (CI to CH)			7741	U	7.50-7.95
			7742	J	8.25
			7743	J	8.70
			7744	W	(6.40)
	8.70				

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

SMD 621

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

SHEET No

Cementation Ground Engineering		soil mechanics department		BOREHOLE No. B.1009	
CONTRACT Cambridge Northern By-Pass.			REPORT No. 8639/SEQ		
Client Eastern Road Construction Unit.			Ground Level 59.7 m. O.D.		
Site Address Girton - Milton, Cambridgeshire.			Boring Commenced 19.5.71 Boring Completed 20.5.71		
Type and Dia. of Boring Shell and Auger 200 mm. diameter.			TL3SNE 29 3711-5994		
Water Strikes		Water Levels Recorded During Boring m			
1. None.	Hole Depth				
2.	Casing Depth				
3.	Water Level				
Remarks					
Description	Scale 20mm = 1 m.		Samples		S.P.T.
	Depth	Legend	Ref. No.	Type	Depth m
Topsoil.	0.15				
Stiff brown boulder clay with specks of chalk (CI to CH)	0.50		2179	J	0.40
			2180	J	0.60
Very stiff brown and grey mottled boulder clay with chalk (CI)			2181	U	1.00-1.45
			2182	J	1.75
			2183	U	2.50-2.95
			2184	J	3.25
	3.80		2185	J	3.90
Very stiff to hard dark grey silty boulder clay with chalk (CI to CH)			2186	U	4.00-4.45
			2187	J	4.95
			2188	U	5.50-5.95
			2189	J	6.25
			2190	U	7.00-7.45
			2191	J	7.75
			2192	U	8.50-8.95

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

SMD 022

Cementation Ground Engineering

soil mechanics department

B.1009

Continuation Sheet No. 1

CONTRACT Cambridge Northern By-Pass.

REPORT No. 8639/SEQ
~~TL3SNE 29. 511. 394~~

Description	Scale 20mm = 1 m.		Samples		Depth	S.P.T. N blows/ft
	Depth	Legend	Ref. No.	Type		
Very stiff to hard dark grey silty boulder clay with chalk (CI to CH) (contd.)			2193	J	9.25	
			2194	U	10.00-10.45	
			2195	J	10.75	
			2196	U	11.50-11.95	
			2197	J	12.25	
			2198	U	13.00-13.45	
			2199	J	13.75	
			2200	U	14.50-14.90	
			7701	J	15.25	
			7702	U	16.00-16.45	
			7703	J	16.75	
			7704	U	17.50-17.95	
		7705	J	18.25		
		7706	U	19.00-19.45		
		7707	J	19.75		
		7708	U	20.50-20.95		

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

SHEET NO

SMD 622

**Cementation
Ground Engineering**

soil mechanics department

B.1009

Continuation Sheet No. 2

CONTRACT Cambridge Northern By-Pass.

REPORT No 8639/SEQ
T.S.S.NE/29 3711.5994

Description	Scale 20mm = 1 m.		Samples		Depth	S.P.T. N blows/ft
	Depth	Legend	Ref.No.	Type		
Very stiff to hard dark grey silty boulder clay with chalk (CI to CH) (cont'd.)			7709	J	21.25	
			7710	U	22.00-22.45	
			7711	J	22.75	
			7712	U	23.50-23.95	
			7713	J	24.00	

SHEET No

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>					Site A428 Caxton Common to Hardwick Improvement		Trialpit Number TP8/19	
Excavation Method Rubber duck		Dimensions 2.6 x 0.7		Ground Level (mOD) 61.74		Client Highways Agency		Job Number 2203
Location 536990 E 259897 N		Dates 06/09/01 - 06/09/01		Engineer Parsons Brinckerhoff		Sheet 1/1		
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.50	J1			61.44	(0.30) 0.30 (0.30)	TOPSOIL		
1.00	B1			61.14	0.60	Firm to stiff fissured, brown CLAY with some subangular to subrounded fine to coarse gravel of chalk and flint.		
1.50	J2					Stiff fissured grey blue mottled brown CLAY with fine to coarse, subangular to subrounded gravel of chalk and flint. Occasional boulder size, cobble size ironstone at 2 - 2.5m BGL.		
2.00	B2				(2.40)			
2.50	J3							
3.00	B3			58.74	3.00	Complete at 3.00m		
Plan						Remarks Pit dry and stable		
						Scale (approx) 1:40		
						Logged By JG		Figure No. 2203.TP819

IAN FARMER ASSOCIATES <i>Geotechnical and Environmental Investigations</i>						Site A428 Caxton Common to Hardwick Improvement		Trialpit Number TP8/13	
Excavation Method JCB 3CX		Dimensions 2.6 x 0.7		Ground Level (mOD) 60.79		Client Highways Agency		Job Number 2203	
		Location 536826 E 260000 N		Dates 11/09/01 - 11/09/01		Engineer Parsons Brinckerhoff		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
					(0.40)	TOPSOIL			
0.50	J1			60.39	0.40	Stiff fissured light brown CLAY with some fine to coarse subangular to subrounded gravel of flint and chalk.			
0.70	240.0kPa		240/Av. 240.0	60.19	(0.20)				
1.00	B1					Stiff fissured grey mottled brown CLAY with much fine to coarse subangular to rounded gravel of flint and chalk.			
1.50	J2				(2.40)				
2.00	B2					Complete at 3.00m			
2.50	J3								
3.00	B3			57.79	3.00				
Plan						Remarks Pit dry and stable			
						Scale (approx) 1:40			
						Logged By JG		Figure No. 2203.TP8/13	

T/36/SE/38
3785 6228

1

187/117 Proctor's Farm, High Street, Dry Drayton

45-11
Surface +148. Lining tubes: 98 x 5 in. LGS +54. R.W.L. +63. Suction +53.
Yield 400 g.p.h. (test). I/c engine. Lock, G., 1933.

Boulder Clay	...	25	25
G	...	69	94
LGS	...	10	104

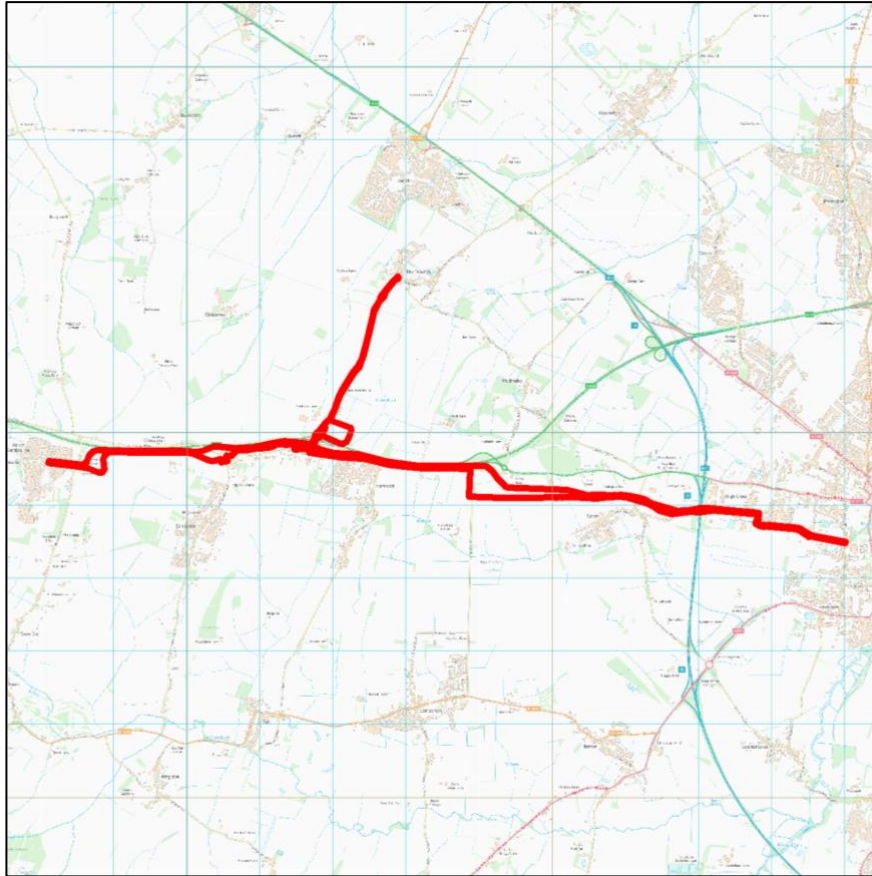
Boulder clay	25	Made ground and boulder clay	25'	25'
Gravel	69	Clay	69'	94'
LGS	10	Sand, clean	10'	104'

17.3.64.

E. Preliminary UXO Risk Assessment Report

PRELIMINARY UNEXPLODED ORDNANCE (UXO) THREAT ASSESSMENT

Meeting the requirements of *CIRIA C681* 'Unexploded Ordnance (UXO) – A guide for the Construction Industry' Risk Management Framework



PROJECT NUMBER	8028	ORIGINATOR	D. Barrett
VERSION NUMBER	2.0	REVIEWED BY	L. Gregory (18 th March 2020)
CLIENT	Mott MacDonald	RELEASED BY	M. Cornforth (18 th March 2020)
STUDY SITE	A428 Cambourne to Cambridge		
RECOMMENDATION	The "High" threat zone of the Study Site requires a Detailed UXO Threat and Risk Assessment		
	No further action is required in the "Low" threat zone to address the UXO risk		



STUDY SITE

The Study Site is described as “A428 Cambourne to Cambridge”, and it is centred on National Grid Reference 538867, 259282.

THREAT POTENTIAL AND RECOMMENDATIONS

The potential for a UXO hazard to occur, and more specifically, the potential for unexploded WWI and WWII ordnance to exist at the Study Site is assessed as being **LIKELY** in certain areas (*Figure 2*).

In accordance with *CIRIA C681 Chapter 5 on managing UXO risks*, *6 Alpha* recommends that the next stage in the risk management framework is:

DETAILED UXO THREAT & RISK ASSESSMENT

We would be pleased to provide this service, please contact *6 Alpha Associates* for further details.

Nonetheless, the potential for a UXO hazard to occur, and more specifically, the potential for unexploded WWI and WWII ordnance to is assessed as being **UNLIKELY** in the majority of the Study Site (*Figure 2*).

In accordance with *CIRIA C681 Chapter 5 on managing UXO risks*, *6 Alpha* concludes that **NO FURTHER ACTION** is required to address the UXO risk in this section of the Study Site. Should you have any queries, please contact *6 Alpha*.

REPORT SUMMARY

During WWII, the Study Site was situated within *Chesterton Rural District* and *Cambridge Municipal Borough*, which recorded one and three High Explosive (HE) bomb strikes per 100 hectares respectively; both very low levels of bombing. *Luftwaffe* aerial reconnaissance photography associated with the Study Site did not identify any primary bombing targets on-site or within 1,000m of the Study Site boundary. However, *Royal Air Force (RAF) Bourn* was located on-site, which would have been considered a primary bombing target had the *Luftwaffe* known of its existence. Moreover, analysis of official *RAF* plans identified several “*Bomb Stores*” (665m south-east), which corroborates further research which identified *RAF Bourn* as a designated *Bomber Command Base*.

Air Raid Precaution (ARP) records did not identify any HE bomb strikes on-site. However, six HE bomb strikes were identified as landing on *RAF Bourn*, some of which could have been on-site. In addition, eleven HE bomb strikes were identified landing near *St Johns College* 890m east-north-east of the Study Site boundary.

Official bomb damage mapping was not available. In addition, an analysis of post-war mapping did not identify any areas of potential bomb damage on-site or within 1,000m, however further research identified bomb damage to *Bridge Street* 900m east-north-east.

Given that *RAF Bourn* was located in the western sector of the Study Site and bomb strikes may have occurred on-site; it would suggest that further action is warranted to address the potential for UXO encounter in the “High” threat zone. However, there is no evidence to suggest that further investigation into UXO is warranted for the “Low” threat zone of the Study Site.

USING THIS REPORT

This Preliminary Assessment is designed to inform environmental and construction professionals of the potential threat of military related explosives and/or ordnance on, or in, the vicinity of the Study Site.

This assessment is designed to be employed as a site-screening tool to meet with the requirement of Phase One of the *CIRIA UXO Risk Management Framework*; there are two broad prospective outcomes; either the threat level requires a detailed threat & risk assessment; or no further action is required. In the former instance we can provide a report within 10 working days (or more quickly upon application).

Two figures accompany the report, the *Second World War (WWII)* High Explosive (HE) Bomb Density and the final Probability of UXO Encounter. The purpose of this approach is to demonstrate that whilst bomb density statistics give an indication for WWII bombing, they should not be relied upon exclusively to generate a holistic assessment.












For further information, please contact *6 Alpha*:

Website: <http://www.6alpha.com>

Telephone: +44 (0)2033 713 900

Email: enquiry@6alpha.com

DATA FINDINGS

Threat Source (within 1,000m)	Detail	
	Identified	Comments
 Airfields/Military Facilities	✓	<i>RAF Bourn (on-site) and Cambridge Camp (180m south).</i>
 Ordnance Manufacture/Storage	✗	None recorded within 1,000m.
 WWII Decoy Bombing Sites	✓	Starfish Decoy Site (620m south).
 WWII Defensive Features	✓	A pillbox (475m south-west).
 WWII <i>Luftwaffe</i> Designated Bombing Targets	✗	<i>Luftwaffe</i> aerial photography did not identify any primary bombing targets on-site or within 1,000m of the Study Site boundary.
 WWII Bomb Strikes Within Study Site Boundary	✓	Further research identified bomb strikes at <i>RAF Bourn</i> , potentially on-site.
 WWII Bomb Strikes Near Study Site Boundary	✓	ARP records identified eleven HE bomb strikes (890m east-north-east).
 WWII Bomb Damage	✓	Further research identified bomb damage (900m east-north-east).
 Abandoned Bomb Register	✗	The official abandoned bomb list did not identify any abandoned bombs on-site or within 1,000m of the Study Site boundary.
 Potential Threat Sources	✓	The most probable UXO threat is posed by WWII <i>German</i> HE bombs and <i>British</i> HE bombs, AXO/LSA/SAA.
 WWII Bombing Density Per 100 Hectares	✓	<i>Chesterton Rural District</i> and <i>Cambridge Municipal Borough</i> , which recorded one and three HE bomb strikes per 100 hectares.

IMPORTANT NOTES

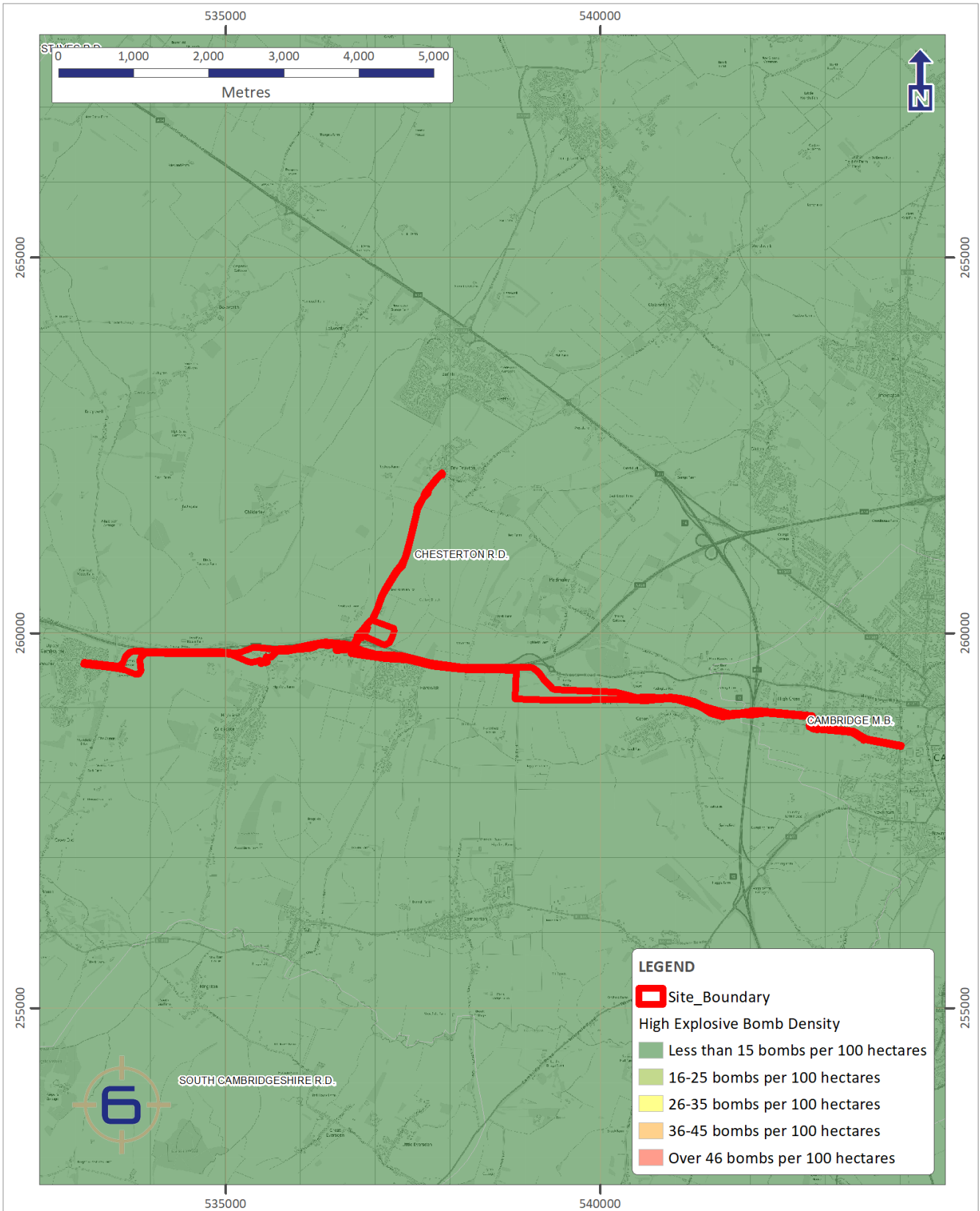
1. The term 'Preliminary UXO Threat Assessment' has been used to describe this report, to fall in line with the *CIRIA* C681 guidelines. Whilst the term 'Risk' can be justifiably used at this stage, the reader should note that the 'Consequence' function of 'Risk' is not considered. Should it be required, this would be addressed in the 'Detailed UXO Threat & Risk Assessment' (Stages 2 and 3).
2. This report is accurate and up to date at the time of writing.
3. The assessment levels have been generated from historical data and third-party sources. Where possible *6 Alpha* have sought to verify the accuracy of such data, but cannot be held accountable for inherent errors that may be in third party data sets (e.g. *National Archives* or library sources).
4. *6 Alpha* have exercised all reasonable care, skill and due diligence in producing this service.
5. Whilst every effort has been used to identify all potential UXO/explosive threats, there were a number of private facilities, which may not have released privately recorded information concerning UXO/explosive threats into the public domain. It is therefore possible that some of the aforementioned sites may not be included within the database.



BRITISH NATIONAL GRID

A428 CAMBOURNE TO CAMBRIDGE

WWII High Explosive Bomb Density



LEGEND

- Site_Boundary
- High Explosive Bomb Density
 - Less than 15 bombs per 100 hectares
 - 16-25 bombs per 100 hectares
 - 26-35 bombs per 100 hectares
 - 36-45 bombs per 100 hectares
 - Over 46 bombs per 100 hectares

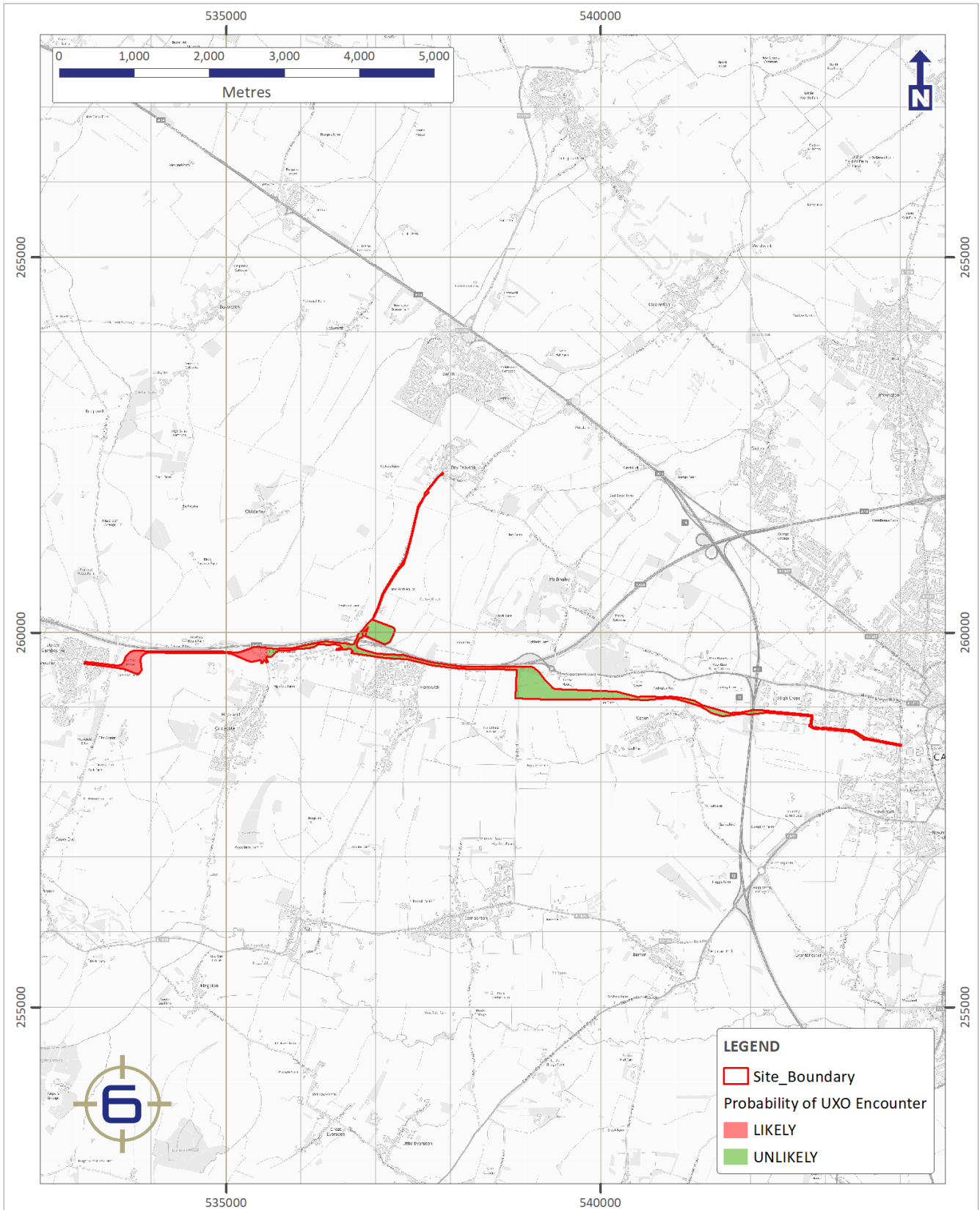
PROJECT NO. 8028	FIGURE 1	DRAWN LH	CHECKED LG	DATE 17 March 2020	Contains Ordnance Survey data © Crown copyright and database right 2017	Produced by and Copyright to 6 Alpha Associates Ltd. Users noting any errors please notify 6 Alpha.	
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BRITISH NATIONAL GRID

A428 CAMBOURNE TO CAMBRIDGE

Probability of UXO Encounter



LEGEND

- Site_Boundary
- Probability of UXO Encounter
- LIKELY
- UNLIKELY

PROJECT NO. 8028	FIGURE 2	DRAWN LH	CHECKED LG	DATE 17 March 2020	Contains Ordnance Survey data © Crown copyright and database right 2017	Produced by and Copyright to 6 Alpha Associates Ltd. Users noting any errors please notify 6 Alpha.	alpha ASSOCIATES
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F. Geotechnical Risk Register

The Geotechnical Risk Register for the scheme is detailed in Table F.5. The risks associated with other aspects of the scheme, such as procedures and contractual and strategic issues are not dealt with here and the scheme risk register should be consulted for information on these elements.

The methodology is based on advice given in HD22/08. The Geotechnical Risk Register should be considered as a live document and updated throughout the course of the scheme. It is incumbent on all parties involved in the scheme to advise the other members when the risks change.

Various threats are identified and the potential consequences of these occurring are described (Table F.1). The risk assessment is qualitative and the various threat are assessed using the following

criteria:

- Cost;
- Programme;
- Health and Safety; and,
- Environment.

The risk is derived by considering the impact and likelihood for each threat and opportunity. Both the impact and likelihood have been assessed using a scale of 1 to 5, corresponding to “very low” to “very high” for impact and “negligible / improbable” to “very likely / almost certain” for likelihood. These ratings are summarised in Table F.1 and Table F.2.

Table F.1: Hazard impact table

Impact			Cost	Programme	Health and Safety	Environment
1	Very Low	Negligible	Negligible	Negligible effect on programme	Negligible	Negligible
2	Low	Significant	1% Budget	5% effect on programme	Minor injury	Minor environmental incident
3	Medium	Serious	10% Budget	12% effect on programme	Major injury	Environmental incident requiring management input
4	High	Threat to future work and Client relations	20% Budget	25% effect on programme	Fatality	Environmental incident leading to prosecution or protestor action
5	Very High	Threat to business survival and credibility	50% Budget	50% effect on programme	Multiple fatalities	Major environmental incident with irreversible effects and threat to public health or protected natural resource

Table F.2: Hazard likelihood index

Likelihood		Probability
1	Negligible / Improbable	< 1%
2	Unlikely / Remote	> 1%
3	Likely / Possible	> 10%
4	Probable	> 50%
5	Very Likely / Almost Certain	> 90%

The risk score is calculated by multiplying the impact score by the likelihood score, giving the scores shown in Table F.3. The actions required depending on the risk score are shown in Table F.4.

Table F.3: Risk level matrix

		Impact				
		1	2	3	4	5
Likelihood	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

Using the matrix in Table F.3, the scores are categorised into the following four threat levels

- Negligible (0 - 4);
- Tolerable (5 - 9);
- Significant (10 - 12); and,
- Intolerable (15 - 25).

The actions required depending on the risk score are shown in Table F.4

Table F.4: Designer Actions

Risk Product (I x L)	Risk Level	Description	Action by Designer
1 – 4	N	Negligible	None
5 – 9	A	Acceptable	Check that risks cannot be further reduced by simple design changes
10 – 12	H	High	Amend design to reduce risk or seek alternative option. Only accept option if justifiable on other grounds
15 – 25	S	Severe	Amend design to reduce risk or seek alternative option. Only accept option if justifiable on other grounds

Ground investigation can help to mitigate ground and groundwater risks; however, these risks cannot be eliminated. Ground investigations by their nature can only investigate and monitor a small part of the sub-surface conditions for a limited duration. Conditions on site identified during construction could reveal ground conditions that could not have been taken into account from the results of the ground investigation.

It is recommended that adequate and appropriate supervision must be provided during construction to assess the ground conditions encountered and interpret the results of the

site testing. When appropriate this supervision during construction should be undertaken by a suitably experienced and qualified Engineering Geologist / Geotechnical Engineer.

Table F.5 highlights the potential hazards that could be encountered during the site investigation and/or construction. The consequence of the hazard is outlined and a score is given for the impact and likelihood for this hazard, giving an overall risk, which is categorised as either a cost, time environment or health and safety. From this potential control measures are stated to alleviate hazard, leading to a rescoring of the impact and likelihood, resulting in a residual risk.

Table F.5: Geotechnical Risk Register

Threat	Consequence	Impact				Likelihood	Risk				Risk Control Measures / Actions to Mitigate	Owner	Action By
		Cost	Programme	Health and Safety	Environment		Cost	Programme	Health and Safety	Environment			
1. Service / structure strike i.e. power cables, water mains and sewers	<ul style="list-style-type: none"> Potential for serious injury to construction workers and disruption of service; and, Delays to construction, severe financial and political repercussion. 	2	3	4	1	3	6	9	12	6	<ul style="list-style-type: none"> Thorough review of detailed service search prior to conducting works; and, Maintain vigilance and adopt best practice during ground investigation and construction 		
2. Presence of UXO	<ul style="list-style-type: none"> Potential serious injury to construction workers, damage to plant and/or structures; and, The Preliminary UXO Risk Assessment identified the potential for unexploded WWI and WWII ordnance to exist at the site, as being unlikely in Zones 3 – 8, and in the east of Zone 2, and likely in Zones 1 and in the west of Zone 2, likely associated with Bourn Airfield 	3	3	5	3	4	12	12	20	12	<ul style="list-style-type: none"> It is recommended that a Detailed UXO Threat & Risk Assessment is undertaken prior to intrusive works to determine any mitigation measures required in Zones 1 and 2. 		
3. Artificial Ground	<ul style="list-style-type: none"> Settlement issues, including differential settlement; Varying engineering properties; Moisture sensitive; Possible obstructions (see 13); Potential low bearing capacity; Presence of soft spots, Potential aggressive ground (see 18); and Possible contamination (see 15). 	4	4	3	3	3	12	12	9	9	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, A suitably qualified Engineering Geologist / Geotechnical Engineer should supervise excavation of materials. 		
4. Oadby Member	<ul style="list-style-type: none"> Variable lithologies and thickness; Stability issues in excavations; Potential to contain boulders which may pose as obstructions to construction; 	3	3	3	2	4	12	12	12	8	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, 		

Threat	Consequence	Impact				Likelihood	Risk				Risk Control Measures / Actions to Mitigate	Owner	Action By
		Cost	Programme	Health and Safety	Environment		Cost	Programme	Health and Safety	Environment			
	<ul style="list-style-type: none"> Potential perched water in granular beds which may be present (see 14); and, Secondary Aquifer (Undifferentiated). 										<ul style="list-style-type: none"> A suitably qualified Engineering Geologist / Geotechnical Engineer should supervise excavation of materials. 		
5. Kimmeridge Clay	<ul style="list-style-type: none"> Variable weathering profile; Potential for beds of siltstone/cementstone which may pose as obstructions for foundations; May contain variable organic content and be sensitive to changes in moisture content; Potential aggressive ground (see 18); Potential for shrink/swell behaviour; and, Unproductive Strata 	3	2	3	2	2	6	4	4	4	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, A suitably qualified Engineering Geologist / Geotechnical Engineer should supervise excavation of materials. 		
6. Woburn Sands Formation	<ul style="list-style-type: none"> Vertical and lateral stability; Varying relative density/engineering properties; Possible groundwater; Stability issues in excavations; Potential pathways for contamination migration (see 15); and, Principal Aquifer 	3	3	3	2	2	6	6	6	4	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, A suitably qualified Engineering Geologist / Geotechnical Engineer should supervise excavation of materials. 		
7. Gault Formation	<ul style="list-style-type: none"> May be overlain by periglacial altered deposits such as fossil solifluction sheets or head deposits, which may contain relict shear surfaces; Variable weathering profile; Settlement issues, including differential settlement; Potential for shrink/swell behaviour; Sensitive to changes in moisture content; 	4	4	4	1	3	12	12	12	3	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, A suitably qualified Engineering Geologist / Geotechnical Engineer should supervise excavation of materials. 		

Threat	Consequence	Impact				Likelihood	Risk				Risk Control Measures / Actions to Mitigate	Owner	Action By
		Cost	Programme	Health and Safety	Environment		Cost	Programme	Health and Safety	Environment			
	<ul style="list-style-type: none"> Vertical and lateral stability, and prone to land sliding due to its engineering properties; Potential for beds of mudstone which may pose as obstructions for foundations; Potential aggressive ground (see 18); Unproductive Strata 												
8. West Melbury Marly Chalk Formation	<ul style="list-style-type: none"> Variable weathering and strength profile; Stability issues in excavations where weathered; Potential groundwater; Potential pathways for contamination migration (see 15); Solubility risk; and, Principal Aquifer. 	4	4	3	3	3	12	12	9	9	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, A suitably qualified Engineering Geologist / Geotechnical Engineer should supervise excavation of materials. 		
9. Folding and faulting of bedrock	<ul style="list-style-type: none"> Localised folding and faulting may alter the underlying geology; and, Potential for small unmapped faulting (associated with folding) to be present, leading to areas of increases weathering and low strength, forming potential groundwater / contaminant pathways. 	2	2	1	2	2	4	4	2	4	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, A suitably qualified Engineering Geologist / Geotechnical Engineer should supervise excavation of materials. 		
10. Sensitivity of units to change in moisture content	<ul style="list-style-type: none"> Trafficability and strength of units i.e. Oadby Member and Gault Formation may reduce with change in moisture content. 	2	2	2	2	3	6	6	6	6	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, A suitably qualified Engineering Geologist / Geotechnical Engineer should supervise excavation of materials. 		

Threat	Consequence	Impact				Likelihood	Risk				Risk Control Measures / Actions to Mitigate	Owner	Action By
		Cost	Programme	Health and Safety	Environment		Cost	Programme	Health and Safety	Environment			
11. Frost susceptibility of units	<ul style="list-style-type: none"> Units highly susceptible to frost e.g. Artificial Ground and Chalk have the potential to heave and affect pavements if not dealt with accordingly. 	3	3	2	1	3	9	9	6	3	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, A suitably qualified Engineering Geologist / Geotechnical Engineer should supervise excavation of materials. 		
12. Presence of solution features within soluble bedrock	<ul style="list-style-type: none"> Potential for near surface cavities within bedrock (Chalk), leading to reduced rock strength, subsidence or collapse. 	3	3	2	2	3	9	9	6	6	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, Previous construction plans / drawings may help identify possible location of foundations 		
13. Underground voids, concrete and relict foundations from previous site use	<ul style="list-style-type: none"> Foundations and unknown voids may be present; and, Potential shallow sub-surface obstructions impacting construction. 	3	3	3	2	2	6	6	6	4	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; Best practice during construction; and, Previous construction plans / drawings may help identify possible location of foundations 		
14. Groundwater	<ul style="list-style-type: none"> No site-specific groundwater information is available Historical boreholes indicate that perched groundwater is likely to be encountered near surface in the Oadby Member 	3	3	2	2	3	9	9	6	6	<ul style="list-style-type: none"> Undertake a detailed ground investigation prior to design, including groundwater monitoring over both short and long-term timeframes. 		
15. Ground and groundwater contamination	<ul style="list-style-type: none"> Risks to operatives who come into contact with contaminated material during the works; Risk of exposure of surrounding environment to contamination; and, 	4	4	3	3	3	12	12	9	9	<ul style="list-style-type: none"> An assessment on the presence of contamination within the soils and/or groundwater at site should be undertaken as part of any ground investigation works; and, 		

Threat	Consequence	Impact				Likelihood	Risk				Risk Control Measures / Actions to Mitigate	Owner	Action By
		Cost	Programme	Health and Safety	Environment		Cost	Programme	Health and Safety	Environment			
	<ul style="list-style-type: none"> Pathways could be opened up that may lead to the contamination of groundwater and soils. 										<ul style="list-style-type: none"> Areas with signs of pollution should be focused on. 		
16. Ground gases / vapours	<ul style="list-style-type: none"> Risks to construction worker health, design changes to structures; and, Potential build-up of ground gas below structures could be harmful to occupants. 	2	2	4	2	3	6	6	12	6	<ul style="list-style-type: none"> Gas monitoring and subsequent gas protection measures (if required), should be included in ground investigation; and, Maintain vigilance and adopt best practice during construction. 		
17. Flooding of site (surface or groundwater flooding)	<ul style="list-style-type: none"> Damage to equipment, delay of works, require for review of design to mitigate against future flooding events Based on the Envirocheck Report, the vast majority of the site is recorded as no to low risk of surface water flooding, with areas at medium to high-risk associated with ponds, drains and existing surface water features. There is potential for groundwater flooding to occur in some areas of the site (See Section 4.9). 	2	2	3	2	2	4	4	6	4	<ul style="list-style-type: none"> It is recommended that a site-specific Flood Risk Assessment is undertaken to assess the risk of flooding at the site. Include any appropriate mitigation within the proposed design. 		
18. Potential for aggressive ground conditions on site	<ul style="list-style-type: none"> Potentially high levels of sulphate within the Made Ground and natural strata at the site. This can lead to degradation of concrete strength and quality; and, Groundwater may pose a similar risk to subsurface infrastructure and foundations. 	3	3	2	2	3	9	9	6	6	<ul style="list-style-type: none"> Ensure chemical testing is conducted as part of the ground investigation; and, Lime treatment (if required) to reduce the pH of the soil. 		
19. Historic mining operations proximal to scheme (e.g. Coton Chalk Pits)	<ul style="list-style-type: none"> Potential for differential settlement of the backfill material to in-situ material Potential for material to be contaminated within the backfill; and, Historic Chalk mining recorded c. 150m south near Coton (Zone 4) 	3	3	2	2	2	6	6	4	4	<ul style="list-style-type: none"> Undertake a ground investigation prior to design; An assessment on the presence of contamination within the soils and/or groundwater at site should be undertaken 		

Threat	Consequence	Impact				Likelihood	Risk				Risk Control Measures / Actions to Mitigate	Owner	Action By
		Cost	Programme	Health and Safety	Environment		Cost	Programme	Health and Safety	Environment			
											as part of any ground investigation works; and, <ul style="list-style-type: none"> Areas with signs of pollution should be focused on. 		
20. Ecological / environmental constraints	<ul style="list-style-type: none"> Based on the Environmental Impact Assessment Scoping Report (see Section 3.5), surveys undertaken to date have identified the presence of badger setts within 250m of the proposed scheme, mostly occurring in the area between the M11 and Grange Road, and the grassland habitat at the Waterworks site at Madingley Mulch considered to be of most conservation significance and is considered a site of high value for invertebrates. TPO's and root protection areas are also recorded across the site. Further surveys are proposed to be undertaken and this report should be updated upon their completion. 	4	4	2	3	2	8	8	4	6	<ul style="list-style-type: none"> Review of ecological surveys should be conducted to understand how design can minimise effect on environment. 		
21. Archaeological constraints	<ul style="list-style-type: none"> The Environmental Impact Assessment Scoping Report records the results of an archaeological assessment and surveys across the site. This summarises several archaeological features ranging from the Lower/Middle Palaeolithic to Medieval, including Iron Age/Roman settlements. Several areas of known buried archaeology may be affected by the proposed scheme across the site (See Section 3.6 for further details). 	3	3	2	4	2	6	6	4	8	<ul style="list-style-type: none"> Review of archaeological surveys should be conducted to understand how design can minimise any potential effects on archaeological sites/finds which may be present within the site footprint and surrounding area. 		

G. Contaminated Land Risk Assessments and Conceptual Site Models

Table G.1: Geoenvironmental Preliminary Risk Assessment – Zone 1

Source	Pathway	Receptor	Consequence	Probability	Unmitigated Risk	Mitigated Risk	Comments
<p><u>On-site:</u></p> <p>S1: Potentially contaminated artificial ground on-site from historical and current land uses e.g. Bourn Airfield and associated ancillary buildings.</p> <p><u>Off-site:</u></p> <p>S2: Artificial ground and associated contamination from surrounding infrastructure and historical land uses i.e. A428, Bourn Airfield and related works and ancillary buildings.</p> <p>S3: Vehicles using existing infrastructure may have resulted in</p>	<p>P1: Human uptake pathways.</p> <p>P2: Horizontal and vertical migration of any volatile vapours resulting from potential fuel spillages and artificial ground.</p>	<p>R1: Construction workers.</p> <p>R2: Final end users (on-site users of the bus route).</p>	<p>Medium</p> <p>Medium</p>	<p>Likely</p> <p>Unlikely</p>	<p>Moderate</p> <p>Low</p>	<p>Low</p> <p>Low</p>	<p>Potential contaminants have been identified from various land uses (e.g. surrounding infrastructure and contemporary trade directory entries) but these are considered unlikely to represent gross contamination. The most significant source of contamination is the Bourn Airfield which covers the majority of Zone 1. It's history as a former RAF airfield suggests there is likely to be hazardous contaminants which could be encountered during works.</p> <p>Construction workers are more likely to come into contact with soil and potentially groundwater. Some earthworks (cutting) are proposed in Zone 1 – if materials are to be re-used elsewhere (within Zone 1 or another Zone e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan.</p>

fuel/oil spillages and airborne particulates.

S4: Industries within 250m of Zone 1 such as cleaners and engineering materials/manufacturers.

A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement.

The airfield may be a potential source for vapours and/or ground gas. Proposed works are unlikely to create any new pathways for exposure. No enclosed spaces are proposed on-site and any gases/vapours are likely to vent directly into the atmosphere.

Final end users will not come into contact with soil or groundwater on the site as the site will comprise hardstanding at ground level and site users will be inside vehicles, providing a barrier to any potential contaminants that may be present.

P3: Horizontal and vertical migration of contaminants in the unsaturated zone.

R3: Groundwater e.g. Oadby Member (Secondary Undifferentiated).

Medium

Unlikely

Low

Low

Although there is potential for significant contamination (i.e. Bourn Airfield), an increase in hardstanding will reduce the infiltration through any potentially contaminated soils on-site, therefore reducing mobility in the unsaturated zone beneath the route.

P4: Horizontal and vertical migration

The proposed works on-site (earthworks may be required – design

<p>of contaminants in the saturated zone.</p>	<p>P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.</p>	<p>unconfirmed) may create new pathways within the Oadby Member (a Secondary Undifferentiated aquifer - variable permeability and transmissivity). If materials are to be re-used elsewhere (within Zone 1 or another Zone) as part of the development (e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan.</p>	<p>It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone. The risk assessment should be updated when new information becomes available.</p>			
<p>R4: Groundwater e.g. Woburn Sands Formation (Principal) beneath the majority of the Zone i.e. Bourn Airfield (east side of Zone 3).</p>	<p>Medium</p>	<p>Unlikely</p>	<p>Low</p>	<p>Low</p>	<p>The thickness of the overlying Oadby Member (at least 17.5m thickness) and its variable permeability and transmissivity suggests that any contaminants in the superficial deposits are unlikely to reach the Principal aquifer in the short term, though it is possible in the long term (moderate risk).</p>	<p>The proposed works on-site (earthworks may be required – design unconfirmed) may create new pathways within the Oadby Member. This is unlikely to reach the Woburn Sands Formation due to the variable characteristics of the overlying Oadby Member its indicative thickness.</p>

It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone. The risk assessment should be updated when new information becomes available.

P6: Surface run-off along roads, pavements, and other surfaces e.g. soil.

R5: Surface water features e.g. drains/small streams.

Mild

Low
Likelihood

Low

Low

Small surface water bodies (nearby streams and drains) have been identified close to the site. There is also a relatively low risk of surface water flooding on-site. There is a greater risk of surface water flooding on the eastern side of the Bourn Airfield.

There is the potential for contaminants to wash into the nearby surface water bodies via surface run-off. An increase in hardstanding on-site is likely to decrease mobilisation of any minor soil contaminants by reducing infiltration. However, there may be increased run off from the hardstanding present on site after construction.

It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone and/or the quality of surface water bodies. The risk assessment should be updated when new information becomes available.

Sources:

- On-site**
S1: Potentially contaminated artificial ground on-site from historical and current land uses e.g. Bourn Airfield and associated ancillary buildings.
- Off-site**
S2: Artificial ground and associated contamination from surrounding infrastructure and historical land uses i.e. A428, Bourn Airfield and related works and ancillary buildings.
S3: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.
S4: Industries within 250m of Zone 1 such as cleaners and engineering materials/manufacturers.

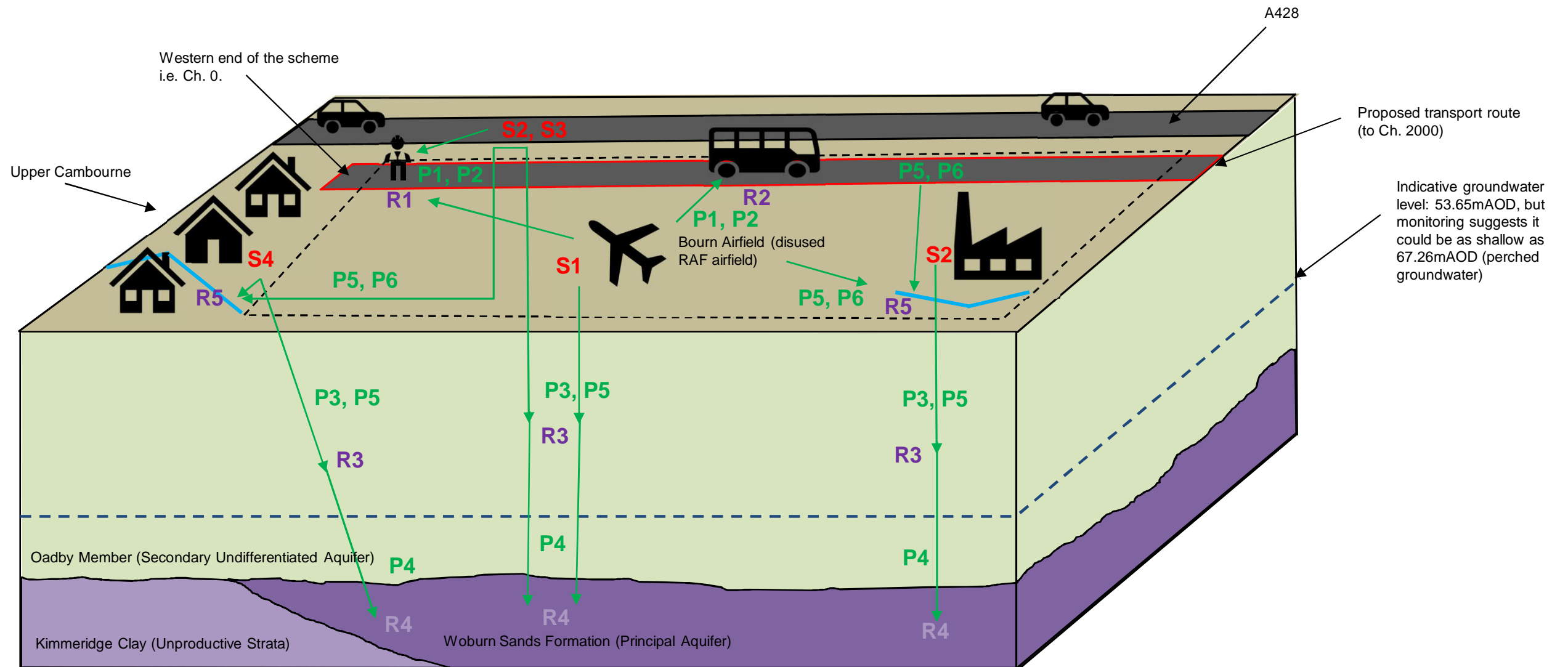
Pathways:

- P1:** Human uptake pathways.
- Direct soil and dust ingestion.
 - Skin contact with soils and dust.
 - Inhalation of outdoor dust vapours.
- P2:** Horizontal and vertical migration of any volatile vapours resulting from potential fuel spillages and artificial ground.
P3: Horizontal and vertical migration of contaminants in the unsaturated zone.
P4: Horizontal and vertical migration of contaminants in the saturated zone.
P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.
P6: Surface run-off along roads, pavements, and other surfaces e.g. soil.

Receptors:

- R1:** Construction workers.
R2: Final end users (i.e. users of the bus route).
R3: Groundwater e.g. Oadby Member (Secondary Undifferentiated).
R4: Groundwater e.g. Woburn Sands Formation (Principal) beneath the majority of the Zone i.e. Bourn Airfield (east side of Zone 3).
R5: Surface water features e.g. drains/small streams.

Approximate ground level: 71 – 72m AOD



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	Project: Cambourne to Cambridge Better Public Transport Project (C2C)	Key: Solid Geology – Woburn Sands Formation (not encountered) Solid Geology – Kimmeridge Clay (not encountered) Superficial – Oadby Member (>17.5m thickness – base not proven) Topsoil (0.2 – 0.4m thick) Surface water body	Notes: 1. This drawing is for information only. 2. This drawing is not for construction. 3. This drawing is not to scale. 4. The location of features shown is indicative only.	Originated	E Jeffrey	11.03.20
	Client: Greater Cambridge Partnership			Checked	J Southall	01.04.20
	Title: Conceptual Site Model – Zone 1			Approved	-	

Table G.2: Geoenvironmental Preliminary Risk Assessment – Zone 2

Source	Pathway	Receptor	Consequence	Probability	Unmitigated Risk	Mitigated Risk	Comments
<u>On-site</u> S1: Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways. S2: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.	P1: Human uptake pathways. P2: Horizontal and vertical migration of any volatile vapours resulting from potential fuel spillages and artificial ground.	R1: Construction workers.	Medium	Likely	Moderate	Low	<p>Potential contaminants have been identified from various land uses (e.g. surrounding infrastructure and contemporary trade directory entries) but these are considered unlikely to represent gross contamination. The biggest source of concern is the fuel station (currently in operation), located within 250m of the proposed route(s).</p> <p>The active fuel station may be a potential source for vapours if any leaks or spills have occurred during operation (i.e. underground fuel tanks).</p> <p>No enclosed spaces are proposed on-site and any gases/vapours are likely to vent directly into the atmosphere. Construction workers are more likely to come into contact with soil and groundwater.</p> <p>Some earthworks (e.g. cutting) are proposed in Zone 2 – if materials are to be re-used elsewhere (within Zone 2 or another Zone e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan.</p> <p>A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to</p>
		R2: Final end users (on-site bus route users, road users).	Medium	Unlikely	Low	Low	
		R3: Final end users (off-site residential).	Medium	Unlikely	Low	Low	
<u>Off-site</u> S3: Potential contamination from the presence of a fuel station i.e. fuel/oil spillages and airborne							

<p>particulates (potential on-site source).</p> <p>S4: Large areas surrounding land are currently designated as agricultural fields so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.</p>							<p>construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement.</p> <p>Final end users (bus route) will not come into contact with soil or groundwater on the site as the site will comprise hardstanding at ground level and site users will be inside vehicles, providing a barrier to any potential contaminants that may be present.</p> <p>There are a small number of residential site users to the north of Wellington Way Roundabout. They are not likely to be affected by the current proposed OBC route – if the proposed route changes then the risk assessment should be revised accordingly.</p>
	<p>P3: Horizontal and vertical migration of contaminants in the unsaturated zone.</p>	<p>R4: Groundwater e.g. Oadby Member (Secondary Undifferentiated).</p>	Medium	Low Likelihood	Moderate / Low	Moderate / Low	<p>An increase in hardstanding will reduce the infiltration through any potentially contaminated soils on-site, therefore reducing mobility in the unsaturated zone beneath the route.</p>
	<p>P4: Horizontal and vertical migration of contaminants in the saturated zone.</p> <p>P5: Migration of contaminants along</p>	<p>R5: Groundwater e.g. Woburn Sands Formation (Principal) beneath the western half of Zone 2.</p>	Medium	Unlikely	Low	Low	<p>The proposed works on-site are likely to involve earthworks, which could create contamination pathways within the Oadby Member (a Secondary Undifferentiated aquifer). This is unlikely to reach the Woburn Sands Formation due to the variable characteristics of the overlying Oadby Member its indicative thickness.</p> <p>If materials are to be re-used elsewhere (within Zone 2 or another Zone) as part of</p>

<p>engineered preferential pathways e.g. construction activity, potential drainage systems.</p>	<p>the development (e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan.</p>					
<p>P6: Surface run-off along roads, pavements, and other surfaces e.g. soil.</p>	<p>R6: Surface water features e.g. drains.</p>	<p>Mild</p>	<p>Likely</p>	<p>Moderate / Low</p>	<p>Moderate / Low</p>	<p>Drains are present in the western side of Zone 2. There is also a relatively low risk of surface water flooding on the majority of the site. There is a greater risk of surface water flooding on the current road network e.g. Wellington Way.</p>
						<p>There is the potential for contaminants to wash into the nearby surface water bodies via surface run-off. An increase in hardstanding on-site is likely to decrease mobilisation of any minor soil contaminants by reducing infiltration. However, there may be increased run off from the hardstanding present on site after construction.</p>
						<p>It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone and/or the quality of surface water bodies. The risk assessment should be updated when new information becomes available.</p>

Sources:

On-site

S1: Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways.

S2: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.

Off-site

S3: Potential contamination from the presence of a fuel station i.e. fuel/oil spillages and airborne particulates (potential on-site source).

S4: Large areas surrounding land are currently designated as agricultural fields so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.

Pathways:

P1: Human uptake pathways.

- Direct soil and dust ingestion.
- Skin contact with soils and dust.
- Inhalation of outdoor dust vapours.

P2: Horizontal and vertical migration of any volatile vapours/ground gas resulting from potential fuel spillages and artificial ground.

P3: Horizontal and vertical migration of contaminants in the unsaturated zone.

P4: Horizontal and vertical migration of contaminants in the saturated zone.

P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.

P6: Surface run-off along roads, pavements, and other surfaces e.g. soil.

Receptors:

R1: Construction workers.

R2: Final end users (i.e. bus route users, road users).

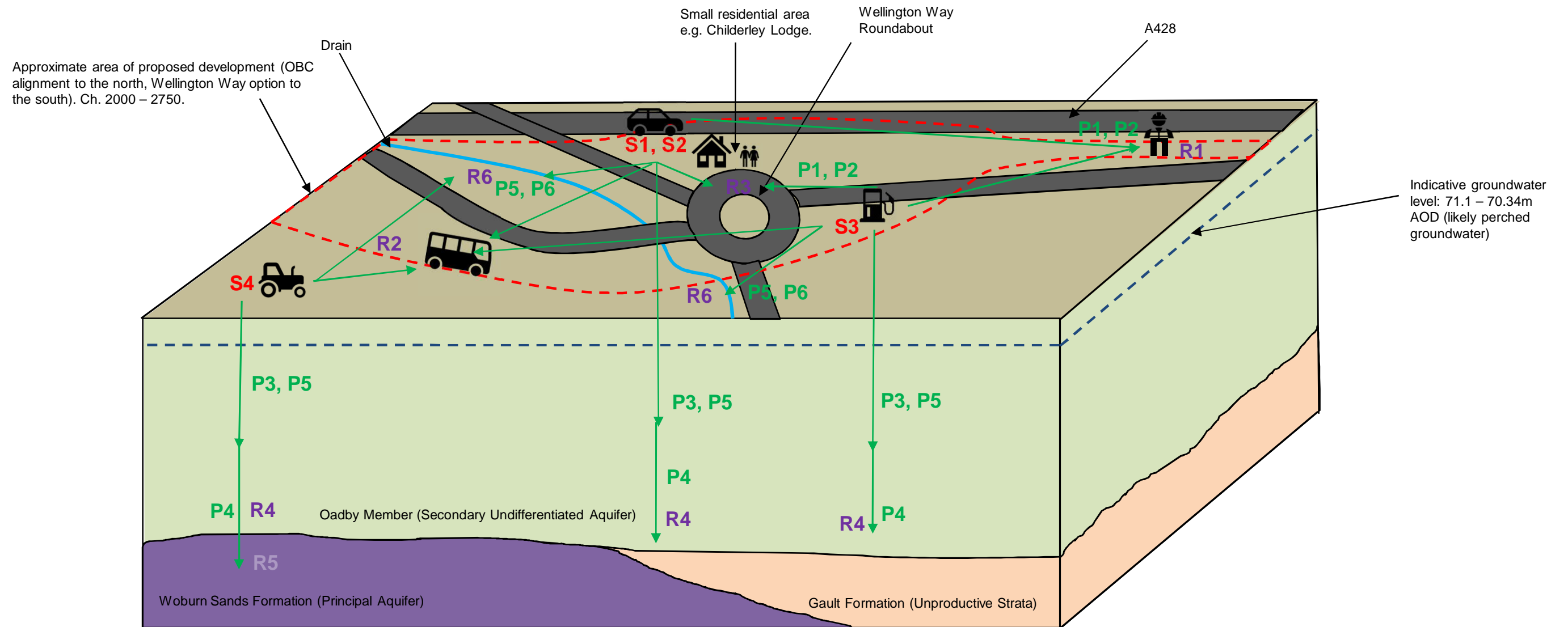
R3: Final end users (residential).

R4: Groundwater e.g. Oadby Member (Secondary Undifferentiated).

R5: Groundwater e.g. Woburn Sands Formation (Principal) beneath the western half of Zone 2.

R6: Surface water features e.g. drains and ponds.

Approximate ground level: 71 – 72m AOD



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	Project:	Key: Solid Geology – Woburn Sands Formation (not encountered) Solid Geology – Gault Formation (not encountered) Superficial – Oadby Member (>17.7m thickness – base not proven) Topsoil (<0.4m thick) Surface water body	Notes: 1. This drawing is for information only. 2. This drawing is not for construction. 3. This drawing is not to scale. 4. The location of features shown is indicative only.	Originated	E Jeffrey	13.03.20
	Cambourne to Cambridge Better Public Transport Project (C2C)			Checked	J Southall	01.04.20
	Client: Greater Cambridge Partnership			Approved	-	
			Title: Conceptual Site Model – Zone 2			

Table G.3: Geoenvironmental Preliminary Risk Assessment – Zone 3

Source	Pathway	Receptor	Consequence	Probability	Unmitigated Risk	Mitigated Risk	Comments
<u>On-site</u> S1: Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways and electrical substation. S2: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.	P1: Human uptake pathways. P2: Horizontal and vertical migration of any volatile vapours resulting from potential fuel spillages and artificial ground.	R1: Construction workers.	Medium	Likely	Moderate	Low	Potential contaminants have been identified from various land uses (e.g. surrounding infrastructure and contemporary trade directory entries) but these are considered unlikely to represent gross contamination. The active fuel station (within 250m of the western side of Zone 3) may be a potential source for vapours if any leaks or spills have occurred during operation (i.e. underground fuel tanks). The risk of harm is considered to be low as no enclosed spaces are proposed on-site and any gases/vapours are likely to vent directly into the atmosphere. The Oadby Member also has relatively low permeability that will prevent/slow migration of contaminants. Construction workers are more likely to come into contact with soil and groundwater. A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers during development are minimised.
		R2: Final end users (on-site bus route users, road users).	Medium	Unlikely	Low	Low	
		R3: Final end users (off-site residential).	Medium	Unlikely	Low	Low	
<u>Off-site</u> S3: Large areas surrounding land are currently/have previously been designated as agricultural fields so agricultural pesticides and							

<p>sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible. Evidence of historical slurry release to nearby waters.</p>	<p>S4: Industries within 250m of Zone 3 such as printers, agricultural engineers, garages, asphalt contractors, sewage pumping stations, fuel station.</p>	<p>As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement.</p>	<p>Some earthworks (e.g. cutting) are proposed in Zone 3 – if materials are to be re-used elsewhere (within Zone 3 or another Zone e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan.</p>	<p>Final end users (bus route) will not come into contact with soil or groundwater on the site as the site will comprise hardstanding at ground level and site users will be inside vehicles, providing a barrier to any potential contaminants that may be present.</p>	<p>Residential site end users in the village of Hardwick (immediately south of the route in Zone 3) are not likely to be affected by the current proposed OBC route – if the proposed route changes then the risk assessment should be revised accordingly.</p>	
<p>P3: Horizontal and vertical migration of</p>	<p>R4: Groundwater e.g. Oadby Member</p>	<p>Medium</p>	<p>Low Likelihood</p>	<p>Moderate / Low</p>	<p>Moderate / Low</p>	<p>An increase in hardstanding will reduce the infiltration through any potentially contaminated soils on-</p>

contaminants in the unsaturated zone.	(Secondary Undifferentiated).					site, therefore reducing mobility in the unsaturated zone beneath the route.
P4: Horizontal and vertical migration of contaminants in the saturated zone.	R5: Off-site groundwater e.g. West Melbury Marly Chalk Formation (Principal) to the north-east/east of Zone 3 (OBC alignment underlain by unproductive strata).	Medium	Unlikely	Low	Low	The proposed works on-site are likely to involve earth works, which could create contamination pathways within the Oadby Member (a Secondary Undifferentiated aquifer - variable permeability and transmissivity). If materials are to be re-used elsewhere (within Zone 3 or another Zone e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan.
P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.						It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone. The risk assessment should be updated when new information becomes available. The risk to the off-site Principal aquifer is considered to be low due to its significant depth (not encountered, but likely to be >14m), distance from the potential sources, and variable permeability of the overlying Oadby Member.

<p>P6: Surface run-off along roads, pavements, and other surfaces e.g. soil.</p>	<p>R6: Surface water features e.g. Callow Brook, balancing ponds, drain network.</p>	Mild	Likely	Moderate / Low	Moderate / Low	<p>Drains are present across the majority of Zone 3. There is also a relatively low risk of surface water flooding on the majority of the site, with some localised areas of increased risk i.e. closer to Callow Brook and the balancing ponds.</p> <p>There is the potential for contaminants to wash into the nearby surface water bodies via surface run-off. An increase in hardstanding on-site is likely to decrease mobilisation of any minor soil contaminants by reducing infiltration. However, there may be increased run off from the hardstanding present on site after construction.</p> <p>It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone and/or the quality of surface water bodies. The risk assessment should be updated when new information becomes available.</p>
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Sources:

On-site

S1: Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways and electrical substation.

S2: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.

Off-site

S3: Large areas surrounding land are currently/have previously been designated as agricultural fields so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible. Evidence of historical slurry release to nearby waters.

S4: Industries within 250m of Zone 3 such as printers, agricultural engineers, garages, asphalt contractors, sewage pumping stations, fuel station.

Pathways:

P1: Human uptake pathways.

- Direct soil and dust ingestion.
- Skin contact with soils and dust.
- Inhalation of outdoor dust vapours.

P2: Horizontal and vertical migration of any volatile vapours resulting from potential fuel spillages and artificial ground.

P3: Horizontal and vertical migration of contaminants in the unsaturated zone.

P4: Horizontal and vertical migration of contaminants in the saturated zone.

P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.

P6: Surface run-off along roads, pavements, and other surfaces e.g. soil.

Receptors:

R1: Construction workers.

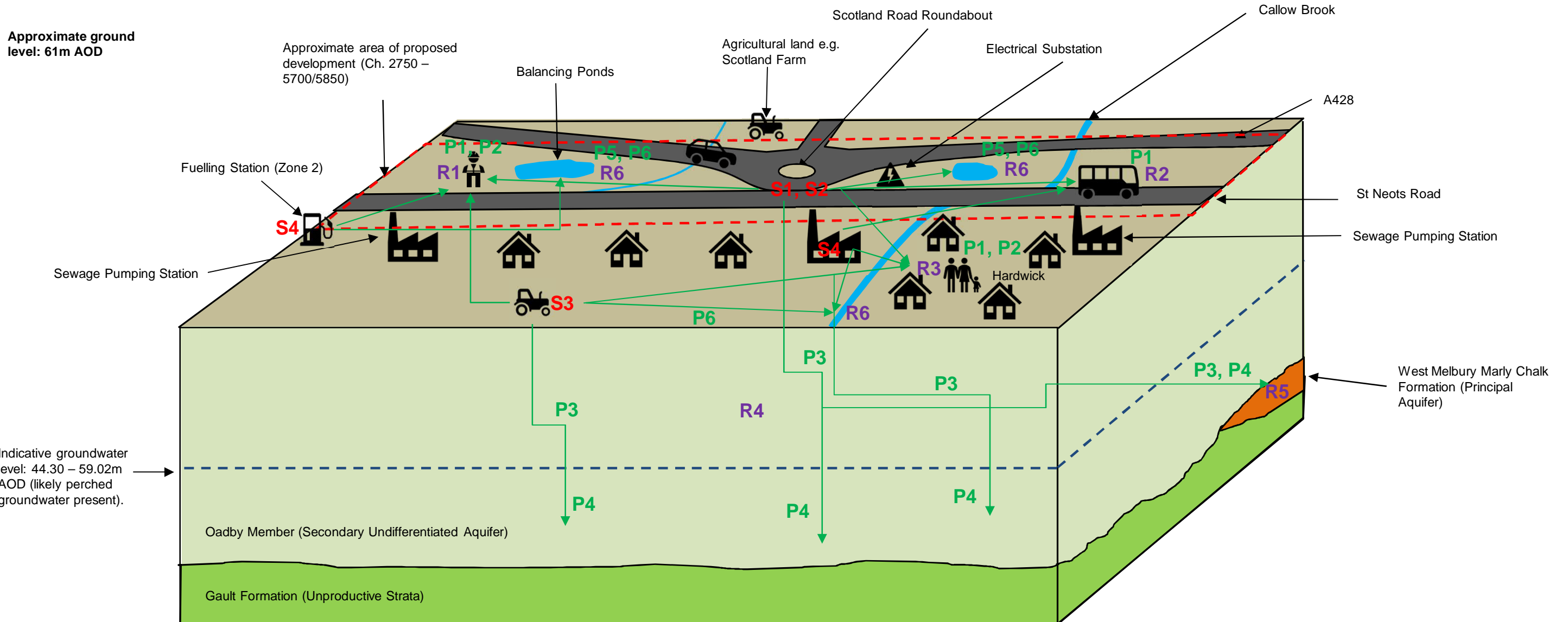
R2: Final end users (i.e. bus route users, road users).

R3: Final end users (i.e. residential).

R4: Groundwater e.g. Oadby Member (Secondary Undifferentiated).

R5: Off-site groundwater e.g. West Melbury Marly Chalk Formation (Principal) to the north-east/east of Zone 3 (OBC alignment underlain by unproductive strata).

R6: Surface water features e.g. Callow Brook, balancing ponds, drain network.



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	Project: Cambourne to Cambridge Better Public Transport Project (C2C)	Key: Solid Geology – Gault Formation (not encountered) Solid Geology – West Melbury Marly Chalk Formation (not encountered) Superficial – Oadby Member (>14.7m thickness – base not proven) Topsoil (<0.4m thick) Surface water body	Notes: 1. This drawing is for information only. 2. This drawing is not for construction. 3. This drawing is not to scale. 4. The location of features shown is indicative only.	Originated	E Jeffrey	16.03.20	
	Client:			Greater Cambridge Partnership	Checked	J Southall	01.04.20
				Approved	-		
			Title: Conceptual Site Model – Zone 3				

Table G.4: Geoenvironmental Preliminary Risk Assessment – Zone 4

Source	Pathway	Receptor	Consequence	Probability	Unmitigated Risk	Mitigated Risk	Comments
<p><u>On-site</u></p> <p>S1: Artificial ground and associated contamination from past and current infrastructure on-site i.e. roads/highways (Ch. 5700 – 6200).</p> <p>S2: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.</p> <p>S3: Large areas surrounding land are currently designated as agricultural fields so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible. Evidence of historical agricultural</p>	<p>P1: Human uptake pathways.</p> <p>P2: Horizontal and vertical migration of any volatile vapours and ground gas resulting from potential on/off-site fuel spillages and off-site artificial ground (e.g. potentially infilled land).</p>	<p>R1: Construction workers.</p>	Medium	Low Likelihood	Moderate / Low	Low	<p>There is not anticipated to be a significant source of contamination at the site. Potential contaminants have been identified from various land uses (e.g. surrounding infrastructure and contemporary trade directory entries) but these are considered unlikely to represent gross contamination.</p> <p>The risk of harm is considered to be low as no enclosed spaces are proposed on-site and any gases/vapours are likely to vent directly into the atmosphere.</p> <p>Construction workers are more likely to come into contact with potentially contaminated soil and groundwater. A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement.</p> <p>Some earthworks (e.g. cutting) are proposed in Zone 4 – if potentially</p>
		<p>R2: Final end users (on-site bus route users, road users).</p>	Medium	Unlikely	Low	Low	
		<p>R3: Final end users (off-site residential).</p>	Medium	Unlikely	Low	Low	

pollution to groundwater.

Off-site

S4: Artificial ground and associated contamination from past and current infrastructure off-site i.e. roads/highways (Ch. 6200 – 8700).

S5: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.

S6: Industries within 250m of Zone 4 such as printers, garages, electrical goods, industrial equipment suppliers and one record of unspecified works.

S7: Historical extractive industries (chalk pit/reservoir) and potentially infilled land within 250m of Zone 4.

P3: Horizontal and vertical migration of contaminants in the unsaturated zone.

P4: Horizontal and vertical

R4: Groundwater e.g. Oadby Member (Secondary Undifferentiated), which is only present from Ch. 5700 to 76590 (OBC).

Medium

Low Likelihood

Moderate / Low

Moderate / Low

contaminated materials are to be re-used elsewhere (within Zone 4 or another Zone e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan. This will likely not be required for areas of agricultural land.

Final end users (bus route) will not come into contact with soil or groundwater on the site as the site will comprise hardstanding at ground level and site users will be inside vehicles, providing a barrier to any potential contaminants that may be present.

Residential site end users in the village of Coton (immediately south of the route in Zone 4) are within 250m of the route but are not likely to be affected by the proposed works – if the proposed route changes then the risk assessment should be revised accordingly.

There is not anticipated to be a significant source of contamination at the site. An increase in hardstanding will reduce the infiltration through any potentially contaminated soils on-site, therefore reducing mobility in the unsaturated zone beneath the route.

<p>S8: Electrical substation within 250m of Zone 4.</p>	<p>migration of contaminants in the saturated zone.</p> <p>P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.</p>	<p>R5: Groundwater e.g. West Melbury Marly Chalk Formation (Principal).</p>	<p>Severe</p>	<p>Low Likelihood</p>	<p>Moderate</p>	<p>Moderate</p>	<p>The proposed works on-site are likely to involve earth works, which could create contamination pathways within the Oadby Member (a Secondary Undifferentiated aquifer - variable permeability and transmissivity) and West Melbury Marly Chalk Formation (Principal aquifer).</p> <p>If potentially contaminated materials are to be re-used elsewhere (within Zone 4 or another Zone e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan. This will likely not be required for areas of agricultural land.</p> <p>It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone. As the Chalk Principal aquifer is likely to be present near surface in this zone, the risk assessment should be updated when new information becomes available.</p>
<p>P6: Surface run-off along roads, pavements, and other surfaces e.g. soil.</p>	<p>R6: Surface water features e.g. Bin Brook and drain network.</p>	<p>Mild</p>	<p>Mild</p>	<p>Low Likelihood</p>	<p>Low</p>	<p>Low</p>	<p>Drains are present across the majority of Zone 4. There is generally a low risk of surface water flooding on the majority of the site, with some localised areas of increased risk i.e. closer to the drains that feed into Bin Brook.</p>

There is the potential for contaminants to wash into the nearby surface water bodies via surface runoff due to an increase in hardstanding after construction.

It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone and/or the quality of surface water bodies. The risk assessment should be updated when new information becomes available.

Sources:

On-site

S1: Artificial ground and associated contamination from past and current infrastructure on-site i.e. roads/highways (Ch. 5700 – 6200 OBC).

S2: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.

S3: Large areas of the route are currently designated as agricultural fields so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible. Evidence of historical agricultural pollution to groundwater.

Off-site

S4: Artificial ground and associated contamination from past and current infrastructure off-site i.e. roads/highways (Ch. 6200 – 8700 OBC).

S5: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.

S6: Industries within 250m of Zone 4 such as printers, garages, electrical goods, industrial equipment suppliers and one record of unspecified works.

S7: Historical extractive industries (chalk pit/reservoir) and potentially infilled land within 250m of Zone 4.

S8: Electrical substation within 250m of Zone 4.

Pathways:

P1: Human uptake pathways.

- Direct soil and dust ingestion.
- Skin contact with soils and dust.
- Inhalation of outdoor dust vapours.

P2: Horizontal and vertical migration of any volatile vapours and ground gas resulting from potential on/off-site fuel spillages and off-site artificial ground (e.g. potentially infilled land).

P3: Horizontal and vertical migration of contaminants in the unsaturated zone.

P4: Horizontal and vertical migration of contaminants in the saturated zone.

P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.

P6: Surface run-off along roads, pavements, and other surfaces e.g. soil.

Receptors:

R1: Construction workers.

R2: Final end users (on-site bus route users, road users).

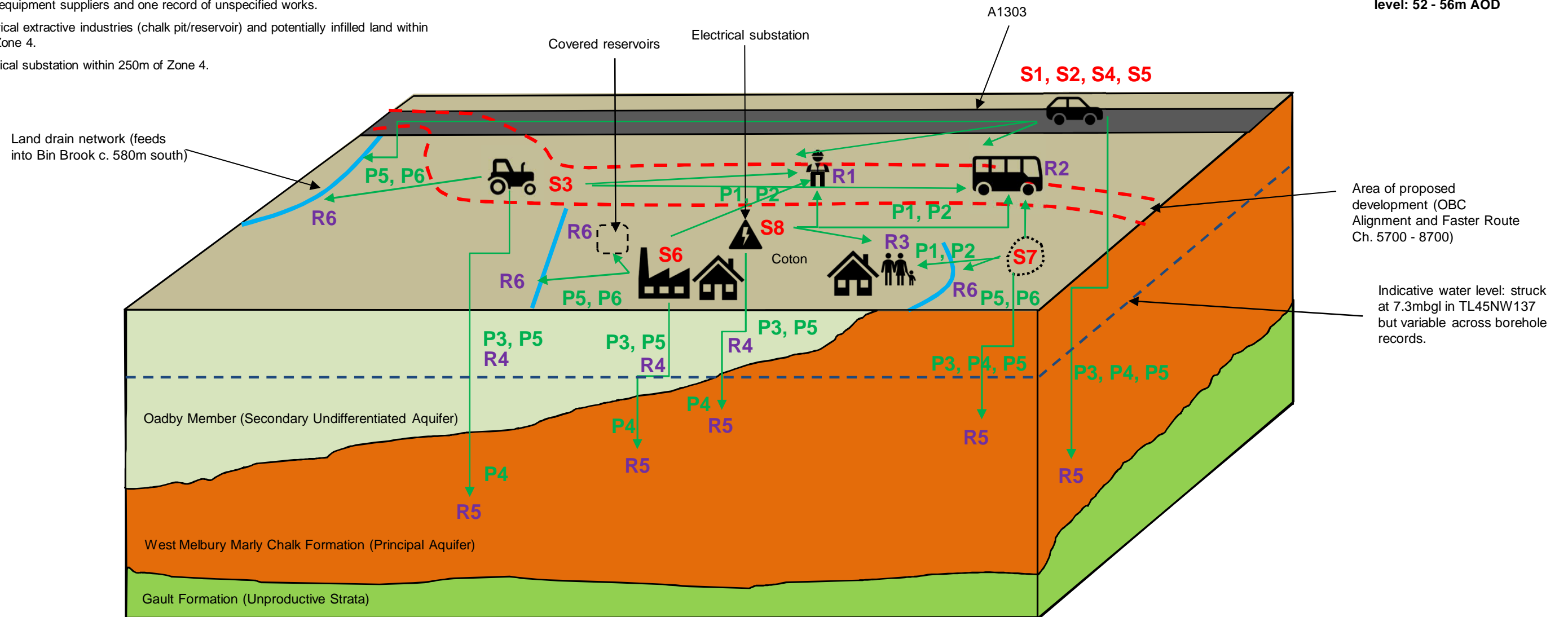
R3: Final end users (off-site residential - Coton).

R4: Groundwater e.g. Oadby Member (Secondary Undifferentiated), which is only present from Ch. 5700 to 76590 (OBC).

R5: Groundwater e.g. West Melbury Marly Chalk Formation (Principal).

R6: Surface water features e.g. Bin Brook and drain network.

Approximate ground level: 52 - 56m AOD



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Project:
Cambourne to Cambridge Better Public Transport Project (C2C)

Key:

- Solid Geology – Gault Formation (>15.8m thickness)
- Solid Geology – West Melbury Marly Chalk Formation (3.7 – 12.5m thickness)
- Superficial – Oadby Member (thickness not reported)
- Topsoil (up to 0.3m thick)
- Surface water body

Notes:

1. This drawing is for information only.
2. This drawing is not for construction.
3. This drawing is not to scale.
4. The location of features shown is indicative only.

Originated	E Jeffrey	20.03.20
Checked	J Southall	01.04.20
Approved	-	

Client: Greater Cambridge Partnership

Title: Conceptual Site Model – Zone 4

Table G.5: Geoenvironmental Preliminary Risk Assessment – Zone 5

Source	Pathway	Receptor	Consequence	Probability	Unmitigated Risk	Mitigated Risk	Comments
On-site S1: Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways (M11/Charles Babbage Road – Ch. 9250 – 9450). S2: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates. S3: Most of the route (Zone 5) is currently designated as agricultural fields, so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.	P1: Human uptake pathways.	R1: Construction workers.	Medium	Low Likelihood	Moderate / Low	Low	Potential contaminants have been identified from various land uses (e.g. surrounding infrastructure and contemporary trade directory entries) but these are considered unlikely to represent gross contamination. The risk of harm is considered to be low as no enclosed spaces are proposed on-site and any vapours are likely to vent directly into the atmosphere. Construction workers are more likely to come into contact with potentially contaminated soil and groundwater. A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement. Some earthworks (e.g. cutting and embankments) are proposed in
	P2: Horizontal and vertical migration of any volatile vapours resulting from potential on/off-site fuel spillages. P3: Horizontal and vertical migration of contaminants within unsaturated and/or saturated zone.	R2: Final end users (on-site bus route users and off-site commercial).	Medium	Unlikely	Low	Low	

S4: Potentially contaminated made ground associated with the construction and operation of the British Antarctic Survey and University of Cambridge campus buildings.

Off-site

S5: Large areas of surrounding land are currently designated as agricultural fields and allotment gardens, so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.

S6: Potentially contaminated made ground associated with the construction and operation of nearby historical and current

P3: Horizontal and vertical migration of contaminants within unsaturated

R5: Off-site groundwater e.g. West Melbury Marly Chalk Formation (immediately to

Medium

Unlikely

Low

Low

Zone 5, particularly in regard to the crossing over the M11. If potentially contaminated materials are to be re-used elsewhere (within Zone 5 or another Zone e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan. This will likely not be required for areas of agricultural land.

Final end users (bus route) will not come into contact with soil or groundwater on the site as the site will comprise hardstanding at ground level and site users will be inside vehicles, providing a barrier to any potential contaminants that may be present.

Commercial site end users in the east (within 250m) of the route (British Antarctic Survey and University of Cambridge site users) are not likely to be affected by the current proposed OBC route – if the proposed route changes then the risk assessment should be revised accordingly.

An increase in hardstanding will reduce the infiltration through any potentially contaminated soils on-site, therefore reducing mobility in the unsaturated zone beneath the route.

<p>industrial/commercial activity.</p>	<p>and/or saturated zone.</p>	<p>the west of Ch. 8700).</p>				<p>The proposed works on-site are likely to involve earth works, which are unlikely to create any pathways within the underlying Gault Formation (Unproductive Strata).</p> <p>The Principal Chalk aquifer is located immediately to the west of Zone 5, making the groundwater vulnerable to any subsurface contamination as a result of proposed earthworks and/or surface run-off from Zone 5 (with no superficial deposits present).</p> <p>If potentially contaminated materials are to be re-used elsewhere (within Zone 5 or another Zone e.g. for fill/embankments), testing and risk assessments should be completed under a Materials Management Plan. This will likely not be required for areas of agricultural land.</p>			
<p>P4: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.</p>		<p>P5: Surface run-off along roads, pavements, and other surfaces e.g. soil.</p>		<p>R6: Surface water features e.g. Bin Brook and drain network.</p>	<p>Mild</p>	<p>Low Likelihood</p>	<p>Low</p>	<p>Low</p>	<p>A significant contamination source has not been identified. Drains surround the majority of Zone 5. There is generally a low risk of surface water flooding on the majority of the site, with some localised areas of increased risk.</p> <p>There is the potential for contaminants to wash into the nearby surface water bodies via surface run-off. There may be</p>

increased run off from an increase in hardstanding on site after construction.

It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone and/or the quality of surface water bodies. The risk assessment should be updated when new information becomes available.

Sources:

- On-site**
- S1:** Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways (M11/Charles Babbage Road – Ch. 9250 – 9450).
 - S2:** Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.
 - S3:** Most of the route (Zone 5) is currently designated as agricultural fields, so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.
 - S4:** Potentially contaminated made ground associated with the construction and operation of the British Antarctic Survey and University of Cambridge campus buildings.
- Off-site**
- S5:** Large areas of surrounding land are currently designated as agricultural fields and allotment gardens, so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.
 - S6:** Potentially contaminated made ground associated with the construction and operation of nearby historical and current industrial/commercial activity.

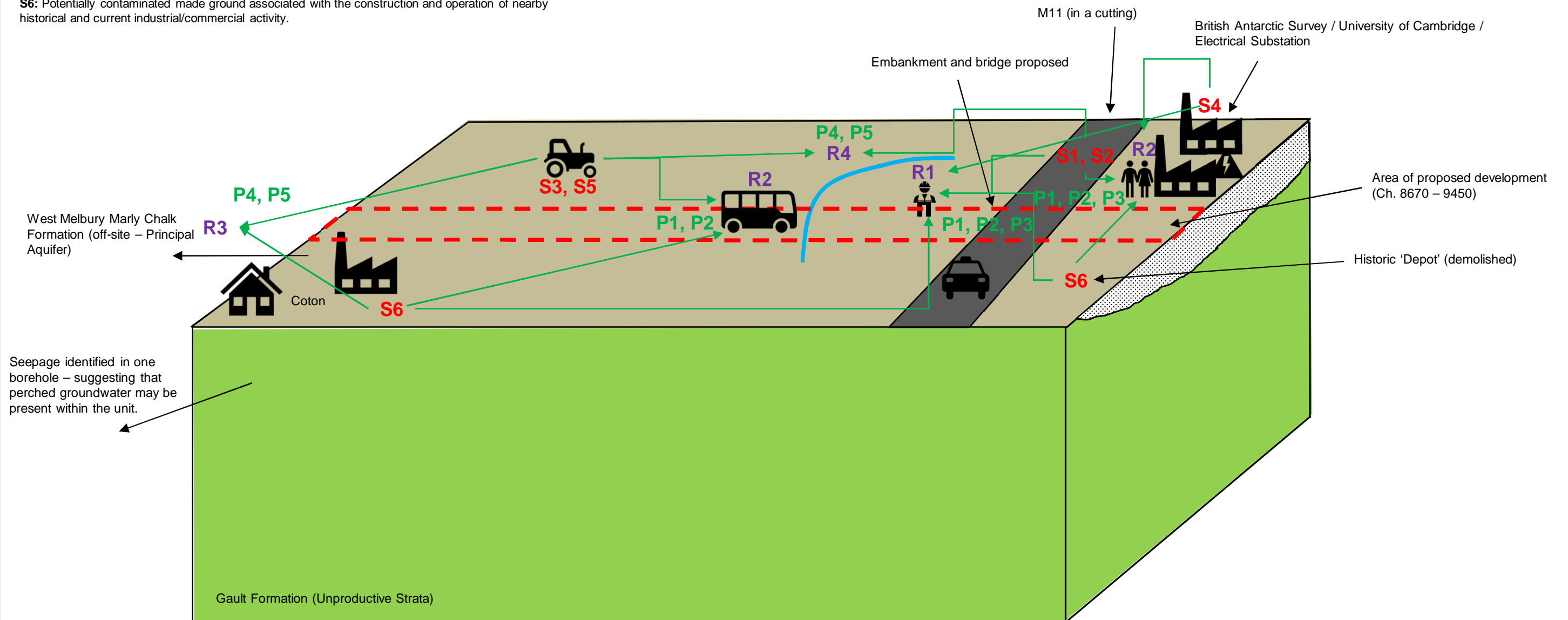
Pathways:

- P1:** Human uptake pathways.
 - Direct soil and dust ingestion.
 - Skin contact with soils and dust.
 - Inhalation of outdoor dust vapours.
- P2:** Horizontal and vertical migration of any volatile vapours resulting from potential on/off-site fuel spillages.
- P3:** Horizontal and vertical migration of contaminants through unsaturated and/or saturated zone.
- P4:** Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.
- P5:** Surface run-off along roads, pavements, and other surfaces e.g. soil.

Receptors:

- R1:** Construction workers
- R2:** Final end users (on-site bus route users and off-site commercial).
- R3:** Off-site groundwater e.g. West Melbury Marly Chalk Formation (immediately to the west of Ch. 8700).
- R4:** Surface water features e.g. Bin Brook and land drains.

Approximate ground level; 19 – 20m AOD



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	Project: Cambourne to Cambridge Better Public Transport Project (C2C)	Key: Solid Geology – Gault Formation (36.6m thickness) Artificial ground (anticipated to be present) Topsoil (<0.45m thick) Surface water body	Notes: 1. This drawing is for information only. 2. This drawing is not for construction. 3. This drawing is not to scale. 4. The location of features shown is indicative only.	Originated	E Jeffrey	23.03.20
				Checked	J Southall	01.04.20
				Approved	-	
Client: Greater Cambridge Partnership	Title: Conceptual Site Model – Zone 5					

Table G.6: Geoenvironmental Preliminary Risk Assessment – Zone 6

Source	Pathway	Receptor	Consequence	Probability	Unmitigated Risk	Mitigated Risk	Comments
On-site S1: Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways. S2: Vehicles using existing on-site infrastructure may have resulted in fuel/oil spillages and airborne particulates. S3: Ch. 10150 – 10550 are currently designated as agricultural fields, so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.	P1: Human uptake pathways.	R1: Construction workers.	Medium	Low Likelihood	Moderate / Low	Low	Potential contaminants have been identified from various land uses (e.g. surrounding infrastructure and contemporary trade directory entries) but these are considered unlikely to represent gross contamination. The risk of harm is considered to be low as no new enclosed spaces are proposed on-site and any vapours are likely to vent directly into the atmosphere. Construction workers are more likely to come into contact with potentially contaminated soil and groundwater. A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement. Final end users (bus route) will not come into contact with soil or
	P2: Horizontal and vertical migration of any volatile vapours resulting from potential on/off-site fuel spillages.	R2: Final end users (on-site bus route users).	Medium	Unlikely	Low	Low	
	P3: Horizontal and vertical migration of contaminants within unsaturated and/or saturated zone.	R3: Final end users (off-site commercial/residential/recreational).	Medium	Unlikely	Low	Low	

<u>Off-site</u>							groundwater on the site as the site will comprise hardstanding at ground level and site users will be inside vehicles, providing a barrier to any potential contaminants that may be present.
S4: Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways (M11).							Commercial, residential and recreational site end users are close to the proposed works but are not likely to be affected by the works, which will consist of hardstanding cover. If the proposed route changes then the risk assessment should be revised accordingly.
S5: Vehicles using existing off-site infrastructure may have resulted in fuel/oil spillages and airborne particulates.							
S6: Large areas of surrounding land are currently designated as agricultural fields, so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.	P3: Horizontal and vertical migration of contaminants within unsaturated and/or saturated zone.	R4: Surface water features e.g. Bin Brook, ponds, canal and land drains.	Mild	Low Likelihood	Low	Low	Hardstanding on-site will reduce the infiltration through any potentially contaminated soils on-site, therefore reducing mobility in the unsaturated zone beneath the route.
S7: Potentially contaminated made ground associated	P4: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.	R5: Flora and fauna e.g. bird sanctuary (north of Ch. 11100).	Mild	Unlikely	Very Low	Very Low	The proposed works on-site (no significant earthworks) are unlikely to create any pathways within the Gault Formation as it is designated as Unproductive Strata. It is currently unknown if any drainage solutions will be installed along the route, which could impact the nearby surface water bodies. The risk assessment
	P5: Surface run-off along roads,						

with the construction and operation of University of Cambridge campus buildings, as well as nearby historical and current industrial/commercial activity.	pavements, and other surfaces e.g. soil.	should be updated when new information becomes available. Drains/streams/canals surround the majority of Zone 6. There is generally a low risk of surface water flooding on the majority of the site, with some localised areas of increased risk. There may be increased run off from the minor additional hardstanding present on-site after construction.
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Sources:

On-site

- S1:** Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways.
- S2:** Vehicles using existing on-site infrastructure may have resulted in fuel/oil spillages and airborne particulates.
- S3:** Ch. 10150 – 10550 are currently designated as agricultural fields, so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.

Off-site

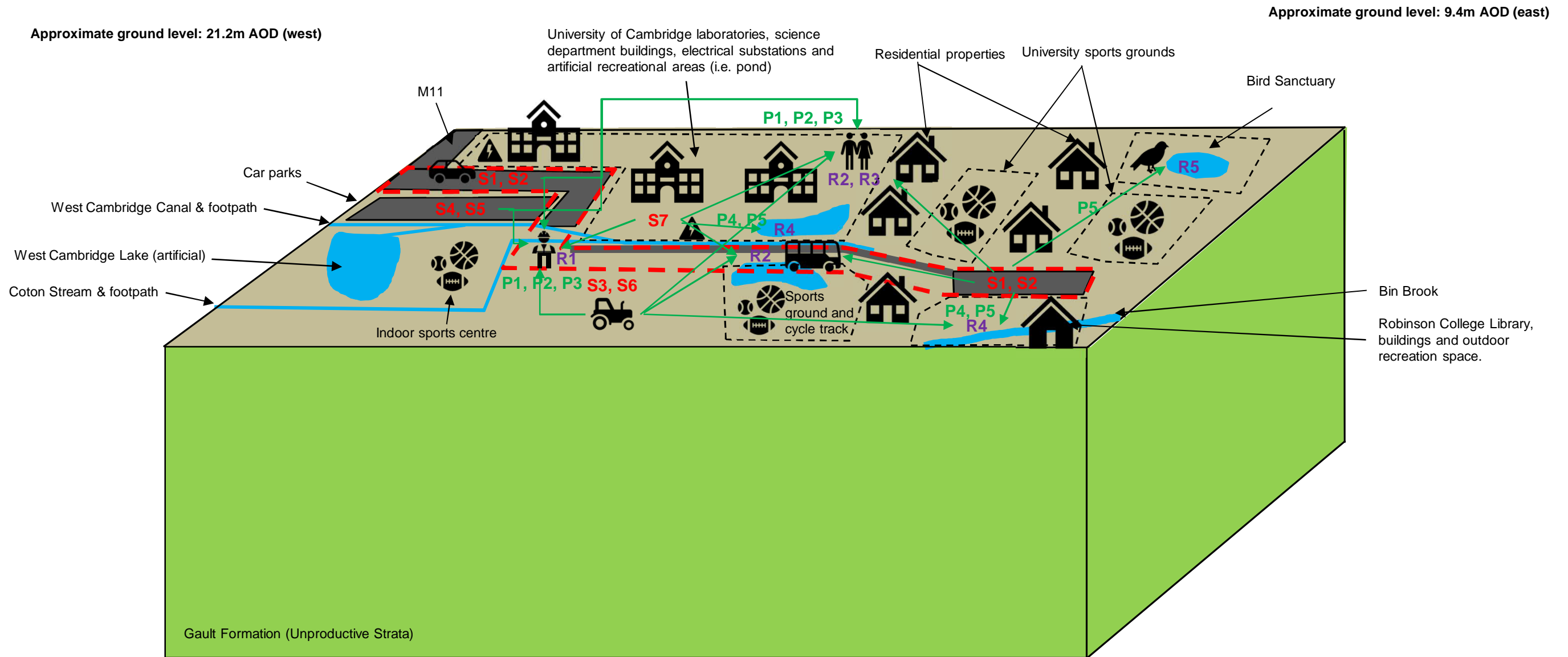
- S4:** Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways (M11).
- S5:** Vehicles using existing off-site infrastructure may have resulted in fuel/oil spillages and airborne particulates.
- S6:** Large areas of surrounding land are currently designated as agricultural fields, so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.
- S7:** Potentially contaminated made ground associated with the construction and operation of University of Cambridge campus buildings, as well as nearby historical and current industrial/commercial activity.

Pathways:

- P1:** Human uptake pathways.
 - Direct soil and dust ingestion.
 - Skin contact with soils and dust.
 - Inhalation of outdoor dust vapours.
- P2:** Horizontal and vertical migration of any volatile vapours resulting from potential on/off-site fuel spillages.
- P3:** Horizontal and vertical migration of contaminants within unsaturated and/or saturated zone.
- P4:** Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.
- P5:** Surface run-off along roads, pavements, and other surfaces e.g. soil.

Receptors:

- R1:** Construction workers
- R2:** Final end users (on-site bus route users).
- R3:** Final end users (off-site commercial/residential/recreational).
- R4:** Surface water features e.g. Bin Brook, ponds, canal and land drains.
- R5:** Flora and fauna e.g. bird sanctuary (north of Ch. 11100).



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	Project: Cambourne to Cambridge Better Public Transport Project (C2C)	Key: Solid Geology – Gault Formation (thickness not reported) Superficial Deposits - River Terrace Deposits: Sand and Gravel (3.0m thickness) Topsoil (0.2 – 0.3m thick) Surface water body	Notes: 1. This drawing is for information only. 2. This drawing is not for construction. 3. This drawing is not to scale. 4. The location of features shown is indicative only.	Originated	E Jeffrey	24.03.20
				Checked	J Southall	01.04.20
				Approved	-	
Client:	Greater Cambridge Partnership		Title:	Conceptual Site Model – Zone 6		

Table G.7: Geoenvironmental Preliminary Risk Assessment – Zone 7

Source	Pathway	Receptor	Consequence	Probability	Unmitigated Risk	Mitigated Risk	Comments
<u>On-site:</u> S1: Potential contamination from current and historical land use as agricultural land e.g. agricultural pesticides, sewage sludge and the potential for localised fuel/oil spillages from agricultural machinery.	P1: Human uptake pathways P2: Horizontal and vertical migration of any volatile vapours/ground gas resulting from potential on/off-site fuel spillages and off-site artificial ground.	R1: Construction workers	Mild	Low Likelihood	Low	Low	<p>No significant contamination source has been identified from the desk study. Potential contaminants (related to agricultural practices on-site and off-site infrastructure) have been identified but are considered unlikely to represent gross contamination.</p> <p>Construction workers are more likely to come into contact with soil and groundwater. A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement.</p> <p>No significant ground gas/ vapour source has been identified on site. Proposed works are unlikely to create any new pathways for exposure. No enclosed spaces are proposed on-site.</p> <p>Final end users will not come into contact with soil or groundwater on the park and Ride site as the site will likely comprise hardstanding at ground level,</p>
		R2: Final end users	Medium	Unlikely	Low	Low	
<u>Off-site:</u> S2: Artificial Ground and associated contamination from surrounding infrastructure i.e. Scotland Road and A428. S3: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.							

<p>S4: Numerous surrounding industries within 250m of Zone 7 such as electricity generation, manufacturers, cleaners, laundrettes, printers, engineers and garages/vehicle services.</p>	<p>P3: Horizontal and vertical migration of contaminants in the unsaturated zone.</p>	<p>R3: Groundwater e.g. Oadby Member (Secondary Undifferentiated).</p>	<p>Medium</p>	<p>Unlikely</p>	<p>Low</p>	<p>Low</p>	<p>providing a barrier to any potential minor contaminants that may be present.</p>
	<p>P4: Horizontal and vertical migration of contaminants in the saturated zone.</p>						<p>No significant contamination source has been identified. An increase in hardstanding will reduce the infiltration through any potentially contaminated soils, therefore reducing mobility in the unsaturated zone.</p>
	<p>P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, Park and Ride drainage system (design dependant) and existing land drains.</p>						<p>The proposed works on-site (no significant earth works) are unlikely to create any new pathways within the Oadby Member (a Secondary Undifferentiated aquifer - variable permeability and transmissivity).</p>
							<p>The proposed drainage solution on the site (surface run-off collection and discharge into Callow Brook) will mitigate infiltration of contaminated surface run-off and reduce the mobilisation of contaminants in the unsaturated and saturated zones. Full drainage design to be confirmed and risk assessment to be updated accordingly.</p>

<p>P6: Surface run-off along roads, pavements, and other surfaces e.g. soil, Park and Ride drainage.</p>	<p>R4: Surface water features e.g. Callow Brook and land drains.</p>	Mild	Low Likelihood	Low	Low	<p>Surface water bodies (Callow Brook – stream, and artificial land drains) have been identified in close proximity to the site, which show a low risk for surface water flooding.</p> <p>There is the potential for contaminants to wash into the nearby surface water bodies via surface run-off. An increase in hardstanding on-site is likely to decrease mobilisation of any minor soil contaminants. However, there may be increased run off from the Park and Ride site.</p> <p>The current proposed site drainage design (surface run-off collection and discharge into Callow Brook) creates a pathway between potential contamination and surface water bodies. Full drainage design to be confirmed and risk assessment to be updated accordingly.</p>
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Sources:

On-site

S1: Potential contamination from current and historical land use as agricultural land e.g. agricultural pesticides, sewage sludge and the potential for localised fuel/oil spillages from agricultural machinery.

Off-site

S2: Artificial ground and associated contamination from surrounding infrastructure i.e. Scotland Road and A428.

S3: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.

S4: Numerous surrounding industries within 250m of Zone 7 such as electricity generation, manufacturers, cleaners, launderettes, printers, engineers and garages/vehicle services.

Pathways:

P1: Human uptake pathways.

- Direct soil and dust ingestion.
- Skin contact with soils and dust.
- Inhalation of outdoor dust vapours.

P2: Horizontal and vertical migration of any volatile vapours/ground gas resulting from potential on/off-site fuel spillages and off-site artificial ground.

P3: Horizontal and vertical migration of contaminants in the unsaturated zone.

P4: Horizontal and vertical migration of contaminants in the saturated zone.

P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, Park and Ride drainage system (design dependant) and existing land drains.

P6: Surface run-off along roads, pavements, and other surfaces e.g. soil, Park and Ride drainage.

Receptors:

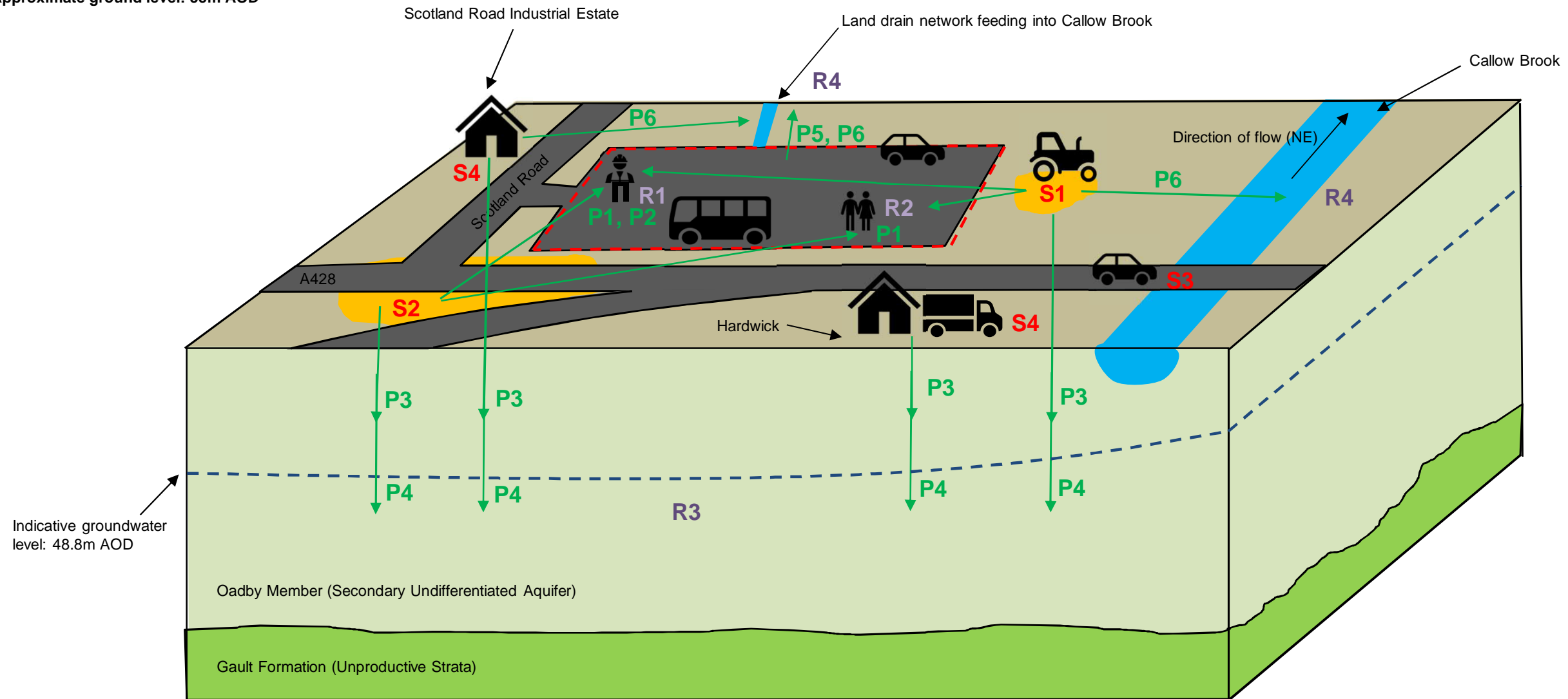
R1: Construction workers.

R2: Final end users (i.e. users of the Park and Ride).

R3: Groundwater e.g. Oadby Member (Secondary Undifferentiated).

R4: Surface water features e.g. Callow Brook and land drains.

Approximate ground level: 55m AOD



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	Project:	Key: Solid Geology – Gault Formation (not encountered) Superficial Deposits – Oadby Member (>20m thickness – base not proven) Topsoil (0.15 – 0.5m thick) Surface water body	Notes: 1. This drawing is for information only. 2. This drawing is not for construction. 3. This drawing is not to scale. 4. The location of features shown is indicative only.	Originated	E Jeffrey	05.03.20
	Cambourne to Cambridge Better Public Transport Project (C2C)			Checked	J Southall	10.03.20
	Client: Greater Cambridge Partnership			Approved	-	
			Title: Conceptual Site Model – Scotland Road Park and Ride (Zone 7)			

Table G.8: Geoenvironmental Preliminary Risk Assessment – Zone 8

Source	Pathway	Receptor	Consequence	Probability	Unmitigated Risk	Mitigated Risk	Comments
<u>On-site</u>	P1: Human uptake pathways. P2: Horizontal and vertical migration of any volatile vapours resulting from potential fuel spillages and artificial ground (e.g. infilled land/extractive industries).	R1: Construction workers.	Medium	Likely	Moderate	Low	No significant contaminant sources have been identified at the site. Potential contaminants have been identified from various land uses (e.g. surrounding infrastructure and contemporary trade directory entries) but these are considered unlikely to represent gross contamination. Construction workers are more likely to come into contact with soil and groundwater. A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement. Some potentially filled land and extractive industries have been identified within 250m of the route, where the presence/content of potential infill material (although they are now labelled as ponds) is not known. The risk of harm is considered to be low as no enclosed spaces are proposed on-site and any gases/vapours are likely to vent directly into the atmosphere. The Oadby Member also has relatively low permeability that will prevent/slow migration of contaminants. Final end users (bus route) and residential site users are unlikely to come into contact with soil or
S1: Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways.		R2: Final end users (i.e. bus route users, road users).	Medium	Unlikely	Low	Low	
S2: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.		R3: Final end users (residential).	Medium	Unlikely	Low	Low	
<u>Off-site</u>							
S3: Large areas surrounding land are currently designated as agricultural fields so agricultural pesticides and							

sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.							groundwater on the site as the site will comprise hardstanding at ground level and site users will be inside vehicles, providing a barrier to any potential contaminants that may be present.
<p>S4: Industries within 250m of Zone 8 such as printers, cleaning services, electronic equipment, chemical product distribution, electrical substation.</p> <p>S5: Potentially infilled land and historical extractive industries within 250m of Zone 8.</p>	<p>P3: Horizontal and vertical migration of contaminants in the unsaturated zone.</p>	<p>R4: Groundwater e.g. Oadby Member (Secondary Undifferentiated).</p>	Medium	Unlikely	Low	Low	No significant contaminant sources have been identified at the site. An increase in hardstanding will reduce the infiltration through any potentially contaminated soils on-site, therefore reducing mobility in the unsaturated zone beneath the route.
	<p>P4: Horizontal and vertical migration of contaminants in the saturated zone.</p>	<p>R5: Off-site groundwater e.g. West Melbury Marly Chalk Formation (Principal) c. 200m east of Zone 8 (OBC alignment underlain by unproductive strata)</p>	Medium	Unlikely	Low	Low	It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone. The risk assessment should be updated when new information becomes available.
	<p>P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.</p>						Despite its variable characteristics, the risk to the Secondary Undifferentiated aquifer (Oadby Member) is considered to be low due to the thinning of the superficial deposits to the north, north west and east of Zone 8.
	<p>P6: Surface run-off along</p>	<p>R6: Surface water features</p>	Mild	Low Likelihood	Low	Low	Drains are present across the majority of Zone 8. There is also a relatively low risk of surface water

roads,
pavements,
and other
surfaces e.g.
soil.

e.g. Callow
Brook, balancing
ponds, drain
network.

flooding on the majority of the site, with some localised areas of increased risk which correlate to the land drain network and Callow Brook.

There is the potential for contaminants to wash into the nearby surface water bodies via surface run-off.

It is currently unknown if any drainage solutions will be installed along the route, which could impact infiltration into the unsaturated zone and/or the quality of surface water bodies. The risk assessment should be updated when new information becomes available.

Sources:

- On-site**
S1: Artificial ground and associated contamination from past and current infrastructure i.e. roads/highways.
S2: Vehicles using existing infrastructure may have resulted in fuel/oil spillages and airborne particulates.
Off-site
S3: Large areas surrounding land are currently designated as agricultural fields so agricultural pesticides and sewage sludge may have been applied to the ground, with localised fuel/oil spillages from agricultural machinery possible.
S4: Industries within 250m of Zone 8 such as printers, cleaning services, electronic equipment, chemical product distribution, electrical substation.
S5: Potentially infilled land and historical extractive industries within 250m of Zone 8.

Pathways:

- P1:** Human uptake pathways.
 • Direct soil and dust ingestion.
 • Skin contact with soils and dust.
 • Inhalation of outdoor dust vapours.
P2: Horizontal and vertical migration of any volatile vapours/ground gas resulting from potential off-site fuel spillages and artificial ground (e.g. infilled land/extractive industries).
P3: Horizontal and vertical migration of contaminants in the unsaturated zone.
P4: Horizontal and vertical migration of contaminants in the saturated zone.
P5: Migration of contaminants along engineered preferential pathways e.g. construction activity, potential drainage systems.
P6: Surface run-off along roads, pavements, and other surfaces e.g. soil.

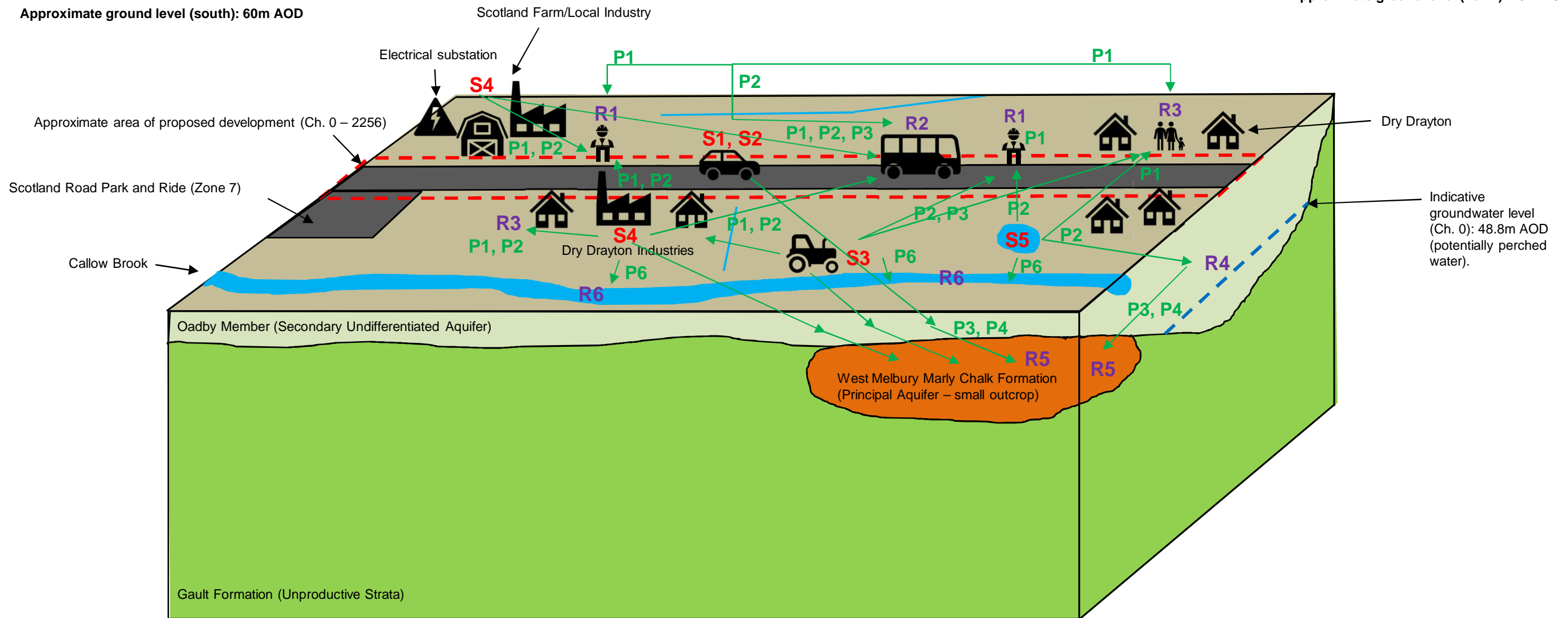
Receptors:

- R1:** Construction workers.
R2: Final end users (on-site bus route users, road users).
R3: Final end users (off-site residential).
R4: Groundwater e.g. Oadby Member (Secondary Undifferentiated).
R5: Off-site groundwater e.g. West Melbury Marly Chalk Formation (Principal) c. 200m east of Zone 8 (OBC alignment underlain by unproductive strata).
R6: Surface water features e.g. Callow Brook and drain network.



Approximate ground level (south): 60m AOD

Approximate ground level (north): 40m AOD



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	Project: Cambourne to Cambridge Better Public Transport Project (C2C)	Key: Solid Geology – Gault Formation (21m thickness) Solid Geology – West Melbury Marly Formation (not encountered) Superficial – Oadby Member (7.62m thickness – including made ground) Topsoil (thickness not reported) Surface water body	Notes: 1. This drawing is for information only. 2. This drawing is not for construction. 3. This drawing is not to scale. 4. The location of features shown is indicative only.	Originated	E Jeffrey	19.03.20	
	Client:			Greater Cambridge Partnership	Checked	J Southall	01.04.20
	Title: Conceptual Site Model – Zone 8			Approved	-	-	

H. Contaminated Land Risk Methodology

The following Contaminated Land Risk Assessment methodology is based on CIRIA C552 (2001) Contaminated Land Risk Assessment – A Guide to Good Practice, in order to quantify potential risk via risk estimation and risk evaluation, which can be adopted at the Phase I (Desk Study) stage. This will then determine an overall risk category which can be used to identify potential investigation or remedial actions. This methodology uses qualitative descriptors and therefore is a qualitative approach based on desk information. The risk assessment should be refined following receipt of ground investigation data. The methodology requires the classification of:

- the magnitude of the **consequence** (severity) of a risk occurring, and
- the magnitude of the **probability** (likelihood) of a risk occurring.

The potential consequences of contamination risks occurring at this Site are classified in accordance with Table H.1 below, which is adapted from the CIRIA guidance.

Table H.1: Classification of Consequence

Classification	Definition of Consequence
Severe	Short-term (acute) risks to human health likely to result in “significant harm” as defined by the Environmental Protection Act 1990, part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem, or organism forming part of such an ecosystem.
Medium	Chronic damage to Human Health (significant harm as defined in DEFRA, 2012). Pollution of sensitive water resources. A significant change in a particular ecosystem, or organism forming part of such an ecosystem.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services (“significant harm” as defined in the DEFRA, 2012). Damage to sensitive buildings/structures/services or the environment.
Minor	Harm, though not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.). Easily repairable effects of damage to buildings, structures, and services.

Source: CIRIA C552

The probability of contamination risks occurring at this site will be classified in accordance with Table H.2 below from the CIRIA guidance. Note: A pollution linkage must first be established before probability is classified. If there is no pollution linkage, then there is no

potential risk. If there is no pollution linkage, then there is no need to apply tests for probability and consequence.

Table H.2: Classification of Probability

Classification	Definition of Probability
High Likelihood	There is pollutant linkage and an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is pollutant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low Likelihood	There is pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place and is less likely in the shorter term.
Unlikely	There is pollutant linkage, but circumstances are such that it is improbable that an event would occur even in the very long-term.

R&D 66:2008 presents definitions of the risk categories, together with the investigatory and remedial actions that are likely to be necessary in each case. These definitions are reproduced in Table H.4, with the probability/consequence matrix presented in Table H.3. These risk categories apply to each pollutant linkage, not simply to each hazard or receptor.

Table H.3: Overall Contamination Risk Matrix

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Moderate / Low risk	Low risk
	Low likelihood	Moderate risk	Moderate / Low risk	Low risk	Very low risk
	Unlikely	Moderate / Low risk	Low risk	Very low risk	Very low risk

Based upon this, CIRIA C552 presents definitions of the risk categories, together with the investigatory and remedial actions that are likely to be necessary in each case, as in Table H.4. These risk categories apply to each pollutant linkage, not simply to each hazard or receptor.

Table H.4: Definitions of Risk Categories and Likely Actions Required

Risk Category	Definition and Likely Actions Required
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not already undertaken) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the long term.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised would at worst be relatively mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

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It is also possible that environmental monitoring has not identified certain conditions because of the relatively short monitoring period. Accordingly, it is possible that the ground investigation and monitoring failed to indicate the presence or significance of hazardous substances or conditions. If so, their presence could not have been considered in the formulation of MML’s findings and opinions.





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