

# High Speed Rail (Crewe – Manchester) Environmental Statement

## Volume 5: Appendix WR-003-0MA05

### **Water resources and flood risk**

MA05: Risley to Bamfurlong

Water resources assessment

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Water resources assessment



Department  
for Transport

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## Contents

<b>1 Introduction</b>	<b>3</b>
1.1 Structure	3
1.2 Scope, assumptions and limitations	3
1.3 Study area description and key features	4
1.4 Stakeholder engagement	5
<b>2 Site specific surface water assessments</b>	<b>6</b>
2.1 Summary of assessment	6
<b>3 Site specific groundwater assessments</b>	<b>26</b>
3.1 Summary of assessment	26
3.2 Impact on groundwater from cuttings	42
3.3 Impacts to groundwater flow and quality from viaduct, embankment and overbridge piling	47
3.4 Impacts to groundwater from borrow pits	49
<b>4 Site specific water dependent habitats assessment</b>	<b>50</b>
4.1 Summary of assessment	50
4.2 Detailed assessment	51
<b>5 Site specific highways drainage assessments</b>	<b>57</b>
5.1 Introduction	57
5.2 Methodology and assessment criteria	57
5.3 Detailed assessment	57
 <b>Tables</b>	
Table 1: Summary of potential impacts on surface water receptors	6
Table 2: Summary of potential impacts on groundwater receptors	26
Table 3: Summary of the parameters for the groundwater assessment of Culcheth cutting	43
Table 4: Summary of the parameters for the groundwater assessment of Lowton cutting	44
Table 5: Summary of the parameters for the groundwater assessment of Abram cutting	46
Table 6: Summary of potential water dependent habitat impacts	50
 <b>Figures</b>	
Figure 1: Holcroft Moss topography and geology	52

**Environmental Statement**

Volume 5: Appendix WR-003-0MA05

Water resources and flood risk

MA05: Risley to Bamfurlong

Water resources assessment

Figure 2: Profile across Holcroft Moss SSSI (approximately east to west)

53

Figure 3: Profile across Holcroft Moss SSSI (north to south)

54

Figure 4: B5207 Wilton Lane realignment

58

Figure 5: A574 Warrington Road realignment

58

# 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 Risley to Bamfurlong area (MA05).
- 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 MA05, the Flood risk assessment (Volume 5: Appendix WR-005-0MA05) should also be referred to as well as the relevant Hydraulic modelling reports (Volume 5: Appendices WR-006-00003, WR-006-00004, WR-006-00005 and WR-006-00006) and the Groundwater modelling report, Volume 5: Appendix WR-008-00001.
- 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-004-0MA05)<sup>1</sup>; and
  - WFD compliance assessment baseline data that is reported for the Proposed Scheme (BID WR-002-00001)<sup>2</sup>.
- 1.1.6 Maps referred to throughout this assessment are contained in the Volume 5, Water resources and flood risk Map Book: Map Series WR-02.

## 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 Risley to Bamfurlong (MA05) area covers a 12.7km 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 Risley Moss Site of Special Scientific Interest (SSSI) and Local Nature Reserve (LNR), that forms part of the Manchester Mosses Special Area of Conservation (SAC), and the whole of the Pennington Flash lake waterbody. 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, MA05 Map Book: Map Series CT-05 and CT-06.

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<sup>1</sup> High Speed Two Ltd (2022), High Speed Rail (Crewe – Manchester), *Background Information and Data, Water resources assessment baseline data*, BID WR-004-0MA05. Available online at: <http://www.gov.uk/government/collections/hs2-phase-2b-crewe-manchester-environmental-statement>.

<sup>2</sup> 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<sup>3</sup>;
  - 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.
- 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. 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)<sup>4</sup> 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.
- 1.2.8 Mineral resources (operational or historical) and potential impacts to groundwater quality from existing land contamination, including Lowton Sidings landfill site, are presented in the Land quality report, Volume 5: Appendix LQ-001-0MA05 and Volume 2, MA05 Risley to Bamfurlong, Section 10, Land quality.

## 1.3 Study area description and key features

- 1.3.1 The study area is predominantly rural, although there are a number of towns, villages, hamlets and farmsteads located within proximity to the Proposed Scheme. These include the eastern parts of Warrington, Culcheth, Golborne, Lowton and Abram.
- 1.3.2 Within the Risley to Bamfurlong area (MA05), the Proposed Scheme will be constructed as a series of cuttings, embankments and viaducts. There are no tunnelled or ground level sections.
- 1.3.3 The main environmental features of relevance to water resources include:
- Glaze Brook, Hey Brook, Carr Brook, Nan Holes Brook, Coffin Lane Brook and Holcroft Lane Brook and their associated tributaries;
  - the Leeds and Liverpool Canal;
  - three potential spring features within the land required for construction of the Proposed Scheme;
  - the Sherwood Sandstone Group Principal aquifer;
  - the Kinnerton Sandstone Formation Principal aquifer;
  - the Appleby Group Principal aquifer;
  - the Pennine Coal Measures Group Secondary A aquifer, includes an area of historical coal mining that is detailed in the Land quality report, Volume 5: Appendix LQ-001-0MA05;
  - the Cumbrian Coast Group Secondary B aquifer;
  - the Mercia Mudstone Group Secondary B aquifer;

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<sup>3</sup> Ponds are not included in the water resources assessment; these are assessed as ecological receptors in Volume 2.

<sup>4</sup> 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>.

- the permeable superficial deposits Secondary A and Secondary (Undifferentiated) aquifers;
- seven groundwater abstractions licensed for public water supply (PWS);
- one licensed private groundwater abstraction;
- Holcroft Moss SSSI and component of the Manchester Mosses SAC, Risley Moss SSSI, LNR and a component of the Manchester Mosses SAC, Bryn March and Ince Moss SSSI, LNR (Wigan Flashes) and Site of Biological Importance (SBI) (Horrocks Flash), Pestfurlong Moss Local Wildlife Site (LWS), Lightshaw Lime Beds SBI and Ponds near Lightshaw Lane SBI, that may be groundwater dependent habitats; and
- Abram Flash SSSI and SBI, Pennington Flash LNR, country park and SBI and Silver Lane Ponds LWS, that are surface water dependent habitats.

## 1.4 Stakeholder engagement

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

- The Environment Agency and Natural England, particularly with regards to Holcroft Moss. Discussions have been held with the Environment Agency and Natural England to agree the scope and nature of the assessment for Holcroft Moss. The assessment is based on groundwater modelling, presented in the Groundwater modelling report, Volume 5: Appendix WR-008-00001 and summarised in Section 4.2;
- Canal & River Trust;
- Warrington Borough Council (WBC) and Wigan Metropolitan Borough Council (WMBC) with regard to private unlicensed water abstractions;
- United Utilities, to confirm details of public water abstractions in the study area. Also to discuss historical changes and possible future trends in groundwater levels, the potential impacts of cuttings on groundwater conditions, and concerns regarding existing groundwater contamination; 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 Water resources assessment baseline data (BID WR-004-0MA05). 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. 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) (see Volume 5: Appendix CT-002-00000) sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme to protect surface waters.

**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
<b>Surface water bodies</b>									
M62 Drainage	Low	<ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>M62 west viaduct</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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)
		<ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>M62 west viaduct</li> </ul>	Approximately 50m of this offline watercourse will be lost during construction of the Culcheth South embankment.	Magnitude of impact – Moderate  Significance of effect – Minor adverse, not significant	The watercourse will be incorporated into the new track drainage. Mitigation measures include avoiding the floodplain and channel. Piers will be set back to remove impacts on flows.	Magnitude of impact – Negligible  Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible  Significance of effect – Negligible, not significant	Construction (permanent)
Holcroft Lane Brook	Moderate	<ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>Holcroft Lane Brook culvert (15m)</li> <li>Realignment (700m)</li> <li>Temporary works such as compounds,</li> </ul>	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 – 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)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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		stockpiles and access routes	through the disturbance of silt or direct contamination by polluting materials.						
		<ul style="list-style-type: none"> <li>• Culcheth South embankment</li> <li>• Holcroft Lane Brook culvert (15m)</li> <li>• Realignment (700m)</li> <li>• Drainage outfall from HS2 attenuation pond</li> </ul>	<p>Approximately 520m of this watercourse will be lost during construction of the Culcheth south embankment.</p> <p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>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.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Moderate adverse, significant</p>	<p>Mitigation measures will include realignment of the watercourse and appropriate watercourse crossing and drainage design.</p> <p>Measures to manage water quality will be adopted during the design process.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Holcroft Lane Brook 1	Low	<ul style="list-style-type: none"> <li>• Culcheth South embankment</li> <li>• Unnamed culvert north of M62 Motorway (5m)</li> <li>• Unnamed culvert west of Culcheth South embankment (5m)</li> <li>• Realignment (17m)</li> <li>• Watercourse crossing by proposed road and access road</li> <li>• Utility diversion</li> <li>• Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>• Unnamed culvert north of M62 Motorway (5m)</li> <li>• Unnamed culvert west of Culcheth South embankment (5m)</li> <li>• Realignment (17m)</li> <li>• Watercourse crossing by proposed access road</li> <li>• Drainage outfalls from track drainage</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>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.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	<p>Mitigation measures will include realignment of the watercourse and appropriate watercourse crossing and drainage design. Measures to manage water quality will be adopted during the design process.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Holcroft Lane Brook 2 (also known as Silver Lane Brook)	Low	<ul style="list-style-type: none"> <li>• Culcheth South embankment</li> <li>• Realignment (360m) including; <ul style="list-style-type: none"> <li>– Holcroft Lane Brook offline culvert (10m)</li> </ul> </li> </ul>	<p>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.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
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 MA05: Risley to Bamfurlong  
 Water resources assessment

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		<ul style="list-style-type: none"> <li>- Unnamed culvert north of M62 Motorway (5m)</li> <li>- Unnamed culvert west of Culcheth South embankment (5m)</li> <li>• Watercourse crossing by proposed road, access road and temporary road</li> <li>• Temporary works such as compounds, stockpiles and access routes</li> </ul>	Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.						
		<ul style="list-style-type: none"> <li>• Culcheth South embankment</li> <li>• Realignment (360m) including;               <ul style="list-style-type: none"> <li>- Holcroft Lane Brook offline culvert (10m)</li> <li>- Unnamed culvert north of M62 Motorway (5m)</li> <li>- Unnamed culvert west of Culcheth South embankment (5m)</li> </ul> </li> <li>• Watercourse crossing by proposed access road</li> <li>• Drainage outfall from HS2 attenuation pond and road drainage</li> </ul>	<p>Approximately 310m of this watercourse will be lost during construction of the Culcheth south embankment access roads and drainage ponds.</p> <p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	<p>Mitigation measures will include minor realignment of watercourse to avoid embankment and appropriate watercourse crossing and drainage design.</p> <p>Measures to manage water quality will be adopted during the design process.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Holcroft Lane Brook 3	Low	<ul style="list-style-type: none"> <li>• Culcheth South embankment</li> <li>• Diversion (360m)</li> <li>• Watercourse crossing by proposed access road</li> <li>• Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>• Culcheth South embankment</li> <li>• Diversion (360m)</li> </ul>	<p>Watercourse will be partially lost during construction of the Culcheth south embankment.</p> <p>Deterioration, loss or change to the existing water environment, flow characteristics and</p>	<p>Magnitude of impact – Moderate</p>	<p>Part of the watercourse will be incorporated into the track drainage.</p> <p>Mitigation measures will also include appropriate</p>	<p>Magnitude of impact – Negligible</p>	None required.	<p>Magnitude of impact – Negligible</p>	Construction (permanent)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Rislely to Bamfurlong  
Water resources assessment

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		<ul style="list-style-type: none"> <li>Watercourse crossing by proposed access road</li> </ul>	<p>morphology from the presence of the design elements.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.</p>	<p>Significance of effect – Minor adverse, not significant</p>	<p>watercourse crossing and drainage design.</p> <p>Measures to manage water quality will be adopted during the design process.</p>	<p>Significance of effect – Negligible, not significant</p>		<p>Significance of effect – Negligible, not significant</p>	
Tributary of Holcroft Lane Brook 4	Low	<ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>Holcroft Lane Brook culvert (15m)</li> <li>Diversion (50m)</li> <li>Realignment (100m)</li> <li>Utility diversion</li> <li>Watercourse crossing by proposed access road</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	<p>Implementation of measures described in the draft CoCP.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	<p>None required.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	<p>Construction (temporary)</p>
		<ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>Holcroft Lane Brook culvert (15m)</li> <li>Diversion (50m)</li> <li>Realignment (100m)</li> <li>Watercourse crossing by proposed access road</li> <li>Drainage outfall from highway attenuation pond</li> </ul>	<p>Approximately 620m of this watercourse will be lost during construction of the Culcheth south embankment.</p> <p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>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.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor, not significant</p>	<p>Mitigation measures will include diversion of watercourse to avoid embankment and appropriate watercourse crossing and drainage design.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	<p>None required.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	<p>Construction (permanent)</p>
Tributary of Holcroft Lane Brook 5	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include sediments, hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	<p>Implementation of measures described in the draft CoCP.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	<p>None required.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	<p>Construction (temporary)</p>
Silver Lane Lake Drains	Low	<ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported,</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	<p>Implementation of measures described in the draft CoCP.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	<p>None required.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	<p>Construction (temporary)</p>

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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.						
		<ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>HS2 attenuation ponds</li> </ul>	<p>Watercourse and associated ponds will be partially lost during construction of the Culcheth south embankment.</p> <p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	The watercourse and ponds will be re-established around the Proposed Scheme with appropriate watercourse crossing and drainage design.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Warrington Road Drains	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include sediments, hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Culcheth Linear Park Drain 1	Low	<ul style="list-style-type: none"> <li>Watercourse crossing by proposed road</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include sediments, hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Drainage outfalls from three highway attenuation ponds</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>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.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Mitigation measures will include appropriate drainage design. Measures to manage water quality will be adopted during the design process.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Cross Brook 1	Moderate	<ul style="list-style-type: none"> <li>Culcheth cutting</li> <li>Diversion (100m)</li> <li>Watercourse crossing by proposed road</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor adverse, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Culcheth cutting</li> <li>Diversion (100m)</li> <li>Watercourse crossing by proposed road</li> </ul>	<p>Approximately 145m of the headwaters of this watercourse will be diverted by 100m during construction of the Culcheth cutting.</p> <p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design element.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor, not significant</p>	The lost section of the watercourse will be diverted and discharged to an existing sewer via a swale.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor, not significant</p>	None required.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor, not significant</p>	Construction (permanent)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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 Glaze Brook 4	Moderate	None	Impact associated with groundwater, no works directly adjacent to the watercourse so limited potential for surface water flow and quality effects (see Section 3.1).	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)
Wigshaw Lane Drains	Low	<ul style="list-style-type: none"> <li>Culcheth cutting</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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)
		<ul style="list-style-type: none"> <li>Culcheth cutting</li> </ul>	Approximately 440m of this offline watercourse will be lost during construction of the Culcheth cutting.  Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design element.	Magnitude of impact – Moderate  Significance of effect – Minor adverse, not significant	The lost part of the watercourse will be incorporated into the new track drainage.  Mitigation measures will include appropriate watercourse crossing design.	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)
Culcheth Linear Park Drain 2	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include sediments, 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 Cockshot Brook	Low	None	Impact associated with groundwater, no works directly adjacent to the watercourse so limited potential for surface water flow and quality effects (see Section 3.1).	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)
Jibcroft Brook	Moderate	<ul style="list-style-type: none"> <li>Watercourse crossing by proposed access road</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include sediments, 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)
		<ul style="list-style-type: none"> <li>Drainage outfall from HS2 attenuation pond</li> </ul>	Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design element.  Deterioration of water quality due to contamination of surface water from both	Magnitude of impact – Minor  Significance of effect – Minor adverse, not significant	Mitigation measures will 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)

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

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.						
Tributary of Carr Brook 1	Low	<ul style="list-style-type: none"> <li>• Unnamed culvert east of HS2 attenuation pond (5m)</li> <li>• Watercourse crossing by proposed access road</li> <li>• Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>Uncontrolled site runoff could impact the flow dynamics and water quality of the receiving watercourse. Mobilised contaminants could typically include sediments, hydrocarbons related to fuel oils and high alkaline substances such as cement and concrete.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>• Unnamed culvert east of HS2 attenuation pond (5m)</li> <li>• Watercourse crossing by proposed access road</li> <li>• Drainage outfalls from HS2 attenuation pond</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design element.</p> <p>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.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Mitigation measures will include appropriate watercourse crossing and drainage design. Measures to manage water quality will be adopted during the design process.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Carr Brook 2	Low	None	Impact associated with groundwater, no works directly adjacent to the watercourse so limited potential for surface water flow and quality effects (see Section 3.1).	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Carr Brook	Moderate	<ul style="list-style-type: none"> <li>• Lowton cutting</li> <li>• Realignment (440m) including;               <ul style="list-style-type: none"> <li>– Carr Brook aqueduct (76m)</li> <li>– Newton Road access offline culvert (35m)</li> <li>– Golborne Pumping Station access culvert (15m)</li> </ul> </li> <li>• Watercourse crossing by proposed access road</li> <li>• Demolition of commercial and other properties</li> <li>• Utility diversion</li> <li>• Temporary works such as compounds,</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Moderate adverse, significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

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							
		<ul style="list-style-type: none"> <li>• Lowton cutting</li> <li>• Realignment (440m) including;               <ul style="list-style-type: none"> <li>- Carr Brook aqueduct (76m)</li> <li>- Newton Road access offline culvert (35m)</li> <li>- Golborne Pumping Station access culvert (15m)</li> </ul> </li> <li>• Watercourse crossing by proposed access road</li> <li>• Drainage outfalls from track drainage and HS2 attenuation pond</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor adverse, not significant</p>	<p>Mitigation measures will include minor realignment of watercourse to avoid proposed roads, and appropriate watercourse crossing and drainage design. Measures to manage water quality will be adopted during the design process. Aqueduct and culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Pennington Flash 1	Moderate	None	Impact associated with groundwater, no works directly adjacent to the watercourse so limited potential for surface water flow and quality effects (see Section 3.1).	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Pennington Flash	High	None	Impact associated with groundwater, no works directly adjacent to the watercourse so limited potential for surface water flow and quality effects (see Section 3.1).	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Small Brook	Low	<ul style="list-style-type: none"> <li>• Lowton South embankment</li> <li>• Realignment (225m) including Golborne Footpath 63 and Small Brook culvert (7m)</li> <li>• Watercourse crossing by proposed access road</li> <li>• Utility diversion</li> <li>• Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>• Lowton South embankment</li> <li>• Realignment (225m) including Golborne</li> </ul>	Deterioration, loss or change to approximately 133m of the existing water environment, flow characteristics and morphology due to the presence of the design elements.	<p>Magnitude of impact – Moderate</p>	Mitigation measures will include minor realignment of watercourse to avoid embankment, and	<p>Magnitude of impact – Negligible</p>	None required.	<p>Magnitude of impact – Negligible</p>	Construction (permanent)



**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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		Footpath 63 and Small Brook Culvert (7m) <ul style="list-style-type: none"> <li>Watercourse crossing by proposed access road</li> <li>Drainage outfall from HS2 attenuation pond and track drainage</li> </ul>	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.	Significance of effect – Minor, not significant	appropriate watercourse crossing and drainage design. Measures to manage water quality will be adopted during the design process.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Slag Lane Drains	Low	<ul style="list-style-type: none"> <li>Lowton South embankment</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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)
		<ul style="list-style-type: none"> <li>Lowton South embankment</li> </ul>	Approximately 32m of this offline watercourse will be lost during construction of the Lowton south embankment.	Magnitude of impact – Moderate  Significance of effect – Minor adverse, not significant	The lost part of the watercourse will be incorporated into the new track drainage.	Magnitude of impact – Negligible  Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible  Significance of effect – Negligible, not significant	Construction (permanent)
Sandy Lane Drain 1	Low	<ul style="list-style-type: none"> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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 Hey Brook 1	Low	<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Slag Lane culvert (15m)</li> <li>Slag Lane offline culvert (10m)</li> <li>Unnamed culvert west of the highways attenuation pond (10m)</li> <li>Realignment (90m) including Garton Common culvert (35m)</li> <li>Watercourse crossing by proposed road and access road</li> <li>Utility diversion</li> <li>Temporary works such as compounds,</li> </ul>	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)

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

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		<ul style="list-style-type: none"> <li>stockpiles and access routes</li> <li>Slag Lane culvert (15m)</li> <li>Slag Lane offline culvert (10m)</li> <li>Unnamed culvert west of the highways attenuation pond (10m)</li> <li>Realignment (90m) including Garton Common culvert (35m)</li> <li>Watercourse crossing by proposed road and access road</li> <li>Drainage outfall from two HS2 attenuation pond, one highway attenuation pond, track drainage and highway drainage</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	<p>Mitigation measures will include minor realignment of watercourse to avoid proposed roads, and appropriate watercourse crossing and drainage design.</p> <p>Measures to manage water quality will be adopted during the design process. Culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Hey Brook 3	Low	<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Diversion (190m)</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Diversion (190m)</li> <li>Drainage outfall from HS2 attenuation pond</li> </ul>	<p>Approximately 120m of this watercourse will be lost during construction of the Lowton south embankment.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	<p>The watercourse will be incorporated into the new track drainage.</p> <p>Measures to manage water quality will be adopted during the design process.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	None required.	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	Construction (permanent)
Tributary of Hey Brook 2	Low	<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Diversion (180m)</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Rislely to Bamfurlong  
Water resources assessment

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
		<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Diversion (180m)</li> </ul>	<p>Approximately 110m of this watercourse will be lost during construction of the Lowton south embankment.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	<p>The lost part of the watercourse will be incorporated into the new track drainage.</p> <p>Measures to manage water quality will be adopted during the design process.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	None required.	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	Construction (permanent)
Tributary of Hey Brook 4	Moderate	<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Unnamed culvert north of Byrom Wood (5m)</li> <li>Realignment (150m) including Golborne Footpath 31/10 and Critchley culvert (15m)</li> <li>Watercourse crossing by proposed access road</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor adverse, not significant</p>	<p>Implementation of measures described in the draft CoCP.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Unnamed culvert north of Byrom Wood (5m)</li> <li>Realignment (150m) including Golborne Footpath 31/10 and Critchley culvert (15m)</li> <li>Watercourse crossing by proposed access road</li> <li>Drainage outfall from HS2 attenuation pond</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design element.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor adverse, not significant</p>	<p>Mitigation measures will include minor realignment of watercourse to avoid embankment. Measures to manage water quality will be adopted during the design process.</p> <p>Culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Lowton Road Drains	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	<p>Implementation of measures described in the draft CoCP.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Tributary of Pennington Flash 2	Moderate	None	<p>No works directly adjacent to the watercourse so limited potential for surface water flow and quality effects.</p>	<p>Magnitude of impact – Negligible</p>	<p>Implementation of measures described in the draft CoCP.</p>	<p>Magnitude of impact – Negligible</p>	None required.	<p>Magnitude of impact – Negligible</p>	Construction (temporary)

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

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
				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Leeds and Liverpool Canal	Very high	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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 – 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)
Haydock Branch Junction Drains	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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)
Windy Bank Brook	Moderate	<ul style="list-style-type: none"> <li>Demolition of commercial and residential properties</li> <li>Lowton North embankment</li> <li>Realignment (100m) including Windy Bank culvert (60m)</li> <li>Watercourse crossing by proposed road and access road</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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)
		<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Realignment (100m) including Windy Bank culvert (60m)</li> <li>Watercourse crossing by proposed road and access road</li> <li>Drainage outfalls from track and road drainage</li> </ul>	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 railway and associated infrastructure or from accidental spillages.	Magnitude of impact – Minor  Significance of effect – Minor adverse, not significant	Mitigation measures will include minor realignment of watercourse to avoid embankment and proposed road, appropriate watercourse crossing and drainage design. Measures to manage water quality will be adopted during the design process.  Culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse.	Magnitude of impact – Negligible  Significance of effect – Negligible, not significant	None required.	Magnitude of impact – Negligible  Significance of effect – Negligible, not significant	Construction (permanent)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
Wigan Road Drain	Low	<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Lowton North embankment</li> </ul>	<p>Approximately 45m of this offline watercourse will be lost during construction of the Lowton south embankment.</p> <p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design element.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	The lost section of the watercourse will be incorporated into the new track drainage.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Nan Holes Brook 1	Low	<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Realignment (160m) including culvert (60m)</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Realignment (160m) including culvert (60m)</li> </ul>	<p>Approximately 110m of this watercourse will be lost during construction of the Lowton north embankment.</p>	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	The lost part of the watercourse will be incorporated into the new track drainage.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Nan Holes Brook 2	Low	<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Lowton North embankment</li> </ul>	<p>This approximately 70m watercourse will be lost during construction of the Lowton north embankment.</p>	<p>Magnitude of impact – Major</p>	The lost watercourse will be incorporated into the new track drainage.	<p>Magnitude of impact – Moderate</p>	None required.	<p>Magnitude of impact – Moderate</p>	Construction (permanent)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
				Significance of effect – Minor adverse, not significant		Significance of effect – Minor, not significant		Significance of effect – Minor, not significant	
Nan Holes Brook	Moderate	<ul style="list-style-type: none"> <li>Lowton North embankment</li> <li>Nan Holes Brook offline culvert (50m)</li> <li>Realignment (80m) including Nan Holes Brook culvert (35m)</li> <li>Watercourse crossing by proposed road and access road</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor adverse, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Nan Holes Brook offline culvert (50m)</li> <li>Realignment (80m) including Nan Holes Brook culvert (35m)</li> <li>Watercourse crossing by proposed road and access road</li> <li>Drainage outfalls from two HS2 attenuation ponds and one highway pond</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>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.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor adverse, not significant</p>	<p>Mitigation measures will include realignment of watercourse, appropriate watercourse crossing and drainage design. Measures to manage water quality will be adopted during the design process.</p> <p>Culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Hey Brook	High	<ul style="list-style-type: none"> <li>Hey Brook offline overbridge</li> <li>Flood relief channel (200m)</li> <li>Watercourse crossing by proposed road</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Moderate adverse, significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Hey Brook offline overbridge</li> <li>Flood relief channel (200m)</li> <li>Watercourse crossing by proposed road</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design element.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Moderate adverse, significant</p>	None required.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Moderate adverse, significant</p>	<p>Mitigation measures will include minor realignment of watercourse to allow for a more suitable crossing place, and appropriate</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
			and associated infrastructure or from accidental spillages.				watercourse crossing and drainage design. Measures to manage water quality will be adopted during the design process.		
		Cumulative impact assessment on Hey Brook	<p>The Hey Brook has a number of tributaries that are impacted by the scheme, including tributaries of Hey Brook 1-6, Small Brook, Windy Bank Brook, Nan Holes Brook, and Coffin Lane Brook.</p> <p>A total of 13 culverts impact on these watercourses, leading to a potentially significant impact on the hydromorphology of Hey Brook.</p> <p>The total length of culverts across these watercourses is 400m, whilst the total length of watercourse realignment associated with those culverts is approximately 925m.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Moderate adverse, significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Moderate adverse, significant</p>	<p>Mitigation options for the permanent impact on the hydromorphology of the Hey Brook catchment will be identified, discussed and agreed with the Environment Agency, with a view to ensuring no impact or deterioration of the Hey Brook catchment.</p> <p>Mitigation options may include the improvement of existing watercourse habitats or daylighting of culverts in other parts of the Hey Brook catchment.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Hey Brook 5	Low	<ul style="list-style-type: none"> <li>• Aye Bridge embankment retaining wall</li> <li>• Diversion (405m) including; <ul style="list-style-type: none"> <li>– Hey Brook tributary culvert (80m)</li> <li>– Hey Brook tributary offline culvert (10m)</li> </ul> </li> <li>• Watercourse crossing by proposed road and access road</li> <li>• Utility diversion</li> <li>• Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
		<ul style="list-style-type: none"> <li>Aye Bridge embankment retaining wall</li> <li>Aye Bridge embankment retaining wall</li> <li>Diversion (405m) including; <ul style="list-style-type: none"> <li>Hey Brook tributary culvert (80m)</li> <li>Hey Brook tributary offline culvert (10m)</li> </ul> </li> <li>Watercourse crossing by proposed road and access road</li> <li>Drainage outfalls from two HS2 attenuation ponds and one highway attenuation pond</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	<p>Mitigation measures will include realignment of watercourse, appropriate watercourse crossing and drainage design. Measures to manage water quality will be adopted during the design process.</p> <p>Culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Coffin Lane Brook 2	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Locker Lane Drain	Low	<ul style="list-style-type: none"> <li>Aye Bridge embankment retaining wall</li> <li>West Coast Main Line (WCML) box structure</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Aye Bridge embankment retaining wall</li> <li>WCML box structure</li> </ul>	Watercourse will be lost during construction of the Aye Bridge embankment retaining wall and WCML box structure.	<p>Magnitude of impact – Moderate</p> <p>Significance of effect – Minor adverse, not significant</p>	The watercourse will be incorporated into the new track drainage.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Coffin Lane Brook	Moderate	<ul style="list-style-type: none"> <li>Abram embankment retaining wall</li> <li>Realignment (75m) including Coffin Lane Brook culvert (60m)</li> <li>Temporary works such as compounds,</li> </ul>	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.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor adverse, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)



**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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	Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.						
		<ul style="list-style-type: none"> <li>Realignment (75m) including Coffin Lane Brook culvert (60m)</li> <li>Drainage outfalls from two HS2 attenuation ponds</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor adverse, not significant</p>	<p>Measures to manage water quality will be adopted during the design process.</p> <p>Culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Coffin Lane Brook 1	Low	<ul style="list-style-type: none"> <li>Abram cutting</li> <li>Unnamed culvert east of Hey Brook culvert (10m)</li> <li>Realignment (50m) including Hey Brook culvert (25m)</li> <li>Watercourse crossing by proposed access road</li> <li>Utility diversion</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
		<ul style="list-style-type: none"> <li>Unnamed culvert east of Hey Brook culvert (10m)</li> <li>Realignment (50m) including Hey Brook culvert (25m)</li> <li>Watercourse crossing by proposed access road</li> <li>Drainage outfalls from HS2 attenuation pond and road drainage</li> </ul>	<p>Deterioration, loss or change to the existing water environment, flow characteristics and morphology from the presence of the design elements.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	<p>Mitigation measures will include realignment of watercourse, appropriate watercourse crossing and drainage design. Measures to manage water quality will be adopted during the design process.</p> <p>Culvert lengths have been reduced during the design process and invert levels set below the bed of the watercourse.</p>	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (permanent)
Tributary of Hey Brook 6	Moderate	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Minor adverse, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
Bamfurlong Drains	Low	<ul style="list-style-type: none"> <li>Watercourse crossing by proposed access road</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	<p>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.</p> <p>Deterioration, loss or change to the existing water environment and the ecology supported, through the disturbance of silt or direct contamination by polluting materials.</p>	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
<b>Discharges to surface water</b>									
Discharge 0174/1	Low	None	Located upstream of the Proposed Scheme, however discharging into a watercourse considered within this assessment. Therefore, the discharge has been included on a precautionary basis.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Discharge 016993444	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	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.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Discharge 016992479	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.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Discharge 01M/346	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	Located within the land required for construction of the Proposed Scheme. This outfall has the potential to be physically impacted by construction work.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Discharge 016992436	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.	<p>Magnitude of impact – Minor</p> <p>Significance of effect – Negligible, not significant</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	None required.	<p>Magnitude of impact – Negligible</p> <p>Significance of effect – Negligible, not significant</p>	Construction (temporary)
Discharge 016920140	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds,</li> </ul>	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	<p>Magnitude of impact – Minor</p>	Implementation of measures described in the draft CoCP.	<p>Magnitude of impact – Negligible</p>	None required.	<p>Magnitude of impact – Negligible</p>	Construction (temporary)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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	potential for mobilisation of contaminants that could impact water quality at the discharge site is considered low.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Discharge NPSWQD007848	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	Located within the land required for construction of the Proposed Scheme. This outfall has potential to be physically impacted by construction work.	Magnitude of impact – Minor	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
Discharge EPRAP3320XC				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant			
Discharge 016993851	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	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Discharge 016992203	Low	<ul style="list-style-type: none"> <li>Lowton north embankment</li> <li>Temporary works such as compounds, stockpiles and access routes</li> </ul>	Located within the land required for construction of the Proposed Scheme. This outfall has potential to be physically impacted by construction work.	Magnitude of impact – Minor	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Discharge 016991186	Low	None	Located upstream of the Proposed Scheme, however discharging into a watercourse considered within this assessment. Therefore, the discharge has been included on a precautionary basis.	Magnitude of impact – Negligible	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
Discharge 16992865				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Discharge 01WIG0117	Low	None	Located upstream of the Proposed Scheme, however discharging into a watercourse considered within this assessment. Therefore, the discharge has been included on a precautionary basis.	Magnitude of impact – Negligible	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Discharge 016992465	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	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
Discharge 016982904				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Discharge 01WIG0130	Low	None	Located upstream of the Proposed Scheme, however discharging into a watercourse considered within this assessment. Therefore, the discharge has been included on a precautionary basis.	Magnitude of impact – Negligible	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Discharge 01WIG0127	Low	<ul style="list-style-type: none"> <li>Temporary works such as compounds,</li> </ul>	Located adjacent to the land required for construction of the Proposed Scheme. This	Magnitude of impact – Minor	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

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	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.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	

### 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 Water resources assessment baseline data (BID WR-004-0MA05). Individual impact assessments for each design element are presented in Section 3.2 to 3.4.
- 3.1.2 Construction compounds may have substantial water demands where they are associated with design elements, such as batching plant. 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.
- 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 design and mitigated by the draft CoCP.
- 3.1.4 The potential impacts of future ground investigations are considered negligible because of the measures outlined in the draft CoCP. As this assessment is applicable for all receptors it is not re-stated in Table 2.
- 3.1.5 In support of the groundwater impact assessment presented in Table 2, further detail is provided in Section 3.2 to Section 3.3 to demonstrate the methodology and assumptions used in relation to cuttings (including tunnel portals), viaducts and overbridges and tunnels of the Proposed Scheme. The locations of these elements are shown in Volume 2, MA05 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
<b>Hydrogeology (aquifers)</b>									
Peat – Unproductive strata	Low	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• utilities diversions</li> <li>• Culcheth South embankment</li> </ul>	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 – 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: <ul style="list-style-type: none"> <li>• M62 west viaduct</li> <li>• Culcheth South embankment</li> </ul>	The permanent below ground features, such as embankment piles and viaduct piers, may alter groundwater flow (see Section 3.2).	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 and permanent)
			Acid sulphate conditions may occur in the deep peat deposits, when oxidised. Piling in this peat could lead to oxidation of these deposits, that could impact on surface watercourses flowing in this area.	Magnitude of impact – Major  Significance of effect – Minor adverse, not significant	Surveys should be undertaken to identify if conditions are present that could lead to acidified peat.	Magnitude of impact – Major  Significance of effect – Minor adverse, not significant	If acid peat conditions exist, then aquifer protection measures should be used to ensure no pathway created to cause oxidation.	Magnitude of impact – Major  Significance of effect – Minor adverse, not significant	Construction (temporary and permanent)

**Environmental Statement**  
 Volume 5: Appendix WR-003-OMA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

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
Alluvium – Secondary A aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• utilities diversions</li> </ul>	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)
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• Lowton cutting</li> </ul>	Temporary and permanent works are above ground or shallow and of small areal extent compared to the aquifer.	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)
Lacustrine deposits – Unproductive strata	Low	None	This unit is not crossed by the Proposed Scheme in this community area. Although likely to be hydraulically connected to the glacial till, groundwater flow or groundwater quality in this unit is not expected to be impacted by 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	None
Head – Secondary (Undifferentiated) aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> </ul>	The head deposits in the study area are located on the opposite side of the valley of the Hey Brook to the Proposed Scheme. Consequently, they are very unlikely to be hydraulically connected to superficial deposits in the area 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)
Glaciofluvial deposits – Secondary A aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• utilities diversions</li> <li>• M62 West viaduct</li> </ul>	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)
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• M62 west viaduct</li> <li>• Culcheth South embankment</li> </ul>	The permanent below ground features (such as piling for the embankment) may alter groundwater flow (see Section 3.2).	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)
Glaciofluvial ice contact deposits – Secondary A aquifer	Moderate	None	This unit is not crossed by the Proposed Scheme in this community area. Although likely to be hydraulically connected to the glacial till, groundwater flows or groundwater quality in this unit is not expected to be impacted by 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	None
Glaciofluvial sheet deposits –	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> </ul>	The temporary works have the potential to affect shallow groundwater quality,	Magnitude of impact – Moderate	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
Secondary A aquifer		<ul style="list-style-type: none"> <li>temporary works such as stockpiles and compounds</li> </ul> Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>M62 West viaduct</li> <li>Culcheth South embankment</li> </ul>	although this is likely to be localised and temporary.	Significance of effect – Moderate adverse, significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>M62 West viaduct</li> <li>Culcheth South embankment</li> </ul>	The permanent below ground features (such as piling for the embankments and viaduct piers) may alter groundwater flow (see Section 3.2).	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)
Glaciolacustrine deposits – Unproductive strata	Low	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> <li>utilities diversions</li> </ul> Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>Culcheth cutting</li> </ul>	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 – 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: <ul style="list-style-type: none"> <li>Culcheth cutting</li> </ul>	Potential impacts from cutting dewatering are assessed in 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)
Glacial till – Secondary (Undifferentiated) aquifer	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> <li>utilities diversions</li> </ul>	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)
		<ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>Culcheth North embankment</li> <li>Lowton South embankment</li> <li>Lowton North embankment</li> </ul>	Temporary and permanent works are above ground or shallow and of small areal extent compared to the aquifer.	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: <ul style="list-style-type: none"> <li>M62 West viaduct</li> <li>Risley East accommodation underbridge</li> <li>A574 Warrington Road overbridge</li> <li>Wigshaw Lane overbridge</li> <li>Footpath Croft 8a/2 and 108/1 overbridge</li> <li>Culcheth north (Railway) viaduct</li> </ul>	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 structures. The location and extent of	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (permanent)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
		<ul style="list-style-type: none"> <li>B5207 Wilton Lane overbridge</li> <li>A580 East Lancashire Road overbridge</li> <li>A572 Newton Road overbridge</li> <li>Slag Lane viaduct</li> <li>A573 Wigan Road viaduct</li> <li>Footpath Golborne 33/10 accommodation underbridge</li> <li>WCML box structure</li> <li>Footpath Ashton-in-Makerfield 22/30 accommodation underbridge</li> </ul>	the foundations/structures are small compared to the much larger area of aquifer.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>Aye Bridge embankment retaining wall</li> <li>Abram embankment retaining wall</li> <li>Abram cutting retaining wall</li> <li>Abram cutting</li> </ul>	The permanent below ground features (such as piling for the embankment and retaining walls) may alter groundwater flow (see Section 3.2).	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: <ul style="list-style-type: none"> <li>Culcheth cutting</li> <li>Lowton cutting</li> </ul>	The temporary and permanent below ground works have the potential to affect groundwater quality and flow, although this is likely to be localised and temporary (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)
			Potential impacts from cutting dewatering are assessed in 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 works including grouting of mine shafts west of Aye Bridge Farm (360400-002 and 360400-003)	There is a potential for the grouting work to locally divert groundwater flow, causing damming of groundwater levels upgradient of the element and lowering on the downgradient side, but this work is small compared to the aquifer and groundwater will flow around the obstruction.	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 – Tarporley Siltstone Formation – Secondary B aquifer	Moderate	None	The unit is not crossed by the Proposed Scheme. Although the unit may be hydraulically connected to the Sherwood Sandstone, it is not expected to be impacted by works in proximity to the Sherwood Sandstone 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



**Environmental Statement**  
Volume 5: Appendix WR-003-OMA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
Sherwood Sandstone Group – Helsby Sandstone Formation – Principal aquifer	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level or embankment track and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul> Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>M62 West viaduct</li> <li>Culcheth South embankment</li> </ul>	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)
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>M62 West viaduct</li> <li>Culcheth South embankment</li> </ul>	Potential alteration of groundwater flow pathways may occur around viaduct piers and embankment piles. The location and extent of the piers are small compared to the much larger area of the aquifer.	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)
Sherwood Sandstone Group – Wilmslow Sandstone Formation – Principal aquifer	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level or embankment track and roads</li> <li>temporary works such as stockpiles and compounds</li> <li>Culcheth cutting</li> <li>Culcheth North embankment</li> <li>Lowton cutting</li> <li>A580 East Lancashire Road overbridge</li> </ul>	There is significant thickness of glacial till/glaciolacustrine deposits overlying the Sherwood Sandstone aquifer. Below ground features such as the Culcheth cutting will only extend into the glacial till that will protect the Sherwood Sandstone aquifer in terms of groundwater quality (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: <ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>Culcheth North (Railway) viaduct</li> </ul>	Potential alteration of groundwater flow pathways may occur around viaduct piers. The location and extent of the piers are small compared to the much larger area of the aquifer.	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)
Sherwood Sandstone Group – Chester Formation – Principal aquifer	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level or embankment track and roads</li> <li>temporary works such as stockpiles and compounds</li> <li>Lowton South embankment</li> <li>Lowton North embankment</li> <li>Footpath Golborne 33/10 accommodation underbridge</li> </ul>	There is significant thickness of glacial till/glaciolacustrine deposits overlying the Chester Formation. Below ground features will only extend into the glacial till or glaciolacustrine deposits that will protect the Sherwood Sandstone aquifer in terms of groundwater 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: <ul style="list-style-type: none"> <li>Lowton cutting</li> </ul>	The cutting will remove the overlying glacial till/glaciolacustrine deposits in some locations, creating a direct pathway into the sandstone aquifer. The construction works have the potential to affect groundwater quality.	Magnitude of impact – Major  Significance of effect – Major 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)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
			The cutting will remove glacial till/glaciolacustrine deposits in some locations, creating a direct pathway into the sandstone aquifer. The location and extent of the cutting are small compared to the much larger area of the aquifer.	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 dewatering on groundwater level and flow are assessed in Section 3.2. The cutting is above groundwater levels in the sandstone in this area.	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)
			The Lowton cutting will pass through the historical Lowton Sidings landfill site and could create a pathway for the movement of contamination into this aquifer – assessment of this is set out in the Land quality report, Volume 5: Appendix LQ-001-0MA05.						
		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 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)
		<ul style="list-style-type: none"> <li>• Carr Brook aqueduct</li> <li>• A572 Newton Road overbridge</li> <li>• Slag Lane viaduct</li> </ul>	Below ground piling will penetrate through the glacial till/glaciolacustrine deposits and into the underlying Chester Formation. The location and extent of the piles are small compared to the much larger area of the aquifer.	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)
Kinnerton Sandstone Formation – Principal aquifer (formerly part of the Sherwood Sandstone Group)	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level or embankment track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• Lowton North embankment</li> <li>• Aye Bridge embankment retaining wall</li> <li>• A573 Wigan Road viaduct</li> <li>• WCML box structure</li> <li>• Abram embankment retaining wall</li> <li>• Abram cutting</li> </ul>	There is significant thickness of glacial till overlying the bedrock aquifers in this area. Below ground features will only extend into the glacial till 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)
Cumbrian Coast Group – Manchester Marls Formation – Secondary B aquifer	Moderate								
Appleby Group – Collyhurst Sandstone Formation – Principal aquifer	High								

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

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
Pennine Coal Measures Group – Pennine Middle Coal Measures Formation – Secondary A aquifer	Moderate								
Cumbrian Coast Group – Manchester Marls Formation – Secondary B aquifer  Pennine Coal Measures Group – Pennine Middle Coal Measures Formation – Secondary A aquifer	Moderate	Deeper works including grouting of two mine shafts west of Aye Bridge Farm <sup>5</sup>	There is potential for the grouting work to locally divert groundwater flow, causing damming of groundwater levels upgradient of the element and lowering on the downgradient side. The scale of the grouting work is small compared to the aquifer.	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)
<b>Abstractions</b>									
United Utilities Ltd Licence identifier confidential (map WR-02-305 – D5, C5, C6, B6, B7, SPZ3 location)	Very high	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track, embankments (Culcheth South and Culcheth North) and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul>	Removal of topsoil or shallow material, and shallow construction activity has potential to cause increased turbidity and impact on groundwater quality in the SPZ3 during construction. Groundwater for this abstraction is taken from the Sherwood Sandstone. There is significant (between 5 and 20m) glacial till overlying the Sherwood Sandstone aquifer at this location.	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: <ul style="list-style-type: none"> <li>Culcheth cutting</li> </ul>	The construction works have the potential to affect groundwater quality in the Sherwood Sandstone, although this is likely to be localised and temporary. Groundwater for this abstraction is taken from the Sherwood Sandstone. A minimum of 13m of glacial till is estimated to separate the base of the cutting drainage from the underlying Sherwood Sandstone aquifer (see Section 3.2) thereby protecting the aquifer during construction.	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)
			The cutting could result in a shorter pathway for surface water to infiltrate to the Sherwood Sandstone (see Section	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (permanent)

<sup>5</sup> Taken from the Coal Authority mine entry locations dataset. The two mine shafts have mine entry reference numbers 360400-002 and 360400-003 respectively.

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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	
			3.2), however, a minimum of 13m of glacial till is estimated to separate the base of the cutting drainage from the underlying Sherwood Sandstone aquifer, therefore preventing any impact on water quality.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• Culcheth South embankment</li> <li>• M62 West viaduct</li> <li>• A574 Warrington Road overbridge</li> <li>• Wigshaw Lane overbridge</li> </ul>	Construction of overbridge and viaduct foundations and embankment piles has the potential to affect groundwater quality and flow during construction, however this will be localised and temporary and is not expected to impact on the abstraction (see Section 3.2).	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)	
United Utilities Ltd Licence identifier confidential (map WR-02-305 – D4, SPZ1 location)	Very high	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track, embankments and roads</li> <li>• temporary works such as stockpiles and compounds</li> </ul>	Removal of topsoil or shallow material, and shallow construction activity, has potential to cause increased turbidity and impact on groundwater quality in the SPZ3 during construction. However, there is significant (more than 20m in places) glacial till overlying the Sherwood Sandstone aquifer at this location.	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: <ul style="list-style-type: none"> <li>• Culcheth cutting</li> <li>• Lowton cutting</li> </ul>	The Culcheth cutting will be excavated in glacial till overlying the Sherwood Sandstone aquifer and is over 1000m from the abstraction. Therefore, the cutting will not cause an impact on groundwater flow or quality (see Section 3.2).  Although the cutting may extend below the top of the Sherwood Sandstone Group aquifer, it would not extend to the groundwater level (see Section 3.2).	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)	
		The Lowton cutting will pass through the historical Lowton Sidings landfill site and could create a pathway for the movement of contamination into this aquifer – assessment of this is set out in the Land quality report, Volume 5: Appendix LQ-001-0MA05.								
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• Wigshaw Lane overbridge</li> <li>• B5207 Wilton Lane overbridge</li> </ul>	Construction of overbridge and viaduct foundations and embankment piles has the potential to affect groundwater quality and flow during construction. However, this will be localised and temporary and is not expected to impact on the abstraction that is located over 1km from the areas of construction.	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)	
United Utilities Ltd Licence identifier confidential (map WR-02-305 – E5, SPZ1 location)	Very high	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track, embankments (Culcheth North and Lowton South) and roads</li> <li>• temporary works such as stockpiles and compounds</li> </ul>	Removal of topsoil or shallow material, and shallow construction activity has potential to cause increased turbidity and impact on groundwater quality in the SPZ3 during construction. However, there is a substantial thickness of glacial till overlying the Sherwood Sandstone aquifer at these locations.	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)	

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

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
United Utilities Ltd Licence identifier confidential (map WR-02-305 – E6, SPZ1 location)	Very high	Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>Lowton cutting</li> <li>Carr Brook aqueduct</li> <li>A572 Newton Road overbridge</li> </ul>	The temporary and permanent impacts of the Lowton cutting on groundwater flow and quality for this abstraction are assessed as negligible. Although the cutting may extend below the top of the Sherwood Sandstone Group aquifer, it would not extend to the groundwater level, as indicated by existing groundwater level data (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)
		The Lowton cutting will pass through the historical Lowton Sidings landfill site and could create a pathway for the movement of contamination into this aquifer – assessment of this is set out in the Land quality report, Volume 5: Appendix LQ-001-0MA05.							
United Utilities Ltd Licence identifier confidential (map WR-02-305 – E5, SPZ1 location)	Very high	Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>Culcheth North (Railway) viaduct</li> <li>Wigshaw Lane overbridge</li> <li>B5207 Wilton Lane overbridge</li> </ul>	The viaduct piers will extend into the bedrock aquifer and have the potential to cause increased turbidity and impact on groundwater quality in the SPZ3 during construction. However, this will be localised and temporary and is not expected to impact on the abstraction that is located over 1km from the areas of construction.	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)
		The Lowton cutting will pass through the historical Lowton Sidings landfill site and could create a pathway for the movement of contamination into this aquifer – assessment of this is set out in the Land quality report, Volume 5: Appendix LQ-001-0MA05.							
United Utilities Ltd Licence identifier confidential (map WR-02-305 – E5, SPZ1 location)	Very high	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track, embankments and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul>	Removal of topsoil or shallow material, and shallow construction activity, has potential to cause increased turbidity and impact on groundwater quality in the SPZ2 during construction. However, there is significant (more than 20m in places) glacial till overlying the Sherwood Sandstone aquifer at this location.	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: <ul style="list-style-type: none"> <li>Lowton cutting</li> </ul>	The Lowton cutting is located in SPZ2 for the abstraction, although construction would not extend down to the groundwater level in the bedrock aquifer as indicated by existing groundwater level data. There is, however, a small risk to groundwater quality, including turbidity, at the abstraction source during construction (see Section 3.2).	Magnitude of impact – Moderate  Significance of effect – Major adverse, significant	A management strategy will need to be agreed with the Environment Agency in consultation with United Utilities. Until the strategy is in place the significant residual effect on this abstraction remains.	Magnitude of impact – Moderate  Significance of effect – Major adverse, significant	Dewatering will require a consent under the abstraction licensing strategy from the Environment Agency in consultation with United Utilities.	Magnitude of impact – Moderate  Significance of effect – Major adverse, significant	Construction (temporary)
		Construction of the Lowton cutting will remove the overlying superficial deposits, creating a pathway to the Sherwood Sandstone (see Section 3.2). There is the potential that this could cause a slight change in groundwater chemistry in this area, although the change is expected 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)	
The Lowton cutting will pass through the historical Lowton Sidings landfill site and could create a pathway for the movement of contamination into this aquifer – assessment of this is set out in the Land quality report, Volume 5: Appendix LQ-001-0MA05.									

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

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
United Utilities Ltd Licence identifier confidential (map WR-02-305 – F5, SPZ1 location)	Very high	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track, embankments (Lowton South and Lowton North) and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul>	Removal of topsoil or shallow material, and shallow construction activity has potential to cause increased turbidity and impact on groundwater quality in the SPZ2 and SPZ3 during construction. However, there is at least 10m of glacial till overlying the Sherwood Sandstone aquifer at these locations.	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)
United Utilities Ltd Licence identifier confidential (map WR-02-305 – F6, SPZ1 location)	Very high	Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>Slag Lane viaduct</li> </ul>	Construction of viaduct foundations has the potential to affect groundwater quality during construction. However, any impact will be localised and temporary, and is not expected to affect the abstractions as the viaduct is in SPZ3 for the licensed sources, and more than 500m away.	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)
Leigh Golf Club Ltd licensed abstraction Licence number 2569016072	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track, embankments and roads</li> <li>temporary works such as stockpiles and compounds</li> <li>Culcheth North embankment</li> </ul>	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)
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>Culcheth cutting</li> <li>Lowton cutting</li> <li>B5027 Wilton Lane overbridge</li> </ul>	The Lowton Cutting and Culcheth cutting are above the water table in the Sherwood Sandstone (based on water levels from boreholes) and more than 600m from this borehole. The borehole is outside of the radius of influence of both cuttings and therefore preventing any impact on water quantity and quality (see Section 3.2).	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)
Phillips Farm unlicensed abstraction	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track, embankments and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul> Deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>Culcheth cutting</li> </ul>	This abstraction is located adjacent to the Proposed Scheme. It is within the land required for the construction of the Proposed Scheme and so is likely to be unusable as a result of the construction. The exact location of the borehole is unknown but the farm building that currently uses this borehole will be destroyed as part of the construction of the Proposed Scheme and therefore the borehole will no longer be in use.	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 and permanent)
<b>Discharges to groundwater</b>									
Discharge NPSWQD002147	Low	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track, embankments (Culcheth South and Aye Bridge and</li> </ul>	These discharges are on the opposite side of the Hey Brook valley to the Proposed Scheme, not within the footprint of the Proposed Scheme or in proximity to any below ground works,	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary and permanent)
Discharge 016993599									

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
		Abram embankment retaining walls) and roads <ul style="list-style-type: none"> <li>temporary works such as stockpiles and compounds</li> </ul> Deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>WCML box structure</li> </ul>	therefore preventing any impact on these discharges.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
<b>Groundwater – surface water interactions</b>									
Potential spring 175m north-west of St. Lewis Catholic Primary School  Potential spring at Diggle Green Farm  Spring 450m east of Aye Bridge Farm	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track, embankments and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul> Construction involving deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>M62 West viaduct</li> <li>Culcheth cutting</li> </ul>	No impacts from construction are predicted, as these features are located upgradient and/or outside of the radius of influence of the cutting.	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 spring 350m north of Lightshaw Hall, Ashton-in-Makerfield  Potential spring 330m west of Smith's Bridge, Leeds and Liverpool Canal  Potential sink 345m west of Smith's Bridge, Leeds and Liverpool Canal  Potential spring at Crankwood Road, 120m west of Chadwick's Farm  Potential spring 220m east of Bamfurlong Bridge	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> <li>Lowton North embankment</li> <li>Aye Bridge embankment retaining walls</li> <li>Abram embankment retaining wall</li> <li>Abram cutting retaining wall</li> </ul>	These features are separated from the Proposed Scheme by the valley of the Hey Brook. Consequently, they 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)

**Environmental Statement**  
Volume 5: Appendix WR-003-OMA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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 220m east of Bamfurlong Bridge									
Potential spring 220m east of Bamfurlong Bridge									
Potential spring 150m north of Water Treatment Works, north Golborne  Spring at Nan Holes Brook, 310m west of Locker Lane Farm	High  Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• utilities diversions</li> <li>• Lowton North embankment</li> </ul>	These features are located within a valley 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 at West Coast Main Line railway, 320m north-west of Aye Bridge Farm	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and road</li> <li>• temporary works such as stockpiles and compounds</li> <li>• Aye Bridge embankment retaining walls</li> </ul>	This spring is in the direct path of the Proposed Scheme. It will be culverted beneath the route and discharged into Tributary of Hey Brook 5. Baseflow to the receiving watercourse is unlikely to be altered but this feature will be lost.	Magnitude of impact – Major  Significance of effect – Major adverse, significant	The spring will be culverted beneath the route. Baseflow to the receiving watercourse is unlikely to be altered.	Magnitude of impact – Major  Significance of effect – Major adverse, significant	Where reasonably practicable, additional measures may include re-establishing a spring near to the original location and mitigating for any adverse impacts as far as is reasonably practicable.	Magnitude of impact – Negligible  Significance of effect – Negligible, not significant	Construction (temporary and permanent)
Potential spring at Public Car Park, Bolton Road, Ashton-in-Makerfield  Potential spring 200m west of Viridor Wood, Bryn Gates	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• Abram embankment retaining wall</li> </ul>	These features are located in a network of drains, up-gradient of the Proposed Scheme. They 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)
Spring at Bamfurlong Bridge	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track, embankments and roads</li> <li>• temporary works such as stockpiles and compounds</li> </ul>	Construction in this location comprises works on the existing railway track, and as the spring is located adjacent to the existing tracks, there is the potential to temporarily affect groundwater quality.	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)
Glaze Brook	High	Construction of above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> </ul>	The temporary works have the potential to affect groundwater quality and flow that contributes to the watercourse although this is likely to be localised and temporary.	Magnitude of impact – Minor	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)



**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
		<ul style="list-style-type: none"> <li>temporary works such as stockpiles and compounds</li> </ul> Deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>M62 West viaduct</li> <li>Culcheth South embankment</li> </ul>		Significance of effect – Moderate adverse, significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Holcroft Lane Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul>	The temporary works and construction of the Culcheth South embankment have the potential to affect groundwater quality that contributes to the watercourse 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)
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>Culcheth South embankment</li> </ul>	The permanent below ground features, such as piled foundations for the Culcheth South embankment, have the potential to alter groundwater flow that contributes to the watercourse (see Section 3.2). Baseflow to parts of the watercourse may be diverted or reduced.	Magnitude of impact – Moderate  Significance of effect – Moderate adverse, significant	Baseflow intercepted by the piled embankment will be returned to the watercourse downstream of the piled embankment by the drainage system of 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)
Tributaries of Holcroft Lane Brook 1 to 3	Low	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul> Deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>Culcheth South embankment</li> <li>M62 West viaduct</li> </ul>	The temporary works and construction of piled foundations for the Culcheth South embankment and M62 West viaduct have the potential to affect groundwater quality that contributes to the watercourse 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: <ul style="list-style-type: none"> <li>Culcheth South embankment</li> </ul>	The construction of the Proposed Scheme is unlikely to have a measurable impact on the groundwater flow contribution to these 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)
Tributaries of Holcroft Lane Brook 5 and 6	Low	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul> Deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>Culcheth South embankment</li> </ul>	These features are on the opposite side of Holcroft Lane Brook valley to the Proposed Scheme and are, therefore, 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)
Tributary of Holcroft Lane Brook 4	Low	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul>	The temporary works and construction of piled foundations for the Culcheth south embankment and M62 west viaduct have the potential to affect groundwater quality that contributes to	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)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
			the watercourse although this is likely to be localised and temporary.						
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• Culcheth South embankment</li> <li>• Culcheth cutting</li> <li>• Culcheth North embankment</li> </ul>	The proposed cutting and piled foundations for the embankment may intercept a small proportion of groundwater that would otherwise discharge to this watercourse (see Section 3.2).	Magnitude of impact – Moderate  Significance of effect – Minor adverse, not significant	Baseflow intercepted by the cutting and piled embankment will be returned to the watercourse downstream of the cutting and piled embankment by the drainage system of 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 Cross Brook 1	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and road</li> <li>• temporary works such as stockpiles and compounds</li> <li>• utilities diversions</li> </ul>	The temporary works and construction of piled foundations for the Culcheth south embankment and M62 west viaduct have the potential to affect groundwater quality that contributes to the watercourse 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: <ul style="list-style-type: none"> <li>• Culcheth cutting</li> <li>• Culcheth North embankment</li> </ul>	The proposed cutting and piled foundations for the embankment may intercept a small proportion of groundwater that would otherwise discharge to this watercourse (see Section 3.2).	Magnitude of impact – Moderate  Significance of effect – Minor adverse, not significant	None required.	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)
Tributary of Glaze Brook 4	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and road</li> <li>• temporary works such as stockpiles and compounds</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourse 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 Cockshot Brook	Low	Construction involving deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• Culcheth cutting</li> <li>• Culcheth North embankment</li> </ul>							
Jibcroft Brook	Moderate	Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• Culcheth cutting</li> <li>• Culcheth North embankment</li> </ul>	The proposed cutting and piled foundations for the embankment may intercept a small proportion of groundwater that would otherwise discharge to these watercourses. Drainage water from the Proposed Scheme would be discharged to Holcroft Lane Brook or Tributary of Carr Brook and not to these watercourses (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)
Tributaries of Carr Brook 1 and 2	Low	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourse although	Magnitude of impact – Minor	None required though the draft CoCP will be implemented	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
Small Brook		<ul style="list-style-type: none"> <li>temporary works such as stockpiles and compounds</li> </ul>	this is likely to be localised and temporary.	Significance of effect – Negligible, not significant	throughout construction.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>Lowton cutting</li> </ul>	These watercourses are outside the zone of influence of the cutting. However, the cutting may intercept a small proportion of groundwater that would otherwise discharge to the watercourses. This intercepted groundwater would be discharged to Carr Brook and not to these watercourses.	Magnitude of impact – Minor  Significance of effect – Negligible, not significant	None required though the draft CoCP will be implemented throughout construction.	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)
Carr Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul> Construction involving deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>Lowton cutting</li> <li>Carr Brook aqueduct</li> <li>A572 Newton Road overbridge</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourse although this is likely to be localised and temporary.  The Lowton cutting will intercept groundwater that would otherwise provide baseflow to this watercourse.	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 and permanent)
				Magnitude of impact – Moderate  Significance of effect – Moderate adverse, significant	Water intercepted by the drainage for the cutting will be returned to the watercourse downstream of the crossing with the Proposed Scheme. As such, less than 200m of the watercourse will receive reduced baseflow.	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 Pennington Flash 1	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul> Deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>Lowton cutting</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourse 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 watercourse is outside the zone of influence of the Lowton cutting. Consequently, no impact from dewatering on groundwater flow to this watercourse is expected.	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)
Pennington Flash	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>ground level track, and roads</li> <li>temporary works such as stockpiles and compounds</li> <li>Lowton North embankment</li> <li>Lowton South embankment</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourse 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 construction of the Proposed Scheme is unlikely to have a measurable	Magnitude of impact – Negligible	None required.	Magnitude of Impact – Negligible	None required.	Magnitude of Impact – Negligible	Construction (permanent)

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
			impact on groundwater flow to this waterbody.	Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Tributaries of Hey Brook 1 and 3	Low	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• utilities diversion</li> <li>• Lowton North embankment</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourse although this is likely to be localised and temporary.	Magnitude of impact – Minor	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
Tributary of Hey Brook 2	Low			Significance of effect – Minor adverse, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Tributary of Hey Brook 4	Moderate								
Tributary of Nan Holes Brook 1	Low	Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• Slag Lane viaduct</li> <li>• A573 Wigan Road viaduct</li> </ul>	The construction of the Proposed Scheme is unlikely to have a measurable impact on groundwater flow to these watercourses.	Magnitude of impact – Negligible	None required.	Magnitude of Impact – Negligible	None required.	Magnitude of Impact – Negligible	Construction (permanent)
Tributary of Nan Holes Brook 2	Moderate			Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Nan Holes Brook	Moderate								
Hey Brook	High	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• Aye Bridge embankment retaining walls</li> <li>• Abram embankment retaining walls</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourse although this is likely to be localised and temporary.	Magnitude of impact – Minor	Implementation of measures described in the draft CoCP.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
Tributary of Hey Brook 5	Low			Significance of effect – Moderate adverse, significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Tributary of Hey Brook 6	Moderate								
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• A573 Wigan Road viaduct</li> <li>• Abram cutting retaining wall</li> </ul>	The piling associated with the viaduct and retaining wall will be shallow, small diameter and sufficiently spaced such that it is unlikely to have a measurable impact on groundwater flow contributions to these watercourses.	Magnitude of impact – Negligible	None required.	Magnitude of Impact – Negligible	None required.	Magnitude of Impact – Negligible	Construction (permanent)
				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
		Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• Abram cutting</li> </ul>	These watercourses are outside the zone of influence of the cutting. Consequently, no impact on groundwater flow to this watercourse is expected.	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)
				Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	
Windy Bank Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• utilities diversions</li> </ul> Deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>• Lowton North embankment</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourse although this is likely to be localised and temporary.	Magnitude of impact – Minor	None required though the draft CoCP will be implemented throughout construction.	Magnitude of impact – Negligible	None required.	Magnitude of impact – Negligible	Construction (temporary)
				Significance of effect – Minor adverse, not significant		Significance of effect – Negligible, not significant		Significance of effect – Negligible, not significant	

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Risley to Bamfurlong  
Water resources assessment

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
Coffin Lane Brook	Moderate	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> </ul> Deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>• Abram cutting</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourse 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 watercourse is within the zone of influence of the cutting. Consequently, a reduction in groundwater flow to this watercourse is expected (see Section 3.2).	Magnitude of impact – Moderate  Significance of effect – Moderate adverse, significant	Water intercepted by Abram cutting will be returned to the watercourse downstream of the cutting by the drainage system of 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)
Tributary of Coffin Lane Brook 1	Low	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• Abram embankment retaining walls</li> </ul> Deeper excavation including (>1mbgl): <ul style="list-style-type: none"> <li>• Abram cutting</li> </ul>	The temporary works have the potential to affect groundwater quality that contributes to the watercourses although this is likely to be localised and temporary.	Magnitude of impact – Minor  Significance of effect – Negligible, not significant	None required though the 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 Coffin Lane Brook 2			The watercourses are within the zone of influence of the cutting. Consequently, a reduction in groundwater flow to these watercourses is expected as water will be returned to Coffin Lane Brook (see Section 3.2).	Magnitude of impact – Major  Significance of effect – Minor adverse, not significant	Water intercepted by Abram cutting will be returned to the watercourse downstream of the cutting by the drainage system of the Proposed Scheme.	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 and permanent)

## 3.2 Impact on groundwater from cuttings

- 3.2.1 Summary parameters for each cutting are presented below in Table 3 to Table 5.
- 3.2.2 Where the groundwater elevation lies above the base of the cutting, 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 below track level is estimated at 3.15m.
- 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.

## Culcheth cutting

**Table 3: Summary of the parameters for the groundwater assessment of Culcheth cutting**

Cutting parameters	Parameter details
Length (km)	1.93
Maximum depth (m)	3.6 to top of rail (6.7 to drainage invert)
Strata intercepted	Glaciolacustrine deposits (Unproductive) Glacial till (Secondary (Undifferentiated) aquifer)
Lowest level of drainage invert along track (metres above ordnance datum: mAOD)	25.8
Groundwater level(s) (mAOD)	Ground level
Principal receptors	Public water supply boreholes United Utilities (map WR-02-305 – D5, C5, C6, B6, B7, SPZ3 location) Public water supply boreholes United Utilities (map WR-02-305 – B6, B7, C4, C5, C6, C7, D3, D4, D5, SPZ3 location) Licenced abstraction Leigh Golf Club Ltd (map WR-02-305 – D5) Tributary of Cross Brook 1 Tributary of Holcroft Lane Brook 4 Glacial till Secondary (Undifferentiated) aquifer Sherwood Sandstone Group (Wilmslow Sandstone Formation) Principal aquifer

- 3.2.7 The cutting would be located within the glacial till Secondary (Undifferentiated) 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 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  $3 \times 10^{-4} \text{m/s}$  for the glacial till<sup>6</sup>, the lateral extent of drawdown (also referred to as the zone of influence) in the glacial till is estimated up to a distance of 202m from the cutting. This is based on maximum cutting depth of 6.7m from ground level to track drainage invert, and a rest water level at ground level.
- 3.2.9 Culcheth cutting will be constructed as an open cutting. At the time of the assessment, no piling, foundations or retaining walls are proposed. The glacial till is estimated to extend at least 13m below the base of the cutting drainage and is laterally extensive. Therefore, potential local changes in groundwater level to the maximum depth of the cutting drainage are assessed as minor, leading to a minor adverse effect which is not significant on the glacial till Secondary (Undifferentiated) aquifer. There may be high permeability horizons within the glacial till 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.
- 3.2.10 The proposed cutting does not penetrate the Sherwood Sandstone Group as the glacial till is anticipated to be at least 13m thick beneath the base of the cutting drainage. With the application of the draft CoCP, groundwater quality and groundwater flow impacts for the Sherwood Sandstone Group resulting from construction of the cutting, should be negligible, leading to negligible effects which are not significant.
- 3.2.11 Tributary of Holcroft Lane Brook 4 may receive reduced baseflow due to the interception of groundwater by the Culcheth cutting. However, the drainage from the cutting will discharge into this watercourse and, therefore, the impact on flows is considered to be negligible. Tributary of Cross Brook 1 may receive reduced baseflow over approximately 300m of its length due to the interception of groundwater by the Culcheth cutting. This impact is assessed to be moderate adverse, leading to a minor effect which is not significant. All other surface watercourses are located outside the calculated zone of influence of this cutting.
- 3.2.12 Two licensed public water supply abstraction sources for United Utilities (SPZ3 location map WR-02-305 – D5, C5, C6, B6, B7 and SPZ3 location map WR-02-305 – B6, B7, C4, C5, C6, C7, D3, D4, D5) have source protection zones that extend across the Culcheth cutting. In addition, the licensed abstraction at Leigh Golf Club is located 600m from the Culcheth cutting. All of these abstractions take groundwater from the Sherwood Sandstone Group. As discussed previously, the proposed cutting is expected to have a negligible effect on groundwater flow and quality in the Sherwood Sandstone Group and will consequently have a negligible effect which is not significant on these abstractions.

<sup>6</sup> On a precautionary basis, high-end sand and gravel conductivity values are assumed for 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.

- 3.2.13 Construction of the Culcheth cutting will remove some of the superficial deposits along the line of the cutting. The glacial till consists generally of interbedded layers of variable permeability that are therefore expected to restrict 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 Sherwood Sandstone that could lead to a slight change in groundwater chemistry in the area. However, a thickness of glacial till of at least 15m will remain between the base of the cutting and the Sherwood Sandstone and the cutting is very limited in area in comparison to SPZ3 for the two abstraction sources. As a result, the impact of this change in chemistry is assessed to be negligible, leading to a negligible effect which is not significant.
- 3.2.14 There are no other recorded groundwater dependent features within the calculated zone of influence of the Culcheth cutting.

## Lowton cutting

**Table 4: Summary of the parameters for the groundwater assessment of Lowton cutting**

Cutting parameters	Parameter details
Length (km)	1.8
Maximum depth (m)	10.1 to top of rail (13.3 to drainage invert)
Strata intercepted	Glaciolacustrine deposits (Unproductive) Glacial till (Secondary (Undifferentiated) aquifer) Sherwood Sandstone Group (Wilmslow Sandstone Formation and Chester Formation) Principal aquifers
Lowest level of drainage invert along track (mAOD)	17.8
Groundwater level(s) (mAOD)	Glacial till: at ground level Sherwood Sandstone Group: maximum 15.25mAOD taken from British Geological Society (BGS) borehole log (borehole code SJ69NW48) in 1962
Principal receptors	Pennington Flash Site of Biological Importance and Local Nature Reserve Public water supply boreholes United Utilities (map WR-02-305 – B6, B7, C4, C5, C6, C7, D3, D4, D5, SPZ3 location) Public water supply boreholes United Utilities (map WR-02-305 – D5, E5, D6, E6, SPZ3 location) Public water supply boreholes United Utilities (map WR-02-305 – E5, SPZ2 location) Public water supply boreholes United Utilities (map WR-02-305 – D5, E5, D6, E6, SPZ3 location) Glacial till Secondary (Undifferentiated) aquifer Sherwood Sandstone Group (Wilmslow Sandstone Formation and Chester Formation) Principal aquifers Carr Brook Tributary of Carr Brook 1 Tributary of Carr Brook 2 Small Brook

- 3.2.15 The cutting would penetrate into the glacial till Secondary (Undifferentiated) aquifer and the top of the Sherwood Sandstone Principal aquifer. There is no currently available information on groundwater elevations or depth to groundwater in this area for the glacial till. 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 cutting.
- 3.2.16 There are several Environment Agency boreholes monitoring the groundwater level in the Sherwood Sandstone in the area of Lowton cutting (Kenyon Lane, Kenyon Farm, Landside North and Landside South), the nearest of which is Kenyon Lane. While historical data is only available at Kenyon Lane for a few years of monitoring (2011–2014), the trend in groundwater levels was similar to the trend in groundwater levels in the same period at Kenyon Farm. Hence, it is possible to extend the water level record for Kenyon Lane approximately, based on the much longer record of monitoring data at Kenyon Farm. The hydrographs of Landside North and Landside South are not as suitable for this purpose as they are more likely to be influenced by abstraction from the public water supply boreholes in the area.
- 3.2.17 The maximum recorded groundwater level at Kenyon Lane was 1.64mAOD in 2014. Correlating the groundwater levels for Kenyon Lane with Kenyon Farm resulted in an estimated groundwater level of approximately 3mAOD for the Sherwood Sandstone Group at Kenyon Lane in 2017. However, there has been a long-term rising trend in groundwater levels in the Sherwood Sandstone at Kenyon Farm since the 1980s, with the level rising by approximately 12m over a period of 36 years. If this same overall long-term trend was to continue into the future at Kenyon Lane, the groundwater level at Kenyon Lane could reach 15mAOD in the mid-2050s. The rise in groundwater level seen at Kenyon Farm since the 1980s is, presumably, a result of major reductions in groundwater abstraction in the area. Whether abstraction will continue

to decrease and, as a result, groundwater levels will continue to rise, is not known. There is evidence of a continuing rise in groundwater level at Kenyon Farm in the period from 2011 to 2017. However, in 2018, the groundwater level declined again slightly at Kenyon Farm.

- 3.2.18 At present, the groundwater level in the Sherwood Sandstone in the area is likely to be more than 10m below the minimum estimated elevation of the drainage in the cutting (17.8mAOD), as indicated by the data for the borehole at Kenyon Lane. As a result, the proposed cutting would be expected to have no impact on groundwater flow in the Sherwood Sandstone Group Principal aquifer. There might be a change in downward leakage to the aquifer from the overlying glacial till in the vicinity of the cutting. However, taking into account the regional extent of the Sherwood Sandstone aquifer, the effect on the aquifer in relation to current conditions is assessed as negligible. Based on the assumption that the long-term rising trend in groundwater levels continues in the future, it is estimated that the groundwater level at Kenyon Lane could reach approximately 15mAOD by the mid-2050s. In these conditions, the groundwater level would remain below the minimum estimated elevation of the drainage in the cutting. In the event that the groundwater level rose further, to a level above the base of the cutting drainage, some groundwater from the Sherwood Sandstone would discharge to the drainage system. However, this would comprise an impact on a possible future aquifer condition and not on the existing situation although, taking into account the regional extent of the Sherwood Sandstone aquifer, the effect on the aquifer would still be a negligible which is not significant.
- 3.2.19 Perched water may be present in the sandy bands within the glacial till and therefore, the cutting could impact on groundwater within the glacial till. Assuming a hydraulic conductivity value of  $3 \times 10^{-4} \text{m/s}$  for the glacial till<sup>6</sup>, the maximum lateral extent of drawdown (also referred to as the zone of influence) from the cutting is estimated as 309m. This is based on a maximum cutting depth of 13.3m from ground level to the track drainage invert, and a rest water level at ground level. The glacial till is assumed to be fully penetrated by parts of the cutting. The Lowton cutting will be constructed as an open cutting. At the time of the assessment, no piling, foundations or walls are proposed.
- 3.2.20 Assuming that the groundwater flow direction in the glacial till follows topography, groundwater will flow towards the north or north-east. The cutting is therefore likely to form a barrier to groundwater flow in the glacial till in this area, leading to local changes in groundwater level. However, taking into account the overall extent of the glacial till aquifer this is assessed to be a minor impact, leading to a minor effect which is not significant. 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 whether there are any high permeability bands likely to be impacted by the cutting. This will inform the detailed design and management of groundwater during and after construction.
- 3.2.21 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.
- 3.2.22 Drainage in the Lowton cutting will be pumped via a pumping station to an attenuation pond before being discharged to Carr Brook and will be subject to approvals required under the protective provisions in the Bill from the Environment Agency. The permanent dewatering from the Lowton cutting could impact on aquifer recharge in the glacial till deposits. The impact on the Sherwood Sandstone is not considered significant as the groundwater level is below the minimum estimated level of the drainage in the cutting. Consideration is required to mitigate the impact on groundwater recharge in the glacial till rather than mitigate the impact of the discharge on the receiving watercourse.
- 3.2.23 The application of the draft CoCP will ensure that the construction of the cutting will have a negligible effect on groundwater quality.
- 3.2.24 The cutting is located within SPZ for the following four public water supply boreholes:
- Public water supply, United Utilities (map WR-02-305 – E5, SPZ2 location);
  - Public water supply, United Utilities (map WR-02-305 – B6, B7, C4, C5, C6, C7, D3, D4, D5, SPZ3 location);
  - Public water supply, United Utilities (map WR-02-305 – D5, E5, D6, E6, SPZ3 location); and
  - Public water supply, United Utilities (map WR-02-305 – D5, E5, D6, E6, SPZ3 location).
- 3.2.25 The proposed cutting would not be expected to alter groundwater flow in the Sherwood Sandstone Group, as the cutting is located above current groundwater levels in the bedrock. If groundwater levels in the Sherwood Sandstone continue to rise, as is occurring at present, and reach the base of the cutting drainage, then the cutting will potentially drain groundwater from the Sherwood Sandstone Group. However, this will not reduce the yield to the four public water supply abstractions below that currently available. Therefore, construction of the cutting is assessed as a negligible impact on the yield for these abstractions.
- 3.2.26 The public water supply; United Utilities (map WR-02-305 – E5, SPZ2 location), is located approximately 450m from the Lowton cutting. The cutting will pass through SPZ2 for this source. Although the cutting is not expected to extend below the groundwater table, there remains a small risk that groundwater quality in the Sherwood Sandstone could be impacted by construction, for example through changes in turbidity or other contamination as a result of infiltration in areas of ground disturbance. On a precautionary basis, the impact on this very high value receptor is assessed as potentially moderate, leading to a major adverse effect, which is significant.



**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

- 3.2.27 Implementation of the draft CoCP will ensure that materials in contact with groundwater will be selected, and method statements developed, to control any potential contaminants. Monitoring will take place before, during and after construction. The monitoring data will be assessed on a regular basis following monitoring rounds, and used to define any additional appropriate mitigation, should it be required. If necessary, an appropriate management and mitigation strategy will be developed by HS2 Ltd in agreement with the Environment Agency, and in consultation with United Utilities. Mitigation will be in place to ensure supplies to customers are not affected.
- 3.2.28 Construction of the Lowton cutting will remove a substantial part of the superficial deposits along the line of the cutting. The glacial till deposits consist of layers of low and higher permeability material and are therefore expected to act as aquitards, restricting the vertical flow of water through the ground. The removal of glacial till along the line of the cutting may create a pathway for surface water to discharge directly into the Sherwood Sandstone. 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 capture zone (SPZ) for the public water supply source, the impact of this change in chemistry is assessed to be negligible, leading to negligible effect which is not significant.
- 3.2.29 The Lowton cutting will pass through the historical Lowton Sidings landfill site. Construction of the cutting through the landfill site could potentially have an adverse effect on groundwater quality in the area although it is noted the cutting would not intersect the groundwater table, as indicated by existing groundwater level data. Little information is currently available on the characterisation of the material within the landfill site and on a precautionary basis this impact is considered to be major on the high value Chester Formation Principal aquifer, leading to a major adverse effect which is significant. Further information and assessment for Lowton Sidings landfill site is provided in the Land quality report, Volume 5: Appendix LQ-001-0MA05. Mitigation measures and potential remediation options will be considered in collaboration with land quality, pending further site (geophysical) investigation.
- 3.2.30 The proposed Lowton cutting could potentially intercept groundwater that would otherwise make a moderate contribution to the baseflow to Carr Brook. Groundwater intercepted by the Lowton cutting would, however, be discharged to Carr Brook, just downstream of the crossing. As a result, groundwater baseflow may be reduced along approximately 250m of the brook. The impact after embedded mitigation on groundwater baseflow to Carr Brook is assessed as minor, leading to a minor adverse effect which is not significant.
- 3.2.31 Small Brook, Tributary of Carr Brook 1 and Tributary of Carr Brook 2 are all located outside the estimated zone of influence of the Lowton cutting. The cutting may however intercept some groundwater that would naturally discharge to these watercourses. Consequently, the impact on these three watercourses is assessed as minor, leading to a minor adverse effect which is not significant.

## Abram cutting (and retaining wall)

**Table 5: Summary of the parameters for the groundwater assessment of Abram cutting**

Cutting and retaining wall parameters	Parameter details
Length (m)	400
Maximum depth (m)	3.7 to top of rail (6.9 to drainage invert)
Strata intercepted	Glacial till (Secondary (Undifferentiated) aquifer) Appleby Group (Collyhurst Sandstone Formation) Principal aquifer Pennine Coal Measures Group (Pennine Middle Coal Measures) Secondary A aquifer
Lowest level of drainage invert along track (mAOD)	26.7
Groundwater level(s) (mAOD)	Ground level
Principal receptors	Bryn Marsh and Ince Moss SSSI, LNR (Wigan Flashes) and SBI (Horrocks Flash) Glacial till Secondary (Undifferentiated) aquifer Appleby Group (Collyhurst Sandstone Formation) Principal aquifer Pennine Coal Measures Group (Pennine Middle Coal Measures) Secondary A aquifer Coffin Lane Brook Tributary of Coffin Lane Brook 1 Tributary of Coffin Lane Brook 2

- 3.2.32 The cutting would only penetrate the glacial till Secondary (Undifferentiated) aquifer. There is no currently available information on groundwater elevations or depth to groundwater in this area for the glacial till. 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 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.

**Environmental Statement**  
Volume 5: Appendix WR-003-0MA05  
Water resources and flood risk  
MA05: Rislely to Bamfurlong  
Water resources assessment

- 3.2.33 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  $3 \times 10^{-4} \text{m/s}$  for the glacial till<sup>6</sup>, the maximum lateral extent of drawdown (also referred to as the zone of influence) from the cutting is estimated as 208m. This is based on a maximum cutting depth of 6.9m from ground level to the track drainage invert, and a rest water level at ground level. The glacial till has a minimum thickness of approximately 15m below the cutting depth (to approximately 5mAOD) and is laterally extensive. Therefore, potential local changes in groundwater level to the maximum cutting depth are assessed as negligible, not significant in terms of the effect on the glacial till aquifer overall. There may be high permeability horizons within the glacial till that may laterally extensive. Further ground investigation and monitoring is required to confirm groundwater levels in this location, and whether there are any high permeability bands likely to be impacted by the cutting. This will inform the detailed design and management of groundwater during and after construction.
- 3.2.34 The cutting will be constructed as an open cutting. At the time of the assessment, no piling, foundations or retaining walls are proposed. The proposed cutting does not penetrate the Appleby Group (Principal aquifer) and Pennine Coal Measures Group (Secondary A aquifer) and the glacial till extends at least 15m beneath the proposed cutting. This, combined with the application of the draft CoCP, means that water quality impacts on these bedrock formations from the construction of the cutting should be negligible, leading to negligible effects which are not significant.
- 3.2.35 Construction of the Abram cutting will remove some of the overlying superficial deposits along the line of the cutting. The glacial till deposits consist of layers of low and higher permeability material and are therefore 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 to the Appleby Group and Pennine Coal Measures Group that could lead to a slight change in groundwater chemistry in this area. In this case, at least 15m of glacial till cover will remain between the cutting and the bedrock and the impact of this change in chemistry is assessed to be negligible impact, leading to negligible effect which is not significant.
- 3.2.36 Tributary of Coffin Lane Brook 1 originates at a culvert at the potential spring at West Coast Main Line railway, east of Bamfurlong recreation ground. The drainage for this cutting will discharge into Tributary of Coffin Lane Brook 1 approximately 250m downstream of the crossing with the Proposed Scheme. This low value watercourse may receive reduced baseflow over the 250m length of the 650m long watercourse due to the interception of groundwater by the Abram cutting. Therefore, the impact on flow in tributary of Coffin Lane Brook 1 is considered to be moderate, leading to a minor effect which is not significant.
- 3.2.37 Coffin Lane Brook and Tributary of Coffin Lane Brook 2 may receive reduced baseflow due to the interception of groundwater by the Abram cutting. Groundwater intercepted by the cutting would be discharged to Coffin Lane Brook downstream of the route of the Proposed Scheme. Therefore, a short section of the brook may receive reduced baseflow. As a result, the impact on groundwater flow to Coffin Lane Brook, a moderate value receptor, is assessed as minor, leading to a minor adverse effect which is not significant. Flow in the tributary of Coffin Lane Brook 2 (low value) may be reduced for most of its length and the impact is assessed to be moderate, leading to a minor adverse effect which is not significant.
- 3.2.38 All other surface watercourses are located outside of the calculated zone of influence of this cutting. There are no recorded groundwater dependent features within the calculated zone of influence.

### 3.3 Impacts to groundwater flow and quality from viaduct, embankment and overbridge 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 potable use. Catchments for groundwater abstraction are indicated by the SPZ1, SPZ2 and SPZ3 areas and are defined by the Environment Agency around all licenced abstraction sites.
- 3.3.2 Piling can impact groundwater flow in an aquifer if the capacity of pathways are reduced during the action of piling or migration of grout into the aquifer. Potential impact from piled structures depends on the spacing of piles and the aquifer type. For example, fissure flow may be impeded if a fracture pathway is intercepted by a pile but matrix flow is less likely to be impeded as groundwater will divert around the structure.

#### Overbridges, underbridges and aqueducts

- 3.3.3 The A572 Newton Road overbridge and Carr Brook aqueduct are located within SPZ2 for the public water supply, United Utilities (map WR-02-305 – E5, SPZ2 location). Although the overbridge and aqueduct piles are not expected to extend below the groundwater table, there remains a minor potential that groundwater quality in the Sherwood Sandstone may be impacted by construction. The potential impacts from construction piling can be mitigated by using bentonite in the process to reduce fluid loss although there is a risk that the use of bentonite can cause turbidity issues if not controlled appropriately; this would be managed through implementation of the draft CoCP. Many methods of piling can also be facilitated by the use of temporary casing, that can be effective in reducing losses.
- 3.3.4 Nonetheless, there is a residual risk that groundwater quality at the private abstractions could be impacted during construction. The impact on these very high value receptors is potentially moderate if there are significant fractures linking the piling locations and the abstraction sites, leading to a major effect, which is significant.

- 3.3.5 Implementation of the draft CoCP will ensure that materials in contact with groundwater will be selected, and method statements developed, to control any potential contaminants. Groundwater monitoring will take place before, during and after construction. If further investigation by the nominated undertaker shows there is a potential risk to the supplies, this will be discussed with United Utilities. An appropriate management and mitigation strategy will be developed by HS2 Ltd in consultation with United Utilities and in agreement with the Environment Agency. Mitigation will be in place to ensure supplies to customers are not affected.
- 3.3.6 The following overbridges and underbridges are also included within MA05:
- Culcheth North (Railway) viaduct;
  - Risley east accommodation underbridge;
  - Footpath Croft 13/1 accommodation underbridge;
  - Slag Lane viaduct;
  - A574 Warrington Road overbridge;
  - Wigshaw Lane overbridge;
  - Footpath Croft 8a/2 and 102/1 overbridge;
  - A573 Wigan Road viaduct;
  - B5207 Wilton Lane overbridge;
  - A580 East Lancashire Road overbridge;
  - Footpath Golborne 33/10 accommodation underbridge; and
  - Footpath Ashton-in-Makerfield 22/3 accommodation underbridge.
- 3.3.7 There is a possibility that groundwater quality in the Mercia Mudstone and Sherwood Sandstone may be impacted by the construction of overbridge piles, although the piles are not expected to extend any deeper than 15m below ground level. The potential impacts from construction piling can be mitigated 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 effective, particularly in preventing losses to immediately adjacent watercourses. 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. Hence the impact on aquifers is assessed as negligible, leading to a negligible effect which is not significant.

## **M62 West viaduct**

- 3.3.8 Foundations for the M62 West viaduct will comprise drilled concrete piles with pile caps. The depth of these piles is currently designed to be up to 11m deep, and the piles are expected to penetrate through the peat and the underlying glaciofluvial deposit, glaciofluvial sheet deposits and into the underlying Sherwood Sandstone 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 is likely to be localised and, taking into account the extent of the glaciofluvial deposits, glaciofluvial sheet deposits and Sherwood Sandstone Group aquifers, the impact will be negligible. The impact on the smaller outcrop of peat is assessed to be moderate, leading to a minor adverse effect, which is not significant.
- 3.3.9 A number of watercourses are present within the immediate vicinity of the M62 West viaduct. There is the potential for adverse impacts on baseflow to parts of Tributary of Glaze Brook 2. However, groundwater modelling carried out for this area (see Groundwater modelling report Volume 5: Appendix WR-008-00001) suggests that there will be negligible impact on flow to Tributary of Glaze Brook 2, resulting in a negligible effect which is not significant.
- 3.3.10 The potential impacts on water quality 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 useful to prevent 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.

## **Culcheth South embankment**

- 3.3.11 The Culcheth South embankment will require piled foundations where ground conditions are poor, such as occurs in peat deposits. The piles may obstruct the flow of groundwater in the immediate vicinity of the embankment, but this impact is likely to be localised. The impact on the peat is assessed to be moderate, leading to a minor adverse effect, which is not significant.

## Environmental Statement

Volume 5: Appendix WR-003-0MA05

Water resources and flood risk

MA05: Risley to Bamfurlong

Water resources assessment

- 3.3.12 A number of watercourses are present within the immediate vicinity of the Culcheth South embankment. There is the potential for adverse impacts on baseflow to Holcroft Lane Brook and Tributary of Holcroft Lane Brook 4. These watercourses are located approximately parallel to the Proposed Scheme and any below ground structures have the potential to obstruct groundwater flow towards the watercourses. The groundwater may be intercepted by the drainage network of the Proposed Scheme. The groundwater would discharge to Holcroft Lane Brook, via the drainage network, but would do so further downstream than would otherwise be the case. The impact on these low value watercourse receptors would be moderate, resulting in a permanent minor adverse effect which would not be significant.

## 3.4 Impacts to groundwater from borrow pits

- 3.4.1 There are no borrow pits within the Risley to Bamfurlong area (MA05).

## 4 Site specific water dependent habitats assessment

### 4.1 Summary of assessment

4.1.1

4.1.2 Table 6 summarises the potential hydrological impacts (for example, changes to flow, level, regime, or quality) related to surface water and groundwater dependent habitats. Details of specific impact assessments are presented in Section 4.2. 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 Volume 5, Appendix EC-015-0MA05. Where there are significant effects, the ecological effects and associated mitigation are reported in Volume 2, Community Area report: Risley to Bamfurlong (MA05), Section 7, Ecology and biodiversity.

**Table 6: Summary of potential water dependent habitat impacts**

Receptor	Design element	Discussion of potential impact to water receptor
<b>Surface water dependent habitats</b>		
Abram Flashes SSSI and SBI	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• Lowton North embankment</li> </ul>	The land required for the construction of the Proposed Scheme is around 500m from the boundary of this site. Any potential for impacts on water quality during the construction phase will be managed through the application of the draft CoCP. Coffin Lane Brook, Tributary of Coffin Lane Brook 1, Hey Brook, Tributary of Hey Brook 5, Nan Holes Brook, Tributary of Nan Holes Brook 1 and Windy Bank Brook are all crossed by the Proposed Scheme before they flow into Abram Flashes SSSI. This assessment shows that through the application of draft CoCP and the design of all crossings in accordance with good industry practice there will be no significant impacts on the flow or quality of these watercourses. Therefore, it is assessed that there would be a negligible impact on water flow and quality at the SSSI.
Pennington Flash LNR, country park and SBI	Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• Lowton cutting</li> </ul>	Pennington Flash is outside the zone of influence of the Lowton cutting and will not be directly impacted by water level changes caused by the construction of the cutting. The cutting may however intercept groundwater that would otherwise contribute baseflow to a short length (around 300m) of Small Brook that ultimately flows into Pennington Flash. This water would be collected by drainage and discharged to Carr Brook and would not reach Pennington Flash. Since the cutting would only impact on a short length of Small Brook, this is considered to be a negligible impact on water flow to Pennington Flash.  There are no surface water design elements affecting Pennington Flash. Any potential for impacts on water quality during the construction phase will be managed through the application of the draft CoCP. All design elements affecting watercourses upstream of Pennington Flash have also been designed according to industry good practice guidance, therefore there is limited potential for surface water flow and quality effects. This is considered to be a negligible impact on water flow and quality at this site.
Silver Lane Ponds LWS	Above ground elements and shallow excavation (<1mbgl) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> <li>• Culcheth South embankment</li> </ul>	There is potential for impacts on water quality during the construction phase, however these will be managed through the application of the draft CoCP. The Culcheth South embankment will pass through the Silver Lane Ponds LWS and will remove one of the in-line ponds, however this is replaced with new attenuation ponds. All design elements affecting the ponds have also been designed according to industry good practice guidance. Therefore, it is assessed that there would be a negligible impact on water flow and quality at this site.
<b>Groundwater dependent habitats</b>		
Manchester Mosses SAC: Holcroft Moss SSSI	Above ground elements and shallow excavation (<1m) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> </ul> Deeper excavation (>1mbgl) including: <ul style="list-style-type: none"> <li>• M62 West viaduct</li> <li>• Glazebrook embankment north (in MA04)</li> </ul>	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 flow and quality during the construction phase (see Section 4.2).
Manchester Mosses SAC: Risley Moss SSSI, LNR and SBI  Pestfurlong Moss LWS	Above ground elements and shallow excavation (<1m) including: <ul style="list-style-type: none"> <li>• ground level track and roads</li> <li>• temporary works such as stockpiles and compounds</li> </ul> Deeper excavation (>1mbgl) including:	It is currently unclear if these sites are supported by groundwater, but they have been included on a precautionary basis. The Proposed Scheme is unlikely to alter groundwater flow to these sites since they are located the other side of a topographical divide from the Proposed Scheme. Therefore, the impact on groundwater flow and quality is assessed as negligible.

**Environmental Statement**  
 Volume 5: Appendix WR-003-0MA05  
 Water resources and flood risk  
 MA05: Risley to Bamfurlong  
 Water resources assessment

Receptor	Design element	Discussion of potential impact to water receptor
	<ul style="list-style-type: none"> <li>M62 West viaduct</li> </ul>	
Bryn Marsh and Ince Moss SSSI, LNR (Wigan Flashes) and SBI (Horrocks Flash)	Above ground elements and shallow excavation (<1m) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> </ul>	The Proposed Scheme is unlikely to alter groundwater quality or flow to this site, since the SSSI is located a significant distance (more than 700m) upgradient of the Proposed Scheme and any significant below ground works. The land required for construction extends along a part of the WCML forming the eastern boundary of the SSSI and could impact on water quality. However, implementation of measures described in the draft CoCP would protect the water quality of runoff during construction.
Lightshaw Lime Beds SBI	Above ground elements and shallow excavation (<1m) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> <li>Lowton North embankment</li> </ul>	There is potential for temporary impacts on water quality during the construction phase. This will be managed through the application of the draft CoCP. There are unlikely to be permanent impacts from the construction of the Proposed Scheme on the habitat, that is located upgradient of Lowton north embankment. Therefore, the impact is assessed as negligible.
Ponds Near Lightshaw Lane SBI	Above ground elements and shallow excavation (<1m) including: <ul style="list-style-type: none"> <li>ground level track and roads</li> <li>temporary works such as stockpiles and compounds</li> <li>Lowton North embankment</li> </ul>	There is potential for temporary impacts on water quality during the construction phase. This will be managed through the application of the draft CoCP. Groundwater flow in the area could potentially be affected. However, the route of the Proposed Scheme is on embankment (Lowton North embankment) with no deep below ground structures to affect the groundwater flow. Therefore, the impact is assessed as negligible.

## 4.2 Detailed assessment

### Holcroft Moss SAC and SSSI

- 4.2.1 Holcroft Moss SAC and SSSI, shown on Figure 1, is an area of raised bog located to the south of the M62, and approximately 300m south-west of the M62 crossing over Glaze Brook. The site is bounded by the M62 to the north and ditches to the east and west. A brick-lined culvert is located close to the southern boundary. The culvert discharges to a minor tributary of Glaze Brook to the east. The Wigan Junction Branch railway was located just outside Holcroft Moss in a cutting that was close to the ditch forming the western boundary of the site. The railway was closed in the 1960's and the cutting later backfilled.
- 4.2.2 Holcroft Moss is underlain by peat that, in the centre of the site, is several metres higher than the ground immediately surrounding the site. Ground level profiles from west to east across Holcroft Moss and surrounding areas are shown in Figure 2. A ground level profile from north to south is shown in Figure 3. The positions of the profiles are indicated in Figure 1.
- 4.2.3 Boreholes were constructed along the route of the M62 prior to construction. A profile for the base of the peat along the M62 is included in Figure 2. The boreholes were located approximately 100m to 150m north of the boundary of Holcroft Moss. Assuming there is reasonable consistency in the peat across the area, the geological logs for the boreholes indicate that the thickness of the peat, at least in the northern part of Holcroft Moss, may be up to approximately 5m. The interpolation of levels at the M62, and at the southern limit of the outcrop, included on Figure 2, indicates that the peat may have a reasonably consistent base level from north to south across the site.
- 4.2.4 BGS mapping indicates that the peat body, of which Holcroft Moss forms a part, extends between Pestfurlong Moss, approximately 1km to the west of Holcroft Moss, and the valley of Glaze Brook in the east. The peat body has, however, been dissected by excavations along the route of the Wigan Junction Branch railway and the M62. The mapping indicates that glacial till, comprising sandy silty clay, and glaciofluvial sheet deposits (sand and gravel), are exposed in these excavated areas. Taking into account the areas of outcrop of these superficial deposits around the peat body, glacial till and glaciofluvial sheet deposits would be expected to underlie the peat in different areas of Holcroft Moss.
- 4.2.5 Bedrock, comprising the Sherwood Sandstone Group (Helsby Sandstone Formation), outcrops to the south-east of Holcroft Moss. The southern part of the peat body overlies bedrock in an area around Glazebrook Moss. Figure 3 indicates that the top of the bedrock rises substantially between the M62 and Glazebrook Moss, although the bedrock profile is based on data only for these two locations.

Figure 1: Holcroft Moss topography and geology

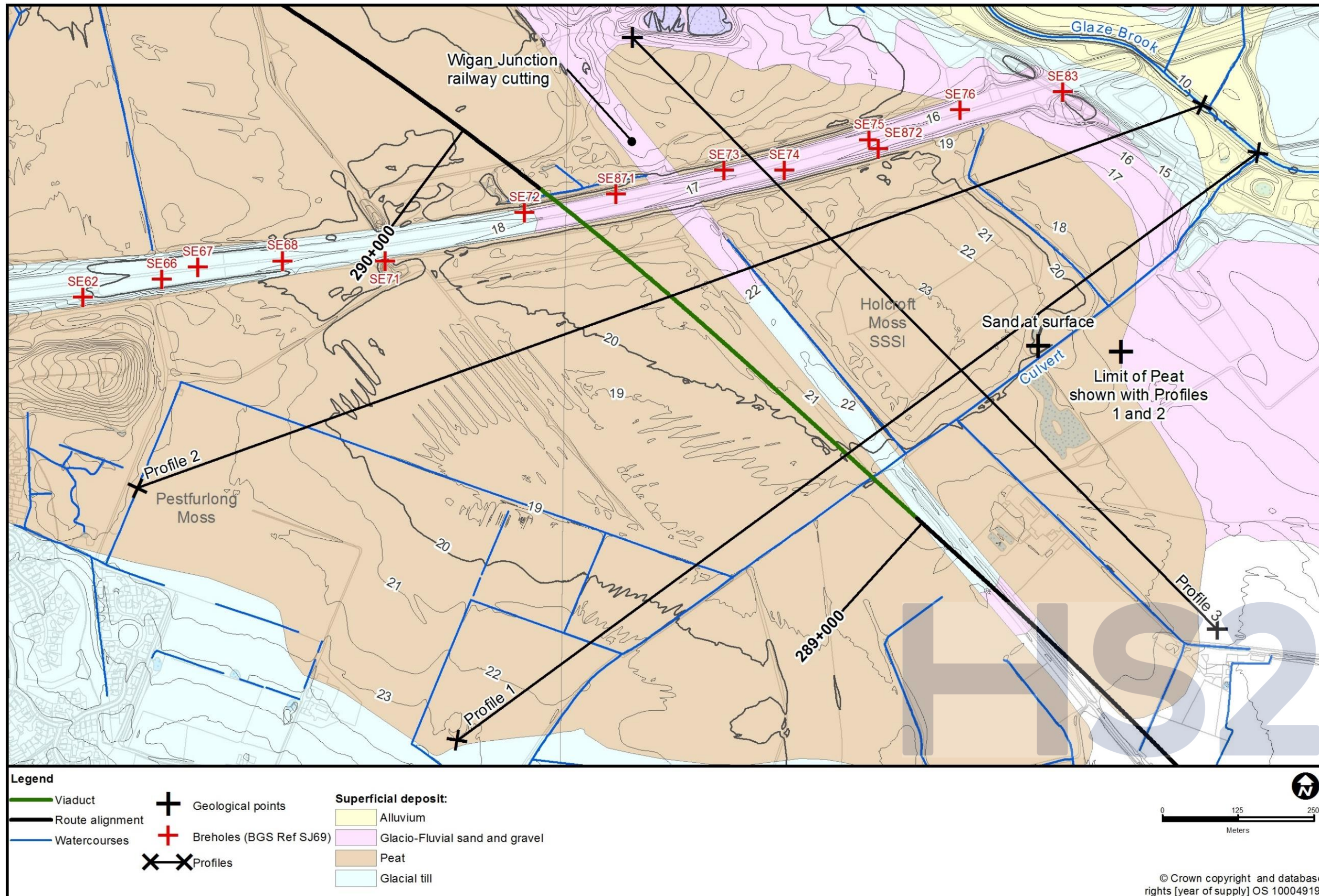


Figure 2: Profile across Holcroft Moss SSSI (approximately east to west)

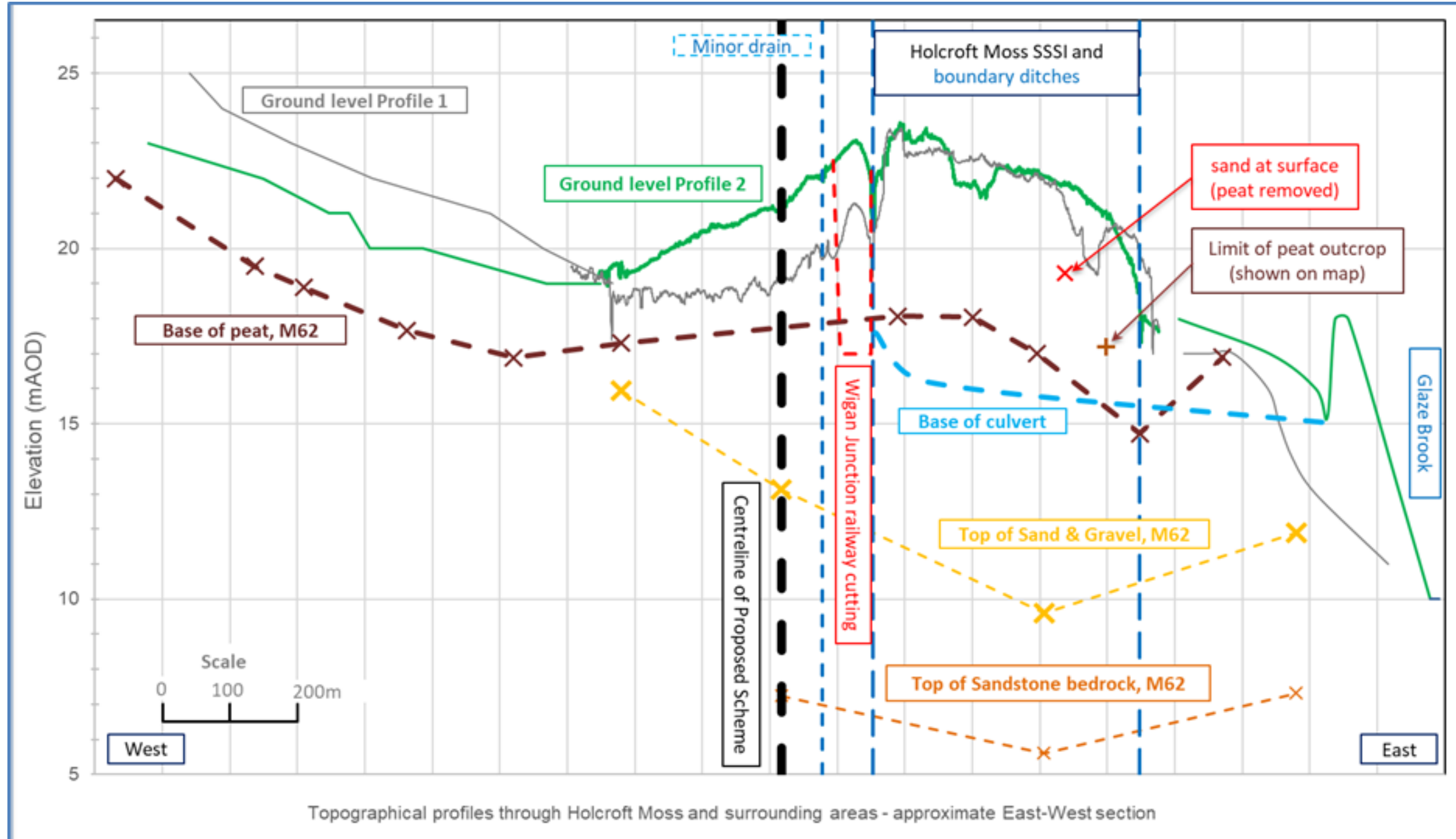
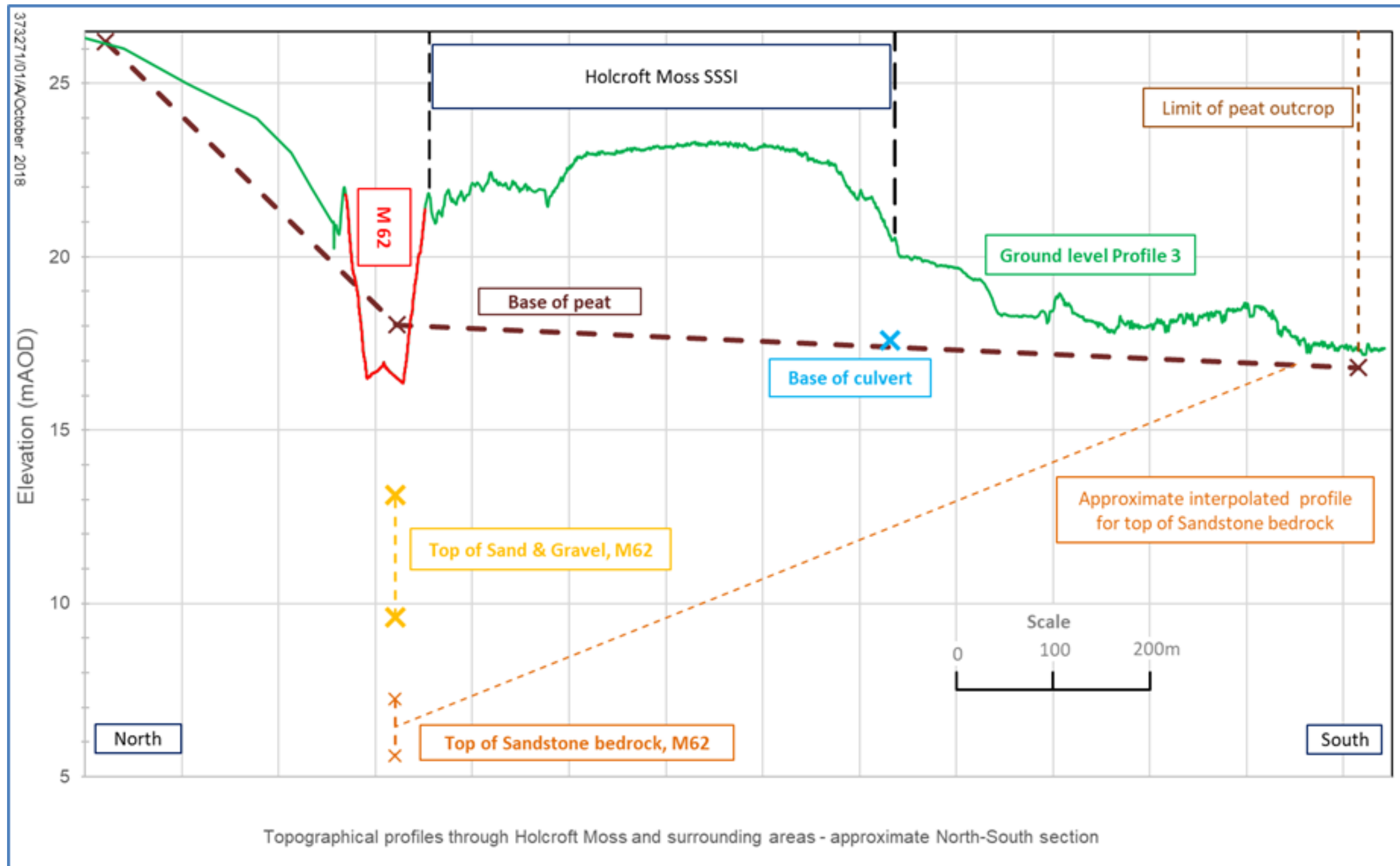




Figure 3: Profile across Holcroft Moss SSSI (north to south)



## Environmental Statement

Volume 5: Appendix WR-003-0MA05

Water resources and flood risk

MA05: Risley to Bamfurlong

Water resources assessment

- 4.2.6 The route of the Proposed Scheme, to the west of Holcroft Moss, is underlain by peat over glacial till and glaciofluvial sheet deposits. BGS mapping indicates that the peat along the route of the Proposed Scheme is separated from the peat underlying Holcroft Moss SSSI by the Wigan Junction Branch Railway Cutting. The depth of the cutting, and the material used to backfill the cutting, are not known.
- 4.2.7 Levels for the culvert located along the south-eastern boundary of Holcroft Moss, based on the level in the ditches at the upstream and downstream ends of the culvert, together with a depth measurement at a manhole access point, were used to produce the approximate culvert section in Figure 2. Figure 3 indicates that the base of the culvert is at the approximate level of the base of the peat, determined by the interpolation of peat levels at the M62 and at outcrop to the south of the site. However, sand, seen on the site visit at a location where the peat had been dug out (see Figure 2), may indicate a higher elevation for the base of the peat in the south-eastern part of Holcroft Moss.
- 4.2.8 The main concern with regards to groundwater resources arising from the Proposed Scheme in this area is whether groundwater could flow from west to east. If this is the case, then groundwater flow might potentially be affected by piling beneath the Glazebrook embankment north in the adjacent Broomedge to Glazebrook area (MA04), and the piers for the M62 West viaduct that are proposed to the south and west of Holcroft Moss. If the groundwater flow in underlying deposits was found to have the potential to support water levels in the peat at Holcroft Moss, water levels in the peat might be reduced as a result of the Proposed Scheme.
- 4.2.9 No groundwater level data are available for the superficial geological formations underlying the peat. In addition, there is no evidence from the ground elevations, or the peat base levels to indicate the direction of groundwater flow in the area. Overall, groundwater might be expected to flow from the higher elevations around Pestfurlong Moss in the west, eventually draining to Glaze Brook in the east. However, the superficial deposits might also be recharged by percolation through the peat in the area of higher elevation at the SSSI. This localised recharge might reverse the local groundwater flow direction on the west side of Holcroft Moss. Ditches around the site, and the culvert, may also affect groundwater flow directions and groundwater discharge locally.
- 4.2.10 In all but one of the boreholes along the M62 in that peat was encountered, the superficial formation underlying the peat is described as a clay or sandy clay, underlain generally by clayey sand. For the other borehole the description is for clayey sand directly below the peat. Therefore, in the north of the site, it is likely that low permeability clayey material is generally present underlying the peat. This material will limit any groundwater seepage between the two formations. BGS mapping indicates that the site is likely to be underlain by either glacial till or glaciofluvial sand and gravel. If a formation comprising predominantly sand and gravel is present, this may produce a better connection with the overlying peat. In one borehole (borehole code SJ69SE871), constructed near the M62 after completion of the motorway and located close to the centre line of the Proposed Scheme, gravely sand was found underlying sandy clay.
- 4.2.11 The Proposed Scheme would cross the M62 on the M62 West viaduct as shown on Figure 1. Piles supporting the piers beneath pile caps will be installed through the peat, the underlying superficial glacial till and/or glaciofluvial sand and gravel and weathered Sherwood Sandstone, and will extend approximately 5m into competent bedrock.
- 4.2.12 The piles will be bored or cased through the glaciofluvial sand and gravel below the peat, although, the formation below the pile caps will not be totally disrupted by the piles. It is assumed at this stage that the piles will replace approximately 10% of the cross-sectional area in the section underlying the total length of the M62 West viaduct.
- 4.2.13 Temporary piling may be used beneath the load transfer platform used during the construction of the viaduct piers. These temporary piles could be in place for a reasonable worst case of approximately 9 months in any one location. These piles would penetrate through the peat and glaciofluvial deposits. It is assumed that when they are removed the ground will be returned to near natural state. Due to the short-term nature of these piles they are not considered further in this assessment.
- 4.2.14 The Glazebrook embankment north will be a piled embankment. These piles will extend through the peat into the underlying glaciofluvial sand and gravel. The piles will be driven into the ground and will therefore disrupt a significant proportion of the ground around the piles. It is assumed at this stage that the piles will take up 33% of the cross-sectional area of the aquifer beneath the embankment.
- 4.2.15 A groundwater model has been created for the area around Holcroft Moss to investigate the potential impact of the Proposed Scheme on the Holcroft Moss site. Details of the modelling are set out in the Groundwater modelling report Volume 5: Appendix WR-008-00001.
- 4.2.16 If groundwater flow is from west to east, the modelling suggests that the Proposed Scheme could result in a reduction in peat groundwater levels, approximately equal to the model error of convergence of 1mm, across 4% of the area of Holcroft Moss. This reduction in groundwater levels was found to result from the presence of the piling beneath Glazebrook embankment north in the adjacent Broomedge to Glazebrook area (MA04), rather than piling associated with the piers for the M62 west viaduct. This impact is assessed to be a permanent minor adverse impact on groundwater levels at Holcroft Moss.
- 4.2.17 Mitigation measures have been included to reduce the impact of the Proposed Scheme on Holcroft Moss. Mitigation, comprising a U-shaped gravel filled trench around the northern end of the Glazebrook embankment north in the Broomedge to Glazebrook area (MA04), was simulated in groundwater modelling. The mitigation option was found to reduce the impact of the Proposed Scheme on peat groundwater levels to less than the model error of convergence (1mm) in all areas of Holcroft Moss. With further modifications to the design of the trench (if required), it appears likely, therefore, that any potential impact on groundwater levels on Holcroft Moss could be eliminated entirely. This gravel filled trench has been embedded into the design and the impact of the Proposed Scheme on groundwater flow and levels is therefore assessed as negligible.

## Environmental Statement

Volume 5: Appendix WR-003-0MA05

Water resources and flood risk

MA05: Risley to Bamfurlong

Water resources assessment

- 4.2.18 There is the potential that piling adjacent to Holcroft Moss could create pathways between any perched groundwater in the peat and the underlying superficial deposits, that could lead to a reduction in water levels in the peat at Holcroft Moss. The piling methods for the viaduct piers and the embankment piles will be selected to avoid creating hydraulic pathways such as cracks and cavities between the piled sections and the natural formations (such as bored piles). Ground investigations will be carried out prior to detailed design to ensure the appropriate methodology for installation is selected (see paragraph below). In addition, the peat underlying the Proposed Scheme is separated from the peat underlying Holcroft Moss by the historical Wigan Junction Branch railway cutting that cut through the peat outcrop. Any potential pathways from the peat to the underlying superficial deposits, resulting from piling, would not impact on Holcroft Moss. Therefore, the potential impact on Holcroft Moss is assessed to be negligible.
- 4.2.19 A ground investigation will be required prior to detailed design in order to establish or confirm:
- the depth of peat beneath Holcroft Moss and the lithology of the superficial formations underlying the peat;
  - groundwater flow directions between the route of the Proposed Scheme and Holcroft Moss;
  - the differences in groundwater levels and the potential for groundwater seepage between the peat and underlying formations;
  - the potential impacts of the viaduct on groundwater flow and groundwater levels in the peat at Holcroft Moss; and
  - the requirement and design of the gravel filled trench around the toe of the Glazebrook embankment north.

## 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 MA05.

### 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<sup>4</sup>. Where highway realignments are to discharge to kerb side ditches that do not have a baseflow, the Groundwater Assessment (Appendix C)<sup>4</sup> 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)<sup>4</sup>.

### 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 MA05 during the construction phase.
- 5.3.2 A screening exercise identified the need for a routine runoff and a pollution risk assessment in MA05 during the operational phase. This is related to the modifications to the B5207 Wilton Lane and the A574 Warrington Road, shown in Figure 4 and Figure 5 respectively. The screening exercise has not identified the need for a spillage pollution risk assessment in MA05 during the operational phase.

Figure 4: B5207 Wilton Lane realignment

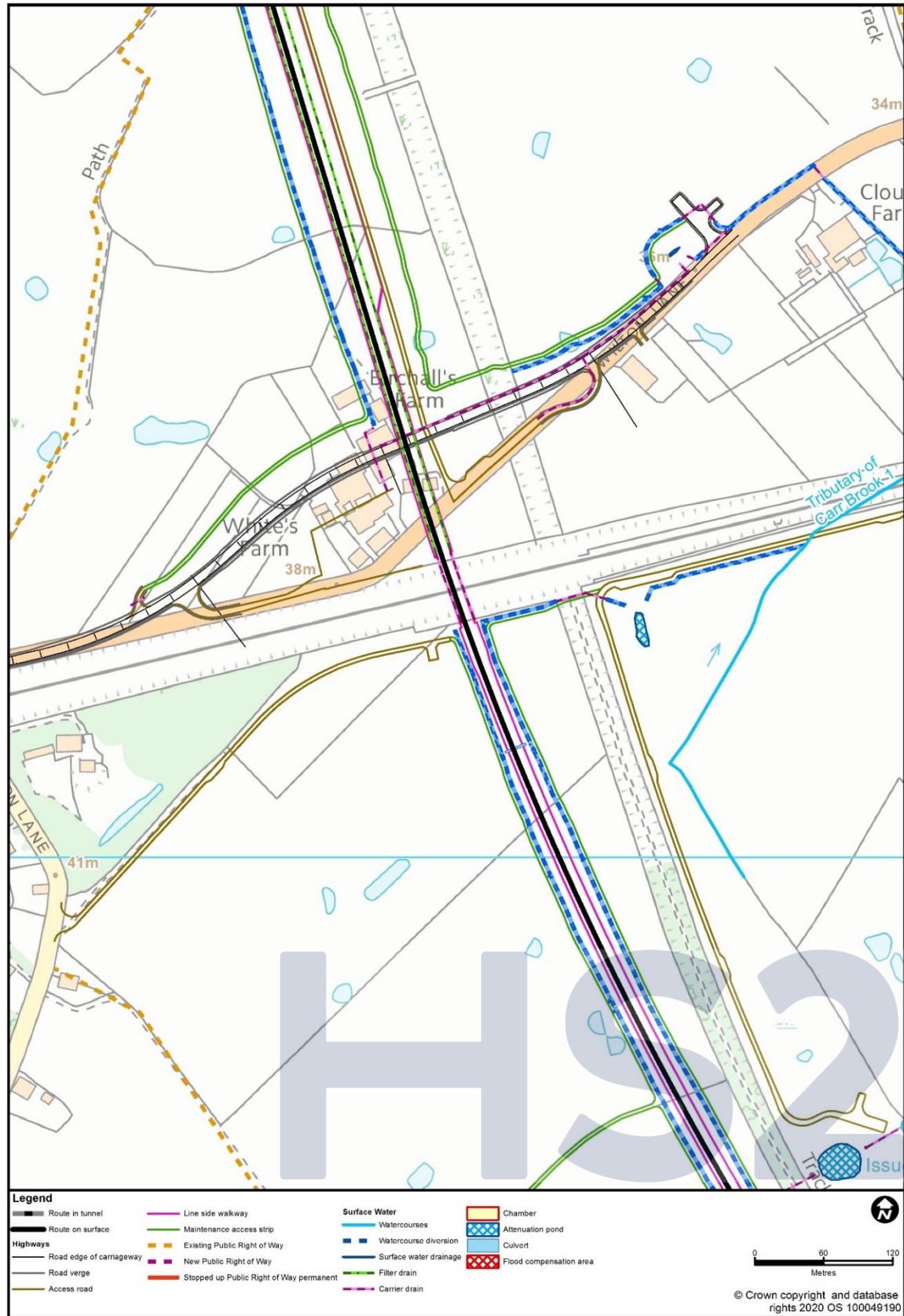
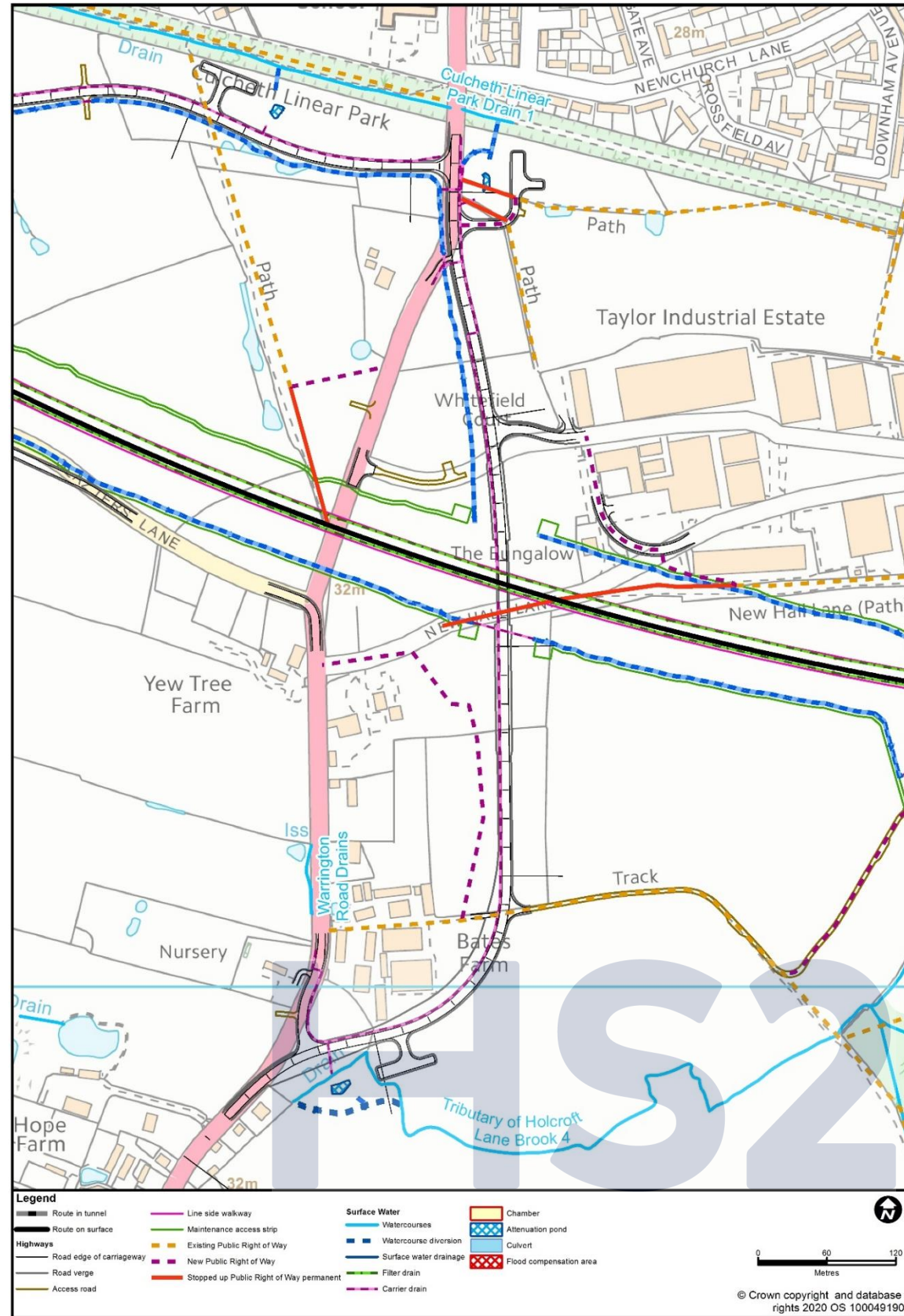


Figure 5: A574 Warrington Road realignment



## Routine runoff pollution risk

### B5207 Wilton Lane realignment

- 5.3.3 The modifications to the B5207 Wilton Lane Realignment between Wilton Grange and Clough Farm, is proposed to be realigned 75m north along a total length of 780m, crossing over the route of the Proposed Scheme in Lowton cutting and the dismantled railway. The existing drainage arrangement is kerbs and gullies.
- 5.3.4 Due to the vertical profile of the overbridge, Wilton Lane is split into two catchments, east and west. On the western side, there are no nearby watercourses downstream of the realigned road, which limits outfall options. In this area, the geology is glacial till over the Wilmslow Sandstone Formation. The permeability of the glacial till is mixed, with sandy layers within the clay bands, and the bedrock has a high permeability. Due to this mixed permeability ground testing will be undertaken to determine infiltration rates. For the eastern catchment, over-the-edge drainage is proposed into an infiltration swale. If infiltration rates are not suitable, the swale can be used for attenuation to greenfield run-off rates. The swale would then outfall to the track perimeter ditch, which ultimately outfalls to Tributary of Carr Brook 1, over 900m to the south east.
- 5.3.5 The groundwater assessment (western catchment) results identified that the magnitude of the impacts of routine runoff from this proposed highway realignment would be moderate on the moderate value glacial till aquifer, leading to a moderate adverse effect which is significant. The Design Manual for Roads and Bridges (DMRB) guidance suggests that a precautionary approach should be adopted in such circumstances and a detailed assessment will be needed to identify if additional measures are required to mitigate the risk of deterioration in groundwater quality. It is assumed there is sufficient space available if such measures are required. This assessment will be carried out during design progression and any mitigation measures will be considered in consultation with the relevant highway authority.
- 5.3.6 The tier 2 surface water assessment results for the eastern catchment identified that both the acute soluble for copper and zinc, and the sediment-bound pollutants aspects of the assessment are failed, and copper exceeds the environmental quality standards (EQS) annual average concentration. This is assessed to be a major impact on this low value receptor, leading to a minor adverse effect, which is not significant. 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 additional mitigation measures, such as the use of a vortex grit separator and a wet retention pond. It is assumed there is sufficient space available if such measures are required. Mitigation will be designed in consultation with the Environment Agency and other stakeholders to mitigate any significant effects on water quality.

### A574 Warrington Road and Wigshaw Lane realignments

- 5.3.7 The A574 Warrington Road and Wigshaw Lane, on the eastern outskirts of Culcheth are both severed by the route of the Proposed Scheme. Warrington Road is proposed to be realigned approximately 160m east with a new overbridge over the Proposed Scheme in Culcheth cutting. Wigshaw Lane is proposed to be realigned 140m west, with also a new overbridge over the route of the Proposed Scheme in Culcheth cutting. To restore connectivity lost through the closure of Glaziers Lane, a new link road is proposed between the two roads, running adjacent to Culcheth Linear Park.
- 5.3.8 The existing drainage arrangement for Warrington Road is kerbs and gullies, and this is also proposed for the realigned road. The area has been split into two catchments serving Warrington Road, south and north, both discharging into highway attenuation ponds. The highway attenuation pond located at the south of the realignment will outfall to Tributary of Holcroft Lane Brook 4 (known as outfall 1), and the highway attenuation pond located at the north of the realignment will outfall to Culcheth Linear Park Drain 1 (known as outfall 2).
- 5.3.9 The tier 2 surface water assessment results for outfall 1 identified that both the acute soluble and sediment-bound pollutants assessments are passed and there are no EQS exceedances of copper and zinc in the discharge. 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 shows that if background concentrations for copper exceed 0.5µg/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, this is assessed to be a moderate impact, on this low value receptor, resulting in a minor effect which is not significant.
- 5.3.10 Flow in Culcheth Linear Park Drain 1 is expected to be low and under some conditions this watercourse may be dry. Therefore, a groundwater assessment has also been carried out for this outfall. The results identified that the magnitude of the impacts of routine runoff from this proposed highway realignment would be moderate adverse, to the moderate value glacial till aquifer. The proposal will therefore result in a moderate adverse effect, which is significant. The DMRB guidance suggests that a precautionary approach should be adopted in such circumstances and a detailed assessment will be needed to identify if additional measures are required to mitigate the risk of deterioration in groundwater quality. This assessment will be carried out during design development and any mitigation measures will be considered in consultation with the relevant highway authority. Mitigation measures may include the use of a wet retention pond.