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TRAMWAY TO HIGHAM WAY

OUTLINE FEASIBILITY REPORT

June 2016

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OUTLINE FEASIBILITY REPORT

Oxfordshire County Council

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WSP | Parsons Brinckerhoff
Mountbatten House
Basing View
Basingstoke

Tel: +44 (0) 1256 318 800
Fax: +44 (0) 1256 318 700
www.wsp-pb.com

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Signature				
Checked by	Graham Slade	Graham Slade	Graham Slade	
Signature				
Authorised by	Graham Slade	Graham Slade	Graham Slade	
Signature				
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PRODUCTION TEAM

CLIENT

Function	Name
Natalie Moore	Oxfordshire CC Project Manager

WSP | PARSONS BRINCKERHOFF

Function	Name
Project Director	Graham Slade
Project Manager/Structures Lead	Georgios Savvidis
Highways Lead	Graham Hemmings
Ecology Lead	Rebecca Mulley
Ground Engineering Lead	Andrew Indoe

SUBCONSULTANTS

None

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APPENDICES

1 EXECUTIVE SUMMARY

This outline feasibility report presents options for linking Tramway Road to Higham Way as part of the Banbury Transport Strategy, contained within the Fourth Oxfordshire Local Transport Plan (LTP4) and in response to a brief provided by Oxfordshire County Council.

The main choices for a link road from Tramway Road to Highway Way are an overbridge or tunnel over / under the existing railway. The tunnel option has been ruled out of this report due to prohibitive costs and risks during construction.

This report describes two structurally viable bridge options at this location and compares the parameters so that a recommendation can be reached. The recommendation of this report is subject to a number of assumptions that may influence the final outcome.

The provisional recommendation is that there are a significant number of adverse issues in developing a bridge solution at this location, and that further investigation of an alternative site for a link road across the railway (east to west) should be pursued to achieve the strategic aim.

2 PROJECT BACKGROUND

The Banbury Transport Strategy contained within the Fourth Oxfordshire Local Transport Plan (LTP4), identified the need for investigating the impact of a highway link within the Grimsbury area of Banbury, from east to west of the railway, and potentially, Oxford Canal and River Cherwell.

WSP | Parsons Brinckerhoff (WSP-PB) was appointed by Oxfordshire County Council (OCC) to carry out an outline feasibility study and advise whether a link from Tramway Road to Higham Way should be ruled out due to constraints, or ruled in for further consideration in a future piece of work.

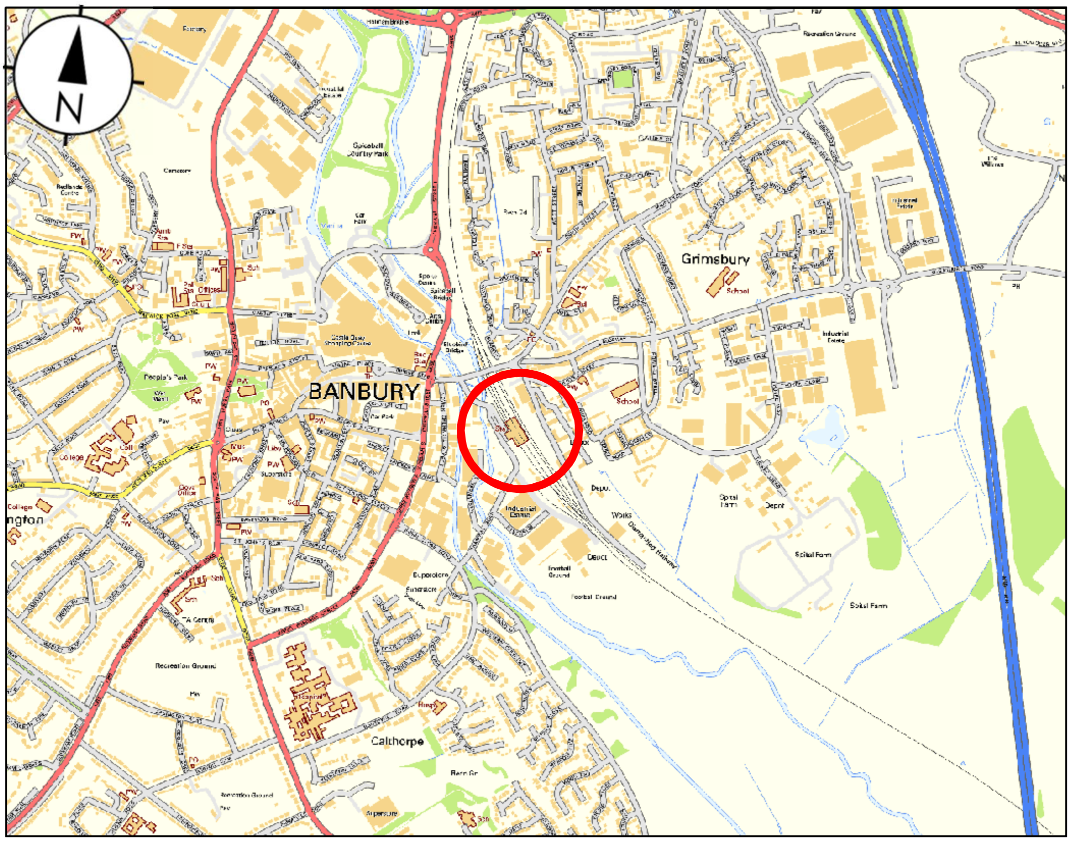

Figure 2.1: Location plan (grid ref. 446237, 240361)

3 SITE DESCRIPTION

3.1 GEOGRAPHY

The proposed highway bridge site lies some 100m south of Banbury Station ticket office. The proposed structure will span the main railway line served by Cross Country services between Birmingham New Street and Reading as well as lines into London Marylebone and London Paddington Stations. Depending on the precise alignment of the structure up to 10no railway lines may be crossed.

The land immediately adjacent and to the west of the railway lines mainly comprises car parking associated with Banbury Station. Beyond the car parking is Tramway Industrial Estate comprising low level industrial units and a fuel depot owned by Certas Energy.

The land immediately adjacent and to the east of the railway line is associated with a small number of light industrial units with associated concrete hardstanding which are accessed along Higham Way. Units include an old corrugated steel stockholders' shed and a disused Grundon's aggregate recycling batching unit. Just to the north of this land is a new development of three and four storey flats and a multi-storey car park also associated with Banbury Station.

The River Cherwell lies approximately 60m west of the proposed bridge site and the Oxford Canal lies 122m west of the site, as shown in Figure 3.1

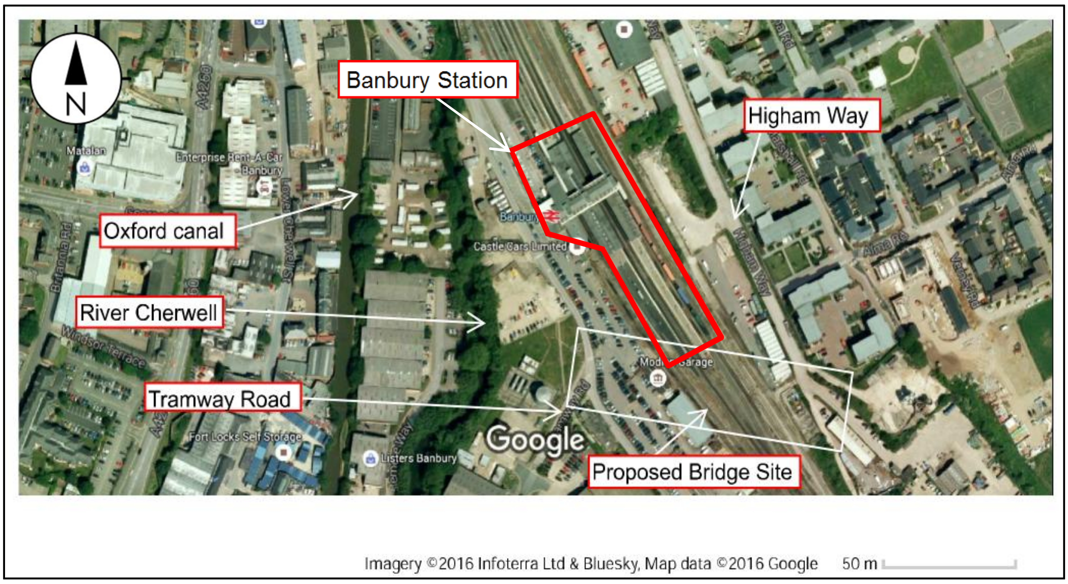

Figure 3.1 Google aerial image of site

The new link road would need to carry vehicle traffic, with environmental weight limit of 7.5 tonnes, over the railway, and potentially river and canal.

Figure 3.2: Tramway Road, looking west towards railway. Road currently closed off (March 2016).


Figure 3.3: Higham Way, looking south from existing Railway multi-storey car park.

Figure 3.4: Banbury Railway lines looking south from existing Railway multi-storey car park
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4 REPORT PHILOSOPHY & ASSUMPTIONS

The philosophy adopted for this report is to first consider the structure needed for the highway link, and then assess the constraints/opportunities surrounding such structure. The below assumptions have been made in developing the options of this outline feasibility report:

- Desk based study only at this stage, no surveys or stakeholder engagement have been undertaken at this stage. Sufficient technical resources are available within the WSP | PB organisations to complete the assignment;
- No third party, specialist cost consultant or contractor have been consulted at this stage;
- Land ownership based on info provided within OCC LTP4;
- This commission focuses on a highway link from Tramway to Higham Way, therefore no comparison with other options is possible;
- Network Rail land can be used for the construction of substructure;
- Required headroom clearance over the railway assumed as 5.2m;
- Required headroom clearance over Tramway Road and Higham Way assumed as 4.65m;
- Departure from Standards/relaxations (if any) can be obtained from approval authorities should there be a strong case for a highway link at this site;
- Topographical info obtained from LiDAR;
- Bridge assumed to carry two lanes of traffic, with a combined footway cycleway to one side, and a footway to the other.
- The geotechnical desk study has been written in accordance with HD22/08, Managing Geotechnical Risk (Highways Agency, 2008) and will inform the feasibility study from a geotechnical perspective.
- The project has been classified provisionally as a Geotechnical Category 3 in accordance with HD22/08 (Highways Agency, 2008). This classification will be revisited at subsequent design stages.

The assessment of the proposed structures as discussed in the following sections, has been carried out based on the below criteria, and ranked using a RAG system (Red, Amber Green) for ease of comparison and assessment:

- Topographical constraints;
- Design & buildability;
- Environmental considerations;
- Costs;
- Value management.

4.1 TOPOGRAPHICAL CONSTRAINTS

RAIL INTERFACE

The railway infrastructure poses the greatest challenge for the realisation of this scheme at the study location. To utilise Network Rail land, whether for temporary or permanent works, the scheme would need to demonstrate that it can generate direct benefits to Network Rail and its stakeholders (such as improve access to the station which would encourage use of trains as a mean of travel, increase parking space etc).

Structures crossing the railway would also need to comply with minimum clearance envelope requirements, such as horizontal distance from running track, sufficient headroom and for future railway upgrades (5.2m or in some cases 5.8m for electrification/high speed trains), and ensure that they do not in any way, obstruct sighting of signalling equipment.

SURROUNDING INFRASTRUCTURE

The structure required to provide a link from Tramway Road to Higham Way, would need to span, a skew length of approximately 156m (7m wide unnamed local road, locally known as Station Approach) providing access from Bridge Street to Banbury railway station and Network Rail land; 47m wide train station car park to east of railway; 72m wide running railway tracks boundary; 22m wide railway depot land to west of the railway lines; and 8m wide Higham Way). However, to achieve the vertical alignment (for headroom clearances), and tie-ins to Tramway Rd and Higham Way, the horizontal alignment of the structure would need to be curved, which lengthens the distance that needs to be spanned (approx. 172m for a 115m radius of plan curvature).

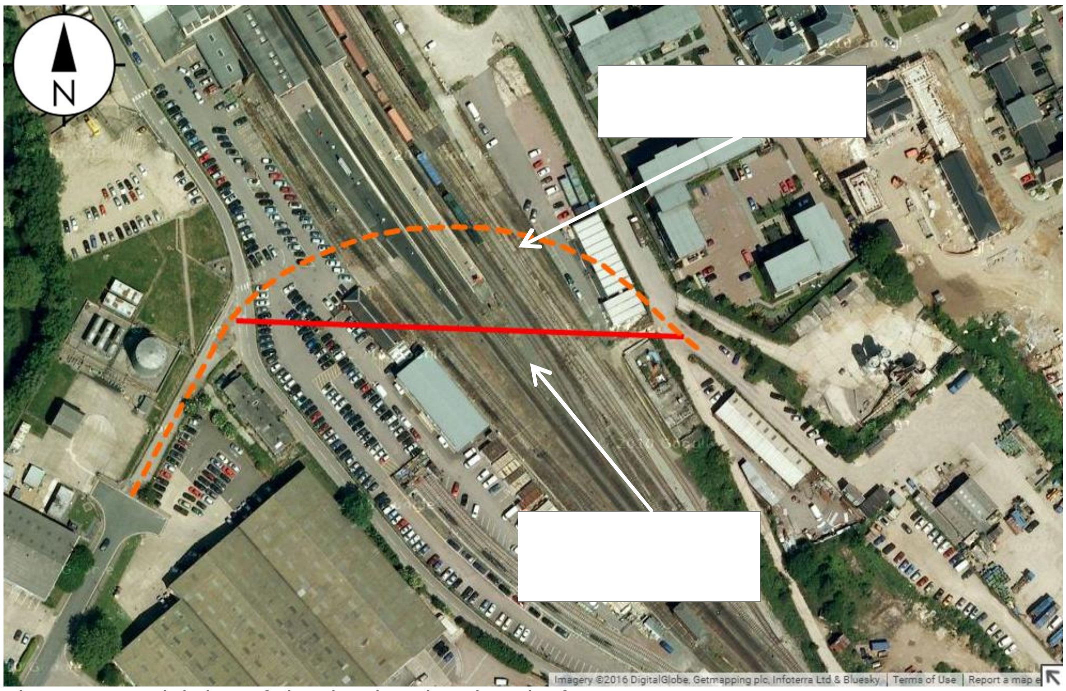

Figure 4.1: Aerial view of site showing skew length of structure.

The area is also highly built-up with railway infrastructure within and outside the running lines boundary (station platforms, building in east car park, and cabins to east of track). East of the railway there are industrial building units, River Cherwell and Oxford Canal, and to the west, there are residential multi-story buildings, a multi-storey car park and small industrial building units.

Figure 4.2: View from car park to west of the railway, looking east.

4.2 DESIGN & BUILDABILITY

The proposed structures will be assessed for their design feasibility (i.e. design and specification of elements which can be procured, compliance with current design standards/departures), and their buildability (i.e. temporary works required, erection methods, railway possessions).

4.3 ENVIRONMENTAL CONSIDERATIONS

The proposed structures have also been assessed for their environmental impact during both the construction and permanent phases.

4.4 COSTS

The solutions presented in this report were assessed based on Whole Life considerations, i.e. capital (temporary works, traffic management etc), and maintenance costs.

4.5 VALUE MANAGEMENT

Value management will consider whether or not the proposals would achieve the overall scheme objectives and aspirations, including:

- Improve highway link from east to west of the railway to alleviate traffic congestion.
- Cost effective scheme

- Positive impact on community

It should be noted that at this stage of the study, WSP | PB has not been commissioned to investigate alternative highway link locations, and so comparison with alternative routes cannot be made

5 STRUCTURAL OPTIONS

Four main options were considered for a bridge crossing, two of which have been rejected due to high costs and/or design and buildability constraints. The discounted options are:

- Tunnel – High construction costs and high risk construction operations.
- Concrete deck – High deck curvature would require long durations for construction making this a high cost and high risk option.

The two other options taken forward for further consideration are:

- Option A: Composite steel box girder bridge;
- Option B: Cable stayed bridge.

5.1 OPTION A: COMPOSITE STEEL BOX GIRDER

5.1.1 STRUCTURE DESCRIPTION

The composite steel box girder construction would comprise a twin steel box arrangement, with a concrete deck.

The proposed structure would comprise two box girders of 2.5m approx. depth. The deck would comprise a 250-300mm concrete slab and the parapets would need to have a containment class of H4a as the structure is over railway.

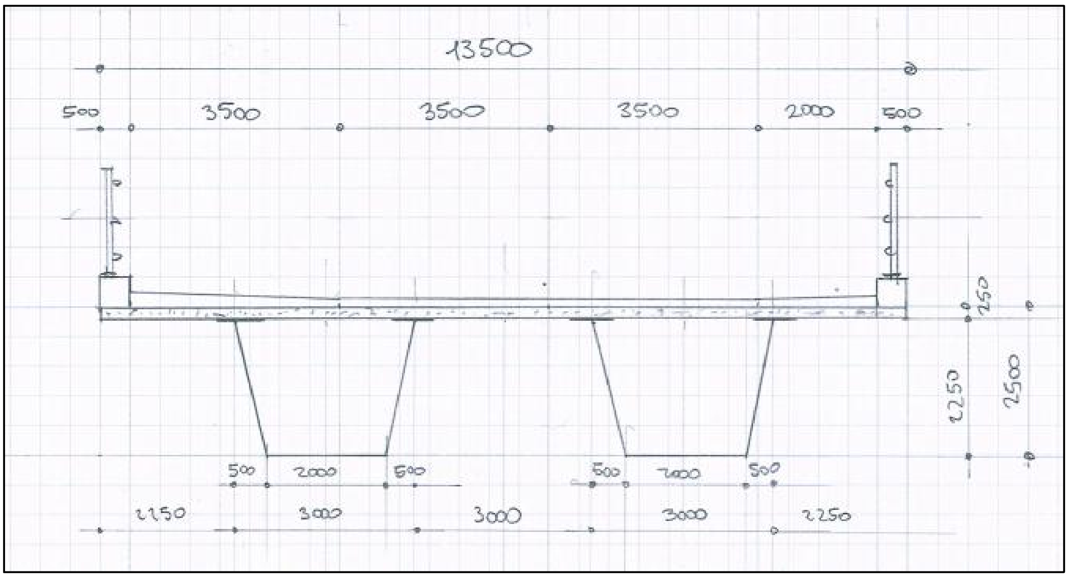

Figure 5.1-1: Composite steel box girder deck cross section – All dimensions are indicative.

Due to the high horizontal curvature (approx. 115m radius), the structure span would need to be limited to approx. 60m in order to achieve the required lateral and torsional stability. This can only be achieved by providing intermediate supports, which means that some supports fall within Network Rail's boundary (both the running lines and land either side of it). Outline renders are shown below to illustrate what a potential bridge might look like - see Appendix A-1 for additional images.

Figure 5.1-2: Composite steel box girder deck bird's eye view – indicative alignment.

Figure 5.1-3: Composite steel box girder deck north elevation.

5.1.2 STRUCTURE ASSESSMENT

Assessment Criteria		RAG Score	Description
Topographical Constraints	Network Rail infrastructure		Intermediate piers within Network Rail land may prove difficult to agree. We think it is unlikely that Network Rail will accept piers within the running lines or car park to the west of the station. The structure also passes over low rise buildings/cabins, and despite sufficient headroom clearance being provided for maintenance of these buildings, it may be difficult to agree with Network Rail.
	Other infrastructure		High impact on existing infrastructure both to the west side, where access to industrial units will require rearrangement, and also to the east with the structure being at a very close proximity with the multi-storey car park and residential buildings.
Buildability	Design		Complex structural design, with costly elements, such as bespoke bearings and expansion joints. Fabrication of the box girders is relatively common practice; however, due to the alignment of the bridge, the webs would need to be curved in two directions which would add significantly to fabrication costs.
	Construction		Complex construction sequence. To minimise impact on the railway, a bridge “launching” technique is envisaged which will be further complicated due to deck curvature. The deck could be launched either from one side or from both sides. Intermediate temporary piers would be required for the deck launch.
Environmental Considerations	Environment		During construction and permanent state, a structure at this location would have a negative impact on the residential buildings and to lesser extent, the industrial buildings.
	River Cherwell and Oxford Canal		River Cherwell and Oxford Canal do not appear to be affected by proposed structure alignment at this stage of the study. However the structure may impact or encroach on existing flood defences increasing the vulnerability of the area to flooding if mitigation measures are not adequate
Costs	Permanent Structure		High cost of construction circa £14.5 million (based on £3,500/m^2 of deck).
	Temporary works		Railway possessions increase the risk of construction – abnormal possessions require 2+ years lead in time. Cost of bridge launching will also

			significantly add to the overall scheme costs, as although bridge launching nowadays is a well-developed technique, it is not common on curved-in-plan decks
	Maintenance		No unusual structure maintenance requirements, however inspections and/or maintenance within the railway boundary would require railway possessions which can cost more than road closures under Traffic Management (TM). However, as steel is not the preferred option from maintenance perspective as it generally requires more maintenance than concrete bridges.
Value Management	Improve highway link		Although a link road at this location would provide a highway link from east to west of the railway, it is uncertain at this stage whether or not it would improve congestion as no traffic modelling has been carried out.
	Cost effective scheme		The costs of the scheme would be very high due to the type of bridge structure required to provide a highway link at this location.
	Positive impact on community		Due to the required bridge alignment, the townscape would potentially be negatively affected particularly for the sensitive residential buildings to the east of the railway.

5.2 OPTION B: CABLE STAYED

5.2.1 STRUCTURE DESCRIPTION

The cable stayed bridge option, with the railway span supported by cables, would eliminate the necessity for an intermediate support between the running lines. One cable stayed bridge solution is presented below in the form of a steel tubular arch. As cable stayed bridges are expensive, it is proposed that the remaining spans either side of the railway are supported on intermediate piers, some of which would fall within Network Rail land. Outline renders below show what this structure might look like - see Appendix A-2 for additional images.

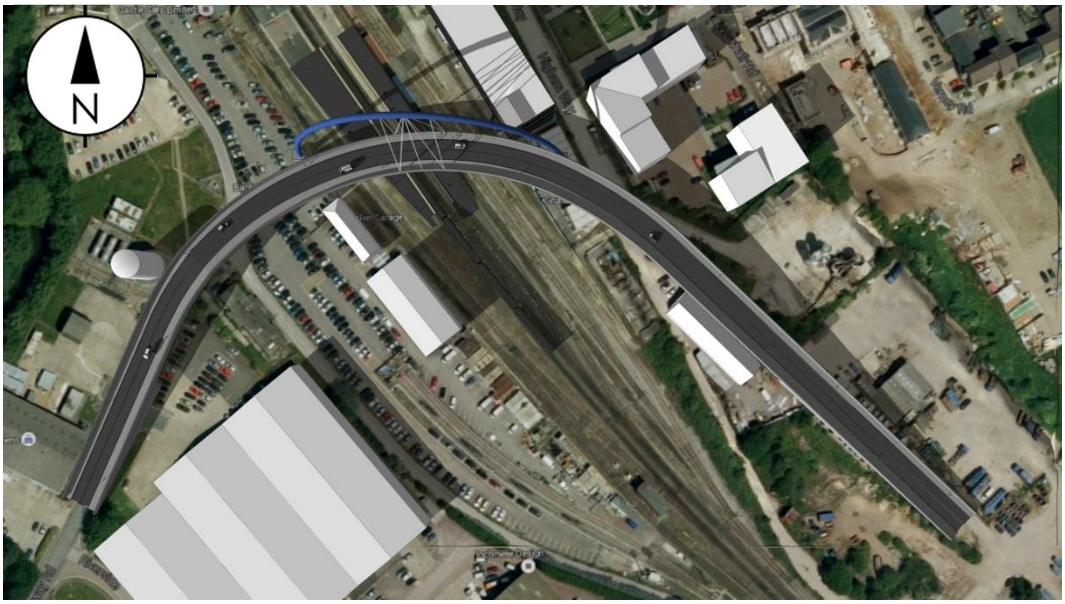

Figure 5.2-1: Cable stayed bridge deck bird's eye view – indicative alignment.


Figure 5.2-2: Cable stayed bridge deck north elevation.

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5.2.2 STRUCTURE ASSESSMENT

Assessment Criteria		RAG Score	Description
Topographical Constraints	Network Rail infrastructure		No intermediate support under the railway span could significantly improve the prospect of agreeing the scheme with Network Rail. Piers within Network Rail land either side of the railway would still be required, but this is less challenging to overcome than a substructure within the vicinity of the running lines.
	Other infrastructure		High impact on existing infrastructure both to the west side, where access to industrial units will require rearrangement, and also to the east with the structure being at a very close proximity with the multi-storey car park and residential buildings.
Buildability	Design		Complex structural design, which costly elements, such as bespoke bearings and expansion joints. Fabrication of the arch requires a highly experienced steelwork fabricator. Each segment of the tube would need to be approx.6.0 m long, and formed from plates. The segments can be welded at the factory to form a sub-assembly of the arch with up to 25.0 m lengths (for transport).
	Construction		The erection of the arch would be a difficult operation and the temporary works requirements would be considerably more significant that for the box girder option.
Environmental Considerations	Environment		During construction and permanent state, a structure at this location would have a negative impact to the residential buildings and to lesser extent, the industrial buildings. The cable stayed bridge option, would likely affect the townscape more negatively than the box girder option due to its size (can be seen from further away).
	River Cherwell and Oxford Canal		River Cherwell and Oxford Canal do not appear to be affected by proposed structure alignment at this stage of the study. However the structure may impact

			or encroach on existing flood defences increasing the vulnerability of the area to flooding if mitigation measures are not adequate
Costs	Permanent Structure		High cost of construction circa £25 million (based on £6,000/m^2 of deck).
	Temporary works		Railway possessions increase the risk of construction – abnormal possessions require 2+ years lead in time. Cost of temporary works, and specialist contractor involvement for segmental erection of the arch sections would also significantly add to the cost of the project.
	Maintenance		Maintenance requirement compared to composite box girder option are higher as cable would need replacement every 25 year. Access for maintenance of the structure of within the railway boundary would require railway possessions which can cost more than road closures under TM.
Value Management	Improve highway link		Although a link road at this location would provide a highway link from east to west of the railway, it is uncertain at this stage whether or not it would improve congestion as no traffic modelling has been carried out.
	Cost effective scheme		The costs of the scheme would be very high due to the type of bridge structure required to provide a highway link at this location.
	Positive impact on community		Due to the required bridge alignment, the townscape would potentially be negatively affected particularly for the sensitive residential buildings to the east of the railway.

6 HIGHWAY OPTIONS

6.1 REVIEW OF HIGHWAY ALIGNMENT INCLUDING CONSTRAINTS

We have produced a feasibility design from scaling and importing an iGIS map into AutoCAD. Three feasibility designs have been produced for horizontal alignment and two feasibility designs have been produced for ramp gradients:

Refer to Appendix B "Highway Alignment Options" for these plans.

Horizontal:

- Sharpest horizontal alignment = 110 metres radius.
  Two steps below desirable minimum radius, 7.0% superelevation, 50kph design speed.
  Similar to the original draft design, no buildings should need to be demolished.
- Sharpest horizontal alignment = 130 metre radius.
  One step below desirable minimum radius, 7.0% superelevation, 50kph design speed.
  One building may need to be demolished.
- Sharpest horizontal alignment = 180 metres radius.
  Desirable minimum radius, 5.0% superelevation, 50kph design speed.
  Three buildings may need to be demolished.

Ramp gradient:

- Ramp gradient of 3.0%, 190 metres length
  Northern side – OK
  Southern side – would require significant structural work to the bridge over the River Cherwell and significant work regarding access to existing properties potentially including additional bridges.
- Ramp gradient of 5.0%, 115 metres length
  Northern side – OK
  Southern side – would require access improvements to some existing properties.

6.2 DEPARTURES FROM STANDARDS (IF REQUIRED)

At this stage, no departures from standards are expected, however, relaxations may be required regarding the bridge and access road alignments.

6.3 NON-MOTORISED USER REQUIREMENTS

National Cycle Route 5 runs around the southern side of Banbury. There is a link from this cycle route to the train station which passes through the section of Tramway Road where the bridge is proposed.

Equal or improved cycle and pedestrian facilities should be installed to retain the Banbury Station and National Cycle Route 5 link. In addition to this, suitable pedestrian and cycle facilities should be provided on the new bridge.

Regional Cycle Route 40 runs from Middleton Cheney through Overthorpe towards Banbury. The installation of this bridge may help link together Regional Cycle Route 40 and National Cycle Route 5.

6.4 TIE-IN CONSIDERATION TO EXISTING NETWORK

The existing road network (e.g. Tramway Road to Bridge Street) may not cope with the additional traffic flows along the road. Transport modelling and an assessment of the carriageway construction should be carried out to determine whether further improvements are required.

Western side (Tramway Road)

The River Cherwell and the Oxford Canal pass under Tramway Road between Hightown Road and Riverside. If Riverside needs to be realigned, access could potentially be opened up alongside the railway. If Haslemere Way needs to be realigned, significant works would be required for example additional bridges, carriageway construction and stopping up orders.

Although there are bollards across Tramway Road where the new bridge is proposed, some bollards may be removable. Emergency services may use this as a through road for the train station or other industrial units. The emergency services will need to be contacted within the early design stage.

There is currently a car park to the eastern side of the proposed bridge ramp. Access could be provided to this car park by creating a new access road which would require either the removal of a large tree or existing bushes and fencing.

The entrance to Magnet Kitchens and the water treatment works may require significant diversions if the ramp is too long.

To maintain the existing connection between Tramway Road, Station Approach and the non-public highway to the industrial area to the south, a parallel at-grade connection would be required as indicatively shown in figure 6.4-1 below.

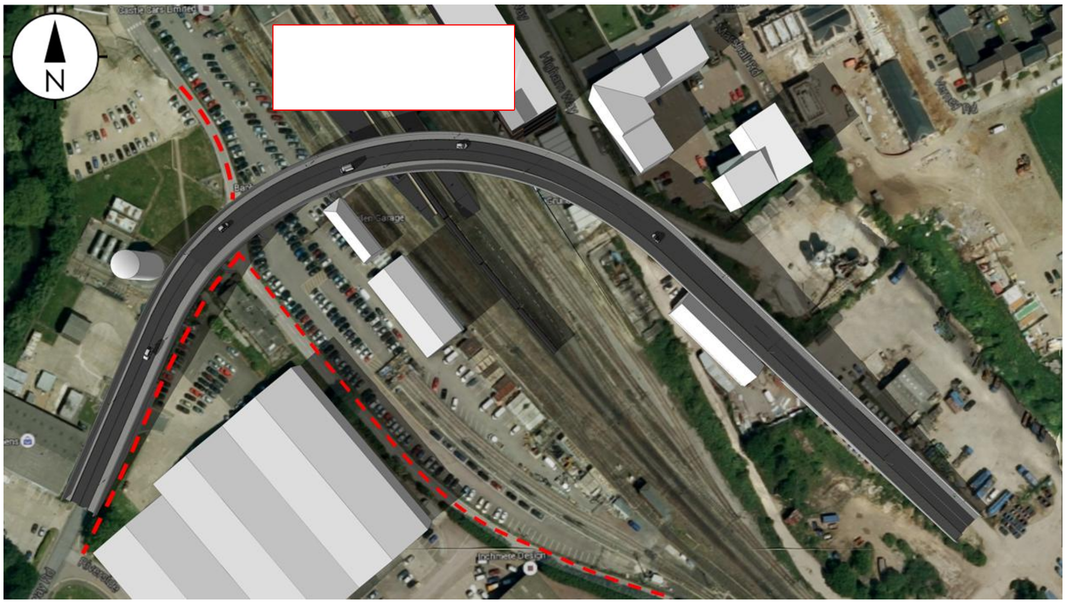

Figure 6.4-1: Re-aligned link road between Tramway Road, Station Approach and non-public highway to the industrial estate.

The additional land-take and Compulsory Purchase Order (CPO) issues would need investigation at an early stage to determine if this connection can be maintained.

Eastern side (Higham Way)

There doesn’t seem to be an issue regarding the ramp length on the northern side however further survey information is required.

7 GEOTECHNICAL INVESTIGATION

GEOTECHNICAL INVESTIGATION EXECUTIVE SUMMARY

The proposed highway bridge site lies some 100m south of Banbury Station ticket office. The proposed structure will span the main railway line served by CrossCountry services between Birmingham New Street and Reading as well as lines into London Marylebone and London Paddington Stations. Depending on the precise alignment of the structure up to 10no lines may be crossed.

The land immediately adjacent and to the west of the railway lines mainly comprises car parking associated with Banbury Station and beyond this is an industrial park comprising low rise industrial units. The land immediately adjacent and to the east of the railway line comprises a multi-storey car park again associated with Banbury Station. Beyond this is a small number of light industrial units with associated concrete hardstanding which are accessed along Higham Way. The River Cherwell lies approximately 60m west of the proposed bridge site and the Oxford Canal lies 122m west of the site

The drift geology in the study area comprises alluvial clays, sands and gravels up to 6.20m thick overlying solid geology comprising stiff to very stiff fissured clays of the Charmouth Formation (Lias Group). The thickness of the Charmouth formation is between 75 – 110m thick in the Banbury area.

Given the nature of the structure it is expected that deep foundations comprising pile groups and a pile cap will be adopted to carry the loads from the bridge piers. The choice of piling technique should consider the effect on adjacent structures and the means of ensuring a structurally sound and acceptable foundation.

Foundations to the approach structures may be able to adopt alternative design solutions such as soil mixing to improve the strength of the alluvial material, vibro-stone columns down to the Lias Clay with an associated load transfer platform or surcharging to reduce long term settlement effects within the alluvial material.

The presence of large obstructions associated with the Made Ground should be anticipated. Allowance for breaking out and removal of such obstructions should be made and any over digging should be backfilled with suitable engineered fill.

Any vertically sided excavations will require sheet pile support to ensure stability and to provide safe man access. Supports should be installed as the excavation proceeds. For service excavations overlapping trench sheets could be used as close support in the unconsolidated deposits to minimise ground loss or alternatively, consideration could be given to the use of trench boxes, provided excavations take place within the boxes.

Groundwater was recorded near surface in all of the historical BGS boreholes. Groundwater control/pumping measures will be required and should be in place for all excavations.

The principal geotechnical risks are:

- Contaminated ground / materials
- Soft compressible alluvial deposits
- Swelling Lias Clays
- Aggressive ground conditions

- Contamination of surface water bodies

Whilst it is considered that all identified potential geotechnical constraints can be adequately managed through the engineering design process, intrusive site investigation works will be required prior to the commencement of any development to clarify ground and groundwater conditions to enable engineering design recommendations to be provided for the proposed structure and associated infrastructure

The geotechnical hazard assessment considers the Site to be of medium to high risk with respect to geotechnical risks.

On the basis of the findings of this preliminary geotechnical risk assessment, it is recommended that geotechnical testing is undertaken during a ground investigation to determine variability of the underlying geology and groundwater conditions, to assess potential impacts of ground conditions on foundation design. When geotechnical parameters are obtained, the risk of potential swell, shrinkage and settlement impacts on the proposed bridge structure can be assessed in greater detail.

Soil and groundwater sampling should be undertaken to establish if ground conditions are aggressive as a result of potential contamination, with aggressive compounds having the potential to dissolve/corrode new foundations.

The environmental soil and groundwater sampling shall include sulphate/sulphide testing to specifically determine effects on buried concrete. Additionally the ground investigation shall specifically target the eastern side of the site where historically there has been a gas works.

The Ground Investigation will consist of, but not limited to the following:

- A Ground Penetrating Radar (GPR) survey to identify below ground obstructions and services;

- A LiDAR survey of all above ground assets to assist design modelling.

- 6 No. Percussion with Rotary follow on boreholes to a maximum depth of 80m and installation of groundwater monitoring apparatus (along the alignment of the proposed bridge structure and approach structures);

- 20no trial pits to maximum 3m depth ; and

- Soil samples with associated geotechnical and chemical laboratory testing.

Access for the investigation within rail land will require close liaison with Network Rail and is likely to be restricted by possession timing.

7.1 INTRODUCTION

In this section of the report considers the Geotechnical aspects of the scheme, providing a clear understanding of the ground and groundwater. It will identify and quantify geotechnical risks in order to permit mitigation of such risks at an early stage, prior to any detailed design.

The section shall define the key findings of a desktop study, including topography, geology and current ground conditions where known.

The requirement of any ground investigation considered necessary to progress the scheme up to preferred option and through to detailed design will be identified in this section of the report.

7.2 GEOTECHNICAL RISK

Subject to agreement by the Client the geotechnical classification of the scheme is provisionally Category 3 in accordance with Eurocode 7. This is primarily assessed based on the potential relatively high level of complexity in respect of the structure over the railway line and the likelihood that any excavations could encounter groundwater.

Potential geotechnical risks include settlement of soft soils, flooding, groundwater inflow to excavations, disposal of unacceptable construction materials, adverse impacts to existing utilities, unexploded ordnance, manmade below ground obstructions, underground and above ground services and removal of contaminated fill/landfill.

7.3 TOPOGRAPHY

The site is relatively flat lying at an elevation of 90m above Ordnance Datum (OD). Land on the western outskirts of Banbury rises to an elevation of 155mOD whilst to the east around the M40 the land remains at around 90mOD.

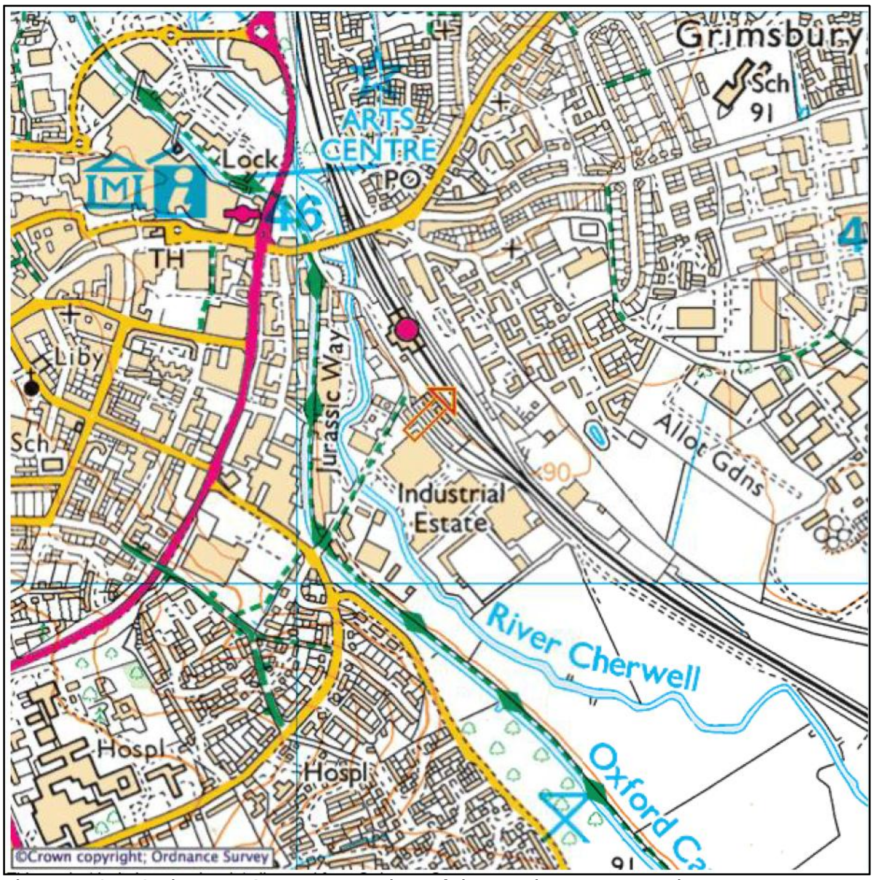

Figure 7.3.1 Ordnance Survey mapping of the study area at scale 1:25000 (www.streetmap.co.uk)

7.4 HISTORICAL DEVELOPMENT

The site has remained primarily dedicated to rail land over the past 130 years though of more recent times the number of lines on the east side of the site has reduced. The history of development in the area is summarised in table 7.4.1 below:

Map	Year	Description	Changes from Previous
1:10,000			
1:10,560	1883-1884	Established railway station with numerous sidings. To the east of the railway lines is Banbury Gas Works. To the west of the railway lines is Britannia Works Depot dealing with agricultural implements.	N/A
1:10,560	1900	Rail land and adjacent land as 1883-1884. Tramway Road constructed.	No change
1:10,560	1923	Rail land and adjacent land as 1900. Allotments Gardens established just north of the Gas Works land.	Allotments established.
1:10,560	1938	Rail land and adjacent land as 1923. Banbury Gas Works and Britannia Works no longer mentioned and therefore deemed to have been decommissioned. Allotment Gardens are still present	Banbury Gas Works and Britannia Works decommissioned.
1:10,000	1955	As 1938. A sewerage works has been constructed on the the site of the Banbury Gas Works.	Construction of Banbury Sewerage works.
1:10,000	1968	As 1955.	No change.
1:10,000	1977-1978	The sewerage works has increased markedly in size. The number of rail lines on the east side of the site has significantly reduced and the land redeveloped to comprise a goods depot and works sheds which may still be rail associated. There is also a gas holder. To the west of the site an industrial estate has been established and Banbury Football ground has been built.	Reduction in rail lines. Land redeveloped comprising a goods depot and works sheds which may still be rail associated. Industrial estate and Banbury Football ground constructed to the west of the site.
1:10,000	1992-1995	As 1977-78. A scrap yard has been constructed adjacent to the rail lines on the east side of the site Further to the east the M40 has	Minor change.

Map	Year	Description	Changes from Previous
		been constructed.	
1:10,000	1999	As 1992-95. The industrial estate on the west side of the site has developed further with more units. A large cattle market has been built to the north east of the site. Higham Way constructed servicing the depot area on the east side of the site	Increase in industrial units on the west side of the site. Development of a large cattle market to the north east of the site.
1:10,000	2006	As 1999. The cattle market has been demolished to be replaced with accommodation (3-4 storey flats). The gas holder adjacent to the rail lines on the east side of the site has been demolished.	Minor changes.
1:10,000	2016	As 2006. The area of accommodation to the north east of the site has spread south covering a large proportion of the old rail land and depot area. A multi-storey car park associated with the station has been constructed	Substantial increase in the size of the housing estate to the north east of the site. Construction of a multi-storey car park for the station.

Table 7.4.1: History of the development in the area.

Historical land use plans for the site are included in the Envirocheck Report (Appendix C).

7.5 GROUND CONDITIONS

The following sections summarise the geological history and regional geology of the area.

EXISTING BOREHOLE DATA

The following borehole data has been extracted from the BGS Onshore GeoIndex. Eight existing boreholes (the results of which were non-confidential) have been identified in close proximity to the access site, indicated in figure 7.5.1.

- SP44SE340 – E445902, N240441, Depth: 21.336m (70 feet).
- SP44SE370 – E446051, N240200, Depth: 7.0m.
- SP44SE372 – E446058, N240389, Depth: 9.0m.
- SP44SE410 – E446478, N240240, Depth 11.50m
- SP44SE412 – E446478, N240129, Depth 10.0m
- SP44SE413 – E446589, N240111, Depth 10.0m

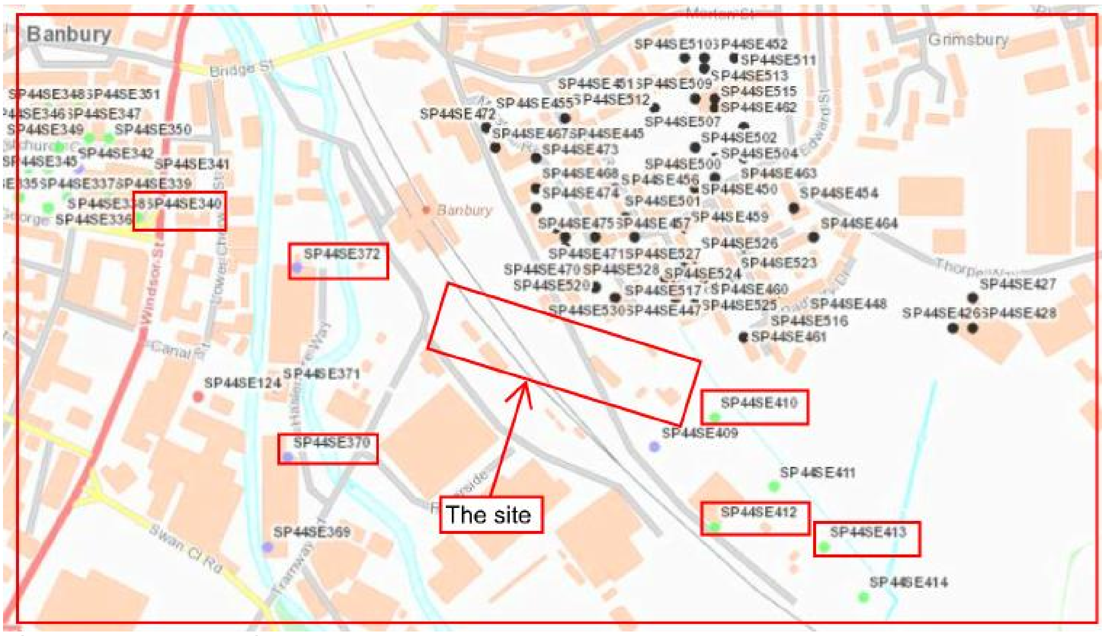

Figure 7.5.1 GI Location Plan

<u>Borehole summaries</u>

Tables 7.5.1 – 7.5.6 summarise the data drawn from the selected existing boreholes within the study area. The full borehole records are presented in Appendix C.

Table 7.5.1: Borehole SP44SE340 (Borehole 6)

Depth (mbgl)	Geological description
0.00 – 0.45	Made Ground (hardcore)
0.45 – 3.35	Alluvium (Firm silty sandy CLAY with traces of organic matter)
3.35 – 3.81	Alluvium (Clayey gravel)
3.81 – 5.94	Stiff to very stiff fissured silty clay with occasional shells.
5.94 – 6.58	Claystone
6.58 – 21.34	Very stiff fissured silty CLAY with occasional shells

Table 7.5.2: Borehole SP44SE370 (Borehole 2)

Depth (mbgl)	Geological description
0.00 - 1.90	Made Ground (Firm Clay, Ash and Brick Fill)
1.90 - 2.20	Alluvium (Firm silty CLAY)
2.20 – 3.90	Alluvium (Soft sandy CLAY)
3.90 – 6.20	Alluvium (Very soft blue silty CLAY
6.20 – 7.00	Very stiff Laminated CLAY

Table 7.5.3: Borehole SP44SE372 (Borehole 4)

Depth (mbgl)	Geological description
0.00 – 2.10	Made Ground (ash and rubble fill)
2.10 – 5.60	Alluvium? (Firm organic silty clay FILL))
5.60 – 6.00	Alluvium (Soft grey CLAY with some roots)
6.00 – 6.20	Alluvium (Small sized GRAVEL)
6.20 – 9.00	Very stiff Laminated CLAY

Table 7.5.4: Borehole SP44SE410 (Borehole B)

Depth (mbgl)	Geological description
0.00 – 2.20	Made Ground (Soft sandy Clay with fine medium gravel, brick, metal, plastic and wood. Oily smell)
2.20 – 3.30	Alluvium (Soft sandy CLAY)
3.30 – 5.10	Alluvium (Soft very sandy fine medium gravelly CLAY)
5.10 – 10.00	Lower Lias (Very Stiff to stiff fissured silty CLAY with partings of silt. Occasional shell fragments below 7.50m. Siltstone at 9.0m depth.)

Table 7.5.5: Borehole SP44SE412 (Borehole D)

Depth (mbgl)	Geological description
0.00 - 1.50	Made Ground (Soft sandy Silt with occasional pockets of sand, fine gravel, brick and clinker. Slight odour.)
1.50 – 3.40	Alluvium (Soft to firm slightly gravelly silty CLAY)
3.40 - 4.40	Alluvium (slightly sandy GRAVEL)
4.40 – 10.00	Lower Lias (Stiff fissured silty CLAY with occasional shells. Very stiff below 5.50m depth)

Table 7.5.6: Borehole SP44SE413 (Borehole E)

Depth (mbgl)	Geological description
0.00 – 0.70	Made Ground (Clayey Sand with clinker, gravel and metal)
0.70 – 1.25	Alluvium (Clayey silty SAND with occasional gravel)
1.25 – 3.35	Alluvium (Soft to firm very silty CLAY with occasional sandy patches)
3.35 – 4.80	Alluvium (Silty sandy fine to coarse GRAVEL with organic smell)
4.80 – 10.00	Lower Lias (Very Stiff to stiff laminated silty CLAY with silt partings and shells)

Groundwater is noted in all of the BGS historical boreholes, varying in depth between 1.80 – 3.35m below existing ground level.

7.6 REGIONAL GEOLOGY

The Regional Geology is dominated by the Lias Group (Late Triassic and Early Jurassic) deposited between 180 and 205million years ago. The outcrop of the Lias extends in a continuous band from the coast of Dorset in a north-easterly direction to Yorkshire. As illustrated in Figure 7.6.1 below.

The Lias Group strata were deposited in a Mediterranean-like climate in warm, shallow seas. Carbonates were deposited as limestone beds and nodules, particularly in the lower part of the succession to form the Blue Lias Formation. The Lias Group is very fossiliferous, and ammonites in particular have been used to sub-divide the group into twenty bio-zones. Traditionally, the group has been divided into the Lower, Middle, and Upper Lias, but the succession is better described in terms of the formations, as defined by Cox et al. (1999). Of these, the main clay-bearing formations are the Blue Lias (Ambrose, 2001), Charmouth Mudstone, and Whitby Mudstone Formations (Engineering Geology of Rocks and Soils – Lias Group, BGS). The latter two strata are found in the Banbury area.

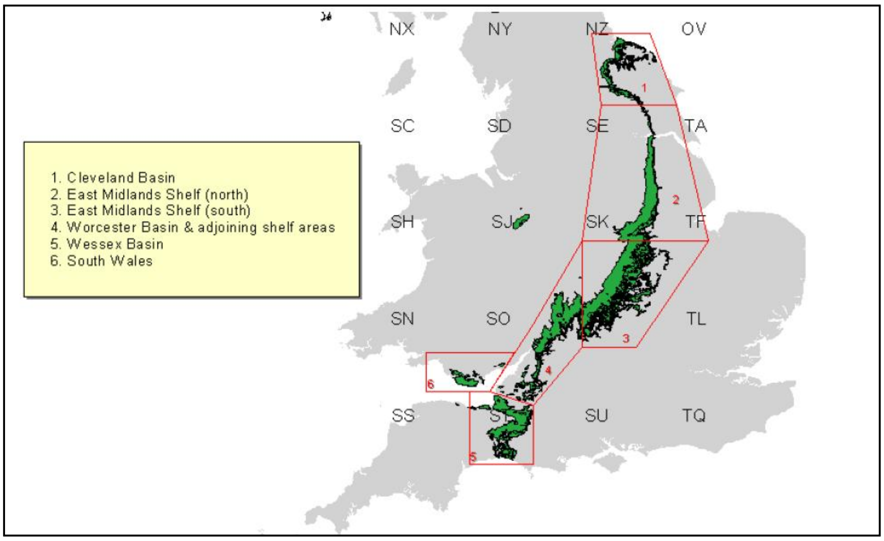

Figure 7.6.1 map showing the outcrop of the Lias Group in England and Wales.

Fresh Lias mudstones tend to be strong and durable but, in common with other Jurassic clay-rich formations, undergo considerable deterioration of most engineering properties following stress relief and weathering (Cripps & Taylor, 1981).

7.7 DRIFT GEOLOGY

The drift geology in the study area comprises alluvial clays, sands and gravels up to 6.20m thick. The clays are described as soft to firm and contain some organic matter. Figure 7.7.1 below extracted from the Envirocheck Report (Appendix C) shows the outcrop of the alluvial deposits.

Figure 7.7.1: Superficial deposits, scale 1:50000 (BGS)

7.8 SOLID GEOLOGY

Underlying the alluvium at the site is stiff to very stiff fissured clays of the Charmouth Formation (Lias Group). The British Geological Survey publication ‘Engineering Geology of Rocks and Soils – Lias Group’ reports the thickness of this formation between 75 – 110m thick in the Banbury area. Figure 7.8.1 below extracted from the Envirocheck Report (Appendix C) shows the solid geology underlying the site.

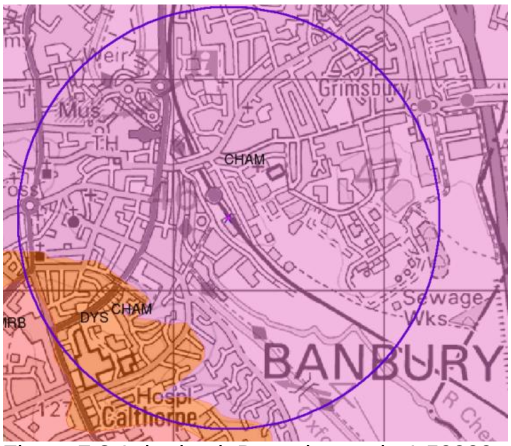

Figure 7.8.1: bedrock Deposits, scale 1:50000 (BGS)

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WHM	Whitby Mudstone Formation	Mudstone	Toarcian - Toarcian
	DYS	Dyrham Formation	Siltstone and Mudstone, Interbedded	Pliensbachian - Pliensbachian
	MRB	Marlstone Rock Formation	Ferruginous Limestone and Ironstone	Toarcian - Pliensbachian
	CHAM	Charmouth Mudstone Formation	Mudstone	Pliensbachian - Sinemurian
		Faults		

7.9 IDENTIFIED GEOLOGICAL RISKS

Reference to the Envirocheck Report (Appendix C) and BGS borehole information identifies the following risks:

- Potential for Made Ground (high);
- Potential for compressible ground stability hazards (moderate);
- Potential for landslide ground stability hazards (low);
- Potential for running sand ground stability hazards (low); and,
- Potential for shrinking or swelling clay ground stability hazards (low).

Having evaluated the information gathered during this study and described in the previous sections, Table 7.9.1 below presents an assessment of potential risks with respect to geotechnical issues in the context of the proposed commercial development.

Geotechnical Hazard	Risk Category	Justification/Evaluation
Made Ground	High	The Site has clearly been subject to contaminants arising from the rail industry. Additionally there was at one time a gas works in close proximity to site along with other light industry all potentially introducing contaminant to the upper materials. Boreholes mention clinker, metals, plastic, wood and slight

Geotechnical Hazard	Risk Category	Justification/Evaluation
		odours. It is considered that encountering contaminated made ground is very likely. The previous land use to the east of the site suggests a potential for contaminated ground associated with the old gas works which can result in the ground being contaminated with tars, oils, hydrocarbon sludges, asbestos, inorganic compounds such as sulphuric acid, sodium hydroxide, cyanides, ammonium and metals such as arsenic, cadmium, lead and mercury. Made Ground is a poor founding stratum due to its heterogeneous composition and variable strength which could lead to differential and excessive settlement.
Variable quality/depth of Natural Deposits - Alluvium	Medium	Variability in composition of the alluvial material makes this stratum poor as a bearing medium and is likely to result in in unacceptable differential settlement and will need confirmation by an appropriately designed ground investigation.
Swelling Clays	Medium to high	The Lias clays typically contain the clay mineral smectite. The smectite content of the Lias Group is variable, and whilst the Lias overall has a 'medium' volume change potential rating, some formations contain smectite-rich layers which have a 'high' rating.
Hydrological and Hydrogeological Regime	Low to Medium	Depth to groundwater is some 1.8 – 3.35m below ground level. There is a very high risk of water ingress when excavating for foundations such as piling foundations to depth. For excavations down into the Alluvial materials, dewatering may be a requirement. It is recommended that the groundwater regime is confirmed by an appropriately designed ground investigation and installation of monitoring equipment.
Obstructions/underground services	High	Given that the Site has largely been developed and there is an extensive development history the risk from underground obstructions, buried services, former foundations etc. is considered high.
Buried concrete	Medium	The Lias stratum beneath the Site is typically high in sulphates requiring any concrete to be designed to the appropriate sulphate resistance (thaumasite concrete attack). Environmental testing during a ground investigation will help to establish sulphate/sulphide concentrations present in the strata.
Implications for Development	Medium	Whilst it is considered that all identified potential geotechnical constraints can be adequately managed through the engineering design process, intrusive site investigation works will be required prior to the commencement of any development to clarify ground and groundwater conditions to enable engineering design recommendations to be provided for the proposed structure and associated infrastructure.
OVERALL RISK	**MEDIUM to HIGH**	

Table 7.9.1 Geotechnical hazard Assessment Summary

The geotechnical hazard assessment considers the Site to be of medium to high risk with respect to geotechnical risks.

On the basis of the findings of this preliminary geotechnical risk assessment, it is recommended that geotechnical testing is undertaken during a ground investigation to determine variability of the underlying geology and groundwater conditions, to assess potential impacts of ground conditions on foundation design. When geotechnical parameters are obtained, the risk of potential swell, shrinkage and settlement impacts of the proposed bridge structure can be assessed in greater detail.

Soil and groundwater sampling should be undertaken to establish if ground conditions are aggressive as a result of potential contamination, with aggressive compounds having the potential to dissolve/corrode new foundations.

The environmental soil and groundwater sampling shall include sulphate/sulphide testing to specifically determine effects on buried concrete. Additionally the ground investigation shall specifically target the eastern side of the site where historically there has been a gas works.

7.10 HYDROLOGY

REGIONAL

The Met Office website (Met Office, 2015) provides weather data averages for various weather stations around the UK. The nearest weather station to the study area is the Oxford weather station which is approximately 48km south from Banbury.

Data contained in table 7.10.1 illustrates the weather averages over a period of 12 months, based on averages from data collected between 1981 and 2010.

Month	Max. temp (°C)	Min. temp (°C)	Days of air frost (days)	Sunshine (hours)	Rainfall (mm)	Days of rainfall >= 1 mm (days)
Jan	7.6	2.1	8.5	62.5	56.6	11.5
Feb	8.0	1.8	9.1	78.9	42.5	8.9
Mar	10.9	3.7	3.8	111.2	47.6	10.1
Apr	13.6	5.0	1.7	160.9	49.1	9.1
May	17.1	7.9	0.1	192.9	57.1	9.7
Jun	20.3	10.9	0	191.0	48.0	8.0
Jul	22.7	13.0	0	207.0	48.9	7.9
Aug	22.3	12.9	0	196.5	56.5	8.1
Sep	19.1	10.7	0	141.2	54.1	9.1
Oct	14.8	7.8	0.9	111.3	69.6	10.9
Nov	10.5	4.6	4.0	70.7	66.6	11.3
Dec	7.7	2.3	9.1	53.8	63.1	10.9
Annual	14.6	6.9	37.1	1577.9	659.7	115.5

Table 7.10.1 Weather averages for Oxford weather station

There is no known available local weather data for the site.

HYDROGEOLOGY

Reference to the Environment Agency (EA) data maps though the EnviroCheck Report (see Appendix C) indicates site classification for the following hydrogeological categories, summarised in Table 7.10.2:

Category	Site Classification
Flood Zone & Risk	Flood Zone 3 (Figure 7.10.1) with the area principally benefiting from flood defences giving a Low risk from flooding (Figure 7.10.2).
Groundwater Source Protection Zone	None (Figure 7.10.3).
Superficial Aquifer Mapping	Secondary A (Figure 7.10.4).
Bedrock Aquifer Mapping	Secondary Undifferentiated (Figure 7.10.5).
Groundwater Vulnerability Zone	Minor Aquifer High (Figure 7.10.6).

Table 7.10.2: Site hydrological classification

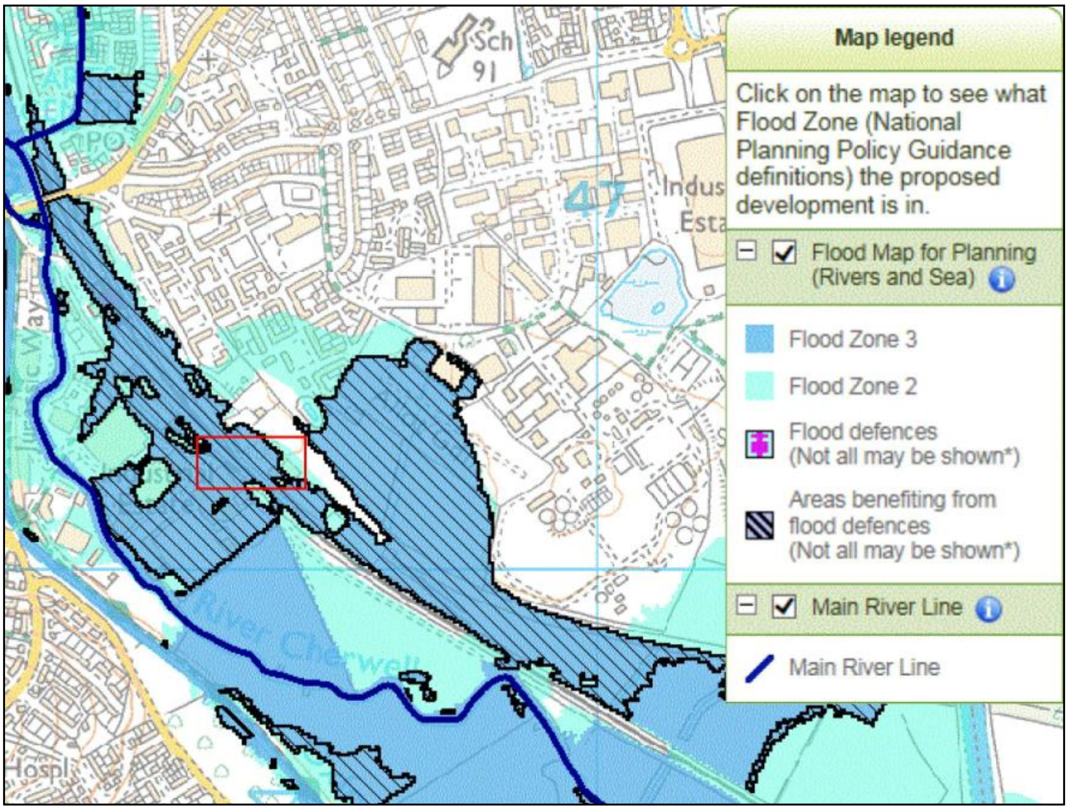

Figure 7.10.1: Flood map for planning, scale 1:15000 (Environmental Agency, 2015).

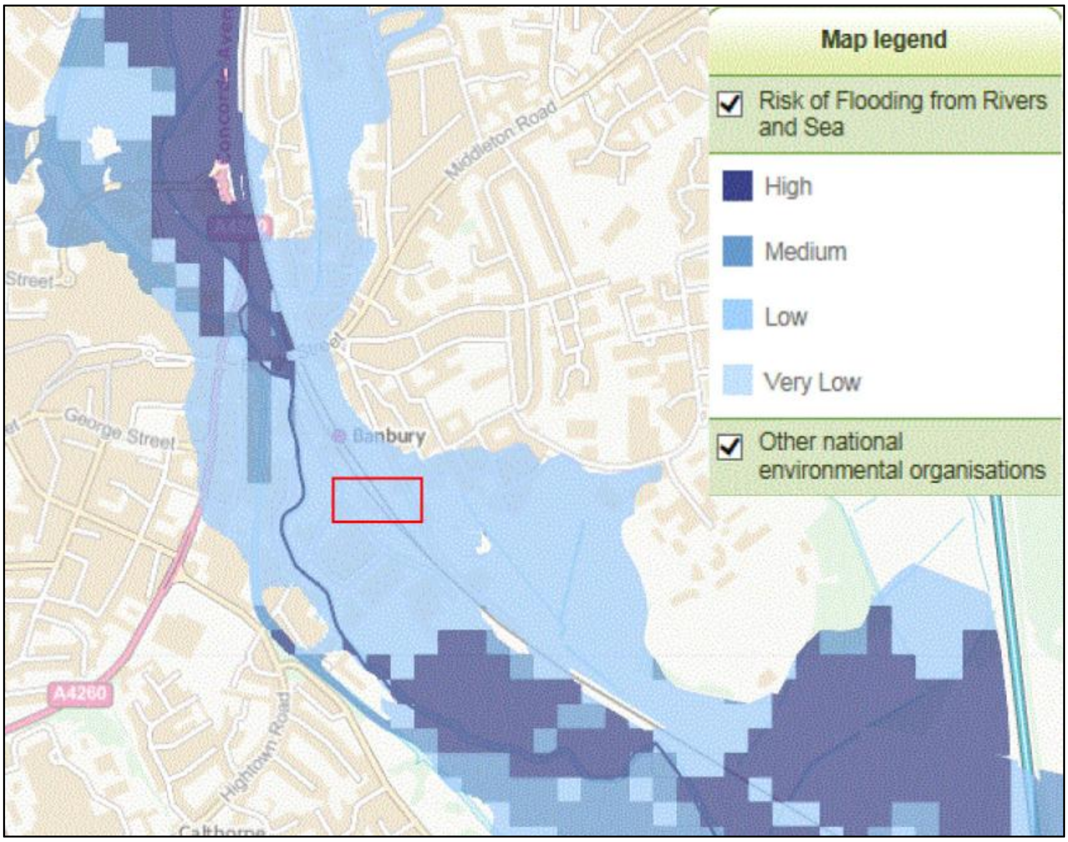

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Figure 7.10.2: Risk of flooding from Rivers and Sea, scale 1:15000 (Environmental Agency, 2015).

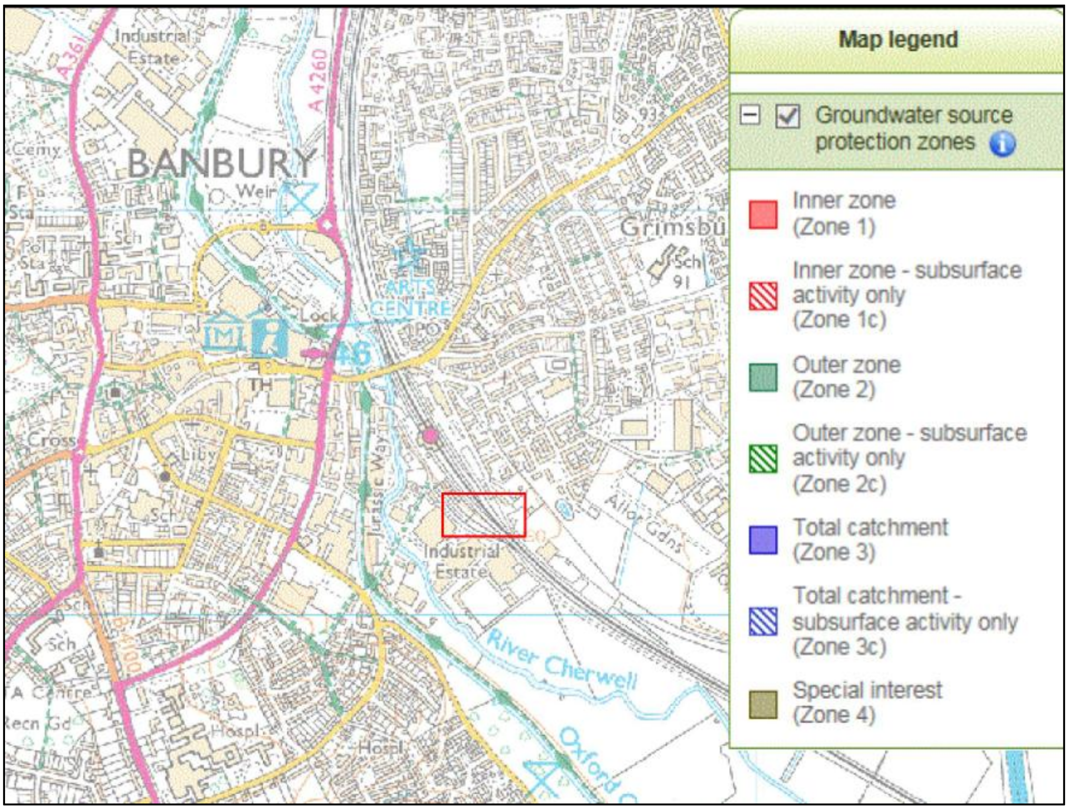

Figure 7.10.3: Groundwater Source Protection Zones, scale 1:40000 (Environmental Agency, 2015).

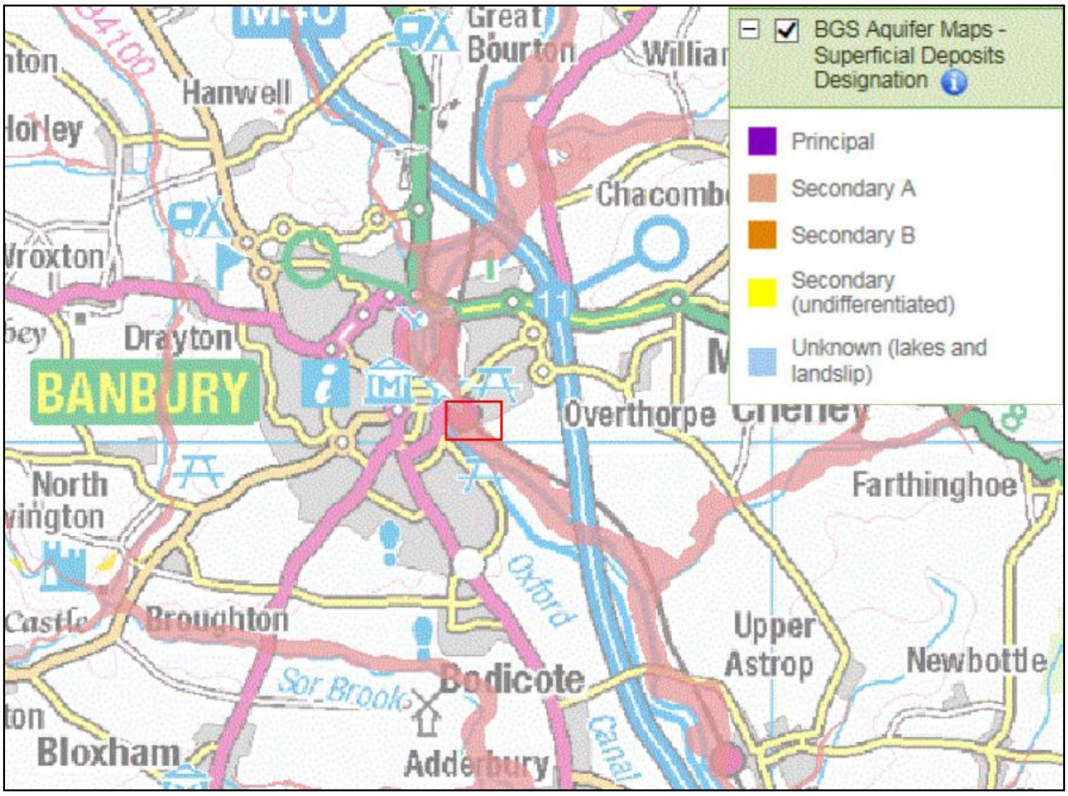

Figure 7.10.4: Aquifer Superficial Deposits Designation, scale 1:75000 (Environmental Agency, 2015).

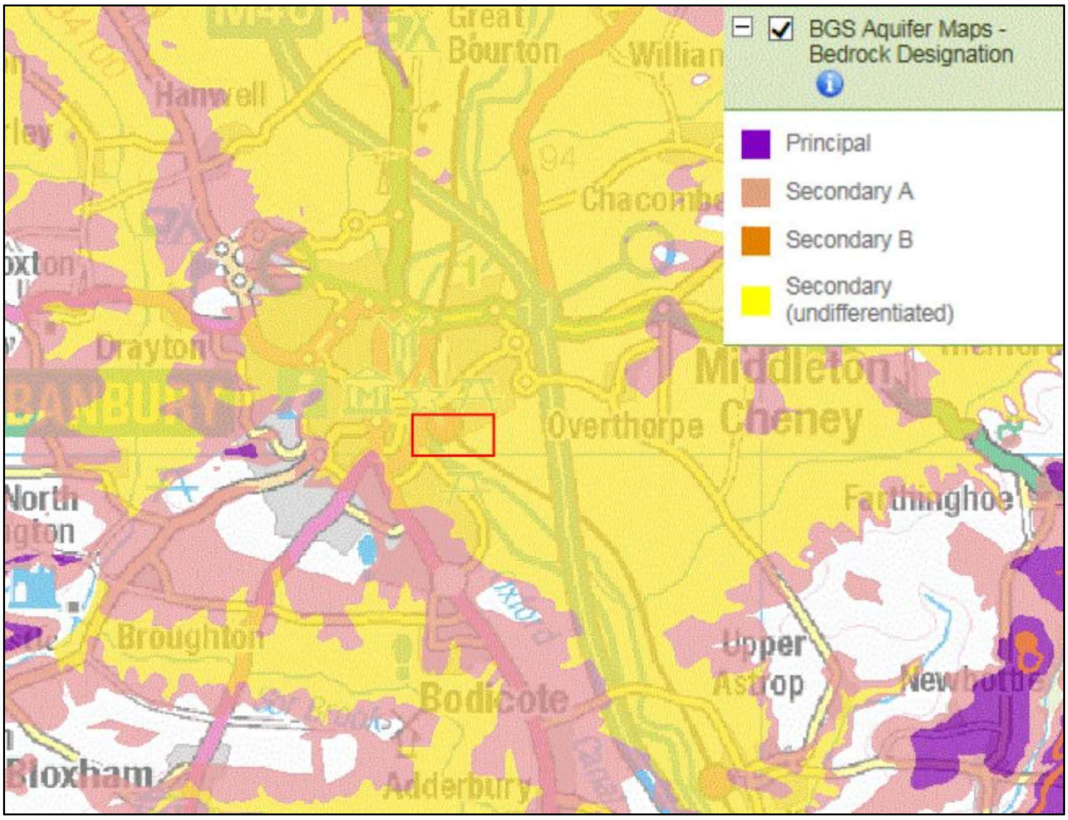

Figure 7.10.5: Aquifer Bedrock Designation, scale 1:75000 (Environmental Agency, 2015).

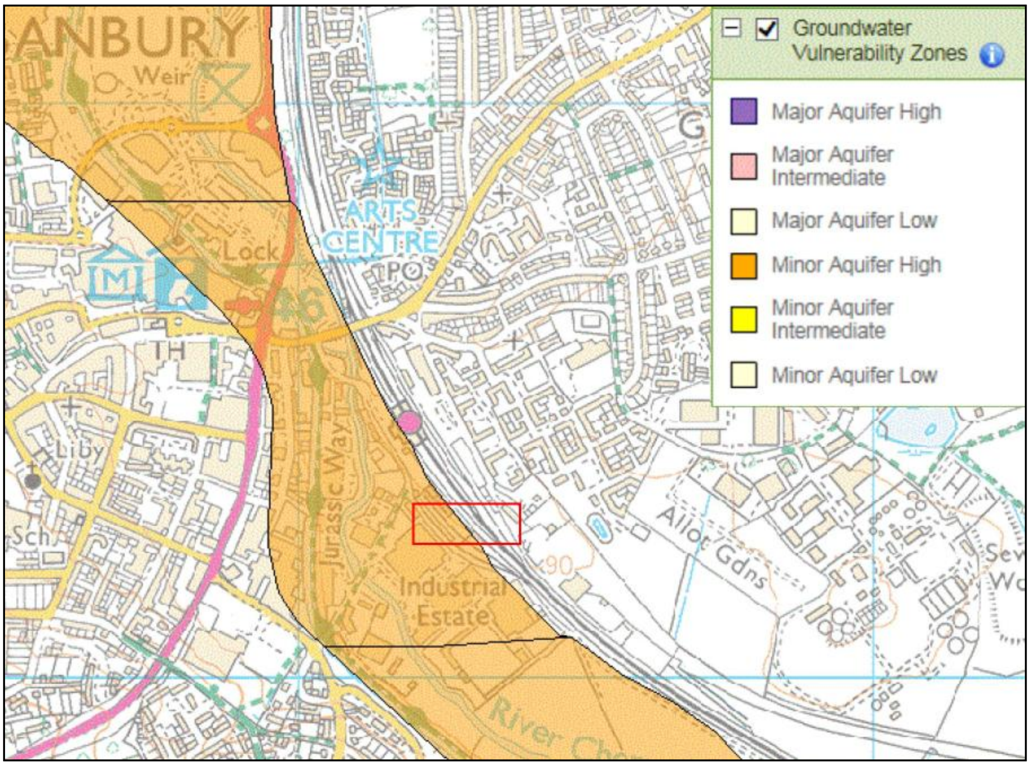

Figure 7.10.6: Groundwater Vulnerability Zones, scale 1:10000 (Environmental Agency, 2015).

7.11 PRELIMINARY ENGINEERING CONSIDERATIONS

RECOMMENDATIONS FOR A GROUND INVESTIGATION

To determine an appropriate and concise ground model for the purposes of design, a ground investigation (GI) is recommended within the site boundaries.

This GI will consist of, but not limited to the following:

- A Ground Penetrating Radar (GPR) survey to identify below ground obstructions and services;
- A LiDAR survey of all above ground assets to assist design modelling.
- 6 No. Percussion with Rotary follow on boreholes to a maximum depth of 80m and installation of groundwater monitoring apparatus (along the alignment of the proposed bridge structure and approach structures);
- 20no trial pits to maximum 3m depth ; and
- Soil samples with associated geotechnical and chemical laboratory testing.

Access for the investigation within rail land will require close liaison with Network Rail and is likely to be restricted by possession timing.

FOUNDATIONS

Given the nature of the structure it is expected that deep foundations comprising pile groups and a pile cap will be adopted to carry the loads from the bridge piers.

Lias Clay Formation is relatively deep across the scheme location and the level/weathering profiles will vary. However this is unlikely to influence the performance of a piled solution given the piles will be founded well below the weathered zone. These items have not yet been determined and full bearing capacity and settlement calculations will be required as part of the Geotechnical Design Report (GDR) when loadings and tolerances are known/determined.

The choice of piling technique should consider the effect on adjacent structures and the means of ensuring a structurally sound and acceptable foundation. Different piling techniques may be suitable for piles founded at different levels in different materials and capacities will depend on the pile dimensions and method of installation.

At this stage it is likely that the majority of foundations will be within Lias Clay Formation.

Foundations to the approach structures may be able to adopt alternative design solutions such as soil mixing to improve the strength of the alluvial material, vibro-stone columns down to the Lias Clay with an associated load transfer platform or surcharging to reduce long term settlement effects within the alluvial material.

EMBANKMENTS

Highway embankments will be formed at the approaches to the bridge abutments. It is proposed that these are formed from reinforced structural fill to minimise land take. Placement of these materials should be to a suitably prepared earthworks specification and using appropriate control testing to allow validation of the placed materials.

EXCAVATABILITY

The presence of large obstructions associated with the Made Ground should be anticipated. Allowance for breaking out and removal of such obstructions should be made and any over digging should be backfilled with suitable engineered fill.

Unsupported temporary safe slope angles must be considered by a competent Temporary Works Designer.

Any vertically sided excavations will require sheet pile support to ensure stability and to provide safe man access. Supports should be installed as the excavation proceeds. For service excavations overlapping trench sheets could be used as close support in the unconsolidated deposits to minimise ground loss or alternatively consideration could be given to the use of trench boxes, provided excavations take place within the boxes.

Groundwater was recorded near surface in all of the historical BGS boreholes. Groundwater control/pumping measures will be required and should be in place for all excavations.

8 ENVIRONMENT

INTRODUCTION

This chapter of the Outline Feasibility Report assesses the key environmental constraints associated with the proposed development, and includes consideration of the following topics:

- Air Quality;
- Cultural Heritage;
- Landscape, Townscape and Visual;
- Nature Conservation;
- Geology and Soils;
- Materials;
- Noise and Vibration;
- People and Communities;
- Road Drainage and the Water Environment.

METHODOLOGY

BASELINE

The environmental baseline conditions for the proposed development have been established by undertaking a desk-based study using publically available data, including GIS data. At this stage, a study area with a 2km radius from the proposed development has been used to obtain information on the key constraints. The following resources were consulted in undertaking the study:

- British Geological Survey (2016), Geology of Britain Viewer
- Cherwell District Council (2015) Air Quality Updating and Screening Assessment
- Cobham Resource Consultants (1995), Cherwell District Landscape Assessment
- DEFRA (2016), Air Quality Management Areas Interactive Map
- DEFRA (2016), Noise Action Planning Important Areas Round 2 England
- EA Catchment Data Explorer (2016) Cherwell (Cropredy to Nell Bridge)
- Environment Agency (2016), Flood Map for Planning (Rivers and Sea)
- Environment Agency (2016), Groundwater Map
- Environment Agency (2016), Risk of Flooding from Reservoirs
- Environment Agency (2016), Risk of Flooding from Rivers and Sea
- Environment Agency (2016), Risk of Flooding from Surface Water
- Environment Agency (2016), Water Abstraction Licences
- Google Maps
- Historic England (2015) Listed Buildings and Scheduled Monuments
- LandIS Soilscapes Map (2015)

- Natural England (2014), Agricultural Land Classification Grades – Post 1988 Survey (polygons)
- Natural England (2014), National Character Area Profile: 95 Northamptonshire Uplands (NE565)
- Oxfordshire County Council (2014) Road Traffic Accident Casualty Data Summary 2014
- UK Government Data Portal

The key baseline information collected during the desktop study is presented in a constraints map in Appendix D.

PRELIMINARY ASSESSMENT

This report contains a high level qualitative assessment based upon readily available data. Impact assessments have been made using professional judgement and experience of impacts encountered on similar schemes.

Should the proposed development be taken forward, further assessments, including site surveys, will be required to enable a comprehensive impact assessment of the proposed development on the environment.

8.1 AIR QUALITY

8.1.1 BASELINE CONDITIONS

AIR QUALITY MANAGEMENT

The proposed development is located within the administrative area of Cherwell District Council (CDC). CDC has designated two Air Quality Management Areas (AQMA) within 2km of the proposed development. The first AQMA is located on the A361, approximately 761m west of the proposed development at its nearest point. The second AQMA is located 1.33km north of the proposed development on the A422/Hennef Way. Both AQMAs are declared for the management of annual mean nitrogen dioxide (NO_2) concentrations and the A422/Hennef way AQMA is also designated for hourly mean NO_2 concentrations.

CDC conducts air quality monitoring of NO_2 using passive monitoring at diffusion tube sites. Data from 2014, taken from CDC's Updating and Screening Assessment (2015), shows both AQMAs are exceeding the national objective NO_2. Of the 20 sites monitored by CDC, 4 exceed the national air quality objective for NO_2.

CDC does not undertake any monitoring for PM_{10}, sulphur dioxide, benzene or any other pollutants.

SENSITIVE RECEPTORS

The nearest residential property to the proposed development is located approximately 20m to the east. The proposed development is bounded primarily by residential properties to the east, industrial and commercial areas to the south and west, with an isolated residential area approximately 200m to the west and mainly residential properties to the north. The nearest residential property to the north is located approximately 230m away from the proposed development. Banbury United Football Club ground is located approximately 350m to the south.

No statutory or non-statutory sensitive ecological receptors that may be affected by a change in air quality were identified within 2km of the proposed development.

Given the elevated levels of NO_2 in the area and the proximity of the proposed development to residential areas to the east, receptors are likely to be sensitive to small changes in pollutant concentrations.

8.1.2 ASSESSMENT

Construction activities are likely to have adverse air quality impacts on sensitive residential receptors, particularly to the east of the proposed development. Any earthworks, demolition, construction works, or construction vehicle movements are likely to increase dust emissions in the vicinity of the proposed development. Due to the close proximity (less than 20m in places) and elevated height of the road, residential receptors to the east are likely to be temporarily adversely impacted by a decrease in air quality resulting from dust emissions. Construction related traffic may also contribute to increased NO_2 exposure, particularly for residential receptors to the east of the proposed development.

Appropriate mitigation measures should be implemented to ensure that good construction practice is followed (e.g. planning site layout to maximise distance from stockpiles to sensitive receptors, removing dusty materials from site as soon as possible, etc.) and impacts are minimised to an acceptable level.

During operation, the proposed development will introduce road traffic where there has previously been none. This introduction of road traffic may cause elevated levels of NO_2 and other exhaust gas pollutants in the vicinity of the new road link. The most sensitive receptors are likely to be the residential receptors directly east of the proposed development, with the commercial and industrial units to the west also likely to experience a detrimental change in air quality. However, positive impacts may also be experienced by sensitive receptors in the vicinity of the wider road network if the proposed development results in a decrease in congestion and queuing. Traffic modelling would be required to feed into a full Air Quality Impact Assessment in order to determine the exact nature of any air quality impacts.

8.2 CULTURAL HERITAGE

8.2.1 BASELINE CONDITIONS

The following cultural heritage assets are located within the 2km study area:

- 1 Grade I Listed Building
- Grade II* Listed Buildings
- 223 Grade II Listed Buildings
- 1 Scheduled Monument

The nearest designated cultural heritage asset is the Grade II Listed Old Town Hall (Chapman Brothers) located approximately 203m west of the proposed development on Lower Cherwell Street.

The Scheduled Monument is a Former World War I National Filling Factory located approximately 1.3km east of the proposed development and includes standing, buried and earthwork remains.

8.2.2 ASSESSMENT

Given the distance of the nearest cultural asset to the proposed development and the intervening buildings, any impacts to the setting of such assets during construction are unlikely.

Although impacts on known assets are not expected, there may be the potential to uncover previously unknown archaeological and cultural assets during construction works. Impacts will be reduced following appropriate archaeological investigation.

Direct impacts on cultural heritage assets during the operation of the proposed development are considered unlikely at this stage. However, indirect impacts on the setting of cultural heritage assets will depend on the design (especially the height) of the proposed development, and the resulting changes to traffic flows on the road network. A full assessment of the potential for cultural heritage impacts would be required at a later stage once more details of the proposed development are available.

8.3 LANDSCAPE, TOWNSCAPE AND VISUAL IMPACT CULTURAL HERITAGE

8.3.1 BASELINE CONDITIONS

The proposed development is located in a primarily urban townscape, with residential, commercial and industrial areas immediately surrounding the proposed development. The wider surrounding area, outside Banbury, is characterised by large, open arable fields on gently rolling hills with a series of roads intersecting them. The proposed development is located within the River Cherwell Valley and has the Oxford Canal and River Cherwell running adjacent to the east.

Landscape Character

The proposed development falls within National Character Area (NCA) 95 – Northamptonshire Uplands. This area consists of an extension of gently rolling limestone and clay hills from the Cotswolds and Cherwell Valley in the south-west to the lowlands of the Leicestershire vales. The landscape primarily consists of extensive open field systems with ridges and furrows and wide views that extend far from ridge tops in the area.

The proposed development also falls within two Landscape Character Areas (LCA), taken from the Cherwell District Landscape Assessment (1995) which are as follows:

- Upper Cherwell Basin: Characterised by a high area of land with open, gently sloping valley sides; and
- Cherwell Valley: Follows the River Cherwell and has steep enclosed valleys.

TOWNSCAPE

To the south-west of the proposed development, the area mainly comprises of one and two storey low rise commercial and industrial units. West of the site is generally residential and commercial units with a large number of Listed Buildings constructed as early as the 17th century onwards, which are centred along the A361 in central Banbury. East of the proposed development are a mix of three and four storey apartment blocks, and two storey residential housing, with the majority built between the mid to late 20th Century. The area is also characterised by numerous roads intersecting residential, commercial and industrial areas.

VISUAL BASELINE

Views of the proposed development from nearby residential streets are likely to be restricted due to the number of multi-storey buildings in the immediate vicinity. Views west from the M40 for motorised vehicles are also likely to be restricted due to roadside vegetation and commercial buildings screening views of the proposed development. Existing views are likely to be short range apart from for elevated receptors in three and four storey housing east of the proposed development that may have views that extend further. Views of the proposed development from the north east are likely to be restricted by the multi-storey station car park located immediately adjacent to the proposed development to the north-east.

8.3.2 ASSESSMENT

Construction of the proposed development will introduce a feature which fits largely within the existing urban character and is unlikely to have an adverse impact on landscape and townscape character. However, consideration will need to be given to the aesthetic design of the proposed development and the extent of any lighting proposed to ensure it is in keeping with the existing townscape.

The elevation of the link road has the potential to cause adverse visual impacts, particularly for the sensitive residential receptors that currently have elevated views, located directly east of the proposed development. Residential receptors to the north east are unlikely to have views of the proposed development facing south-west due to the multi-storey station car park screening the proposed development. The eastern ramp of the proposed development would be located within 20m of sensitive receptors and will noticeably change their views facing west at both construction and operation phases. The addition of road lighting and vehicle headlights during operation is also likely to adversely impact the existing views of residential receptors at night.

8.4 NATURE CONSERVATION

8.4.1 BASELINE

No statutory or non-statutory designated nature conservation sites were identified within 2km of the proposed development.

Two UK Biodiversity Action Plan (BAP) priority habitats were identified within the 2km search radius namely Coastal and Floodplain Grazing Marsh approximately 900m south-east of the proposed development and Deciduous Woodland, located 600m south of the proposed development

Two watercourses are located within the study area namely the River Cherwell, approximately 60m west of the proposed development at its closest point and the Oxford Canal, approximately 122m west of the proposed development at its closest point. A single water body used as a fishing lake is located 800m to the east of the proposed development.

At this stage of the project, it is not possible to determine the presence of any protected species within the study area. An Extended Phase 1 Habitat Survey will be required, potentially followed by protected species surveys, to acquire a more comprehensive baseline.

8.4.2 ASSESSMENT

At this stage, no sites designated for nature conservation have been identified in the vicinity of the proposed development, and therefore it is not considered likely that there will be any impacts on designated sites as a result of the proposed development, either through the construction or operational phases. However, consideration should be given to the potential for impacts on the River Cherwell, Oxford Canal and the two priority habitats found nearby. In addition, there is the potential for protected species to inhabit the study area (e.g. bats and invertebrates) and these may be adversely impacted by the proposed development. Suitable mitigation measures will be required should any protected species be found to be impacted by the proposed development.

8.5 GEOLOGY AND SOILS

8.5.1 BASELINE

SUPERFICIAL GEOLOGY

The site contains River Cherwell deposits (clay, silt, sand and gravel) which the British Geological Survey describe as a normally soft to firm consolidated, compressible silty clay that can contain layers of sand, peat, silt and gravel.

SOLID GEOLOGY

The proposed development sits upon superficial alluvial deposits of clay, silt, sand and gravel overlying bedrock of Charmouth mudstone.

Approximately 400m to the west of the proposed development, the geology changes to a Dyrham formation which is silt and mudstone embedded.

DESIGNATED SITES

There are no geological SSSIs or Regionally Important Geological Sites (RIGS) located within the study area.

SOILS

The proposed development falls within land ‘predominantly in urban use’. To the north, west and south of Banbury are areas of mixed soils that have an Agricultural Land Classification (ALC) of Grade 1 (Excellent), Grade 2 (Very Good) and Grade 3a and 3b (Good to Moderate). The ALC map from Natural England (2014) on which this review is based forms part of a regional scale series at 1:250,000 scales that provides an indication of soil quality, however is not intended for use in assessment of individual sites at a smaller scale.

The proposed development sits upon loamy and clayey floodplain soils with naturally high groundwater associated with the River Cherwell. This soil type follows the river and represents the base of the Cherwell valley. Approximately 50m west and 70m east of the proposed development, the soil changes to a slowly permeable, seasonally wet, slightly acidic but base-rich loamy and clayey soil.

In absence of site specific information, the permeability of the soils is likely to be low due to the naturally high groundwater.

CONTAMINATED LAND

There are five historic landfill sites within the study area with the closest located 426m south-west on Tramway Road. These five historic landfills contain a range of inert, industrial, commercial, household and liquid/sludge wastes.

The proposed development crosses an operational railway, and there may be historical and recent contamination present in the immediate vicinity of the tracks, including polyaromatic hydrocarbons (PAHs), heavy metals and polychlorinated biphenyls (PCBs).

Current land use within the immediate vicinity of the proposed development is mainly industrial and commercial, including a car servicing business and the Certas Fuel Centre which is located 100m west of the proposed development. These units may have the potential to cause land contamination or release pollutants such as fuels, oils and lubricants into the local environment.

8.5.2 ASSESSMENT

At this stage, the amount of land take required for the proposed development is unknown. Due to the urban and industrial nature of the location of the proposed development, it is possible that construction works may disturb existing contaminants already in the ground. A Contaminated Land Desk Study and full ground investigation will be required at a later stage to inform site specific conditions, and potential impacts on geology and soils.

During operation, there is the potential for soil quality to be impacted as a result of increasing pollutant exposure from exhaust emissions. Consideration of operational mitigation measures e.g. to prevent pollutants from surface water run-off entering the ground, will be required.

8.6 MATERIALS

8.6.1 BASELINE

Material resources will be required to create the new road link and any associated infrastructure. This is likely to include primary materials such as aggregates, or secondary recycled materials such as recycled concrete, either sourced on site or brought in from off-site and produced by another nearby construction project.

8.6.2 ASSESSMENT

At this early stage, no information on materials or waste generation associated with the proposed development is available, however a detailed assessment of materials and potential waste generation should be conducted once more detailed design information is available.

8.7 NOISE AND VIBRATION

8.7.1 BASELINE CONDITIONS

Immediately north-east and east of the proposed development are residential properties which are considered to be sensitive receptors in noise terms. At the closest point, these sensitive receptors are approximately 20m away from the proposed development. To the west of the site there is a mix of industrial and commercial units with an isolated residential area approximately 200m to the west of the development.

There are seven Noise Important Areas located within 2km of the proposed development with the nearest being located approximately 435m south-east, where Gatteridge Street meets the A4260.

Given the proximity to the railway, the M40, the urban setting and numerous roads in the vicinity of the proposed development, it is likely that the existing noise environment is dominated by road and rail traffic, with relatively high baseline levels. The sensitive receptors identified may be sensitive to small increases in noise levels.

8.7.2 ASSESSMENT

During the construction phase, it is likely that construction works and associated traffic will have an adverse impact on existing noise levels, particularly for residential receptors directly to the east and north-east of the proposed development. Vibration from the construction phase may also cause an impact on nearby properties. Mitigation, for example using Best Practical Means in terms of construction methodology should be implemented to reduce the levels of noise and vibration arising from the construction works.

During operation, it is likely that the noise environment will change due to the proposed development. New noise will be introduced in the vicinity of the proposed development due to the introduction of road traffic where it previously did not travel. However, it may be that noise levels will be reduced at other locations due to a reduction in traffic, and potentially congestion, on the wider network as a result of the proposed development. A full Noise and Vibration Assessment will be required to determine the exact nature of any noise and vibration impacts and to recommend any specific mitigation measures such as low noise surfacing or noise barriers that may be required.

8.8 PEOPLE AND COMMUNITIES

8.8.1 BASELINE CONDITIONS

EFFECTS ON ALL TRAVELLERS

- **MOTORISED TRAVELLERS: VIEWS FROM THE ROAD**

  Views from motorised travellers (MT) have been considered where views of the proposed development area are likely. They include:

  - Approaching the proposed development from the south-west, along Tramway Road, the views are relatively restricted and are screened by two-storey industrial and commercial units and various trees. Currently the road concludes at a dead end that permits pedestrian through traffic but not motorised vehicles;

- Approaching the proposed development from the north-east along Higham Way provides enclosed views with three and four storey housing on the left and industrial units and the multi-storey station car park to the right, screening views of the proposed development area;

- There is likely to be intermittent views of the proposed development area between three and four storey flats while travelling on Alma road looking out west and travelling north on Marshall road looking out west;

- The Station Approach to the west, extending north-west adjacent to the proposed development is likely to have prolonged views of the proposed development area;

- When crossing the railway in both directions on Bridge Street, there are open views of the railway to the north and south;

- Views of the proposed development area from the M40 are screened by roadside vegetation and industrial units in both directions.

➤ MOTORISED TRAVELLERS: DRIVER STRESS

- Cherwell District has experienced an overall increase in road safety since 2000, however there has been a slight increase in road casualties between 2013-2014.

- Currently, Bridge Street is the nearest link between central Banbury and the residential areas of Grimsbury without having to travel north to Hennef Way/A422 and then south on Ermont Way or Daventry Road. There is currently access to the M40 along Middleton Road followed by Daventry Road or Ermont Way.

➤ NON-MOTORISED USERS

- There are a number of Public Rights of Way (PRoW) which are in the immediate vicinity of the proposed development in the form of footpaths and bridleways providing pedestrian access to local shops, schools, amenity areas and recreational facilities.

- The only access across the railway for pedestrians is across Bridge Street for users to and from Banbury and the residential area of Grimsbury.

- A regional Sustrans Cycle Route runs 1km north-east of the proposed development. Currently the only access to it is from the west, across the railway on Bridge Street.

COMMUNITIES

The proposed development is located to the south-east of Banbury town centre with the nearest communities being Grimsbury, Neithrop, Esington, Overthorpe and Bodicote.
Banbury has a population of 46,853 and contains a number of community facilities including a hospital, shopping centre, schools, commercial and industrial areas, retail parks and superstores. Banbury station is located approximately 50m north of the proposed development and there are a number of key road transport links nearby including the M40, A422 and the A423.

Likely journeys to take place to and from Banbury include:

- Travel between different urban centres including Northampton, Milton Keyes, Bicester, Coventry, Stratford-upon Avon and Birmingham;
- Journeys into Banbury from the surrounding smaller settlements and communities such as Middleton Cheeney and Bodicote to access facilities associated with an urban centre;
- Daily commuting into Banbury from surrounding settlements and communities to access employment;
- Migratory traffic from the M40 stopping off at Banbury to access resting facilities and service stations.

8.8.2 ASSESSMENT

Views from roads are likely to change, particularly from Higham Way, Alma Road, Marshall Road, the Station Approach south-west of the proposed development and Bridge Street.

Driver stress may potentially decrease due to a reduction in congestion along the A4260 and Hennef Way to access the M40 during the operation of the proposed development, however drivers within the area of Grimsbury may experience an increase in driver stress as a result of increased traffic volumes, although traffic modelling will be required to assess any impact fully.

Amenity for PRoW users is likely to increase during operation of the proposed development as it is likely to provide a shorter journey time for NMUs between Banbury and the area of Grimsbury. Access to the regional Sustrans cycleway is also likely to be improved.

The proposed development is likely to reduce journey times to and from central Banbury to the area of Grimsbury, surrounding villages and communities due to lower congestion on the roads and the shorter distance for pedestrians and cyclists to cross the railway.

8.9 ROAD DRAINAGE AND THE WATER ENVIRONMENT

8.9.1 BASELINE CONDITIONS

SURFACE WATER

The proposed development is located approximately 60m east of the River Cherwell and 122m east of the Oxford Canal.

The River Cherwell flows in a southerly direction comprising a number of tributaries that provide land drainage in the local area. The Oxford Canal extends parallel to the River Cherwell continuing from the village of Cropredy, through Banbury and ends in Oxford, 32km south of the proposed development.

The Environment Agency's (EA) Water Abstraction Map shows that there is one large surface water abstraction point located 1.4km north-west of the proposed development.

Catchment data from the EA shows the River Cherwell (between Cropredy and Nell Bridge) has Moderate ecological quality and Moderate chemical quality. The Oxford

Canal has not been assessed under the Water Framework Directive (WFD) since 2009 where it was given a chemical status of Good.

FLOOD RISK

The EA Flood Map for Planning (Rivers and Sea) shows the proposed development to be located entirely within Flood Zone 3 (High Risk) with the ‘area benefitting from flood defences’. These areas could be affected by a river flood that has a 1 per cent (1 in 100) or greater chance of happening each year.

Flood defences were constructed in 2012 and include a flood storage reservoir upstream of Banbury, raised sections of the A361, 2m earth embankments with culverts at three locations in Banbury and a water pumping station at Moorfield Brook.

The EA Risk of Flooding from Surface Water Map indicates the River Cherwell and Oxford Canal are at high risk of surface water flooding along with George Street, High Street and the A4260, all directly west of the proposed development. The annual probability of flooding for ‘high risk’ areas is 1 in 30 (3.3%).

The EA Risk of Flooding from Reservoirs Map shows that the proposed development falls entirely within the ‘maximum extent of flooding’ and is at risk of flooding from Clattercote, Boddington, Grimsbury Reservoirs and Banbury Flood Alleviation Reservoir.

GROUNDWATER

The EA Groundwater Source Protection Zones Map shows there are no Groundwater Source Protection Zones within a 2km radius of the proposed development.

The EA Groundwater Map shows the proposed development lays on a secondary A superficial deposit aquifer overlying a secondary, undifferentiated bedrock aquifer.

The EA Water Abstraction Licences Map shows there are no groundwater abstraction points within the study area.

There is no available data on chemical status of groundwater within study area.

8.9.2 ASSESSMENT

Potential effects to surface water features, groundwater features and flood risk during construction could arise from:

- Impacts on water quality and chemistry in the vicinity of construction works from mobilised suspended solids or spillage of fuels, lubricants, cements and hydraulic fluids from the main area of construction, if there are inadequate mitigation measures in place. The River Cherwell, its tributaries and the Oxford Canal are particularly sensitive due to their proximity to the works;

- Construction of the proposed development may impact or encroach on existing flood defences increasing the vulnerability of the area to flooding if mitigation measures are not adequate;

- Surface water abstraction points within the area are upstream; it is unlikely the proposed development would impact water abstraction in the area;

- Migration of pollutants into the ground and the secondary A aquifer.

At this early stage, little is known about the design of the proposed development and its associated drainage, but it is likely that discharge from the proposed development will drain into the River Cherwell and potentially the Oxford Canal. There is therefore a risk of mobilised suspended solids or spillage of fuels, lubricants, cements and hydraulic fluids entering the watercourses through the surface water drainage system during construction

Potential effects to surface water features, groundwater features and flood risk during operation could arise from:

- Surface water run-off consisting of pollutants such as silts or hydrocarbons associated with traffic on the proposed development;
- Surface water containing pollutants infiltrating into ground water and reducing water quality and impacting water chemistry;
- Increased rates and volumes of surface water runoff associated with the elevation and downward slopes of the proposed development potentially causing changes to the existing drainage;
- Increased localised flood risk, particularly at the base of ramps associated with the proposed development.

During operation, the proposed development will introduce vehicular traffic to an area that previously has none or very little, therefore it is likely there will be an increase in the deposition of pollutants that may potentially enter surface and groundwater through the drainage system.

It is recommended measures are implemented to stop the outfall of pollutant surface water entering the River Cherwell and Oxford Canal.

9 STATUTORY UNDERTAKERS

Utility information has been gathered from online services only. The table below summarises the findings of the online search.

Utility Company	Services
BT	• Overhead apparatus is present on the eastern side of the railway. • Underground apparatus is present on the eastern and western side of the railway.
SGN	• Medium and low pressure mains are present on the northern and southern side of the railway.
Thames Water	• Water mains are present to the eastern and western side of the railway.
Western Power	• Electricity cables are present to the eastern and western side of the railway.
Virgin Media	• Virgin Media does not have any apparatus present in the area.

The BT overhead apparatus in its existing location, would likely clash with the bridge alignment. Permanent diversion of this apparatus would be required should the scheme is considered to be moved forward.

The underground apparatus would likely clash with some of the bridge foundations and would also require temporary or permanent diversions.

Utility services diversions can significantly add to the costs of the project, and in some cases, require long lead-in times 6+ months.

10 RISK REGISTER

The risk register contained in this section of the report is based on available site which has been prepared based on the available information.

Risk assessment criteria

Probability (P)		Impact/ Consequence (I)		Risk Rating	Risk (PxI=R)	Response
Very likely	5	Very high	5	Intolerable	17 to 25	Unacceptable
Probable	4	High	4	Intolerable	13 to 16	Unacceptable
Likely	3	Medium	3	Substantial	9 to 12	Early attention
Unlikely	2	Low	2	Tolerable	5 to 8	Regular attention
Negligible	1	Very low	1	Trivial	1 to 4	Monitor

Tramway Road to Higham Way - Risk Register

Feature	Hazard	Before Control			Risk Control Measure (RCM)	After Control		
		P	I	R		P	I	R
Land take	Foundations within Network Rail land.	5	5	25	Early consultation with Network Rail to discuss the scheme and agree what is acceptable.	3	4	12
Construction Programme	Long lead-in times for abnormal possessions (2+ years).	5	3	15	Early planning by Main Contractor to avoid programme delays.	3	3	9
Access Issues	Works within a live rail environment. Programme delays/increased costs. Possessions will be required.	5	5	25	Early consultation with Network Rail to discuss site works proposals. Early booking of possessions required. Early contractor involvement to enable access issues to be discussed and remediated prior to finalising design and construction programme.	1	5	5
Proximity to residential properties and commercial tenants	Complaints from residential property residents living on the east side of the site with regard to noise or disruption caused by construction plant, and/or from commercial tenants on the west side of the site given that Tramway Road is a single point of access to site.	4	4	16	Early communication with residents and tenants, to inform them of the potential works and to discuss options for location and timing of operations to fit in with their activities. Continue flow of information and regular updates throughout works. May require some operations to be time restricted or the use of more specialist/costly noise suppressed plant. Potential for the use of an offsite fabrication or storage facility to keep site works to a minimum and restrict the inflow of materials to certain time periods.	1	4	4
Buried Services	Location of unidentified services clashing with the proposed location of bridge foundations or access structures causing programme delays and/or cost increase during initial construction works.	5	4	20	Commissioning of C2 utilities searches followed by a comprehensive Ground Penetrating Radar survey to identify all underground services. The use of CAT scanners and the excavation of hand dug inspection pits to at least 1.2m to check for buried services in locations where probing or piling is to be undertaken.	1	4	4

Feature	Hazard	Before Control			Risk Control Measure (RCM)	After Control		
		P	I	R		P	I	R
	Damage to uncharted services during the construction works leading to health and safety issues, programme delays/cost increases due to diversions or redesign work.	5	4	20		1	4	4
Buried obstructions	Conflict with uncharted buried structures including foundations to old/previously demolished structures.	3	3	9	Early consultation with land owners and the local authority to obtain historic maps and as-built drawings pertinent to the site. Early detailed site specific ground investigation at the location of each structural foundation element, to include both intrusive elements and a GPR survey to identify obstructions.	1	3	3
Contaminated ground / materials	Contaminated materials encountered during the site clearance and construction ground works, leading to delays and increased disposal/ treatment costs.	5	4	20	Commissioning of an EnviroCheck Report. Early detailed site specific ground investigation at the location of each structural foundation element, to include appropriate chemical analysis to inform handling and disposal. Appropriate treatment or removal of any materials identified. Implement all recommendations of BRE Special Digest 1 during detailed design of buried structures.	1	4	4
Aggressive ground conditions	Aggressive ground conditions encountered, in particular Sulphate, which could lead to chemical attack on concrete, steel and other buried materials.	5	3	15	Commissioning of an EnviroCheck Report. Early detailed site specific ground investigation at the location of each structural foundation element, to include appropriate chemical analysis to inform handling and disposal. Appropriate treatment or removal of any materials identified. Implement all recommendations of BRE Special Digest 1 during detailed design of buried structures.	1	3	3
Unexpected ground conditions encountered	Unexpected geology potentially including voiding, fissures or buried river channels encountered.	2	4	8	Review of geological maps and memoirs for the area. Early detailed site specific ground investigation at the location of each foundation location to a sufficient depth to provide all necessary geotechnical data required to undertake a robust design. Ensure that appropriate geotechnical testing is included to advise on appropriate design parameters and to identify changes in geology or voiding that may significantly affect the structural foundation design.	1	4	4

Feature	Hazard	Before Control			Risk Control Measure (RCM)	After Control		
		P	I	R		P	I	R
Soft compressible alluvial deposits	Settlement of structures, potential long term maintenance issues	5	5	25	Early detailed site specific ground investigation to determine the nature of alluvial materials. Design solutions to eliminate/mitigate settlement issues.	1	5	5
Swelling Lias Clays	Potential effect on pile capacity. Potential heave of raft structures founded on clays.	4	5	20	Commissioning of an EnviroCheck Report. Early detailed site specific ground investigation at the location of each structural foundation element, to include appropriate laboratory testing and mineralogy study to determine clay composition and potential for swelling.	1	5	5
Damage to adjacent structures	Vibration or instability during foundation construction causing damage to adjacent structures.	2	4	8	Review of as built drawings and documentation to help identification of at-risk structures. Use of low vibration plant where required. Monitoring of vibrations during works. Detailed GI to assist with design of appropriately robust temporary works. Pre, during and post works condition surveys.	1	4	4
Contamination of surface water bodies	Potential contamination of the River Cherwell due to creation of pathways in the alluvial material through the construction process.	3	5	15	Undertake an early Environmental Impact Assessment and subsequent groundwater modelling as part of the detailed design.	1	5	5
Flooding	Programme and cost implications due delays to construction	3	4	12	Ensure critical elements in flood prone areas are constructed during summer months	1	4	4
	Construction of approach embankments results in long term flooding of properties due to ‘damming’ effect. Cost and reputation issues.	3	5	15	Undertake an early Environmental Impact Assessment and subsequent groundwater modelling as part of the detailed design. Design to ensure no negative impact on surface water movement.	1	5	5

Feature	Hazard	Before Control			Risk Control Measure (RCM)	After Control		
		P	I	R		P	I	R
Archaeology / Scientifically or historically important findings	Archaeological finds made during the works cause delays to the programme and/or changes in the structural design.	2	5	10	Review of geological maps and memoirs for the area. Early detailed site specific ground investigation at the location of each foundation location. Designer and Contractor to consult with archaeologist prior to undertaking any intrusive investigations. Review of historic maps during final design process. Watching archaeological brief to be present during initial excavations.	1	5	5
Legally Protected and Notable Species and Protected Habitats	Works in areas where such species live and in areas of such habitat, that cause a programme delay, an alteration in design or prosecution.	3	3	9	Designer and Contractor to consult with ecologist prior to finalising design and programme and prior to undertaking any intrusive works. Early consultation with statutory bodies to ensure legal compliance in areas where construction is due to take place – particularly in relation to the river/river bank where delicate ecosystems may be present.	1	3	3
Voiding within the Lias Clay	Voiding encountered within the Lias Clay at depth may lead to insufficient pile bearing capacity or skin friction, thus forcing a change in pile design length or pile group quantity increase, with significant impact on programme and cost.	2	5	15	Review of geological maps and memoirs for the area. Early detailed site specific ground investigation at the location of each foundation. Use of down-hole sonic logging techniques during the detailed GI to ensure that any voiding is highlighted and thus can be incorporated within the design at an early stage.	1	5	5
Buried river channel and in-filled erosional features	Competent geology encountered at a greater depth than expected, due to historic river channel erosion, thus forcing a change in pile design length, location or pile group quantity increase, with significant impact on programme and cost.	3	5	15	Review of geological maps and memoirs for the area and review of historic GI. Early detailed site specific ground investigation at the location of each foundation.	1	5	5

Feature	Hazard	Before Control			Risk Control Measure (RCM)	After Control		
		P	I	R		P	I	R
Groundwater/ River Water inundation into temporary excavations	Due to proximity of the River Cherwell and near surface groundwater temporary excavations undertaken may become flooded leading to instability and serious Health and safety issues.	4	5	20	Early detailed site specific ground investigation at the location of each foundation, to include permeability testing, pumping trials and natural groundwater regime. Correct design and design check procedure initiated for all temporary works. Where possible design structures to avoid the need to undertake and work within deep excavations. Where unavoidable use localised dewatering further to dewatering trials to establish parameters to enable safe working conditions at all stages of the tide.	1	5	5

11 RECOMMENDATIONS & CONCLUSIONS

This outline engineering feasibility report has assessed two bridge structural options (with three broad horizontal curvature alignments) utilising the information available at this high level outline feasibility stage.

There are advantages and disadvantages for each structure type which have been assessed against a set of criteria using the RAG scoring system.

The broad costs of the structure have been identified as circa £14.5 million for the composite box girder option, and £25 million for the cable stayed option.

A list of significant risks has been identified and actions have been recommended to control or mitigate these risks; these include land ownership, Network Rail procedures, ground conditions and environmental constraints. However, despite the control measures proposed, the Rail interface and land ownership risks would continue to be high risk items for the realisation of this scheme.

At this stage of the study WSP | PB has not been commissioned to investigate alternative highway link locations, and so comparison cannot be made. Whilst the construction of a bridge to link Tramway Road to Higham Way appears technically viable, there are a number of significant issues and potential blockers which suggest that alternative crossing sites should be investigated before progressing further with this site.

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