Preliminary Ground Assessment

Cambridge Rapid Mass Transport

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1 OBJECTIVES

This document aims to outline the general ground conditions anticipated during the construction of the Cambridge Rapid Mass Transport Project. This report assumes the following structures:

- Portal near Addenbrookes
- Station near Cambridge Central
- Station in the City Centre
- Portal near the Girton Interchange
- Portal near Cambridge North
- Tunnelled connection

The plan is based on a modified version of the "Isaac Newton Line" proposed by Cambridge Connect and can be seen in Figure 1.

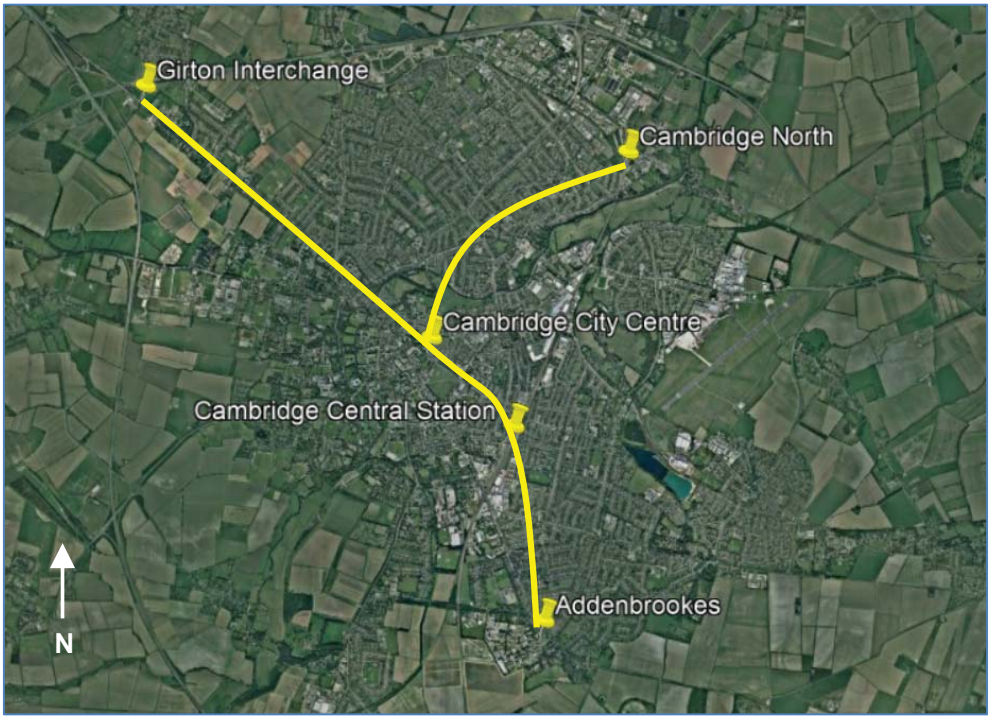

Figure 1. Proposed Cambridge Rapid Mass Transport Scheme

2 REGIONAL GEOLOGY

Cambridgeshire is fairly low lying, with approximately 50% of the county below 30m above sea level. It is drained by 2 major rivers, the Great Ouse and the Nene and their tributaries. There are several large, flat topped plateaux's in south Cambridgeshire and north Bedfordshire.

Cambridgeshire is underlain by Jurassic limestones, mudstones and sandstones, known as the Inferior Oolite Group and Green Oolite Group. This is overlain by the middle to late Jurassic Kellaway and Oxford Clay formation and Ampthill Clay, known as the Ancholme Group.

There are 4 main surface lithographic units that are relevant to this study:

- Lower Greensand
- Gault Clay
- Chalk Group
- Superficial Deposits

2.1 Lower Greensand

The Greensand formation consists of the Lower Greensand and Upper Greensand, separated by the Gault Clay. The Lower Greensand is fairly persistent throughout the Cambridge area. It is a marine sediment, early Cretaceous (Aptian) in age, and is a smectite rich clay, with common glauconite and mica, which give it its distinctive green colour.

2.1.1 Engineering Issues

- High proportions of glauconite have previously been linked to deoxygenated air within tunnels during construction
- Interbedded hard and softer layers make the Lower Greensand highly susceptible to landslides, which can make any excavation unstable
- The Lower Greensand is a known aquifer and is therefore likely to contain water, although permeability is assumed to be lower when confined by the Gault Clay.

2.2 Gault Clay

The Gault clay overlies the Lower Greensand in the Cambridge area, of Lower Cretaceous (middle Albian) in age. It is a stiff blue clay, deposited in a deep water marine environment, with an approximate thickness of 40m. It is known to contain numerous phosphatic nodules, and contains glauconite, selenite and contains approximately 20% quartz.

2.2.1 Engineering Issues

- A study of the geotechnical properties of this unit show that regional variations exist
- High percentages of quartz can cause high significant wear on machinery
- High proportions of glauconite have previously been linked to deoxygenated air within tunnels during construction
- Gault clay is generally classed as medium to hard; however the excavation can become unstable during excavation
- The addition of water to the clay makes the material sticky and hard to work with
- Ancient and recent landslides have been recognised throughout the Gault Clay
- It has a high expansive potential in areas
- An aqueous solution of sulphate and sulphuric acid has been identified within this unit, which has the potential to cause a chemical attack on concrete in high enough concentrations
- It is recommended that rotary core drilling will yield better quality samples than cable percussive techniques when completing boreholes within the Gault Clay.

2.3 Chalk Group

The Chalk Group in this area is Late Cretaceous Limestone and overlies the Gault Clay. It is generally soft and porous, with little to no signs of bedding except lines of flint nodules – especially common in the upper parts. Pyrite is often common.

2.3.1 Engineering Issues

- It is a known aquifer and will be water bearing
- It Is vulnerable to pollution and groundwater flooding which needs to be considered in any civil engineering project.
- Areas of hard material are common within this unit which can make excavation difficult and cause excessive wear on machinery.

2.4 Superficial Deposits

Overlying the Chalk Group are superficial deposits of glacial till. These are widespread throughout the Cambridge area; however varies in depth and properties.

3 LOCAL GEOLOGY

A search has been completed of previous boreholes, via the BGS borehole viewer, to establish baseline predicted geological conditions at each site.

3.1 Addenbrookes

- Alluvium is seen at the surface at this location and is measured at approximately 4m thick
- The Chalk is not identified in all of the boreholes; however where it was observed it was a soft material of about 9m thickness.
- The Gault Clay was identified from 13m depth, with an approximate thickness of 35m.
- The Lower Greensand is identified at a depth of 48m, the base was not recorded on the boreholes.

3.2 Cambridge Central Station

- Alluvium is seen at the surface at this location and is measured at approximately 5m thick
- The Chalk is not identified in all of the boreholes; however where it was observed it was a soft material of about 10m thickness. Water was identified, at pressure, at 7m.
- The Gault Clay was identified from 10m depth, with an approximate thickness of 26m.
- The Lower Greensand is identified at a depth of 36m, the base was not recorded on the boreholes.

3.3 Cambridge City Centre

- Alluvium is seen at the surface at this location and is measured at approximately 5m thick
- The Chalk is not identified within the boreholes at this location
- The Gault clay is identified from a depth of 5m to 35m, a thickness of 30m.
- The Lower Greensand is identified at a depth of 35m, the base was not recorded on the boreholes.

3.4 Girton Interchange

- Alluvium is seen at the surface at this location and is measured at approximately 1m thick
- The Chalk is not identified in any of the boreholes
- The Gault Clay was identified from 1m depth, with an approximate thickness of 19m

- The Lower Greensand is identified at a depth of 20m, with an approximate thickness of 28m.

3.5 Cambridge North

- Alluvium is seen at the surface at this location and is measured at approximately 2m thick
- The Chalk is not identified in any of the boreholes
- The Gault Clay was identified from 2m depth, with an approximate thickness of 30m.
- The Lower Greensand is identified at a depth of 32m, the base was not recorded on the boreholes.

4 CONCLUSION

Due to the depth and properties of the Gault Clay it is likely that this would make the best medium for tunnelling in. Further non-intrusive and intrusive testing are recommended prior to further development of the scheme.