In Parliament – Session 2021 - 2022

HS2

High Speed Rail (Crewe – Manchester) Environmental Statement

Volume 5: Appendix WR-003-0MA06

Water resources and flood risk

MA06: Hulseheath to Manchester Airport

Water resources assessment

HS2

High Speed Rail (Crewe – Manchester) Environmental Statement

Volume 5: Appendix WR-003-0MA06

Water resources and flood risk

MA06: Hulseheath to Manchester Airport

Water resources assessment

M311

Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

High Speed Two (HS2) Limited
Two Snowhill
Snow Hill Queensway
Birmingham B4 6GA

Telephone: 08081 434 434

General email enquiries: HS2enquiries@hs2.org.uk

Website: www.hs2.org.uk

A report prepared for High Speed Two (HS2) Limited:

ARUP+ ERM | FOSTER + PARTNERS | JACOBS
RAMBOLL | TYPSA | COSTAIN

MWJV
Mott MacDonald | WSP

High Speed Two (HS2) Limited has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the HS2 website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard, please contact High Speed Two (HS2) Limited.

recycle

Printed in Great Britain on paper containing at least 75% recycled fibre.

Contents

Tables

Figures

1 Introduction

1.1 Structure

1.1.1 This report is an appendix to the water resources and flood risk assessment. It presents the water resources assessment for the Proposed Scheme in relation to the Hulseheath to Manchester Airport area (MA06).

1.1.2 This appendix should be read in conjunction with:

- Volume 2, Community Area reports;
- Volume 3, Route-wide effects;
- Volume 4, Off-route effects; and
- Volume 5, Appendices.

1.1.3 The water resources and flood risk assessments include both route-wide and community area specific appendices. The route-wide appendices comprise:

- a Water Framework Directive (WFD) compliance assessment (Volume 5: Appendix WR-001-00000); and
- a Draft water resources and flood risk operation and maintenance plan (Volume 5: Appendix WR-007-00000).

1.1.4 For MA06, the Flood risk assessment (Volume 5: Appendix WR-005-0MA06) should also be referred to as well as the relevant Hydraulic modelling report (Volume 5: Appendix WR-006-00007).

1.1.5 Additional information relevant to this assessment is set out in Background Information and Data (BID):

- Water resources assessment baseline data (BID WR-004-0MA06)[1]; and
- WFD compliance assessment baseline data (BID WR-002-00001)[2].

1.1.6 For Rostherne Mere and the Mere, Mere additional information is set out in the Document to inform a Habitats Regulations Assessment for Rostherne Mere Ramsar site and Midland Meres and Mosses Phase 1 Ramsar site (see Volume 5: Appendix EC-016-00003).

1.2 Scope, assumptions and limitations

1.2.1 The scope, assumptions and limitations for the water resources assessment are set out in the Environmental Impact Assessment Scope and Methodology Report (SMR) (see Volume 5: Appendix CT-001-00001).

1.2.2 The MA06 area covers a 10.7km long section of the Proposed Scheme. The spatial scope of the assessment is based initially on the identification of surface water and groundwater features within 1km of the route of the Proposed Scheme. However, within this area the spatial scope has been extended to include the entire catchment of Rostherne Brook, that feeds Rostherne Mere Ramsar site, Site of Special Scientific Interest (SSSI) and National Nature Reserve (NNR). For the purposes of this assessment this spatial scope is defined as the study area.

1.2.3 The assessment considers the construction and operational features of the Proposed Scheme within this study area. These are shown on Volume 2, MA06 Map Book, Map Series CT-05 and CT-06.

[1] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Background Information and Data, Water resources assessment baseline data,* BID WR-004-0MA06. Available online at: http://www.gov.uk/government/collections/hs2–phase–2b–crewe–manchester–environmental–statement.

[2] High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Background Information and Data, Water Framework Directive compliance assessment baseline data,* BID WR-002-00001. Available online at: http://www.gov.uk/government/collections/hs2–phase–2b–crewe–manchester–environmental–statement.

1.2.4 This assessment covers the potential impacts of the Proposed Scheme on existing surface water and groundwater resources, including consideration of:

- surface waters[3];
- aquifers;
- abstractions (licensed and unlicensed) and consented discharges;
- springs and other groundwater-surface water interactions with implications for water resources; and
- water dependent habitats.

1.2.5 The route-wide WFD compliance assessment (Volume 5: Appendix WR-001-00000) provides a comprehensive review of the potential impacts of the Proposed Scheme on designated WFD surface water and groundwater bodies. The WFD compliance assessment, that involved extensive walkover surveys, informed both the value attributed to relevant receptors, such as watercourses, and the assessment of impacts and effects used in this assessment.

1.2.6 The water resources assessment considers the pollution risks associated with spillage and routine discharges of runoff from all roads within the study area that are affected by the Proposed Scheme during the construction and operational phases. Where background surface water quality data in the vicinity of the Proposed Scheme is not available to support the Highways England Water Risk Assessment Tool (HEWRAT)[4] assessment, an assumption has been made, on a precautionary basis, that there is still the potential to exceed environmental quality standards (EQS) in the receiving watercourse.

1.2.7 The risk to water resources associated with accidents or spillages from trains during the operation of the Proposed Scheme are considered on a route-wide basis within Volume 3: Route-wide effects, Section 16, Water resources and flood risk.

1.2.8 Mineral resources (operational or historical) and potential impacts to groundwater quality from existing land contamination are presented in the Land quality report, Volume 5: Appendix LQ-001-0MA06.

1.3 Study area description and key features

1.3.1 The study area is a mixture of urban and rural. The western part of the Proposed Scheme is largely rural, although in some places it is located close to the M56. The north-eastern section of the study area includes part of Warburton Green to the east of Hale, and some areas of Manchester Airport.

1.3.2 Within MA06, the Proposed Scheme will be constructed as a series of cuttings and embankments. The only exceptions to this are the crossings of Agden Brook, Blackburn's Brook, Mid-Cheshire (railway) and Mobberley Road, and the River Bollin, where the Proposed Scheme will be constructed on viaducts. There are no tunnelled or ground level sections.

1.3.3 The main environmental features of relevance to water resources include:

- Agden Brook, Blackburn's Brook, Birkin Brook, Mobberley Brook, Sugar Brook, River Bollin and Timperley Brook, and their associated tributaries;
- one licensed surface water abstraction;
- four private unlicensed groundwater abstractions;
- three potential spring features within the land required for construction of the Proposed Scheme;
- the Sherwood Sandstone Group classified as a Principal aquifer;
- the Mercia Mudstone Group classified as a Secondary B aquifer;
- the permeable superficial deposits Secondary A and Secondary (Undifferentiated) aquifers; and
- nature conservation sites that may be hydraulically impacted by the Proposed Scheme comprising:
  - Rostherne Mere Ramsar site, SSSI, NNR and ancient woodland (Harpers Bank Wood and Wood Bongs);

[3] Ponds are not included in the water resources assessment; these are assessed as ecological receptors in Volume 2.

[4] Standards for Highways (2020), *Design Manual for Roads and Bridges* (*DMRB) – LA 113 Road Drainage and the Water Environment Revision 1*. Available online at: https://www.standardsforhighways.co.uk/prod/attachments/d6388f5f-2694-4986-ac46-b17b62c21727?inline=true.

- Cotteril Clough SSSI, ancient woodland and Site of Biological Importance (SBI);
- Wood Near Arden House Local Wildlife Site (LWS) and ancient woodland; Grey's Gorse LWS and SBI; Yarwood Heath Covert LWS; Hancock's Bank North LWS and ancient woodland; Hancock's Bank South LWS, SBI and ancient woodland; Ryecroft Covert LWS and ancient woodland; Old Deer Enclosure, Tatton Park LWS; Ecclesfield Wood LWS; Jackson's Bank East LWS; Brickhill Wood LWS and ancient woodland; Mill Wood, Castle Mill LWS; Bollin Oxbow at Castle Hill LWS; and
- Rossmill SBI; Warburton Wood ancient woodland; Wood Near Chapel Lane SBI and ancient woodland; Sunbank Wood and Ponds ancient woodland and SBI and Ponds at Davenport Green SBI.

1.4 Stakeholder engagement

1.4.1 Discussions have been held with the following stakeholders to inform the water resources assessment:

- the Environment Agency;
- Natural England;
- Canal & River Trust;
- Cheshire East Council (CEC), Trafford Metropolitan Borough Council (TMBC) and Manchester City Council (MCC) with regard to private unlicensed water abstractions;
- local councillors for communities around Rostherne Mere (and The Mere, Mere in Pickmere to Agden and Hulseheath MA03) to discuss the Proposed Scheme and the councillors' knowledge of water resources and drainage in the area; and
- the owners of private licensed and unlicensed abstractions (where access has been available).

2 Site specific surface water assessments

2.1 Summary of assessment

2.1.1 Table 1 presents the potential impacts and effects related to surface water resources and features potentially affected by the Proposed Scheme. Further baseline details for these receptors are provided in the Water resources assessment baseline data (BID WR-004-0MA06). Those surface water features potentially affected by groundwater interactions are described in Section 3.1.

2.1.2 The WFD compliance assessment (Volume 5: Appendix WR-001-00000) provides a comprehensive review of the aspects of the Proposed Scheme that have potential to cause permanent impacts on water bodies, or that could constrain the future achievement of water body objectives. Temporary construction impacts, defined as those that would last less than three years, may not have implications for WFD compliance, but may nevertheless result in significant effects related to water resources. Such temporary effects have therefore been considered in this assessment, as shown in Table 1.

2.1.3 Construction compounds may have substantial water demands where they are associated with design elements, such as batching plant and tunnelling by Tunnel Boring Machine (TBM). At these locations the construction compounds may require water abstractions to augment other supply options. Where these are required, then an assessment will include location-specific engagement with the Environment Agency and other water undertakers on the availability of water at that location.

2.1.4 The draft Code of Construction Practice (CoCP) sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme to protect surface waters (see Volume 5: Appendix CT-002-00000).

Table 1: Summary of potential impacts on surface water receptors

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Millington Clough	High	• Hulseheath North embankment • Millington Clough underbridge (60m) • Millington Clough offline underbridge (10m) • Crossing by proposed road • Utility diversion • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Millington Clough underbridge (60m) • Millington Clough offline underbridge (10m) • Crossing by proposed road • Drainage outfalls from road drainage	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Mitigation measures include avoiding the floodplain and channel. Piers are set back to remove impacts on flows. Structure lengths have been reduced during the design process. Appropriate drainage design, and measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Agden Brook	Moderate	• Agden Brook viaduct • Utility diversion • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Agden Brook viaduct • Drainage outfalls from track drainage and road drainage	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Mitigation measures include avoiding the floodplain and channel. Piers are set back to remove impacts on flows. Appropriate drainage design, and measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Tributary of River Bollin 10	Moderate	None	There are no elements of the route of the Proposed Scheme likely to impact this waterbody. Impacts possible on groundwater – surface water interactions due to temporary works and ground level track and roads (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of River Bollin 11	Moderate	• Utility diversion • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Drainage outfalls from highway attenuation pond	Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Appropriate drainage design, and measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Rostherne Mere	High	None	No works directly adjacent to the waterbody so limited potential for surface water flow and quality impacts. A detailed assessment of the impacts of proposed cuttings on the groundwater contributions to Rostherne Mere has been undertaken in Section 4.2 and summarised in Table 2.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Rostherne Brook	Moderate	None	No works directly adjacent to the watercourse so limited potential for surface water flow and quality impacts. A detailed assessment of the proposed cuttings on the groundwater environment has been undertaken in Section 3.2.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Yarwood Heath Drain	Low	• Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Blackburn's Brook	Moderate	• Blackburn's Brook North viaduct • Temporary works such as compounds, stockpiles and access routes • Ashley railhead	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Blackburn's Brook North viaduct • Drainage outfall from HS2 attenuation pond and road drainage	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Mitigation measures include avoiding the floodplain and channel. Piers are set back to reduce impacts on flows. Mitigation measures also include appropriate drainage design crossing of the proposed road. Measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Tributary of Blackburn's Brook	Moderate	None	There are no elements of the route of the Proposed Scheme likely to impact this waterbody. Impacts possible on groundwater – surface water interactions due to temporary works and ground level track and roads (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Birkin Brook	High	• Blackburn's Brook north viaduct • Temporary works such as compounds, stockpiles and access routes • Ashley railhead	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported,	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• Ashley Infrastructure Maintenance Base – Rail (IMB-R)	through the disturbance of silt or direct contamination by polluting materials.						
		• Blackburn's Brook north viaduct • Drainage outfalls from HS2 attenuation pond and track drainage • Ashley IMB-R	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Mitigation measures include avoiding the floodplain and channel. Piers are set back to remove impacts on flows. Mitigation measures include appropriate drainage design and measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Tributary of Birkin Brook 9 Tributary of Birkin Brook 8 Tributary of Birkin Brook 7 Tributary of Birkin Brook 6 Tributary of Birkin Brook 5	Low	• Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of Birkin Brook 4	Low	• Ashley embankment retaining wall • Ashley Road offline west culvert (45m) • Watercourse crossing by proposed road and access road • Temporary works such as compounds, stockpiles and access routes • Ashley railhead	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Ashley embankment retaining wall • Ashley Road offline west culvert (45m) • Watercourse crossing by proposed road and access road	85m of the watercourse headwaters will be partially lost during construction of the Ashley embankment retaining wall. Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.	Magnitude of impact – Moderate Significance of effect – Minor adverse, not significant	The lost section of watercourse will be incorporated into the new track drainage. Flow in the watercourse will be supported by proposed drainage. Culvert lengths have been reduced during the	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Construction (permanent)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
					design process and invert levels set below the bed of the watercourse.				
		• Watercourse crossing by proposed road and access road • Drainage outfalls from HS2 attenuation pond and highway attenuation pond	Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Moderate Significance of effect – Minor adverse, not significant	Appropriate drainage design, and measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Tributary of Birkin Brook 1	Moderate	• Diversion (910m) including Ashley Road offline east culvert (25m) • Watercourse crossing by proposed road and access road • Temporary works such as compounds, stockpiles and access routes • Ashley railhead	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Diversion (910m) including Ashley Road offline east culvert (25m) • Watercourse crossing by proposed road and access road • Drainage outfalls from highway attenuation pond • Ashley railhead	Deterioration, loss or change to the existing water environment in a 500m reach of watercourse, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse. Mitigation measures will include appropriate watercourse, watercourse crossing and drainage design as a result of the proposed road and railhead, to include a range of habitats appropriate to this water body and to improve river morphology as far as reasonably practicable. Measures to manage water quality will be adopted during the design process.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Mobberley Brook	Moderate	• Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Tributary of Sugar Brook	Moderate	• Temporary works such as compounds, stockpiles and access routes • Ashley railhead	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Sugar Brook	Moderate	• Temporary works such as compounds, stockpiles and access routes • Ashley railhead	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of Birkin Brook 3	Low	• Mid- Cheshire (railway) and Mobberley Road viaduct • Unnamed culvert north- west of the attenuation pond (5m) • Diversion (45m) • Watercourse crossing by proposed road and access road • Temporary works such as compounds, stockpiles and access routes • Ashley railhead	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Mid- Cheshire (railway) and Mobberley Road viaduct • Unnamed culvert north-west of the attenuation pond (5m) • Diversion (45m) • Watercourse crossing by proposed road and access road • Drainage outfall from attenuation pond	Deterioration, loss or change to the existing water environment to 250m reach of watercourse, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Mitigation measures include avoiding the floodplain and channel. Piers are set back to remove impacts on flows. Culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse. Mitigation measures will include appropriate watercourse and watercourse crossing design as a result of the proposed road and	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
					railhead, to include a range of habitats appropriate to this water body and to improve river morphology as far as reasonably practicable. Measures to manage water quality will be adopted during the design process.				
Tributary of Birkin Brook 2	Low	• Thorns Green embankment • Realignment (30m) • Diversion (20m) • Watercourse crossing by proposed access road • Temporary works such as compounds, stockpiles and access routes • Ashley railhead	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Thorns Green embankment • Realignment (30m) • Diversion (20m) • Watercourse crossing by proposed access road • Drainage outfalls from two HS2 attenuation ponds and highway attenuation pond	Watercourse will be partially lost during construction of the Thorns Green embankment. Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Moderate Significance of effect – Minor adverse, not significant	The lost section of watercourse will be incorporated into the new track drainage. Mitigation measures will include appropriate watercourse and watercourse crossing design as a result of the proposed road and railhead, to include a range of habitats appropriate to this water body and to improve river morphology as far as reasonably practicable. Measures to manage water quality will be adopted during the design process.	Magnitude of impact – Moderate Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Moderate Significance of effect – Minor adverse, not significant	Construction (permanent)
Brickhill Wood Drains	Low	• Watercourse crossing by proposed road and access road • Utility diversion • Temporary works such as compounds,	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported,	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		stockpiles and access routes	through the disturbance of silt or direct contamination by polluting materials.						
		• Watercourse crossing by proposed road and access road • Drainage outfalls from track drainage	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Mitigation measures will include appropriate watercourse crossing by proposed road and appropriate drainage design. Measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Tributary of River Bollin 7	Moderate	None	There are no elements of the route of the Proposed Scheme likely to impact this waterbody. Impacts possible on groundwater – surface water interactions due to temporary works and ground level track and roads (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of River Bollin 6	Moderate	None	There are no elements of the route of the Proposed Scheme likely to impact this waterbody. Impacts possible on groundwater – surface water interactions due to temporary works and ground level track and roads (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
River Bollin	Very high	• River Bollin East viaduct • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• River Bollin East viaduct • Drainage outfalls from two HS2 attenuation ponds and highway attenuation pond	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Mitigation measures include avoiding the floodplain and channel, as far as reasonably practicable. Piers are set back to remove impacts on flows. Mitigation measures also include appropriate drainage design. Measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Tributary of River Bollin 4	Moderate	• Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of River Bollin 8	Moderate	None	There are no elements of the route of the Proposed Scheme likely to impact this waterbody. Impacts possible on groundwater – surface water interactions due to temporary works and ground level track and roads (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of River Bollin 3	Moderate	• Watercourse crossing by proposed temporary road • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials. Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP. Mitigation measures will include appropriate watercourse crossing by the proposed temporary road.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Drainage outfalls from highway attenuation pond	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Tributary of River Bollin 2	Moderate	• Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of River Bollin 1	Moderate	None	There are no elements of the route of the Proposed Scheme likely to impact this waterbody. Impacts possible on groundwater – surface water interactions due to temporary works and ground level track and roads (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Cotteril Clough Brook	Moderate	None	No works directly adjacent to the watercourse so limited potential for surface water flow and quality impacts. Impacts possible on groundwater – surface water interactions due to temporary works and ground level track and roads (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of River Bollin 5	Moderate	• Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Drain to M56 1	Low	• Ringway cutting • Watercourse crossing by proposed temporary road • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials. Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Ringway cutting • Temporary realignment of M56	Watercourse will be partially lost during construction of the Ringway cutting and the temporary realignment of the M56 motorway. Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.	Magnitude of impact – Major Significance of effect – Minor adverse, not significant	The watercourse will be incorporated into the new track drainage.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Construction (temporary and permanent)
Drain to M56 2	Low	• M56 East tunnel • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Drainage outfalls from road drainage	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both	Magnitude of impact – Minor	Mitigation measures will include appropriate drainage design. Measures to manage water quality will be	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (permanent)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
			routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Significance of effect – Negligible, not significant	adopted during the design process.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Tributary of River Bollin 9	Moderate	None	There are no elements of the Proposed Scheme likely to impact this waterbody. Impacts possible on groundwater – surface water interactions due to temporary works and ground level track and roads (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of Timperley Brook 1	Low	• Demolition of residential properties • Manchester Airport High Speed station cutting retaining wall north • Watercourse crossing by proposed road • Utility diversion • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Manchester Airport High Speed Station cutting retaining wall north • Watercourse crossing by proposed road • Surface water attenuation tank • Drainage outfalls from attenuation ponds and track drainage	275m of the headwaters of this watercourse will be lost due to construction of the Manchester Airport Station cutting retaining wall. Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.	Magnitude of impact – Moderate Significance of effect – Minor adverse, not significant	The lost section of watercourse will be incorporated into drainage design, and flow will be augmented from scheme drainage. Mitigation measures will include appropriate watercourse crossing and appropriate drainage design of the proposed road.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Construction (permanent)
		• Drainage outfalls from attenuation ponds and track drainage	Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages.	Magnitude of impact – Moderate Significance of effect – Minor adverse, not significant	Measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Drain to M56 3	Low	• Manchester Airport High Speed station • Watercourse crossing by proposed road • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported,	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
			through the disturbance of silt or direct contamination by polluting materials.						
		• Manchester Airport High Speed station • Watercourse crossing by proposed road • Drainage outfall from attenuation tank	Watercourse will be lost during construction of the Manchester Airport Station. Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.	Magnitude of impact – Moderate Significance of effect – Minor adverse, not significant	The watercourse will be incorporated into the new attenuation ponds. Measures to manage water quality will be adopted during the design process.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Timperley Brook	Moderate	• Manchester Airport High Speed station cutting retaining wall north • Realignment (300m) including; – 170m Timperley Brook inverted siphon – 80m extended motorway culvert • Realignment west of Brooks Drive (330m) • Watercourse crossing by proposed road • Utility diversion • Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		• Manchester Airport High Speed station cutting retaining wall north • Realignment (300m) including; – 170m Timperley Brook inverted siphon – 80m extended motorway culvert • Realignment west of Brooks Drive (330m) • Watercourse crossing by proposed road	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements. Deterioration of water quality due to contamination of surface water from both routine discharges from the Proposed Scheme and associated infrastructure or from accidental spillages. A detailed assessment of the potential impact of below ground works on groundwater – surface water interactions has been undertaken in Section 4.2.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	See Section 2.2.	Magnitude of impact – Minor Significance of effect – Minor, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor, not significant	Construction (permanent)
		• Realignment (330m)	215m of the existing open channel through Humphreys Wood will receive a reduced flow	Magnitude of impact – Moderate	Flow in this section of the watercourse will be partly supported by drainage	Magnitude of impact – Minor	None required	Magnitude of impact – Minor	Construction (permanent)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
			due to the realignment of the main channel, away from the culvert under Brooks Drive.	Significance of effect – Moderate adverse, significant	from the Proposed Scheme discharged into Tributary of Timperley Brook 1.	Significance of effect – Minor, not significant		Significance of effect – Minor, not significant	
Tributary of Timperley Brook 2	Moderate	None	There are no elements of the Proposed Scheme likely to impact this waterbody. Impacts possible on groundwater – surface water interactions due to temporary works, ground level track and roads, utilities divisions and cutting (see Section 3.2).	Magnitude of impact – Negligible. Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of Timperley Brook 3	Low	• Temporary works such as compounds, stockpiles and access routes	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Surface water abstractions									
Estate Office, Rostherne, Knutsford 2569020032	High	• Temporary works such as compounds, stockpiles and access routes	Located within the land required for construction of the Proposed Scheme. There is potential for a reduction in water quality at the abstraction location due to the possible mobilisation of contaminants from the construction area upstream. Typically, these would include sediments, hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. Reduction in local water quality has the potential to impact abstraction.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Ringway Golf Club, Altrincham 2569017036/R02	Moderate	None	Located downstream of the Proposed Scheme, however abstraction is from a watercourse considered within this assessment. Therefore, the abstraction has been included on a precautionary basis.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharges to surface water									
Discharge 016892564	Low	None	Located downstream of the Proposed Scheme and discharging into a watercourse considered within this assessment. Therefore, the discharge has been included on a precautionary basis.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharge 016892417	Low	• Temporary works such as compounds, stockpiles and access routes	Located within the land required for construction of the Proposed Scheme, the outfalls have the potential to be physically impacted by construction work.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Discharge 016991418 Discharge 016940002	Low	None	Both discharges are located upstream of the Proposed Scheme, however discharging into a watercourse considered within this assessment. Therefore, these discharges have been included on a precautionary basis.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharge 01TRA0053	Low	• Temporary works such as compounds, stockpiles and access routes	Located adjacent to the land required for construction of the Proposed Scheme. This area will be used for access only and no works will be undertaken in this area. Therefore, the potential for mobilisation of contaminants that could impact water quality at the discharge site is considered low.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharge 016910022	Low	None	Located downstream of the Proposed Scheme and discharging into a watercourse considered within this assessment. Therefore, the discharge has been included on a precautionary basis.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharge 016981478 Discharge 01MAC0076	Low	None	Both discharges are located upstream of the Proposed Scheme, however discharging into a watercourse considered within this assessment. Therefore, these discharges have been included on a precautionary basis.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharge 0171/1482	Low	• Temporary works such as compounds, stockpiles and access routes	Located adjacent to the land required for construction of the Proposed Scheme. This area will be used for access only and no works will be undertaken in this area. Therefore, the potential for mobilisation of contaminants that could impact water quality at the discharge site is considered low.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharge 016982142 Discharge 016891704	Low	None	Both discharges are located upstream of the Proposed Scheme, however discharging into a watercourse considered within this assessment. Therefore, these discharges have been included on a precautionary basis.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharge 016982808	Low	None	Located downstream of the Proposed Scheme and discharging into a watercourse considered within this assessment. Therefore, the discharge has been included on a precautionary basis.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharge 01TRA0030	Low	None	Located upstream of the Proposed Scheme, however discharging into a watercourse considered within this assessment.	Magnitude of impact – Negligible	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
			Therefore, the discharge has been included on a precautionary basis.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Discharge 0171/1379	Low	• Temporary works such as compounds, stockpiles and access routes	Located adjacent to the land required for construction of the Proposed Scheme. This area will be used for access only and no works will be undertaken in this area. Therefore, the potential for mobilisation of contaminants that could impact water quality at the discharge site is considered low.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Discharge 016891948 Discharge EPRGB3398RG Discharge EPRCB3299EN Discharge 016993345 Discharge 01TRA0018 Discharge EPRHB3690WL Discharge 01M/333	Low	None	All discharges are located upstream of the Proposed Scheme, however discharging into watercourses considered within this assessment. Therefore, these discharges have been included on a precautionary basis.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

2.2 Detailed assessment

2.2.1 In support of the impact assessment presented in Section 2.1, further detail is provided in this section to demonstrate the more detailed assessment of any elements with potential for a significant effect on surface water receptors. The locations of these elements are shown in Volume 2, MA06 Map Book, Map Series CT-05 and CT-06.

Timperley Brook inverted siphon

2.2.2 The Timperley Brook inverted siphon will have potential to impact on Timperley Brook, a moderate value receptor. The inverted siphon will be 170m in length and will be constructed under Manchester Airport Station, re-joining the existing watercourse west of the station (see Figure 1).

2.2.3 Manchester Airport High Speed station will be located at the headwaters of Timperley Brook, downstream of an existing culvert where Timperley Brook drains from Manchester Airport under the M56. The constraints of existing infrastructure and the tunnel portal entrance Proposed Scheme just to the north mean that the level of the station requires an inverted siphon solution to convey Timperley Brook beneath it. Construction of the siphon will result in the loss of approximately 275m of natural sinuous channel. Consideration was given to a number of options to convey the watercourse beneath the Proposed Scheme including:

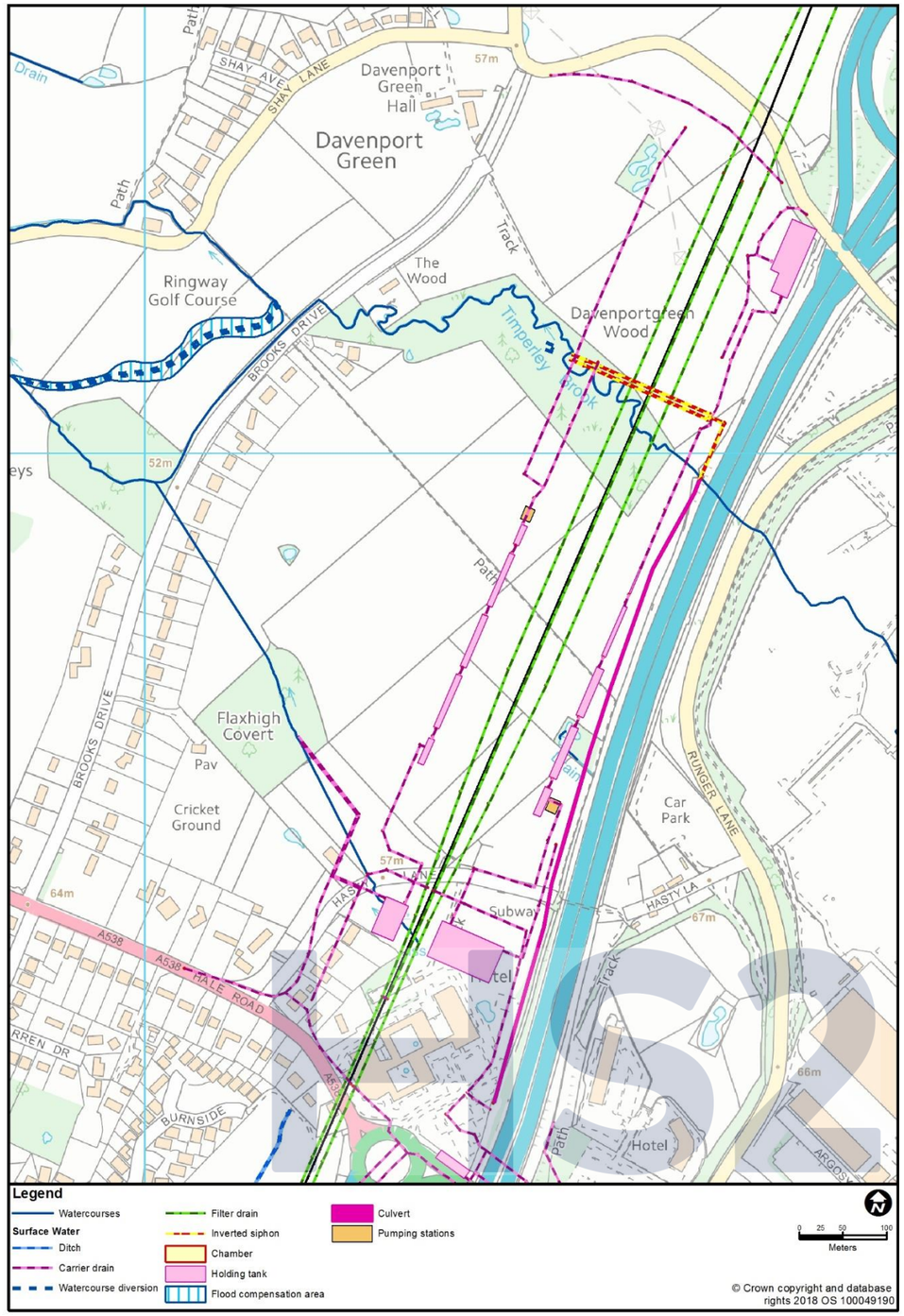
- a culvert under the station, north of Davenport Green Wood, in an open channel on the west, which would result in a loss of 331m² of woodland and 305m of open channel;
- a culvert under the station, north of Davenport Green Wood, in a closed channel on the west, which would result in a loss of 120m² of woodland and 405m of open channel;
- a culvert under the station, south of Davenport Green Wood, in an open channel on the west, which would result in a loss of 705m² of woodland and 345m of open channel;
- a culvert under the station, south of Davenport Green Wood, in a closed channel on the west, which would result in a loss of 296m² of woodland and 525m of open channel; and
- an inverted siphon under the station, south of Davenport Green Wood which would result in a loss of 25m² of woodland and 275m of open channel.

2.2.4 The siphon was chosen as it had the smaller footprint impact on the hydromorphology of Timperley Brook and associated woodland than the alternative options of a culvert and watercourse realignment, due to the topography of the local area. Despite the challenges associated with the siphon, this option is considered the best available and engagement with the Environment Agency has been undertaken to gain an agreement in principle, for this option. The existing Manchester Airport drainage system is comprised of six separate outfalls to watercourses around the site. Only one of these outfalls drains to the Timperley Brook, and drains the airport car park runoff. The areas adjacent to the car parks drain to the River Bollin. The other catchments drain to Cotteril Clough Brook, and the tributaries of the River Bollin. The location of the siphon is at the headwater of the river, where the only upstream catchment area is airport car park run off, so there are limited issues with severance/continuity of the watercourse. However, the change in footprint requires mitigation. Prior to mitigation therefore, the impact on the moderate value receptor is expected to be moderate adverse, which is significant.

2.2.5 The water quality of Timperley Brook could be affected by runoff from the construction area. Mobilised contaminants would typically include sediments, hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete. These risks would be managed by implementation of measures in the draft CoCP, and therefore have a negligible impact, leading to a negligible effect, which is not significant.

2.2.6 Proposed mitigation, agreed during the design and engagement with the Environment Agency, consists of creating a new open channel (linked with the floodplain to create flood storage) of approximately 330m length of Timperley Brook, where the brook is currently culverted under and along a road, downstream of Brooks Drive. As the watercourse is a moderate value receptor, deterioration from the existing status is not expected but there is sensitivity around the removal of any good habitat in the existing river and potential conflict with mitigation measures.

Figure 1: Timperley Brook Inverted Siphon



3 Site specific groundwater assessments

3.1 Summary of assessment

3.1.1 Table 2 presents all groundwater receptors within the study area and summarises potential impacts from the design elements of the Proposed Scheme that are relevant to the water environment. Further baseline details for these receptors are provided in the Water resources assessment baseline data (BID WR-004-0MA06). Individual impact assessments for each design element are presented in Section 3.2.

3.1.2 Construction compounds may have substantial water demands where they are associated with design elements, such as batching plant and tunnelling by TBM. At these locations, the construction compounds may require water abstractions to augment other supply options. Where these are required, then an assessment will include location-specific engagement with the Environment Agency, water companies and other water undertakers on the availability of water at that location.

3.1.3 The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme to protect groundwaters. All above ground temporary works within construction compounds are included in the design and mitigated by the draft CoCP.

3.1.4 In support of the groundwater impact assessment presented in Table 2, further detail is provided in Section 3.2 to Section 3.4 to demonstrate the methodology and assumptions used in relation to cuttings, overbridges and viaducts of the Proposed Scheme. The locations of these elements are shown in Volume 2, MA06 Map Book, Map Series CT-05 and CT-06.

Table 2: Summary of potential impacts on groundwater receptors

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Hydrogeology (aquifers)									
Alluvium – Secondary A aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; • utilities diversions; and • Birkin Brook embankment. Deeper excavation (>1mbgl) including: • Agden Brook viaduct; • Blackburn's Brook North viaduct; • utilities diversions (new pylons); and • River Bollin East viaduct.	The temporary works have the potential to affect shallow groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			The permanent below ground features, such as viaduct and utilities pylons, may alter groundwater flow (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
River terrace deposits – Secondary A aquifer	Moderate	None	This unit is not crossed by the Proposed Scheme in this community area. Although it may be hydraulically connected to the glacial till (or underlying bedrock), no impact on the river terrace deposits is expected from works in proximity to the glacial till.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None
Shirdley Hill Sand Formation – Secondary A aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including:	The temporary works have the potential to affect shallow groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• ground level track and road; • temporary works such as stockpiles and compounds; and • utilities diversions.		Significance of effect – Moderate adverse, significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Glaciofluvial deposits – Secondary A aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; • utilities diversions; • Hulseheath North embankment; • Ashley embankment; • Ashley embankment retaining wall; and • Ashley IMB-R. Deeper excavation (>1mbgl) including: • Agden Brook viaduct; • Millington cutting; and • Ashley railhead.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential alteration of shallow groundwater flow pathways may occur around below ground structures (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
Glaciofluvial sheet deposits – Secondary A aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; • Blackburn's Brook embankment; • Birkin Brook embankment; • Ashley IMB-R; • Ashley embankment retaining wall; and • Ashley embankment. Deeper excavation (>1mbgl) including: • Rostherne East box structure; • Blackburn's Brook North viaduct; and • utilities diversions (new pylons).	The temporary works have the potential to affect shallow groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Temporary and permanent works are above ground or shallow and of small areal extent compared to the aquifer therefore are likely to have a negligible impact on recharge and groundwater flow.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including: • Ashley Footpath 6/5 overbridge.	Construction of overbridge foundations and piles have the potential to affect groundwater quality and flow during	Magnitude of impact – Negligible	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
			construction, however this will be very limited in extent and temporary.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
		Deeper excavation (>1mbgl) including: • Ashley railhead.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential alteration of shallow groundwater flow pathways may occur around shallow below ground structures (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
Glacial till – Secondary (Undifferentiated) aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level or embankment track and roads; • temporary works such as stockpiles and compounds; • Hulseheath North embankment; • Blackburn's Brook embankment; • Birkin Brook embankment; • Ashley embankment retaining wall; • Ashley embankment; • Ashley IMB-R; • Thorns Green embankment; • River Bollin South embankment; and • River Bollin North embankment.	The temporary works have the potential to affect shallow groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Temporary works and permanent works are above ground or shallow and of relatively small areal extent compared to the aquifer, therefore are likely to have a limited impact on recharge and groundwater flow.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including: • Ashley Footpath 6/5 overbridge; • A556 Chester Road overbridge; • Yarwood Heath Farm accommodation overbridge; • Back Lane accommodation overbridge;	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential alteration of shallow groundwater flow pathways may occur around new foundations/below ground	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• Castle Mill Lane overbridge; • Sunbank Lane overbridge; • A538 Hale Road overbridge; • Hasty Lane overbridge; • Provision for Metrolink; and • Thorley Lane overbridge.	structures. Due to the location and minor extent of the foundations/structures within the much larger area of aquifer, the impact on groundwater flow pathways will be negligible.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
			The below ground structures of A556 Chester Road overbridge may form a barrier to groundwater flow in the glacial till (see Section 3.3).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
		Deeper excavation (>1mbgl) including: • Millington cutting; • Rostherne cutting retaining wall west; • Rostherne cutting; • Rostherne cutting retaining wall east; • Rostherne East box structure; and • Thorns Green cutting.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			The permanent below ground features, such as cuttings, may alter groundwater flow and level (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
			Potential impacts from cutting dewatering are assessed as minor (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including: • Ashley railhead.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential alteration of shallow groundwater flow pathways may occur around shallow below ground structures of Ashley railhead.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		Deeper excavation (>1mbgl) including: • Blackburn's Brook North viaduct; • Mid-Cheshire (railway) and Mobberley Road viaduct; • River Bollin East viaduct; • utilities diversions (new pylons); and • Ringway cutting.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential alteration of shallow groundwater flow pathways may occur around below ground structures. However, due to the location and minor extent of the structures within the much larger area of aquifer, the impact on groundwater flow pathways will be negligible.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
		Deeper excavation (>1mbgl) including: • M56 cutting retaining wall; and • M56 East tunnel.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Below ground features may have an impact on groundwater flow. However, due to the minor extent of the design elements in comparison to the aquifer areal extent, the impact on groundwater flow is likely to be negligible.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
			Potential impacts from cutting retaining wall dewatering are assessed as negligible (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including: • Manchester Airport High Speed station cutting retaining wall south; • Manchester Airport High Speed station cutting; and • Manchester Airport High Speed station cutting retaining wall north.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			The permanent below ground features, such as cuttings and retaining walls, may alter groundwater flow (see Section 3.2).	Magnitude of impact – Minor	Retaining walls along this part of the cutting will reduce the radius of influence of the cuttings as well as the below	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
				Significance of effect – Minor adverse, not significant	ground structures covering a minor extent of the substantial area of aquifer around Manchester airport.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Mercia Mudstone Group – Sidmouth Mudstone Formation – Northwich Halite Member – Unproductive strata	Low	None	This unit is not crossed by Proposed Scheme in this community area. Although it may be hydraulically connected to other aquifers in the Mercia Mudstone Group, it is not expected to be impacted by works in proximity to the Mercia Mudstone Group.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required
Mercia Mudstone Group – Tarporley Siltstone Formation – Secondary B aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level or embankment track and roads; • temporary works such as stockpiles and compounds; • utilities diversions; and • Hulseheath North embankment.	The temporary works have the potential to affect shallow groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Temporary works and permanent works are above ground or shallow and of relatively small areal extent compared to the aquifer, therefore are likely to have only a limited impact on recharge and groundwater flow.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)
		Above ground elements and shallow excavation (<1mbgl) including: • ground level or embankment track and roads; • temporary works such as stockpiles and compounds; and • Ashley embankment.	There is significant thickness of glaciofluvial deposits and glacial till overlying the Mercia Mudstone aquifers in much of this area. Below ground features will only extend into the superficial deposits that will protect the Mercia Mudstone in terms of both groundwater flow and quality.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
		Above ground elements and shallow excavation (<1mbgl) including: • ground level or embankment track and roads; • temporary works such as stockpiles and compounds; and • Ashley IMB-R. Deeper excavation (>1mbgl) including: • Ashley railhead.	The construction works have the potential to affect groundwater quality. The construction works for the Ashley IMB-R and Ashley railhead extend approximately 2.3km south of the Proposed Scheme. While the Ashley railhead works are temporary, they will have an extensive impact.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			There is significant thickness of glacial till overlying the Mercia Mudstone aquifers in this area. Below ground features will only extend into the glacial till that will protect the Mercia Mudstone in terms of both groundwater flow and quality.	Magnitude of impact – Negligible	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary and permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
		Deeper excavation (>1mbgl) including: • Agden Brook viaduct.	Below ground features will extend through the glacial till and into the Mercia Mudstone Group that may affect the aquifer in terms of both groundwater flow and quality (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including: • Mid-Cheshire (railway) and Mobberley Road viaduct.	The construction works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential alteration of groundwater flow may occur around viaduct piers. Below ground features will extend into the Mercia Mudstone aquifer. The location and extent of the piers are not significant in comparison to the area of the aquifer (see Section 3.3).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Mercia Mudstone Group – Sidmouth Mudstone Formation – Bollin Mudstone Member – Secondary B aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level or embankment track and roads; • temporary works such as stockpiles and compounds; • Blackburn's Brook embankment; • Birkin Brook embankment; • Ashley embankment retaining wall; • Ashley embankment; and • Thorns Green embankment.	There is significant thickness of glacial till, glaciofluvial deposits, glaciofluvial sheet deposits and alluvium overlying the Mercia Mudstone aquifers. Below ground features will only extend into the superficial deposits that will protect the bedrock aquifers in terms of both groundwater flow and quality.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including: • Millington cutting.	There is a significant thickness of glacial till overlying the Mercia Mudstone aquifer in this area. Below ground features will only extend into the glacial till that will protect the Mercia Mudstone in terms of both groundwater flow and quality.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including:	The construction works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• Rostherne cutting retaining wall west; • Rostherne cutting; • Rostherne cutting retaining wall east; and • Rostherne East box structure.		Significance of effect – Moderate adverse, significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
			Below ground structures may extend into the bedrock aquifer however temporary works and permanent works are of relatively small areal extent compared to the aquifer, therefore are likely to have only a limited impact on recharge and groundwater flow.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
			Potential impacts from cutting dewatering are assessed as negligible (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
		Above ground elements and shallow excavation (<1mbgl) including: • ground level or embankment track and roads; • temporary works such as stockpiles and compounds; and • Ashley IMB-R. Deeper excavation (>1mbgl) including: • Ashley railhead.	The construction works have the potential to affect groundwater quality. The construction works for the Ashley IMB-R and Ashley railhead extend approximately 2.3km south of the Proposed Scheme. While the Ashley railhead works are temporary, they will have an extensive impact.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			There is a significant thickness of glacial till overlying the Mercia Mudstone aquifers in this area. Below ground features will only extend into the glacial till that will protect the Mercia Mudstone in terms of both groundwater flow and quality.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
		Above ground elements and shallow excavation (<1mbgl) including: • ground level or embankment track and roads; • temporary works such as stockpiles and compounds; • River Bollin South embankment; and • River Bollin North embankment.	There are no superficial deposits over parts of the Mercia Mudstone and shallow excavations will create a direct pathway into the aquifer. However, due to the location and minor extent of the works within the much larger area of the aquifer, the impact on groundwater quality and flow will be minor.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including: • Blackburn's Brook North viaduct;	The construction works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• Mid-Cheshire (railway) and Mobberley Road viaduct; • River Bollin East viaduct; and • utilities diversions (new pylons).		Significance of effect – Moderate adverse, significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
			Potential alteration of groundwater flow pathways may occur around viaduct and utilities piers. Below ground features will extend through the superficial deposits into the Mercia Mudstone Group. Due to the location and minor extent of the piers within the much larger area of the aquifer, the impact on groundwater flow pathways will be negligible.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
		Deeper excavation (>1mbgl) including: • Millington Footpath 7/4 accommodation overbridge; • A556 Chester Road overbridge • Yarwood Heath Farm accommodation overbridge; • Ashley Footpath 6/5 overbridge; • Back Lane accommodation overbridge; • Castle Mill Lane overbridge; • Sunbank Lane overbridge; • A538 Hale Road overbridge; • A538 Hale Road/station access gyratory (eastbound traffic) overbridge; • Provision for Metrolink; and • Thorley Lane overbridge.	Construction of overbridge foundations and piles have the potential to affect groundwater quality and flow during construction. However, this will be very localised and temporary thus assessed as negligible.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		Deeper excavation (>1mbgl) including: • Rostherne East box structure.	As there is a significant thickness of glacial till overlying the Mercia Mudstone, below ground features will not extend into the Mercia Mudstone aquifer. As such, the impact on groundwater flow and quality is expected to be negligible.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
			Below ground features may have an impact on groundwater flow. However, due to the minor extent of the box structure in comparison to the aquifer areal extent, the impact on groundwater flow is likely to be negligible.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
		Deeper excavation (>1mgbl) including: • Thorns Green cutting.	The construction works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
				Significance of effect – Moderate adverse, significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
			There is a significant thickness of glacial till below the cutting except for a short section of approximately 20m where the cutting will penetrate through the glacial till into the top of the bedrock, thus creating a direct pathway into the bedrock aquifer at the northern end of the cutting. Due to the location and minor extent of the cutting within the much larger area of the aquifer, the impact on groundwater quality will be minor.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
			Potential impacts from cutting dewatering are assessed as negligible (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including: • Ringway cutting; • M56 cutting retaining wall; • M56 East tunnel; • Manchester Airport High Speed station cutting retaining wall south; • Manchester Airport High Speed station cutting; and • Manchester Airport High Speed station cutting retaining wall north.	The cuttings will remove most of the glacial till, potentially creating a direct pathway into the bedrock aquifer. The construction works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Below ground features, such as retaining walls, may have an impact on groundwater flow. However, due to the minor extent of the cutting in comparison to the aquifer areal extent, the impact on groundwater flow is minor (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
			Potential impacts from cutting dewatering are assessed as minor (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)
Sherwood Sandstone Group – Helsby Sandstone Formation – Principal aquifer	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level or embankment track and roads; and	The temporary works have the potential to affect shallow groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• temporary works such as stockpiles and compounds.						Significance of effect – Negligible, not significant	
			Temporary and permanent works are above ground or shallow and of small areal extent compared to the aquifer therefore are likely to have a negligible impact on recharge and groundwater flow.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
		Deeper excavation (>1mbgl) including: • Agden Brook viaduct.	Below ground features will extend through the glacial till and into the Sherwood Sandstone aquifer, that may affect the aquifer in terms of groundwater quality (see Section 3.3).	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential alteration of groundwater flow pathways may occur around viaduct piers. Due to the location and minor extent of the piers within the much larger area of the aquifer, the impact on groundwater flow pathways will be negligible.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
		Deeper excavation (>1mbgl) including: • Millington cutting.	Although there is a significant thickness of glacial till overlying the Sherwood Sandstone aquifer in this area, the removal of superficial deposits during construction will create a shorter pathway to the underlying Sherwood Sandstone. However, below ground features will only extend into the glacial till and the cutting is very limited in area in comparison to the areal extent of the bedrock aquifer that will protect the Sherwood Sandstone in terms of both groundwater flow and quality.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
Abstractions									
Abstraction west of Lower House Farm	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • Thorns Green embankment. Deeper excavation (>1mbgl) including:	The temporary construction works have the potential to affect groundwater flow and quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• Ashley railhead							
Well at Birtles Farm	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • Ashley embankment. Deeper excavation (>1mbgl) including: • Ashley railhead.	The temporary construction works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Well at Mobberley Road	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • utilities diversions (new pylons); and • Ashley railhead.	The abstraction is located within the land required for the construction of the Proposed Scheme and so may be unusable as a result of the construction.	Magnitude of impact – Major Significance of effect – Major adverse, significant	None required.	Magnitude of impact – Major Significance of effect – Major adverse, significant	Investigation into the use of this well – if detailed investigations by the nominated undertaker confirm a risk of impact on the abstraction, mitigation measures will be agreed with the owner. Mitigation measures may include provision of a new borehole or connection to mains water.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Well at Arden House	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; • Ashley embankment retaining wall; • Ashley embankment; and • Ashley IMB-R. Deeper excavation (>1mbgl) including: • utilities diversions (new pylons); and • Ashley railhead.	The temporary construction works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			The abstraction is located within the land required for the construction of the Proposed Scheme and so there is a risk that the abstraction may be unusable as a result of the construction. The permanent below ground structures are likely to alter groundwater flow to the abstraction (see Section 3.2).	Magnitude of impact – Major Significance of effect – Major adverse, significant	None required.	Magnitude of impact – Major Significance of effect – Major adverse, significant	An investigation and monitoring is required. If detailed investigations by the nominated undertaker confirm a risk of permanent impact on the abstraction, mitigation measures will be agreed with the owner. Mitigation measures may include provision of a new borehole or connection to mains water.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Discharges									
There are no discharges to groundwater in the study area.									
Groundwater – surface water interactions									
Potential spring at Blackshaw Heys Farm	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • Thorns Green embankment.	No impacts from construction are predicted as this potential spring is located upgradient of the Proposed Scheme and over 500m from any construction works.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Potential spring in Bucklow Hill	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	No impacts from construction are predicted as this potential spring is located over 1km from any construction works.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		Deeper excavation (>1mbgl) including: • Hoo Green North cutting (in Pickmere to Agden and Hulseheath MA03).	A proportion of the baseflow to the potential spring may be intercepted by permanent below ground structures of Hoo Green North cutting (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Site survey needed to determine whether potential spring is present.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	None required	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Construction (permanent)
Potential spring east of Chester Road	High	Deeper excavation (>1mbgl) including: • Hoo Green North cutting (in Pickmere to Agden and Hulseheath MA03).	No impacts from construction are predicted as this potential spring not located downgradient of the Proposed Scheme and is over 1km from any construction works.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Potential spring at Ecclesfield Wood	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • Thorns Green embankment.	This potential spring which feeds into Tributary of Birkin Brook 2, is located 40m south of the route of the Proposed Scheme and 40m west of Back Lane Farm access diversion. Therefore, the potential spring could be impacted during construction.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Site survey needed to determine whether spring is present.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	If spring is present, mitigation could include protection during construction or diversion and re-establishing the spring elsewhere such that downstream water bodies are not adversely impacted.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
		Deeper excavation (>1mbgl) including: • Thorns Green cutting.	The feature is located up hydraulic gradient of the zone of influence of Thorns Green cutting and thus is unlikely to be impacted (see Section 3.2).	Magnitude of impact – Negligible	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary and permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Spring at Sunbank Wood east, 230m north of Memorial Stone Spring at Sunbank Wood east, 316m north of Memorial Stone Potential spring at Oak Farm Cottages, Sunbank Lane	Moderate Moderate High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	These features are located upgradient of the Proposed Scheme and are unlikely to be affected by the construction of the Proposed Scheme.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
Spring 130m south–east of Pigleystair Bridge, River Bollin Spring 115m south–east of Pigleystair Bridge, River Bollin	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Thorns Green cutting; and • River Bollin East viaduct.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary. A proportion of the baseflow to the seasonal springs[5] may be intercepted by permanent below ground structures of Thorns Green cutting (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction. None required.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary) Construction (permanent)
Spring 90m north of Lower Thornsgreen Farm	Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Potential spring 127m south-east of Keepers Cottage, Sunbank Lane Potential spring 120m east of	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions.	The temporary works have the potential to affect groundwater quality, although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

[5]Details on the identification of these springs as seasonal are presented in Background Information and Data, Water resources assessment baseline data, BID WR-004-0MA06.

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Keepers Cottage, Sunbank Lane Potential spring at Harpers Bank Wood, 216m east of Hunters Moon, Rostherne Lane Potential spring at Hunters Moon, Rostherne Lane Potential spring at Hunters Moon, Rostherne Lane Potential spring in Harpers Bank Wood									
Spring at Pigleystair Bridge, River Bollin	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Thorns Green cutting; and • River Bollin East viaduct.	This seasonal spring[5] is within the land required for construction of the Proposed Scheme and baseflow to the receiving feature is likely to be altered (see Section 3.2).	Magnitude of impact – Major Significance of effect – Moderate adverse, significant	Water intercepted by the cutting will be discharged at the spring via the drainage network of the Proposed Scheme. This will help to support the baseflow to the watercourse downstream.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)
Potential spring 222m west of Pigleystair Bridge, River Bollin	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Thorns Green cutting; and • River Bollin East viaduct.	Some baseflow to the potential spring may be intercepted by permanent below ground structures of Thorns Green cutting (see Section 3.2).	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Site survey needed to determine whether spring is present.	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	None required	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Construction (permanent)
Potential spring 60m north-east of River Bollin M56 subway Potential spring 60m north-east of River Bollin M56 subway	Low Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	These features are on the opposite side of the valley of Tributary of River Bollin 3 and 5 (and also the M56 motorway) to the Proposed Scheme and so are unlikely to be hydraulically connected to the Proposed Scheme.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Potential spring 60m north-east of River Bollin M56 subway Potential spring 70m south of Haslemere Avenue, Hale Spring 90m west of Haslemere Avenue, Hale	Low High Moderate								
Spring at Keepers Cottage, Sunbank Lane (south) Potential spring at Keepers Cottage, Sunbank Lane (north)	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions. Deeper excavation (>1mbgl) including: • M56 East tunnel; • Manchester Airport High Speed station cutting retaining wall south; and • Manchester Airport High Speed station cutting.	The temporary works have the potential to affect groundwater flow and quality, although this is likely to be localised and temporary. These features are located within the zone of influence of the cuttings that may impact groundwater flow feeding the potential springs (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP. Retaining walls along this part of the cutting will reduce the radius of influence of the cuttings.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	None required None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Construction (temporary) Construction (permanent)
Potential spring at Jackson's Bank, 35m west of Hale Golf Course south Potential sink at Jackson's Bank, 20m west of Hale Golf Course south	High	None	No impacts from construction are predicted as these features are located over 500m from any construction works (and over 900m from the route of the Proposed Scheme).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required.
Potential spring at River Mead Avenue, Hale Spring at Carrwood, 45m west of Pump House Potential spring at Carrwood, 75m east of Pump House	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	These features are located over 800m from the Proposed Scheme on the opposite side of the valley of Tributary of River Bollin 3 and 5, and so should not be hydraulically connected to the Proposed Scheme.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Potential spring at hotel on Hasty Lane	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions. Deeper excavation (>1mbgl) including: • Manchester Airport High Speed station cutting retaining wall.	This potential spring is in the direct path of the Proposed Scheme. As such, the potential spring would be lost during construction. This will impact the baseflow to the receiving watercourse (see Section 3.2).	Magnitude of impact – Major Significance of effect – Major adverse, significant	Site survey needed to determine whether spring is present.	Magnitude of impact – Major Significance of effect – Major adverse, significant	If spring is present, mitigation could include diversion and re-establishing the spring elsewhere such that downstream water bodies are not adversely impacted.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
Potential spring 145m west of Roaring Gate Farm, Roaring Gate Lane	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Manchester Airport High Speed station cutting retaining wall north; and • Manchester tunnel portal south.	The feature is located more than 400m from land required for the construction of the Proposed Scheme and more than 500m from the zone of influence of the Manchester Airport High Speed Station cutting. The baseflow and groundwater quality in the area of the potential spring are, therefore, very unlikely to be affected by the Proposed Scheme.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
Spring at Davenport Green, Roaring Gate Lane	Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		Deeper excavation (>1mbgl) including: • Manchester Airport High Speed station cutting retaining wall north.	The proposed cutting may intercept a small proportion of groundwater that would otherwise provide baseflow to this spring. This water would be discharged to Tributary of Timperley Brook 3 and would not be returned to the spring (see Section 3.2).	Magnitude of Impact – Minor Significance of effect – Negligible, not significant	None required.	Magnitude of Impact – Minor Significance of effect – Negligible, not significant	None required	Magnitude of Impact – Minor Significance of effect – Negligible, not significant	Construction (permanent)
Millington Clough	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and	The temporary works have the potential to affect quality of groundwater contributing to the watercourse, although the impact is likely to be localised and temporary.	Magnitude of Impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• Hulseheath North embankment. Deeper excavation (>1mbgl) including: • Millington cutting.	The route of the Proposed Scheme is parallel to the expected direction of groundwater flow to the watercourse and, hence, unlikely to have a measurable impact on groundwater discharge to the watercourse.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required, although water intercepted by the drainage for the Proposed Scheme will be returned to the Agden Brook at the crossing with the Proposed Scheme.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
Agden Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • Hulseheath North embankment. Deeper excavation (>1mbgl) including: • Agden Brook viaduct; and • Millington cutting.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Cutting drainage for Millington cutting could intercept some of the baseflow to Agden Brook as flow in drainage is diverted away from Agden Brook.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
Rostherne Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	No impacts from construction are predicted as this watercourse is located over 500m from any construction works.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
Blackburn's Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • Blackburn's Brook embankment. Deeper excavation (>1mbgl) including: • Rostherne cutting retaining wall east; • Rostherne East box structure; • Blackburn's Brook viaduct (north); and • utilities diversions (new pylons).	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			The deeper excavations in cuttings and piers may have an impact on groundwater flow to this watercourse, although the impact should be reduced following installation of structures.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required, although water intercepted by the drainage for the below ground structures will be returned to the watercourse upstream of the crossing with the Proposed Scheme.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
Tributary of Blackburn's Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	This feature is located upgradient of the Proposed Scheme and is unlikely to be affected by the construction of the Proposed Scheme.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
Tributary of River Bollin 10 Tributary of River Bollin 11	Low Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Millington cutting.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential for groundwater flow to the watercourses to be intercepted by the below ground structures of Millington cutting (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
Tributary of Birkin Brook 9	Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • Birkin Brook embankment. Deeper excavation (>1mbgl) including: • Blackburn's Brook North viaduct; and • utilities diversions (new pylons).	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Moderate Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Moderate Significance of effect – Minor adverse, not significant	Construction (temporary)
			The below ground structures are located upgradient of the Proposed Scheme but are separated from Tributary of Birkin Brook 9 by Birkin Book. Hence, flow to Tributary of Birkin Brook 9 is unlikely to be affected by the construction of the Proposed Scheme.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary and permanent)
Birkin Brook	High	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Blackburn's Brook North viaduct;	Potential for groundwater flow to the watercourse to be intercepted by the cutting. As a result, the brook may have reduced flow (see Section 3.2). However, the Birkin Brook is in culvert within the radius of influence of the cuttings and, therefore, is unlikely to be significantly affected by dewatering impacts.	Magnitude of impact – Minor Significance of effect – Moderate adverse, significant	Water intercepted by the drainage for the cuttings will be returned to Blackburn's Brook upstream of Birkin Brook, hence overall contribution to Birkin Brook is not affected.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• utilities diversions (new pylons); • Rostherne cutting; and • Rostherne East box structure.							
River Bollin	Very high	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions. Deeper excavation (>1mbgl) including: • Thorns Green cutting; • River Bollin East viaduct; and • Ringway cutting.	The temporary works have the potential to affect groundwater quality contributing to the River Bollin, although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential for groundwater flow to the watercourse to be intercepted by the below ground structures of the cuttings and viaduct piling. Considering the scale of the features compared to the River Bollin catchment, the impact of groundwater interception on the river flow is likely to be negligible (see Section 3.2).	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required, though water intercepted by the drainage for the below ground structures will be returned to the watercourse upstream and downstream of the crossing with the Proposed Scheme.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Tributary of Birkin Brook 8 Tributary of Birkin Brook 7 Tributary of Birkin Brook 6 Tributary of Birkin Brook 5	Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions. Deeper excavation (>1mbgl) including: • utilities diversions (new pylons).	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Below ground structures for pylons have the potential to intercept some groundwater flow that would otherwise provide baseflow to these watercourses. However, the dimensions of the pylons will cause a negligible impact to groundwater flow, thus a negligible impact on the watercourses.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Tributary of Birkin Brook 4	Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; • utilities diversions; • Ashley IMB-R; and • Ashley embankment retaining wall. Deeper excavation (>1mbgl) including: • Ashley railhead.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Headwaters are located within land required for construction of Ashley IMB-R. Below ground structures for Ashley railhead have the potential to intercept some groundwater flow that would otherwise provide baseflow to this watercourse.	Magnitude of Impact – Moderate Significance of effect – Minor adverse, not significant	None required, though water intercepted by the drainage for the below ground structures will be returned to the watercourse 100m	Magnitude of Impact – Moderate Significance of effect – Minor	None required	Magnitude of impact – Moderate Significance of effect – Minor	Construction (permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
					downstream of the headwater.	adverse, not significant		adverse, not significant	
Tributary of Birkin Brook 1	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; • Ashley embankment; • Ashley IMB-R; and • Thorns Green embankment. Deeper excavation (>1mbgl) including: • Ashley railhead.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Ashley railhead may intercept some groundwater that would otherwise provide baseflow to this watercourse.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required, though watercourse diversions reroute water to other tributaries of Birkin Brook. As such, there is no impact to the baseflow of the whole Birkin Brook waterbody.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Mobberley Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
		Deeper excavation (>1mbgl) including: • utilities diversions (new pylons); and • Ashley railhead.	The watercourse is located upgradient of below ground structures for Ashley railhead and therefore is unlikely to be impacted in terms of water quality.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Below ground structures for pylons have the potential to intercept some groundwater flow that would otherwise provide baseflow to this watercourse. However, the dimensions of the pylons will cause a negligible impact to groundwater flow, thus a negligible impact on the watercourse.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Sugar Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and	This feature is located downgradient of the construction of the Proposed Scheme and as such there is potential for groundwater quality to be affected although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• Ashley IMB-R. Deeper excavation (>1mbgl) including: • Ashley railhead; and • utilities diversions (new pylons).	This feature is located upgradient of below ground structures for Ashley railhead and therefore is unlikely to be impacted in terms of flow.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (permanent)
Tributary of Sugar Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • Ashley IMB-R. Deeper excavation (>1mbgl) including: • Ashley railhead.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			This feature is located upgradient of below ground structures for Ashley railhead and therefore is unlikely to be impacted in terms of flow.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of Birkin Brook 3	Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; • Ashley IMB-R; • Ashley embankment; and • Thorns Green embankment. Deeper excavation (>1mbgl) including: • Mid-Cheshire (railway) and Mobberley Road viaduct; and • Ashley railhead.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential for groundwater flow to the watercourse to be intercepted by piling for the viaduct. A small stretch of the watercourse may have reduced flow (see Section 3.3).	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required, though water intercepted by the drainage for below ground structures will be returned to the watercourse downstream of the crossing with the Proposed Scheme.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Construction (permanent)
			Due to culverting and watercourse diversions for the Ashley railhead, groundwater baseflow to a 200m stretch of the watercourse will be lost.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required, though water intercepted by the drainage for below ground structures will be returned to the watercourse downstream of the crossing with the Proposed Scheme.	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of Birkin Brook 2	Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads;	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• temporary works such as stockpiles and compounds; • Ashley IMB-R; and • Thorns Green embankment. Deeper excavation (>1mbgl) including: • Mid-Cheshire (railway) and Mobberley Road viaduct; • Ashley railhead; and • Thorns Green cutting.		Significance of effect – Minor adverse, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
			Potential for groundwater flow to the watercourse to be intercepted by piling for the viaduct or the cutting (see Section 3.3).	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required, though water intercepted by the drainage for below ground structures will be returned to the watercourse downstream of the crossing with the Proposed Scheme.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Construction (permanent)
Cotteril Clough Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of River Bollin 1 Tributary of River Bollin 5 Tributary of River Bollin 8 Tributary of River Bollin 9	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	These features are located approximately 500m or more from the Proposed Scheme and/or are separated from the Proposed Scheme by other tributaries of the River Bollin. As such, they are unlikely to be affected by the construction of the Proposed Scheme.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
Tributary of River Bollin 2	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions. Deeper excavation (>1mbgl) including: • Ringway cutting; • M56 cutting retaining wall; and • M56 East tunnel.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential for groundwater flow to the watercourse to be intercepted by the below ground structures of the cutting (see Section 3.2).	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
Tributary of River Bollin 3	Moderate	Above ground elements and shallow excavation (<1mbgl) including:	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible	None required	Magnitude of impact – Negligible	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		• ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Ringway cutting; • M56 cutting retaining wall; and • M56 East tunnel.		Significance of effect – Moderate adverse, significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
			The cuttings could potentially intercept groundwater that would otherwise contribute to the flow in Tributary of River Bollin 3.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
Tributary of River Bollin 4	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Thorns Green cutting.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Thorns Green cutting could potentially intercept groundwater that would otherwise contribute to the flow in this watercourse.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required, though surface water drainage will be returned to the watercourse downstream of the Proposed Scheme, which will help to maintain flow.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
Tributary of River Bollin 6 Tributary of River Bollin 7	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Thorns Green cutting.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Minor adverse, not significant	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Thorns Green cutting could potentially intercept groundwater that would otherwise contribute to the flow in these watercourses.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (permanent)
Tributary of Timperley Brook 1	Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate Significance of effect – Minor adverse, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential for groundwater flow to the watercourse to be intercepted by the cutting. Half of the length of the	Magnitude of Impact – Major	None required.	Magnitude of impact – Major	None required	Magnitude of impact – Major	Construction (permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effects	Duration of effect
		Deeper excavation (>1mbgl) including: • Manchester Airport High Speed cutting retaining wall north.	watercourse may have reduced flow (see Section 3.2).	Significance of effect – Minor adverse, not significant		Significance of effect – Minor adverse, not significant		Significance of effect – Minor adverse, not significant	
Timperley Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Manchester Airport High Speed cutting retaining wall north; and • Provision for Metrolink.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Moderate Significance of effect – Moderate adverse, significant	Implementation of measures described in the draft CoCP.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			Potential for groundwater flow to the watercourse to be intercepted by below ground structures of the cutting and overbridge (see Section 3.2).	Magnitude of impact – Moderate Significance of effect – Moderate adverse, significant	Highways drainage and drainage from the station area will discharge to the brook to help support river flows, although the timing of flow may change.	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	None required	Magnitude of impact – Minor Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)
Tributary of Timperley Brook 2 Tributary of Timperley Brook 3	Low	Above ground elements and shallow excavation (<1mbgl) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions. Deeper excavation (>1mbgl) including: • Manchester Airport High Speed cutting retaining wall north.	The temporary works have the potential to affect groundwater quality although this is likely to be localised and temporary.	Magnitude of Impact – Minor Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	Magnitude of Impact – Negligible Significance of effect – Negligible, not significant	None required	Magnitude of impact – Negligible Significance of effect – Negligible, not significant	Construction (temporary)
			There may be potential for groundwater flow to the watercourse to be intercepted by the cutting (see Section 3.2).	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Minor Significance of effect – Negligible, not significant	None required	Magnitude of impact – Minor Significance of effect – Negligible, not significant	Construction (permanent)

3.2 Impact on groundwater from cuttings

3.2.1 Summary parameters for each cutting are presented below in Table 3 to Table 10.

3.2.2 Where the groundwater elevation lies above the base of the cutting, a detailed assessment of the likely maximum zone of influence from dewatering of the cutting has been undertaken. In the case that the groundwater level is not known, the groundwater level is assumed to be at surface and a detailed assessment is undertaken accordingly.

3.2.3 Assessment of the likely maximum zone of influence from dewatering of the cuttings has been made using Sichardt's formula as set out in the SMR Technical Note: Groundwater assessment.

3.2.4 Hydraulic conductivity values from the high end of the range, presented in literature, have been used in the assessment, to provide a conservative estimate of the dewatering zone of influence. Where groundwater levels are not known, the worst-case assumption, that groundwater is at ground level, has been used.

3.2.5 Cuttings are assumed to be open and any permanent works such as retaining walls or drainage measures do not form part of the quantitative assessment. Maximum drainage invert is estimated to be a maximum of 3.15m below track level.

3.2.6 Based on these precautionary assumptions, the zone of influence is likely to be overestimated. However, for the purpose of this preliminary assessment, this precautionary approach is considered to be appropriate.

Millington cutting

Table 3: Summary of the parameters for the groundwater assessment of Millington cutting

Cutting parameters	Parameter details
Length (km)	1.5
Maximum depth (m)	11.5 to top of rail (13.2 to drainage invert)
Strata intercepted	Glaciofluvial deposits (Secondary A aquifer) Glacial till (Secondary (Undifferentiated) aquifer)
Lowest level of drainage invert along track (metres above ordnance datum: mAOD)	24.8
Groundwater level(s) (mAOD)	Assumed to be at ground level
Principal receptors	Glaciofluvial deposits (Secondary A aquifer) Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member (Secondary B aquifer)) Sherwood Sandstone Formation (Helsby Sandstone Formation) (Principal aquifer) Millington Clough Agden Brook Tributary of River Bollin 10 Tributary of River Bollin 11 Rostherne Mere Ramsar site, SSSI, NNR and ancient woodland including Harper's Bank Wood and Wood Bongs, located within the SSSI. Grey's Gorse SBI and LWS Yarwood Heath Covert LWS

3.2.7 The cutting would penetrate through the glacial till Secondary (Undifferentiated) aquifer and into the Sherwood Sandstone Group Principal aquifer. There is some historical information on groundwater elevations and depth to groundwater currently available in this area. The information comprises groundwater level monitoring data for July to November 1991, collected for the A556 (M56 – M6) Improvement Ground Investigation[6]. It has, however, been conservatively assumed that groundwater levels within the superficial deposits and bedrock are at ground level, and groundwater flow within the superficial deposits and bedrock may be affected by the Millington cutting. Application of the draft CoCP will ensure that materials and fluids used during construction are managed so that there is no significant adverse effect on groundwater quality.

3.2.8 Assuming a hydraulic conductivity value of $3x10^{-4}$m/s for the glaciofluvial deposits and glacial till[7], the lateral extent of drawdown (also referred to as the zone of influence) in the glacial till is estimated to extend up to 400m. This is based on a maximum cutting depth of 13.2m, and a rest water level at ground level. Millington cutting will be constructed as an open cutting and at present no piling, foundations or retaining walls are proposed for the cutting itself. However, a retained cut beneath the A556, Chester Road over a length of approximately 40m towards the eastern end of Millington cutting, is proposed that will be constructed as a tangent piled wall. The piled wall may effectively form an impermeable barrier in superficial deposits beneath the A556 Chester Road overbridge locally but will not affect the aquifer as a whole, considering the spatial extent of the glacial till in the area. The glacial till has a minimum thickness of approximately 10m below the cutting depth (approximately 25mAOD at the minimum depth of drainage below cutting). Therefore, potential local changes in groundwater level in the glacial till to the maximum cutting depth are assessed as minor, leading to a minor adverse effect which is not significant.

3.2.9 There may be high permeability horizons in some areas within the glacial till that could be laterally extensive. Further ground investigation and monitoring is required to confirm groundwater levels in this location, and the presence of any high permeability bands likely to be impacted by the cutting. The results of the ground investigation will inform the detailed design and management of groundwater during construction.

[6] A556 (M56 - M6) Improvement - Factual Report on Ground Investigation D1133 (June 1992).

[7] On a precautionary basis, high-end sand and gravel conductivity values are assumed for glaciofluvial deposits and glacial till to allow for potential presence of middle sands: Hydraulic conductivity from Domenico, P.A and Schwartz, F. W. (1990), *Physical and Chemical Hydrogeology*. John Wiley & Sons.

3.2.10 The proposed cutting does not extend into either the Sherwood Sandstone Group (Helsby Sandstone Formation) or the underlying Mercia Mudstone Group (Sidmouth Mudstone Member – Bollin Mudstone Member). The substantial thickness of glacial till overlying the bedrock below the cutting, combined with the application of the draft CoCP, means that water quality and flow impacts on the Sherwood Sandstone Group and Mercia Mudstone Group from the construction of the cutting are likely to be negligible, leading to negligible effects which are not significant.

3.2.11 Construction of the Millington cutting will remove some of the superficial deposits along the line of the cutting. The reduction in thickness of the superficial deposits could potentially create a shorter pathway for surface water to discharge into the Sherwood Sandstone. This might potentially lead to a slight change in groundwater chemistry in the bedrock aquifer in the area. However, over almost the entire section of the cutting overlying the Sherwood Sandstone, there are expected to be at least 10m of superficial deposits below the drainage invert. In addition, the cutting is very limited in area in comparison to the areal extent of the superficial and bedrock aquifers. As a result, the impact of this potential change in chemistry is assessed to be negligible for the Sherwood Sandstone aquifer, leading to negligible effect which is not significant.

3.2.12 Groundwater flow towards Agden Brook is expected to be parallel to Millington cutting, hence the cutting should not disrupt the groundwater flow to the watercourse in the area. There may, however, be a slight reduction in groundwater discharge to the watercourse, due to the interception of some groundwater flow in the zone of influence of the cutting. There would, therefore, be a slight reduction in baseflow in the Agden Brook. As a result, the impact on groundwater flow and discharge to Agden Brook is assessed as minor, leading to a minor adverse effect, which is not significant.

3.2.13 While the Tributary of River Bollin 10 is located approximately 50m outside of the zone of influence of the Millington cutting, it is located downgradient of the route of the Proposed Scheme and as such, flow in the catchment of this watercourse could be intercepted by the cutting. The uppermost reach of Tributary of River Bollin 11 is located 150m downgradient of the route of the Proposed Scheme and within the zone of influence of the Millington cutting. Groundwater flow intercepted by the cutting drainage system will be directed to Blackburn's Brook via carrier drain and as such, the uppermost reach of the watercourses may receive reduced groundwater discharge. This would produce a slight reduction in contribution to the baseflow in the two watercourses. The impact on flow in Tributary of River Bollin 10 and 11 is considered to be minor, leading to a minor adverse effect, which is not significant. All other surface watercourses are located outside of the calculated zone of influence of the Millington cutting.

3.2.14 Rostherne Mere surface water and groundwater dependent habitat is within the calculated zone of influence of Millington cutting and thus has the potential to be impacted (see Section 4.2 for further detail). Yarwood Heath Covert, a potentially groundwater dependent habitat, is also within the calculated zone of influence and may receive reduced groundwater discharge. Grey's Gorse, a potentially groundwater dependent habitat, is located outside of the calculated zone of influence of Millington cutting. Further details for these sites are presented in Section 4.2.

Rostherne cutting and retaining walls

Table 4: Summary of the parameters for the groundwater assessment of Rostherne cutting and retaining walls

Cutting and retaining walls parameters	Parameter details
Length (km)	1.2 (including the Rostherne cutting retaining wall west, Rostherne cutting and Rostherne cutting retaining wall east)
Maximum depth (m)	7.0 to top of rail (10.2 to drainage invert)
Strata intercepted	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member (Secondary B aquifer))
Lowest level of drainage invert along track (mAOD)	24.8
Groundwater level(s) (mAOD)	Assumed to be at ground level
Principal receptors	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Northwich Halite Member (Unproductive)) Mercia Mudstone Group (Tarporley Siltstone Formation (Secondary B aquifer)) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member (Secondary B aquifer)) Blackburn's Brook Birkin Brook Rostherne Mere Ramsar site, SSSI and NNR, and ancient woodland including Harper's Bank Wood and Wood Bongs, located within the SSSI. Yarwood Heath Covert LWS Hancock's Bank North LWS and ancient woodland Hancock's Bank South SBI, LWS and ancient woodland Ryecroft Covert LWS and ancient woodland

3.2.15 The Rostherne cutting is composed of the Rostherne cutting retaining wall west, Rostherne cutting and Rostherne cutting retaining wall east. Rostherne cutting retaining wall west will be constructed as a contiguous pile wall embedded to 10m depth. Rostherne cutting will be constructed as an open cutting up to 5.5m deep. Rostherne cutting retaining wall east will be constructed as sheet piles and as secant pile walls and the

piles will be installed to varying depths up to 12m below ground level. As the glacial till is estimated to be approximately 15m thick, the piles will penetrate through the glacial till and into the top of the underlying Mercia Mudstone bedrock along parts of the Rostherne cutting retaining wall east. Generally, however, there is a thickness of at least 5m of glacial till cover between the base of the cutting and the Mercia Mudstone, and a thickness of at least 1m of glacial till between the base of the retaining wall piles and the Mercia Mudstone, although it is assumed on a precautionary basis that the below ground structures penetrate the upper limits of the Mercia Mudstone Group.

3.2.16 There is some historical information on groundwater elevations and depth to groundwater currently available in this area. The information comprises groundwater level monitoring data for July to November 1991, collected for the A556 (M56 – M6) Improvement Ground Investigation. It has, however, been conservatively assumed that groundwater levels within the superficial deposits and bedrock are at ground level, and that groundwater flow within the superficial deposits and bedrock may be affected by the Rostherne cutting and retaining walls. Application of the draft CoCP will ensure that materials and fluids used during construction are managed so that there is no significant adverse effect on groundwater quality.

3.2.17 As defined above, the zone of drawdown has been calculated assuming the cutting is an open cutting without retaining walls. Assuming a hydraulic conductivity value of $3x10^{-4}$m/s for the glacial till[7], the lateral extent of drawdown (also referred to as the zone of influence) in the glacial till is estimated to extend up to 309m. This is based on a maximum cutting depth of 10.2m, and a rest water level at ground level. The glacial till has a thickness of at least 5m below the cutting depth and is laterally extensive. The cutting and retaining walls may act as a barrier to groundwater flow locally, but will not affect the aquifer as a whole, considering the spatial extent of the glacial till in the area. Therefore, potential local changes in groundwater level to the maximum cutting depth are assessed as minor impact, leading to a minor adverse effect which is not significant on the Secondary (Undifferentiated) aquifer.

3.2.18 The application of the draft CoCP, combined with the large areal extent of the aquifer, means that water quality and flow impacts on the Mercia Mudstone Group from the construction of the cutting are likely to be negligible, leading to a negligible effect which is not significant.

3.2.19 Construction of the Rostherne cutting will remove some of the superficial deposits, comprising glacial till, along the cuttings. The glacial till consists generally of interbedded layers of variable permeability. There are high permeability horizons within the glacial till, some of which might be laterally extensive. Further ground investigation and monitoring is required to confirm groundwater levels in this location, and the presence of any high permeability bands likely to be impacted by the cutting. The results of the ground investigation will inform the detailed design and management of groundwater during construction. Low permeability layers within the glacial till are expected to act as aquitards, restricting the vertical flow of water through the ground. The reduction in thickness of the glacial till along the line of the cutting could potentially create a shorter pathway for surface water to discharge into the Mercia Mudstone and could lead to a slight change in groundwater chemistry in the area. However, the cutting is very limited in area in comparison to the areal extent of the superficial and bedrock aquifers. The impact of this change in groundwater chemistry is assessed to be negligible, leading to negligible effect which is not significant.

3.2.20 Birkin Brook may receive reduced groundwater discharge due to the interception of groundwater by the Rostherne cutting that would otherwise make a minor contribution to the baseflow to Birkin Brook. Groundwater intercepted by the cutting will be diverted to Blackburn's Brook via the drainage system of the Proposed Scheme. Rostherne Mere discharges into Blackburn's Brook. Blackburn's Brook is an upstream tributary of Birkin Brook and therefore there will be a negligible overall impact on the baseflow of Birkin Brook, leading to a negligible effect which is not significant. Additionally, only a 140m stretch of the Birkin Brook is located within the radius of influence of the cutting and the watercourse is in culvert in this area, passing underneath the M56. The impact on groundwater flow to Blackburn's Brook is also assessed as negligible, leading to a negligible effect which is not significant.

3.2.21 Rostherne Mere surface water and groundwater dependent habitat is within the calculated zone of influence of the Rostherne cutting and retaining walls and thus has the potential to be impacted (see Section 4.2 for further detail). Hancock's Bank South, a surface water and groundwater dependent habitat, and Yarwood Heath Covert and Hancock's Bank North, potentially groundwater dependent habitats, are also within the calculated zone of influence and may be affected by the cuttings (further information in Section 4.1).

Rostherne East box structure

Table 5: Summary of the parameters for the groundwater assessment of Rostherne East box structure

Box structure parameters	Parameter details
Length (m)	240
Maximum depth (m)	4.7 to top of rail (7.9 to drainage invert)
Strata intercepted	Glacial till (Secondary (Undifferentiated) aquifer) Glaciofluvial sheet deposits (Secondary A aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member (Secondary B aquifer))
Lowest level of drainage invert along track (mAOD)	27.2
Groundwater level(s) (mAOD)	Assumed to be at ground level
Principal receptors	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member (Secondary B aquifer)) Blackburn's Brook Birkin Brook Rostherne Mere Ramsar site, SSSI and NNR, and ancient woodland including Mere Covert and Harper's Bank Wood, located within the SSSI Hancock's Bank North LWS and ancient woodland Hancock's Bank South SBI, LWS and ancient woodland

3.2.22 The box structure would be located within the glacial till Secondary (Undifferentiated) aquifer. The bored piles associated with the box structure are expected to be installed from existing ground level to varying depths from 10m to 20m depth and may extend into the underlying Mercia Mudstone Secondary B aquifer. There is some historical information on groundwater elevations and depth to groundwater currently available in this area. The information comprises groundwater level monitoring data for July to November 1991, collected for the A556 (M56 – M6) Improvement Ground Investigation. It has, however, been conservatively assumed that groundwater levels within the superficial deposits and bedrock are at ground level, and that groundwater flow within the superficial deposits and bedrock may be affected by the Rostherne East box structure. Application of the draft CoCP will ensure that materials and fluids used during construction are managed so that there is no significant adverse effect on groundwater quality.

3.2.23 As defined above, the zone of drawdown has been calculated assuming the cutting is an open cutting without retaining walls. Assuming a hydraulic conductivity value of $3x10^{-4}$m/s for the glaciofluvial sheet deposits and glacial till[7], the lateral extent of drawdown (also referred to as the zone of influence) in the superficial deposits is estimated to extend up to 238m. This is based on a maximum cutting depth of 7.9m, and a rest water level at ground level. The superficial deposits have a thickness of at least 5m below the box structure and are laterally extensive, although the box structure may penetrate the superficial deposits fully at the eastern end of the structure. The pile foundations and concrete side walls may locally act as a barrier to groundwater flow in the area but will not impact on the aquifers as a whole, considering the spatial extent of the superficial deposits. Therefore, potential local changes in groundwater level to the maximum cutting depth are assessed as a minor impact, leading to a minor adverse effect which is not significant on the glacial till Secondary (Undifferentiated) aquifer and the glaciofluvial sheet deposits (Secondary A) aquifer.

3.2.24 There may be high permeability horizons within the superficial deposits that may be laterally extensive. Further ground investigation and monitoring is required to confirm groundwater levels in this location, and the presence of any high permeability bands likely to be impacted by the cutting. The results of the ground investigation will inform the detailed design and management of groundwater during construction.

3.2.25 The proposed box structure may penetrate the Mercia Mudstone Group towards the eastern end of the structure, although there is generally a thickness of at least 5m of glacial till cover between the base of the structure and the Mercia Mudstone. It is assumed on a precautionary basis that the below ground structures penetrate the upper limits of the Mercia Mudstone Group. The application of the draft CoCP combined with the large areal extent of the aquifer means that water quality and flow impacts on the Mercia Mudstone Group from the construction of the cutting are likely to be negligible, leading to a negligible effect which is not significant.

3.2.26 Blackburn's Brook and Birkin Brook may receive reduced baseflow due to the interception of groundwater by the Rostherne East box structure that would otherwise make a local contribution to the baseflow of these watercourses. However, groundwater intercepted by the box structure will be diverted into Blackburn's Brook by the drainage system of the Proposed Scheme, thereby mitigating the impact of groundwater interception. Additionally, a 140m stretch of the Birkin Brook is located within the radius of influence of the cutting and the watercourse is in culvert in this area as it passes underneath the M56. The impact on groundwater flow to Blackburn's Brook is therefore assessed as negligible, leading to a negligible effect which is not significant. Blackburn's Brook is an upstream tributary of Birkin Brook, and the overall impact on the baseflow of Birkin Brook would also be negligible, leading to a negligible effect which is not significant.

3.2.27 Hancock's Bank South, a surface water and groundwater dependent habitat, and Hancock's Bank North, a potentially groundwater dependent habitat, are within the calculated zone of influence and may also be affected by the box structure (further information in Section 4.1).

Thorns Green cutting

Table 6: Summary of the parameters for the groundwater assessment of Thorns Green cutting

Cutting parameters	Parameter details
Length (km)	1.0
Maximum depth (m)	9.0 to top of rail (12.2 to drainage invert)
Strata intercepted	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member (Secondary B aquifer))
Lowest level of drainage invert along track (mAOD)	43.7
Groundwater level(s) (mAOD)	Assumed to be at ground level
Principal receptors	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member (Secondary B aquifer)) Spring at Pigleystair Bridge, River Bollin Potential spring 222m west of Pigleystair Bridge, River Bollin Spring 115m south-east of Pigleystair Bridge, River Bollin Spring 130m south-east of Pigleystair Bridge, River Bollin Potential spring at Ecclesfield Wood Tributary of Birkin Brook 2 River Bollin Tributary of River Bollin 4 Tributary of River Bollin 6 Tributary of River Bollin 7 Ecclesfield Wood LWS Jackson's Bank East LWS Brickhill Wood LWS and ancient woodland Mill Wood, Castle Mill LWS Wood Near Chapel Lane SBI and Hennersley Bank ancient woodland

3.2.28 The cutting would penetrate through the glacial till Secondary (Undifferentiated) aquifer and into the Mercia Mudstone Group Secondary B aquifer. There is no currently available information on groundwater elevations or depth to groundwater in this area. It has therefore been conservatively assumed that groundwater levels within the glacial till are at ground level and that groundwater flow within the glacial till may be affected by the Thorns Green cutting. Application of the draft CoCP will ensure that materials and fluids used during construction are managed so that there is no significant adverse effect on groundwater quality.

3.2.29 Assuming a hydraulic conductivity value of $3x10^{-4}$m/s for the glacial till[7], the lateral extent of drawdown (also referred to as the zone of influence) in the glacial till is estimated to extend a distance of up to 369m. This is based on a maximum cutting depth of 12.2m, and a rest water level at ground level. The glacial till is partially penetrated by the cutting, with the drainage invert above the base of the glacial till over approximately 90% of the length of the cutting. The cutting traverses an area of elevated ground between Tributary of Birkin Brook 2 in the west and the River Bollin in the east. Assuming that the groundwater flow direction in the glacial till generally follows topography, there is likely to be a divide in groundwater flow in the vicinity of the cutting. The cutting is unlikely therefore to form a barrier to groundwater flow in the area, although there may be minor local changes in groundwater level. However, taking into account the overall extent of the glacial till aquifer, the impact on the aquifer is assessed to be negligible, leading to a negligible effect which is not significant.

3.2.30 There may be high permeability horizons within the glacial till that could be laterally extensive. Further ground investigation and monitoring is required to confirm groundwater levels in this location, and the presence of any high permeability bands likely to be impacted by the cutting. The results of the ground investigation will inform the detailed design and management of groundwater during construction.

3.2.31 Thorns Green cutting will be constructed as an open cutting. The drainage for the proposed cutting may penetrate through the superficial deposits and into the top of the Mercia Mudstone Group in a section approximately 100m long. As a result, the zone of influence for the bedrock aquifer is estimated to extend a distance of up to 101m to either side of the cutting. As the cutting intercepts only a small area of the

Mercia Mudstone Group, and measures listed in the draft CoCP will be applied, impacts on water quality and groundwater flow in the Mercia Mudstone Group from the construction of the cutting are assessed as negligible, leading to a negligible effect which is not significant.

3.2.32 Construction of the Thorns Green cutting will remove some of the superficial deposits, comprising glacial till, along the cuttings. The glacial till consists generally of interbedded layers of variable permeability. Low permeability layers within the glacial till are expected to act as aquitards, restricting the vertical flow of water through the ground. The reduction in thickness of the glacial till along the line of the cutting could potentially create a shorter pathway for surface water to discharge into the Mercia Mudstone. In addition, in a short section of the cutting all superficial deposits may be removed, creating a direct pathway for surface water to discharge into the Mercia Mudstone. These changes in pathway to the bedrock aquifer could lead to a slight change in groundwater chemistry in the area. However, since the section of cutting is small in comparison to the areal extent of the superficial and bedrock aquifers, the impact of the change in chemistry is assessed to be negligible, leading to a negligible effect which is not significant.

3.2.33 The spring at Pigleystair Bridge, River Bollin is within the land required for the construction of the Proposed Scheme and baseflow to the spring is likely to be altered. The spring is within the calculated zone of influence of Thorns Green cutting, downgradient of the Proposed Scheme, but will receive drainage discharge from an attenuation pond constructed as part of the Proposed Scheme. It is assumed on a precautionary basis that flow may change in some periods if there is less contribution from drainage than from the spring. The overall impact on this spring is assessed as minor, leading to a minor adverse effect which is not significant.

3.2.34 The potential spring 222m west of Pigleystair Bridge, River Bollin has not yet been surveyed and, thus, is assumed to be a high value receptor. It is located on the boundary of the zone of influence of the cutting and, therefore, some of the groundwater flow feeding this spring is likely to be intercepted by the cutting. This is assessed as a moderate impact leading to a moderate effect which is significant.

3.2.35 The spring 115m south-east of Pigleystair Bridge, River Bollin, and spring 130m south-east of Pigleystair Bridge, River Bollin are outside of the calculated zone of influence of Thorns Green cutting. The cutting may intercept a small proportion of the groundwater flow in parts of the contributing catchments upstream of the springs. The impacts on groundwater flow to these features are assessed as minor, leading to moderate effects which are significant.

3.2.36 The potential spring at Ecclesfield Wood, that has not yet been surveyed, is located outside the maximum calculated zone of influence, and the contributing catchment is upgradient of the zone of influence. Therefore, this feature is unlikely to be impacted by the cutting.

3.2.37 Tributary of Birkin Brook 2, a low value receptor, and tributaries of River Bollin 4, 6 and 7, moderate value receptors, are located outside the calculated zone of influence of the Thorns Green cutting. However, the cutting may intercept some groundwater in the catchment that would otherwise discharge into these watercourses, thus reducing the baseflow. The impacts on groundwater discharge to the Tributary of Birkin Brook 2 and tributaries of River Bollin 4, 6 and 7 is assessed as minor, leading to negligible effects which are not significant.

3.2.38 Thorns Green cutting may intercept some groundwater that would otherwise discharge into the River Bollin, thus reducing the baseflow in the river. However, the drainage system of the Proposed Scheme will discharge any groundwater intercepted by the cutting to the River Bollin. Hence, there would be a negligible impact to the groundwater discharge and baseflow in the river.

3.2.39 Ecclesfield Wood and Wood Near Chapel Lane, that are potentially groundwater dependent habitats, and Jackson's Bank East, a potentially groundwater or surface water dependent habitat, are located outside the calculated zone of influence of Thorns Green cutting, although these habitats are downgradient of the zone of influence. As a result, parts of the catchments upstream of these habitats may be within the zone of influence of the cutting, and the habitats may receive reduced groundwater flow (further information in Section 4.1). Brickhill Wood, a potentially groundwater dependent habitat, is located partially within the zone of influence of Thorns Green cutting and is downgradient of the Proposed Scheme. The drainage along the cutting could carry flow away from the habitat as the drainage diverts flow towards the River Bollin in this area. As such, groundwater discharge and baseflow to the habitat could be reduced (further information in Section 4.1).

3.2.40 A small section of Mill Wood, Castle Mill, a surface water and groundwater dependent habitat, is located within the zone of influence of Thorns Green cutting. Drainage to the cutting may therefore affect any groundwater discharge contributing to the site (further information in Section 4.1).

Ringway cutting

Table 7: Summary of the parameters for the groundwater assessment of Ringway cutting

Cutting parameters	Parameter details
Length (m)	430
Maximum depth (m)	11.1 to top of rail (14.3 to drainage invert)
Strata intercepted	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member (Secondary B aquifer))
Lowest level of drainage invert along track (mAOD)	42.8
Groundwater level(s) (mAOD)	Assumed to be at ground level
Principal receptors	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member (Secondary B aquifer)) River Bollin Tributary of River Bollin 2 Tributary of River Bollin 3 Committed developments MA07/026 and MA07/027 Sunbank Wood and Ponds SBI and ancient woodland Wood near Chapel Lane SBI and Hennersley Bank ancient woodland

3.2.41 The cutting would penetrate the glacial till Secondary (Undifferentiated) aquifer and into the Mercia Mudstone Group. There is no currently available information on groundwater elevations or depth to groundwater in this area. It has therefore been conservatively assumed that groundwater levels within the glacial till and Mercia Mudstone are at ground level and that groundwater flow within the glacial till may be affected by the Ringway cutting. Application of the draft CoCP will ensure that materials and fluids used during construction are managed so that there is no significant adverse effect on groundwater quality.

3.2.42 Assuming a hydraulic conductivity value of $3x10^{-4}$m/s for the glacial till[7], the lateral extent of drawdown (also referred to as the zone of influence) in the glacial till is estimated to extend up to 142m. This is based on a maximum cutting depth of 14.3m, and a rest water level at ground level. The glacial till has a maximum thickness of approximately 4.7m in the area and is fully penetrated over the whole length of the cutting. As there is no groundwater monitoring available in the area, the groundwater level is assumed to be at ground level. The cutting will be constructed as an open cutting and at present no piling, foundations or walls are proposed. Assuming that the groundwater flow direction in the glacial till follows topography, groundwater will flow towards the River Bollin to the south-west, approximately parallel to the alignment of the cutting. The cutting is therefore unlikely to form a barrier to groundwater flow, although there may be minor local changes in groundwater level. Taking into account the extent of the glacial till in the area overall, the impact on the aquifer is assessed to be negligible, resulting in a negligible effect which is not significant.

3.2.43 There may be high permeability horizons within the glacial till that could be laterally extensive, or thin, more permeable, groundwater bearing horizons within the Mercia Mudstone Group. Further ground investigation and monitoring is required to confirm groundwater levels in this location, and whether there are any more permeable bands likely to be impacted by the cutting. This will inform the detailed design and management of groundwater during construction.

3.2.44 Assuming a hydraulic conductivity value of $2.7x10^{-5}$m/s for the Mercia Mudstone[8], the zone of influence in the Bollin Mudstone Member is estimated to extend at up to 148m. The assessment is based on the full cutting depth through the glacial till and into the Mercia Mudstone, and the groundwater level condition as described for the glacial till. Based on hydrogeological mapping[9], it is assumed the groundwater flow direction in the Mercia Mudstone is towards the north or north-west. The cutting may therefore form a partial barrier to groundwater flow in the area and, combined with the impact of groundwater drainage within the zone of influence, could lead to local changes in groundwater level. However, taking into account the regional extent and overall depth of the Mercia Mudstone aquifer, the impact of dewatering on groundwater flow is assessed to be minor, leading to a minor adverse effect which is not significant.

[8] Jones, H K, Morris, B L, Cheney, C S, Brewerton, L J, Merrin, P D, Lewis, M A, MacDonald, A M, Coleby, L M, Talbot, J C, McKenzie, A, Bird, M J, Cunningham, J, and Robinson, V K. (2000), *The physical properties of minor aquifers in England and Wales*. British Geological Survey Technical Report, WD/00/4. 234pp, Environment Agency R&D Publication 68.

[9] Institute of Geological Sciences (1989), *Hydrogeological Map of Clwyd and the Cheshire Basin*. 1:100,000 map, British Geological Survey.

3.2.45 Construction of the Ringway cutting will remove the superficial deposits along the line of the cutting. The removal of glacial till will create a shorter pathway for surface water to enter into the Mercia Mudstone. This could lead to a slight change in groundwater chemistry in the area. However, since the area of the cutting is small in comparison to the areal extent of the Mercia Mudstone, the impact of this change in chemistry is assessed to be negligible, leading to a negligible effect which is not significant.

3.2.46 Ringway cutting could potentially intercept groundwater that would otherwise make a local contribution to the baseflow of the River Bollin, thus reducing the baseflow to the river. Groundwater intercepted by the Ringway cutting will be discharged to the river by the drainage system of the Proposed Scheme. As a result, the impact on groundwater discharge and baseflow to the River Bollin is assessed as negligible, leading to a negligible effect which is not significant. There may be differences in timing between discharge from the drainage system and the natural groundwater throughflow in the zone of influence. However, taking into account the scale of the River Bollin compared to the below ground structures, a slight variation in timing should make no significant difference to flow in the River Bollin.

3.2.47 Ringway cutting could potentially intercept groundwater that would otherwise contribute to the flow in Tributary of River Bollin 3, a moderate value receptor. As a result, the impact on groundwater flow to Tributary of River Bollin 3 is assessed as minor, leading to a minor effect which is not significant. Tributary of River Bollin 2 is located outside the calculated zone of influence of the Ringway cutting. The zone of influence is, however, located close to and possibly just within the catchment for Tributary of River Bollin 2 and, therefore, the cutting may intercept some groundwater that would naturally discharge to this watercourse. The impact on this watercourse is assessed as minor, leading to a minor adverse effect which is not significant.

3.2.48 The below ground structures also have the potential to obstruct groundwater flow within the area of two committed developments, MA07/026 and MA07/027, however the reduction in flow is unlikely to impact on the two committed developments.

3.2.49 The Wood Near Chapel Lane, a potentially groundwater dependent habitat, is located within the calculated zone of influence of the Ringway cutting. Thus, there is the potential for the habitat to receive reduced groundwater discharge as a result of interception by the cutting (see Section 4.1 for further detail). Sunbank Wood and Ponds, a partially groundwater dependent habitat, is outside the zone of influence of the cutting and while Sunbank Wood and Ponds is located upgradient of the Proposed Scheme, part of the catchment upgradient of Sunbank Wood and Ponds is located within the zone of the influence. As a result, the impact from Ringway cutting on Sunbank Wood and Ponds may result in reduced baseflow to the habitat (see Section 4.1 for further detail).

M56 cutting retaining wall

Table 8: Summary of the parameters for the groundwater assessment of M56 cutting retaining wall

Cutting retaining wall parameters	Parameter details
Length (m)	70
Maximum depth (m)	13.9 to top of rail (17.1 to drainage invert)
Strata intercepted	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member) (Secondary B aquifer)
Lowest level of drainage invert along track (mAOD)	43.5
Groundwater level(s) (mAOD)	Assumed to be at ground level
Principal receptors	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member) (Secondary B aquifer) Potential spring at Keepers Cottage, Sunbank Lane (north) Spring at Keepers Cottage, Sunbank Lane (south) Tributary of River Bollin 2 Tributary of River Bollin 3 Committed developments MA07/026 and MA07/027 Sunbank Wood and Ponds SBI and ancient woodland

3.2.50 The cutting would penetrate through the glacial till Secondary (Undifferentiated) aquifer and into the Mercia Mudstone Group Secondary B aquifer. There is no currently available information on groundwater elevations or depth to groundwater in this area. It has therefore been conservatively assumed that groundwater levels within the glacial till and Mercia Mudstone are at ground level and that groundwater flow within the glacial till may be affected by the M56 cutting retaining wall. Application of the draft CoCP will ensure that materials and fluids used during construction are managed so that there is no significant adverse effect on groundwater quality.

3.2.51 Assuming a hydraulic conductivity value of $3x10^{-4}$m/s for the glacial till[7], the lateral extent of drawdown (also referred to as the zone of influence) in the glacial till is estimated to extend up to 142m. This is based on a maximum cutting depth of 17.1m, and a rest water level at ground level. The glacial till, that has a maximum thickness of approximately 5m in the area, is fully penetrated over the whole length of the cutting retaining wall that extends into the underlying Mercia Mudstone. The cutting will be constructed as a secant bored piled wall. As there is no groundwater monitoring available in the area, the groundwater level is assumed to be at ground level. Assuming that the groundwater flow direction in the glacial till follows topography, groundwater will flow towards the River Bollin to the south-west, approximately parallel to the alignment of the cutting. The cutting is therefore unlikely to form a barrier to groundwater flow in the area although there may be minor local changes in groundwater level. Taking into account the scale of the glacial till aquifer overall, the impact on the aquifer is assessed to be a negligible, leading to a negligible effect which is not significant.

3.2.52 Construction of the M56 cutting retaining wall will remove the superficial deposits along the line of the cutting. The removal of glacial till will create a pathway for surface water to discharge directly into the Mercia Mudstone. This could lead to a slight change in groundwater chemistry in the area. However, since the cutting is small in comparison to the areal extent of the Mercia Mudstone, combined with implementation of the draft CoCP, the impact of this change in chemistry is assessed to be negligible, leading to a negligible effect which is not significant.

3.2.53 Assuming a hydraulic conductivity value of $2.7x10^{-5}$m/s for the Mercia Mudstone Group[8], the lateral extent of drawdown in the Bollin Mudstone Member is estimated at up to 156m. The assessment is based on the full cutting depth through the glacial till and into the Mercia Mudstone, and the groundwater level condition as described for the glacial till. Based on hydrogeological mapping, it is assumed the groundwater flow direction in the Mercia Mudstone is towards the north or north-west. The cutting may therefore form a partial barrier to groundwater flow in the area and combined with the impact of groundwater drainage within the zone of influence could lead to local changes in groundwater level. However, taking into account the regional extent and overall depth of the Mercia Mudstone aquifer, the impact of the cutting on groundwater flow and groundwater levels is assessed as minor, leading to a minor adverse effect which is not significant.

3.2.54 There may be high permeability horizons within the glacial till that could be laterally extensive, or thin, more permeable, groundwater bearing horizons within the Mercia Mudstone Group. Further ground investigation and monitoring is required to confirm groundwater levels in this location, and whether there are any more permeable bands likely to be impacted by the cutting. This will inform the detailed design and management of groundwater during construction.

3.2.1 Tributary of River Bollin 2 and Tributary of River Bollin 3 are located outside the maximum calculated zone of influence of the M56 cutting retaining wall hence is unlikely to intercept any groundwater flow to these watercourses. As a result, the impact of the M56 cutting retaining wall is assessed as negligible, leading to a negligible effect which is not significant.

3.2.2 The below ground structures also have the potential to obstruct groundwater flow within the area of two committed developments, MA07/026 and MA07/027, however the reduction in flow is unlikely to impact on the two committed developments.

3.2.3 A small area of Sunbank Wood and Ponds, a partially groundwater dependent habitat, is located within of the calculated zone of influence of M56 cutting retaining wall. However, taking into account the total extent of the habitat compared to the area within the zone of influence, the impact would be minor (see Section 4.1 for further detail).

M56 East tunnel

Table 9: Summary of the parameters for the groundwater assessment of M56 East tunnel

Cutting parameters	Parameter details
Length (m)	130
Maximum depth (m)	15.0 to top of rail (18.1 to drainage invert)
Strata intercepted	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member) (Secondary B aquifer)
Lowest level of drainage invert along track (mAOD)	43.7
Groundwater level(s) (mAOD)	Assumed to be at ground level
Principal receptors	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member) (Secondary B aquifer) Potential spring at Keepers Cottage, Sunbank Lane (north) Spring at Keepers Cottage, Sunbank Lane (south) Potential spring 120m east of Keepers Cottage, Sunbank Lane Potential spring 127m south-east of Keepers Cottage, Sunbank Lane Tributary of River Bollin 2 Tributary of River Bollin 3 Committed developments MA07/026 and MA07/027 Sunbank Wood and Ponds SBI and ancient woodland

3.2.4 The cutting would penetrate through the glacial till Secondary (Undifferentiated) aquifer and into the Mercia Mudstone Group Secondary B aquifer in the area. There is no currently available information on groundwater elevations or depth to groundwater in this area. It has therefore been conservatively assumed that groundwater levels within the glacial till and Mercia Mudstone are at ground level and that groundwater flow within the glacial till may be affected by the M56 East tunnel. Application of the draft CoCP will ensure that materials and fluids used during construction are managed so that there is no significant adverse effect on groundwater quality.

3.2.5 As defined above, the zone of drawdown has been calculated assuming the cutting is an open cutting without retaining walls. Assuming a hydraulic conductivity value of $3x10^{-4}$m/s for the glacial till[7], the lateral extent of drawdown (also referred to as the zone of influence) in the glacial till is estimated to extend up to 273m. This is based on a maximum cutting depth of 18.1m, and a rest water level at ground level. The M56 East tunnel will be constructed using a 'cut and cover' method as a twin box structure by first installing contiguous piled wing walls and main structural walls, and the box structure roof slab. The tunnel will then be excavated out. The M56 East tunnel fully penetrates the thickness of the glacial till and extends into the underlying Mercia Mudstone. Assuming that the groundwater flow direction in the glacial till follows topography, groundwater will flow towards the south-west, approximately parallel to the alignment of the cutting. The box structure is therefore unlikely to form a barrier to groundwater flow in the area. Taking into account the extent of the glacial till aquifer overall, the impact is assessed to be a negligible, leading to a negligible effect which is not significant.

3.2.6 Construction of the M56 East tunnel will remove the superficial deposits along the line of the cutting. The removal of glacial till will create a pathway for surface water to discharge directly into the Mercia Mudstone. This could lead to a slight change in groundwater chemistry in the area. However, since the cutting is small in comparison to the areal extent of the Mercia Mudstone, combined with implementation of the draft CoCP, the impact of this change in chemistry is assessed to be negligible, leading to a negligible effect which is not significant.

3.2.7 The zone of influence is not as extensive in the Mercia Mudstone Group compared to the glacial till. Based on hydrogeological mapping, it is assumed the groundwater flow direction in the Mercia Mudstone is towards the north or north-west. The cutting may therefore form a partial barrier to groundwater flow in the area that, combined with the impact of groundwater drainage within the zone of influence, could lead to local changes in groundwater level. However, taking into account the regional extent and overall depth of the Mercia Mudstone aquifer, the impact of the cutting on groundwater flow and groundwater levels is assessed as minor, leading to a minor adverse effect which is not significant.

3.2.8 There may be high permeability horizons within the glacial till that could be laterally extensive, or thin groundwater bearing horizons within the Mercia Mudstone Group. Further ground investigation and monitoring is required to confirm groundwater levels in this location, and whether there are any more permeable bands likely to be impacted by the cutting. This will inform the detailed design and management of groundwater during construction.

3.2.9 The spring at Keepers Cottage, Sunbank Lane (south) and potential spring at Keepers Cottage, Sunbank Lane (north) are located within the maximum calculated zone of influence. Depending on construction methods and the drainage of the M56 East tunnel, some groundwater flow feeding the springs may be intercepted by the tunnel. As there is no drainage discharge incorporated in the Proposed Scheme to allow for any loss of spring flow, this is assessed on a precautionary basis as a moderate impact on these features, leading to a moderate effect which is significant. Although the retaining walls along this part of the cutting will reduce the radius of influence of the M56 East tunnel, on a precautionary basis the effect on the spring and potential spring remains as moderate and therefore significant.

3.2.10 Tributary of River Bollin 2 and Tributary of River Bollin 3, both moderate value receptors, are located within or downgradient of the calculated zone of influence and, therefore, the M56 East tunnel may intercept groundwater flow that discharges to these watercourses. The majority of Tributary of Bollin Brook 2 is located upgradient of the Proposed Scheme, hence the impact of the M56 East tunnel is assessed as minor, resulting in a minor adverse effect which is not significant. The impact of the M56 East tunnel on Tributary of Bollin Brook 3 is assessed as moderate, leading to a moderate adverse effect which is significant.

3.2.11 The below ground structures also have the potential to obstruct groundwater flow within the area of two committed developments, MA07/026 and MA07/027, however the reduction in flow is unlikely to impact on the two committed developments.

3.2.12 A small area of Sunbank Wood and Ponds, a partially groundwater dependent habitat, is located within of the calculated zone of influence of M56 East tunnel. However, taking into account the total extent of the habitat compared to the area within the zone of influence, the impact would be minor (see Section 4.1 for further detail).

Manchester Airport High Speed station cutting and retaining walls

Table 10: Summary of the parameters for the groundwater assessment of Manchester Airport High Speed Station cutting and retaining walls

Cutting and retaining walls parameters	Parameter details
Length (km)	2.1
Maximum depth (m)	15.1 to top of rail (18.2 to drainage invert)
Strata intercepted	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member) (Secondary B aquifer)
Lowest level of drainage invert along track (mAOD)	44.9
Groundwater level(s) (mAOD)	Assumed to be at ground level
Principal receptors	Glacial till (Secondary (Undifferentiated) aquifer) Mercia Mudstone Group (Sidmouth Mudstone Formation – Bollin Mudstone Member) (Secondary B aquifer) Potential spring at Keepers Cottage, Sunbank Lane (north) Spring at Keepers Cottage, Sunbank Lane (south) Potential spring at hotel on Hasty Lane Spring at Davenport Green, Roaring Gate Lane Timperley Brook Tributary of Timperley Brook 1 Tributary of Timperley Brook 2 Tributary of Timperley Brook 3 Sunbank Wood and Ponds SBI and ancient woodland Ponds at Davenport Green SBI

3.2.13 The three components of the Manchester Airport High Speed station cutting comprise the Manchester Airport High Speed station cutting retaining wall south, Manchester Airport High Speed Station cutting and a second, much longer, Manchester Airport High Speed station cutting retaining wall north that extends to the MA06/MA07 boundary. The total length of the cuttings is approximately 2.1km.

3.2.14 The cutting would penetrate the glacial till Secondary (Undifferentiated) aquifer and the Mercia Mudstone Group Secondary B aquifer in the area. There is no currently available information on groundwater elevations or depth to groundwater in this area. It has therefore been conservatively assumed that groundwater levels within the glacial till and Mercia Mudstone are at ground level and that groundwater flow within the glacial till may be affected by the Manchester Airport High Speed station cutting and retaining walls. Application of the draft CoCP will ensure that materials and fluids used during construction are managed so that there is no significant adverse effect on groundwater quality.

3.2.15 As defined above, the zone of drawdown has been calculated assuming the cutting is an open cutting without retaining walls. Assuming a hydraulic conductivity value of $3x10^{-4}$m/s for the glacial till[7], the lateral extent of drawdown (also referred to as the zone of influence) in the glacial till is estimated to extend up to 273m. This is based on a maximum cutting depth of 18.2m, and a rest water level at ground level. The cutting and retaining walls will be constructed as an open cutting and secant pile walls. The glacial till is fully penetrated over the majority of the length of the cutting and retaining walls and extend into the underlying Mercia Mudstone aquifer. The cutting is therefore likely to form a barrier to groundwater flow in the glacial till over at least some parts of the cutting length that, combined with the potential impact of groundwater drainage within the zone of influence, could lead to local changes in groundwater level. Taking into account the extent of the glacial till aquifer in the area around Manchester Airport, this is assumed to be a minor impact, leading to a minor adverse effect which is not significant. Construction of retaining walls will reduce the influence of the construction and presence of the cuttings on groundwater dependent features.

3.2.16 The glacial till is fully penetrated by the cutting and retaining walls. Assuming that the groundwater flow direction in the glacial till follows topography, groundwater will flow towards the west and south-west. As this is not parallel to the cutting and retaining walls, these features are likely to form a barrier to groundwater flow in the area, leading to a risk of groundwater flooding on the upgradient side. The assessment of this is set out in the Flood risk assessment, Volume 5, Appendix WR-005-0MA06.

3.2.17 Construction of the Manchester Airport High Speed station cutting and retaining walls will remove a substantial part of the superficial deposits along the route of the Proposed Scheme. The removal of glacial till will create a pathway for surface water to discharge directly to the Mercia Mudstone. This could lead to a slight change in groundwater chemistry in the area. However, since the area and extent of the cutting is small in comparison to the areal extent of the Mercia Mudstone, combined with the implementation of the draft CoCP, the impact of this change in chemistry is assessed to be negligible, leading to a negligible effect which is not significant.

3.2.18 The radius of influence is not as extensive in the Mercia Mudstone Group compared to the glacial till. Based on hydrogeological mapping, it is assumed the groundwater flow direction in the Mercia Mudstone is towards the north or north-west. The cutting may therefore form a partial barrier to groundwater flow in the area, leading to local changes in groundwater level. However, taking into account the regional extent and overall depth of the Mercia Mudstone aquifer, the impact of the cutting on groundwater flow is assessed as minor, leading to a minor effect which is not significant.

3.2.19 There may be high permeability horizons within the glacial till that could be laterally extensive, or thin groundwater bearing horizons within the Mercia Mudstone Group. Further ground investigation and monitoring is required to confirm groundwater levels in this location, and whether there are any more permeable bands likely to be impacted by the cutting. This will inform the detailed design and management of groundwater during construction. The permanent below ground features, including the retaining walls, have potential to cause groundwater flooding in the area. In the detailed design, consideration should be given to land drainage to reduce groundwater flood risk in addition to groundwater level monitoring. The impact of groundwater flooding, after land drainage mitigation, is assessed as minor, leading to a minor adverse effect which is not significant.

3.2.20 The spring at Keepers Cottage, Sunbank Lane (south) and potential spring at Keepers Cottage, Sunbank Lane (north) are located within the calculated zone of influence of the Manchester Airport High Speed station cutting and retaining wall south. Although the retaining walls act to reduce the radius of influence of the cuttings, the positions of these features, and the proximity of the contributing catchments, means that some groundwater flow feeding the springs may drain to the cutting. There is no drainage discharge incorporated into the Proposed Scheme to compensate for any loss of spring flow. As a result, the impact on these features is assessed as minor, leading to a moderate effect which is significant.

3.2.21 The potential spring at hotel on Hasty Lane is located adjacent to the route of the Proposed Scheme and is within the zone of influence of the cutting retaining wall north. This feature will be lost during construction, together with any groundwater flow feeding the potential spring. This is assessed to be a major impact on the potential spring, leading to a major effect which is significant. The potential spring at hotel on Hasty Lane discharges into Tributary of Timperley Brook 1, a low value receptor. This watercourse may receive reduced baseflow due to the interception of groundwater by the cutting retaining wall north and the loss of the spring. As a result, an upper section of approximately 250m of the tributary might receive reduced baseflow, potentially reducing flow over approximately a third of its length. The impact of the Proposed Scheme on Tributary of Timperley Brook 1 would be moderate, leading to a minor effect which is not significant.

3.2.22 Spring at Davenport Green, Roaring Gate Lane has been assessed as a low value spring with land drainage outfalls at the site. The spring is located outside the zone of influence of the cutting. However, parts of the catchment upstream of the drainage outfall may be within the zone of influence of the cutting. Impacts on groundwater flow to this spring are assessed as minor leading to a negligible effect which is not significant. The watercourse this spring supports, Tributary of Timperley Brook 3, a low value receptor, is also outside the zone of influence. However, reduced flow from the spring could affect the baseflow in the watercourse. This is also assessed as a minor impact, leading to a negligible effect which is not significant.

3.2.23 Timperley Brook is likely to receive reduced baseflow due to the interception of groundwater by the Manchester Airport Station cutting. Highways drainage and drainage from the station area will discharge into Timperley Brook and as such, will help to support flow in the watercourse, although the timing of flow is likely to change. The change in timing of the flow in the brook is assessed as a minor impact on this moderate value receptor, leading to a minor effect which is not significant.

3.2.24 Sunbank Wood and Ponds, a partially groundwater dependent habitat, and Davenport Green Wood, a potentially groundwater dependent habitat, are located within the calculated zone of influence of Manchester Airport High Speed station cutting and retaining walls and have the potential to be impacted by the cutting (see Section 4.1 for further detail).

3.2.25 Ponds at Davenport Green, a potentially groundwater dependent habitat, is located outside the calculated zone of influence of the cutting. However, parts of the catchment upstream of the drainage outfall from the ponds may be within the zone of influence, thus the habitat may receive reduced groundwater discharge. The possible impact on groundwater flow to this habitat is assessed as minor (further information in Section 4.1).

3.3 Impacts to groundwater quality from overbridge and viaduct piling

3.3.1 Piling can affect groundwater quality where the works have hydraulic connection to an aquifer or are in the aquifer itself. Potential impacts may occur from losses of circulation fluid, turbidity resulting from the breakdown of in-situ aquifer material, and possible contamination by hydraulic fluids and greases from machinery. There is likely to be a more rapid transfer of these materials through fracture or fissure flow if present. If within a catchment for a groundwater abstraction, then degraded groundwater quality may render the abstraction unsuitable for use. Catchments for groundwater abstraction are indicated by the SPZ1 and SPZ2 areas and are defined by the Environment Agency around all licensed abstraction sites.

Overbridges

3.3.2 The following overbridges are located within MA06:

- Millington Lane overbridge;
- Footpath Millington 7/4 accommodation overbridge;
- A556 Chester Road overbridge;
- Yarwood Heath Farm accommodation overbridge;
- Back Lane accommodation overbridge;
- Castle Mill Lane overbridge;
- Sunbank Lane overbridge;
- A538 Hale Road overbridge;
- A538 Hale Road/station access gyratory (eastbound traffic) overbridge;
- provision for Metrolink; and
- Thorley Lane overbridge.

3.3.3 There is a possibility that groundwater quality and flow in the Mercia Mudstone and Sherwood Sandstone may be impacted by the construction of overbridge piles. The piles are not expected to extend any more than 20m below ground level. The potential impacts from construction piling can be mitigated using bentonite in the process to reduce fluid loss. Many methods of piling can also be facilitated by the use of temporary casing, that is generally more effective in preventing losses to immediately adjacent watercourses. Therefore, the impact from the construction of overbridges is expected to be localised and temporary and of minor extent in comparison to the areal extent of the superficial and bedrock aquifers. Thus, the impact is assessed as negligible, leading to a negligible effect which is not significant.

3.3.4 The A556 Chester Road overbridge will be constructed as a tangent pile wall, extending over a length of approximately 40m, and has a greater potential to impact on groundwater flow pathways than the piling for other overbridges. However, when compared to the overall extent of the superficial and bedrock aquifers in the area, the tangent pile wall is expected to have a minor impact on the glacial till, leading to a minor adverse effect which is not significant. The overbridge is located close to, and just outside, the catchment for the Rostherne Mere catchment. If, however, groundwater is moving towards Rostherne Mere from this area, the effect of the impermeable barrier caused by the tangent pile wall could be to raise the groundwater level in the glacial till on the opposite side of the overbridge to Rostherne Mere. This could potentially produce an increase in discharge to the filter drainage in the Millington cutting below the overbridge. However, as a result of the localised increase in groundwater level, much of the groundwater would be expected to move around the pile wall by extended routes in more permeable, sandier deposits in the glacial till. Taking into account the relatively short length of the overbridge, any impact on groundwater discharge in the Rostherne Mere SSSI due to the pile wall is expected to be negligible. However, a full assessment of the hydrogeology and directions of groundwater flow will be undertaken at a later stage when site investigation boreholes are installed.

Agden Brook viaduct

3.3.5 Foundations for the Agden Brook viaduct will comprise drilled concrete piles with pile caps. The piles are currently designed to be up to 25m deep and are expected to penetrate through the alluvium and glaciofluvial deposits and into the underlying Mercia Mudstone Group and Sherwood Sandstone Group. Therefore, these piles may obstruct the flow of groundwater in the superficial deposits and an upper section of the bedrock in the immediate vicinity of the foundations for the viaduct. Any impacts are likely to be localised. The impact on the alluvium and the glaciofluvial deposits is expected to be minor, leading to a minor effect which is not significant. Taking account of the extent and over depth of the bedrock aquifers, the impact and resulting effect will be negligible which is not significant.

3.3.6 Agden Brook is crossed by the Agden Brook viaduct. There is the potential for localised adverse impacts on baseflow to Agden Brook as the below ground structures have the potential to partially obstruct groundwater flow towards the watercourse. However, any groundwater flow affected by the viaduct should still discharge into Agden Brook in the vicinity of the viaduct. As a result, permanent effects on Agden Brook would be negligible, leading to a negligible effect which is not significant.

Blackburn's Brook North viaduct

3.3.7 Foundations for the Blackburn's Brook North viaduct will comprise drilled concrete piles with pile caps. The piles are currently designed to be up to 19m deep and are expected to penetrate through the alluvium, glaciofluvial sheet deposits and glacial till and into the underlying Mercia Mudstone Group. Therefore, these piles may obstruct the flow of groundwater in the superficial deposits and an upper section of the bedrock in the immediate vicinity of the foundations for the viaduct. Any impacts are likely to be localised. The impact on the alluvium superficial deposit is expected to be minor, leading to a minor effect which is not significant. The impacts and resulting effect on the glaciofluvial sheet deposits and glacial till is expected to be negligible. Taking account of the extent and overall depth of the bedrock aquifers, the impact and resulting effect will be negligible which is not significant.

3.3.8 The Blackburn's Brook North viaduct crosses Blackburn's Brook and Birkin Brook. There is the potential for minor adverse impacts on baseflow to these watercourses as the below ground structures have the potential to obstruct groundwater flow. However, any groundwater affected by the viaduct should still discharge into the watercourses in the vicinity of the viaduct. As a result, the permanent impacts and resultant effects of Blackburn's Brook North viaduct on baseflows in surface watercourses is negligible, leading to a negligible effect which is not significant.

3.3.9 Blackburn's Brook North viaduct is located, in part, within the habitat for Hancock's Bank South. It is possible that the construction and permanent below ground structures of the viaduct may affect groundwater flow and the quality of groundwater supporting the habitat (further information in Section 4.1). Ryecroft Covert is located, in part, on alluvium that extends upgradient to the area around Blackburn's Brook North viaduct. Piling might have an impact on the discharge from any springs in Ryecroft Covert that receive groundwater flow from the alluvium in the area around the viaduct however the habitat is located on the opposite bank of the Birkin Brook to the viaduct over most of its length, hence piling from the viaduct should not affect any groundwater flow path to Ryecroft Covert.

3.3.10 There is also a utilities diversion of electrical overhead high voltage (OH HV) lines resulting in new pylons with foundations up to 20m deep being installed in the area. The pylon foundations will penetrate through the superficial deposits into the underlying Bolling Mudstone Member (Sidmouth Mudstone Formation – Mercia Mudstone Group). The utilities diversion crosses the route of the Proposed Scheme at Blackburn's Brook North viaduct and extends south-east, approximately following the course of Birkin Brook. While the new pylon foundations have potential to impact groundwater flow pathways in the superficial and bedrock deposits, the minor extent of the below ground structures, compared to the much more extensive area of aquifer, leads to a negligible impact on groundwater flow pathways. The pylon foundations also have the potential to intercept some groundwater flow that would otherwise provide baseflow to Blackburn's Brook, Birkin Brook and Tributaries of Birkin Brook including Mobberley Brook. However, the extent of the pylon foundations will cause a negligible impact to groundwater flow, thus a negligible impact on the watercourses, leading to a negligible effect which is not significant.

Mid-Cheshire (railway) and Mobberley Road viaduct

3.3.11 Foundations for the Mid-Cheshire (railway) and Mobberley Road viaduct will comprise drilled concrete piles with pile caps. The depth of these piles is currently designed to be up to 23m deep, and the piles are expected to penetrate through the glacial till and into the underlying Mercia Mudstone Group. Therefore, these piles may obstruct the flow of groundwater in the superficial deposits and an upper section of the bedrock in the immediate vicinity of the foundations for the viaduct. The impact is likely to be localised and, taking into account the extent of these aquifers, the impact will be negligible, leading to a negligible effect which is not significant.

3.3.12 Tributary of Birkin Brook 2 and Tributary of Birkin Brook 3, both low value receptors, are present in the vicinity of the viaduct, with Tributary of Birkin Brook 3 crossed by the viaduct. There is the potential for impacts on baseflow to parts of Tributaries of Birkin Brook 2 and 3 resulting from piling for the viaduct, as the below ground structures have the potential to obstruct groundwater flow towards the watercourses. However, if any groundwater to Tributary of Birkin Brook 3 is obstructed, the groundwater may discharge further upstream giving rise to a minor beneficial impact over a short section of the watercourse. A minor adverse

impact might, however, apply to the downstream section of Tributary of Birkin Brook 2 that is located downgradient of the viaduct. The impacts on Tributary of Birkin Brook 2 and Tributary of Birkin Brook 3 by the Mid-Cheshire (railway) and Mobberley Road are negligible leading to negligible effects which are not significant.

River Bollin East viaduct

3.3.13 Foundations for the River Bollin East viaduct will comprise drilled concrete piles with pile caps. The piles are currently designed to be up to 25m deep and are expected to penetrate through the alluvium and into the underlying Mercia Mudstone Group. Therefore, the piles may obstruct the flow of groundwater in the superficial deposits and an upper section of the bedrock in the immediate vicinity of the foundations for the viaduct. The impact on the superficial deposits is expected to be minor, leading to a minor effect which is not significant. Taking into account the regional extent and overall depth of the bedrock aquifer, the impact will be negligible leading to a negligible effect which is not significant.

3.3.14 Below ground structures have the potential to obstruct groundwater flow towards the River Bollin in the vicinity of the viaduct. However, any groundwater obstructed by the viaduct would still discharge into the River Bollin in the vicinity of the viaduct, but at a slightly different location. As a result, permanent effects on the River Bollin would be negligible which are not significant.

3.3.15 The below ground structures also have the potential to obstruct groundwater flow within the area of two committed developments, MA07/026 and MA07/027, however the reduction in flow is unlikely to impact on the two committed developments.

3.3.16 The surface water and groundwater dependent habitat Mill Wood, Castle Mill and the partially groundwater dependent habitat Sunbank Wood and Ponds have potential to be adversely impacted by the piling from River Bollin East viaduct in terms of baseflow to the habitats. However, considering both habitats are located upgradient of the Proposed Scheme, it is unlikely that flow to the habitats will be affected adversely by the viaduct (further information in Section 4.1).

3.3.17 The potential impacts from construction piling can be mitigated (for example by using bentonite) in the process to reduce fluid loss. Many methods of piling can also be facilitated by the use of temporary casing, that is generally more useful to stop losses to immediately adjacent watercourses. Implementation of the draft CoCP will ensure that materials that may come into contact with groundwater will be selected, and method statements developed, to control any potential contaminants.

3.4 Impacts to groundwater from borrow pits

3.4.1 There are no borrow pits within the Hulseheath to Manchester Airport area (MA06).

4 Site specific water dependent habitats assessment

4.1 Summary of assessment

4.1.1 Table 11 summarises the potential hydrological impacts (for example, changes to flow, level, regime, or quality) related to surface water and groundwater dependent habitats. Further details of the ecology of these sites and the assessment of the local level ecological effects arising from water impacts, are provided in Volume 5, Ecological register of local level effects, Appendix EC-015-0MA06. Where there are significant effects, the ecological effects and associated mitigation are reported in Volume 2, Section 7, Ecology and biodiversity.

Table 11: Summary of potential water dependent habitat impacts

Receptor	Design element	Discussion of potential impact to water receptor
Surface water dependent habitats		
Wood near Arden House LWS (including East Arden House ancient woodland)	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; • temporary works such as stockpiles and compounds; • utilities diversions; and • Ashley embankment. Deeper excavation (>1mbgl) including: • Mid-Cheshire (railway) and Mobberley Road viaduct.	Tributary of Birkin Brook 1 flows through the habitat. There may be the potential for impacts on water quality during the construction phase, that will be managed through the implementation of the draft CoCP. There is a culverted section of the watercourse, immediately upstream of the habitat. However, culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse. Therefore, the impact on the water dependent habitat from temporary construction will be negligible. Measures to manage the water quality of the permanent drainage outfalls from highway attenuation ponds will be adopted during the drainage design process, resulting in a negligible impact.
Davenport Green Wood SBI	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions. Deeper excavation (>1mbgl) including: • Manchester Airport High Speed station cutting retaining wall north; and • provision for Metrolink.	Timperley Brook flows through this habitat. There is potential for impacts on water quality during the construction phase. This will be managed through implementation of the draft CoCP. Measures to manage the water quality of the permanent drainage outfalls from highway attenuation ponds will be adopted during the drainage design process.
Surface water and groundwater dependent habitats		
Rostherne Mere Ramsar site, SSSI, NNR and ancient woodland (Harpers Bank Wood and Wood Bongs)	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Millington cutting; • Rostherne cutting retaining wall west; • Rostherne cutting; • Rostherne cutting retaining wall east; • Rostherne East box structure; and • Hoo Green North cutting (located in Pickmere to Agden and Hulseheath MA03).	Rostherne Mere has been assessed as a groundwater dependent habitat that also receives runoff during rainfall events. There is potential for minor impacts on groundwater quality during the construction phase. This will be managed through implementation of the draft CoCP resulting in a negligible impact on the habitat. The Millington and Rostherne cuttings, together with the Hoo Green North cutting in Pickmere to Agden and Hulseheath MA03, may reduce the total groundwater contribution to Rostherne Mere. The marginal reduction in groundwater inflow could produce a very small reduction in water levels (see Section 4.2). The reduction in water levels would almost certainly be undetectable, taking into account the existing variations in water levels between seasons and from year to year, together with the limitations for accurate measurement of the water level in natural surroundings and conditions, however, due to high sensitivity of the habitat and pending further investigation, this reduction in groundwater flow to the mere is assessed to be a minor hydrological impact on a precautionary basis. Groundwater seepages are present in the slopes above Gale Bog that form part of the Rostherne Mere SSSI and NNR. On a precautionary basis, it is assumed that the Millington and Rostherne cuttings could cause the seepages in the slopes above Gale Bog to dry up in all conditions under which seepage discharges currently occur. However, the seepages dry up already in 'drier than average' conditions, such as occurred in July to September 2018. The seepages could not, therefore, be affected in summers comparable to or drier than 2018. There are also some occasions following prolonged heavy rainfall when Blackburn's Brook can flow back into Rostherne Mere. As part of the proposed scheme, an attenuation tank has been incorporated into the design to collect runoff from the Millington and Rostherne cuttings. The tank discharges to Blackburn's Brook. During detailed design, measures will be incorporated into the design of the attenuation tank to manage the quality of water to ensure the discharge has a negligible impact on water quality in Blackburn's Brook.

Receptor	Design element	Discussion of potential impact to water receptor
Cotteril Clough SSSI, ancient woodland and SBI	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	It is currently unclear whether this habitat is supported by groundwater, including discharge from springs, or runoff from rainfall events. The site has been included as a surface water and groundwater dependent habitat on a precautionary basis. Cotteril Clough is located more than 750m from the route of the Proposed Scheme. The site is not located downgradient of any zones of influence of cuttings and is more than 600m from the closest zone of influence. No permanent impact on groundwater is, therefore, expected at the site. There is a potential for impacts on water quality during the construction phase, associated with areas within the land required for construction approximately 170m from Cotteril Clough. These potential impacts will be managed through implementation of the draft CoCP, resulting in a negligible impact on the habitat.
Hancock's Bank South SBI, LWS and Ancient Woodland (including Birkin House ancient woodland)	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • Blackburn's Brook embankment. Deeper excavation (>1mbgl) including: • Rostherne cutting; • Rostherne East box structure; and • Blackburn's Brook North viaduct.	It is currently unclear if this site is supported by groundwater but it has been included on a precautionary basis. This habitat is crossed by the route of the Proposed Scheme. There is potential for impacts on water quality during the construction phase. This will be managed through implementation of the draft CoCP. Hancock's Bank South is located within the zone of influence of Rostherne cutting and thus may receive reduced groundwater flow as a result of interception by the cutting. In addition, there is potential for piling from Rostherne East box structure and Blackburn's Brook North viaduct to affect the supply and flow path of groundwater to Hancock's Bank South, due to changes to conditions in superficial deposits, and the upper section of the bedrock in the vicinity of Blackburn's Brook North viaduct. The impact on groundwater flow to Hancock's Bank South is assessed as minor.
Jackson's Bank East LWS	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Thorns Green cutting.	It is currently unclear if this site is supported by groundwater or surface water but it has been included on a precautionary basis. Jackson's Bank East is located downgradient of the Proposed Scheme, although it is more than 300m outside the zone of influence of Thorns Green cutting and over 500m from the Proposed Scheme. The cutting may, however, intercept a small proportion of any groundwater flow contribution to the habitat in parts of the catchment upstream of the site. This is assessed as a minor impact on a precautionary basis.
Mill Wood, Castle Mill LWS	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • River Bollin East viaduct; and • Thorns Green cutting.	Mill Wood, Castle Mill is partially supported by seasonal springs[5] discharging from alluvium and glacial till along the bank of the River Bollin as well as supported from overland flow. The habitat has therefore been assessed as surface water and groundwater dependent. There is potential for impacts on water quality during the construction phase. This will be managed through implementation of the draft CoCP, resulting in a negligible impact on the habitat. While there is potential for piling from River Bollin East viaduct to affect groundwater flow paths, Mill Wood, Castle Mill is located upgradient of the Proposed Scheme along the River Bollin, hence it is unlikely that flow to the habitat will be affected adversely by the viaduct. However, a small part of Mill Wood, Castle Mill is located within the zone of influence of the Thorns Green cutting. Drainage to the cutting may therefore affect any groundwater discharge contributing to the site. This is assessed, on a precautionary basis, as a minor hydrological impact.
Warburton Wood ancient woodland	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	Warburton Wood is partially supported by a spring discharging from glaciofluvial deposits and glacial till as well as ponds supported by overland flow. This habitat has therefore been assessed as surface water and groundwater dependent. The habitat is located outside the zone of influence of Ringway cutting. The catchments of Tributary of River Bollin 3 and 5 are also located between Warburton Wood and the zone of influence. Therefore, the habitat is unlikely to be hydraulically connected to the Proposed Scheme and no impacts are expected.
Sunbank Wood and Ponds SBI and ancient woodland (including Bollin Bank ancient woodland)	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Ringway cutting; • M56 cutting retaining wall; • M56 East tunnel; and • Manchester Airport High Speed station cutting and cutting retaining wall south.	Surveys have shown this habitat is at least partially groundwater dependent with two main streams that are supported by springs within the habitat. There is potential for impacts on water quality during the construction phase. This will be managed through implementation of the draft CoCP. A part of the catchment upgradient of Sunbank Wood is within the zone of influence of Ringway cutting, M56 East tunnel and Manchester Airport High Speed station cutting and cutting retaining wall south, hence there may be a reduction in groundwater flow supporting this habitat due to interception by the cuttings. As drainage in the cuttings would affect only a small part of the catchment, the impact on groundwater flow to this habitat is assessed as minor. While there is potential for piling from River Bollin East viaduct to affect groundwater flow paths, Sunbank Wood and Ponds is located upgradient of the Proposed Scheme along the River Bollin, hence it is unlikely that flow to the habitat will be affected by the viaduct.
Ponds at Davenport Green SBI	Above ground elements and shallow excavation (<1m) including:	It is currently unclear if this site is supported by groundwater but has been included on a precautionary basis.

Receptor	Design element	Discussion of potential impact to water receptor
	• ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Manchester Airport High Speed station cutting retaining wall north.	Ponds at Davenport Green is located outside the zone of influence of Manchester Airport High Speed station cutting retaining wall north. However, parts of the catchment upstream of the site may be within the zone of influence of the cutting, thus the habitat may receive a slightly reduced contribution from groundwater as a result of drainage to the cutting. This is assessed as a minor hydrological impact on a precautionary basis.
Groundwater dependent habitats		
Grey's Gorse SBI and LWS	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Millington cutting.	It is currently unclear if this site is supported by groundwater, but it has been included on a precautionary basis. Grey's Gorse is approximately 350m from the zone of influence of Millington Cutting, and is over 500m from the Proposed Scheme. Topographical contouring also indicates that the habitat is located across gradient from the Proposed Scheme, hence any groundwater flow to Grey's Gorse should not be affected by the cutting.
Yarwood Heath Covert LWS	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Millington cutting; and • Rostherne cutting.	It is currently unclear if this site is supported by groundwater, but it has been included on a precautionary basis. There is potential for impacts on water quality during the construction phase. This will be managed through implementation of the draft CoCP. Yarwood Heath Covert is located just within the zone of influence for Millington and Rostherne cuttings, hence the groundwater flow to the habitat may be affected by drainage in the cutting. This is assessed as a minor hydrological impact.
Hancock's Bank North LWS and ancient woodland	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Rostherne cutting; and • Rostherne East box structure.	It is currently unclear if the site is supported by groundwater but it has been included on a precautionary basis. A part of the habitat is located within of the zone of influence of Rostherne cutting but is separated from the route of the Proposed Scheme by the M56, some of which is in cutting close to Hancock's Bank North. Additionally, most of the habitat is located at a lower elevation than the base of the cutting. As a result, the habitat is unlikely to experience a discernible change in any groundwater flow or discharge. Therefore, the impact on groundwater flow to the site is assessed as negligible.
Ryecroft Covert LWS and ancient woodland	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds. Deeper excavation (>1mbgl) including: • Rostherne cutting; • Blackburn's Brook North viaduct; and • utilities diversions (new pylons).	It is currently unclear if this site is supported by groundwater but it has been included on a precautionary basis. There is potential for impacts on water quality during the construction phase. This will be managed through implementation of the draft CoCP. Ryecroft Covert is located outside the zone of influence of the proposed Rostherne cutting and on the opposite side of the Blackburn's Brook and Birkin Brook to the cutting. The habitat is located upgradient of Blackburn's Brook North viaduct, and on the opposite bank of the Birkin Brook to the viaduct over most of its length, hence piling from the viaduct should not affect any groundwater flow path to Ryecroft Covert. There should, therefore, be a negligible impact on groundwater flow to Ryecroft Covert. A new pylon is being installed on the edge of Ryecroft Covert as part of the utilities diversion that may impact groundwater quality during installation and groundwater flow once installed. The habitat is located within the utilities construction zone of the diversion, and as such, the impact on the site is assessed as a minor, temporary impact.
Old Deer Enclosure, Tatton Park LWS	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	It is currently unclear if this site is supported by groundwater, but it has been included on a precautionary basis. The Proposed Scheme is unlikely to affect groundwater quality or flow to this site since it is approximately 900m from the Proposed Scheme (on Birkin Brook embankment) and is separated from the closest areas within the land required for construction by sections of Birkin Brook and Mobberley Brook. Consequently, the habitat should not be hydraulically connected to the Proposed Scheme.
Ecclesfield Wood LWS	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; • temporary works such as stockpiles and compounds; • utilities diversions; and • Thorns Green embankment. Deeper excavation (>1mbgl) including: • Thorns Green cutting.	It is currently unclear if this site is supported by groundwater but it has been included on a precautionary basis. Ecclesfield Wood is located directly adjacent to the Proposed Scheme and there is potential for impacts on water quality during the construction phase. This will be managed through implementation of the draft CoCP. The route of the Proposed Scheme is on embankment (Thorns Green embankment) adjacent to Ecclesfield Wood. The embankment has no deep, below ground structures to affect any groundwater flow in the area. The habitat is approximately 100m outside the zone of influence of Thorns Green cutting, although the catchment upstream of the habitat may be partly within the zone of influence. Therefore, Ecclesfield Wood may receive reduced groundwater discharge at the site, or surface flow from any discharges in the catchment upstream, as a result of drainage to the cutting. This is assessed as a minor hydrological impact.

Receptor	Design element	Discussion of potential impact to water receptor
Brickhill Wood LWS and ancient woodland	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions. Deeper excavation (>1mbgl) including: • Thorns Green cutting.	Partial survey of Brickhill Wood found no evidence of groundwater dependency, but further surveys are required to visit the remainder of the habitat unavailable due to land access restrictions. The site has been included as groundwater dependent on a precautionary basis until further surveys can be undertaken. There is potential for impacts on water quality during the construction phase. This will be managed through implementation of the draft CoCP, resulting in a negligible impact on the habitat. Brickhill Wood is located downgradient of the Proposed Scheme and is located partially within the zone of influence of Thorns Green cutting. The Brickhill Wood drain, that flows into or through the site, originates at a contact between glaciofluvial deposits and glacial till within the zone of influence and approximately 70m from the Thorns Green cutting. Discharge in the drain may therefore be supported by groundwater discharge from the glaciofluvial deposits. Drainage to the Thorns Green cutting could reduce baseflow in the drain, or groundwater discharge within the Brickhill Wood site. This is assessed, on a precautionary basis, as a minor impact on Brickhill Wood LWS and ancient woodland.
Bollin Oxbow at Castle Hill LWS	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	It is currently unclear if this site is supported by groundwater but has been included on a precautionary basis. The Proposed Scheme should not alter groundwater quality or any groundwater flow to this site as the site is located upgradient of the Proposed Scheme, 800m from the route of the Proposed Scheme, and is adjacent to the River Bollin. Consequently, the habitat should not be hydraulically connected to the Proposed Scheme and no impacts are expected.
Rossmill SBI	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; and • temporary works such as stockpiles and compounds.	It is currently unclear if this site is supported by groundwater but has been included on a precautionary basis. The habitat is located outside the zone of influence of Ringway cutting, with the catchments of Tributary of River Bollin 3 and 5 located between the habitat and the zone of influence. Rossmill SBI is also separated from the Proposed Scheme by the M56. Therefore, the habitat should not be hydraulically connected to the Proposed Scheme and no impacts are expected.
Wood Near Chapel Lane SBI and Hennersley Bank ancient woodland	Above ground elements and shallow excavation (<1m) including: • ground level track and roads; • temporary works such as stockpiles and compounds; and • utilities diversions Deeper excavation (>1mbgl) including: • Thorns Green cutting; and • Ringway cutting.	Wood Near Chapel Lane SBI is located along the banks of the more northerly channel of Tributary of River Bollin 3. It is currently unclear if this site is supported by groundwater but has been included on a precautionary basis. There is potential for impacts on water quality at the site during the construction phase. This will be managed through implementation of the draft CoCP. Wood Near Chapel Lane is located partly within the zone of influence of Thorns Green cutting. However, the site is located on the opposite side of the River Bollin to Thorns Green cutting and, therefore, should not be affected by the cutting. Wood Near Chapel Lane is located outside, but downgradient of, the zone of influence of Ringway cutting. The site, and Tributary of River Bollin 3 that runs through the site, could receive reduced groundwater discharge as a result of interception by the cutting. This is assessed, on a precautionary basis, as a minor hydrological impact for the Wood Near Chapel Lane SBI.

4.2 Detailed assessment

Rostherne Mere Ramsar site and SSSI

4.2.1 Rostherne Mere Ramsar site and SSSI is located in the catchment of the River Bollin. The outflow from Rostherne Mere discharges to Blackburn's Brook that then contributes to the Birkin Brook near the M56. The Birkin Brook joins the River Bollin just to the north of the M56. The surface water catchment upstream of the outlet from Rostherne Mere is shown on the map in Figure 2. A second SSSI, The Mere, Mere, which includes Little Mere and is a part of the Midland Meres and Mosses Ramsar site, is located upstream of Rostherne Mere within the same catchment.

4.2.2 The water resources in and around Rostherne Mere may be affected by two sets of cuttings, shown on Figure 2:

- Millington and Rostherne cuttings located in MA06 just to the north of Rostherne Mere; and
- Hoo Green North cutting located in or close to the Rostherne Mere surface water catchment in Pickmere to Agden and Hulseheath (MA03), to the north-west of The Mere, Mere.

4.2.3 The superficial geology of the Rostherne Mere catchment comprises mainly glacial till and glaciofluvial deposits, with both formations covering major areas of the catchment. Some alluvium is also present around Rostherne Mere and in other low-lying wetland areas. The superficial geology of the catchment is shown on Figure 3. The glaciofluvial deposits to the north and east of Rostherne Mere are described by the British Geological Survey (BGS) as glaciofluvial sheet deposits. Both the glaciofluvial deposits and the glaciofluvial sheet deposits are likely to comprise mainly sand and gravel.

4.2.4 The Millington and Rostherne cuttings are located mainly in glacial till, with a band of glaciofluvial deposits intercepted by the Millington cutting to the north-west of the Rostherne Mere catchment. Piling for a retained cut beneath the A556 Chester Road, over a length of approximately 40m towards the eastern end of Millington cutting, will go through the superficial deposits and into the underlying Mercia Mudstone. The

piling may effectively form an impermeable barrier in superficial deposits beneath the A556 Chester Road overbridge. For the Rostherne cutting retaining wall west, just to the south of the A556/M62 junction, partial retaining walls, not expected to extend much deeper than the actual depth of the cut, are likely to be constructed where space is constrained.

4.2.5 The Hoo Green North cutting to the north-west of The Mere, Mere are also located in glacial till and glaciofluvial deposits within and close to the Rostherne Mere catchment.

4.2.6 The substantial number of springs in the Rostherne Mere catchment, shown on Figure 2 and Figure 3, indicates that groundwater has a major role in supporting base flows in streams, particularly in dry periods and, therefore, in maintaining mere water levels. As a result, it is important to understand the relative contributions to Rostherne Mere of springs and watercourses, particularly during drier months in the period June to September. Many of the springs are located within the glaciofluvial deposits, or close to the contact between the glaciofluvial deposits and the glacial till.

Figure 2: Rostherne Mere catchment

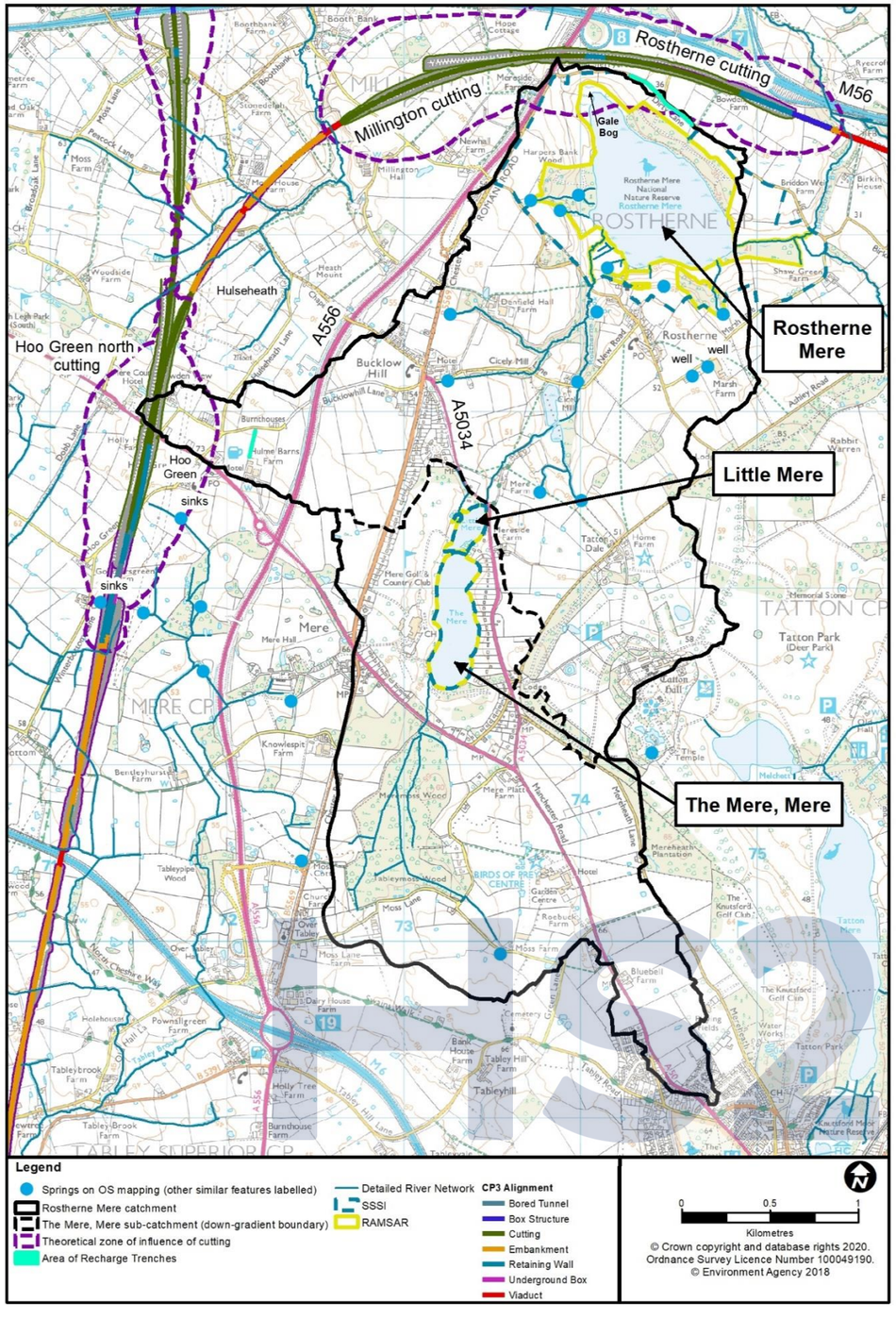
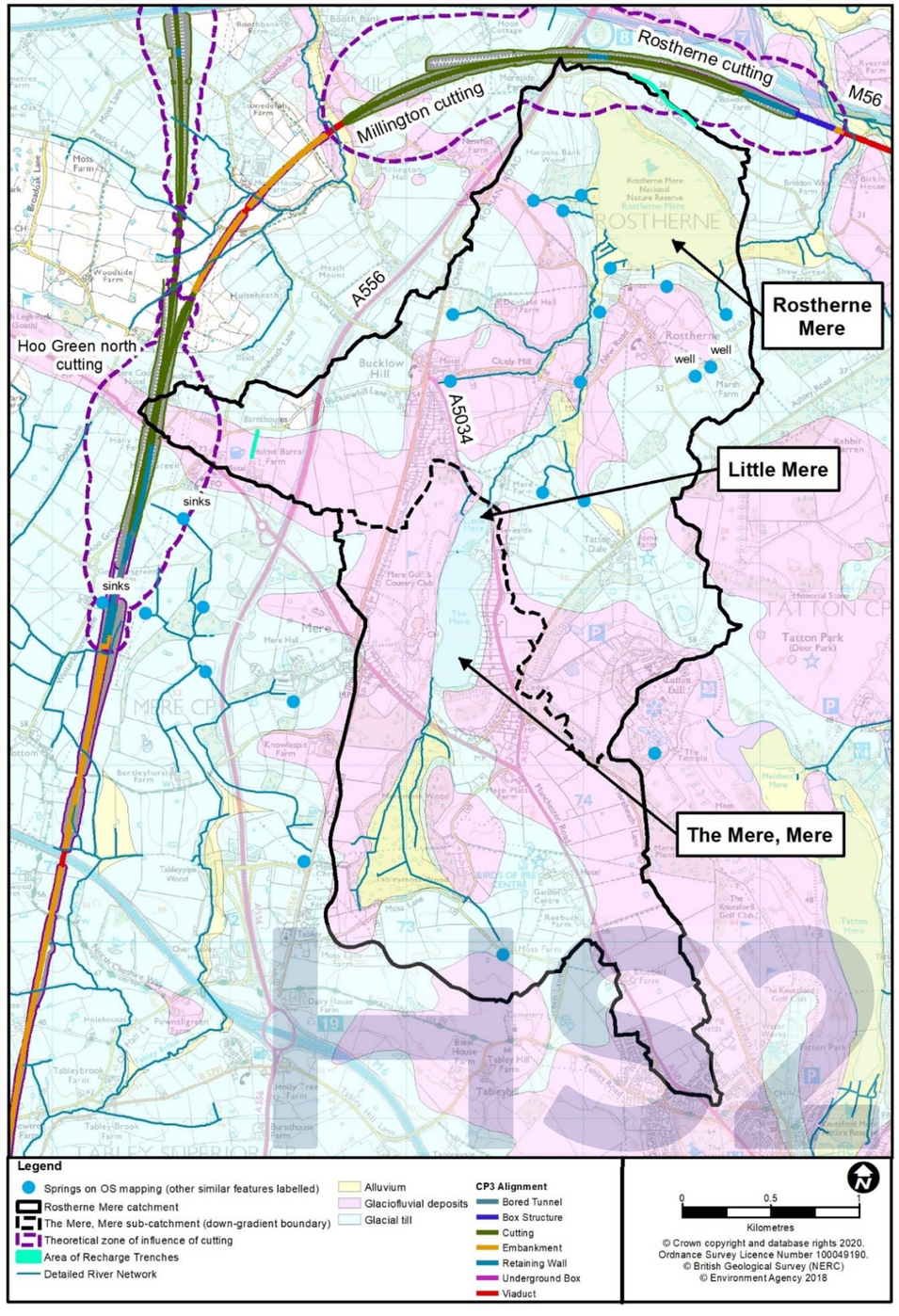


Figure 3: Superficial geology of Rostherne Mere catchment



4.2.7 Groundwater catchments contributing to springs and surface water bodies do not always coincide with surface water catchments. However, for Rostherne Mere, the groundwater supplying springs is likely to be located within the relatively shallow superficial deposits comprising sands and gravels or more permeable horizons within glacial till. With shallow groundwater it is reasonable to assume that, in many areas, the groundwater catchment coincides approximately with the topographical surface water catchment.

4.2.8 Figure 2 and Figure 3 show the likely maximum zones of influence on groundwater from drainage in the Millington and Rostherne cuttings in MA06, and the Hoo Green North cutting in Pickmere to Agden and Hulseheath MA03 to the north-west of The Mere, Mere. The derivation of the zones of influences for Millington, Rostherne and Hoo Green North cuttings are discussed in Section 3.2 in the Water resource assessment Volume 5, Appendix WR-003-0MA03.

4.2.9 Based on the assumptions made in the calculations, including the assumption that the groundwater level is at ground level, the zones of influence are likely to be overestimated. Groundwater level monitoring data for the area close to the Millington and Rostherne cuttings are available from 1991, collected for the A556 (M56 – M6) Improvement Ground Investigation in a period of average summer/early autumn conditions (between July and October). Using the maximum recorded water levels during this period, the zone of influence from the Millington and Rostherne Cutting would be reduced substantially. However, on a precautionary basis, giving maximum zones of influence is considered to be appropriate for this assessment.

4.2.10 The zone of influence for the Millington and Rostherne cuttings extends across an area of the Rostherne Mere catchment between the cuttings and Rostherne Mere in the north of the catchment. The zone of influence for the Hoo Green North cutting includes an area of the Rostherne Mere catchment that extends out to the west and across a part of the route of the Proposed Scheme in Pickmere to Agden and Hulseheath (MA03).

Flow and water level monitoring

4.2.11 A reconnaissance survey of Rostherne Mere was made in May 2018, followed by three site visits to monitor flows in watercourses and springs discharging into the mere in the period July to September 2018. All the visits took place during periods of mainly dry weather in which inflows to Rostherne Mere would have been dominated by baseflow contributions from springs.

4.2.12 Figure 4 shows Rostherne Mere and names of woodland, wetland and other features within and around the site. It includes estimates of flows in various areas during a site visit on 26 July 2018. The field team made approximate estimates of larger flows, using channel dimension measurements and floats for velocity measurements, on the following three watercourses:

- the Rostherne Brook, that provides the main inflow to Rostherne Mere, at two locations close to the mere;
- the main spring fed stream in Harpers Bank Wood; and,
- a channel in Mere Field fed by spring flow from Wood Bongs.

4.2.13 In Figure 4 the areas visited during the site visit are outlined in red and blue to distinguish them from each other and the text boxes coloured accordingly with the correspond area. The colours are used to provide clarity and do not have any other hydrological significance.

4.2.14 The outflow from Rostherne Mere in Blackburn's Brook was also estimated approximately in July 2018.

4.2.15 On a visit in August 2018, the inflows to Rostherne Mere in the three main watercourses were also measured using current metering equipment to give more accurate flow values and provide a check on the approximate flow estimates. There was less than 10% difference between the flow measurement by current metering and an approximate flow estimate using channel dimensions and floats on the Rostherne Brook in August 2018. There was also reasonable consistency between measurements at the two locations on the Rostherne Brook by current metering in August 2018 (33 and 35l/s), and between approximate estimates made in July 2018 (33 and 37l/s) and in September 2018 (31 and 33l/s). The consistency in flow estimates and measurements gives confidence that there was reasonable accuracy in the flow estimates made on the Rostherne Brook in the period July to September 2018.

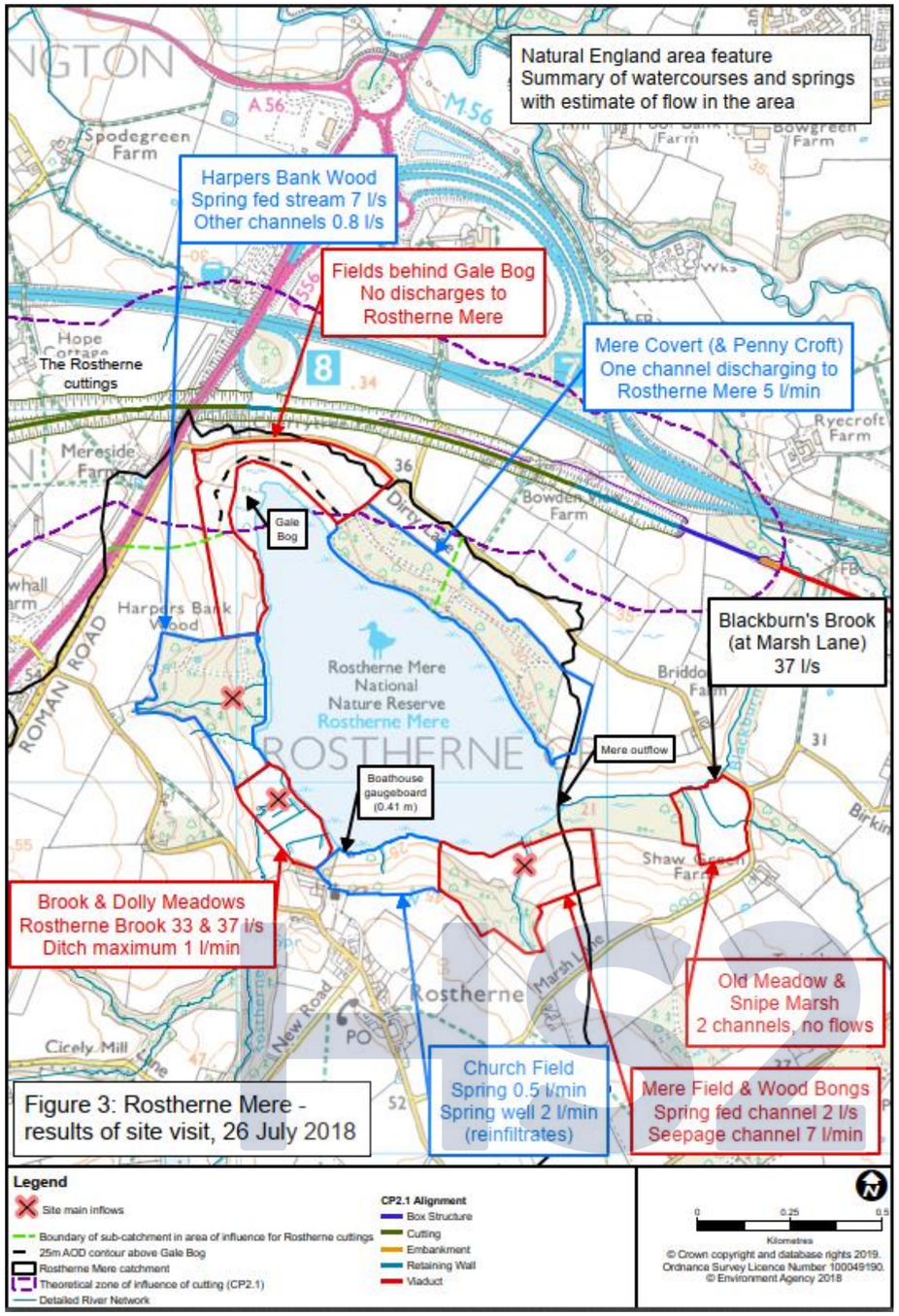
4.2.16 On each visit, a visual assessment of flows was made on approximately ten additional small spring fed channels and seepages that discharge into Rostherne Mere around the site. For some of the channels, it was also possible to estimate flows by using very approximate channel dimensions and floats for velocity measurements, or by filling a measuring jug. Although only very approximate, the flow values provided a useful indication of the relative contributions of various springs and seepages to the mere.

4.2.17 The estimated total inflows to Rostherne Mere were 45, 41 and 39l/s respectively for monitoring rounds in July, August and September 2018. The Rostherne Brook provided by far the most important single contribution, comprising approximately 80% of the total inflow to Rostherne Mere. The three watercourses, listed above, provided 98% or more of the total inflow to the mere.

4.2.18 During each site visit a reading was taken from an existing gauge board attached to the Natural England boat house at Rostherne Mere. The minimum water level recorded, 0.41m, was in late July 2018, with a similar reading, 0.42m, in mid-August 2018. Water levels of 0.58 to 0.60m were recorded in late July 2019. A water level logger was installed in Rostherne Mere in late October 2019 at a time when the water level on the

gauge board was 0.84m. Data from the logger indicated that the maximum water level recorded between late October and late November 2019 was equivalent to 1.37m on the gauge board. Combining the observed low levels seen in the summer 2018 with the logger data indicates a range in Rostherne Mere water levels of 0.96m (960mm) between July 2018 and November 2019.

Figure 4: Rostherne Mere – results of site visit, 26 July 2018



Potential impact of the Millington and Rostherne cuttings

4.2.19 The theoretical zone of influence of the Millington and Rostherne cuttings includes parts of Gale Bog, the fields behind Gale Bog and also the northernmost part of the open water of Rostherne Mere (see Figure 4). Approximate boundaries to the sub-catchment area that could contribute groundwater to the zone of influence are included on the figure. Groundwater in this sub-catchment area could be intercepted within the zone of influence and, hence, might discharge to the drainage in the cuttings.

4.2.20 The lowest level in the Millington and Rostherne cuttings is approximately 25mAOD, allowing for drainage channels of up to 2m depth below the base of the cuttings. Gale Bog is at an elevation of approximately 21mAOD. As this is below the lowest possible level of cutting dewatering to the base of the drainage channels, the zone of influence of the cuttings would not extend as far as Gale Bog or the open water of Rostherne Mere. The cuttings might intercept groundwater above 25mAOD that could otherwise discharge from seepages located between the 25mAOD contour, highlighted on Figure 4, and Rostherne Mere. However, the cuttings could not create a reversal in groundwater flow that might cause water from Rostherne Mere to seep down through the bed of the mere and flow towards the cuttings.

4.2.21 The zone of influence of the cuttings includes an area of the Rostherne catchment that extends into the northern corner of Mere Covert. It is possible that any seepages which discharge in Mere Covert, within or downgradient of the zone of influence, could be intercepted by the drainage in the cuttings. The zone of influence also extends into an area near Mere Covert that is just outside the Rostherne Mere catchment. The area just to the north of the catchment is flat-lying relative to the slopes around Rostherne Mere. It is possible, therefore, that some groundwater in this flat-lying area could discharge in Mere Covert rather than following the more subdued topographic gradient to the north.

4.2.22 Three seepage locations were identified in the fields close to or just above the boundary of Gale Bog during the reconnaissance visit in May 2018, with a total discharge of less than 2litres/minute (equivalent to 0.03l/s). However, no seepages with any visible permanent flow were seen in the same area in July to September 2018. Therefore, in conditions that are similar to, or drier than, the conditions occurring in July to September 2018, the Millington and Rostherne cuttings could have no impact on inflows above Gale Bog. A flow was present in a channel in the centre of Mere Covert, discharging into Rostherne Mere, in July to September 2018. The flow was estimated to be approximately 5l/min to 7l/min (0.08l/s to 0.12l/s) in July and September. However, during the visit in August, the flow was too small to attempt any measurement; a visual estimate indicated a flow of approximately 1l/min to 2l/min (0.02l/s to 0.03l/s). The observed variation in this flow, combined with information provided by a local councillor who farms land adjacent to Mere Covert, indicates that this discharge through Mere Covert comprises runoff and near-surface land drainage rather than discharge from groundwater.

4.2.23 The total discharge in areas below or close to the zone of influence of the Rostherne cuttings equated to between 0.1 and 0.3% of the total inflows estimated for Rostherne Mere at the time of site visits in the period May to September 2018.

4.2.24 The minor groundwater discharges occurring in the fields above Gale Bog in May 2018 could result from the presence of more permeable sandy bands in the glacial till. Assuming the deposits underlying Gale Bog include some fine silty or clayey material from deposition in still water conditions, then the permeability would be low, limiting any upward leakage from below. As a result, any groundwater originating at a higher elevation in the vicinity of the Millington and Rostherne cuttings, and moving towards Rostherne Mere, is likely to follow a pathway through more permeable deposits in bands in the glacial till. The groundwater would then discharge above the level of Gale Bog. The presence of minor seepages in the fields above Gale Bog indicates that groundwater does emerge in this way. Significant additional discharges are unlikely to occur in Gale Bog, or within the open water areas of Rostherne Mere. If any minor discharges are, however, present in Gale Bog or Rostherne Mere, drainage in the cuttings would be expected to have a negligible impact on groundwater feeding these discharges.

Water balance

4.2.25 An approximate water balance model was developed for Rostherne Mere in order to assess the likely impact of the reduction in inflow to Rostherne Mere resulting from the construction of cuttings. The model took account of inflows and outflows to and from the mere, together with open water evaporation and changes in storage within the mere. The following calculations and assumptions were made in the model:

- the model was run with a daily timestep from the end of January to the end of September 2018 and, therefore, included the late spring and summer in which several extended hot, dry periods occurred;
- total daily inflows to Rostherne Mere were derived using the daily flows for a gauging station on the River Bollin at Wilmslow[10]. The daily flows were correlated very approximately with the assessments of total inflows to Rostherne Mere made in May to September 2018. The correlation was then used to estimate daily inflows to Rostherne Mere from January to September 2018;

[10] Environment Agency (2018), *National River Flow Archive*. Available online at: https://nrfa.ceh.ac.uk.

- approximate open water evaporation values were derived for the area for each half month period using an evapotranspiration data set[11], together with temperature data for central England[12];
- daily changes in mere storage were calculated based on the difference between inflows and open water evaporation plus outflow for the previous daily time step;
- outflows from Rostherne Mere were determined from calculations of flow over a V-shaped (V-notch) weir and the mere water levels determined during the water balance, taking into account changes in storage. The outflow channel in the south-eastern corner of Rostherne Mere is crossed by a boardwalk located approximately 20m to the east of the open water. The channel is several metres wide and reed-filled. As a result, it is not known how the channel might vary in size and form away from the boardwalk. A simplified approach was, therefore, adopted in using the V-notch weir formula; and
- the outflows were determined for a partially submerged V-notch weir that should represent more closely the natural conditions in a narrow, low-flow channel with low gradient. The free-flowing discharge over the weir, calculated using a standard V-notch weir equation, was adjusted for submergence using the Villemonte formula[13]. The formula is valid up to a submergence of 90%. Submergence of 90% may be reasonably realistic as an approximation for conditions in a natural channel where the discharge is controlled by a change in gradient in the channel.

4.2.26 In a worst-case scenario, it is assumed that the Millington and Rostherne cuttings could intercept all the inflows observed to the north of Rostherne Mere. This equates to a reduction of 0.3% of the total inflow to Rostherne Mere. The reduction is based on an estimated total discharge of up to approximately 7l/min in July to September 2018 in the area between the Millington and Rostherne cuttings and Rostherne Mere, and the lowest estimated total inflow to Rostherne Mere of 39l/s in September 2018. It is considered to be a worst-case potential impact for the following reasons:

- the zone of influence of the cuttings extends into the Rostherne catchment over an area that includes only the northern corner of Mere Covert. As a result, the cuttings may not actually affect the discharge that occurs in the centre of Mere Covert;
- it is possible that in prolonged dry conditions, the minor discharge in the centre of Mere Covert, that comprised the entire contribution from the area in July, August and September, would decline at a faster rate than other spring discharges and watercourses in the catchment providing more than 98% of the inflow to the mere. A much lower flow was seen in Mere Covert in August (approximately 1l/min to 2l/min) than in either July or September 2018. This variation in flow is likely to indicate that the water is from a shallow source with small and variable discharge. Information provided by a local councillor indicated that the flow in the centre of Mere Covert comprises near-surface drainage that responds rapidly to, and reduces very quickly after, rainfall. He indicated there is clay below the soil layer in the fields above Mere Covert and the water drains quickly above this clay layer. It is therefore reasonably to assume that the small flows seen in the centre of Mere Covert are rainfall fed. These flows are, therefore, not likely be affected at all by the presence of the cuttings; and
- water quality measurements during the site visits in August and September showed that the overall salinity of the water in the channel in Mere Covert is significantly lower than the salinity of the water in other watercourses in the area. The lower salinity is likely to indicate the water is from a shallow source that dries up relatively quickly.

4.2.27 The model was run for two scenarios, with and without the 0.3% reduction in inflow to the mere. The impact of the reduction in inflows on water level was calculated from the difference in mere water levels modelled each day for the two scenarios. The results of the analysis are discussed below.

4.2.28 Records for gauging stations across the River Bollin catchment indicate that the summer in 2018 was drier than average but was not an exceptionally dry year. Recorded flows were at their lowest in the River Bollin catchment in the summers in 1976 and 1996. Therefore, in order to assess the impacts of a reduction in inflows to Rostherne Mere in the driest recorded conditions, the water balance model was re-run using data for 1976 and 1996. The following calculations and assumptions were made:

- the model was also run with a daily timestep for 1976 and 1996 from the end of January to the end of September;
- total daily inflows to Rostherne Mere were derived using the very approximate correlation of daily flows for a gauging station on the River Bollin at Wilmslow and the assessments of total inflows to Rostherne Mere made in May to September 2018. The correlation was applied to the data for 1976 and 1996 for the River Bollin in order to derive daily inflows for Rostherne Mere for these years of lowest flow;
- open water evapotranspiration values were derived for each half month period using the evapotranspiration data set11; and
- outflows from Rostherne Mere were again determined from calculations of flow over a sharp-crested V-shaped (V-notch) weir with 90% submergence and the mere water levels determined as part of the water balance.

[11] Robinson EL, Blyth E, Clark DB, Finch J, Rudd AC, (2015), *Climate hydrology and ecology research support system potential evapotranspiration dataset for Great Britain (1961-2012) [CHESS-PE]*, NERC Environmental Information Data Centre. Available online at: https://doi.org/10.5285/d329f4d6-95ba-4134-b77a-a377e0755653.

[12] Met Office (2019), *Hadley Centre observations datasets*. Available online at: https://www.metoffice.gov.uk/hadobs/hadcet/index.html.

[13] Villemonte, J. R. (1947). *Submerged weir discharge studies*. Engineering News Record.

Potential impacts of the Hoo Green North cutting

4.2.29 The potential zone of influence of the Hoo Green North cutting to the north-west of The Mere, Mere in the catchment of Rostherne Mere is shown in Figure 2 and Figure 3. This zone of influence intersects approximately 2% of the area of the Rostherne Mere catchment. The area extends out between the catchments to the south of Hoo Green (Tabley Brook) and to the north towards Hulseheath (Millington Clough) in MA03. Some groundwater in the zone of influence of the cuttings may, therefore, contribute to the adjacent catchments rather than following a more extended groundwater flow path towards Rostherne Mere. However, for the analysis, it was assumed the whole of the potential zone of influence, comprising approximately 2% of the catchment, contributes groundwater to Rostherne Mere downgradient of The Mere, Mere sub-catchment.

4.2.30 Assuming there are no major variations in recharge across the Rostherne Mere catchment, a reduction of 2% was applied in the water balance model for Rostherne Mere in 2018.

4.2.31 The possible reductions in mere water level for the two sets of cuttings were then combined to give the overall maximum potential reduction in mere water level for a total reduction in discharge of 2.3%.

Results of assessment

4.2.32 The following results were obtained by comparison of the water balance model with and without a fixed percentage reduction in flow (0.3%), based on the discharges close to the Millington and Rostherne cuttings in the summer in 2018:

- the Millington and Rostherne cuttings are likely to have a maximum impact of one millimetre on water levels in Rostherne Mere; and
- water levels are likely to be unaffected by the presence of the cuttings during extended dry periods in the summer, as seepages in the fields above Gale Bog already dry up during dry periods.

4.2.33 With a fixed percentage reduction in flow (2%), based on possible reductions as a result of drainage to the Hoo Green North cutting, water levels in Rostherne Mere from April onwards through the summer in dry or very dry condition may be reduced by a few millimetres (up to approximately 3mm to 4mm). However, these impacts may be reduced depending on:

- the actual directions of drainage and groundwater flow in the surface water catchment area to the west of The Mere, Mere;
- the impact that the recently constructed section of the A556 has had on groundwater flow and the existing drainage systems in the area; and
- whether surface water and groundwater flow contributions to Rostherne Mere from the upstream sub-catchment of The Mere, Mere are taken into account in the calculations (the reduction in inflow of 2% to Rostherne Mere is based on the area of the Rostherne Mere catchment downgradient of The Mere, Mere sub-catchment and not the entire catchment).

4.2.34 Overall, the total impact of the cuttings, producing a decline in water levels of 4mm to 5mm in dry or very dry conditions, is marginal when compared to the actual variation in water level of approximately 960mm in the period July 2018 to November 2019. The model results also indicate there would only be short periods in any year in which the mere water level with the cuttings in place would fall below the minimum water level for that year prior to construction of the Proposed Scheme. These short periods would vary between a total of approximately five and ten days in a drought or dry year similar to 1976, 1996 or 2018.

4.2.35 The water balance scenarios are based on a series of approximations and assumptions applied to the data sets in the model. As a result, flows and water levels for each individual water balance scenario may not be accurate. However, as the assessment is based on the difference in the results for model scenarios, the analysis should give a reasonable indication of the approximate impact of reductions in inflow to Rostherne Mere. The results demonstrate that the combined impact of the cuttings is likely to produce a reduction in water level of only a few millimetres in Rostherne Mere in dry or extreme dry summer conditions. The impact on water levels increases slightly as outflows from Rostherne Mere increase, most often in winter or early spring conditions. However, at these times, the water levels also rise substantially in response to the increased inflow to the mere.

4.2.36 In conclusion, the reduction in water levels is very small and almost certainly undetectable, taking into account the existing variations in levels between seasons and from year to year, together with the limitations for accurate measurement in natural surroundings and field conditions. However, given the international designation of the site and pending further investigation, this is assessed as a potential minor impact on groundwater flows to Rostherne Mere, on a precautionary basis.

Mitigation

4.2.37 Although the potential impacts on water levels are small, mitigation has been embedded into the design associated with the potential impact of both sets of cuttings.

4.2.38 For the Millington and Rostherne cuttings, drainage from an area of the cuttings extending a considerable distance outside the Rostherne Mere catchment will be recharged to Rostherne Mere, via a recharge trench. The approximate section of the cuttings contributing to the mitigation drainage scheme is indicated on Figure 2 and Figure 3. Taking into account the potentially very low permeability of an upper clay layer in the

glacial till in the area of the mitigation scheme, a trench with recharge wells might be used to discharge to sandier deposits underlying the clay. The timing of the recharge from the cuttings may be different to the timing of any natural groundwater discharge in the area. However, the additional discharge from the extended area of the cuttings would mean that the total discharge exceeds the natural groundwater discharge in the area.

4.2.39 Sealed carrier drainage pipes and connecting manholes will be located below the Rostherne cutting to convey the drainage water to a discharge point on Blackburn's Brook. The carrier drainage pipes will be installed with a suitable sandy backfill bedding material. The rest of the trench, excavated for installation of the drainage pipes, will be backfilled generally with solidly compacted, granular materials. Due to the sensitivity of this area, groundwater in the vicinity of Rostherne Mere could drain away through the bedding material around the carrier drain. Concrete dams or geomembrane will be installed across the lower section of the trench just downgradient of points of significant groundwater inflow. In addition, the trench above the carrier drain could be backfilled with material of varying permeability to:

- prevent groundwater drainage; and
- maintain continuity of groundwater flow across the trench within any sandy layers in the glacial till.

4.2.40 For the Hoo Green North cutting to the north-west of The Mere, Mere, drainage from an area of the cuttings extending across and outside the Rostherne Mere catchment will be pumped to a recharge trench scheme in the superficial deposits to the east of the zone of influence of the cuttings. The approximate sections of the cuttings contributing to the mitigation, and also the provisional location of the recharge trench scheme, are indicated on Figure 2 and Figure 3. The sections of cuttings from which drainage water can be utilised for recharge were determined taking into account the varying levels of the cuttings on the Scheme main line and the Manchester spur. The geological mapping in Figure 3 indicates that glaciofluvial deposits comprising permeable sands and gravels should be present at the location of the recharge scheme.

4.2.41 The recharge scheme should produce a contribution that exceeds the natural recharge in the area of the zone of influence. There may be differences in precise timing between recharge through the trench scheme and the natural groundwater throughflow in the zone of influence. However, taking into account the distance of the recharge scheme from Rostherne Mere, a slight variation in the timing of recharge should make no significant difference to the timing of groundwater discharge in the Rostherne Mere catchment.

Seepages above Gale Bog

4.2.42 Groundwater level monitoring data for the area close to the Millington and Rostherne cuttings is available from 1991, collected for the A556 (M56 – M6) Improvement Ground Investigation[6] in a period of average summer/early autumn conditions. The data indicate that drainage in the Millington and Rostherne cuttings could intercept some groundwater that may otherwise discharge in seepages in the slopes above Gale Bog. The slopes form part of the Rostherne Mere SSSI. The seepages dry up already in 'drier than average' conditions, such as occurred in July to September 2018. However, some seepages in the slopes above Gale Bog, at elevations below the lowest level in the filter drainage (approximately 25mAOD), might not dry up entirely as a result of the presence of the cuttings in average summer/early autumn, similar to 1991, or in higher groundwater level conditions. The impact on the seepages is dependent on the groundwater hydraulic gradient between the area of the cuttings and Gale Bog.

4.2.43 On a precautionary basis, however, it is assumed that the cuttings would cause the seepages in the slopes above Gale Bog to dry up in all conditions in which seepage discharges currently occur. As indicated above, the seepages dry up already in 'drier than average' conditions such as occurred in July to September 2018. The seepages could not be affected, therefore, in summers comparable to, or drier than, 2018.

Potential spring near Bucklow Hill

4.2.44 The potential spring in Bucklow Hill, assumed to be a high value receptor, is shown in Figure 2. The potential spring is located outside the zone of influence of the Hoo Green North cutting. However, parts of the catchment upstream of the potential spring may be within the zone of influence of the cuttings. The impacts on groundwater flow to the potential spring is assessed as minor on a precautionary basis, leading to a moderate effect which is significant. The recharge trench associated with the Hoo Green cuttings should return groundwater back into the superficial deposits in an area which may feed this potential spring. However, further investigation is needed to assess whether the recharge trench will reduce any potential impact on this spring to negligible.

4.2.45 Further investigation is required to determine:

- whether the potential spring is present in Bucklow Hill; and
- if the proposed recharge trench will mitigate for any potential impacts on the spring.

5 Site specific highways drainage assessments

5.1 Introduction

5.1.1 Roads are designed to drain freely to prevent the build-up of standing water on the carriageway whilst avoiding exposure to, or causing, flooding. Contaminants deposited on the road surface are quickly washed off during rainfall. Where traffic levels are high, the level of contamination increases and therefore the potential for unacceptable harm being caused to the receiving water also increases. There are many circumstances in that runoff from roads is likely to have no discernible effect, however a precautionary and best practice approach indicates the need for the assessment of the possible impact of pollutant discharges on the water environment from roads affected by the Proposed Scheme. These effects can either be through spillage and routine runoff pollution from new roads that are used during the construction and operational phases or changes in traffic movements on the existing road network.

5.1.2 The Proposed Scheme makes provision for two methods for draining new sections of highway: direct runoff to soakaway and drainage via an attenuation pond to an existing watercourse. Where changes in traffic volumes have been identified along the existing road network, steps have been taken to identify the type of drainage in place and an assessment has been made of whether the highway works proposed have implications for pollution risk within MA06.

5.2 Methodology and assessment criteria

Routine runoff pollution risk

5.2.1 Where highway drainage is discharged to local watercourses, the assessment for determining whether routine runoff is likely to have a detrimental impact on water quality uses the HEWRAT. Where highway realignments are to discharge to kerb side ditches that do not have a baseflow, the Groundwater Assessment (Appendix C)[4] has been used.

5.2.2 The significance of the impact of the predicted effects on surface water and groundwater receptors has been assessed in accordance with the methodology described in the SMR.

Spillage pollution risk

5.2.3 In addition to assessing the potential for adverse effects of routine surface water runoff from highways, an assessment of the potential spillage risk to water quality has been undertaken for highway realignments. The methodology for assessing spillage risk follows the Spillage Risk Assessment (Appendix D)[4].

5.3 Detailed assessment

Screening results

5.3.1 A screening exercise has not identified the need for a routine runoff and pollution risk assessment or a spillage pollution risk assessment in MA06 during the construction phase.

5.3.2 A screening exercise identified the need for a routine runoff assessment in MA06 during the operational phase. This is related to the modifications to the A538 Hale Road and Hasty Lane to the A538 Hale Road/station access gyratory (eastbound traffic), and the combined changes to the M56 East and West Links, Manchester Airport High Speed station access road (east), Manchester Airport High Speed station access road (west) and Runger Lane, shown in Figure 5 and 6 respectively. The screening exercise has not identified the need for a spillage pollution risk assessment in MA06 during the operational phase.

5.3.3 The road modifications and associated drainage is complex in this area. There are four key road modifications within the area surrounding the proposed Manchester Airport High Speed station. The existing drainage network in the area includes surface water sewers that discharge to the Tributary of Timperley Brook 1. Existing highway drainage collecting runoff from the M56 also discharges to Timperley Brook and the Tributary of Timperley Brook 1.

5.3.4 The proposed Manchester Airport High Speed station will require a new separate drainage system to collect surface water runoff from the station building, surrounding roads and also HS2 track drainage. The drainage strategy will involve routing runoff to 13 attenuation tanks across the site before discharging to existing watercourses via gravity or pumping. The location of ten of the tanks will be in landscaped areas between the station car parks and roads, two tanks will be located within the highway gyratory and one tank at the north east.

Figure 5: Change of the A538 Hale Road and Hasty Lane to the A538 Hale Road/station access gyratory (eastbound traffic)

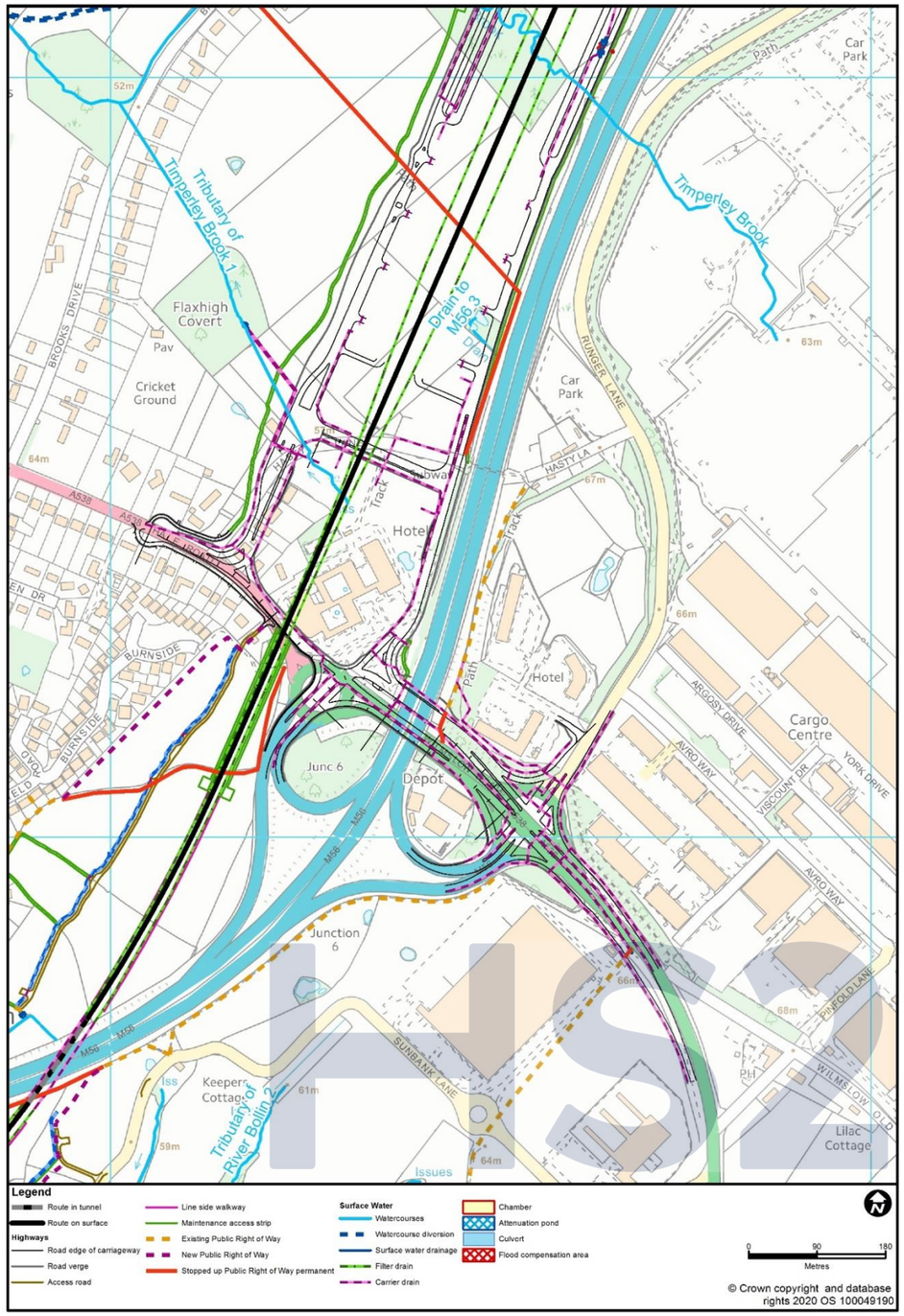
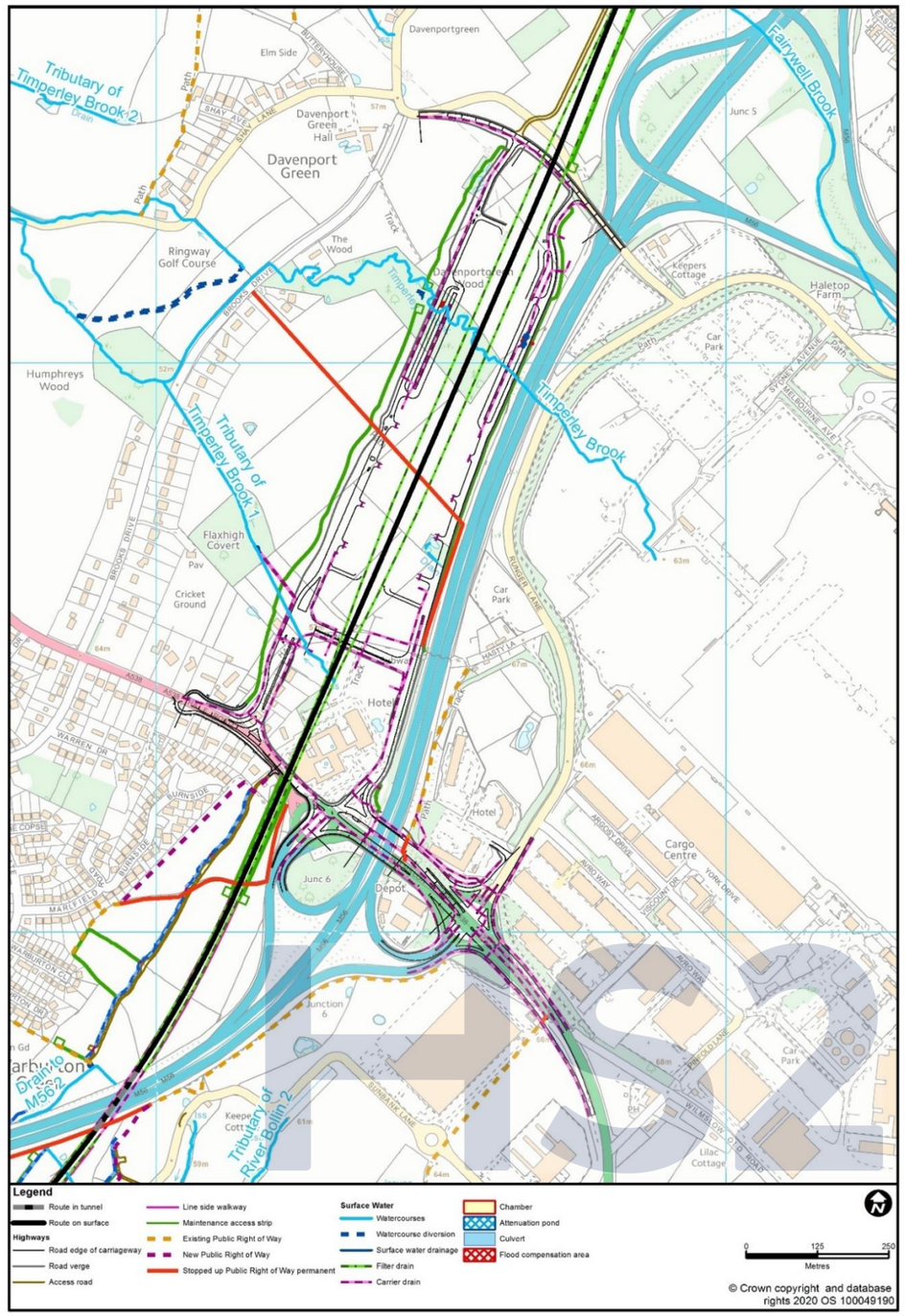


Figure 6: Modifications to the M56 East and West Links, Manchester Airport High Speed station access road (east), Manchester Airport High Speed station access road (west) and Runger Lane



5.3.5 Tanks located on the eastern side of the route of the Proposed Scheme will discharge to the Timperley Brook inverted siphon, crossing beneath the Proposed Scheme and discharge to Timperley Brook. Tanks located on the west of the Proposed Scheme will discharge to Tributary of Timperley Brook 1. As the connection from the Hasty Lane culvert crossing the M56 is now diverted to the Timperley Brook Siphon, the west side of the station is proposed to discharge to Tributary of Timperley Brook 1 to provide flow during rainfall events.

Routine runoff pollution risk

A538 Hale Road and Hasty Lane to station access gyratory (eastbound traffic)

5.3.6 The modification to the A538 Hale Road between Altrincham and the M56 involves the realignment of the carriageway along a total length of approximately 300m, and incorporation of the road into the proposed western highways drainage catchment, that will be collected and routed into attenuation tanks, before discharging to the Tributary of Timperley Brook 1. The realignment of A538 Hale Road and Hasty Lane to include the Station access gyratory around Manchester Airport involves the diversion of approximately 300m of carriageway, and incorporation of the road into the proposed western highways drainage catchment, that will be collected and routed into attenuation tanks, before discharging to the Tributary of Timperley Brook 1.

5.3.7 The impermeable non-highways areas, including roofs, footways and public realm areas, do not contribute to the soluble pollutants copper and zinc assessments. Therefore, these areas of the catchment have been included as permeable areas in the soluble metals assessment but are included in the sediment assessment.

5.3.8 A cumulative assessment was undertaken for Tributary of Timperley Brook 1. The assessment results identified that the magnitude of the impacts of routine runoff from the proposed highway changes would be major, as the acute soluble pollutants assessment is failed for zinc and copper and copper exceeds the environmental quality standards (EQS) annual average concentration. The sediment-bound pollutants assessment is passed. The receptor is of low value. The proposal will therefore result in a minor adverse effect which is not significant.

5.3.9 Mitigation measures have been embedded within the design and include attenuation tanks, vortex grit separators and rain gardens. All highways drainage will pass through attenuation tanks and vortex grit separators. Fifty three percent of the highway drainage will also be treated by rain gardens. With the inclusion of this mitigation the sediment-bound and soluble pollutants aspects pass the assessment. No data is currently available with regards to the background concentrations of copper in the watercourse (upstream of the discharge), therefore sensitivity testing has been carried out. This testing found that, following the implementation of the embedded mitigation, if background concentrations for copper exceed 0.25µg/l the water quality in the receiving watercourse after discharge would exceed the EQS. During the passage of the Bill further investigations, such as monitoring and analysis of the bioavailability of metals and dilution, will be carried out, where reasonably practicable, to identify whether further mitigation measures are required. If further mitigation is required these will be designed in consultation with the Environment Agency and other stakeholders to mitigate any significant effects on water quality. On a precautionary basis, pending results from the additional investigations, this is assessed to be a moderate impact, on this low value receptor, resulting in a minor effect, which is not significant.

Modifications to the M56 Junction 6 East and West sliproads, Manchester Airport High Speed station access road (east), Manchester Airport High Speed station access road (west) and Runger Lane

5.3.10 The modifications to the M56, Manchester Airport High Speed station access roads and Runger Lane have been assessed together as all of these roads are incorporated into the proposed eastern highways drainage catchment, that will be collected and routed into attenuation tanks. The tanks located on the eastern side of the Proposed Scheme will discharge to the Timperley Brook inverted siphon, crossing beneath the Proposed Scheme and discharge to Timperley Brook.

5.3.11 The impermeable non-highways areas, including roofs, footways and public realm areas, do not contribute to the soluble pollutants copper and zinc assessments. Therefore, these areas of the catchment have been included as permeable areas in the soluble metals assessment but are included in the sediment assessment.

5.3.12 A cumulative assessment was undertaken for the Timperley Brook. The assessment results identified that the magnitude of the impacts of routine runoff from this proposed highway realignment would be major, as both the acute soluble for copper and zinc and sediment-bound pollutants aspects of the assessment are failed and copper exceeds the EQS annual average concentration. The receptor is of moderate value. The proposal will therefore result in a moderate adverse effect which is significant.

5.3.13 Mitigation measures have been embedded within the design include attenuation tanks, vortex grit separators and rain gardens. All highways drainage will pass through holding tanks and vortex grit separators. Forty two percent of the highway drainage will also pass through rain gardens. With the inclusion of this mitigation the sediment-bound and soluble pollutants aspects pass the assessment. No data is currently available with regards to the background concentrations of copper in the watercourse (upstream of the discharge), therefore sensitivity testing has been carried out. This testing found that, following the implementation of the embedded mitigation, if background concentrations for copper exceed 0.2µg/l the water quality in the receiving watercourse after discharge would exceed the EQS. During the passage of the Bill further

investigations, such as monitoring and analysis of the bioavailability of metals and dilution, will be carried out, where reasonably practicable, to identify whether additional mitigation measures are required. If mitigation is required these will be designed in consultation with the Environment Agency and other stakeholders to mitigate any significant effects on water quality. On a precautionary basis, pending results from the additional investigations, until these investigations are complete this is assessed to be a moderate impact, on this moderate value receptor, resulting in a moderate effect, which is significant.