highways england

European Union
European Regional Development Fund

A30 Chiverton to Carland Cross TR010026

6.2 ENVIRONMENTAL STATEMENT CHAPTER 13 ROAD DRAINAGE AND WATER ENVIRONMENT

Planning Act 2008

APFP Regulation 5(2)(a)
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Volume 6

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The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A30 Chiverton to Carland Cross
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6.2 ENVIRONMENTAL STATEMENT

CHAPTER 13 ROAD DRAINAGE AND WATER ENVIRONMENT

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13 Road Drainage and Water Environment

13.1 Introduction

13.1.1 This chapter provides an assessment of the likely significant effects on the water environment that may arise from the scheme. For the purposes of this chapter, the water environment is considered to comprise:

- surface watercourses within the study area;
- groundwater contained within aquifer units that underlie the study area; and
- other waterbodies or water dependent features that may potentially be affected (set out in Section 13.4).

13.1.2 The chapter describes the baseline conditions of the existing water environment in the study area and the methodology used to assess potential impacts during the construction and operational phases of the scheme (Section 13.6), before presenting the results of those assessments and mitigation or monitoring deemed necessary.

13.1.3 The assessment considers the potential effects on the quality and quantity of surface and ground waters, geomorphology and flood risk as a result of construction activities, the operational road drainage and accidental spillages. These assessments have been carried out in accordance with the National Networks National Policy Statement (NN NPS) for flood risk (paragraphs 5.92 to 5.97) and water quality and resources (paragraphs 5.221 to 5.223).

13.1.4 Any associated effects on ecology are considered in **Ecology and nature conservation** (Volume 6 Document Ref 6.2 ES Chapter 8). Effects on ground conditions, water quality arising from existing land contamination and interactions between the scheme, groundwater and abandoned mine workings are considered in **Geology and soils** (Volume 6 Document Ref 6.2 ES Chapter 9).

13.2 Competent Expert

13.2.1 The Road Drainage and Water Environment lead is a Chartered Water and Environmental Manager (CWEM), Chartered Scientist (CSci) and Chartered Environmentalist (CEnv). They hold an MSc in Catchment Dynamics and Management (University of Leeds), and is a Practitioner Member of the Institute of Environmental Management and Assessment (IEMA). Full details are provided in Volume 6 Document Ref 6.4 Appendix 1.1

13.3 Legislative and Policy Framework

European Legislation

Water Framework Directive (WFD) 2000/60/EC

13.3.1 The WFD provides a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. The Directive requires Member States to establish River Basin Districts and for each of these a River Basin Management Plan (RBMP), which are prepared, implemented and reviewed every six years. The current period from 2015-21 is Cycle 2 of these RBMPs.

Groundwater Daughter Directive 2006/118/EC

13.3.2 A Daughter Directive of the WFD, the Groundwater Directive establishes a regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. This was amended by Directive 2014/80/EU to clarify groundwater information to be provided to the European Commission. Member States must provide information on groundwater bodies classified as being at risk and threshold values for the respective pollutants and indicators established.

Floods Directive 2007/60/EC

13.3.3 The Floods Directive requires Member States to assess if water courses and coastlines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. The Directive requires that Flood Risk Management Plans be prepared, implemented and reviewed every six years for each River Basin District, in coordination with RBMPs prepared under the WFD.

Habitats Directive 92/43/EEC & Birds Directive 2009/147/EC

13.3.4 The Habitats Directive and Birds Directive ensure the conservation of a range of rare or threatened species. They establish the EU wide Natura 2000 ecological network of protected areas to safeguard against potentially damaging developments.

Priority Substances Directive 2013/39/EU

13.3.5 The Priority Substances Directive amends WFD 2000/60/EC and the Directive on Environmental Quality Standards (Directive 2008/105/EC) by updating the list of priority substances that would apply to WFD assessment.

Urban Wastewater Treatment Directive 91/271/EEC (as amended) (UWWT Directive (consolidated))

13.3.6 This Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The objective of the Directive is to protect the environment from the adverse effects of the aforementioned waste water discharges.

National Legislation

Environmental Protection Act 1990

13.3.7 The Act sets out legislative provisions aimed at controlling pollution arising from industrial and other processes for waste management.

Water Industry Act 1991

13.3.8 The Water Industry Act relates to water supply and the provision of wastewater services in England and Wales.

Land Drainage Act 1991 (as amended)

13.3.9 The Land Drainage Act 1991 requires that a watercourse be maintained by its owner. The Act provides functions to internal drainage boards and local

authorities to manage watercourses and provide consenting powers for proposed works to watercourses associated with development.

Water Resources Act (England and Wales) 1991 (Amended 2009)

13.3.10 The Water Resources Act 1991 (WRA) (as amended) sets out the responsibilities of the Environment Agency (EA) in relation to water pollution, resource management, flood defence, fisheries, and navigation.

Environment Act 1995

13.3.11 The Environment Act sets standards for environmental management, such as requiring national strategies for air quality and waste. It also sets out the basis of establishing the EA.

Water Act 2003

13.3.12 The Water Act 2003 amends the Water Resources Act 1991 and the Water Industry Act 1991 to make provision with respect to compensation under Section 61 of the Water Resources Act 1991.

Water Resources (Abstraction and Impounding) Regulations SI 2006/641

13.3.13 These Regulations contain provisions relating to the licensing of abstraction and impounding of water in England and Wales in the light of amendments made by the Water Act 2003 to the Water Resources Act 1991.

Flood Risk Regulations 2009

13.3.14 The Flood Risk Regulations 2009 transposes the EC Floods Directive (Directive 2008/60/EC) on the assessment and management of flood risk into domestic law in England and Wales and implements its provisions. The regulations designate a Local Lead Flood Authority (LLFA) and imposes duties on the EA and Lead Local Flood Authorities to prepare a number of documents including:

- Preliminary Flood Risk Assessments;
- Flood hazard and flood risk maps; and
- Flood Risk Management Plans.

The Water Supply (Water Quality) Regulations 2018

13.3.15 These Regulations provide the framework for drinking water quality in England in respect of public supplies provided by water companies and licensed water suppliers. The Drinking Water Inspectorate, acting on behalf of the Secretary of State, enforces the legislation.

Flood and Water Management Act 2010

13.3.16 The Act makes provision for water, including provision about the management of risks in connection with flooding and coastal erosion.

Environmental Damage (Prevention and Remediation) (England) Regulations 2015

13.3.17 These Regulations are based on the ‘polluter pays principle and imposes obligations on operators of economic activities requiring them to prevent, limit or remediate environmental damage. They apply to damage to protected species,

natural habitats, Sites of Special Scientific Interest (SSSIs), water and land, and implement Directive 2004/35/EC, on environmental liability.

The Water Framework Directive (Standards and Classification) Directions England and Wales 2015

13.3.18 The Water Framework Directive (WFD) Directions presents the updated environmental standards to be used in the second cycle of the Water Framework Directive (2000/60/EC) River Basin Management planning process in England and Wales. Environmental standards help assess risks to ecological quality of the water environment.

The Groundwater (Water Framework Directive) (England) Direction 2016

13.3.19 This sets out instructions to the EA on obligations to protect groundwater, including requirements to monitor and set thresholds for pollutants, add new pollutants to the monitoring list and change the information reported to the European Commission.

The Environmental Permitting Regulations 2016

13.3.20 The Environmental Permitting (England and Wales) (Amendment) (No. 2) Regulations SI 2016/475 came into force on 6th April 2016. They amend the Environmental Permitting (England and Wales) Regulations SI 2010/675 in order to extend the requirement for an environmental permit to flood risk activities, in addition to polluting activities already included under the previous regulations. The new permitting requirements for flood risk activities replaces the current "flood defence consent scheme", allowing the EA (as regulator for England) to concentrate on higher risk activities.

Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

13.3.21 The WFD has been transposed into the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. WFD is delivered in England and Wales through a framework of River Basin Management Plans (RBMPs). England and Wales are divided into 11 River Basin Districts (RBDs), each comprising smaller management units known as water bodies, including all river, lake, groundwater, coastal, and transitional waters located within that RBD.

National Policy

National Policy Statement for National Networks (NN NPS) 2014

13.3.22 This sets out the Government policies for nationally significant rail and road projects in England.

13.3.23 **The Flood Risk Assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.2) has complied with the requirements of Section 5.90 to 5.115, which cover the assessment of flood risk to and from a scheme.

13.3.24 This chapter and its appendices have compiled with the requirements of Section 5.219 to 5.231 which potential effects to water quality and resources.

The National Planning Policy Framework 2018

13.3.25 This provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans. Section 14, titled “Meeting the challenge of climate change, flooding and coastal change” relates to flooding. The document aims to direct development away from areas of the highest risk of flooding but where necessary, development must be safe without increasing flood risk elsewhere.

Regional Policy

South West River Basin Management Plan (RBMP) 2015

13.3.26 This provides a framework for protecting and enhancing the benefits provided by the water environment. It also informs decisions on land use planning. It contains four sets of information which are important for the management of land and water;

- baseline classification of water bodies,
- statutory objectives for protected areas,
- statutory objectives for water bodies,
- summary programme of measures to achieve statutory objectives.

West Cornwall Catchment Flood Management Plan (CFMP) 2012

13.3.27 The CFMP for Cornwall is made up of one relatively large catchment – the River Fal and many other smaller catchments. The Fal Estuary is the major estuary in the West Cornwall catchment with smaller estuaries at Hal and Helford. This scheme is within the Upper Fal and Carnon sub area which uses the preferred approach of Policy 6, defined by the EA as, “areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits”.

Local Policy

The Cornwall Local Flood Risk Management Strategy: Part 1 – Strategic Vision (2014 - 2020)

13.3.28 Sets out how Cornwall Council and its partner authorities intend to work together to manage flood risk from all sources. This document comprises three parts:

- Strategic Vision,
- Local Flood Risk Management Profiles, and
- Local Flood Risk Management Action Plans.

This Local Flood Risk Management Strategy has been adopted to guide the development of policy and programmes across Cornwall Council’s operations and in its work with other organisations, communities and stakeholders.

Cornwall Local Plan Strategic Policies 2010 – 2030

13.3.29 Cornwall Local Flood Risk Management Strategy sets out how the Council and partner organisations such as the EA and South West Water intend to work together to manage flood risk. Policy 26 addresses flood risk management and is intended to complement national policy and guidance on avoiding and minimising flood risks.

Strategic Flood Risk Assessment (SFRA) for the Cornwall Local Plan 2009

13.3.30 A tool for planning authorities to identify and evaluate flood risk in their area with the aim of directing development to the areas of lowest risk of flooding valid until 2026.

Strategic Flood Risk Assessment (SFRA) for the Minerals Safeguarding Development Plan Document (DPD) 2016

13.3.31 Updates of the 2009 SFRA take into account changes in national policy and guidance, particularly changes made by the introduction of the National Planning Policy Framework (NPPF), changes to EA data and new flood risk strategies published by Cornwall Council.

Cornwall Sustainable Drainage Policy 2016

13.3.32 Sets out Cornwall's LLFA's approach to sustainable drainage and aims to clarify what is appropriate in Cornwall. Cornwall council takes a proactive approach to encourage the use of sustainable urban drainage system (SUDS) for the management of surface water.

Guidance

13.3.33 The assessment methodology is based upon the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 10: HD 45/09 Road Drainage and the Water Environment (November 2009), subsequently referred to as HD 45/09.

13.3.34 The assessment strategy was also set out in the EIA Scoping Report[1].

13.3.35 Due reference has been made to Environment Agency guidance for preventing pollution[2], working on or near water[3] and for managing water on land[4].

13.3.36 Institute of Hydrology Report No. 108 was used to provide a methodology for estimating Q95 flows in receiving watercourses as catchment areas were too small for the LowFlows tool to be used.

13.3.37 CIRIA guidance used for the assessment includes:

- Control of Water Pollution from Construction Sites – Guide to Good Practice (SP156)
- Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors (C532)
- Control of Water Pollution from Linear Construction Projects – Technical Guidance (C648)
- Control of Water Pollution from Linear Construction Projects – Site guide (C649)
- Environmental good practice on site (C692)
- Groundwater control: design and practice (second edition) (C750)

[1] https://infrastructure.planninginspectorate.gov.uk/projects/south-west/a30-chiverton-to-carland-cross-scheme/
[2] The Environment Agency, "Pollution prevention for businesses," 12 07 2016. [Online]. Available: https://www.gov.uk/guidance/pollution-prevention-for-businesses. [Accessed 10 2017].
[3] The Environment Agency, "Check if you need permission to do work on a river, flood defence or sea defence," 2017. [Online]. Available: https://www.gov.uk/permission-work-on-river-flood-sea-defence. [Accessed 2017].
[4] The Environment Agency, "Manage water on land: guidance for land managers," 19 02 2015. [Online]. Available: https://www.gov.uk/guidance/manage-water-on-land-guidance-for-land-managers. [Accessed 10 2017].

13.4 Study Area

13.4.1 The study area has been selected based on a source – pathway – receptor approach, as recommended by HD 45/09.

13.4.2 For direct effects on surface waters, the study area includes the geographical extent of the full scope of the works and all surface water features within 500m of the scheme. Indirect effects on surface waters have been considered up to 1km away where features have hydrological connectivity to the scheme.

13.4.3 For groundwater, the study area includes the geographical extent of the full scope of the works and all groundwater features within 1km of the scheme.

13.4.4 The size of the study area has been selected based on professional judgement and is proportionate with the potential impacts posed by the scheme.

13.5 Potential Impacts

13.5.1 The scheme has the potential to impact the water environment during construction and operation.

13.5.2 Table 13-1 summarises pollutant linkages that have the potential for significant effects during construction of the scheme.

Table 13-1 Summary of potential source – pathway – receptor linkages during construction

Source	Pathway	Receptor
Spillage of pollutants (e.g. fuels, lubricants)	Infiltration to groundwater or runoff to watercourses	Groundwater underlying construction areas or watercourses receiving runoff from the construction areas
Exposed sediments	Sediment transport as a result of heavy rainfall or site drainage	Watercourses receiving runoff from construction areas
Temporary culverting for site access or construction	Direct modification of watercourses	Watercourses crossed by the scheme
Dewatering of excavations	Temporary reduction in groundwater levels	Groundwater features (e.g. boreholes, wells, springs)

13.5.3 Table 13-2 summarises pollutant linkages that have the potential for significant effects during operation of the scheme.

Table 13-2 Summary of potential source – pathway – receptor linkages during operation

Source	Pathway	Receptor
Spillage of pollutants (e.g. fuels, lubricants)	Infiltration to groundwater or runoff to watercourses	Groundwaters and surface waters receiving runoff from the highway

Source	Pathway	Receptor
Heavy metals or fuels released by road traffic	Transport through the highway drainage system, either as soluble or sediment-bound pollutants	Receiving waters including groundwater (where infiltration is allowed) and surface watercourses (where road drainage outfalls are located)
Culverts or road drainage outfalls	Direct modification of watercourse	Watercourses crossed by the scheme or receiving discharges from the road drainage system
Embankments or cuttings	Changes in existing flow pathways (overland and through the ground) Changes in groundwater levels	Groundwaters close to the highway
Dewatering of excavations	Temporary reduction in groundwater levels	Groundwater features (e.g. boreholes, wells, springs)
Increased rates and volumes of surface water runoff from an increase in impermeable area	Highway drainage system	Receiving waters – groundwater and surface watercourses
New culverts	Reduced flood flow conveyance increasing local flood risk	Property at risk of flooding in the vicinity of new culverts

13.5.4 Drainage from the existing A30 is thought to discharge directly to the water environment without treatment and therefore the scheme may provide an opportunity for betterment.

13.5.5 Accidents occurring on roads can cause fuel spills and other spills of potentially polluting substances. These spills can enter into the road drainage system, and consequently enter surface water bodies that receive highway drainage. There is also a risk of spills entering groundwater from natural infiltration. Information relating to pollution incidents within the study area, and traffic collisions have been obtained from the following source:

- Traffmap Accident Analysis System – Accident data provided between 01/01/2012 and 31/12/2016.

13.6 Assessment Methodology

13.6.1 The assessment methodology follows the guidance set out in HD 45/09. It is noted that this guidance is being updated and where available, the assessment methodology has been aligned with any emerging guidance.

13.6.2 HD 45/09 provides a methodology and criteria for assessing the impact of a proposed road scheme on the water environment. This standard methodology is made up of the four steps described below:

- Identification of potential water receptors within the study area (Table 13-3) and an assessment of the importance, value and sensitivity of each of these receptors (HD 45/09, Annex 4, Table A4.3).
- Identification of potential impacts to the water features during construction or operation (HD 45/09, Annex 4, Table 4.1).
- Assessment of the potential magnitude of the effect of any construction or operation impacts on the receptor (HD 45/09, Annex 4, Table A4.4).

- Assessment of the overall significance of any effects to receptors due to impacts (HD 45/09, Annex 4, Table A4.6). The significance of effect is determined by comparison of the identified importance/sensitivity of the receptors with the estimated magnitude of the effect (HD 45/09, Annex 4, Table A4.5). For the purpose of this assessment, values of moderate adverse and above have been defined as significant potential effects, and mitigation measures are necessary.

13.6.3 Specific methods required by HD 45/09, which only have relevance to particular construction or operation impacts, are detailed in the following sections.

Construction impacts

13.6.4 HD 45/09 recommends that construction impacts are considered using the source – pathway – receptor approach and defers specific guidance of highway construction impacts to CIRIA 648 Control of Water Pollution from Linear Construction Projects.

13.6.5 The potential impacts of construction on surface water or sediment runoff, water quality, flood risk and groundwater quality or levels have been assessed based on the planned construction methods and sequencing. Where construction methods are not available, standard construction practices are assumed. Cumulative impacts as a result of construction phasing are also assessed.

13.6.6 Where measures to reduce construction impacts are considered standard practice they have been included in **Outline CEMP Annex G** (Volume 6 Document Ref 6.4 ES Appendix 16.1) within this ES. It has been assumed that they will be carried out in respect of the impact assessment presented in this chapter. Measures beyond standard practice are typically considered to be mitigation, and have been identified as such in the chapter.

Operational impacts

13.6.7 The assessment of the potential impacts during operation has covered five key aspects of the water environment;

- surface water quality & quantity,
- flood risk,
- geomorphology,
- groundwater quality & quantity, and
- accidental spillage.

13.6.8 The assessment approach is outlined in the following sections, with detailed methodologies provided in **DMRB assessments** (Volume 6 Document Ref 6.4 ES Appendix 13.3). All assessments follow a source – pathway – receptor approach.

<u>Surface water</u>

13.6.9 An assessment of the potential impacts of routine runoff on surface waters has been undertaken to determine the significance of the risk and if pollution mitigation measures are needed. The assessment has used the Method A outlined in HD 45/09. This methodology uses the Highways Agency Water Risk Assessment Tool (HAWRAT), which has been developed specifically for the purpose of supporting water quality assessments.

13.6.10 The proposed alignment of the scheme results in discharges to relatively minor watercourses, all of which have a catchment area of less than 1km^2 at drainage outfall locations. Given that these minor receiving watercourses are likely to dry up in periods of low rainfall and that infiltration from the detention basins is the preferred method of discharging road runoff, there is an increased likelihood of infiltration to groundwater. To ensure that all risks to water quality were captured in the assessment, the potential effect of the discharge of routine runoff to both ground and surface water was considered.

Geomorphology

13.6.11 A qualitative assessment of possible impacts on the hydromorphology of watercourses has been undertaken based on a geomorphologist's understanding of the potential for impacts to the flow dynamics and sediment transport processes and the subsequent effects that this might have on the ecological potential of the water feature (where relevant).

13.6.12 The assessment has been made using professional judgement and experience and is focussed on locations where the proposed route physically interacts with watercourses (for example proposed culverts or realignments) or where sediment loading from the proposed drainage system may occur.

Groundwater quality

13.6.13 Annex I of HD 45/09 provides a methodology (Method C) to assess the potential impact on the quality of groundwater resources from routine runoff discharges to the ground.

13.6.14 For there to be a risk of impact to groundwater, a source, pathway and receptor all have to be present to create a pollutant linkage. In the context of this chapter, sources comprise the drainage water that would be discharged at the outfalls of the proposed drainage system, and the receptors are defined as controlled water bodies, including the groundwater that underlies the scheme area.

Hydrogeology and groundwater resources

13.6.15 A specific methodology for the assessment of potential effects on hydrogeology and groundwater resources is not covered by HD 45/09. The method of assessment includes the following:

- Use of desk study information, the findings from site walkover studies and ground investigations to develop a ground model, including the likely groundwater levels across the scheme.
- Identification of any sensitive receptors that are reliant on the current groundwater levels, such as EA designated groundwater Source Protection Zones (SPZ), groundwater dependent terrestrial ecosystems (GWDTEs), existing abstraction wells, or spring lines that feed surface water courses.
- Identification of potential features or activities that are proposed for the scheme that may result in an impact on groundwater levels, such as the long-term dewatering of highway cuttings. Dependant on the rate and duration of any dewatering an abstraction licence may be required.

Accidental spillage

13.6.16 The operational pollution effects from accidental spillage have been calculated using Method D from the HD 45/09 guidance. In line with HD 45/09 guidance for assessment of the risk posed by accidental spillage, if the annual probability that a spillage would cause a serious pollution incident to a water body is less than 1%, or 0.5% where spillage could affect protected areas for conservation, then the risk posed is considered acceptable and no further assessment has been carried out. The risk is assessed initially without any mitigation measures. If mitigation measures are needed to reduce the probability, a reduction factor is applied, depending on the type of mitigation used.

WFD Compliance

13.6.17 A standalone WFD compliance assessment has been undertaken for the scheme and is included in **WFD compliance assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.1) The methodology used for the assessment is described there.

Flood risk

13.6.18 A standalone FRA has been undertaken for the scheme, in accordance with the Scoping Report[1], and is included in **Flood risk assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.2) Flood risk assessment. The methodology used for the assessment is described there. The methodology has been agreed with Highways England (as the Highway Authority), Cornwall Council (as the Lead Local Flood Authority (LLFA)) and, the Environment Agency (as Lead Authority for main rivers).

13.7 Baseline Conditions

Baseline methodology

13.7.1 The baseline describes the existing condition of surface waters, groundwater and flood risk within the study area. The value of each water feature identified has been determined based on the attributes and indicators of quality listed in HD45/09, Annex 4, Table A4.1.

13.7.2 The following data sources were used to compile the baseline conditions in the subsequent sections:

- Observations from a site walkover on 16th November 2017;
- EA Catchment Data Explorer[5];
- EA What's in your backyard (WIYBY)[6];
- South West River Basin Management Plan (2015);
- West Cornwall Catchment Flood Management Plan (2012);
- Existing highway drainage plans;
- National River Flow Archive[7];
- Natural England, MAGIC[8];

[5] The Environment Agency, "Catchment Data Explorer," Environment Agency, 01 11 2017. [Online]. Available: http://environment.data.gov.uk/catchment-planning/. [Accessed 10 2017].
[6] The Environment Agency, "What's In Your Backyard?," The Environment Agency, 18 09 2017. [Online]. Available: http://apps.environment-agency.gov.uk/wiyby/default.aspx. [Accessed 10 2017].
[7] Centre for Ecology and Hydrology, "National River Flow Archive," 10 2017. [Online]. Available: http://nrfa.ceh.ac.uk/data/station/meanflow/64001. [Accessed 10 2017].http://nrfa.ceh.ac.uk/data/station/meanflow/64001
[8] MAGIC, "Interactive mapping at your fingertips," 10 2017. [Online]. Available: http://www.magic.gov.uk/. [Accessed 10 2017].

- Ordnance Survey (OS) mapping (including topography);
- British Geological Survey (BGS) mapping[9];
- Groundsure reports[10];
- Information from historic and recent ground investigations;
- A30 River Habitat Appraisal[11];
- A30 Fish Population Surveys report[12];
- A30 Aquatic Ecology Surveys[13];
- EA flood risk mapping[14];
- Drinking Water Inspectorate (DWI) Map showing the rate of hardness in mg/l as Calcium Carbonate in England and Wales[15]; and
- The Coal Authority interactive map viewer[16].

13.7.3 The geomorphology baseline conditions were identified during a site walkover and using information contained in the River Habitat Appraisal report[11]. Channel dimensions, slope and roughness, as required by the Method A assessments (HAWRAT, Step 2, Tier 2) were estimated from these sources. A visual inspection during a site visit is an appropriate method for undertaking a geomorphology survey to inform this level of assessment.

13.7.4 To establish a baseline condition, fisheries and invertebrate surveys[10,11] have been conducted for watercourses and ponds that would potentially be modified by the scheme.

13.7.5 Current and future potential traffic and accident data was obtained from predicted 2038 AADT flows (the design year) to account for future growth.

13.7.6 Existing ground conditions and the potential for opening up pollution pathways from existing contaminated land have been considered in **Geology and soils** (Volume 6 Document Ref 6.2 ES Chapter 9).

Surface Water

13.7.7 A review of OS mapping indicates that there are approximately 26 watercourses and surface water features within the 500m study area, see Table 13-3.

13.7.8 All watercourses identified in the study area are classified as Ordinary Watercourses and come under the jurisdiction of Cornwall Council as LLFA. Downstream extents (typically in excess of 1km from the scheme alignment) are classified as main rivers and therefore under the jurisdiction of the EA.

13.7.9 The alignment of the existing A30 broadly follows a ridgeline and, as such, surface water runoff generally falls to the north and south of the A30 and all existing and proposed crossings are close to the head of any watercourses.

[9]British Geological Survey, "Geology of Britain viewer," 2017. [Online]. Available: http://mapapps.bgs.ac.uk/geologyofbritain/home.html . [Accessed 10 2017].
[10] Groundsure Envirosight Reports covering the study area (GS-62105222ENV_A, GS-62105222ENV_B & GS-62105222ENV_C). Created on 4th March 2016.
[11] Volume 6 Document Ref 6.4 ES Appendix 8.4 River Habitat Appraisal Report.
[12] Volume 6 Document Ref 6.4 ES Appendix 8.10 Fish Survey Report.
[13] Volume 6 Document Ref 6.4 ES Appendix 8.9 Freshwater Macroinvertebrates Survey Report.
[14] gov.uk, "Flood map for planning," 2017. [Online]. Available: https://flood-map-for-planning.service.gov.uk/. [Accessed 10 2017].
[15] Defra, "Map showing the rate of hardness in mg/l as Calcium Carbonate in England and Wales," 2009. [Online]. Available: http://www.dwi.gov.uk/consumers/advice-leaflets/hardness_map.pdf . [Accessed 10 2017].
[16] The Coal Authority, "Coal Mining Reporting Area," 2017. [Online]. Available: http://mapapps2.bgs.ac.uk/coalauthority/home.html. [Accessed 10 2017].

13.7.10 Within the study area, watercourses to the north of the scheme alignment include Perranporth Stream, Bolingey Stream, Holywell Stream and Benny Stream, whilst to the south of the scheme alignment watercourses are part of the River Kenwyn and River Allen catchments. These watercourses are all relatively short and steep and discharge along the north or south coast of Cornwall.

Table 13-3 Summary of water features within proximity of scheme alignment

Approx. chainage (m)	Location relative to scheme	Description	Scheme elements	Value[17]	Value rationale
0+200	Crossed by scheme within existing road alignment	Ordinary Watercourse known as Calenick Stream. Flows south through the Carrick Heaths SSSI c. 700m downstream. Water quality monitored against WFD and current ecological quality is moderate. In NVZ (ID ET5). Not included in **Fish survey report** (Volume 6 Document Ref 6.4 ES Appendix 8.10) or **Freshwater macroinvertebrates survey report** (Volume 6 Document Ref 6.4 ES Appendix 8.9).	Existing culvert, new drainage outfall.	Medium	Has low amenity value.
1+300	220m north of scheme alignment	Ordinary Watercourse known as Perranporth Stream. Flows northwards. Not included in **Fish survey report** (Volume 6 Document Ref 6.4 ES Appendix 8.10) or **Freshwater macroinvertebrates survey report** (Volume 6 Document Ref 6.4 ES Appendix 8.9).	New drainage outfall.	Medium	Has low amenity value (footpath/bridge).
1+700	240m south of scheme alignment	Ordinary Watercourse. Flows east to confluence with River Kenwyn c. 2.3km downstream. Unsuitable for fish as ephemeral. Macroinvertebrates at Moderate WFD status.	New drainage outfall.	Medium	Has low amenity value.
2+200	400m south of scheme alignment	Ordinary Watercourse. Flows south to confluence with River Kenwyn c. 2km downstream. Suitable habitat but no fish present in survey, macroinvertebrates at High WFD status. Otter present.	New drainage outfall	High	Has low amenity value. Potential for fish, otter present.

[17]Based on the attributes and indicators of quality listed in HD45/09, Annex 4, Table A4.1

Approx. chainage (m)	Location relative to scheme	Description	Scheme elements	Value[17]	Value rationale
2+200	500m south of scheme alignment	Pond assumed to be in hydraulic connectivity to Ordinary Watercourse also at chainage 2000m. Not included in ecological surveys.	N/a	High	Connected to high value watercourse. Has low amenity value.
3+400	270m north of scheme alignment	Ordinary Watercourse known as Bolingey Stream. Flows north through the Callestick Vean CWS c. 750m downstream. Not surveyed due to lack of access, assumed to be similar to feature at ch 4+400.	N/a	High	Quality of watercourse supports habitats and species in CWS
3+800	260m south of scheme alignment	Ordinary Watercourse known as River Kenwyn. Flows south. Bullhead and brown trout fry found during fish survey, macroinvertebrates at High WFD status.	N/a	High	Species protected under EU/UK legislation.
4+400	100m north of scheme alignment	Ordinary Watercourse. Flows north through the Callestick Vean CWS c. 300m downstream. Confluences with Bolingey Stream c. 550m downstream. No fish present during survey but suitable habitat, macroinvertebrates at High WFD status.	New drainage outfall	High	Quality of watercourse supports habitats and species in CWS
4+400	200m north of scheme alignment	Pond assumed to be in hydraulic connectivity to ordinary watercourse north of chainage 4100m. Moderate conservation status for invertebrates, high conservation status for plants.	New drainage outfall	High	Connected to high value watercourse.
5+000	500m south of scheme alignment	Ordinary Watercourse. Flows south to confluence with River Kenwyn c. 2km downstream. Scoped out of ecological surveys.	N/a	Medium	Has low amenity value.
6+000	200m south of scheme alignment	Pond assumed to be in hydraulic connectivity to ordinary watercourse south of chainage 6000m. Moderate conservation status for invertebrates, high conservation status for plants.	New drainage outfall	High	Connected to high value watercourse.

Approx. chainage (m)	Location relative to scheme	Description	Scheme elements	Value[17]	Value rationale
6+050	80m south east of scheme alignment	Ordinary Watercourse. Flows south-east through the Carrick Heaths SSSI c. 680m downstream. Confluences with Zelah Brook c. 2km downstream. Surface water flow path upstream of the watercourse will be culverted. Brown trout present and suitable salmonid habitat, macroinvertebrates at High WFD status.	Culvert, New drainage outfall	High	Species protected under UK legislation.
7+200	140m south of scheme alignment	Ordinary watercourse. Flows east to confluence with Zelah Brook c. 1.4km downstream. Access unavailable at time of fish survey, macroinvertebrates at High WFD status.	New drainage outfall	Medium	Has low amenity value.
7+700	490m north of scheme alignment	Ordinary Watercourse. Flows north to confluence with Bolingey Stream c. 2.4km downstream. Scoped out of ecological surveys.	N/a	Medium	Has low amenity value.
8+000	960m south east of scheme alignment at 181297, 50191.	Active licenced surface water abstraction from tributary of River Allen. Used for Lake and Pond Flow Throughflow (non-potable).	N/a	Medium	Provides water for non-potable use.
8+900	Crossed by scheme within existing road alignment	Ordinary Watercourse known as Zelah Brook. Flows south to confluence with the River Allen c. 4.7km downstream. Water quality monitored against WFD and current ecological quality is good. Bullhead, lamprey and brown trout present in watercourse, macroinvertebrates at Good WFD status. Otter present.	New drainage outfall, Culvert	High	Species protected under EU/UK legislation.
9+250	Crossed by scheme within existing road alignment	Ordinary Watercourse. Flows south- east to confluence with Zelah Brook c. 340m downstream. Fish survey showed no presence but connected to nearby watercourses with protected species. Macroinvertebrates at Poor WFD Status.	Culvert	High	Species protected under EU/UK legislation in watercourse <100m downstream.

Approx. chainage (m)	Location relative to scheme	Description	Scheme elements	Value[17]	Value rationale
10+000	470m north-west of scheme alignment	Ordinary Watercourse. Flows west to confluence with Bolingey Steam c. 3.3km downstream. Scoped out of ecological surveys.	N/a	Medium	Has low amenity value.
10+500	25m and 100m north of scheme alignment	Small ponds located north of scheme alignment. No known hydraulic connectivity with watercourses. Registered private water supply for agricultural use. Moderate conservation status for invertebrates, high conservation status for plants.	N/a	Medium	No known hydraulic connectivity, moderate ecological value.
10+900	460m north of scheme alignment	Ordinary Watercourse known as Holywell Stream. Flows north. Water quality monitored against WFD and current ecological quality is moderate. Suitable conditions for fish but none present, macroinvertebrates at Moderate WFD status.	New drainage outfall	Medium	Has low amenity value and potential for fish.
11+050	Crossed by scheme by new road alignment	Ordinary Watercourse known as River Allen. Flows south through the Trenerry Woods CWS c. 750m downstream. No fish present during survey but suitable habitat, macroinvertebrates at High WFD status.	New drainage outfall, Culvert, Cutting	High	Quality of watercourse supports habitats and species in CWS
		Two ponds assumed to be in hydraulic connectivity with watercourse at same location. Moderate conservation status for invertebrates and plants.	Cutting	High	Connected to high value watercourse.
		Registered private water supply from watercourse	Embankment construction	Very High	Private water supply (potential potable use)
11+900	150m south of scheme alignment	Ordinary Watercourse. Flows south through the Trenerry Woods CWS c. 300m downstream. Confluences with River Allen c. 900m downstream. Brown trout present and macroinvertebrates at High WFD status.	New drainage outfall	High	Species protected under UK legislation. Quality of watercourse supports habitats and species in CWS

Approx. chainage (m)	Location relative to scheme	Description	Scheme elements	Value[17]	Value rationale
12+300	470m south of scheme alignment	Ordinary Watercourse. Flows south-west through the Trenerry Woods CWS c. 920m downstream. Confluences with River Allen c. 1.1km downstream. Not included in ecological surveys.	N/a	High	Quality of watercourse supports habitats and species in CWS
12+700	Crossed by scheme by new road alignment	Disused quarry that has since filled with water. Scoped out of surveys due to unsafe access.	N/a	Low	No known hydraulic connectivity or ecological/amenity value.
12+900	220m north of scheme alignment	Ordinary Watercourse located within the Newlyn Downs SSSI and Special Area of Conservation (SAC) c.110m north of scheme options. Tributary of Benny Stream. Flows north through the SSSI and SAC. No fish present but suitable habitat, macroinvertebrates at Good WFD status.	N/a	Very High	Within SSSI/SAC.
13+400	300m south of scheme	Ordinary Watercourse known as Kestle Stream. Flows south through the Carrick Heaths SSSI c. 290m downstream. No fish surveys undertaken as deemed unlikely to support, macroinvertebrates at High WFD status.	N/a	High	<500m upstream of SSSI.
13+700	80m north of scheme alignment	Ordinary Watercourse. Flows north through Goonwinnow CWS c.500m downstream. Confluences with tributary of Benny Stream 2.5km downstream. No fish present but suitable habitat, macroinvertebrates at High WFD status.	New drainage outfalls, Culvert	High	Quality of watercourse supports habitats and species in CWS.
14+500	690m north east of scheme alignment at 186400, 54600	Active licensed surface water abstraction for spray irrigation.	N/a	Medium	Provides water for non-potable use.

13.7.11 Watercourses within the study area include Ordinary Watercourses with no known designations, recreational/economic value and limited ecological value, which are considered to be of Medium value. However, a number of the watercourses, whose flows support designated sites of national and/or county-wide importance and/or have been identified as habitat for protected species (from ecological surveys) are deemed to be of High value. The watercourse at ch 10050 is a

registered private water supply and is assigned a value of Very High. The watercourse at ch. 12900 is within a SSSI and SAC that is designated due to water features (Newlyn Downs) and as such is considered to have a value of Very High.

13.7.12 Several ponds have also been identified within close proximity to the scheme. Ecological surveys have been conducted for ponds most likely to be impacted by the scheme[12,13] and the results have been used to inform the value classification. Ponds with direct connectivity to the wider watercourse network have been assigned the same value as the watercourse they are connected to, with offline ponds assigned a value based on their use (e.g. as an agricultural water supply) and ecological value.

13.7.13 Many of the watercourses within the study area flow through designated sites which are reliant on the water environment associated with the watercourse. These sites are considered as important features in the assessment, including Newlyn Downs SAC/SSSI, Carrick Heaths SSSI (comprised of several components located across the length of the scheme), Trenerry Wood CWS, Callestick Vean CWS and Goonwinnow CWS. All designated sites are discussed in more detail in **Ecology and nature conservation** (Volume 6 Document Ref 6.2 ES Chapter 8), whilst those classed as WFD protected areas have been considered in the **WFD compliance assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.1).

13.7.14 The existing A30 is primarily drained using traditional kerb and gully systems on embankments, and combined filter drains in cuttings. In some older sections, the carriageway appears to be drained by over the edge drainage into adjacent field ditches. Many of the minor existing side roads appear to have no defined drainage networks and rely on over the edge drainage into field ditches or runoff into adjacent land.

13.7.15 Due to the age of some sections, it is deemed unlikely that attenuation or treatment is present and no evidence of either was found during the site walkover. As a result, the existing highway runoff is likely to discharge uncontrolled into field ditches and adjacent watercourses. The exception to this is at Chiverton Junction (ch 13300), where there is an attenuation pond located to the west of the existing junction.

13.7.16 There are two active licensed surface water abstractions within 1km of the scheme[10], both of which are for non-potable use. There are also various historic licensed surface water abstractions in the study area.

13.7.17 Fish population surveys were conducted by APEM Ltd. in 2017 on watercourses surrounding the A30 corridor between Chiverton Cross and Carland Cross to understand the baseline aquatic conditions associated with the proposed works on the A30. Four sites were thought to be ‘directly impacted’ and 14 potentially ‘indirectly impacted’.

13.7.18 Electrofishing surveys were carried out on 12 sites, which were selected based on the scheme footprint and an understanding of the watercourses derived during an earlier walkover survey[11]. No fish were present at 7 of the 12 sites. Brown trout were present at five survey locations, bullhead at three locations and lamprey at two locations (noted in Table 13-3, full description in **Fish survey report** (Volume 6 Document Ref 6.4 ES Appendix 8.10)).

13.7.19 The aquatic physico-chemical conditions at each of the fish survey sites was generally good with moderate to high dissolved oxygen concentrations, neutral pH and low conductivity. The lack of fish in seven of the sites is attributed to the ephemeral nature of these watercourses.

13.7.20 Volume 6 Document Ref 6.3 ES Figure 13-1 shows the surface water features identified in relation to the scheme.

Groundwater

13.7.21 The proposed scheme alignment is underlain by Porthtowan Formation and Grampound Formation bedrock geology, comprising mudstone, sandstone and siltstone[8].

13.7.22 A review of the EA's Groundwater map, on WIYBY[18] confirms that bedrock geology is classified as a Secondary A Aquifer, described as "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. Superficial deposits within this area are limited, with a scattering of clay, silt, sand and gravel overlying the bedrock geology in places"[19].

13.7.23 Volume 6 Document Ref 6.3 ES Figure 9-4 shows the existing groundwater features (other than licensed abstractions) identified in relation to the scheme.

13.7.24 Five active licenced groundwater abstractions are located within the study area[10], of which four are registered for potable use. Further details (including the location) of these features are listed in Table 13-4. Various historical licenced groundwater abstractions have also been identified in the study area.

13.7.25 There are 178 registered private water supplies noted within 1km of the scheme alignment. Owners of these supplies have been given opportunity to engage with HE during various stages of public consultation. Several supply owners have provided information about their water supply arrangements at these events. The location of these features is shown on Volume 6 Document Ref 6.3 ES Figure 9-4.

13.7.26 Historic mapping also notes 55 wells or springs within the study area.

13.7.27 All groundwater features potentially affected by the scheme are identified within Section 5.2 of **DMRB assessments** (Volume 6 Document Ref 6.4 ES Appendix 13.3).

13.7.28 All licensed abstractions and private water supplies used for potable use are deemed to be within Source Protection Zone 1 and are therefore deemed a value of Very High. Features in use for non-potable supply are deemed to have a value of Medium. Given that the overall aquifer properties are only deemed to be of value at a local scale and have a WFD status of Poor, all other groundwater features are deemed to be of Low value. These values are explained further in Table 13-4.

[18] Environment Agency, "Groundwater," 2017. [Online]. Available: http://apps.environment-agency.gov.uk/wiyby/151261.aspx. [Accessed 2017].
[19] The Environment Agency, "What are the aquifer designations?," 18 09 2017. [Online]. Available: http://apps.environment-agency.gov.uk/wiyby/117020.aspx. [Accessed 2017].

Table 13-4 Underlying aquifer value

Chainage, m	Location relative to scheme	Feature description	Value assigned	Value rationale
Various locations: See Volume 6 Document Ref 6.3 ES Figure 9-4		Registered private water supplies for potable use	Very High	Groundwater abstraction for potable use (SPZ1)
13+500 13+600	Licenced abstraction at 184800, 54200 Licenced abstraction at 184900, 54300	Active licenced groundwater abstractions for potable use.	Very High	Groundwater abstraction –for potable use.
Various locations: See Volume 6 Document Ref 6.3 ES Figure 9-4		Registered private water supplies for non-potable use.	Medium	Groundwater abstraction for non-potable (typically agricultural) use.
1+200	Licenced abstraction at 176000, 47500	Active licenced groundwater abstraction.	Medium	Groundwater abstraction for non-potable (typically agricultural) use.
Other historic groundwater features underlying scheme area		Secondary A Aquifer	Low	Only local importance as an aquifer. Features no longer in use.

WFD compliance

13.7.29 A detailed baseline of the existing status and objectives of WFD quality elements within the study area has been included in the **WFD compliance assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.1). Volume 6 Document Ref 6.3 ES Figure 13-3 and Volume 6 Document Ref 6.3 ES Figure 13-4 show the WFD surface water bodies and WFD ground water bodies respectively.

Flood risk

13.7.30 The scheme alignment is located entirely in the low risk Flood Zone 1, which is defined as having a risk of flooding from fluvial and tidal sources of less than 1 in 1000 (0.1%) in any year.

13.7.31 Sections of the scheme alignment are indicated on the EA mapping (see Volume 6 Document Ref 6.3 ES Figure 13-1) to be at risk of flooding from surface water sources. This mapping does not distinguish between areas at risk of flooding purely from surface water runoff (specifically during heavy rainfall events) and areas at risk from small watercourses that are too small to be included on fluvial flood risk mapping. Following a review of these locations, the main areas of surface water flood risk along the proposed scheme alignment are coincident with small watercourses crossed by the existing A30, indicating flooding from fluvial sources, rather than areas where the road drainage network is overwhelmed during rainfall events.

13.7.32 Potential flood risk receptors include the proposed highway, residential properties and agricultural land. The proposed highway is considered to have Very High importance as an essential infrastructure route. Residential receptors are considered to have High value and agricultural land is considered to have Low value, see Table 13-5.

Table 13-5 Flood risk

Name	Value justification	Value assigned
Proposed highway	Regionally important infrastructure asset	Very High
Residential properties	Floodplain protecting between 1 and 100 residential properties	High
Agricultural land	Limited constraints and low probability of flooding residential and industrial properties	Low

13.8 Consultation

13.8.1 Stakeholders have been consulted at various stages of the assessment, including during baseline data gathering and all stakeholders were offered the opportunity to comment on the PEIR. The scoping opinion is available in **Scoping opinion** (Volume 6 Document Ref 6.4 ES Appendix 4.1). The responses to the Scoping opinion is available in **Response to scoping opinions** (Volume 6 Document Ref 6.4 ES Appendix 4.2).

13.8.2 Cornwall Council has been consulted to obtain baseline data including local and unlicensed abstractions and in their capacity as LLFA with regards to the assessment of flood risk and crossing of ordinary watercourses.

13.8.3 The Environment Agency has been consulted at the PEIR stage and indicated that they were satisfied with the contents on the document.

13.8.4 The Planning Inspectorate has been consulted during the scoping stage and provided an opinion along with collated responses from South West Water and Public Health England.

13.8.5 Landowners have been consulted during formal public consultation sessions and to obtain information about known abstractions and private water supplies.

13.9 Assessment Assumptions and Limitations

13.9.1 For the assessment of construction impacts, where construction methods are not available, standard construction practices are assumed where construction methods and sequencing information is not available.

13.9.2 Assessment of the drainage and the water environment aspects of the scheme have been carried out in accordance with HD 45/09, and supplementary methods as explained in the above sections for potential impacts not covered by this guidance.

13.9.3 Limitations and assumptions associated with the recommended methods are discussed below.

Surface water

13.9.4 The baseline condition described in the assessment was obtained from the EA's 'Catchment Data Explorer' website, along with the River Habitat Appraisal report.

13.9.5 For the HAWRAT model flow data is required. Due to the small size of the surface watercourses in the study area there is no available flow data available. An estimate of the Q95 flow at a subset of these watercourses was undertaken using the method described in the Institute of Hydrology Report No. 108. This indicated

that a Q95 of 0.0013 m^3/s is appropriate for the assessments of receiving waters at all proposed outfalls.

13.9.6 The water hardness parameter for HAWRAT was obtained from the Drinking Water Inspectorate (DWI) map which shows the rate of water hardness. This data is considered to be appropriate to use in the absence of chemical data for each watercourse. It is assumed that local potable water would have a similar hardness characteristic as the local surface water and the three water hardness levels used by the HAWRAT model are based on broad ranges.

13.9.7 Several stages of public consultation have been held for the scheme to allow owners of licenced surface water abstractions to engage with HE. Where licence owners have not engaged, historic licenced surface water abstractions identified by Groundsure reports[10] have been assumed to no longer be in use.

Groundwater

13.9.8 The Method C assessment results in a significance of effect that is relevant to the specific locale of the point of discharge. This is not considered to be relevant to the wider groundwater body due to dilution effects. Supplementary risk assessment has been undertaken where required.

13.9.9 Several stages of public consultation have been held for the scheme to allow owners of licenced groundwater abstractions to engage with HE. Where licence owners have not engaged, historic licenced groundwater abstractions identified by Groundsure reports[10] have been assumed to no longer be in use.

Gaps and uncertainties

13.9.10 Historic mapping has identified groundwater features such as wells or springs at various locations along the proposed route. The continued use of these features is unclear, other than where landowners have responded to consultation. It is likely that many of these features are no longer in use but have been included in the assessment as a precautionary measure.

Limits of deviation

13.9.11 An assessment has been conducted within the limits of deviation outlined in Limits of Deviation within **Approach to EIA** (Volume 6 Document Ref 6.2 ES Chapter 4).

13.9.12 Deviations within the LOD could result in changes to groundwater levels and flows due to the interception of groundwater via the highway drainage. Areas of cutting below the existing water table would be the most sensitive, particularly to decreases in the vertical alignment of the highway. Any decrease in vertical alignment could result in the highway drainage intercepting groundwater or increase the extent of groundwater interception in areas where the scheme is already anticipated to be interacting with groundwater. Any such area would require dewatering during construction and operation of the scheme, which would result in a depression of groundwater levels surrounding the dewatering, with potential impacts to nearby groundwater receptors (e.g. boreholes or springs).

13.9.13 The assessment undertaken for the ES has considered the elevation of all potential groundwater receptors relative to the elevation of areas of cutting. Given the uncertainty of exact groundwater levels due to seasonal fluctuations (several metres) relative to any changes in highway elevation within the LOD (+/- 0.5m),

all receptors potentially effected within the LOD have already been considered in the assessment of effects. Therefore, the proposed LOD will not give rise to any materially new or materially worse adverse environmental effects from those reported in the ES.

13.10 Design, Mitigation and Enhancement Measures

Engineering design

13.10.1 The design of the carriageway drainage includes mitigation to ensure that flood risk is not increased in the vicinity of the scheme and to ensure that soluble and suspended pollutants in carriageway runoff are reduced to acceptable levels prior to discharge to groundwater (preferred) or to local watercourses at the Greenfield Runoff Rate.

13.10.2 The carriageway drainage would include a two-stage or three-stage treatment train, consisting of filter drains and detention ponds, along with grassed swales (dry) or wet ponds where additional treatment is required. Details of the treatment trains for each area of road drainage are included in **DMRB assessments** (Volume 6, Document Ref 6.4, ES Appendix 13.3). The levels of treatment embedded in the scheme design are sufficient to reduce pollutants in road drainage discharges to levels acceptable to HAWRAT.

13.10.3 Attenuation/infiltration basins would be designed to ensure that groundwater levels would not impede their performance.

13.10.4 Where embankments are to be constructed above key groundwater/surface water interactions (springs), culverts or drainage blankets will be incorporated into the design to maintain the existing flow regime and to ensure the sub-surface flows do not compromise the integrity of the earthworks.

13.10.5 The drainage of cuttings seeks to retain existing flow directions within catchment areas where possible and to maintain flow regimes in groundwater-fed features. In these areas, road runoff would be drained to combined surface water/groundwater drains in the verge.

13.10.6 Cut-off ditches at the top of cuttings and at the bottom of embankments would intercept natural runoff. If the natural topography falls away from the road alignment, cut-off ditches would not generally be provided other than to mitigate local flooding risk.

13.10.7 Where the scheme crosses watercourses, flows would be maintained within their catchment through culverts where possible. These culverts would be designed to convey flow equivalent to the 100-year event plus 40% allowance for climate change beneath the proposed highway. Where the catchment area draining to the cross drainage culvert is not readily defined, the minimum culvert diameter would be 1200mm in accordance with the DMRB Volume 4, Section 2 Part 7, HA 107/04.

13.10.8 Outfalls from the road drainage system would be set back from existing watercourses and to discharge into new or existing lengths of field ditches where possible.

Construction mitigation

13.10.9 **Outline CEMP annex G** (Volume 6, Document Ref 6.4, ES Appendix 16.1) includes measures that are considered as standard good practice that would be implemented by the construction contractor to reduce the likelihood of effects or their magnitude if they were to occur. The **Outline CEMP** (Volume 6 Document Ref 6.4 ES Appendix 16.1) also describes the procedures to be followed after an accidental spillage or other release of pollutants.

13.10.10 Works would also be carried out in accordance with any additional permitting requirements, for example Ordinary Watercourse Consent.

Operation mitigation

13.10.11 The mitigation listed in this section are summarised in the Register of Environmental Actions and Commitments (REAC) within **Outline CEMP** (Volume 6, Document Ref 6.4, ES Appendix 16.1).

13.10.12 **Outline CEMP Annex G** (Volume 6, Document Ref 6.4, ES Appendix 16.1) includes measures that would be implemented by the contractor which are to be maintained by the operator in accordance with the Handover Management Plan (HEMP) to ensure the required level of performance is maintained within the drainage system.

Culvert design

13.10.13 The detailed design of new culverts shall ensure that:

- The base of the culvert is set >150mm below the existing bed of the watercourse with structures attached to the base of the culvert (e.g. wooden batons) to retain sediment within the full length of the culvert. This will help to retain habitat connectivity either side of the culvert and promote continued sediment transport downstream;
- Scour protection at the inlet or outlet uses bioengineering methods wherever practicable to maximise habitat potential; and
- A geomorphologist is consulted during the detailed design of these structures.

Outfall design

13.10.14 The design of any new outfalls shall ensure that:

- The headwall structure is set back from or flush with the channel profile and does not protrude into the channel;
- The outfall is angled to direct flow at an angle no greater than 60 degrees from the existing flow direction in the watercourse;
- Any scour protection surrounding the outfall headwall uses bioengineering methods wherever practicable to maximise habitat potential; and
- A geomorphologist is consulted during the detailed design of these structures.

Private water supplies

13.10.15 Several private water supplies have been identified as potentially being impacted by the scheme. Where the potential for impacts remains unclear, a detailed assessment of groundwater levels and flows shall be undertaken during detailed design to fully understand the potential impact upon each feature of interest. This

should include hydrogeological calculations of the likely drawdown of the water table.

13.10.16 Where the potential for impact remains unclear or is certain, a new private water supply (e.g. a borehole) will be established following discussion with the landowner. This replacement may be temporary or permanent dependant on the duration of expected impacts (i.e. during construction only or during construction and operation).

13.10.17 It is likely that the construction of the side road beneath the new A30 at chainage 11+000 would impact upon the water levels in the ponds at chainage 11+050 and 11+100. These ponds currently provide water for livestock. The predicted impact will be confirmed by detailed assessment and monitoring of recharge mechanisms during detailed design. If the potential for impact is confirmed the ponds will be locally re-profiled to maintain their ecological and resource value. Any works will be designed in consultation with the landowner and water user.

Enhancement

13.10.18 The shift of the majority of traffic from the existing A30 to the new road can be considered an enhancement to the water environment. At present the road runoff from the existing A30 discharges without treatment, whilst the new road will include SUDS to attenuate and treat road runoff and also to promote infiltration to groundwater. The reduction in traffic using the existing road will likely improve the quality of the discharges, whilst the drainage system of the new road will provide a suitable level of pollutant reduction prior to discharge to the wider water environment.

13.11 Assessment of Effects

Construction effects

Surface water

Surface water quantity

13.11.1 The proposed scheme alignment generally traverses a boundary between two watersheds. Several springs emerge along the flanks of this watershed boundary, flowing to the north and south and as such there are interactions with earthworks associated with the scheme.

13.11.2 Potential impacts include modifications to the hydrology of existing springs or watercourses due to local changes in groundwater flow or levels resulting from cutting or embankment drainage.

13.11.3 Five areas of embankment have been noted to be over existing springs and headwater streams. The location, hydrology and potential impact of each of these are summarised within Table 13-6.

Table 13-6 Summary of springs and headwater streams affected by embankments construction

Hydrological/ hydrogeological receptor	Embankment	Chainage (m)	Potential effect	Embedded design/ mitigation	Residual effect
Surface water flow path – collects 80m south-east, downstream of the culvert, as a tributary of Zelah Brook.	Tresawsen Embankment	5+900 to 6+200	Embankment constructed over and blocking the flow of the headwater stream	Culvert/ drainage blanket – this will also prevent water causing instability in the earthworks	Maintenance of current flow regime
Headwater stream – spring 45m north-west feeds the headwaters before crossing at ch 8+910. Stream continues to flow east before joining a river network eventually merging with the River Allen.	Tolgroggan Earthworks 2	8+750 to 8+950			
Spring and headwater stream – spring beneath or at the toe of the existing A30 embankment. Headwater crosses under the scheme at ch 9+250. Stream flows south-east before joining a river network eventually merging with the River Allen.	Zelah Earthworks 2	9+200 to 9+400			
Headwater stream – flows south-east, crossing scheme at ch 11+040. Continues to flow south-east before joining the River Allen.	Penny-Come-Quick Embankment	11+000 to 11+150			
Spring and headwater stream – flows north-east at ch 13+680 and continues north before joining the River Gannel.	Carland Cross Earthworks 2	13+400 to 13+850			

13.11.4 The assessment of impacts of cutting construction on groundwater-fed features (Volume 6, Document Ref 6.4, ES Appendix 13.3 **DMRB assessments**, Section 13.2) noted features that would be potentially impacted as a result of the cutting drainage. The location, hydrology and potential impact of each of these are summarised within Table 13-7.

Table 13-7 Surface water receptors potentially impacted by lowering groundwater levels following installation of cutting drainage.

Receptor (Chainage)	Distance to cutting m	Potential effect	Embedded design/ mitigation	Residual effect
Seepage (1+750 - 1+950)	270m E	Groundwater – surface water connection lost following installation of cutting drainage, resulting in change in hydrology and potential loss of surface water feature.	Cutting drainage maintains flow directions and existing catchment areas wherever possible. Detailed assessment of groundwater-surface water interaction during detailed design.	Minimal changes in flow regime in low value receptors.
Watercourse (7+800)	410m N			
Watercourse (8+850)	350m E			
Wet disturbed ground (9+900)	170m NE			
Seepage (10+150 - 10+250)	415m S			
Pond (10+350)	140m N			
Pond (10+450)	35m N			
Pond & Watercourse (10+500)	150m N			
Pond (11+050)	Online			
Pond (11+100)	30m E			
Wet depression (11+200 – 11+300)	250m E			

13.11.5 Given the minimal potential changes in hydrology as a result of construction of the scheme, impacts upon watercourses or other surface water features designated as protected areas (e.g. Newlyn Downs SAC/SSSI, Carrick Heaths SSSI) are not anticipated.

13.11.6 The potential magnitude of impact of embankment construction on surface waters is negligible as the existing flow directions and regimes will be maintained.

13.11.7 The potential magnitude of impact of cutting construction on the features identified in Table 13-7 is moderate adverse as flow regimes would be modified at a local scale, without a significant impact on the wider catchments. For features with a low value, which includes all features that do not provide a water supply, have no direct hydrological connectivity to the wider drainage network and limited ecological value, this would result in a significance of effect of **slight adverse**.

13.11.8 For all other features a detailed assessment would be undertaken during detailed design to establish the likelihood for impacts of the scheme on each feature. Where an impact is established, additional mitigation such as provision of a new water supply would be implemented. These mitigation measures would be developed in consultation with the landowner and water user. With this mitigation in place the magnitude of impact would be reduced to negligible, leading to a significance of effect of **neutral**.

13.11.9 It is likely that the construction of the side road beneath the new A30 at chainage 11+000 would impact upon the water levels in the ponds at chainage 11+050 and 11+100. In isolation, these ponds have moderate ecological value[11] but as they are connected to a watercourse which supports protected sites downstream, they have been assigned a high value (Table 13-3). The predicted impact will be confirmed by detailed assessment and monitoring of recharge mechanisms during detailed design. If the potential for impact is confirmed the ponds will be locally re-profiled to maintain their ecological and resource value. Any works will be designed in consultation with the landowner and water user. With this mitigation in place the magnitude of impact would be reduced to negligible, leading to a significance of effect of **neutral**.

Surface water quality & geomorphology

13.11.10 Following the implementation of mitigation listed in the **Outline CEMP** (Volume 6, Document Ref 6.4, ES Appendix 16.1), the magnitude of any pollution incident or temporary physical modification as a consequence of the construction of the scheme is likely to be negligible. Therefore, the significance of effect would be **neutral**.

Groundwater

Groundwater levels

13.11.11 The assessment of potential impact on groundwater resulting from the proposed road drainage intercepting groundwater (i.e. in cuttings), is presented in Volume 6, Document Ref 6.4, ES Appendix 13.3 **DMRB assessments**, Section 5.2. This assessment has highlighted a potential effect upon various groundwater features identified along the scheme. These are listed in Table 13-8.

13.11.12 Historic mapping has identified groundwater features such as wells or springs at various locations along the proposed route. The continued use of these features is unclear, other than where landowners have responded to consultation. Where features are known to be in use (or if it is still unclear) a detailed assessment would be undertaken at detailed design and if an impact cannot be screened out, mitigation (i.e. a new water supply) would be provided ahead of cutting construction, as outlined in 13.10.154.

Table 13-8 Groundwater receptors potentially impacted by cutting drainage from the scheme.

Receptor	Chainage, m	Distance to cutting, m	Potential effect	Embedded design/ mitigation	Residual effect
GW abstraction licence (FID 6)	1+700	145E	Reduction in groundwater levels due to cutting drainage results in a change to flows or levels from features. Potential impacts upon domestic and agricultural water supplies.	Detailed assessment undertaken at detailed design stage. Temporary or permanent relocation of private water supplies where impacted.	Negligible effect upon water users. Limited changes in flow regime from natural features (e.g. springs).
Private water supply (well)	1+800	220E			
Private water supply (BH)	7+150	Online			
Well/spring	7+200	35mN			
Spring	7+750	350m NW			
Spring	7+750	345m NW			
Spring	7+800	300m NW			
GW abstraction licence (FID 25)	8+000	40m N			
Well/spring	8+050	80m N			
Well/spring	8+250	260m N			
Well/spring	8+275	50m S			
Well/spring	8+550	165m N			
Private water supply	8+550	110m N			

Receptor	Chainage, m	Distance to cutting, m	Potential effect	Embedded design/ mitigation	Residual effect
Private water supply	8+700	420m NE			
GW abstraction licence (FID 32)	8+700	450m NE			
Spring	8+750	420m NE			
Well/spring	8+900	80m NE			
Well/spring	9+600	140m W			
GW abstraction licence (FID 35)	9+600	110m W			
Well/spring	9+700	250m S			
Well/spring	9+700	online			
Spring	9+800	370m N			
Well/spring	9+900	250m NE			
GW abstraction licence (FID 36)	9+900	250m NE			
Well/spring	10+100	390m E			
GW abstraction licence (FID 36)	9+900	175m N			
Well/spring	10+100	45m N			
Well/spring	10+250	75m N			
Well/spring	10+300	120m N			
Well/spring	10+400	340m N			
Spring	10+550	500m NW			
Well/spring	10+900	395m NE			
Well/spring	11+100	260m NE			
Private water supply (BH)	12+100	490m E			
Private water supply (BH/well)	12+100 - 12+700	495m E			

13.11.13 Given that a change in groundwater level or flow may impact upon local aquifers, private water supplies or wetland features, mitigation is proposed in Section 13.10 to reduce this impact to negligible.

13.11.14 The initial assessment noted the proximity and proposed level of the Penglaze Cutting (Volume 6, Document Ref 6.4, ES Appendix 13.3 **DMRB assessments**, Section 13.5) in relation to the Newlyn Downs SAC/SSSI, which is believed to be at least partially reliant upon groundwater recharge to support the Temperate Atlantic wet heaths that the site is designated for. A further assessment of the hydrogeological setting was undertaken to determine the likelihood of connectivity between the two groundwater areas, which concluded that the bedrock formations underlying both sites are unlikely to be in hydraulic continuity (Volume 6, Document Ref 6.4, ES Appendix 13.3 **DMRB assessments**, Section 13.6) and affects to the Newlyn Downs SAC/SSSI are not anticipated.

13.11.15 Wells or springs not in use for water supply are considered to have a low importance, leading to a significant of effect of **neutral**.

13.11.16 Groundwater features in use for private water supply are considered to be SPZ Zone 1 and therefore have an importance of very high. Following the implementation of mitigation including detailed assessment during detailed design and the temporary/permanent replacement of water supplies where appropriate, the magnitude of impact is reduced to negligible, the significance of effect is considered to be **neutral**.

Groundwater quality

13.11.17 Groundwater receptors have been identified by ground investigation, water level monitoring, consultation with landowners and geophysical surveys to ensure that the location and connectivity with the scheme is understood prior to works.

13.11.18 Following the implementation of mitigation required by the **Outline CEMP** (Volume 6, Document Ref 6.4, ES Appendix 16.1), the magnitude of any pollution incident is likely to be negligible.

13.11.19 Therefore, the significance of effect would be **neutral**.

Accidental spillage

13.11.20 The **Outline CEMP** (Volume 6 Document Ref 6.4 ES Appendix 16.1) includes best practice measures for the storage of hazardous substances, the siting of higher risk activities (e.g. vehicle washdown areas) and the maintenance of plant.

13.11.21 Following the implementation of these practices, the magnitude of any accidental spillage is likely to be negligible. Therefore, the significance of effect would be **neutral**.

WFD Compliance

13.11.22 The **WFD compliance assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.1) has indicated that the scheme will not result in a change in status of any WFD quality elements or prevent any water bodies from reaching good status in the future.

Flood Risk

13.11.23 The risk of flooding to the site during construction of the scheme is considered to be very low, although several areas at high risk of pluvial flooding have been identified in **Flood risk assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.2). Suitable practices, such as the storage of plant and materials outside of flood prone areas, have been included in the **Outline CEMP** (Volume 6 Document Ref 6.4 ES Appendix 16.1) to negate this risk.

13.11.24 The risk of flooding from the site is minimal. Several watercourses and streams cross the route of the proposed scheme, however there are no main rivers crossed by the proposed alignment. The road drainage, including suitably sized culverts to maintain the flow paths of watercourses crossed by the scheme, would be installed early in the construction period and surface water generated across the site would be managed as per the **Outline CEMP** (Volume 6 Document Ref 6.4 ES Appendix 16.1).

13.11.25 Following the implementation of mitigation required by the **Outline CEMP** (Volume 6 Document Ref 6.4 ES Appendix 16.1), the risk posed by flooding to

and from the site is considered to be negligible. Therefore, the significance of effect would be **neutral**.

Operational effects

Surface water

Surface water quantity

13.11.26 The effects upon surface water quantity are principally related to new embankments and cuttings and the interactions with existing water features. These potential effects are very similar during construction and operation of the scheme and have been discussed in full in Construction Effects (Section 13.11.1 onwards). The significance of effects is therefore considered to be the same as the construction assessment, which for features with a low value, including surface water features that do not provide a water supply, have no direct hydrological connectivity to the wider drainage network and limited ecological value, is **slight adverse**.

13.11.27 For all other features a detailed assessment would be undertaken during detailed design to establish the likelihood for impacts of the scheme on each feature. Where an impact is established, additional mitigation such as provision of a new water supply would be implemented. These mitigations would be developed in consultation with the landowner and water user. With this mitigation in place the magnitude of impact would be reduced to negligible, leading to a significance of effect of **neutral**.

13.11.28 It is likely that the construction of the side road beneath the new A30 at chainage 11+000 would impact upon the water levels in the ponds at chainage 11+050 and 11+100. In isolation, these ponds have moderate ecological value but as they are connected to a watercourse which supports protected sites downstream, they have been assigned a high value (**Table 13-3**). The predicted impact will be confirmed by detailed assessment and monitoring of recharge mechanisms during detailed design. If the potential for impact is confirmed the ponds will be locally re-profiled to maintain their ecological and resource value. Any works will be designed in consultation with the landowner and water user. With this mitigation in place the magnitude of impact would be reduced to negligible, leading to a significance of effect of **neutral**.

13.11.29 Protected areas (e.g. Newlyn Downs SAC/SSSI, Carrick Heaths SSSI) are supported by runoff from the A30 ridgeline. Given the limited changes in existing catchment areas as a result of the proposed road drainage (Table 13-6 and Table 13-7), effects on the areas are not anticipated.

Surface water quality

13.11.30 The drainage design of the scheme directs runoff from the mainline carriageway and realigned side roads to 18 outfalls to surface waters. The locations of the attenuation basins and water bodies are illustrated in Volume 6 Document Ref 6.3 ES Figure 13-1 and Volume 6 Document Ref 6.3 ES Figure 13-2.

13.11.31 Given the low estimated flows of these watercourses (Q95 of 0.0013 m^3/s), the assessment of risk to groundwater following infiltration is most appropriate but on a precautionary basis the Method A assessment has also been conducted to assess risk to surface waters. The methodology for the Method A assessment

and the inputs used for the HAWRAT models are presented in Volume 6 Document Ref 6.4 ES Appendix 13.3 **DMRB assessment**, Section 2.

13.11.32 At Step 1, where runoff quality is considered prior to any pre-treatment, all outfalls failed the assessment.

13.11.33 At Step 2, where runoff quality is considered in relation to the morphology of the receiving watercourse, all mainline outfalls failed but half of the side road outfalls (those draining impermeable areas <0.4 ha) passed the assessment.

13.11.34 At Step 3 the embedded design mitigation (treatment trains) were incorporated into the models. This resulted in passes at all outfall locations.

13.11.35 A cumulative assessment was undertaken for outfalls within 1km of each other for soluble pollutants and within 100m for sediment. Outfalls only qualified if they were within the same catchment. With embedded mitigation incorporated, all outfalls pass for soluble pollutants. All outfalls pass for sediment aside from Ponds B and 1 and Ponds D and 2 which fail by 0.3% and 3.3% respectively.

13.11.36 Given the marginal nature of these results relative to the estimations in the assessment process and that ground conditions indicate the infiltration potential is favourable at these locations, further mitigation has not been proposed.

13.11.37 A long-term impact assessment of surface water runoff from the highway has been undertaken by comparing the annual average concentrations of copper and zinc estimated by the HAWRAT models with the EQSs stated in the WFD (Standards and Classifications) Directions 2015. The predicted concentrations are under the EQS thresholds for both copper and zinc at all discharge locations.

13.11.38 It is therefore considered that the magnitude of impact of sediment and dissolved metals discharging into surface watercourses is negligible with a significance of effect of **neutral**.

13.11.39 Effects upon protected areas (e.g. Carrick Heaths SSSI) downstream of the discharge locations for the proposed drainage network are not anticipated.

Geomorphology

13.11.40 Five new culverts are proposed within the scheme to enable the proposed highway to cross existing watercourses (Table 13-9). None of these watercourses are designated as main rivers.

Table 13-9 New culverts proposed as part of the scheme.

Chainage m	Watercourse	Description	Potential effect	Embedded design/ mitigation	Residual effect
6+050	Unnamed tributary of Zelah Brook	1.2m culvert to account for existing watercourse.	Local shading of watercourse; Local conversion of natural river channel to culvert;	Culverts are oversized to allow partial burial of culvert bed. This would promote sediment transport through	Sediment transport regime maintained. Limited upstream watercourse extent in all
8+900	Unnamed tributary of Zelah Brook	2.4m box culvert to account for existing watercourse and associated existing culvert on A30.			

9+250	Unnamed tributary of Zelah Brook	2.4m box culvert to account for existing watercourse and associated existing culvert on A30.	Scour at inlet/outlet if poorly designed. Barrier to fish and invertebrate passage. Barrier to sediment transport.	the culvert and maintain connectivity for invertebrates.	cases so effect upon fish and invertebrates would be negligible.
11+050	River Allen	1.2m culvert to account for existing watercourse.			
13+700	Unnamed tributary of Benny Stream	1.2m culvert to account for existing culvert on A30			

13.11.41 Eighteen new outfalls would be installed to discharge treated carriageway runoff from the drainage system to surface watercourses. The discharges would be limited to the Greenfield Runoff Rate and would be located near to the proposed attenuation basins. The outfalls would be located in the receiving watercourses listed in Table 13-3.

13.11.42 New outfall structures within a watercourse can alter local channel cross section and induce local bank or bed erosion, as well as reduce the available natural bank habitat area. These potential effects can be minimised by ensuring that outfall structures are sensitively designed based on the mitigation proposed.

13.11.43 The effects of these structures on WFD quality elements are discussed in greater detail in the **WFD compliance assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.1)

13.11.44 Provided the design mitigation (Section 13.10) is incorporated in the detailed design of the scheme, the magnitude of impact of geomorphological impacts (e.g. culverts/outfalls) is considered to be minor adverse.

13.11.45 Watercourses where new physical modifications (i.e. culverts/outfalls) are proposed have an importance of either medium or high. For watercourses of high importance, this leads to a significance of effect of **slight/moderate adverse**. For watercourses of medium importance, this leads to a significance of effect of **slight adverse**.

13.11.46 Given that the existing A30 also crosses these watercourses and has drainage infrastructure with lower pollution treatment capability than that included in the scheme design, no further mitigation is proposed.

Groundwater

Groundwater levels

13.11.47 The effects upon groundwater quantity are principally related to new embankments and cuttings and any changes in groundwater levels or flows related to dewatering by the road drainage. These potential effects are very similar during construction and operation of the scheme and are discussed in full in Construction Effects (Section 13.11.8 onwards).

13.11.48 Given that a change in groundwater level or flow may impact upon local aquifers, private water supplies or wetland features, mitigation is proposed in Section 13.10 to reduce this impact to negligible.

13.11.49 The initial assessment noted the proximity and proposed level of the Penglaze Cutting (Volume 6 Document Ref 6.4 ES Appendix 13.3 **DMRB assessments**, Section 13.5) in relation to the Newlyn Downs SAC/SSSI, which is believed to be at least partially reliant upon groundwater recharge to support the Temperate Atlantic wet heaths that the site is designated for. A further assessment of the hydrogeological setting was undertaken to determine the likelihood of connectivity between the two groundwater areas, which concluded that the bedrock formations underlying both sites are unlikely to be in hydraulic continuity (Volume 6 Document Ref 6.4 ES Appendix 13.3 **DMRB assessments**, Section 13.6) and affects to the Newlyn Downs SAC/SSSI are not anticipated.

13.11.50 Wells or springs not in use for water supply are considered to have a low importance, leading to a significant of effect of **neutral**.

13.11.51 Groundwater features in use for private water supply are considered to be SPZ Zone 1 and therefore have an importance of very high. Following the implementation of mitigation including detailed assessment during detailed design and the temporary/permanent replacement of water supplies where appropriate, the magnitude of impact is reduced to negligible, the significance of effect is considered to be **neutral**.

Groundwater quality

13.11.52 The proposed scheme design is for routine runoff to be discharged to attenuation basins with some infiltration prior to discharge to surface watercourses. The anticipated flow during summer months within the attenuation basins is likely to have a Q95 of less than or equal to 0.0013m^3/s and would therefore discharge to groundwater. Thus, the ‘first flush’ discharge into attenuation ponds and infiltration from the ponds results in little discharge entering the watercourse.

13.11.53 Therefore, following HD45/09, a Method-C assessment which considers the impact of infiltration of road runoff to groundwater is most appropriate. Assessments have been carried out for all discharge locations given in Table 13-3.

13.11.54 As stated in the HAWRAT analysis, an AADT of 42,766 is predicted for the A30 in 2038 (the design year). This is in the low risk range (0-50,000 AADT) used in the HD 45/09 Method-C approach for assessing pollution impacts from routine runoff to groundwater. On this basis, the assessments carried out for the scheme are likely to overstate the potential risk to groundwater quality.

13.11.55 The full Method-C assessments for the potential impacts to the groundwater body and specific receptors are available in **DMRB assessments** (Volume 6 Document Ref 6.4 ES Appendix 13.3).

13.11.56 The overall risk score for the HD45/09 Method-C assessment for mainline basins is between 220 and 240 depending on water table depth. This is within the 150 to 250 suggested action class range, which indicates there is a ‘medium’ risk of impact as a result of discharge to groundwater from routine runoff at these locations.

13.11.57 In accordance with the HD45/09 Method-C assessment, with a ‘medium’ risk of impact, depending on the quality of surface water, mitigation measures may be required for the protection of groundwater. If this were to be the case, the need for (and type) of any measures would be informed by additional risk assessment. However, the HAWRAT modelling undertaken for each pond location derived

copper and zinc concentrations below the EQS threshold. This indicates that heavy metal concentrations measured in pond discharge would not pose a risk to groundwater quality.

13.11.58 Therefore, no further assessment has been carried out and the significance of effect is **neutral**.

Accidental spillage

13.11.59 The Method-D spillage risk assessment outlined in the HD45/09 Volume 11, Section 3, Part 10 was carried out using vehicle numbers from the 2038 AADT flows to account for future growth.

13.11.60 On all roads, there is a risk that an accidental spillage or vehicle fire may lead to an acute pollution incident. HD 45/09 states that the pollution risk on any road is linked to the risk of a HGV road traffic accident. Where a spillage does reach a surface watercourse the pollution effect can be severe, but is usually of short duration.

13.11.61 The acceptable risk of a pollution incident, as stated in HD45/09, is an annual probability of less than 1%, or a return period of 1 in 100 years.

13.11.62 Using the HD45/09 assessment method, the risk of spillages has been calculated for predicted future traffic conditions. The greatest risk of accidental spillage at any location is below 0.03%, well within the acceptable limit. Based on the spillage assessment, the magnitude of potential impact on surface or groundwater is considered to be negligible. The significance of effect is therefore **neutral**.

WFD compliance

13.11.63 The **WFD Compliance assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.1) has indicated that the scheme will not result in a change in status of any WFD quality elements or prevent any water bodies from reaching good status in the future.

Flood risk

13.11.64 The **Flood risk assessment** (Volume 6 Document Ref 6.4 ES Appendix 13.2) has indicated that the scheme is not expected to cause any detriment to fluvial, surface or groundwater flood risk. Additionally, the greater standard of flood protection included for the new road (See Section 13.10) over the old road would be a benefit to road users travelling through the area.

13.11.65 The magnitude of effect is therefore considered negligible and the significance of effect is **neutral**.

13.12 Monitoring

13.12.1 This section describes monitoring required to inform the mitigation of likely significant adverse residual effects.

13.12.2 At the point of producing this ES additional groundwater level monitoring is being carried out, although this is considered to be part of the engineering design. This monitoring will inform the detailed design of the scheme, which includes relevant groundwater mitigation listed in Section 13.10.

13.12.3 The residual effects of the scheme on the water environment have been assessed as neutral for all elements other than surface water quantity during construction and operation (slight adverse) and geomorphology during operation (slight to moderate adverse). Therefore, no monitoring has been proposed.

13.13 Summary

13.13.1 The road drainage and water environment chapter describes the existing condition of the water environment in the study area before undertaking an assessment of the potential effects on the quality and quantity of surface and ground waters, flood risk and WFD compliance as a result of the scheme.

13.13.2 The assessment of effect on the water environment from the construction of the scheme has found that when incorporating the mitigation measures included in the **Outline CEMP** (Volume 6 Document Ref 6.4 ES Appendix 16.1) there would be a **neutral** effect on all elements other than surface water quantity which had a **slight adverse** effect. For operation of the scheme, the assessment of effects has indicated a **neutral** impact from the scheme on flood risk, accidental spillage risk, groundwater resource and water (surface and ground) quality. A **slight adverse** significance of effects was identified for surface water quantity as a result of potential changes in flow regime due to cutting drainage. A **slight to moderate adverse** effect was identified to geomorphology as a result of new culverts and outfalls.

13.13.3 The assessment of effects to surface and ground waters from the construction and operation of the scheme has indicated an overall assessment of significance of **slight adverse**.

Table 13-10 Summary of assessment of effects due to construction

Receptor(s) (chainage)	Description of potential impact	Embedded design, mitigation and enhancement measures	Sensitivity /value of receptor	Duration of impact	Magnitude of potential impact	Significance of potential impact
Surface Water						
All surface water features in the construction area	Degradation of water quality (incl. spillage)	See **Outline CEMP** (Volume 6, Document Ref 6.4, Appendix 16.1)	Low to Very High	Short & Long term	Negligible	**Neutral**
Historic surface water features (e.g. springs) across scheme area	Modification of flow regimes due to construction of cutting or embankment drainage	Embankments: drainage blankets or culverts. Cuttings: Maintenance of existing drainage pathways as far as practicable.	Low	Short term	Moderate adverse	**Slight adverse**
Seepage (1+750 - 1+950) Watercourse (6+050) Watercourse (7+800) Zelah Brook (8+900) Watercourse ((9+250) Wet disturbed ground (9+900) Seepage (10+150 - 10+250) Pond (10+350) Pond (10+450) Pond (10+500) Pond & Watercourse (11+050) Pond (11+100) Wet depression (11+200 – 11+300)		Embankments: drainage blankets or culverts. Cuttings: Maintenance of existing drainage pathways as far as practicable. Detailed assessment, relocation of water supply or works to maintain habitat/resource quality if required.	Medium to High	Short term	Negligible	**Neutral**

Receptor(s) (chainage)	Description of potential impact	Embedded design, mitigation and enhancement measures	Sensitivity /value of receptor	Duration of impact	Magnitude of potential impact	Significance of potential impact
Watercourse (13+700)						
Watercourses crossed by the scheme including: Unnamed tributary of Zelah Brook (6+050) Unnamed tributary of Zelah Brook (8+900) Unnamed tributary of Zelah Brook (9+250) River Allen (11+050) Unnamed tributary of Benny Stream (13+700)	Temporary physical modification of water features	See **Outline CEMP** (Volume 6, Document Ref 6.4, Appendix 16.1)	Low to Very High	Short term	Negligible	**Neutral**
Groundwater						
All groundwater features underluying the construction area	Degradation of water quality (incl. spillage)	See **Outline CEMP** (Volume 6, Document Ref 6.4, Appendix 16.1)	Medium to Very High	Short & Long term	Negligible	**Neutral**
Receptors listed in Table 13-8	Change in groundwater resource due to temporary dewatering	Embankments: drainage blankets or culverts. Cuttings: Detailed assessment and relocation of water supply if required.	Low to Very High	Short term	Negligible	**Neutral**
WFD Compliance						
The **WFD compliance assessment** (Volume 6 Document Ref 6.4 Appendix 13.1) has indicated that the scheme will not result in a change in status of any WFD quality elements or prevent any water bodies from reaching good status in the future.						
Flood Risk						
The **Flood risk assessment** (Volume 6 Document Ref 6.4 Appendix 13.2) has indicated that the scheme is not expected to cause any detriment to fluvial, surface or groundwater flood risk. The significance of effect is considered to be **neutral**.						

Table 13-11 Summary of assessment of effects due to operation

Receptor(s) (chainage)	Description of potential impact	Embedded design, mitigation and enhancement measures	Sensitivity /value of receptor	Duration of impact	Magnitude of potential impact	Significance of potential impact
Surface Water						
All watercourses receiving discharges from the road drainage system (listed in Table 13-5 of Volume 6 Document Ref 6.4 Appendix 13.3)	Degradation of water quality from routine runoff	Treatment train in SUDS system	Medium to High	Short & Long term	Negligible	**Neutral**
	Degradation of water quality from accidental spillage	N/a	Medium to High	Short term	Negligible	**Neutral**
Watercourses crossed by the scheme (culverts) and receiving road drainage (outfalls) including.	Physical modification of water features (e.g. new culverts/outfalls)	Best practice detailed design of structures	Medium to High	Long term	Minor adverse	**Slight to slight/moderate adverse**
Historic surface water features (e.g. springs) across scheme area	Modification of surface water flows as a result of cuttings or embankments	Embankments: drainage blankets or culverts. Cuttings: Maintenance of existing drainage pathways as far as practicable.	Low	Long term	Moderate adverse	**Slight adverse**
Seepage (1+750 - 1+950) Watercourse (6+050) Watercourse (7+800)		Embankments: drainage blankets or culverts. Cuttings: Maintenance of existing drainage pathways as far as	Medium to High	Long term	Negligible	**Neutral**

Receptor(s) (chainage)	Description of potential impact	Embedded design, mitigation and enhancement measures	Sensitivity /value of receptor	Duration of impact	Magnitude of potential impact	Significance of potential impact
Zelah Brook (8+900) Watercourse ((9+250) Wet disturbed ground (9+900) Seepage (10+150 - 10+250) Pond (10+350) Pond (10+450) Pond (10+500) Pond & Watercourse (11+050) Pond (11+100) Wet depression (11+200 – 11+300) Watercourse (13+700)		practicable. Detailed assessment, relocation of water supply or works to maintain habitat/resource quality if required.				
Groundwater						
All groundwaters receiving discharges from the road drainage system (listed in Table 13-2 of Volume 6 Document Ref 6.4 Appendix 13.3).	Degradation of water quality from routine runoff	Treatment train in SUDS system	Medium to Very High	Short & Long term	Negligible	**Neutral**
	Degradation of water quality from accidental spillage	N/a	Medium to Very High	Short term	Negligible	**Neutral**
Receptors listed in Table 13-8	Change in groundwater resource due to cuttings,	Embankments: drainage blankets or culverts. Cuttings: Detailed assessment and	Low to Very High	Long term	Negligible	**Neutral**

Receptor(s) (chainage)	Description of potential impact	Embedded design, mitigation and enhancement measures	Sensitivity /value of receptor	Duration of impact	Magnitude of potential impact	Significance of potential impact
	embankments or road drainage	relocation of water supply if required.				
WFD Compliance						
The **WFD compliance assessment** (Volume 6 Document Ref 6.4 Appendix 13.1) has indicated that the scheme will not result in a change in status of any WFD quality elements or prevent any water bodies from reaching good status in the future.						
Flood Risk						
The **Flood risk assessment** (Volume 6 Document Ref 6.4 Appendix 13.2) has indicated that the scheme is not expected to cause any detriment to fluvial, surface or groundwater flood risk. The significance of effect is considered to be **neutral**.						

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