M3 Junction 9 Improvement

Scheme Number: TR010055

7.7 Water Framework Directive Assessment

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7.7 WATER FRAMEWORK DIRECTIVE ASSESSMENT

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EXECUTIVE SUMMARY

This Water Framework Directive (WFD) Compliance Assessment has been prepared to support the National Highways M3 Junction 9 Improvement Scheme ('the Scheme'). This Scheme will include widening the M3 from two lanes to four lanes, reconfiguring the existing roundabout, improving existing motorway slip roads and providing a new footway/cycleway crossing of the River Itchen, which will connect wider networks. The focus of this WFD Compliance Assessment is on providing a new footway/cycleway bridge crossing across the River Itchen, as well as a public footway running alongside the River Itchen underneath the new bridge and the known temporary construction works associated with the bridge and new drainage outfalls.

The key objectives of the WFD are to prevent deterioration in the status of water bodies and aim to achieve good ecological and chemical status/potential (including quantitative status in groundwater bodies). Water bodies must also comply with standards and objectives of Protected Areas (i.e., an area designated under another European Directive, such as a Special Area of Conservation or Special Protection Area), where these apply. In addition, discharges, emissions and losses of priority substances to surface water bodies must be progressively reduced and emissions of priority hazardous substances prevented. Finally, action must be taken to reverse any identified sustained upward trend in pollution concentrations in groundwater bodies. The South East River Basin Management Plan (RBMP) 2016 is the applicable management plan for the site and has been used to assess the impacts of the proposals.

The works are to be completed on the River Itchen, Nun's Walk Stream, and Itchen Navigation Canal WFD surface water bodies, and the WFD Itchen River Chalk groundwater body, which have all been assessed within this WFD Compliance Assessment. This WFD Compliance Assessment details the potential impact that the Scheme and associated works could have on the watercourses' ability to meet WFD requirements, and any mitigation measures that will be implemented. The report provides a specific assessment of the Scheme in relation to the three quality elements: biological, physico-chemical and hydromorphological for surface water bodies and quantitative and chemical elements for groundwater bodies. The creation of potential new pollutant pathways through piling and the temporary impacts during the construction phase will be avoided and minimised through the adoption of best practice techniques and the implementation of a robust **first iteration Environmental Management Plan (fiEMP) (Document Reference 7.3)** and second iteration EMP (siEMP), and Environmental Control Plans (detailed in the **fiEMP (Document Reference 7.3)** and siEMP) which will be completed prior to construction commences, such as an Erosion Prevention and Sediment Control Plan and Emergency Spill Response Plan.

A temporary drainage strategy has been prepared for the construction phase. This outlines how runoff would be collected and directed through the temporary drainage system to protect water quality of receiving water bodies in terms of contamination and sediments. It has been demonstrated that the proposed widening of the M3 Junction 9

carriageway and implementation of the new footway/cycleway bridge crossing will not have any significant long-term impacts on the ecology, hydromorphology or water quality within the water bodies. The Scheme does not result in a significant change away from baseline conditions for the overall WFD water bodies, and, as demonstrated, will not result in deterioration of the current WFD potential of the River Itchen, Nun's Walk Stream and Itchen Navigation Canal surface water bodies. The works will not affect the ability for the key actions identified in the RBMP to be implemented for the catchment. As such, the works are compliant with the WFD and will not prevent the water bodies from achieving Good status in the future.

1 Introduction

1.1 Background

1.1.1 This Water Framework Directive (WFD) Compliance Assessment has been prepared to support the National Highways M3 Junction 9 Improvement Scheme (the Scheme). This Scheme will include widening the M3 from two lanes to four lanes, reconfiguring the existing roundabout, improving existing motorway slip roads and providing a new footway/cycleway crossing of the River Itchen, which will connect wider networks. The focus of this WFD Compliance Assessment is on providing a new footway/cycleway bridge crossing across the River Itchen, as well as a public footway running alongside the River Itchen underneath the new bridge and the known temporary construction works associated with the bridge and new drainage outfalls.

1.1.2 This WFD Compliance Assessment details the potential impact that the Scheme and associated works could have on the watercourses' ability to meet WFD requirements, and any mitigation measures that will be implemented.

1.1.3 Regulation 5(2) (l) (iii) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) requires Nationally Significant Infrastructure Projects to provide an assessment of effects upon water bodies in a River Basin Management Plan (RBMP) alongside their application.

1.2 The Water Framework Directive

1.2.1 The WFD was transposed into law in England and Wales by the Water Environment Regulations 2003 and subsequent regulations/guidance implemented through Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and WFD (Standards and Classification) Directions (England and Wales) 2015. These Regulations implement a holistic approach to the management, protection and monitoring of the water environment. The aim of the WFD is to prevent further deterioration in water resources (volume and quality); protect and enhance the status of aquatic ecosystems and associated wetlands; promote sustainable water consumption; and contribute to mitigating the effects of floods and droughts.

1.2.2 The key objectives of the WFD are to prevent deterioration in the status of water bodies and aim to achieve good ecological and chemical status/potential (including quantitative status in groundwater bodies) by 2021. Water bodies must also comply with standards and objectives of Protected Areas (i.e., an area designated under another European Directive, such as a Special Area of Conservation or Special Protection Area), where these apply. In addition, discharges, emissions and losses of priority substances to surface water bodies must be progressively reduced and emissions of priority hazardous substances prevented. Finally, action must be taken to reverse any identified sustained upward trend in pollution concentrations in groundwater bodies.

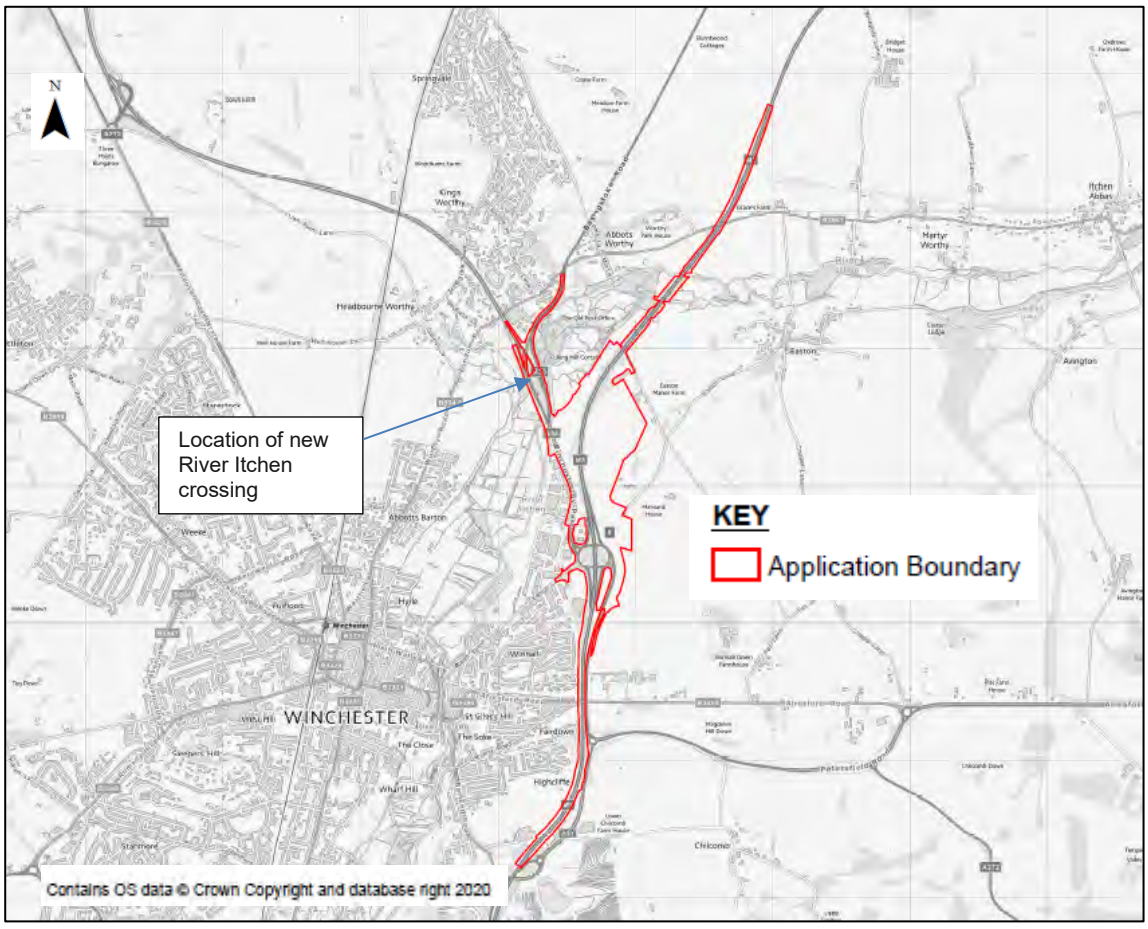
1.2.3 The South East RBMP 2016 is the applicable management plan for the site and has been used to assess the impacts of the proposals.

2 Scheme overview and baseline conditions

2.1 Site description and location

2.1.1 The overall Scheme is located along the Winchester Bypass (A34), Basingstoke Road (A33), M3, A31 and A272 in the location of interest (see **Figure 2.1**). The new proposed bridge is implemented on the A34 over the River Itchen, in between two existing bridges (A34 north bound and south bound crossings). The length of the Scheme is approximately 2km.

Figure 2.1: Site Location (not to scale)



2.1.2 The M3 Junction 9 carriageway is a major transport route, which starts at Eastleigh and ends at Basingstoke. It is bordered by tree and grass verges with the River Itchen flowing underneath it. Landscapes to the north and south of the M3 Junction 9 are mainly rural and agricultural with some urban areas including Headbourne Worthy (north west) and Winchester (south west).

2.1.3 The surrounding area is primarily urban to the west of the M3 and mainly rural to the east. There are large concentrations of residential receptors close to the A34 in the north of the Application Boundary (in Headbourne Worthy, Kings Worthy and Abbots Worthy) and close to the M3 to the south of the study area

(on the eastern fringe of Winchester). The River Itchen and associated floodplain are present within the north part of the Application Boundary. It lies along the River Itchen valley with the base of the valley to the west of the junction. The River Itchen Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI) are within the vicinity of the proposed site and extend to the north east and south west.

2.2 Geology and groundwater

2.2.1 The online British Geological Society (BGS) website[1] indicates that the bedrock underlying the southern area of M3 Junction 9 route consists of Holywell Nodular Chalk Formation, Zag Chalk Formation, and New Pit Chalk Formation. The southern area also includes superficial deposits including head and Alluvium, which consist of Clay, Silt, Sand and Gravel particles.

2.2.2 The BGS website also shows that the underlying bedrock of the northern area of the M3 Junction 9 route is the Seaford Chalk Formation. However, there is also the bedrock Newhaven Clay Formation within the vicinity. These bedrock formations have superficial deposits including Head and Alluvium (Clay, Silt, Sand and Gravel), and river terrace deposits (Sand and Gravel).

2.2.3 The Defra MAGIC website[2] shows that the M3 Junction 9 route is located partially in a Source Protection Zone (SPZ). This includes Zone I (Inner Protection Zone), Zone II (Outer Protection) and Zone III (Total Catchment).

2.2.4 The Chalk Group within the site has been identified as a Principal Aquifer where chalk layers have high fracture permeability, providing high groundwater storage levels. The groundwater body which runs through this chalk group is known as River Itchen Chalk.

2.3 Designated WFD water bodies

2.3.1 The study area crosses the River Itchen, which is a WFD surface water body (ID: GB107042022580). A further WFD surface water body within the Application Boundary is the Nun's Walk Stream WFD surface water body (ID: GB107042022730). The Itchen Navigation WFD canal (ID: GB70710008) is located further then 1km from the Application Boundary (a heavily modified water body located just under 5km to the south of the site) has been included as the River Itchen drains to this watercourse.

2.3.2 The Application Boundary is also underlain by the River Itchen Chalk WFD groundwater body (ID: GB40701G505000).

2.3.3 The WFD water bodies are shown on **Figures 3.2** to **3.4**.

[1] British Geological Survey, Geology of Britain Viewer. Accessed April 2021

[2] DEFRA, MAGiC [www] Available at: < https://magic.defra.gov.uk/> Accessed April 2021

2.4 Ecology

2.4.1 An aquatic ecological survey has been conducted by for the Scheme area (see **Appendix C**).

2.4.2 The River Itchen SAC has been surveyed for the presence of native flora and fauna species within the river. Flora native to the River Itchen include *Ranunculion Fluitantis* and *Callitricho-Batrachion* vegetation. Fauna native to the River Itchen include bullhead fish, Southern damselflies, white-clawed crayfish, brook lamprey, Atlantic salmon, and otter. However, the survey's main focus was on Annex II species of the River Itchen SAC, which includes bullhead, brook lamprey, Atlantic salmon and otter.

2.4.3 The survey has shown the riverbed at the points where the proposed new footbridge crosses the River Itchen is diverse, compromising a mixture of boulders, cobbles, pebbles, gravels, sand and silt. However, it is largely dominated by sand, which is a fine substrate material more easily shifted by channel velocities than the coarser substrates.

2.4.4 Although sand provides habitat for some species, it is not preferred by any of the SAC fish species for spawning or during adult life-stages. In addition, the coarse substrates (boulders, cobbles, pebbles, and gravel) which were present were often covered in overlying silt. This condition of the riverbed is not preferred by bullhead, brook lamprey or Atlantic salmon who all prefer clean gravel/pebble substrates. Therefore, the habitat surveyed within the River Itchen at both of the existing A34 road crossings is considered unsuitable spawning habitat for bullhead, brook lamprey and Atlantic salmon. The exception to this is one localised section, approximately 4m x 2m upstream of Kingsworthy Bridge on the left bank, with a deep silt bed with adjacent clean gravel substrates. This silt bed is considered optimum for juvenile (ammocoete) brook lamprey development.

2.4.5 The presence of otters has been confirmed within the area with evidence of spraints (otter dung), dry and fresh, and confirmed resting places recorded along the main channels of the River Itchen (however outside the Application Boundary) and its tributaries. The majority of habitats associated with the River Itchen system is suitable for otter foraging, resting, commuting and breeding purposes. The SAC also offers suitable food resources, hydrological connectivity, and vegetative covers, such as scrub and deciduous woodland. However, no holts (otter resting places) were recorded within the Application Boundary.

2.4.6 Until recently white-clawed crayfish were considered absent from this stretch of the River Itchen following an outbreak of crayfish plague in the 1990s. However, on 18 January 2022 approximately 20 individual white-clawed crayfish were recorded in a small watercourse within Winnall Moors Nature Reserve approximately 100m west of the Scheme. The watercourse where the white-clawed crayfish were found is hydrologically connected to the River Itchen, and

therefore it is possible this species is also present within the stretch of the River Itchen within the Scheme.

2.5 The Scheme

The improvements proposed as part of the Scheme both maintain existing connectivity on the road network, whilst providing enhanced capacity, simplifying routing, improved facilities for walkers, cyclists and horse-riders and landscaping enhancements. The Scheme would provide new free flow links between the M3 and A34, as well as a dedicated new A33 alignment. The Scheme elements are as follows:

- Widening of the M3 from a dual two-lane motorway (two-lane motorway with hard shoulders) to a four-lane motorway (with hard shoulders) between the proposed M3 Junction 9 gyratory north and south slip roads.
- A new smaller grade separated gyratory roundabout arrangement within the footprint of the existing roundabout, incorporating new connections over the M3 with improved walking, cycling and horse-riding routes.
- Connector roads from and to the new gyratory roundabout.
- Improved slip roads to/from the M3.
- New structures (in the form of gyratory bridges, underpasses, retaining walls, subway and a new cycle and footbridge over the River Itchen).
- A new surface water runoff system with associated drainage and infiltration features.
- New signage and gantries.
- Utility diversions.
- New lighting (subways, underpasses and gantries).
- Modifications to topography through cuttings and false cuttings as well as re-profiling of existing landform.
- New walking, cycling and horse-riding provision.
- Creation of new areas of chalk grassland, woodland, scrub planting and species rich grassland.

The Application Boundary covers an area of approximately 109 hectares (ha). This includes the proposed land required for gantries, signage, temporary construction compound areas, areas for environmental mitigation, areas for drainage requirements (some of which would be temporary) and traffic management.

The Scheme includes a package of environmental mitigation and enhancement measures to reduce the impacts from the Scheme to the environment where possible. Consideration has also been given to the enhancement of the South Downs National Park where reasonably practicable.

Bridleways, footpaths and cycleways have been designed to allow all gradients to be less than 1:20 to comply with Department for Transport's (DfT) inclusive mobility impaired users. Also, the walking, cycling and horse-riding routes are designed for cyclists, and therefore all horizontal radii are suited for cyclists. They are also considered acceptable for mobility impaired users. The range of opportunities and barriers to all forms of movements have been given due consideration in the design of the Scheme.

A number of new structures are required to be both constructed and demolished to facilitate the Scheme. Some of the main structures are as follows:

- The existing bridges at the M3 Junction 9 gyratory roundabout are proposed to be demolished and replaced by the two new bridge structures carrying the new gyratory.

- A new underpass is proposed to carry the A34 southbound under the new A33 link road and the existing M3. The A34 northbound underpass would carry the new A34 northbound over the new A33 link.

- The existing subways (Winnall Subway East and Winnall Subway West) located under the existing gyratory are proposed to be demolished to facilitate the construction of the reconfigured roundabout. New subways are proposed along the proposed footpath and cycle path route.

- A new bridge to accommodate the footpath and cycle path over the River Itchen is proposed between the existing Itchen Bridge, (which carries the A34 northbound carriageway), and the existing Kings Worthy Bridge would carry the A33 north and southbound carriageways and the A34 southbound carriageway, respectively.

The walking, cycling and horse-riding facilities around and within the Scheme are to be upgraded. This includes an improvement to the National Cycle Network (NCN) Route 23. An additional footpath, cyclepath and bridleway is proposed on the eastern side of the Scheme to link Easton Lane with Long Walk. Such a route would provide a circular leisure path for those using the South Downs National Park with a link to the other paths around Long Walk with their links to local villages. A new combined footpath and cyclepath for the western side of the Scheme is proposed to link the A33 / B3047 Junction to Winnall Industrial Estate situated on Easton Lane.

A detailed description of the Scheme is provided in **Chapter 1 (Introduction)** and **Chapter 2 (The Scheme and its Surroundings) of the Environmental Statement (ES) (Document Reference 6.1)**.

2.5.1 To enable construction and delivery of the Scheme, temporary works are required. Discussions have been held with the Environment Agency with regards to the proposed temporary works and any mitigation measures that may be implemented, notably in the meeting held on 4 October 2021.

2.5.2 The below outlines the temporary works that have been identified as required at present. The applicable temporary works will be permitted through the Flood Risk Activity Permit process meaning any alterations made to the required temporary works will be approved and subsequently permitted by the Environment Agency prior to construction commencement.

2.5.3 The temporary works of the Scheme within 8m of the River Itchen consist of:

- Proposed cycle/footbridge over River Itchen (although no intrusive in-channel works proposed)
- Kingsworthy Bridge strengthening (although no intrusive in-channel works proposed)
- Isolation and dewatering of an area around the existing drainage outfall for cleaning works, as well as the temporary works to install temporary measures to isolate and dewater an area around each outfall location to facilitate the permanent installation of the two new outfalls

2.5.4 Drawing of the general arrangement and bridge are provided in **Appendix A** and **B**.

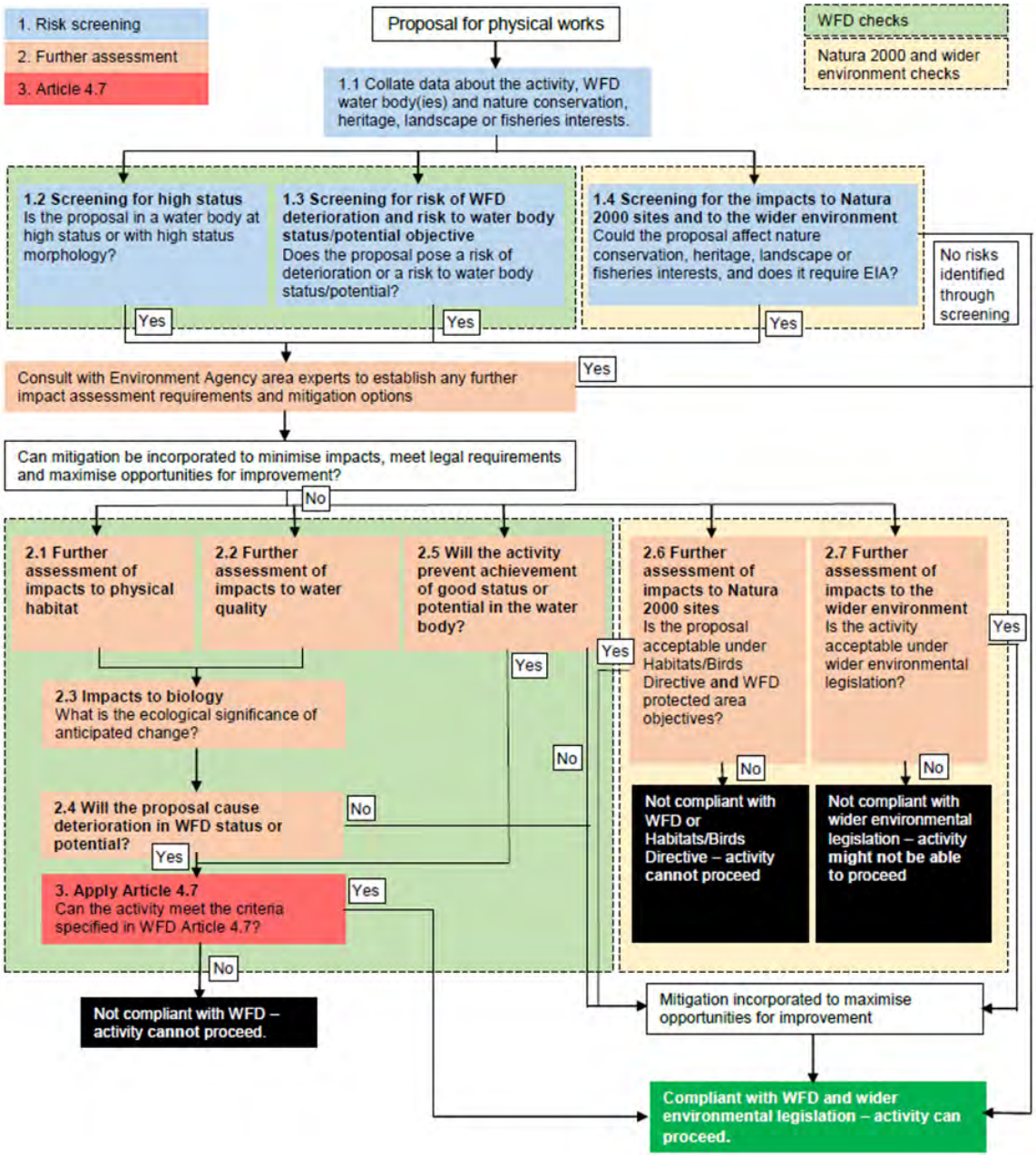
2.5.5 Temporary works are outlined in further detail in **Section 5.2** alongside the mitigation measures that are proposed to be implemented.

3 WFD screening

3.1 Methodology

3.1.1 The Environment Agency recommended methodology for WFD assessment, demonstrated in **Figure 3.1**, was followed and is compliant with the guidance detailed throughout **Section 3.** Planning Inspectorate Advice Note Eighteen: The Water Framework Directive (2017) has also been adhered to.

Figure 3.1: Environment Agency WFD Methodology (2016) - sources from Environment Agency Doc No 488_10



3.2 Waterbody status and catchment objectives

3.2.1 The South East RBMP completed in March 2016, classifies the water body catchment that the site lies in as the Test and Itchen catchment. Within this management catchment the priority issues are:

- Poor water quality caused by diffuse pollution, mainly sources of nitrate, phosphates and pesticides
- Physical modifications
- The maintenance of water resources
- Abstractions and artificial flow regulations
- Urban and transport pollution
- Organic pollution
- Undissolved or suspended sediment particles within the water (Sedimentation).

3.2.2 The proposed works are located within the River Itchen, Nun's Walk Stream, and Itchen Navigation Canal surface water bodies **(Figure 3.2** and **Figure 3.3)** and the River Itchen Chalk groundwater body **(Figure 3.4).**

Figure 3.2: WFD Surface Water Bodies (River Itchen and Nun's Walk Stream)

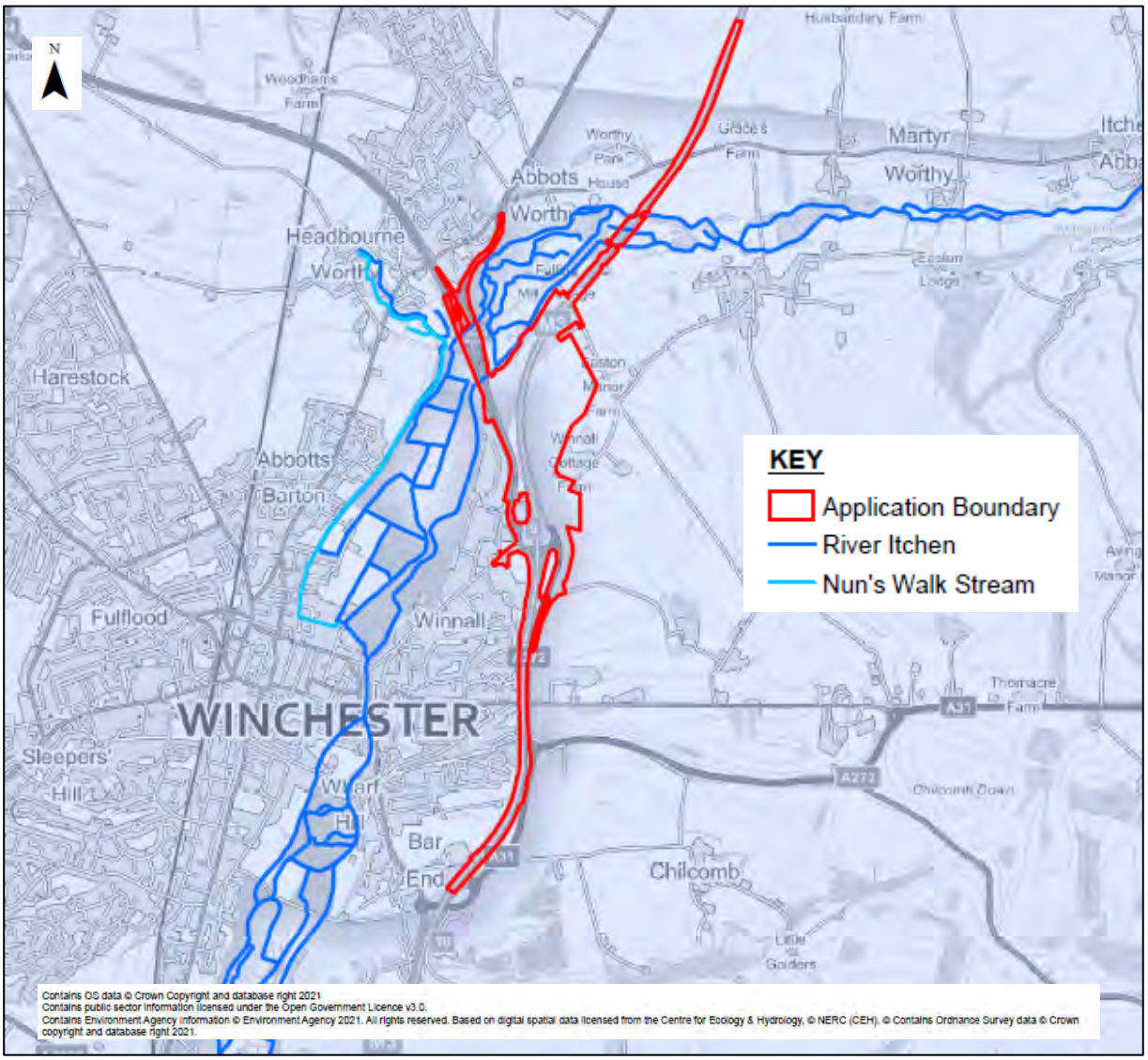


Figure 3.3: WFD Surface Water Bodies (Itchen Navigation Canal)

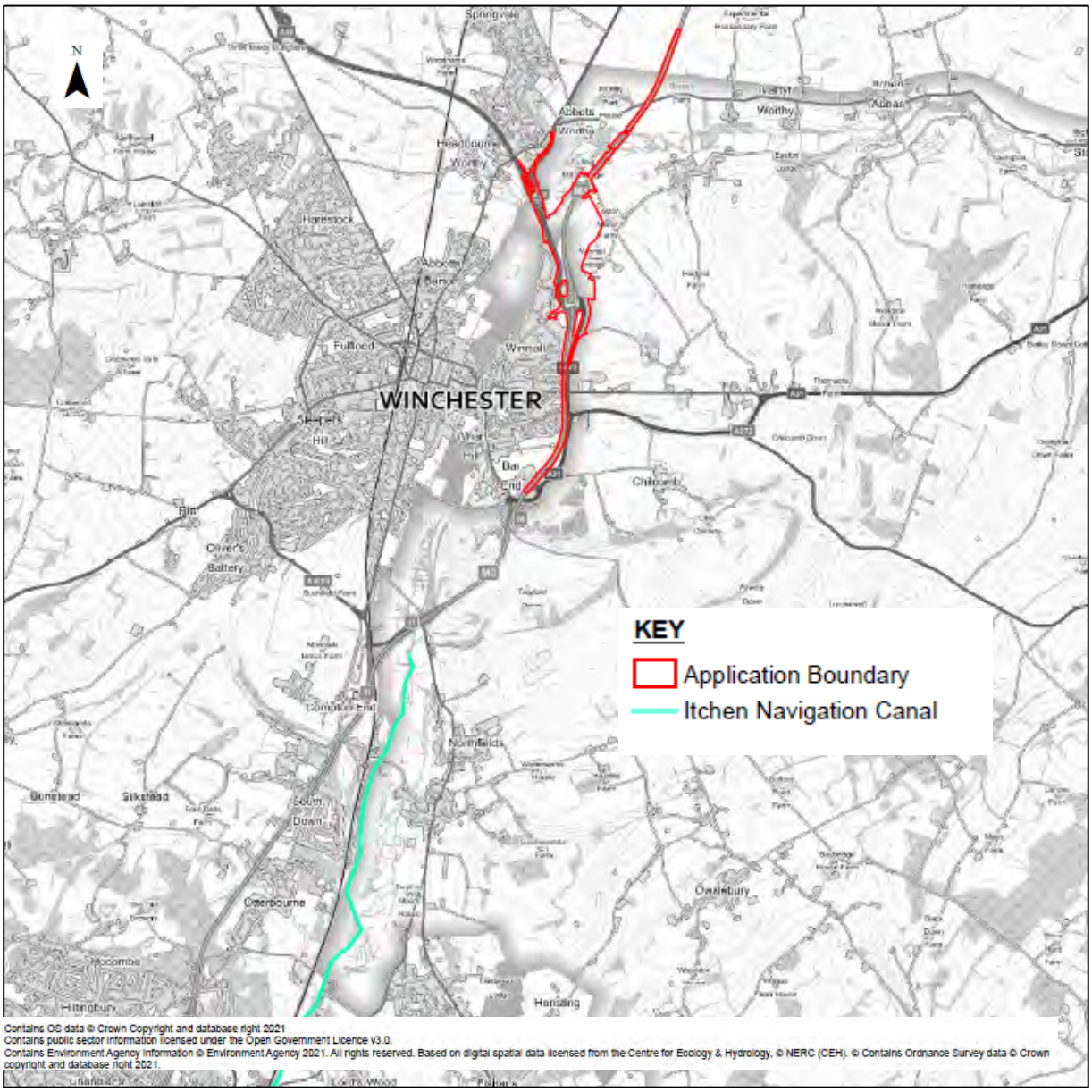
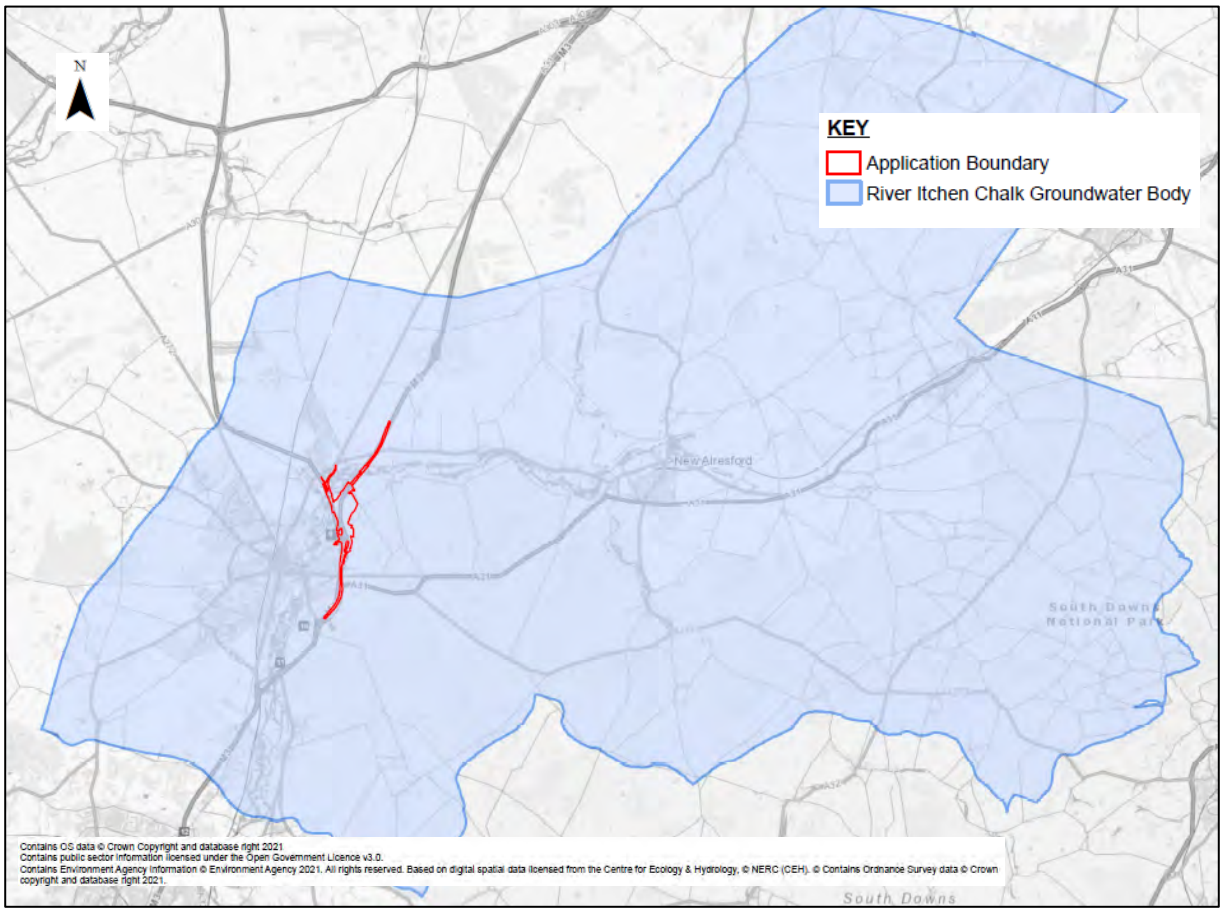


Figure 3.4: WFD Groundwater Bodies (River Itchen Chalk)



3.2.3 The Cycle 2 data (2019), accessed via the Environment Agency's Catchment Data Explorer, provides the best available information, which was used to inform this assessment.

Itchen surface water body WFD status

3.2.4 The Itchen WFD water body is not designated as an artificial or heavily modified water body. It is currently classified as overall Moderate status (Cycle 2, 2019) which is driven by the Fail classifications for Chemical. The water body has an overall biological quality element status of Good.

3.2.5 The water body has a biological quality element status of Good, hydromorphological supporting element status of supports good, physio-chemical status of High, and specific pollutant status of High.

3.2.6 The WFD water body has an overall chemical status of Fail (Cycle 2, 2019), meaning it is currently failing to achieve its objective of overall Good chemical status for chemical elements by 2015. It should be noted that the chemical status between 2011 and 2016 was classified as Good. Cycle 2 2019 required inclusion of additional elements which now drive the Fail classification. This includes polybrominated diphenyl ethers (PBDE) and benzo(g-h-i) perylene.

The status of mercury and its compounds is shown to have deteriorated between 2016 and 2019 from Good to Fail.

3.2.7 The overall WFD water body objective is to achieve overall Good status by 2021. The water body is therefore not currently achieving its objectives under the WFD.

Nun's Walk Stream surface water body WFD status

3.2.8 Nun's Walk Stream is not designated as an artificial or heavily modified water body. It is currently classified as at overall Moderate status (Cycle 2, 2019) which is driven by the Fail classifications for Chemical. The water body has an overall biological quality element status of Good.

3.2.9 The water body has a biological quality element status of Good, hydromorphological supporting element status of supports good, physicochemical status of High and specific pollutants status of High.

3.2.10 The WFD water body has an overall chemical status of Fail (Cycle 2, 2019), meaning it is currently failing to achieve its objective of overall Good chemical status for chemical elements by 2015. It should be noted that the chemical status between 2013 and 2016 was classified as Good. Cycle 2 2019 required inclusion of additional elements which now drive the Fail classification. This includes Polybrominated diphenyl ethers (PBDE) and mercury and its compounds.

3.2.11 The overall WFD water body objective is to achieve overall Good status by 2021. The water body is therefore not currently achieving its objectives under the WFD.

Itchen navigation canal water body WFD status

3.2.12 Itchen Navigation Canal is designated as a heavily modified water body. It is currently classified as at overall Moderate potential (Cycle 2, 2019) which is driven by the Fail classifications for Chemical.

3.2.13 The overall ecological potential is noted to be Good, with Good potential for supporting elements.

3.2.14 The WFD water body has an overall chemical status of Fail (Cycle 2, 2019), meaning it is currently failing to achieve its objective of overall Good chemical status for chemical elements by 2015. It should be noted that the chemical status between 2013 and 2016 was classified as Good. Cycle 2 2019 required inclusion of additional elements which previous did not require assessment. These elements now drive the Fail classification. This includes Polybrominated diphenyl ethers (PBDE) and mercury and its compounds.

3.2.15 The overall WFD water body objective is to achieve overall Good potential by 2021. The water body is therefore not currently achieving its objectives under the WFD.

River Itchen chalk groundwater body WFD status

3.2.16 River Itchen Chalk is currently classified as an overall Poor status (Cycle 2, 2019).

3.2.17 The groundwater body has a quantitative status of Poor, which is driven by Poor quantitative dependent surface water body status.

3.2.18 According to the Environment Agency RNAG, the overall Poor status for River Itchen Chalk is due to poor nutrient management from agricultural and rural land management practices, and groundwater abstraction activities from the water industry.

3.2.19 The WFD groundwater body currently has an overall chemical status of Poor (Cycle 2, 2019), driven by Poor status for chemical drinking water protected area and general chemical test. It is currently failing to achieve its objective of overall Good chemical status for chemical elements by 2027.

3.2.20 The overall WFD water body objective is to achieve overall Good status by 2021. The water body is therefore not currently achieving its objectives under the WFD.

South East RBMP objectives

3.2.21 The obligations of the WFD were transposed into domestic law in the WFD (England and Wales) Regulations 2017. This includes the requirement to publish a RBMP for each river basin district and review and update those plans every 6 years. A RBMP is a strategic plan for achieving sustainable use of water and to protect and improve surface waters, groundwater and coastal waters within a river basin district.

3.2.22 The 2016 South East RBMP identifies a number of contributions made to achieve measures and identify future aims for the Test and Itchen management catchment. The proposed measures will not directly affect the Scheme.

3.2.23 Contribution to environmental outcomes for 2021:

- Projects to address sediment at source (from tracks and highways) in the Bourne and Cheriton sub-catchments supporting Catchment Sensitive Farming prevent deterioration, meet protected area objectives and complement work by the local Flood Action Group to reduce flood risk in the Bourne catchment. Habitat restoration in the River Dun will tackle sediment inputs to the river and improvements to morphology (removing/modifying barriers) will make the upstream river accessible to fish. The cost will be £26,000 capital costs and £11,000 operation costs over 1 year

- Several other projects are in progress, including action to plant trees to reduce the impact of climate change on chalk rivers ('Keeping Rivers Cool'); improving uptake of the Anglers Monitoring Initiative to detect incidents of water pollution; investigating restoration options for Alresford Pond Site of

Scientific Special Interest (SSSI); and holding an annual 'Rivers Week' to increase awareness and engagement, especially around domestic waste water inputs. This will contribute to protected area objectives, preventing deterioration and potentially reducing phosphate failures

3.2.24 Future Aims:

- Ideas for additional measures with £100,000 per year:

  A Water Friendly Farming Project tackling nutrients and pesticides within micro-catchments around boreholes and Source Protection Zones, linked to modelling undertaken by a SDNPA-led partnership, implementing actions within Diffuse Water Pollution Plans

  Expanding work through the Sediment Pathways project to additional sub-catchments, prioritised by environmental risk

- Ideas for additional measures with £1,000,000 per year (as above plus the following):

  Major river restoration projects based around the Lower Test and/or Upper Itchen aimed at integrating implementation of Biodiversity 2020 targets, natural flood risk management, supporting free movement of fish and eels, and improving water quality. Working closely with Hampshire County Council, the project will identify areas where integrated catchment management can complement traditional flood risk management measures by working with natural processes. The project will also seek to incorporate channel and flood plain enhancements linked to achievement of Southern Water's implementation of the Itchen Restoring Sustainable Abstraction targets

  Habitat restoration to achieve SSSI objectives at Alresford Pond and to prevent future release of phosphorus and sediment to the downstream protected area

3.3 Screening for high status

3.3.1 The proposed works are to be completed within the area designated as the Itchen WFD surface water body. The Nun's Walk Stream WFD surface water body and Itchen Navigation WFD canal are included for consideration. Works are not proposed on the Nun's Walk Steam WFD water body, and the Itchen Navigation WFD water body is located just under 5km of the Scheme. The site is underlain by the River Itchen Chalk WFD groundwater body.

3.3.2 The water bodies are not classified as High status water bodies.

3.3.3 Although not considered 'High Status' waterbodies, all four waterbodies have been assessed to identify any residual risks associated with the proposed works and therefore ensure WFD compliance.

3.4 Screening for risk of WFD deterioration and risk to water body status/potential objective

3.4.1 The proposed construction/operational works associated with the Scheme specific to WFD include:

- Implementing a new proposed crossing of the River Itchen
- Increased surface water runoff from increased impermeable areas due to road widening
- Temporary construction works associated with drainage outfalls and new bridge crossing

3.4.2 **Table 3.1** provides information on the specific elements taken into consideration when determining the status of each WFD quality element for the surface water body.

Table 3.1: Specific components of WFD water bodies.

Surface Water Quality Elements			
Biological	**Hydromorphological**	**Physico-chemical**	**Specific Pollutants**
Macrophytes and phytobenthos combined Fish Invertebrates	Hydrological regime	Acid neutralising capacity Ammonia (Phys-Chem) Dissolved oxygen pH Phosphate Temperature	Chlorothalonil Pendimethalin Manganese Arsenic Copper Iron Zinc

3.4.3 For the purposes of this assessment, the biological, hydromorphological and physico-chemical elements of water body status will be screened ‘in’ for WFD assessment.

3.4.4 All specific pollutants monitored are currently (Cycle 2, 2019) classified as at High status for River Itchen and Nun’s Walk Stream. The proposed construction and operation phases do not involve activities which would contribute to the release or introduction of the referenced specific pollutants.

3.4.5 **Table 3.2** provides information on the specific components taken into consideration when determining the status of the quantitative and chemical WFD quality elements for groundwater bodies.

Table 3.2: Specific components of the quantitative and qualitative quality elements for WFD groundwater bodies.

Groundwater Quality Elements	
Quantitative	**Chemical**
Quantitative saline intrusion Quantitative water balance Quantitative GWDTEs test Quantitative dependent surface water body status	Chemical drinking water protected area General chemical test Chemical GWDTEs test Chemical dependent surface water body status Chemical saline intrusion

3.4.6 For the purposes of this assessment and taking into account the sensitivity of the area, the groundwater WFD quantitative and chemical elements will be considered for assessment.

3.5 Screening for impacts to nationally and internationally designated sites

3.5.1 The Defra MAGIC Map[2] shows that the River Itchen designated as a SSSI (unfavourable - no change) and SAC at the proposed crossing location. The SSSI extends to the floodplain of the River Itchen, whereas the SAC is limited to the River Itchen watercourse.

3.5.2 Consultation on The Conservation of Habitats and Species Regulation 2017 (Regulation 77) has taken place with both Natural England and the Environment Agency and consultations will continue as the Scheme progresses.

3.5.3 Full consultation details are provided in **Chapter 4 (Environmental Assessment Methodology)** of the **ES (Document reference 6.1)** and the **Consultation Report (Document Reference 5.1).** Natural England confirmed that a Nutrient Neutrality Assessment was not required and agreed that there did not appear to be nutrient input pathways. The scope of surveys and assessment in the **Habitats Regulation Assessment (HRA) (Document Reference 7.5)** has been agreed with Natural England.

3.5.4 Progress meetings have been held with the Environment Agency which confirmed that no specific hydromorphological assessment would be required. The hydraulic modelling of the River Itchen (baseline and proposed with Scheme in place) has been approved by the Environment Agency. Discussions relating to pollution control measures and water quality raised the importance of ensuring no impact on the groundwater at this location. Discussions have also been had on proposed temporary construction methods to reduce impacts on the watercourses and ecology e.g. impacts on fish migration

3.5.5 Natural England has deferred to the Environment Agency in relation to effects on river habitats and fish. The mitigation measures for the Scheme are outlined within the Register of Environmental Actions and Commitments, to form part of the **first iteration Environmental Management Plan (fiEMP) (Document Reference 7.3)** which will be submitted with the DCO application. The detailed mitigation design will be determined and approved by the Environment Agency as part of the Flood Risk Activity Permit (FRAP) application for the works

4 WFD scoping assessment

4.1 Proposed scheme components

4.1.1 **Table 4.1** provides an overview of the Scheme elements and indicates whether each has been screened 'in' (or 'out') for further assessment based on the potential for impacts to occur on the WFD waterbodies within the study area. For the components screened 'in' these are assessed in detail in **Section 5** of this report, to support the Scheme.

Table 4.1: Screening of Scheme Elements

Scheme Component	Element	Screened 'in' or 'out'?
Temporary Works	New footbridge/cycleway construction over River Itchen	Screened 'in'
	Kingsworthy Bridge strengthening works over River Itchen	Screened 'in'
	Cleaning and construction of drainage outfalls to River Itchen	Screened 'in'
Construction	Construction of new proposed crossing of River Itchen	Screened 'in'
	Construction of overall Scheme	Screened 'in'
Operation	New proposed crossing of River Itchen	Screened 'in'
	Increased impermeable area from road widening	Screened 'in'

4.1.2 **Table 4.1** indicates that the project elements are all screened 'in' for assessment. This will be completed for the biological, hydromorphological and physico-chemical elements as indicated in **Section 3**. This will be completed for the Itchen and Nun's Walk Stream WFD surface water body and Itchen Navigation WFD canal water body. As indicated in **Section 3**, the quantitative and chemical elements are included for consideration with regards to the River Itchen Chalk WFD groundwater body.

5 WFD impact assessment

5.1 Identification of potential impacts

5.1.1 The following aims to provide a specific assessment of the Scheme in relation to the three quality elements: biological, physico-chemical and hydromorphological for surface water bodies and quantitative and chemical elements for groundwater bodies. Each element is assessed against the key components identified for the project, assuming the mitigation measures outlined in Section 5.2 are in place.

5.1.2 The baseline conditions in relation to WFD elements is outlined in **Section 3.2** where the WFD waterbodies and their current WFD status within the Application Boundary are identified

5.2 Mitigation measures

5.2.1 This section summarises the proposed mitigation measures which are proposed so that the Scheme does not have an adverse effect on the WFD water bodies.

First and second iteration environmental management plans and temporary construction works

5.2.2 A **fiEMP (Document Reference 7.3)** has been produced to accompany the DCO application and which has been discussed with relevant statutory consultees. A second iteration Environmental Management Plan (siEMP) would be produced prior to commencement of construction and would be prepared in accordance with the **fiEMP (Document Reference 7.3)**. The fiEMP and the siEMP are secured through the **DCO (Document Reference 3.1).**

5.2.3 The **fiEMP (Document Reference 7.3)** outlines good practice recommendations for the prevention of contamination. It also includes measures to comply with relevant legislation, guidance and best practice measures, in line with the Considerate Contractors Scheme and 'Site Handbook for the Construction of SuDS' (CIRIA C698). The **fiEMP (Document Reference 7.3)** includes a commitment for an Erosion Prevention and Sediment Control Plan to be prepared to reduce the quantity of sediment entrained in runoff and to prevent hydromorphological changes to surface water features. The **fiEMP (Document Reference 7.3)** also a commitment to an Emergency Spill Response Plan which will describe the procedures in the event of an environmental emergency such as a fuel or chemical spillage.

5.2.4 A temporary drainage strategy has been prepared for the construction phase. This outlines how runoff would be collected and directed through the temporary drainage system to protect water quality of receiving water bodies in terms of contamination and sediments. The temporary surface water drainage strategy forms **Appendix J** of the **fiEMP (Document Reference 7.3).**

5.2.5 Any impacts would be temporary during the construction phase and managed through the, siEMP and contractors' Methods Statement during construction.

5.2.6 The construction works would be appropriately phased to include suitable surface water drainage measures prior to construction works commencing, to intercept potential contaminates which may arise. Such measures are secured through the **fiEMP (Document Reference 7.3)** and include:

- The aim to control any pollution event at source
- Reduce the need for dewatering through the prevention of water entering excavations by limiting their time of opening to only that required
- Minimising the amount of exposed ground and soil stockpiles, stripping topsoil only when needed and minimising time that the ground is exposed where possible
- Soil stockpiles would be located away from watercourses
- Re-seeding/planting of soil stockpiles to limit soil erosion and run-off
- Use of silt fences to minimise silt entry into aquatic systems
- Plant and wheel washing, as well as haul road dampening
- Plant re-fuelling to take place in designated locations at a safe distance from water courses and good practice measures installed to reduce pollution (for example, adequate bunding)
- Spill kits to be positioned at strategic locations on site and comprehensive training provided for staff to ensure a rapid and effective response to incidents
- Use of settlement tanks as required
- Working in wet weather to be reviewed
- Use of an Ecological Clerk of Works
- Toolbox talks to ensure contractors are aware of potential risks and mitigating measures

5.3 Temporary works

Drainage outfalls

5.3.1 Temporary works would involve the isolation and dewatering of an area around the existing outfall location for cleaning works, as well as the temporary works to install temporary measures to isolate and dewater an area around each proposed outfall location to facilitate the permanent installation of the two new outfalls. A drainage outfall methodology optioneering report has been

undertaken within the **ES (Document Reference 6.1)** which forms part of the DCO application) and this confirms that the preferred option of a framed dam will ensure that no piling is necessary. An appropriate silt prevention methodology will be employed. The activities will be subject to consent and licences from the Environment Agency.

5.3.2 To avoid risk to white-clawed crayfish from introduction of non-native species or pathogens, biosecurity measures would be implemented when carrying out works within the watercourses. This would include disinfecting all equipment, personal protective equipment (PPE), and machinery with a broad-spectrum disinfectant. This treatment would be repeated whenever machinery, equipment or PPE is transferred to another site or watercourse.

5.3.3 No in-river working activities to the river channel or its banks would be undertaken without prior checks for white-clawed crayfish. If found to be present within the working area, white-clawed crayfish would be moved to an adjacent (unaffected) section of the River Itchen. If required, a licence would be obtained for the works.

5.3.4 The timing of in-river works would be scheduled between 1 July and 30 September to avoid the sensitive period for white-clawed crayfish. This also avoids sensitive 1 October to 31 May inclusive for salmonid fish and 15 March to 15 June inclusive for cyprinid fish) as agreed with the Environment Agency.

New River Itchen cycle/footbridge

5.3.5 The proposed cycle/footbridge would comprise a single-span (clear span) through truss supported on reinforced concrete abutments founded on piled foundations without the need for direct or intrusive works within the River Itchen. It is envisaged that piled foundations would be pre-cast to seek to avoid the use of wet concrete reaching the river system through ground fissures. Timber and steel are being considered for the proposed structure, which would be lifted into place as a pre-constructed item with the crane situated on the adjacent highway. Separate reinforced concrete wing walls perpendicular to the abutments would likely be required on all four corners. The abutments, which are envisaged to be precast units to seek to avoid the use of wet concrete, would be set back from the riverbank and outside the SAC and SSSI to reduce environmental impact and to allow preventative measures should wet concrete be required.

5.3.6 The bridge deck follows the same horizontal alignment as the existing adjacent road bridges (Itchen and Kingsworthy Bridge) to make certain it does not present an additional blockage to animals such as bats commuting along the River Itchen. Fencing is to be provided along the footpath/cycleway either side of the River Itchen to prevent pedestrians from entering woodland habitat potentially used by otter (although no otter signs were recorded during a specific survey of this woodland as detailed in the **Habitats Regulations Assessment (HRA) (Document Reference 7.5).**

5.3.7 Any litter items such as packaging would be regularly removed from this work area and in the interim to prevent litter being blown into the river area netted bins would be provided.

5.3.8 During the construction phase the risk of a hydraulic failure on a machine resulting in fluid leakage into the River Itchen would be controlled by bunds situated around the machine and plant nappies installed underneath the machine.

5.3.9 If piling works are required, low vibration methods will be used or will adhere to the timing restrictions detailed above.

5.3.10 To reduce the impact on the remaining trees during construction of the bridge abutments and placement of the main span, ground protection mats would be utilised and exclusion zones provided to prevent root damage. Liaison will be carried out with vegetation clearance specialists to ensure the optimum route is utilised taking safety and minimum clearance into account.

5.3.11 Depending on the bridge deck installation detail, access may be required to potential bolt connections positions. If this is necessary, pontoons could be used to support an access system to the bridge. It is anticipated that this pontoon would only be in place for a few days and would be across the river width. The design of any pontoon configuration would be undertaken in consultation with an ecologist.

Kings worthy bridge

5.3.12 Modifications in terms of strengthening works are proposed to the existing Kings Worthy Bridge structure to carry the bi-directional A33 traffic and the A34 southbound traffic, in the form of attaching carbon fibre plates to the underside of the edge beams. These plates are lightweight and are both carried and fixed into position by hand. In order to prepare the concrete structure to accept the adhesive, those sections would require to be ground back by a few millimetres to prepare a clean surface, which would be undertaken in conjunction with a vacuum designed to collect approximately 90% of the dust generated. Additionally, a dust protection frame with cover would be placed across the river in the works area for the duration of the griding operation. The design of any dust protection frames for pontoons would be undertaken in consultation with an ecologist.

Ecology

5.3.13 Ecologists will undertake pre works checks for white-clawed crayfish, nesting birds, otter and invasive species prior to the staged vegetation removal of some shrubs to enable construction of the drainage outfalls.

5.3.14 The **HRA (Document Reference 7.5)** undertaken for the Scheme focused on the presence of fish and proposed a number of mitigation measures which have been agreed by Natural England and the Environment Agency. In order to avoid any adverse effect it is proposed that there will be no in-river activities (those

that generates noise or vibration) between 1 October to 31 May inclusive for salmonid fish and 15 March to 15 June inclusive for cyprinid fish, and between 1 July and 30 September to avoid the sensitive period for white-clawed crayfish. There will be no piling works proposed in the channel.

5.3.15 The ecological mitigation measures included for the temporary works are outlined within the Temporary Works section above.

Drainage and materials movement

5.3.16 Movement of materials around the site will be managed under an appropriate Materials Management Plan (MMP) (a draft is appended to the **fiEMP (Document Reference 7.3)**) to minimise any hydromorphological disturbances and minimise flood risk. The impacts of material placement and how the protection would be secured will be assessed in the context of the principles of Definition of Waste Code of Practice (DoWCoP). It should be noted that the proposed locations for temporary materials storage are located outside of the floodplain and flood zones and are not indicated to have surface water flow routes present. It is therefore highly unlikely that the temporary storage will impact upon the surface water bodies due to the lack of pathways present.

5.3.17 A Method Statement will be prepared to outline how surface water drainage will be managed during the construction phase and appended to the **fiEMP (Document Reference 7.3).** This will be prepared for approval through the appropriate permitting and consenting process (e.g. Flood Risk Activity Permit).

5.3.18 A permanent surface water drainage system has been designed to support the Scheme, for acceptance by the Lead Local Flood Authority (LLFA), such that that there is no increase in the volume of road drainage into the River Itchen throughout its lifetime. Details of the surface water drainage strategy are provided in **Appendix 13.1 (Drainage Strategy Report)** of the **ES (Document Reference 6.3)** separately, however it is discussed at a high level within this WFD Compliance Assessment due to the improved pollution management measures that are included.

Surface water drainage

5.3.19 The design approach is to install new gravity drainage for all new carriageway, or to replace existing highway drainage that is being built over by new impermeable highway, such as hardening of the central reserve and lane widenings. In areas where existing carriageway is being overlaid only, then existing highway drainage is retained.

5.3.20 Areas of local, minor lane widenings proposed remote from the main works, are drained to existing highway drainage, which is modified, where required, to maintain existing discharge rates and no-flooding capacity.

5.3.21 All new drainage conveys run-off to soakaways or extended detention basins (EDBs), which infiltrate to ground where the National Highways Water Risk Assessment Tool (HEWRAT) assessment of risk to groundwater, allows.

Further measures to manage pollution include catchpits, swales and unsaturated zones above geocell tank.

5.3.22 The treatment of run-off before discharge is detailed in **Appendix 13.1 (Drainage Strategy Report)** of the **ES (Document Reference 6.3)** and has been developed from the M3J9 Technical Note "Proposed Assessment Method and Pollution Control Measures for Road Runoff" (**0**) and **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3).** This provides a comprehensive account of the assessment and mitigation of pollution risk from highway runoff.

5.3.23 The proposed measures for the M3 Junction 9 surface water drainage system include:

- Over-the-edge drainage of run-off from carriageways on embankments to filter strips and to infiltration ditches
- Collection of run-off at carriageway edge in linear drains, gullies or filter drains, which is piped to the following:
  - Attenuation and Primary Settlement treatment in filtration forebays and unplanted, lined detention basins
  - Attenuation, Secondary Settlement and Filtration treatment in vegetated extended detention basins, containing both wet and dry habitats
  - Tertiary treatment in a grassed swale prior to discharge to the River Itchen
  - In areas where existing carriageway is being overlaid and existing highway drainage is being retained, run-off is either discharged over-the-edge to filter strips or infiltration ditches, or is captured in road gullies and channels, and conveyed to infiltration features such as existing soakaways or trenches

5.3.24 **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)** has been completed to assess the effectiveness of the proposed extended detention basins at removing pollutants before discharging to ground/River Itchen.

6 Potential impacts to WFD surface water bodies

6.1 Introduction

6.1.1 This section assesses the potential impacts (biological, chemical, hydromorphological) to the surface water bodies, including the Itchen WFD water body as the key receptor for the Scheme, the Nun's Walk Stream WFD water body due to its proximity to the Scheme and interaction with the River Itchen (not direct receptor) and the Itchen Navigation WFD canal as a downstream receiving water body.

6.2 Biology – construction and operation

Potential impacts on aquatic flora and benthic invertebrates

6.2.1 Installation of a new crossing over the Itchen WFD surface water body will have a **Negligible** effect on the composition and abundance of aquatic flora and benthic invertebrate fauna for the operation phase due to the localised nature of the works, proposed wide span of the bridge and relatively narrow nature of the bridge for the pedestrian usage. No in-channel works are proposed. Therefore, for the River Itchen and Nun's Walk Stream surface water bodies the impacts on the composition and abundance of aquatic flora and fauna will be **Negligible**. Also, due to the localised nature of the works in context of the overall WFD water body, there will be no major impacts on overall WFD status and the surface water bodies will not be prevented from achieving good status in the future. Impacts on aquatic flora and fauna will also be **Negligible** in the Itchen Navigation Canal surface water body because of its distance downstream from the A34 carriageway. It is highly unlikely that impacts from localised installation of a new crossing will be conveyed further downstream due to the surface water body's **Negligible** localised impact and distance downstream of Scheme.

6.2.2 During the construction phase, there is the minor potential for materials to enter the channel during the construction phase, however this will be mitigated through the implementation of mitigation measures outlined in the **fiEMP (Document Reference 7.3)** and siEMP and any associated Method Statements prepared prior to construction commencement. The mitigation measures will outline how construction chemicals and materials will be prevented from entering the Itchen water body. Examples of contamination prevention include filtration in the swales to remove particles, and retention in lined ponds before the soakaway to reduce the organic contamination. The **fiEMP (Document Reference 7.3)** and siEMP will be agreed with statutory consultees prior to commencement of construction.

6.2.3 The temporary dewatering of the channel for installation of the new drainage outfalls will result in a portion of the river bed to be exposed for a short period of time (anticipated to be approximately 1 week) and will be subject to physical disturbance. This is likely to result in short-term temporary degradation (in terms of weeks) of the river and riverbed during construction of the drainage outfalls. Works would be undertaken sequentially, so only one location would be

degraded at any one time. There will be no permanent loss or degradation of qualifying SAC habitats.

6.2.4 The construction/refurbishment of the three drainage outfalls will result in permanent loss of approximately 2m^2 of existing riverbank in each location, which will be replaced with a concrete headwall. In this area the riverbanks have been heavily modified during construction of the existing road bridges, and the Itchen Way footpath runs along the top of the bank. The predominant habitat along the riverbank is woodland and scrub which is not a qualifying feature of the SAC. There will be no permanent loss of qualifying habitats of the SAC.

6.2.5 The location of the new footbridge/cycleway is in an area which already experiences shading as a result of the existing adjacent Itchen Bridge, Kings Worthy Bridge and tree canopy. As such, potential impacts are likely to result in no change (no observable impact) compared to the existing situation.

6.2.6 The temporary loss of habitat in this localised area is therefore unlikely to impact upon the overall WFD status of the River Itchen water body.

6.2.7 The increased impermeable area of the bridges will have a **Negligible** effect on aquatic flora and benthic invertebrate fauna. The National Highways HEWRAT demonstrates **Negligible** increases of pollutants (copper and zinc) following an increase in the impermeable area of the bridges. The installation of the proposed highways drainage system will have a localised **Minor Beneficial** effect on the composition and abundance of aquatic flora due to the removal of sediment and pollutants from surface water runoff. The HEWRAT assessment and Hydrogeological Risk Assessment confirm that there will be no adverse impact on surface water and groundwater quality as a result of the drainage strategy due to effective removal of suspended solids and pollutants.

6.2.8 The Scheme also aims to maximise biodiversity delivery within the land acquired for the Scheme design. National Highways have adopted a corporate target of no net loss of biodiversity across its activities by 2025, progressing towards delivering a net gain in biodiversity by 2040.

6.2.9 An Ecological Clerk of Works would be present on site during key periods of the construction phase. They would be required to make certain that all committed mitigation measures are adhered to.

6.2.10 **0** shows the area in which the A34 crosses the River Itchen, has existing vegetation, which will be retained and enhanced, and native shrubs planting areas. This demonstrates that the operation phase/permanent result of the Scheme will be similar or better than that which currently exists. Therefore, the impact on the current and future status of all three surface water bodies will be **Negligible**.

Potential impacts on fish species

6.2.11 Noise and vibration from piling and shading activities could potentially have a minor adverse effect on fish species should the works be scheduled at an

inappropriate time. It has been noted there are bullhead, brook lamprey, and Atlantic salmon present within the Itchen SAC area, but the river environment near the existing A34 crossings is unsuitable for these fish species because the banks are artificially modified underneath the bridges and the river flow is homogenous. The exception to this is one localised section, approximately 4m x 2m upstream of Kingsworthy Bridge on the left bank, with a deep silt bed with adjacent clean gravel substrates. This silt bed is considered optimum for juvenile (ammocoete) brook lamprey development. The timings mentioned above will be adhered to as per Environment Agency requirements.

6.2.12 Shading activities may have a localised impact, but the activities themselves will be minimal in terms of the overall surface water bodies (River Itchen, Nun's Walk Stream, and Itchen Navigation Canal). These impacts will be minimal due to the proposed bridge being adjacent to an existing bridge and relatively narrow due to pedestrian use only. Therefore, impacts on the current and future status of these surface water bodies will be **Negligible** overall.

6.2.13 Temporary construction methods proposed in the watercourse are confirmed to not include piling. The noise and vibration will therefore have a **Negligible** effect of fish species with appropriate timing of works in all three WFD surface water bodies (River Itchen, Nun's Walk Stream, and Itchen Navigation Canal).

6.2.14 The temporary damning and dewatering will be localised around the two new drainage outfalls and extend approximately 5-10 meters along the riverbank, and across no more than 50% of the channel. Mitigation set out in the **fiEMP (Document Reference 7.3)** will avoid the impacts through direct mortality. Where dewatering of sections of the river is required to facilitate construction, fish would be removed from these areas using electrofishing, in agreement with the Environment Agency and under any necessary permits as agreed at meetings with the Environment Agency. The use of a sediment pump is confirmed to be required and choice of pump needs to be fish friendly in accordance with Environment Agency requirements.

6.2.15 Passage for fish along the River Itchen will be maintained at all times and in-river working will follow timing restrictions set out by the Environment Agency. As such potential fragmentation and disturbance impacts to fish will be avoided.

6.2.16 Potential impacts to freshwater fish could arise through habitat degradation associated with a reduction in water quality from pollution events such as traffic collisions once the Scheme is operational. The embedded mitigation measures set out in the Drainage Strategy report for managing surface water runoff from the road which includes provision of measures for treatment of surface water will avoid adverse operational impacts and are likely to be an improvement compared to the existing situation. The inclusion of the mitigation would result in no change or negligible beneficial impact, resulting in **Neutral** or **Slight beneficial** effect.

6.2.17 Therefore, construction and operation of the Scheme does not have an impact on the current status of these surface water bodies, and it will not prevent them from achieving good overall water body status in the future.

6.3 Physico-chemical – construction and operation

6.3.1 The temporary works required for the installation/maintenance of each outfall will be in location for only a week (each outfall done subsequently). Any impacts to physico-chemical elements will therefore be localised and temporary, limited to the period of time that the works are occurring.

6.3.2 The use of any pontoons/dust protection frames/vacuum system in the bridge works will provide mitigation to reduce the likelihood of nutrients entering the watercourse. Strict biosecurity measures will be in place, with cleaning and disinfection of any pontoons/dust frames completed prior to and after use. The temporary works will not alter diffuse pollution pathways to the watercourse meaning the ammonia (phy-chem), Biological Oxygen Demand (BOD) and phosphate elements will remain as per existing.phy-chem), Biological Oxygen Demand (BOD) and phosphate elements will remain as per existing.

6.3.3 It is therefore anticipated that the impact of the temporary works will be **Negligible** with regards to physico-chemical elements of the overall River Itchen WFD water body.

6.3.4 The implementation of the proposed new crossing and overall Scheme could potentially have a **Negligible** effect on physico-chemical elements. The **fiEMP (Document Reference 7.3)** and siEMP and the temporary surface water drainage plan provides mitigation so the impact on WFD water bodies (River Itchen, Nun's Walk Stream and Itchen Navigation Canal) is overall **Negligible**.

6.3.5 The permanent surface water drainage strategy will convey all runoff to soakaways or extended detention basins which infiltrate to ground where the DQRA assessment of risk to groundwater confirms it is acceptable. This is outlined **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3).**

6.3.6 The drainage design of the Scheme discharges into eight EDBs. A HEWRAT/DQRA assessment for acute and chronic pollution of watercourses has been undertaken for all attenuation basins and the single geocellular tank (which does discharge directly to River Itchen) as if all these features discharged directly into the River Itchen. The HEWRAT assessment confirms that each detention basin provides sufficient removal of sediments and pollutants to preclude exceedance of the thresholds for acute and chronic pollutant contaminations. The lowest return for a spillage incident is 1 in 253 (for the proposed drainage system) years which meets the minimum 1 in 200-year return period expected for spillage probability in the context of River Itchen SAC. The HEWRAT assessment is included in the Pollution Prevention Control Technical Note in **Appendix D**.

6.3.7 The increased impermeable area of the bridges will have a **Negligible** effect on physico-chemical elements during the operation phase. As stated above, the HEWRAT assessment tool demonstrates **Negligible** increases of pollutants (copper and zinc) following an increase in the impermeable area of the bridges. The installation of the surface water drainage system will include contamination and pollution control measures to treat surface water prior to discharging to the River Itchen, Nun's Walk Stream and Itchen Navigation Canal WFD surface water bodies. Examples of contamination and pollution control measures are included in Section 5.2 and the Stage 3 – Drainage Strategy Report.

6.4 Hydromorphological – construction and operation

6.4.1 The timing of the temporary works are such that they will be completed when flows are generally low (June to October) and would be removed in the event of a flood warning. Final construction methods are not confirmed at this stage but if a pontoon is required for the bridge installation/maintenance it will not occupy more than 50% of the watercourse channel and will only be required for a week. The River Itchen channel will remain free flowing and unobstructed. The temporary de-watering in-channel works associated with the drainage outfalls will cause temporary short term damage to the river bank. The works will last for approximately a week and conditions within the channel will be restored following completion of the works. Any impacts observed would be minor localised and temporary, limited to the periods of time that the works are in place.

6.4.2 The construction/refurbishment of the three drainage outfalls would result in permanent loss of approximately 2m^2 of existing riverbank in each location, which would be replaced with a concrete headwall. In this area the riverbanks have been heavily modified during construction of the existing road bridges, and the Itchen Way footpath runs along the top of the bank. The predominant habitat along the riverbank is woodland and scrub which is not a qualifying feature of the SAC. There would be no permanent loss of qualifying habitats of the SAC (water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation) and therefore the permanent works associated with the headwalls would therefore have a **Negligible** effect on the overall River Itchen water WFD designated body.

6.4.3 The implementation of a new proposed crossing of the River Itchen is not expected to have a significant effect on flow mechanisms during the construction phase or operation phase. The Scheme has been implemented within the relevant hydraulic model for the River Itchen which shows **Negligible** impact upon river flood levels. This is due to the appropriate design of the bridge, which has a wider span than the existing upstream and downstream bridge (35m) and a soffit level set an appropriate level above modelled flood level **(Appendix A)**. Therefore, flow conveyance and flow area of the River Itchen remains unchanged.

6.4.4 Sediment control will be managed during the construction phase using appropriate mitigation measures which is set out in the **fiEMP (Document**

Reference 7.3) and will be refined further in the siEMP through the Erosion Prevention and Sediment Control Plan.

6.4.5 The increased impermeable area of the A34 bridge is minor in relation to the bridges already in existence and the overall size of the WFD designated water body catchment area, and therefore would have a **Negligible** effect on the quantity and dynamics of water flow in all three surface water bodies (River Itchen, Nun's Walk Stream and Itchen Navigation Canal), therefore it will not prevent them achieving Good Status in future.

7 Potential impacts to WFD groundwater body

7.1.1 The Scheme is located within the River Itchen Chalk WFD groundwater body. It has an overall biological quality element status of Poor. The overall WFD water body objective is to achieve overall Good status by 2021. The water body is therefore not currently achieving its objectives under the WFD.

7.2 Quantitative

7.2.1 The quantitative elements of the River Itchen Chalk WFD groundwater body have achieved good status. However, the groundwater body has achieved poor quantitative dependent surface water body status. The Scheme, therefore, will have a **Negligible** impact on the River Itchen Chalk WFD groundwater body and will cause no further deterioration of the overall WFD groundwater body status.

7.2.2 Construction methods / control measures such as appropriate piling techniques (if required) to minimise the risk of mixing of aquifer bodies through the creation of new pathways are outlined in the **fiEMP (Document Reference 7.3)** and will ensure groundwater levels/flows/pathways are not adversely affected. Control measures may include the provision of a FWRA which would be undertaken once the proposed foundation solutions are known, in accordance with the Environment Agency guidance *'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination' (Environment Agency, 2001)*. Further details are provided in **Chapter 9 (Geology and Soils)** of the **ES (Document Reference 6.1).**

7.2.3 A piling risk assessment will be completed at a later stage once the exact location and size of piles are known. This activity will be considered in relation to the River Itchen Chalk WFD groundwater body, however due to its significance in size in comparison to the Scheme and its elements, they are not significant in the context of the overall water body therefore the impact is likely to be **Negligible**.

7.2.4 Stabilisation material options and methods will be determined during Stage 5 detailed design with use of lime and cement as potential options for binding of excavated wetter chalk to be re-used as engineering fill. Risk to Controlled Waters from the potential stabilisation and treatment options has been considered at this early design stage for infiltration capacity. The infiltration capacity of the Chalk will be limited to infiltration through the Chalk matrix and infiltration basins located in areas of filled Chalk material have been designed accordingly. It is considered extremely unlikely that treating or stabilising the Chalk would result in any significant change in its infiltration capacity compared to un-treated or stabilised Chalk and no further assessment is considered necessary. The impact is likely to be **Negligible**.

7.3 Chemical

7.3.1 The embedded mitigation measures set out in the Drainage Strategy report for managing surface water runoff from the road includes provision of measures for treatment of surface water will avoid adverse operational impacts (associated with a reduction in water quality from pollution events such as traffic collisions) and are likely to be an improvement compared to the existing situation.

7.3.2 A HEWRAT screening assessment and DQRA has been undertaken as part of the Hydrogeological Risk Assessment in **Appendix 13.2** (**Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)** to confirm the impact of the proposed EDBs on groundwater quality. The results of the HEWRAT are included in **Appendix D** of this WFD report.

7.3.3 The results of the HEWRAT screening assessment show that all but one of the currently proposed EDBs have a 'medium' risk to groundwater and one has a high risk. In order to mitigate against the high risk EDB, it is proposed that this EDB would be lined, thus preventing discharge to groundwater. The DQRA undertaken to further assess the risk from the un-lined EDB's confirms that the acute risk from soluble contaminants has been assessed as low. The contaminant concentrations in the EDBs as derived from the HEWRAT assessment are below the UK Drinking Water Standards and thus pose no significant risk to groundwater.

7.3.4 The lowest return for a spillage incident is 1 in 253 years which meets the minimum 1 in 200-year return period expected for spillage probability in the context of River Itchen SAC.

7.3.5 The proposed drainage discharges runoff via a far greater area of infiltration over granular soils, which provides a betterment in risk to groundwater from the existing M3 Junction 9 drainage configuration.

7.3.6 Infiltration features (basins) that are located in solid chalk geology have been sized assuming an impermeable liner, so that no infiltration is possible (Extended Detention Basins 1, 3A and 4). Where basins overlie granular, drift geology, infiltration has been assumed within the design of basin volumes.

7.3.7 The models demonstrate that none of the EDB's are likely to result in an impact in groundwater from soluble contaminants within the sediment lining the base of EDBs (chronic risk).

7.3.8 The Hydrogeological Risk Assessment model shows that there is a sufficient thickness of unsaturated zone beneath the EDB's, comprising material with sufficient organic carbon content to provide sufficient attenuation and ensure there is no discharge of PAH compounds to the water table. Model results are provided in **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)**.

7.3.9 Soil and water testing on samples as part of the Controlled Waters risk assessment confirmed that risk to groundwater was low based on soil samples from soil disposal and fill areas.

7.3.10 As part of the ground stabilisation and treatment works, the addition of lime to Chalk is unlikely to result in any significant change to the Chalk chemistry. Lime is a natural material with a similar composition to Chalk.

7.3.11 Chalk that has been treated with cement is less likely to release contaminants to Controlled Waters that un-stabilised Chalk and could have a beneficial impact on Controlled Water Quality.

7.3.12 If, during the detailed design phase, it is established that additives will be required and/or different stabilisation or treatment methods are necessary, then the appropriate Controlled Waters risk assessments will eb undertaken and agreement sought from the EA.

7.3.13 It is considered that following the inclusion of the embedded mitigation as part of the operational drainage strategy (secured through the DCO submission), the permanent Scheme is unlikely to affect the integrity of the groundwater environment. No measurable impact upon the aquifer/chalk groundwater WFD body has been identified by HEWRAT/DQRA (both acute soluble and chronic sediment related pollutants) and risk of pollution from spillages has been assessed as less than 0.5%.

7.3.14 Therefore, the impact on the current and future status of the River Itchen Chalk groundwater body will be **Negligible**.

8 WFD compliance

8.1 Summary of potential impacts

8.1.1 The Scheme will replace any disturbed or damaged riparian vegetation associated with the temporary works and construction period to a similar or better standard than that which currently exists so that there will not be a loss of existing habitat in the riparian area for the overall construction phase.

8.1.2 The operation phase includes the construction of a new footway/cycleway over the River Itchen, strengthening works to an existing bridge and installation of new drainage outfalls. The riparian and in-channel habitats will not be materially altered from that which currently exists meaning the Scheme will therefore not result in a significant change to the existing habitats during the operation phase.

8.1.3 The assessment contained in **Sections 6** and **7** show that all potential effects are **Negligible** or **Minor Beneficial**. The Scheme will therefore not have any significant adverse effects on the WFD designated surface water body or groundwater body. Where an element has been Scoped 'in' this has a negligible effect, mainly because the works are small scale and localised and/or because the effects would be mitigated either by design or by adhering to a contractors' CEMP and Method Statements likely to be required by Natural England / Environment Agency because of the high degree of sensitivity (importance) of the water body. The assessment is based partly on informed professional judgement, but they are supported by a HEWRAT assessment and **HRA (Document Reference 7.5)**.

8.1.4 As detailed above, the River Itchen Chalk WFD groundwater body is significant in size and the Scheme and its elements are not significant in the context of the overall water body. Mitigation measures are embedded in the design therefore the introduction of chemicals to the water body are minimised.

8.1.5 The Scheme will therefore have a **Negligible** impact on the River Itchen Chalk WFD groundwater body and not deteriorate its current and future overall groundwater body status.

8.2 Summary of WFD compliance

8.2.1 Article 4.9 of the WFD specifies that where an area requires special protection under another EC Directive, or where water is used for the abstraction of drinking water, then these areas should be identified as 'protected areas'. Such areas have their own objectives and standards. Where water body boundaries overlap with protected areas, the most stringent objective applies, that is the requirements of one particular EC Directive should not undermine the requirement of another.

8.2.2 The European Union (EU) legislation shown to be of relevance to this project on the Environment Agency's Catchment Data Explorer are:

- Itchen Drinking Water Protected Area (UKGB107042022580)
- River Itchen Habitats and Species Directive (UK0012599)
- River Itchen (Hampshire) Urban Wastewater Treatment Directive (UKENRI110)
- River Itchen (Hampshire) Urban Waste Water Treatment Directive

8.2.3 The Scheme would not impact on these designations. HEWRAT assessment shows that any changes to water chemistry would not be significant. There would be a betterment in terms of containment of spills.

8.2.4 A **HRA (Document Reference 7.5)** to inform Statement of Appropriate Assessment has been undertaken for the River Itchen SAC.

8.3 Assessment of WFD compliance

8.3.1 The assessment contained in **Section 6** and **Section 7** show that all potential effects are **Negligible**. **Table 8.1** and **Table 8.2** provide a summary of the likely compliance for the Proposed Scheme against the WFD objectives outlined in the detailed WFD assessment (respectively for surface water and groundwater).

8.3.2 If the mitigation measures referred to in **Table 8.1** and **Table 8.2** are adhered to it is considered that at a WFD water body scale the Scheme would be complaint with the WFD legislation. It can be concluded that no exemption is required for the Scheme.

Table 8.1: Overview of Compliance with WFD Legislation (Surface Water)

Compliance Criteria	River Itchen, Nun's Walk Stream, and Itchen Navigation Canal
Deterioration in the Status/Potential of the water body (including individual quality elements)	No deterioration (Mitigation measures include temporary drainage strategy, permanent drainage strategy, pollution control measures and effective silt management during temporary works – all outlined in the **fiEMP (Document Reference 7.3)**. HEWRAT and Hydrogeological Risk Assessment confirms no adverse impacts on water quality and ecological receptors.
Ability of the water body to achieve Good Status/Potential	Ability of the water body to achieve Good Status/ Potential not affected due to mitigation measures outlined above ensuring no adverse impact

Compliance Criteria	River Itchen, Nun's Walk Stream, and Itchen Navigation Canal
	on water quality and ecological receptors.
Impact on the WFD objectives of other water bodies within the same River Basin District	No impact
Impact on implementation of the WFD mitigation measures and EU legislation	No impact

Table 8.2: Overview of Compliance with WFD Legislation (Groundwater)

Compliance Criteria	River Itchen Chalk
Deterioration in the Status/Potential of the water body	No deterioration (Mitigation measures include temporary drainage strategy, pollution control measures and effective silt management during temporary works – all outlined in the **fiEMP (Document Reference 7.3).** HEWRAT and Hydrogeological Risk Assessment confirms no adverse impacts on water quality and ecological receptors.
Impact on quantitative status element	No impact
Impact on chemical status element	No impact

9 Summary and conclusion

9.1.1 The works are to be completed on the River Itchen, Nun's Walk Stream, and Itchen Navigation Canal WFD surface water bodies, and the WFD Itchen River Chalk groundwater body, which have all been assessed within this WFD Compliance Assessment.

9.1.2 It has been demonstrated that the proposed widening of the M3 Junction 9 carriageway and implementation of the new footway/cycleway bridge crossing will not have any significant long-term impacts on the ecology or water quality within the water bodies.

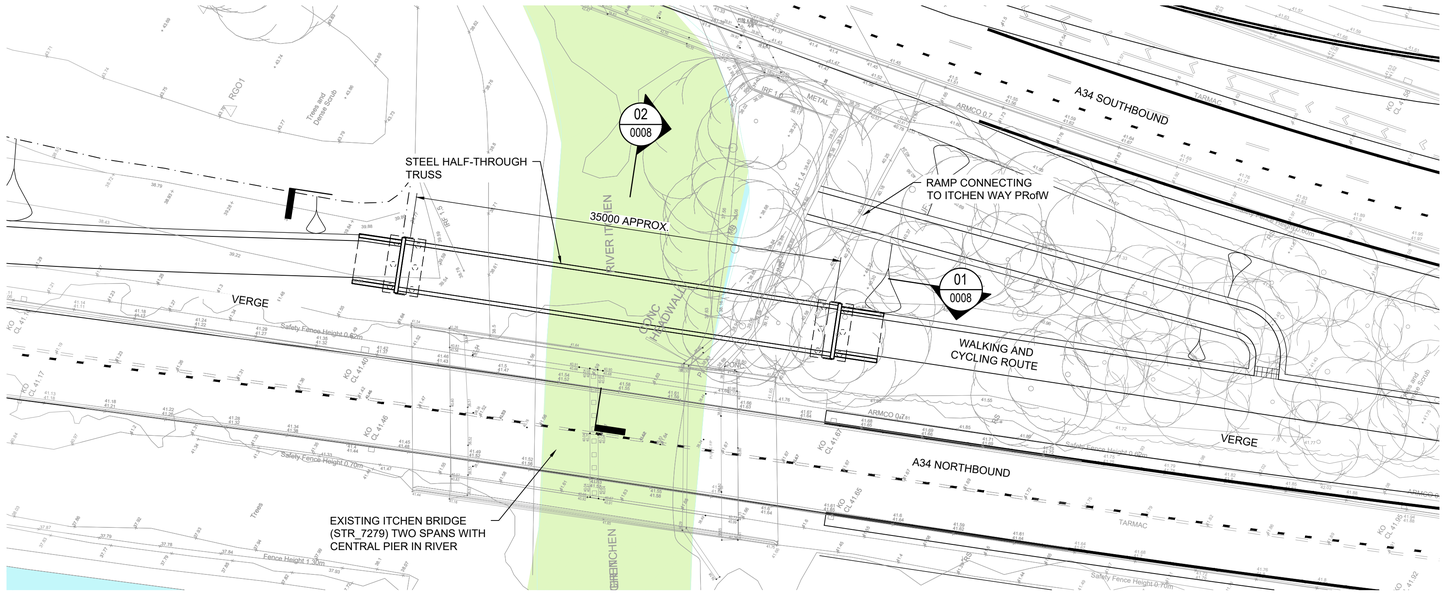
9.1.3 The Scheme does not result in a significant change away from baseline conditions for the overall WFD water bodies, and, as demonstrated, will not result in deterioration of the current WFD potential of the River Itchen, Nun's Walk Stream and Itchen Navigation Canal surface water bodies.

9.1.4 The creation of potential new pollutant pathways through piling and the temporary impacts during the construction phase will be avoided and minimised through the adoption of best practice techniques and the implementation of a robust **fiEMP (Document Reference 7.3)** and siEMP, and Environmental Control Plans (detailed in the **fiEMP (Document Reference 7.3)** and siEMP) which will be completed prior to construction commences.

9.1.5 The works will not affect the ability for the key actions identified in the RBMP to be implemented for the catchment.

9.1.6 As such, the works are compliant with the WFD and will not prevent the water bodies from achieving Good status in the future.

Appendix A Proposed Bridge Development Drawings



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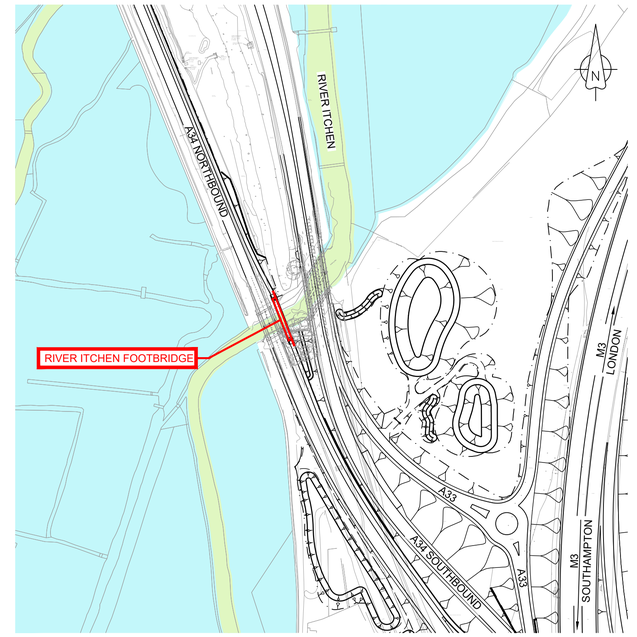

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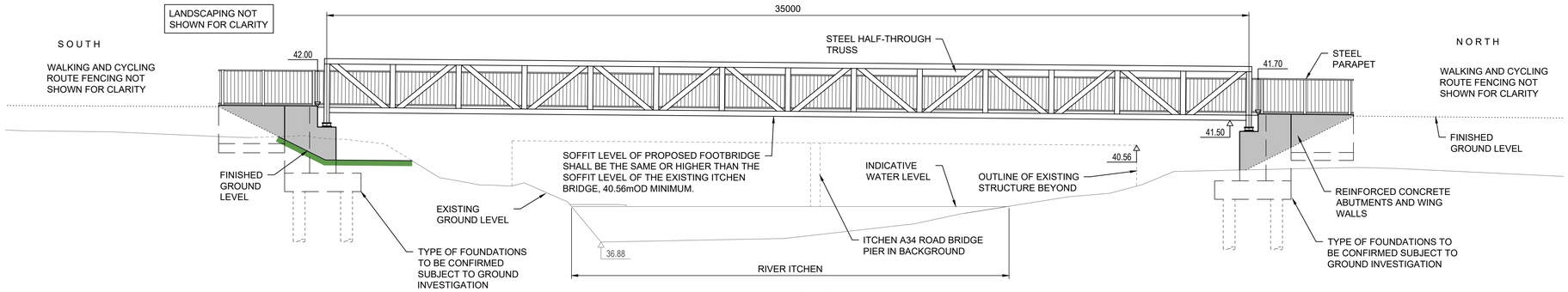

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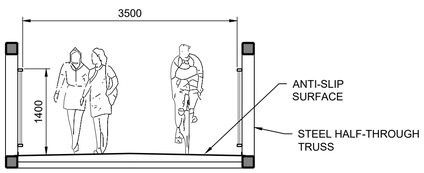

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NOTES

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2. All levels are in metres and relevant to Ordnance Datum Newlyn.
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KEY TO SYMBOLS

AREA OF SACs

AREA OF SSSI

REV	DATE	REVISION NOTE	ORIG	CHKD	APPD
P03	28.01.22	DCO REVIEW COMMENTS INCORPORATED	CRD	JAS	JWS
P02	15.12.21	DCO REVIEW COMMENTS INCORPORATED	GCP	JWS	JWS
P01	29.10.21	FOR DCO SUBMISSION	GCP	JAS	JWS

Purpose of use: FOR DCO SUBMISSION

Development Consent Order Number / Document: TR010055/2.7

DESIGNER: Stantec

CONTRACTOR: VolkerFitzpatrick

CLIENT: national highways

PROJECT TITLE: M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE: PCF STAGE 3

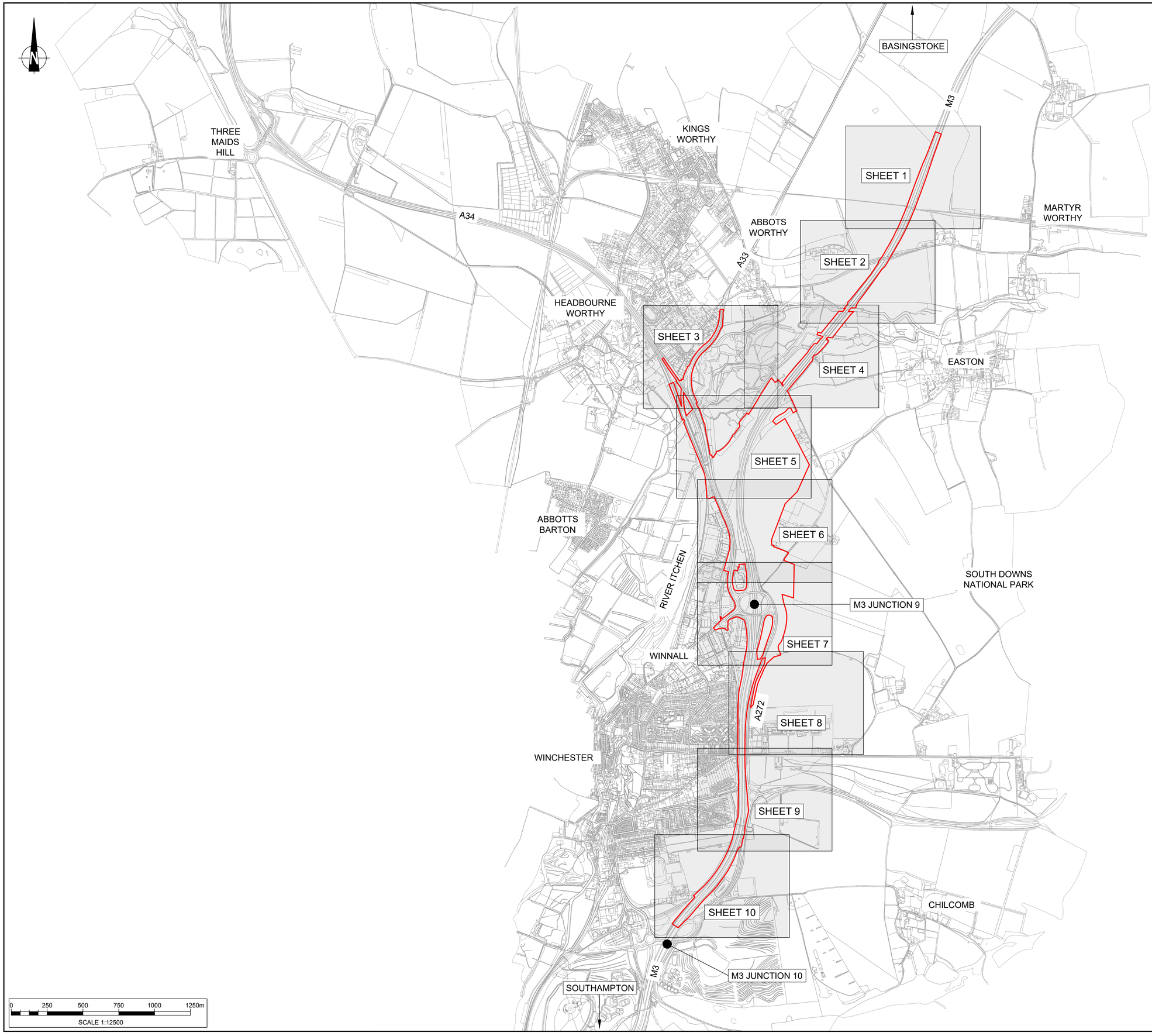
DRAWING TITLE: STRUCTURES PLANS & SECTIONS APFP REGULATIONS 6(2) RIVER ITCHEN FOOTBRIDGE GENERAL ARRANGEMENT DOCUMENT REFERENCE: 2.7

SUITABILITY: DCO APPLICATION

SHEET SIZE: A1 | SCALE: As indicated | STATUS: S2

DOCUMENT REFERENCE: HE551511-VFK-LSI-W_NMUX_01-DR-CB-8041

Appendix B Scheme Drawings



NOTES

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DEVELOPMENT CONSENT ORDER BOUNDARY

REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
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DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
KEY PLAN
DOCUMENT REFERENCE: 2.5

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:12,500	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3000

BASINGSTOKE

M3

PRIVATE FARM TRACK

PRIVATE FARM TRACK

FOR CONTINUATION SEE SHEET 2 OF 10

0 25 50 75 100 125m

SCALE 1:1250

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- PROPOSED CHALK GRASSLAND
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- PROPOSED ATTENUATION BASIN
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- PROPOSED FENCING

REV	DATE	REVISION NOTE	ORIG	CHKD	APPD
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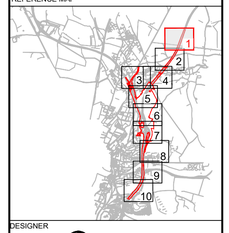
REFERENCE MAP



DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
SHEET 1 OF 10
DOCUMENT REFERENCE: 2.5

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

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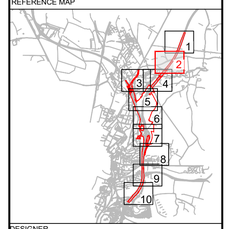

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
SHEET 2 OF 10
DOCUMENT REFERENCE: 2.5

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3002

CART AND HORSES

A33

B3047

A34

RIVER ITCHEN

FULLING MILL

BUSINESS PARK

PROPOSED TIE-IN TO EXISTING FOOTWAY

EXISTING CART AND HORSES JUNCTION CONFIGURATION TO REMAIN

PROPOSED 3m WIDE FOOTPATH AND CYCLE PATH

PROPOSED AMENDMENTS TO EXISTING UNCONTROLLED PEDESTRIAN CROSSING

PROPOSED TIE IN TO EXISTING A33

EXISTING PRIVATE MEANS OF ACCESS TO REMAIN

PROPOSED REALIGNED CENTRAL RESERVE

PROPOSED REALIGNED ACCESS AND EGRESS TO EXISTING BUSINESS PARK

PROPOSED DEDICATED RIGHT TURN LANE

PROPOSED 3m WIDE FOOTPATH AND CYCLE PATH TO UTILISE ABANDONED A33 CARRIAGEWAY

PROPOSED 2m WIDE FOOTPATH LINK TO NUN'S WALK PUBLIC RIGHT OF WAY

EXISTING PRIVATE MEANS OF ACCESS TO REMAIN

PROPOSED 3m WIDE FOOTPATH AND CYCLE PATH TO RUN BENEATH EXISTING A34 SOUTHBOUND VIA EXISTING STRUCTURE

EXISTING A33 TO BE RECONFIGURED TO PROPOSED TWO-WAY (BI-DIRECTIONAL) LAYOUT

PROPOSED VARIABLE MESSAGE SIGN MAINTENANCE BAY

FOR CONTINUATION SEE SHEET 5 OF 10

FOR CONTINUATION SEE SHEET 4 OF 10

0 25 50 75 100 125m

SCALE 1:1250

NOTES

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REV	DATE	REVISION NOTE	ORIG	CHKD	APPD
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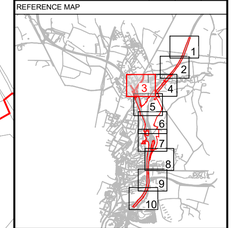

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
SHEET 3 OF 10
DOCUMENT REFERENCE: 2.5

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3003

RIVER ITCHEN

RIVER ITCHEN

RIVER ITCHEN

RIVER ITCHEN

RIVER ITCHEN

RIVER ITCHEN

FULLING MILL

M3

FOR CONTINUATION SEE SHEET 2 OF 10

EXISTING M3 NORTHBOUND CARRIAGEWAY

EXISTING M3 SOUTHBOUND CARRIAGEWAY

FOR CONTINUATION SEE SHEET 3 OF 10

PROPOSED TIE-IN TO EXISTING M3 NORTHBOUND

LONG WALK

PROPOSED TIE-IN TO EXISTING LONG WALK

FOR CONTINUATION SEE SHEET 5 OF 10

0 25 50 75 100 125m

SCALE 1:1250

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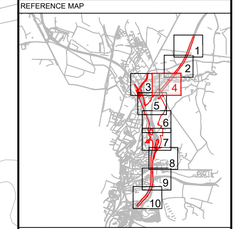
0	NOVEMBER 2022	APPLICATION SUBMISSION	GP	LC	MF

REFERENCE MAP



DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
SHEET 4 OF 10
DOCUMENT REFERENCE: 2.5

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3004

RIVER ITCHEN

FOR CONTINUATION SEE SHEET 3 OF 10

PROPOSED TIE-IN TO EXISTING A34 NORTHBOUND

PROPOSED TIE-IN TO EXISTING A34 SOUTHBOUND

EXISTING CARRIAGEWAY BRIDGE UTILISED FOR PROPOSED ROAD LAYOUT DESIGN

PROPOSED 3m WIDE FOOTPATH AND CYCLE PATH

PROPOSED RETAINING WALL

EXISTING CARRIAGEWAY BRIDGES UTILISED FOR PROPOSED ROAD LAYOUT DESIGN (POSSIBLE REMEDIAL WORKS TO BRIDGES REQUIRED)

PROPOSED RIVER ITCHEN FOOTBRIDGE 3.5m WIDE

PROPOSED SURFACE WATER INFILTRATION AND ATTENUATION BASIN

PROPOSED 2m WIDE FOOTPATH LINK TO EXISTING PUBLIC RIGHT OF WAY

PROPOSED SURFACE WATER ATTENUATION BASIN

PROPOSED SURFACE WATER SWALE

PROPOSED BASIN MAINTENANCE ACCESS

PROPOSED VARIABLE MESSAGE SIGN MAINTENANCE BAY

PROPOSED A33 / M3 NORTHBOUND ONSLIP ROUNDABOUT

PROPOSED RETAINING WALL

PROPOSED BASIN MAINTENANCE ACCESS TRACK

PROPOSED INFILTRATION AND ATTENUATION BASIN

0 25 50 75 100 125m

SCALE 1:1250

RIVER ITCHEN

EXISTING M3 NORTHBOUND CARRIAGEWAY

EXISTING M3 SOUTHBOUND CARRIAGEWAY

PROPOSED TIE-IN TO EXISTING M3 NORTHBOUND

FOR CONTINUATION SEE SHEET 4 OF 10

LONG WALK

PROPOSED CENTRAL RESERVE VEHICLE RESTRAINT SYSTEM

PROPOSED TIE-IN TO EXISTING M3 SOUTHBOUND

PROPOSED M3 NORTHBOUND ON-SLIP

PROPOSED SURFACE WATER SWALE

PROPOSED 0.5m HIGH BUND WITH SWALE

PROPOSED CHALK GRASSLAND TO TIE IN WITH EXISTING GROUND LEVELS

PROPOSED INFILTRATION AND ATTENUATION BASIN

PROPOSED FOOTWAY, CYCLEWAY AND HORSE RIDING ROUTE FROM EASTON LANE TO LONG WALK

PROPOSED M3 SOUTHBOUND OFF-SLIP

FOR CONTINUATION SEE SHEET 6 OF 10

NOTES

Purpose of use

APPLICATION SUBMISSION

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REV	DATE	REVISION NOTE	ORIG	CHKD	APPD
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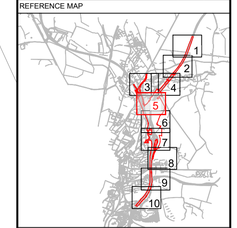


DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
SHEET 5 OF 10
DOCUMENT REFERENCE: 2.5

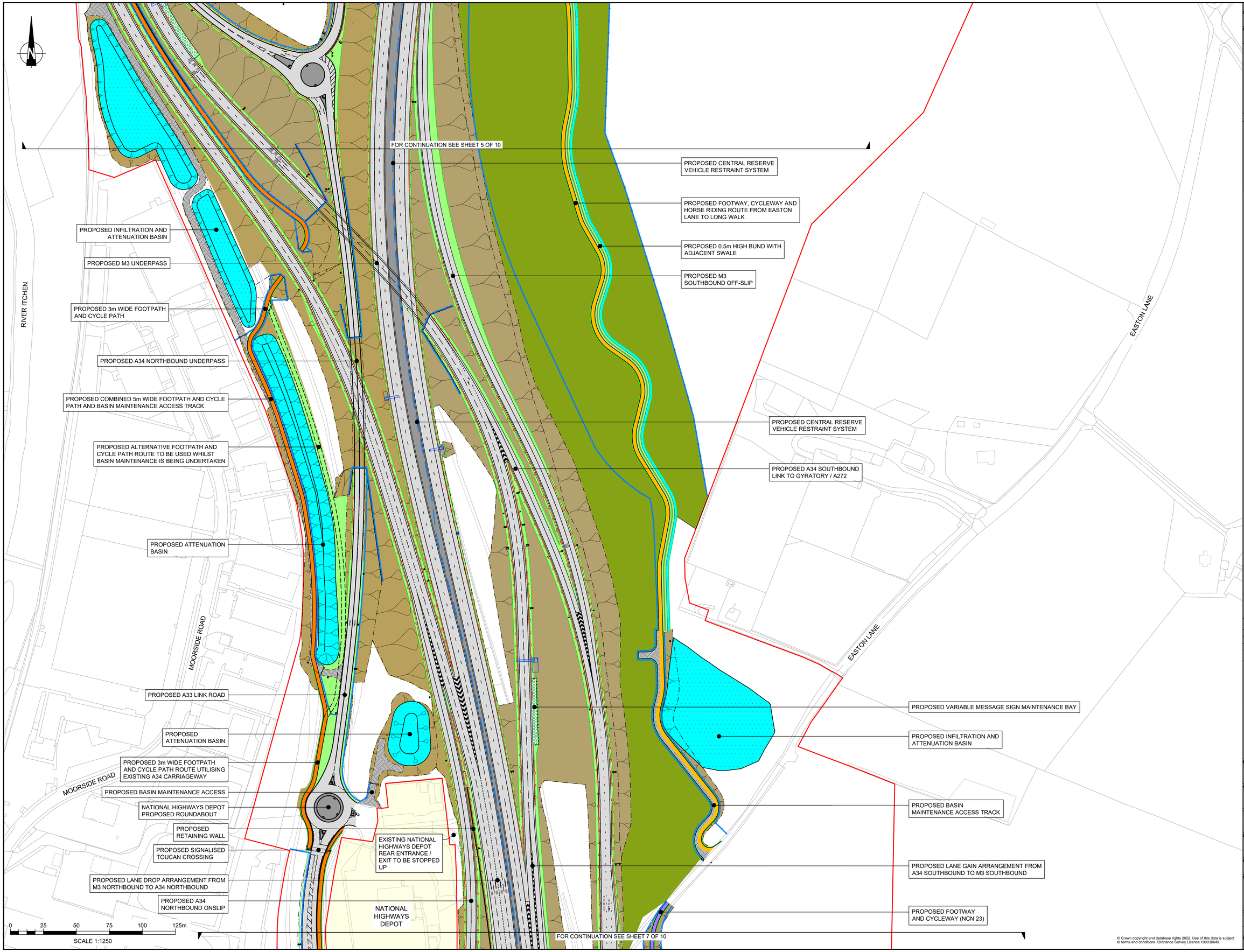
SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3005



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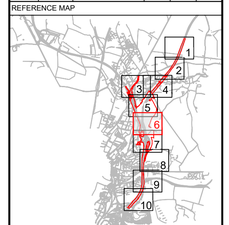

DESIGNER

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VolkerFitzpatrick

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national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
SHEET 6 OF 10
DOCUMENT REFERENCE: 2.5

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3006

MOORSIDE ROAD

NATIONAL HIGHWAYS DEPOT

FOR CONTINUATION SEE SHEET 6 OF 10

PROPOSED LOCATION OF CONSTRUCTION COMPOUND

PROPOSED M3 JUNCTION 9 GYRATORY NORTH BRIDGE

PROPOSED FOOTWAY AND CYCLEWAY (NCN 23)

PROPOSED GYRATORY SUBWAY (NORTH WEST)

PROPOSED HORSE RIDER MOUNTING BLOCKS

PROPOSED GYRATORY SUBWAY (NORTH EAST)

PROPOSED 3m WIDE FOOTPATH AND CYCLE PATH ROUTE

PROPOSED M3 JUNCTION 9 GYRATORY

ROUTE WIDENED TO PROVIDE PROPOSED TURNING FACILITY FOR HORSE RIDERS

PROPOSED DEDICATED LEFT TURN LANE FROM EASTON LANE TO A33

PROPOSED M3 JUNCTION 9 GYRATORY SOUTH BRIDGE ACCOMMODATING FOOTWAY / CYCLEWAY

PROPOSED PEDESTRIAN LINK WITH ASSOCIATED STEPS

PROPOSED REALIGNED A272 CARRIAGEWAY

PROPOSED GYRATORY SUBWAY (SOUTH WEST)

PROPOSED RETAINING WALL

PROPOSED TIE-IN TO EASTON LANE

PROPOSED GANTRY

PROPOSED RETAINING WALL

PROPOSED RETAINING WALL

PROPOSED 3m WIDE FOOTPATH AND CYCLE PATH ROUTE TO TIE INTO EXISTING

INDICATIVE TEMPORARY HAUL ROUTE TO TEMPORARY CONSTRUCTION COMPOUND. EXACT ALIGNMENT TO BE DETERMINED DURING DETAILED DESIGN

EASTON LANE

PROPOSED REALIGNED AND WIDENED M3 CARRIAGEWAYS

PROPOSED TIE-IN TO EXISTING A272

PROPOSED RETAINING WALL

PROPOSED RETAINING WALL

PROPOSED M3 NORTHBOUND OFF-SLIP

PROPOSED CENTRAL RESERVE VEHICLE RESTRAINT SYSTEM

TESCO STORE

PROPOSED A272 TEMPORARY ACCESS / EGRESS LEADING TO PROPOSED CONSTRUCTION COMPOUND

FOR CONTINUATION SEE SHEET 8 OF 10

0 25 50 75 100 125m

SCALE 1:1250

NOTES

Purpose of use

APPLICATION SUBMISSION

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REV	DATE	REVISION NOTE	ORIG	CHKD	APPD
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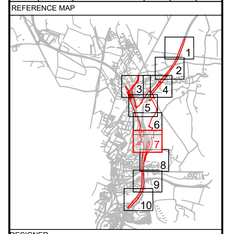

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
SHEET 7 OF 10
DOCUMENT REFERENCE: 2.5

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3007

TESCO STORE

FOR CONTINUATION SEE SHEET 7 OF 10

PROPOSED AUXILIARY LANE MERGE ARRANGEMENT FROM M3 SOUTHBOUND ON-SLIP TO M3 SOUTHBOUND MAINLINE CARRIAGEWAY

PROPOSED TIE-IN TO EXISTING M3 NORTHBOUND

PROPOSED RETAINING WALL

PROPOSED GANTRY

PROPOSED RETAINING WALL

PROPOSED TIE-IN TO EXISTING M3 SOUTHBOUND

ST SWITHUN'S SCHOOL

FOR CONTINUATION SEE SHEET 9 OF 10

ALRESFORD ROAD

0 25 50 75 100 125m

SCALE 1:1250

NOTES

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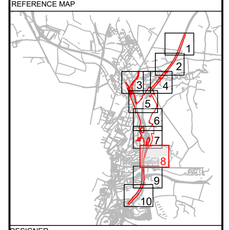


DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
SHEET 8 OF 10
DOCUMENT REFERENCE: 2.5

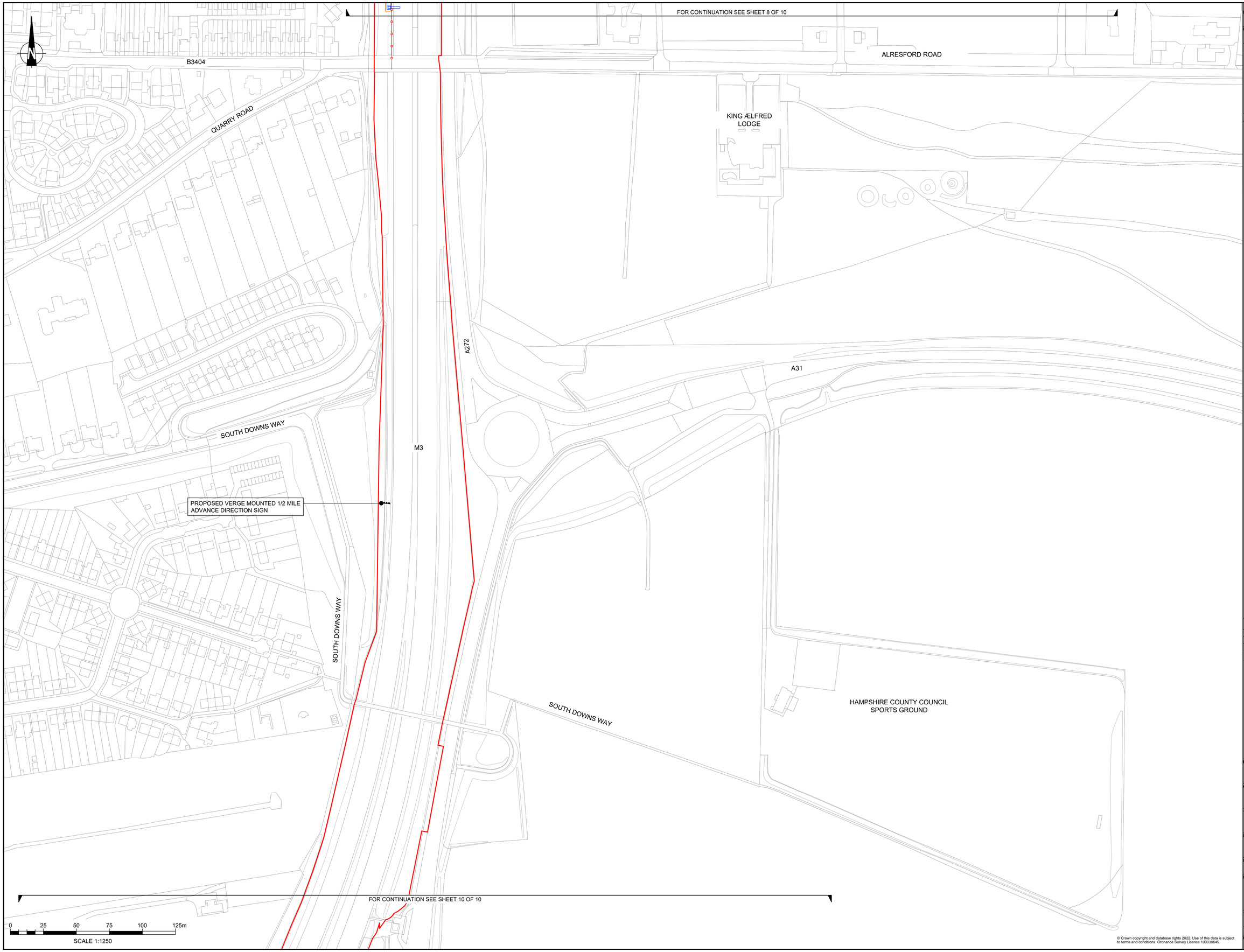
SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3008



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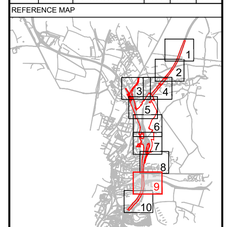

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PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT SCHEME

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

GENERAL ARRANGEMENT PLANS
APFP REGULATION 5(2)(o)
SHEET 9 OF 10
DOCUMENT REFERENCE: 2.5

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3009

FOR CONTINUATION SEE SHEET 9 OF 10

KING GEORGE V PLAYING FIELDS

M3

WINCHESTER BYPASS

PROPOSED VERGE MOUNTED 1 MILE ADVANCE DIRECTION SIGN

CHILCOMB LANE

SOUTHAMPTON

A31

0 25 50 75 100 125m

SCALE 1:1250

NOTES

Purpose of use

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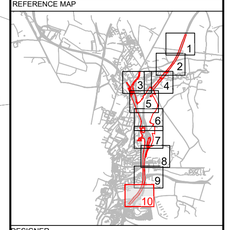

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GENERAL ARRANGEMENT PLANS
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SHEET 10 OF 10
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SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A1	SCALE: 1:1,250	STATUS: REV 0

DRAWING NUMBER

HE551511-VFK-LSI-X_XXXX_XX-DR-ZL-3010

Appendix C Aquatic Ecological Survey Report

M3 Junction 9 Improvements

Aquatic Ecology Survey Report

HE551511-JAC-EGN-0_00_00-RP-LE-0027 | P01
07/08/20

Registered office Bridge House, 1 Walnut Tree Close, Guildford, GU1 4LZ

Highways England Company Limited registered in England and Wales number 09346363

Document Control

Project Manager:	Paul McKay
Originator (Company):	Jacobs
Document Number:	HE551511-JAC-EGN-0_00_00-RP-LE-0027
Rev Number:	P01
Date:	07/08/20
Client Ref Number (PIN):	HE551511
PCF Stage:	3

Document history and status

Revision	Date	Description	By	Check	Review	Approved
P01	07/08/20	FOR REVIEW AND COMMENT	LG	LW	HR	HR

Contents

1. Introduction

1.1 Proposed Scheme

M3 Junction 9 is a key transport interchange which connects South Hampshire and the wider sub-region, with London via the M3 and the Midlands/North via the A34. A significant volume of traffic currently uses the grade separated, partially signalised gyratory (approximately 6,000 vehicles per hour during the peak periods) which acts as a bottleneck on the local highway network and causes significant delay throughout the day. Northbound and southbound movements between the M3 and A34 are particularly intensive, with downstream queues on the northbound off-slip of the M3 often resulting in safety concerns during peak periods.

On 22nd August 2019, post Project Control Framework (PCF) Stage 3 consultation, the M3 Junction 9 Improvements scheme ('the Proposed Scheme') entered a design review period following concerns of risks significant enough to likely impact a successful outcome of a Development Consent Order (DCO) application. The key issues impacting the Proposed Scheme are local stakeholder safety perception concerns, traffic capacity, operational safety and the DCO process.

An integrated design workshop was held on 22nd October 2019 to discuss alternative design solutions for four keys areas, aimed at removing or reducing these risks and issues. The workshop identified various potential design solutions in each of the four key areas which require further investigation to determine:

- Whether there is a permutation of those solutions that leads to a viable option which addresses the risks: and
- What is an adequate and acceptable permutation that leads to a successful DCO application, and also meets project objectives in relation to budget and programme as best as possible?

The recommendation for the Proposed Scheme to proceed with PCF Stage 3 preliminary design in two further phases are detailed below, and were endorsed at a Highways England Major Projects Investment Decision Committee on 16 December 2019.

Highways England commissioned Jacobs in February 2020 to undertake Stage 3A, which involves an assessment of the potential design solutions and a review of the viability of the design solutions, taking cognisance of the key issues identified during PCF Stage 3.

On the basis of the Stage 3A solutions assessment process, the outcome was that Solution 2 was the best performing solution overall and recommended that it be taken forward as the preferred solution for the Proposed Scheme.

Solution 2 included a new Stage 3A Walking Cycling Horse-riding river crossing over the River Itchen Special Area of Conservation (SAC). This requires survey of the watercourses to inform subsequent ecological and Habitats Regulations Assessment (HRA). It should be noted, the existing Scoping Report (Highways England, 2019) states the M3 Junction 9 Improvements scheme has been "specifically designed to avoid any impact on the River Itchen floodplain, thus avoiding the requirement for flood compensation and potential increased environmental mitigation". The new proposed river crossing is not consistent with the Scoping Report and these surveys are therefore considered to be outside of the existing Scoping Opinion from the Planning Inspectorate.

1.2 Site context

The Proposed Scheme is located within the River Itchen Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC). The SAC and SSSI are notified for its classic chalk-stream and river, fen meadows, flood pasture and swamp habitats. The primary reasons for SAC site selection are due to the presence of Annex I habitat watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and Annex II species bullhead (*Cottus gobio*) and Southern damselfly (*Coenagrion mercuriale*). The River Itchen also has the following species present as qualifying features of the site; white-clawed crayfish (*Austropotamobius pallipes*); brook lamprey (*Lampreta planeri*); Atlantic salmon (*Salmo salar*) and otter (*Lutra lutra*).

This Aquatic Habitat Survey focusses on the Annex II species of the River Itchen SAC; bullhead, brook lamprey, Atlantic salmon and otter.

1.3 Purpose of this report and survey objectives

The purpose of these aquatic surveys is to provide a detailed assessment and factual report regarding aquatic habitat suitability for River Itchen SAC species (site selection and qualifying species) to inform and support the M3 Junction 9 Improvement Scheme. The specific aims of the surveys are provided below.

River Itchen SAC Annex II species: fish

- Identify principal flow types within the Study Area;
- Identify substrate types (%) and distribution in the Study Area; and
- Assessment of habitat suitability for bullhead, Atlantic salmon and brook lamprey.

River Itchen SAC Annex II species: otter

- Identify foraging habitat suitable for otter within the Study Area;
- Identify presence, distribution, and abundance of otter, or likely absence in the Study Area; and
- Record the location of any sites used by otter for refuge / shelter / protection and other field signs indicative of activity, should they be present within the Study Area.

1.4 River Itchen SAC species

1.4.1 Fish

Bullhead are protected under Annex II of the European Union Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (the Habitats Directive). Bullhead predominantly occur in stony streams and rivers with moderate flows and cool, oxygen rich waters.

Atlantic salmon are protected under the Salmon and Freshwater Fisheries Act (1975) and under the Water Framework Directive (2000/60/EEC). Atlantic Salmon are a Species of Principal Importance under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006. Salmon require different habitats at different life stages. Clean gravels are required for spawning, and water depth, velocity and substrate size are important factors in the suitability for spawning.

The brook lamprey is the most abundant and widespread of the British lampreys and is often found in the absence of the other lamprey species (river and sea). The adults of brook

lamprey have similar spawning habitat requirements to salmonids; spawning areas must contain suitable refuges and clean spawning gravels but must also be in close proximity to slow flowing areas with sandy/silt substrate to act as ammocoete (larval stage) nursery areas.

Further detailed habitat descriptions of these species of European Importance can be found in the Conserving Natura 2000 Rivers Ecology publications for each species (English Nature, 2008).

1.4.2 Otter

Otters are afforded full protection under the Conservation of Habitats and Species Regulations 2017 (as amended) and the Wildlife and Countryside Act 1981 (as amended) which render the following activities as illegal offences:

- Capture, kill, disturb or injure otters (on purpose or by not taking enough care);
- Damage or destroy a breeding or resting place (deliberately or by not taking enough care);
- Obstruct access to their resting or sheltering places (deliberately or by not taking enough care); and
- Possess, sell, control or transport live or dead otters, or parts of otters.

Otter are also listed as Species of Principal Importance under Section 41 of the NERC Act 2006. Otter are also listed on the Hampshire Biodiversity Action Plan (BAP) (Hampshire Biodiversity Partnership, 1998).

2. Methodology

2.1 Study area

The Proposed Scheme is located at Junction 9 of the M3, centred on grid reference SU 49320 31583, near Winchester, Hampshire. The Proposed Scheme boundary is provided in Figure 1. The aquatic ecology Study area extends along all watercourses for approximately 250m from this.

The Study area includes the River Itchen main channels and smaller tributaries forming part of the River Itchen system; ditches within the water meadow habitats west of the road; and some highways drainage ditches. For the purposes of reporting, each watercourse or section of watercourse has been assigned a code (0XX) as shown in Figure 1. The watercourses have been labelled in this manner to be consistent with the previous otter report (Highways England, 2017).

The south of the Study Area comprises two channels of the River Itchen, connected through several ditches creating a water meadow system. The landscape consists of hay meadows and grazing grasslands, and localised woodland or scrub areas. Based on aerial photography, the north of the Study Area is covered by lowland fens priority habitat and deciduous woodland priority habitat.

2.2 Aquatic habitat mapping

The aquatic habitat mapping survey was carried out by experienced Senior Freshwater Ecologist Alice Shoebridge (CBiol) on 15th and 16th July 2020. Aquatic habitat mapping was carried out within all channels of the River Itchen and its tributaries in the Study Area, where access was permitted and was safe.

Characteristics of the channel and banks were recorded for mapping:

- Substrate composition (boulders, cobbles, pebbles, gravel, sand, silt and overlying silt (%));
- Flow type (for example run, glide, pool, riffle);
- Width and depth;
- Presence of macrophytes, including water crowfoot (*Ranunculus* sp.) communities;
- Bank structure and marginal vegetation (vegetation type and complexity, shading, large woody debris inputs);
- Photography; and
- National Grid Reference.

2.3 Otter survey

The otter survey was undertaken on 15th and 16th July 2020, led by experienced ecologist Emilie Gorse (GCIEEM). The survey comprised a thorough assessment of all suitable water features and terrestrial environs to visually inspect and assess them for their potential to support otter. The following signs of activity were sought: confirmed visual, potential holts and resting places, prints, sprints, urination sites, feeding / prey remains, slides and pathways. Where access was restricted, potential holts / resting areas were viewed from the opposite bank without need to enter the water.

The survey was undertaken during suitable weather conditions, as detailed below in Table 2.1.

Table 2.1 Weather condition during survey

Date	Weather
15th July 2020	Temperature:14°C (start), 18°C (end); Wind: 4 to 6 mph (W to WNW); cloud cover: 100%; rain: none.
16th July 2020	Temperature:16°C (start), 2°C (end); Wind: 7 to 9 mph (NNW); cloud cover: 100% - 50%; rain: none.

2.3.1 Otter resting sites

A description of different otter resting sites (i.e. any site that an otter uses to stop when not engaged in foraging or commuting) is provided in Table 2 2 and is based on Roper & Bassett (2007).

Table 2.2 Description of otter resting sites

Resting Site	Description
Natal holt	Discreet holt site that is used by the female to birth cubs, often on small feeder streams or some distance from water. Mother and cub remain for three months after birth before moving onto secondary holt. Natal holts are extremely difficult to locate without radio-telemetry / long term surveillance as minimal signs of activity except for bedding.
Breeding site	An area of land, or open water and land, large enough to provide a breeding otter with the following: security from disturbance; one or more potential natal den sites; play areas for cubs; no risk of flooding; and access to a good food supply. Breeding sites may be large and are particularly sensitive to disturbance as young cubs are at risk out of the natal holt. Nursery areas within breeding sites show high levels of cub activity, e.g. evidence of play and learning, paths around or over obstacles, flattened patches of vegetation, grooming hollows, spraint stations, signs heaps and feeding remains. Holts in these areas are unlikely to be the primary natal holt where cubs where born.
Non-breeding holt	Cavity or hole in river / ditch bank; can be some distance from water, often within 50m but sometimes much further away. Located in the ground, under tree roots, with rocks or caves, in or under man-made structures. Back of holt cannot be readily seen. Otters may excavate ground if it is soft enough or take over a rabbit warren or sheep lay. Considered of suitable seclusion usually located away from direct disturbance where otter can rest undisturbed for long periods. Active holts contain field evidence such as spraints or prints and may occasionally have bedding material.
Grooming hollow	Depressions from otter cleaning and grooming activity. Often located in soft sand / fine gravel / bracken, although rabbit warrens or old badger setts can be used too.
Couch	Above ground area where otter can lie up / groom. Often a simple swirl or depression in tall grasses or may be covered in grass / bracken / reeds and sometimes contain bedding. In very

Resting Site	Description
	isolated locations, females have been known to birth cubs in some couches although this is considered rare.
Hover	Ledge or similar along bankside used for temporary cover when exiting the water. Distinguishes a site from a secluded holt where they are likely to rest up for long periods (during the day in river systems or at night in coastal areas). Back of the hover can be readily seen, footprints, feeding evidence and/or spraints often visible.

2.3.2 Otter spraints

The most diagnostic field sign left by otter are faecal remains known as spraint. When recorded, these were divided into three categories according to their age as listed below in Table 2.3

Table 2.3 Description of otter spraints

Category	Description
Fresh	Wet spraints likely to have been deposited in the past 48 hours
Recent	Spraints in good condition (i.e. have retained shape and smell) but are likely to have been deposited in the last two weeks
Old	Spraints with a degraded structure and little or no smell are likely to be more than two weeks old

2.4 Limitations

2.4.1 Land access

Access was not granted for the area located to the north of the A34 carriageway and no Public Rights of Way were located in this area. Therefore, the two northern branches of River Itchen (002 and 008), four streams (004, 005, 006 and 007) and the northern under bridge section (001) could not be surveyed. The left bank of the waterbody 032, underneath the A34 carriageway was safely accessed using the Public Right of Way (PRoW) for approximately 35m. Figure 1 gives a summary of the accessible area.

Drainage ditches associated with the A34 (003, 009 and 030) were not accessible for health and safety reasons.

Of the watercourses where land access was permitted, direct access to the entire length of the bank at a number of these watercourses was not available due to factors such as thick scrub/tall herbs, dense reed beds and soft, unstable ground. In these instances, habitat mapping and otter surveys were carried out where access to the river allowed and was safe. This resulted in spot checks along the length of these watercourses.

Inaccessible areas cover approximately 40% of the wider Study Area. As the survey focussed on the southern extents, the lack of data gathered in the northern section is deemed a limitation to the results of this report. Habitat characterisation, substrate and flow mapping is therefore unknown in the northern extents and the resulting suitability of habitat for SAC fish species cannot be assessed in these areas. Otter is considered present in the area north of the Proposed Scheme and further assessment should be conducted in the

northern Study Area. If this is not possible, a suitable precautionary approach to design and construction should be implemented.

2.4.2 Aquatic habitat mapping specific limitations

Some of the watercourses surveyed could only be safely accessed from one bank. In the larger, wider channels, this limited the ability to view substrate composition in localised areas. Estimates were made of substrate complexity where visible. It is considered this limitation does not affect the validity of the data collected or the estimates made.

2.4.3 Otter survey specific limitations

Otters occupy extensive territories of up to 30km – 40km, in which they pursue a semi-nomadic existence exploiting seasonally available food sources (Green et al., 1984). Therefore, some areas within an otter territory may not be surveyed and no field signs being recorded. This will lead to an assumption that otters are not present at a site, when in fact the resident otter is elsewhere and absent from the site in the short term. This limitation should be factored in to any impact assessment produced in the future.

It should be noted that it is not possible to accurately assess the population of otter in an area using the presence of otter spraint (Kruuk et al. 1989). The survey effort and the data gathered, is deemed sufficient to inform an impact assessment for otter, and lack of population assessment is not considered as a limitation.

Most watercourses within the Study Area were accessible for means of survey. However, some sections could not be safely accessed due to dense vegetation and/or unstable ground. It is therefore possible that field signs such as couches and spraints were not recorded in these areas. Inaccessible areas are identified in Appendix C for each watercourse. Should areas of dense reed bed be affected by the Proposed Scheme then alternative survey method should be sought, or suitable precautionary mitigation employed.

A number of drainage ditches located along the verge of the A34 Road (003, 009 and 030) were not accessible for health and safety reasons and are not assessed within this report. The ditches are considered sub-optimal for otter due to their shallow water depth, limited food resources, overgrown vegetation and disturbance from the road. The limitation to the survey is not considered significant as the Proposed Scheme is not likely to affect these habitats.

3. Results and Evaluation

3.1 Aquatic habitat mapping

3.1.1 A34 road crossings: River Itchen

The A34 road crosses the River Itchen at two locations within the Study Area, which will be referred to in this section as the 'north crossing' (NGR SU 49255 31810) and 'south crossing' (NGR SU 49365 31475). At both of these crossings there is a northbound and southbound carriageway. The Proposed Scheme includes a footbridge over the River Itchen, upstream of the south crossing on the River Itchen, which is the focus/scope of this survey. The wider Study Area is covered in Section 3.1.2.

Habitat mapping was successfully carried out at the north crossing downstream of the A34; access upstream was not permitted. The south crossing was surveyed from approximately 35m upstream to the full extent of the Study Area downstream. For the purposes of reporting in this section, approximately 100m downstream is included in the detailed habitat mapping.

Data collected has been produced as two figures; substrate and flow mapping (Figure 2); and habitat suitability mapping (Figure 3) at the north and south crossings. Associated photographs are provided in Appendix A.

Downstream of the north crossing for approximately 100m, the River Itchen ranges from 7m - 10m in width and depths vary; shallow localised marginal areas to depths of approximately 1m mid-channel. Flow type is predominantly glide, with some slack and slow flowing water in marginal areas, mainly amongst in-channel vegetation. Substrate complexity is diverse, including coarse substrates (boulders, cobbles, pebbles, gravel) and dominated by fine substrates (sand). Overlying silt and algal mats were recorded in-channel, reducing exposure of any clean coarse substrates. Slow flows were evident in some marginal areas, causing shallow silt beds to form, often large in places (3m x 1m). Connectivity to the marginal/riparian zone was evident with a complex mix of scrub, tall herbs and trees lining the banks, also providing some in-channel shading. Large submerged beds of bur-reed (*Sparganium emersum*) were noted, covering approximately 85% of the channel.

Upstream of the south crossing (approximately 35m), large swathes of bur-reed and common club rush (*Schoenoplectus lacustris*) were noted in-channel across the width, which was approximately 15m. Mid-channel the depth was estimated to be approximately 1m, with a typical glide habitat; marginal areas had slower flowing water and silt deposits. Substrates reflected the flow of the River Itchen, with clean coarse substrates present in small quantities, but a predominantly sand based substrate (70%). Immediately upstream of the bridge on the left bank, a silt bed approximately 4m x 2m had formed, adjacent to which was a section of clean gravels. The banks were heavily modified with concrete walls, with some simple vegetation. The right bank was not visible.

Underneath the south A34 crossing road bridge, the channel has been heavily modified with concrete lined banks and in-channel structural bridge supports. Macrophytes were not present due to heavy shading from the structure. Although coarse substrates were evident, overlying silt covered much of the channel on the left bank, and large silt deposits were noted on the right bank underneath the northbound carriageway. The River Itchen was deep (>1m) and slow flowing underneath the bridges. Between the northbound and southbound carriageway, there was approximately 30m of watercourse not shaded by the bridge structures. Pebbles and gravel were recorded with overlying silt and filamentous algae in localised sections. Depth was approximately 1m, a glide habitat and some in-stream macrophytes recorded; the channel here was shaded by overhanging trees on the banks.

Downstream of the A34 south crossing, velocities increased from upstream to form a faster flowing glide habitat. The channel was deep (1m – 2m) and wide (20m) with localised in-stream macrophytes within a largely open channel. After the modified banks forming part of the bridge structure, the banks become more naturalised with complex vegetation including sections of reedbeds. Substrates were diverse, with a mixture of boulders, cobbles, pebbles, gravels and sand. Overlying silt was evident in those visible sections where water depth permitted.

3.1.2 Wider study area

The wider Study Area compromises all other watercourses that were successfully visited in the Study Area downstream of the A34 (watercourses 010-020, 022-028). Four watercourses were not accessible; 021, 029, 030 and 031. As described in Section 2.4, access to each watercourse varied, and not all had accessible banks along the entirety of the reach. Where this was the case, spot checks were undertaken as and when access was safe.

A detailed description of the in-channel habitat and bank characteristics with associated photographs is provided in Appendix B. An evaluation of the suitability of the habitat in the wider Study Area is provided in Section 4.

3.2 Otter survey

3.2.1 Summary of 2017 survey results

The previous otter survey (Highways England, 2017) confirmed the presence of otter presence along the River Itchen. Evidence of two potential resting places with spraints were noted on artificial structures under the road bridges crossing the River Itchen. All of the watercourses surveyed were also noted as having suitable habitat features for otter resting places.

3.2.2 2020 Survey results

Thirty-two waterbodies or section of waterbodies were identified. Twenty-one watercourses or sections of watercourses were surveyed in 2020 along the River Itchen. As detailed in Section 2.4.3, the remaining 11 waterbodies or sections of waterbodies were not surveyed due to lack of access or presence of dense vegetation (reed bed).

All watercourses surveyed have suitable habitat features for otter resting places and offer suitable commuting opportunities for otters (see Appendix C). No confirmed holts were recorded during the otter survey. Appendix D presents a summary of the results of otter field signs identified in 2017 and 2020. A summary of the survey findings is presented in Table 3.1.

Evidence of American mink (*Neovison vison*) was recorded by the footbridge along watercourse 013 with the presence of five mink scat, including two fresh scats (see Figure 4). A well-used run was also noted nearby between watercourses 017 and 013.

Fresh and dried spraints, and confirmed couches were identified to the west of the A34 carriageway along the River Itchen and connecting ditches (watercourses 010, 017, 018 and 022), within the water meadow habitat. Evidence of otter was also found on natural banks of the watercourses, within the reed cover and within grassy section of the banks; as well as under footbridges (see Figure 4).

Table 3.1 Summary of otter survey results

Watercourse ID	Spraints	Couch	Habitat Description
010	Yes - Fresh	Yes	River Itchen, 5 to 10m wide, slow flow with areas of reedbed / scrub on the left bank and thin strip of managed reed on the right bank offering cover to otters.
013	No	Yes	Ditch flowing parallel to River Itchen with developed bank cover formed of dense reed species.
017	Yes – Dry	Yes	Short and fast flowing section between 010 and 013, managed by a sluice. Banks covered by grass species maintained short by management and grazing.
018	Yes - Dry	Yes	Ditch flowing slowly between the two branches of the River Itchen. Both banks densely covered by reed species.
022	Yes - Dry	Yes	Branch of the River Itchen, partly bordered by a PRoW on the right bank. Presence of large reedbed on the left bank, by the A34 carriageway, and thin reed cover along its banks.

The majority of the habitats associated with the River Itchen system were considered suitable for otter foraging, resting, commuting and breeding purposes. The Study Area offers suitable food resources (large fish were observed during the survey), hydrological connectivity and vegetative cover such as dense reed bed, scrub and small areas of deciduous woodland. A summary of the habitat suitability and its potential for otter resting places for each watercourse/section of watercourse is presented in Appendix C.

Although no further signs were noted during the survey, all watercourses in the Study Area are considered suitable for foraging and commuting purposes due to the abundance and connectivity of suitable riparian habitat.

4. Discussion

4.1 Evaluation of habitat suitability for River Itchen SAC fish species

The River Itchen SAC is noted for its chalk stream habitat; high quality base-rich clear waters and as a result is characterised by an abundance of diverse flora and fauna.

The qualifying River Itchen SAC fish species require specific habitat for spawning and/or juvenile life-stages. Bullhead fish are nest-builders and require clean gravels/pebbles for spawning and clean cobble/pebble/gravel substrates as adults, with variable flow preferences. Brook lamprey require clean gravel/pebble substrates for spawning with good flows adjacent to nearby deep silt beds for larval (ammocoete) development. These fish species perform localised migrations between reaches foraging for food and spawning habitats. Atlantic salmon are similar to brook lamprey in their preference for spawning habitat but require fast flows and well oxygenated water. Atlantic salmon are migratory species, moving from the marine environment to the freshwaters of the River Itchen for spawning.

Substrate diversity within river ecosystems is correlated with increased diversity of flora and fauna due to the increase in niches available for colonisation by different species with different habitat preferences. Although the bed at the crossing points is diverse, comprising a mixture of boulders, cobbles, pebbles, gravels, sand and silt, it is largely dominated by sand. Sand is a fine substrate material which is more easily shifted by channel velocities than the coarser substrates. Although sand provides habitat for some species, it is not preferred by any of the SAC fish species for spawning or during adult life-stages. In addition, the coarse substrates (boulders, cobbles, pebbles and gravel) which were present were often covered in overlying silt. This condition of the riverbed is not preferred by bullhead, brook lamprey or Atlantic salmon whom prefer clean gravels.

Therefore, the habitat surveyed within the River Itchen at both of the existing A34 road crossings is considered unsuitable spawning habitat for bullhead, brook lamprey and Atlantic salmon. Although substrates are diverse, encompassing a mixture of coarse and fine substrates, the substrate is dominated by sand, with overlying silt smothering those coarse substrates in several areas. Flow is homogenous and immediately upstream and downstream of the bridges and underneath the bridges the banks are modified and un-natural. It is therefore assumed that adult salmon and indeed bullhead and brook lamprey moving through the River Itchen system would move through this section of the river to find preferable spawning/habitat upstream. It is considered the Atlantic salmon spawning grounds are likely to be (preferentially) in the chalk stream tributaries of the upper catchment.

One localised section, approximately 4m x 2m immediately upstream of the south crossing on the left bank was a deep silt bed with adjacent clean gravel substrates (Figure 3, Sheet 2). Although the presence of clean gravel substrates suggests optimum spawning habitat for the SAC fish species, flows were sub-optimal. However, the large silt bed is considered optimum for juvenile (ammocoete) brook lamprey development.

There are a number of watercourses in the wider Study Area which are linked to the River Itchen, several through hatches. Downstream of the south crossing, a number of these watercourses were dry and/or not visible. Of those that could be observed, habitat is considered sub-optimal for the SAC fish spawning; homogeneity of flows and sand and silt present in large abundances. Watercourse 017, which links the River Itchen to the other smaller channels in the Winnall Moor nature reserve was approximately 10m of run habitat, with clean coarse substrates, predominantly boulders and cobbles. Although fast flows were evident, substrate composition was considered unsuitable for optimum fish spawning habitat for SAC species.

Downstream of the A34 north crossing, watercourse 023 is considered the 'main' channel in this area, with smaller watercourses feeding in. Watercourses 023 and 024 were wetted, whilst the remaining watercourses were either dry or not visible. Although watercourse 023 was sinuous with good lateral connectivity to complex margins, flow was not diverse. Coarse substrates were visible however, a thin layer of overlying silt covered much of the channel. Thicker silt deposits were recorded downstream of the confluence with watercourse 024. As such, it is considered sub-optimal habitat for the River Itchen SAC qualifying fish species. Watercourse 024 was considered unsuitable for fish spawning habitat for bullhead, brook lamprey and Atlantic salmon. The channel had no perceived flow and had 100% macrophyte cover, restricting light penetration.

4.2 Evaluation of otter survey results

The results show that evidence of otter presence has been recorded within the two channels of the River Itchen during two survey seasons i.e. 2017 and 2020. Both channels show evidence of otter during both survey seasons which suggest the regular and continued use of the habitat by otters.

4.3 Conclusion

4.3.1 Aquatic habitats

The River Itchen and associated watercourses were successfully surveyed downstream of the A34 road crossings, and approximately 35m upstream of the south crossing. Detailed aquatic habitat mapping of flows and substrates were recorded to inform habitat suitability for bullhead, Atlantic salmon and brook lamprey; qualifying feature species of the River Itchen SAC.

It is considered habitat is sub-optimal for these species within the Study Area. Flows are homogenous, comprising of a glide habitat with lack of riffle-run sequences. This is reflected in the substrate composition, which although is diverse, is dominated by sand substrates and overlying silt in large reaches. Where pockets of clean cobbles/pebbles/gravels were visible, the flow/velocity of the water is sub-optimal habitat for spawning, for all three species.

Larval (ammocoete) development of brook lamprey require deep silt beds near clean gravels for spawning. One large deep silt bed (4m x 2m) was recorded upstream of the A34 south crossing and is considered optimum habitat for brook lamprey larvae (Figure 3, Sheet 2).

Localised movement of fish within reaches and tributaries of the River Itchen occurs as fish forage and search for spawning habitat. Atlantic salmon migrate large distances from the marine environment to reach suitable spawning habitat in freshwaters. It is considered Atlantic salmon and to a lesser extent bullhead and brook lamprey, will pass through the Study Area to find suitable spawning/foraging/resting habitat.

The River Itchen at the north A34 crossing, upstream of the northbound carriageway was not surveyed due to land access. Upstream of the A34 (both crossings) in the wider Study Area, access was also not granted. Therefore, the habitat suitability for bullhead, brook lamprey and Atlantic salmon have not been assessed in these locations.

4.3.2 Otter

Otter presence was confirmed in the Study Area with evidence of spraints, dry and fresh, and confirmed resting places recorded along the main channels of the River Itchen and its tributaries. It is considered the majority of the habitats associated with the River Itchen system is suitable for otter foraging, resting, commuting and breeding purposes.

The Study Area offers suitable food resources, hydrological connectivity and vegetative cover such as dense reed bed, scrub and small areas of deciduous woodland. No confirmed holts were recorded within the Study Area although the non-accessible sections of the Study Area (i.e. northern area), dense vegetation presents suitable habitat opportunity for such purposes. Upstream of the A34 (both crossings) in the wider Study Area, access was also not granted. Therefore, the otter activity has not been assessed in these locations.

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Figures

N

LEGEND

- Red Line Boundary
- Survey area
- Access granted and watercourse surveyed
- No access granted watercourse not surveyed

0 250 500 1,000 1,500 m

SCALE 1:15000

KEY PLAN

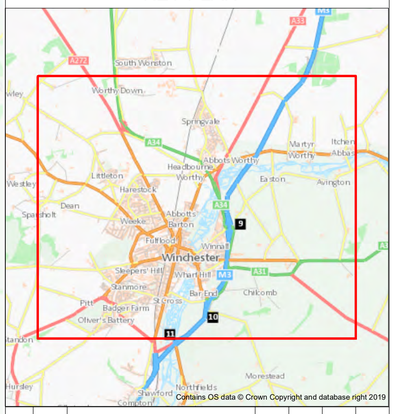

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FIGURE 1
STUDY AREA AND
WATERCOURSE LOCATIONS

DRAWING UNITS U.N.O.
ALL DIMENSIONS IN METRES UNLESS STATED OTHERWISE

SCALE AT A1 (841 x 594mm)
1:15000

DRAWING No.
HE551511-JAC-EGN-0_00_00-DR-GI-0042

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P01

\\Gbrmcdfs\v01\GIS\B229\H160_M3J9\ArcGIS\MXDs\Adhoc Plans\B229H160_001_Rev0_OtterStudyArea.mxd

N

Substrates:
cobbles 10%
pebbles 10%
gravels 30%
sand 50%

Substrates:
pebbles 10%
gravels 20%
sand 70%

Not visible

Substrates:
boulders 5%
cobbles 5%
pebbles 20%
gravels 35%
sand 35%

Winchester By-Pass

A34

\\Gbrmcdfs01\GIS\B229\ti180_M3J9\ArcGIS\Ecology\SAC_Survey\M3_J9_A1_SAC_Substrates.mxd

LEGEND

- Proposed Scheme Extent
- Silt + slow flow habitat
- Pockets of clean gravel
- Overlying silt
- Algal mats
- Glide habitat

0 5 10 20 30 m

SCALE 1:300

KEY PLAN

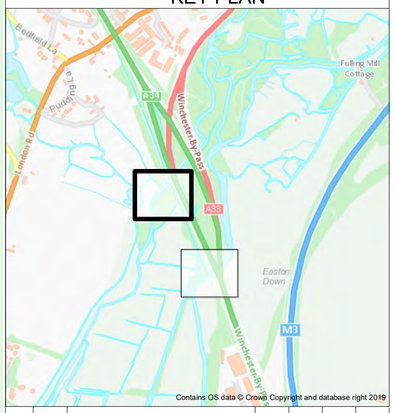

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FIGURE 2
SUBSTRATE AND FLOW MAPPING
- RIVER ITCHEN

Sheet 1 of 2

DRAWING UNITS U.N.O.
ALL DIMENSIONS IN METRES UNLESS STATED OTHERWISE

SCALE AT A1 (841 x 594mm)
1:300

DRAWING No.
HE551511-JAC-EGN-0_00_00-DR-GI-0043

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N

Winchester By-pass

Substrates:
pebbles 50%
gravels 50%

Substrates:
boulders 5%
cobbles 5%
pebbles 35%
gravels 35%
sand 20%

Substrates:
boulders 2%
cobbles 5%
pebbles 3%
gravels 20%
sand 70%

Not visible

Substrates:
pebbles 20%
gravels 20%
sand 60%

Substrates:
boulders 40%
cobbles 10%
pebbles 20%
gravels 15%
sand 15%

Substrates:
boulders 5%
cobbles 30%
pebbles 20%
gravels 30%
sand 15%

Substrates:
cobbles 2%
pebbles 3%
gravels 40%
sand 55%

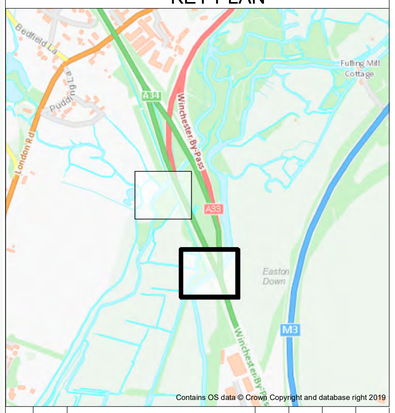
LEGEND

- Proposed Scheme Extent
- Silt + slow flow habitat
- Gravel
- Glide habitat

0 5 10 20 30 m

SCALE 1:300

KEY PLAN



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DRAWING TITLE

FIGURE 2
SUBSTRATE AND FLOW HABITAT
- RIVER ITCHEN

Sheet 2 of 2

DRAWING UNITS U.N.O.
ALL DIMENSIONS IN METRES UNLESS STATED OTHERWISE

SCALE AT A1 (841 x 594mm)
1:300

DRAWING No.
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P01

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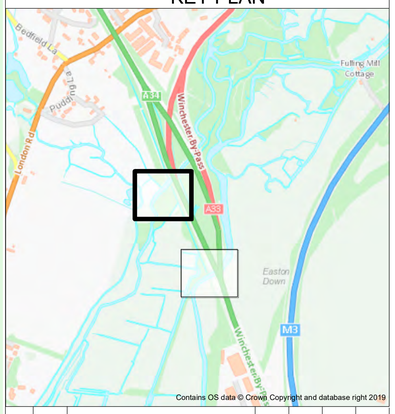
LEGEND

- Proposed Scheme Extent
- Lamprey Ammocoete (larval) habitat
- Sub - optimal habitat
- Poor / unsuitable habitat

0 5 10 20 30 m

SCALE 1:300

KEY PLAN



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DRAWING TITLE

FIGURE 3
HABITAT SUITABILITY FOR QUALIFYING FEATURE FISH SPECIES - RIVER ITCHEN
Sheet 1 of 2

DRAWING UNITS U.N.O.
ALL DIMENSIONS IN METRES UNLESS STATED OTHERWISE

SCALE AT A1 (841 x 594mm)
1:300

DRAWING No.
HE551511-JAC-EGN-0_00_00-DR-GI-0045

REV.
P01

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LEGEND

- Proposed Scheme Extent
- Lamprey Ammocoete (larval) habitat
- Sub - optimal habitat (gravel bed)
- Poor / unsuitable habitat

0 5 10 20 30 m

SCALE 1:300

KEY PLAN

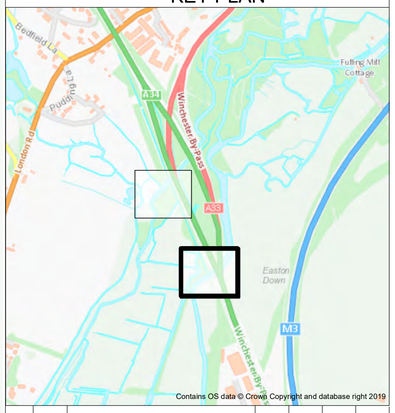

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FIGURE 3
HABITAT SUITABILITY FOR QUALIFYING FEATURE FISH SPECIES - RIVER ITCHEN
Sheet 2 of 2

DRAWING UNITS U.N.O.
ALL DIMENSIONS IN METRES UNLESS STATED OTHERWISE

SCALE AT A1 (841 x 594mm)
1:300

DRAWING No.
HE551511-JAC-EGN-0_00_00-DR-GI-0046

REV.
P01

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N

LEGEND

- Red Line Boundary
- Survey area
- Access granted and watercourse surveyed
- No access granted watercourse not surveyed
- Confirmed couch
- Spraint
- Mink scat
- Otter footprint

0 50 100 150 200 m

SCALE 1:2000

KEY PLAN

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd
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FIGURE 4
OTTER SURVEY RESULTS

DRAWING UNITS U.N.O.
ALL DIMENSIONS IN METRES UNLESS STATED OTHERWISE

SCALE AT A1 (841 x 594mm)
1:2000

DRAWING No.
HE551511-JAC-EGN-0_00_00-DR-GI-0047

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P01

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Appendix A. Aquatic Habitat Mapping: A34 Road Crossings

Table A.1 Photographs of the A34 north crossing of the River Itchen - Downstream

North crossing – downstream of the A34 road bridge (SU 49200 31759; northbound carriageway) – River Itchen		
		

Table A.2 Photographs of the A34 south crossing of the River Itchen

South Crossing – upstream of the A34 road bridge (SU 49409 31513; southbound carriageway) – River Itchen		
		
South Crossing – below the A34 road bridge (SU 49402 31492; southbound carriageway) – River Itchen.		
		

South Crossing – in-between the A34 road bridges (SU 49367 31471; northbound and southbound carriageways) – River Itchen
 
South Crossing – below A34 road bridge (SU 49357 31469; northbound carriageway) – River Itchen


South Crossing – downstream A34 road bridge (SU 49339 31449; northbound carriageway) – River Itchen
 

Appendix B. Aquatic Habitat Mapping: Wider Survey Area

Table B.1 Aquatic habitat descriptions of watercourses downstream of the A34 road crossing

Watercourse Number	Description	Photograph
010 – River Itchen	The south A34 road crossing of the River Itchen (downstream) is covered in detail in Section 3.1. Downstream of the road crossing (>100m), the River Itchen was accessible on the right bank in the scope of the Study Area, which equates to approximately 500m downstream of the road bridge. The river is wide (approximately 15m) throughout this reach and meanders gently through a landscape dominated by grassland and hay meadows. The banks of the channel are dominated by reeds (*Phragmities australis*/*Phalaris arundinacea*) on the left bank and tall herb rank on the right bank. The reach is a series of run-glide complexes and heterogenous flows: a series of shallow mid-channel sections dominated by run habitat and large water crowfoot (*Ranunculus* sp.*)* beds (<1m deep) followed by sections of glide habitat and deeper water (>2m) where submerged bur reed (*Sparganium emersum)* beds were noted. Substrate where visible is dominated by coarse materials (cobbles, pebbles with localised areas of gravel) and small areas of sand. There is a greater abundance of sand in large sections along the marginal areas of the left bank. Marginal areas were generally deep (>0.75m), but in localised areas, the marginal area shelved gently to the mid-channel, creating visible cobble and pebble beds in the shallow margins. This reach of the River Itchen would be described as classic chalk-stream habitat.	

Watercourse Number	Description	Photograph
011 and 012	Watercourse 011 and 012 are small drains located within the grassland and hay meadows. These watercourses were dry at the time of survey.	
013	The character of the channel changes as the watercourse flows from north to south. In the northernmost reach, nearest the A34 carriageway, the watercourse is ponded, with no perceived flow and visible duckweed (*Lemna* sp.) on the surface. The channel is heavily shaded by trees, tall herbs and reedbed stands. A large silt bed section was identified upstream of the small hatched channel off the River Itchen on the left bank (watercourse 017), this silt bed is exposed due to low flows. The channel is approximately 6m wide with glide habitat on the right bank and slack on the left bank.	

Watercourse Number	Description	Photograph
	Downstream of the small hatch channel (watercourse 017) the watercourse is approximately 4m-5m wide, with varying depths of <1m, and sections of mid-channel >1m. The glide habitat provides continuous movement of water throughout the channel. Substrate is composed predominantly of sand throughout this reach, with localised areas of cobbles, pebbles and gravel. Submerged macrophytes were present providing in-stream habitat for aquatic fauna.	
014 and 015	These watercourses were not visible – access was restricted by dense reedbed vegetation on both banks.	

Watercourse Number	Description	Photograph
016	This watercourse was not visible due to dense reedbeds on both banks.	

Watercourse Number	Description	Photograph
017	This watercourse reach is approximately 10m in length, controlled by a hatch from the River Itchen (watercourse 010) joining to watercourse 013. This reach has vegetated banks, is approximately 1.5m wide and 0.3cm – 0.75cm depth. Habitat is defined as a run and substrates reflected this with lack of fine sediments and dominated by boulders, cobbles and pebbles.	

Watercourse Number	Description	Photograph
018	The watercourse was accessible by spot checks only due to the dense reedbed on both banks. Where visible, the channel is approximately 2m – 5m wide with shallow margins (<50cm) and deeper mid-channel sections (0.5m - 1m). Substrate composition varied throughout the reach, with spot checks indicating predominantly sand and gravel at the east extent to predominantly gravel and to a lesser extent cobbles, pebbles and sand. The easterly extent of this watercourse flows from the River Itchen (watercourse 022).	
019	Small watercourse which flows into watercourse 013. No perceived flow, dense common reed on right bank and scrub/tall herbs on left bank. Glide habitat and where substrates visible comprised of gravel and pebble. Width is approximately 6m, depth could not be judged due to visibility.	

Watercourse Number	Description	Photograph
020	Small drain which flows into watercourse 018 from watercourse 022. Substrate not easily visible due to safe access; thought to be predominantly sand and some gravel. Large sedge (C*arex* sp.) and reedbed stands on left bank and reedbed along right bank. Flow type described as a slow glide, approximately 2m wide with shallow margins and deep pools (>50cm).	
022 – River Itchen	The north A34 road crossing of the River Itchen (downstream) is covered in detail in Section 3.1. Downstream of the A34 crossing (>100m), the River Itchen habitat would be described as a classic glide; a large body of slow to medium flowing water. The channel is roughly 10m wide and 1m deep. The banks are composed of complex vegetation including reedbed, sweet-grass *(Glyceria* sp.), willowherb (*Epilobium hirsutum)*, starwort (*Callitriche* sp.), fool's watercress (*Apium* sp.*),* sweetflag *(Iris* sp.) and other tall herbs. Macrophytes including *Callitriche* sp. and bur reed (*Sparganium emersum)* were present in the channel. Substrates were visible and compromised predominantly sand, and to a lesser extent gravels, cobbles, pebbles and boulders. Some marginal areas had localised patches of 100% sand substrate (approx. 3m x 1m).	

Watercourse Number	Description	Photograph
	As above	
023	Watercourse 023 is a sinuous watercourse flowing through grassland landscape, with a series of connecting ditches and wetland areas. The channel is homogenous; a slow glide is prevalent throughout the reach, interspersed with deeper areas (<1m) and shallow margins. River width is approximately 3m -5m, and the sinuous channel is bordered by vegetated banks including species such as fool's watercress (*Apium* sp.), bur-reed (*Sparganium erectum)* and sweetgrass (*Glyceria* sp.). Evidence of duckweed (*Lemna* sp.) and starwort *(Callitriche* sp.) were present in-stream. Substrates recorded upstream of the confluence with watercourse 024 in the mid-channel are a broad mix of coarse and fine substrates (boulders, cobbles, pebbles, gravel and sand). Silt was recorded in the marginal areas of slow water on meanders, sometimes in large areas (2m x 4m); these areas were a mixture of silt beds and overlying silt. Downstream of the confluence with watercourse 024, the bed becomes silt dominated and the channel slow flowing. Width is approximately 3m, with complex marginal vegetation but no in-stream macrophytes. Depth is 0.5m – 0.7m and although the water was moving, it was slower than a glide.	

Watercourse Number	Description	Photograph
	As above	
024	Small drain located in a grassland field. It was dry at time of survey.	

Watercourse Number	Description	Photograph
025	A small ditch flowing through grassland. Approximately 1m wide with no perceived flow. Surface covered by 98% algae. Substrates and depth not visible.	
026	An overgrown small ditch which was not clearly visible; approximately <1cm of water.	

Watercourse Number	Description	Photograph
027	This ditch-like watercourse was overgrown with vegetation and not accessible.	
028	No access to the watercourse; right bank was overgrown with vegetation and the left bank had a field of young bullocks and it was not safe to enter.	

Appendix C. Otter Habitat Descriptions

Table C.1 Otter habitat descriptions for the watercourses

Waterbody ID	Waterbody type	Habitat Description	Opportunities for Resting and Breeding	Limitations
003	Drainage ditch	Dry highway drainage located between the northbound and southbound of the A34. Surrounded by scrub and trees offering cover, the dry drainage is highly disturbed by surrounding carriageways.	Sub-Optimal.	-
010	River	Southern section of the main River Itchen channel bordered by permanent grassland (right bank), wetland and scrub vegetation (left bank). The section starts after crossing the A34 bridge structure. Both banks are densely covered by common reed and yellow iris, regularly managed and sparsely cut down	Optimal.	No access to the left bank due to dense vegetation (common reed and scrub).
011	Ditch	Dry ditch located within a grazing grassland. Area identified as a temporary wetland area with shallow banks.	Unsuitable.	-
012	Ditch	Dry ditch located within a grazing grassland. Area identified as a temporary wetland area with shallow banks.	Unsuitable.	-
013	Ditch	Ditch bordered by hay meadow and grazing grassland with dense cover of common reed. Presence of footbridge with space underneath for passage and resting of riparian species.	Sub-optimal. Dense common reed cover and footbridge offering suitable resting places.	-
014	Ditch	Ditch surrounded by hay meadow and densely covered by common reed. Presence of footbridge.	Sub-optimal. Dense common reed cover and footbridge offering suitable resting places.	-

Waterbody ID	Waterbody type	Habitat Description	Opportunities for Resting and Breeding	Limitations
015	Ditch	Ditch surrounded by hay meadow and densely covered by common reed.	Sub-optimal. Dense common reed cover offering suitable resting places.	-
016	Ditch	Ditch surrounded by hay meadow and densely covered by common reed. Presence of footbridge.	Sub-optimal. Dense common reed cover and footbridge offering suitable resting places.	-
017	Ditch	Short ditch flowing fast from the River Itchen towards 013 and managed by a sluice. Presence of footbridge with underneath space.	Sub-optimal.	
018	Ditch	Ditch located at the boundary between grassland fields managed for cattle and hay. Banks covered in dense common reed. Presence of a footbridge with underneath space, pebbled area and scrub where the ditch is connected to 022.	Sub-optimal. Presence of various features offering suitable resting places.	-
019	Ditch	Sluggish end of the ditch densely covered by scrub and located along the northbound of the A34. Presence of dense common reed on right bank.	Sub-optimal. Scrub offering cover for potential resting place or holt, disturbance from highway (noise) and cattle would limit use of the drainage ditch.	No access to most of the ditch due to dense vegetation.
020	Ditch	Ditch located between a wetland area and a permanent grassland. Shallow banks densely covered by common reed which are managed and cut on the left bank.	Sub-optimal. Dense common reed cover offering suitable resting places.	No access to right (north) bank due to dense cover of common reed.
022	River	Section of the River Itchen located in the southern area from the A34. The banks of the river are shallow and offered different type of habitats including areas of dense common reed as well as trees and scrub vegetation. The River Itchen	Optimal.	No access to the bridge under the A34 and to a stretch of the left bank of the river due to the

Waterbody ID	Waterbody type	Habitat Description	Opportunities for Resting and Breeding	Limitations
		is connected to several ditches, creating a large water meadow. Presence of footbridges with large underneath space.		presence of a wetland area, south of the A34 bridge.
023	River	River flowing towards River Itchen through grassland and connected to several ditches and a wetland area. Shallow banks with presence of riparian vegetation including occasional trees and scrubs, as well as emergent vegetation along the bank toes and within the river bed. Presence of footbridges with underneath space.	Optimal.	No access to the left bank in the northern section (up to the PRoW). Limited access in the southern section due to dense vegetation.
024	Ditch	Dry ditch along boundaries between a permanent grassland and an arable field. Covered by overgrown scrub vegetation.	Sub-optimal. Scrub and presence of trees offering cover for potential resting place or holt.	Limited access due to dense vegetation.
025	Ditch	Wet and stagnant ditch within permanent grassland. No cover provided on the banks.	Unsuitable.	-
026	Ditch	Wet ditch covered by dense common reed and trees on both banks.	Sub-optimal. Presence of tree roots offering potential resting place or holt.	Limited access due to dense vegetation.
027	Ditch	Wet ditch flowing through permanent grasslands and covered by overgrown and dense scrub.	Sub-optimal. Scrub offering cover for potential resting place or holt.	Limited access due to dense vegetation.
028	Ditch	Ditch flowing through permanent grasslands and covered by overgrown and dense scrub vegetation.	Sub-optimal. Scrub offering cover for potential resting place or holt.	Limited access due to dense vegetation and presence of bulls in field.

Waterbody ID	Waterbody type	Habitat Description	Opportunities for Resting and Breeding	Limitations
029	Drainage	Dry drainage along the northbound embankment of the A34 and covered by overgrown and dense scrub vegetation.	Sub-optimal. Scrub offering cover for potential resting place or holt, disturbance from highway (noise) and nearby PRoW would limit use of the drainage channel.	Limited access due to dense vegetation.
032	River	Section of River Itchen under A34 northbound and southbound bridges. Wide section of the river with presence of manmade structures and scrub / trees on both sides of the bridge.	Sub-optimal. Structures offer suitable resting locations, however disturbance (PRoW) on the left bank would limit use of the bank for resting.	Access limited to the PRoW along the left bank of the River Itchen. No access to the right bank.

Appendix D. Summary of Otter Field Survey Evidence

Table D.1: Otter Survey Detailed Results

Waterbody ID	Results from 2017		Access in 2020	Results from 2020					
	Evidence of Otters Presence	Potential Otter Resting Place		Potential Otter Resting Place	Actual Otter Resting Place	Spraint	Footprints	Runs Away From Water	Evidence of Otters Present
001	5 dry intact and 4 dry fragmented otter spraints recorded.	Yes	No	-	-	-	-	-	-
002	-	Yes	No	-	-	-	-	-	-
003	Not Identified	Not Identified	Yes	Yes	-	-	-	-	No
004	Not Identified	Not Identified	No	-	-	-	-	-	-
005	-	Yes	No	-	-	-	-	-	-
006	-	Yes	No	-	-	-	-	-	-
007	-	Yes	No	-	-	-	-	-	-
008	-	Yes	No	-	-	-	-	-	-
009	No Access	No Access	No	-	-	-	-	-	-
010	-	Yes	Yes	Yes	Yes	1 fresh	Yes	Yes	Yes
011	-	-	Yes	-	-	-	-	-	No
012	-	-	Yes	-	-	-	-	-	No
013	-	Yes	Yes	Yes	Yes	-	-	Yes	No. (Evidence of mink)
014	-	Yes	Yes	Yes	-	-	-	-	No
015	-	Yes	Yes	Yes	-	-	-	-	No
016	-	Yes	Yes	Yes	-	-	-	-	No

Waterbody ID	Results from 2017		Access in 2020	Results from 2020					
	Evidence of Otters Presence	Potential Otter Resting Place		Potential Otter Resting Place	Actual Otter Resting Place	Spraint	Footprints	Runs Away From Water	Evidence of Otters Present
017	Not Identified	Not Identified	Yes	Yes	Yes	1 dry	-	Yes	Yes
018	-	Yes	Yes	Yes	Yes	2 dry	-	-	Yes
019	-	Yes	Yes	Yes	-	-	-	-	No
020	-	Yes	Yes	Yes	-	-	-	-	No
021	Not Identified	Not Identified	No	-	-	-	-	-	-
022	-	Yes	Yes	Yes	Yes	2 dry	Yes	No	Yes
023	-	Yes	Yes	Yes	-	-	-	-	No
024	Not Identified	Not Identified	Yes	Yes	-	-	-	-	No
025	No Access	No Access	Yes	-	-	-	-	-	No
026	Not Identified	Not Identified	Yes	Yes	-	-	-	-	No
027	No Access	No Access	Yes	Yes	-	-	-	-	No
028	-	-	Yes	Yes	-	-	-	-	No
029	No Access	No Access	Yes	Yes	-	-	-	-	No
030	No Access	No Access	No	-	-	-	-	-	-
031	Not Identified	Not Identified	No	-	-	-	-	-	-
032	-	Yes	Yes	Yes	-	-	-	-	No

Appendix D Proposed M3J9 Runoff Pollution Assessment Method and Control Measures Technical Note

TECHNICAL NOTE

Job Name: M3 Junction 9 Improvement Scheme

Job No: 48176/2000

Note No: HE551511-VFK-HGN-X_XXXX_XX-TN-CH-0003

Date: March 2021 (updated May 2022)

Revision: P02

Prepared By: P. Rogers / A. Champion

Checked by: T. Allen

Subject: **Proposed M3J9 Runoff Pollution Assessment Method and Control Measures.**

Contents

Figures

Tables

Appendices

1. Executive Summary

The control of pollution within the M3 Junction 9 Improvement Scheme (M3J9), includes runoff volume from a portion of the proposed M3 Junction 9 to 14 Safety Barrier Improvement Scheme immediately to the south, which drains into M3J9. This document does not address pollution control within the M3 Junction 9 – 14 Safety Barrier Improvement Schemes drainage which lies outside the M3J9 works area.

The M3J9 Improvement Scheme substantially reduces the existing discharge of M3J9 highway runoff to groundwater, and replaces it with a combination of either discharge to groundwater and discharge to the River Itchen, following treatment, attenuation and detention.

Soluble contaminants, Total Suspended Solids and Spillage pollution risks have been assessed using the HEWRAT v2.0.4 tool. Mitigation measures are included in the assessment.

A Hydrogeological Risk Assessment (HgRA) has been undertaken to supplement the HEWRAT screening assessment. In this Technical Note, a brief summary of the HgRA conclusions has been provided.

A literature review of current research into Microplastics pollution of stormwater has been undertaken.

Insoluble Microplastics have been assessed and mitigated as portion of the Total Suspended Solids pollution category. Also, a qualitative Source-Pathway-Receptor methodology of risk assessment has been applied to Microplastics. Mitigation measures are included in the assessment.

Standards of compliance for the mitigation for Microplastics have been proposed, or it has been indicated where further consultation is required with regulatory bodies.

Assessments of pollution risk for the baseline (existing) and the proposed stormwater drainage conditions have been undertaken, which indicate that a beneficial effect is provided by the proposed M3J9 drainage networks.

The maintenance of SUDS Mitigation Measures is indicated in a Maintenance Schedule.

2. Introduction

This document sets out the methodology and results of the assessment and mitigation of pollution within highway runoff from the M39 Improvement Scheme.

The categories of pollution considered in this document are:

1. Copper, Zinc, Cadmium, Total Polyaromatic Hydrocarbons (PAH), Pyrene, Fluoranthene, AntHgRAcene, Phenanthrene, which are the suite of contaminants in the Highway England Water Risk Assessment Tool v. 2.0.4 (HEWRAT.

2. Total Suspended Solids (TSS)

3. HGV-load spillage (unspecified liquids)

4. Microplastics (MPs)

This Technical Note should be read in conjunction with the M3J9 Improvement Scheme Stage 3 – Drainage Strategy Report (DSR) and highway drainage drawings, prepared by Stantec.

Refer to Section 9 for a full list of citation references and abbreviations.

3. Project Overview

The M3J9 scheme runs north-south, and lies immediately to the east of Winchester, centred in the Winnall area and extending north to Headbourne Worthy.

Abutting the west of the scheme are commercial and light industrial land uses associated with the Wykeham Trade Park and Winnall Industrial Estate, which fall away from the M3J9 towards the River Itchen.

Land rises to the east of the M3J9 and comprises entirely arable land or woodland, with a low density of minor agricultural settlements. 206 hectares (ha) of arable land draining overland to the west is intercepted by the M3J9 earthworks. 192 ha of the intercepted flow drains to ground on the eastern side of the M3J9 scheme. 14 ha of overland flow passes under the M3J9 earthworks in an existing 300mm dia culvert.

Proposed modifications to M3J9 comprise the introduction of new on/off slip-roads to both northbound and southbound sides of the M3, new link roads between A33/A34/A272 and M3 roads and a new overhead gyratory above the M3 corridor. Junction 9 is located in a low spot of the M3, towards which a total of approximately 2km of the existing M3 corridor drains.

A separate Safety Barrier Improvement Scheme is currently being constructed immediately to the south of M3J9. The Improvement Scheme to the mainline M3 will extend into the M3J9 Improvement scheme works boundary.

A summary of retained, removed and proposed carriageway areas is given in Table 3

Retained (overlaid) Carriageway (ha)	Abandoned Carriageway (ha)	New (additional) Carriageway (ha)	Proposed Carriageway to River Itchen (ha)	Proposed carriageway to soakaways (ha)	Area of Cutting draining to carriageway drainage (ha)
12.3 *1,2	**1.1**	**9.1** *1,2	**14.3** *1,2	**7.1** *3	**10.5** *1

*1 (includes the M3 Junction 9 to 14 Safety Barrier Improvement Scheme which contributes inflows to M3J9)

*2 (includes new A33/A34 verge modifications north of River Itchen)

*3 (includes existing M3 Junction 9 to 14 Safety Barrier Improvement Scheme & A272 areas to retained soakaway trenches)

Table 3 – Existing and Proposed Carriageway Areas Summary

3.1. M3 Junction 9 – 14 Safety Barrier Improvement Scheme Implications

Safety barrier improvements to the M3 are under construction to the south of M3J9 between Junctions 9 to 14. The proposed improvements comprise hardening of the central reserve, installation of a new concrete safety barrier and improvements to the existing highway drainage to account for the increase in hard surfaces. Approximately 2.9ha of the Safety Barrier Improvement Scheme enhancements drain into the M3J9 project area, resulting in an overall drained area of 16.3ha passing through the main M3J9 drainage network to the River Itchen. Carriageway areas in Table 3, and in the HEWRAT assessments in this Technical Note, include the additional Safety Barrier Improvement Schemes drained area.

4. Methodologies

The methods of assessment of risk to groundwater and to watercourses, from the 4no. pollution categories above, are indicated in Table 2 below.

(Note: Refer to Table 9 for full list of references and citation abbreviations).

Pollutant Type	Nature of impact	Assessment Method	Primary Reference(s)	Citation Ref.
1. HEWRAT suite of pollutants	Acute impact - Soluble pollutants	HEWRAT v2.0.4 + Supplementary HGRA	Defined in LA 113 Road drainage and the water environment (DMRB)	LA113
2. Total Suspended Solids (TSS)	Chronic impact - sediment	HEWRAT v2.0.4 + Supplementary HGRA		
3. HGV-load Spillage	Acute Impact (rare single event)	HEWRAT v2.0.4		
4. Microplastics (MP)	Acute impacts – soluble pollutants	Review of current research + apply a qualitative source-pathway-receptor (S-P-R) assessment.	DEFRA Report 14784 - *Investigating the sources and pathways of synthetic fibre and vehicle tyre wear contamination into the marine environment* National Highways Task 1-902 Final project Report (2020) *Investigation of 'microplastics' from brake and tyre wear in road runoff* *Microplastics in urban and highway stormwater retention ponds* - Science of the Total Environment 671 (2019) 992–1000 *Retention of microplastics in sediments of urban and highway stormwater retention ponds* - Environmental Pollution 255 (2019) 113335 *Microplastics in a Stormwater Pond* - Water 2019, 11, 1466; doi:10.3390/w11071466 (Water 2019)	DEFRA MPBTW 2020 TE 2019 EP 2019 Water 2019
	Chronic Impact - sediments			

Table 4 – Assessment Methodologies

4.1. Hydrogeological Risk Assessment

In order to provide a more detailed assessment of hazards to controlled waters, where the HEWRAT screening identifies elevated levels of risk, a separate Hydrogeological Risk Assessment (HgRA) has been undertaken of the proposed highway drainage only. Please refer to Stantec document 330610074R1 M3 Junction 9 DQRA, included in Appendix E of this document. A summary of the HgRA is as follows:

The HgRA has followed the Environment Agency's Remedial Targets Methodology (RTM). A Level 2 assessment has being undertaken, which considers attenuation processes within the unsaturated zone and dilution within the saturated zone. The input to the RTM is source concentrations for acute and chronic risk is based on HEWRAT Step 2 output (i.e. representative concentrations within the Extended Drainage Basins). Outputs from the RTM model are predicted concentrations at the identified receptors. A sensitivity analysis is provided to demonstrate the effect of uncertain parameters on the assessment. The objective of the RTM assessment is to assess the degree of risk posed to groundwater from the EDBs, which are installed over superficial deposits or directly over chalk and have a variety of unsaturated zone thicknesses.

Where the HEWRAT screening indicates a High Risk to groundwater, it is proposed that the EDB will be lined, thus preventing discharge to groundwater. On this basis the HgRA has been undertaken to further assess the risk from the un-lined EDBs. The conclusions of the HgRA are as follows:

- Acute risk from soluble contaminants present in the EDBs has been assessed as low. The contaminant concentrations in the EDBs, as derived from the HEWRAT assessment are below the UK DWS and thus pose no significant risk to groundwater.

- The models demonstrate that none of the EDBs are likely to result in an impact on groundwater from determinands present within the sediment lining the base of the EDBs (chronic risk).

- For the hazardous PAH compounds, the aqueous source term concentration leached from the EDB sediments is limited by the determinand pure phase solubility and the fact that these determinands are highly sorbed onto the sediment matrix. Thus, concentrations leaching from the sediment are modest. The HgRA model shows that there is likely to be a sufficient thickness of unsaturated zone, comprising material with sufficient organic carbon content to provide sufficient attenuation and ensure that there is no discharge of PAH compounds to the water table.

- Copper and cadmium also sorb highly to the EDB sediment such that aqueous concentrations in the EDBs are unlikely to reach concentrations that would cause pollution of groundwater. Predicted aqueous source term zinc concentrations are higher, but attenuation within the unsaturated zone, combined with dilution in the receiving groundwater is sufficient to ensure there is no pollution by this determinand.

- Once the following data from site-investigation works are available, the HgRA should be reviewed and updated based on the complete dataset.

    - Time series data on the depth of the water table, to provide more confidence on the unsaturated zone thickness at each of these structures.

    - Infiltration tests at the proposed EDB locations, which will inform the unsaturated zone hydraulic conductivity.

    - testing for organic carbon fraction, which will refine the DQRA model and inform predictions of the risk to groundwater from the Scheme's drainage design.

4.2. Microplastics (Research Overview)

Pollutant category 4 (Microplastics) is not yet considered in National Highways (HE) or other Statutory Authority assessment tools or legislation, but is currently recognised within research as a potential hazard for consideration in relation to highway schemes. An overview of relevant findings from research into MPs is given below.

Microplastics (MPs) is a category of pollutant within Total Suspended Solids and is defined as synthetic plastic particles of size < 5mm. These particles fall into two broad categories of synthetic fibres (various polymers) and tyre particles; wear or crumb. The sources of MPs and the range of MP sizes and mass in the environment is extremely diverse (Water 2019) and it is not considered practical to consider source as an area for assessment or mitigation in this Technical Note. However, it is being found in some research that there is a correlation between catchment land-use and MP loading in sediments. Industrial and commercial land uses, for instance, which abut the western M3J9 boundary, tend to produce pond sediments in which smaller and lighter MPs prevail. MPs in ponds serving residential catchments tend to be the heaviest and largest. Highway catchments tend to result in pond sediments in the mid-rage of size and mass. (TE 2019).

National Highways have undertaken the early stage of an ongoing research project into Microplastics from brake and tyre wear in road runoff (MPBTW 2020). A key outcome of this first stage is that HE conclude that current methods of assessment (LA113) and mitigation (CG 501) are not proposed to be changed at present (MPBTW 2020).

Figure 4.1 indicates the typical composition of MPs by polymer-type within sediments, water and fauna in stormwater ponds (Water 2019).

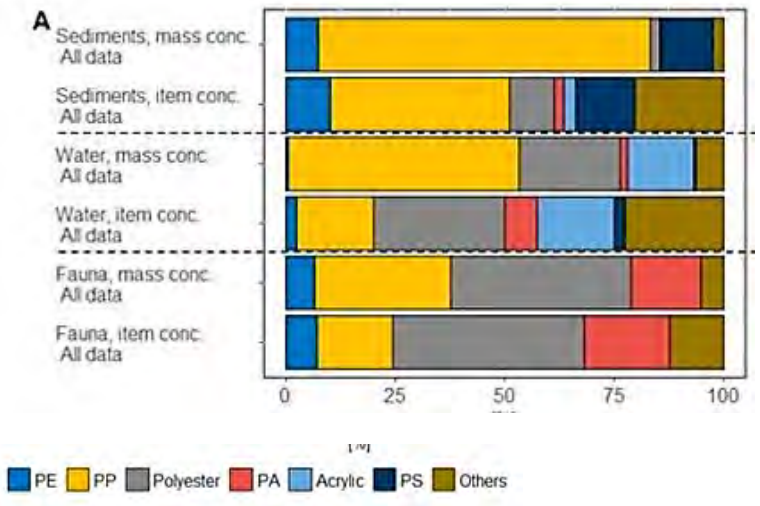


Figure 4.2 – Composition of Polymers in Ponds

Figure 4.2 indicates the distribution of MPs by mass and dimension in the sediments, water and fauna of stormwater ponds (Water 2019).

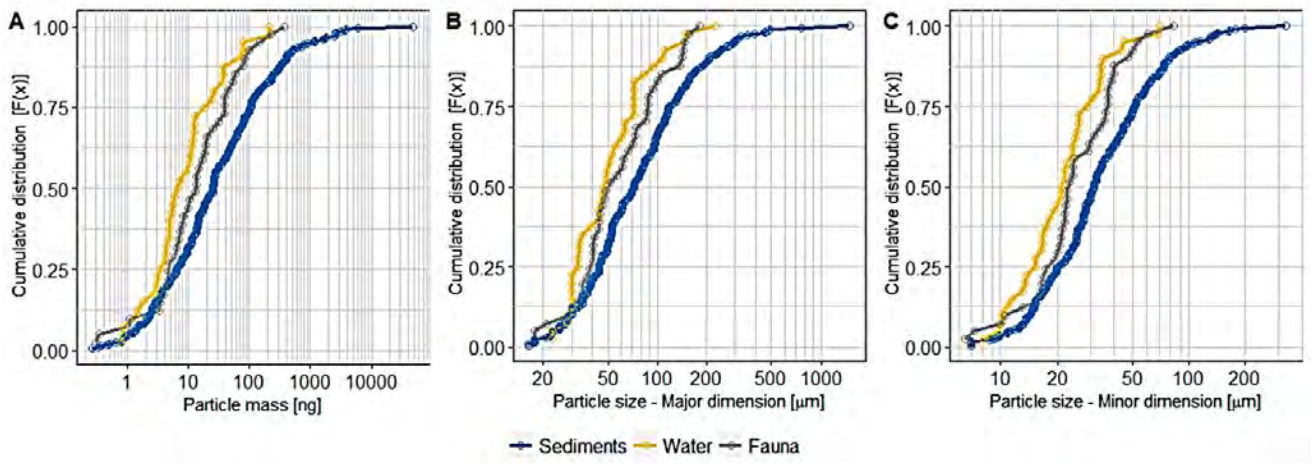


Figure 4.2a – Distribution of Polymers in Ponds

Generally, there is a close correlation between particle size and location in the water environment. Larger or heavier MP particles tend to be prevalent in sediments, at typical concentration of 0.4g/kg. The lightest and smallest MP particles tend to be prevalent in suspension (typically at concentrations of 4 mg/l). MP particles taken up by fauna, tend to be of mid-range mass and size and are typically present in fauna at concentrations similar to those in sediments (Water 2019).

Tyre particles, or crumb, typically exhibit a particle size distribution that is similar to coarse sand, but not as coarse as gravel.

Road runoff is identified as a significant pathway for tyre particles and ponds are shown to be sinks for MPs, by trapping MPs in sediments (EP 2019, Water 2019). Settlement rates for MPs have been shown to be similar to other particulates in settlement and detention ponds, with up to 85% of MPs removed from flows.

Sediments containing MPs need to be disposed of appropriately to avoid recirculation of settled MPs back into soil or water environments.

4.3. Microplastics Assessment Rationale

In light of the overview of current research findings, above, it is not currently possible to quantitatively assess the impact of MPs or design quantitative mitigation. It is therefore proposed to apply mitigation measures that research indicates are most effective at intercepting or ameliorating the source-pathway-receptor (S-P-R) linkages in the pollutant risk assessment of MPs as far as is practical within the M3J9 scheme,

MPs, which include tyre particles, are shown to be treatable as a fraction of the TSS load in stormwater flows. The mitigating mechanisms that are indicated as most effective are:

- Settlement and Filtration, followed by removal of MP-loaded sediments to a licenced waste facility

Separation of the tyre crumb component of MPs from the water flow is considered important, to minimise leaching of additives from tyre crumb into solution. It is not as important to separate other polymer MPs from the water environment, where leaching of volatile constituents is much reduced. Notably, tyre particles tend to be the larger particles in the particle size distribution within the MP load and so mechanical screening or vertical filtration within filter media will be an effective primary treatment that captures the coarser tyre crumb and removes it from the wet environment.

Further mitigation mechanisms proposed to capture smaller particle sizes in the MP load are:

- Detention and Biofiltration of flow that may be carrying finer MPs in suspension for extended periods, to maximise capture in sediments.

5. Baseline Drainage

The large majority of the existing M3/A33/A34/A272 interchange road surfaces (7.7ha out of 8.8ha) drains to existing soakage features, comprising linear soakaway trenches or ditches and single soakaway pits, which were constructed typically in the 1970s and 1980s.

There are no stand-alone pollution or attenuation mitigation measures built into the existing M3J9 highway drainage infrastructure in addition to the highway edge drainage, which is largely soakaway or edge-of-carriageway filter trenches leading to soakaway structures. There is one spillage containment structure (comprising a 25m long ditch, a penstock and an oil interceptor) that exists at the outfall from the A34 southbound carriageway drainage into the River Itchen.

The greatest concentration of drained area to a single soakage feature (4.1 ha), is the M3 mainline corridor, which drains to a single existing soakaway ditch running parallel to the M3, which lies to the north of the National Highways depot and west of the M3 (Figure 5). This is the most critical case location for the concentration of contaminated highway runoff within the existing scheme, in terms of traffic volume and drainage ratio (drained area/infiltration area).

It is apparent that the size and volume of the existing soakaway ditch (225m x 2.0m wide x 0.55m deep) could not by justified using current flood management design standards; it is undersized to contain the 100-year + 40% climate change within the highway boundary. It is likely that existing highway runoff to the soakaway ditch would overflow onto arable land downslope of the ditch, which lies outside the highway boundary (figure 5). The location of the existing soakaway trench coincides with chalk bedrock

close to existing ground levels (ref. geotechnical logs DS114/TP11, Appendix A), and so it is likely that the existing soakaway trench is founded into fissured/fractured geology.

The A33/A34 carriageway north of the River Itchen (3.3ha) discharges runoff to the River Itchen via a series of existing drainage ditches.

The northernmost section of M3 mainline being upgraded within the M3J9 scheme, comprises 1.8ha of resurfaced carriageway that will continue to discharge to the River Itchen or local tributaries, via existing highway drainage.

5.1. Assessment of baseline risk to groundwater from existing drainage

In order to establish the baseline pollution risk to groundwater from runoff and HGV-load spillage, via the existing M3 drainage infiltration drainage, a HEWRAT screening assessment has been undertaken (Appendix B) for the existing critical-case soakage ditch in Figure 5.

The HEWRAT groundwater screening results (Appendix B) indicate that:

- the existing soakaway ditch risk to groundwater is in the high end of the Medium category, bordering the High category (scoring 245 out of 250).

- The existing return period probability for a spillage incident on the existing M3 corridor is 1 in 297 years, which would pass the 1 in 200 year return period risk expected by the Environment Agency in the context of the adjacent River Itchen SAC (Special Area of Conservation).

5.2. Assessment of run-off flow within geology from existing drainage

It is recognised that there is a possibility that karstic (solution) features may be present within the solid chalk geology, such as ‘pipes’ or swallow-holes, which may convey surface runoff to groundwater without major filtration or dissipation. The presence of Karstic features within the solid chalk geology at the infiltration surfaces of existing filter trenches and soakaways can not be ascertained without excavation and inspection. Until such inspection can be undertaken, the assessment of existing, baseline risk to groundwater assumes that no karstic features are present.

However, the assessment of proposed risk to groundwater does take account of the possible occurrence of karstic features beneath proposed infiltration surfaces by assuming that ponds are impermeably lined where solid geology underlies infiltration features, which serve traffic volumes that are sufficiently large to pose a significant source of pollution (refer to Appendix C – Proposed HEWRAT screening results).

5.3. Assessment of baseline risk to watercourse flow from existing drainage.

In order to establish the baseline pollution risk to the River Itchen from existing runoff, a HEWRAT assessment has been undertaken for the existing discharge point; an outfall adjacent to the A34/A33 road bridges.

The Existing HEWRAT screening results (Appendix B) indicate that:

- the existing discharge to the River Itchen does not result in an unacceptable risk of pollution due to the exceedance of thresholds set for soluble contaminants or sediments, as defined in HEWRAT.

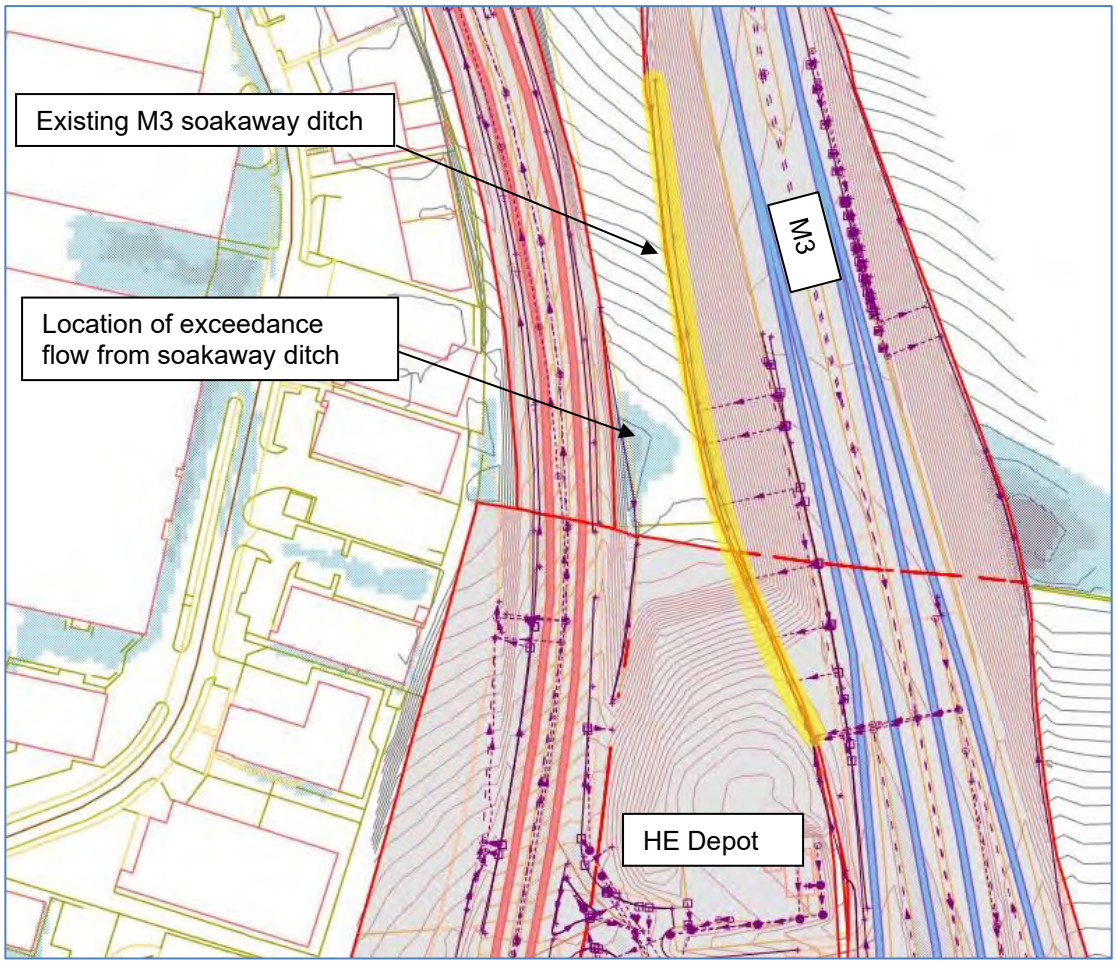


Figure 5 – Existing M3 soakage feature

5.4. Assessment of baseline risk to the water environment from Microplastics

As discussed in Section 4.2, a quantitative assessment of baseline risk from existing MPs is not possible given the current lack of research and policy guidance.

It should be noted however, that there are no specific existing mitigation measures for the settlement and filtration of MPs, or for the removal of MP-loaded sediments, within the existing drainage infrastructure. A source-pathway-receptor evaluation would find that the pathway taken by most of the existing MP load in highway runoff would terminate in sediments in filter trenches and soakaways.

6. Proposed Drainage

The proposed M3J9 scheme proposes to construct a new M3/A34NB off-slip embankment over the existing main M3 soakage ditch shown in Figure 5, rendering it obsolete. Also, M3 Junction 9 - 14 Safety Barrier Improvement Scheme changes to the M3 corridor will result in much of the existing M3 central reserve soakaway trenches and carriageway edge drainage being replaced. As such, all existing M3 carriageway runoff will be conveyed to the western side of the M3J9 scheme to be attenuated and treated in detention basins (EDBs) before being discharged to ground where possible, before a controlled discharge to the River Itchen.

The only areas where existing linear infiltration highway drainage, or sealed, piped highway drainage, is proposed to be retained and enhanced, where necessary to limit flooding, will be:

- A33/A34 carriageway to the north of the River Itchen (above latitude 131500 N)

- M3 carriageway to the north of latitude 131500 N.

Both these retained areas are proposed to discharge to the River Itchen via existing open ditches or filter trenches.

For full details of the proposed M3J9 drainage infrastructure, please refer to Stantec's *M3J9 Improvement Scheme Stage 3 – Drainage Strategy Report* and associated drawings and specifications.

In summary, the proposed drainage for new M3J9 carriageway areas comprises

- Over-the-edge drainage of run-off from carriageways on embankments to filter strips and to infiltration ditches

- Collection of run-off at carriageway edge in channel drains, gullies or filter drains, which is piped to:

- Primary Filtration treatment in filtration forebays followed by settlement in unplanted, lined detention basins.

- Attenuation, Secondary Settlement and Filtration treatment in vegetated, un-lined Extended Detention Basins containing both wet (marsh) and dry (grass) habitat zones.

- Tertiary treatment in a grassed swale prior to discharge to the River Itchen

- In areas where existing carriageway is being overlaid and existing highway drainage is being retained, run-off is either discharged over-the-edge to existing filter strips or infiltration ditches, or is captured in road gullies and channels, and conveyed to existing infiltration features such as existing soakaways or trenches.

7. Proposed Mitigation Measures

The mitigation effects of such Sustainable Drainage Systems (SuDS) features on suspended solids and soluble contaminants are well documented and quantifiable within National Highways and Environment Agency guidance (HEWRAT, EA 2003).

Current research findings conclude that insoluble Microplastics can be treated as part of the total suspended solids contaminant-load and managed in a similar way; that is, Settlement to remove larger MP particles from the flow and fix those particles in sediments; and Filtration to allow smaller particles to settle in lower flow velocities and be fixed by adsorption or absorption within the grassed surface or macrophyte zone in EDBs.

Peak concentrations of MPs in the 'first flush' of highway runoff are proposed to be treated through vertical filtration forebays to basins, which primarily separate floating debris and larger MPs from the water flow.

Thereafter, Basins 2, 3B and 3C (Refer to Drainage Schematic Plan, Appendix D) are the main, long-retention, secondary-treatment basins, prior to runoff out-falling to the River Itchen. Retention times of at least 20 hours have been calculated for in the 1-year, 60-minute storm volume, which represents 10.42 mm of rainfall in this location,

Typical removal rates in vertical filtration features are expected to be in the order of 100% for floating debris and 80% for larger MPs such as tyre crumb (figure 7.1).

A typical removal rate of 50% for sediments and heavy metals, has been assumed for EDBs 2, 3B and 3C. 50% has been taken to represent a conservative case for removal rates in dry basins. EDBs (i.e. basins which incorporate at least 25% of semi-permanent marsh or pools), are indicated to achieve typically at least 60% removal of sediments and metals (Figure 6). Basins 2 and 3C are proposed to be Extended Detention Basins.

It should be noted that both Basins 2 and 3C have at least one other settlement basin or detention basin upstream of them, which would achieve similar removal rates for suspended solids and heavy metals. Compounded removal rates have not been considered in this Technical Note, to allow for future bypassing of basins during maintenance or spill recovery.

7.1. Basin Sediment removal

Removal of sediments from detention basins is driven by both a need to maintain a minimum volume capacity within attenuation features and by the need to remove contaminated sediments from the environment.

With regard to removing contaminated material from the environment, a maximum fraction of 25% of basin area is assumed to be a reasonable estimate of basin area that can be removed and replanted every 4 years, without an overly detrimental effect to basin performance and habitat.

With regard to maintaining basin capacity, a minimum 90% capacity is targeted as the minimum basin capacity to be maintained at all times in the maintenance cycle.

Considering the two driving factors above, frequencies and volumes of sediment removal from basins (to a licensed facility) have been indicated in the summary table in Appendix C. These are based on the EA's Guidance Manual for Constructed Wetlands R&D Technical Report P2-159/TR2, an assumed sediment capture rate of 5m3/ha/yr from drained areas and an annual frequency of sediment removal operations.

Monitoring of the build-up of sediments within basins would be expected to be undertaken within the periodic maintenance inspections of basins, to assist in checking that sediment accumulation rates are as assumed, and that sediment removal frequencies are adjusted to accommodate the site-specific conditions.

7.2. Assessment of risk to groundwater from proposed M3J9 drainage

A HEWRAT screening assessment has been undertaken for all areas of infiltration within the proposed M3J9 works. The results are included in Appendix C and indicate that all but one basin are considered 'medium risk' to groundwater. This compares favourably to HEWRAT results for the existing M3 infiltration drainage for the M3. The proposed drainage discharges runoff via a far greater area of infiltration over granular soils, which provides a betterment in risk to groundwater from the M3J9 scheme.

Refer to the HgRA in Appendix E and summary in Section 4.1 for further quantitative groundwater risk assessment.

7.3. Assessment of run-off flow within geology from proposed M3J9 drainage

It is intended, in principle, to allow runoff to percolate into underlying solid or drift geology. It is recognised that there is a possibility that karstic (solution) features may be present, such as 'pipes' or swallow-holes, which may convey surface runoff to groundwater without major filtration or dissipation. The presence of Karstic features within the underlying solid chalk geology has been assessed from cavities survey data and the risk has been found to be low.

Nevertheless, infiltration features (basins) that are located in solid chalk geology have been sized as if lined with an impermeable liner, so that no infiltration is possible. Where basins overlie granular, drift geology, infiltration has been assumed within the design of basin volumes.

Proposed M3J9 basins serving high traffic volumes, and which are also founded on fissured/fractured chalk geology (Basins 3A and 4), have screening results close to, or within, the High risk category. Basins 3A and 4 are therefore proposed to be lined with an impermeable liner, to mitigate the risk to groundwater.

Refer to the HgRA in Appendix E and summary in Section 4.1 for further quantitative risk assessment of the risk to groundwater flows within geology.

Table 3.3 SuDS Pollutant Removal and Flow Attenuation Capacities

	Percentage Pollutant Removal Efficiency							Flow Attenuation Efficiency	
	Litter and Debris	Solids	BOD	P	N	Metals	Bacteria	Peak (allowable discharges)	Volume
Wetlands (Combined Ret/Det Basins)	NA	■	⊡—⊞	⊞—■	⊡—⊞	■	⊞—■	⊡—⊞	□
Wet Retention Basins (With marginal vegetation)	NA	■—■	⊞	⊞—■	⊡	⊞—■	⊡—⊞	⊞—■	⊡
ED Basins (<10 hour detention; with marsh)	■	■	⊡	⊡	⊡	⊞	?	■	□
ED Basins (10-24 hour detention; with marsh)	■	■	⊞	⊡—■	⊡	■	?—□	■	⊡
Dry Detention Basin (First flush infiltration)	■	■	■	⊞	⊡—⊞	⊞	⊡	■	⊡—⊞
Dry Detention Basin (Total infiltration)	■	■	■	■	⊞—■	■	■	■	■—■

KEY: ■ 80-100%; ■ 60-80%; ⊞ 40-60%; ⊡ 20-40%; □ 0-20%

Figure 7.3 - Pollutant Removal Rates (Table 3.3 -EA Guidance Manual for Constructed Wetlands R&D Technical Report P2-159/2003)

7.4. Assessment of risk to watercourses from HGV-spillage.

The lowest return period for a spillage incident is 1 in 253 years, which meets the minimum 1 in 200 year return period expected for spillage probability, in the context of adjacent River Itchen SAC (Special Area of Conservation).

7.5. Assessment of risk to watercourse flow from proposed M3J9 drainage.

A HEWRAT risk assessment for acute and chronic pollution of watercourses has been undertaken for all attenuation basins and the only geocellular tank. The basins and tank have been assessed individually, as if these features each discharged directly into the River Itchen, without the ameliorating effects of basins upstream within their catchment. The cumulative effect of basins in series has therefore not been considered in this Technical Note in order to account for future bypassing of basins during maintenance or spill recovery.

The HEWRAT Runoff Risk Assessment results (Appendix C) indicate that:

- Each detention basin provides sufficient removal of sediments and pollutants to preclude exceedance of the thresholds for acute and chronic pollutant concentrations within the HEWRAT assessment tool.
- A Tier 2 assessment has been included in HEWRAT, which considers proposed pollutant removal efficiencies in light of the diluting effect of flows in the receiving watercourse. The Tier 2 assessment indicates no mitigation of runoff flows is required; mitigation is, however, proposed in detention basins.
- The lowest return period for a spillage incident is 1 in 253 years, which meets the minimum 1 in 200 year return period expected for spillage probability, in the context of adjacent River Itchen SAC (Special Area of Conservation).

7.6. Assessment of risk to the water environment from Microplastics (insoluble)

Table 7.6 below indicates the S-P-R assessment and the mitigation measures that are proposed within the M3J9 scheme, to ameliorate Microplastics contamination of groundwater and surface waters.

MP Source	Mitigation at Source	Pathway	Mitigation in pathway	Receptor	Outcome	Standard of Compliance
Wind	n/a	In suspension to River	Settlement, filtration, adsorption in vegetated detention basin	Direct- runoff flow (fluvial)	As TSS removal rates (min 50%) - To be monitored?	EA 2003, SuDS Manual
	n/a	In suspension to groundwater	Settlement, filtration, adsorption in vegetated detention basin, and filtration in sat/unsat. zone	Baseflow (fluvial)	100% retention in sat./unsat. zone	EA 2003, SuDS Manual
	n/a	In suspension to groundwater	Infiltration thro' granular blanket on basin base, then conveyance in Karstic features	Groundwater Abstraction	To be monitored?	EA Infiltration consent?
	n/a	Wind entrained to basins	Settlement, filtration, adsorption in vegetated detention basin, and filtration in sat/unsat. zone	Soils/sediments	As TSS removal rates (50%) - To be monitored?	EA 2003, SuDS Manual
Vehicles (incl. Tyre crumb)	HE road sweeping + disposal as hazardous waste	In suspension to river	Primary vertical filtration in forebays, then settlement and adsorption in vegetated detention basin (Minimum sequence of catchpits, sediment forebays, detention basins and swale).	Direct runoff flow (fluvial)	As TSS removal rates (min 50%)	EA 2003, SuDS Manual
		In suspension to groundwater		Baseflow (fluvial)	100% retention in sat/unsat. zone	EA 2003, SuDS Manual
				Groundwater Abstraction	To be monitored?	EA Infiltration consent
		Mechanical (scattering)	n/a	Soils (Verge, adj. landscape)	To be monitored?	n/a
MP Load Spillages	HE road sweeping/cleaning + disposal as hazardous waste (Spill captured in Pollution Control Device (lined ditch + penstock). <1hr response time by HE.	In suspension to River	Liquid (wash-down) flows to Pollution Control Device. HE Disposal as hazardous Waste.	Direct- runoff flow (fluvial)	Spill clean-up to HE/HCC standards	National Highways/HCC
		In suspension to groundwater	Liquid (wash-down) flows to Pollution Control Device. HE Disposal as hazardous Waste.	Baseflow (fluvial)	Spill clean-up to HE/HCC standards	National Highways/HCC
		Mechanical (scattering)	Mechanical or manual clean up and disposal to suitable waste facility	Soils (Verge, adj. landscape)	Spill clean-up to HE/HCC standards	National Highways/HCC
Litter from Traffic	HE road sweeping + disposal as hazardous waste	In suspension to River	Settlement and filtration in vegetated detention basin (incl trash screen on outlet)	Direct- runoff flow (fluvial)	100% retention in surface of basins	EA 2003, SuDS Manual
		In suspension to groundwater	Settlement and filtration in vegetated detention basin (incl trash screen on outlet).	Baseflow (fluvial)	100% retention in surface of basins	EA 2003, SuDS Manual
		Mechanical (scattering)	Mechanical or manual clean up and disposal to suitable waste facility	Soils (Verge, adj. landscape)	Litter removal to HE standards	National Highways/HCC
Basin Sediment	Flow velocity reduction/channelling to reduce re-suspension	In suspension to River	Primary vertical filtration in forebays, then settlement and adsorption in vegetated detention basin	Direct runoff flow (fluvial)	As TSS removal rates (min 80%)	EA 2003, SuDS Manual
		In suspension to groundwater	Primary vertical filtration in forebays, then settlement and adsorption in vegetated detention basin	Baseflow (fluvial)	100% retention in sat./unsat. zone	EA 2003, SuDS Manual
	Waste disposal practices to recognised DEFRA and EA standards (WAC testing, licenced transport, disposal etc)		Settlement, filtration in forebays, adsorption in vegetated detention basin downstream of accidental re-suspension during disposal	Direct runoff flow and baseflow(fluvial)	TSS removal rate of 50%	EA 2003, SuDS Manual

Table 7.6 – Microplastics: Risks and Mitigation

8. Maintenance Schedule

A Maintenance Schedule has been proposed to demonstrate that the performance of highway drainage and SuDS components can be maintained at a sufficient level to implement the removal rates for the pollutant types assessed, over the lifetime of the network.

Sediment removal in the primary vertical filtration areas (sediment forebays) is proposed to be the most frequent maintenance operation, as forebays are relatively small features, through which all runoff will flow and within which entrained, suspended solids will concentrate. It is envisaged that the frequency of replacement of the vertical filtration layer will be proportional to the filter media grading, rather than absolute MP or sediment load. Once the matrix voids become clogged with silt, MPs and tyre crumb, then it would be disposed of as hazardous waste. Once replacement frequencies are monitored, filter media grading can be reviewed to increase replacement frequencies if required. A lowest permeability limit of 500mm/min in filter media should be maintained to at least cater for the runoff flow from a 1-year return period, 60-min duration storm event, which is the standard of 'first flush' filtration treatment performance being targeted, and which represents 10.42mm of rainfall depth (EA 2003).

Sediment removal frequency in detention basins has been calculated on the basis of maintaining a minimum 90% volume capacity for attenuation, assuming 5 m3/ha/yr capture rate of sediments within detention basins from highway drainage catchments (EA 2003). This is a conservative figure when compared to the 3m3/ha/yr indicated in the EA guidance. It is proposed to remove sediment and macrophyte (root zone) layers, containing contaminated silts and MPs, at a rate of 25% of the basin footprint over 4 years. The sediment removal proposals are indicated in Table 8 below.

Basin	Attenuation m3/ha	m3/ha/yr silt accmulation rate	Est. time to 10% loss of capacity	Silt Storage Vol.	Forebay Area	Forebay Min. depth of freeboard	Comments
			yrs	m3	m2	mm	
1	1234	5	26	6	58	52	Check HEWRAT + MPs + cCLEA contaminant loadings in sediment 2 -yearly.
2	2084	5	44	13	36	333	Check HEWRAT + MPs + cCLEA contaminant loadings in sediment 2 -yearly.
3A	475	5	10	46	36	333	Check HEWRAT + MPs + cCLEA contaminant loadings in sediment 2 -yearly.
3B	286	5	6	53	36	333	Check HEWRAT + MPs + cCLEA contaminant loadings in sediment 2 -yearly.
3C	564	5	12	68	46	885	Check HEWRAT + MPs + cCLEA contaminant loadings in sediment 2 -yearly.
4	377	5	8	32	36	333	Check HEWRAT + MPs + cCLEA contaminant loadings in sediment 2 -yearly.
5	87	1	9	78			Not for highway
6	78	1	8	14			Swale to replace forebay for primary treatment
7	646	5	14	3	36	333	Check HEWRAT + MPs + CLEA contaminant loadings in sediment 2 -yearly.
	Notes	1. Forebay area to be adjusted where forebay depth of freeboard > 300mm, to achieve max. 300mm depth.					
	Ref: Fig. 4.1 - Guidance Manual for Constructed Wetlands R&D Technical Report P2-159/TR2						

Table 8 – Proposed Sediment Removal Regine

It is proposed to periodically test sediment forebay and detention basin sediments also for contaminant loadings against contaminated land quality standards. This ensures that the need for filter matrix replacement or sediment removal to meet contamination standards is also captured, rather than just for operational permeability and attenuation volume reasons.

All filter media removed for disposal should also be 'WAC tested' to identify compliance with the Waste Acceptance Criteria of the receiving disposal facility.

The regime for testing and replacement or removal of SUDS materials will be subject to a methodology agreed with the Environment Agency.

Ref.	Activity	Frequency	Organisation Responsible	Notes
1.0	**Litter Management**			
	Collect all litter in SuDS and Landscape areas, including wetlands and ponds or any debris lodged in planting.	Annually	National Highways	Frequency of litter removal at the extents of the highway boundary to be as required, in response to landowners' notifications, to avoid nuisance to public amenity.
2.0	**Grass Cutting**			
	All grass verges, paths and access to SuDS features. All cuts at 35-50mm with 75mm max. All cuttings collected at first and last cut annually removed to wildlife or compost piles otherwise left in-situ.	Monthly in the growing season	National Highways	
	All filter strips, swales and margins to low flow channels. All cut at 75-100mm with 150mm max. All cuttings collected at first and last cut annually removed to wildlife or compost piles otherwise left in-situ.	Monthly in growing season	National Highways	
	All basin/pond edges to be cut to 100mm during September-October annually or on a 3 year rotation and cuttings removed to wildlife or compost piles.	As required in growing season	National Highways	Avoid strimming where possible to minimise injury to fauna concealed in long grass.
	Any wildflower areas included within SuDS features to be cut to 100mm during September-October annually and all cuttings removed to wildlife or compost piles.	Annually	National Highways	Avoid strimming where possible to minimise injury to fauna concealed in long grass.
2.0	**Trash Screens and Forebays to all Basins**			
	Check Trash screens for blockages. Remove all accumulated solids and fibres to licenced waste facility	Monthly and as required.	National Highways	
	Check annually for free-flowing permeability of filtration blanket (minimum 500 mm/min). If filter matrix is clogged to an extent that hinders	Check annually, replace filter	National Highways	

Ref.	Activity	Frequency	Organisation Responsible	Notes
	permeability, replace full thickness of filter media.	media as required.		
	Inspect forebays to ensure min. 50% volume capacity is present above filter media.	6-monthly	National Highways	
	Remove all silt/sediment accumulation above filter media to restore full capacity of forebay	As required, when 50% full	National Highways	
3.0	**Settlement Basins**			
	Check sediment volume is less than 10% of basin volume.	Annually	National Highways	
	When sediment volume reaches 10% of basin volume, implement phased removal of all sediment to restore original basin volume. Replsnt with full plant assemblage	As required	National Highways	Expected 10-25 years depending on basin drainage ratio.
	All grass verges, paths and access to SuDS features. All cuts at 35-50mm with 75mm max. All cuttings collected at first and last cut annually removed to wildlife or compost piles otherwise left in-situ.	Monthly in the growing season	National Highways	
	All filter strips, swales and margins to low flow channels. All cut at 75-100mm with 150mm max. All cuttings collected at first and last cut annually removed to wildlife or compost piles otherwise left in-situ.	Monthly in growing season	National Highways	
	All pond edges to be cut to 100mm during September-October annually or on a 3 year rotation and cuttings removed to wildlife or compost piles.	As required in growing season	National Highways	Avoid strimming where possible to minimise injury to fauna concealed in long grass.
	Any wildflower areas within SuDS features to be cut to 100mm during September-October annually and all cuttings removed to wildlife or compost piles.	Annually	National Highways	Avoid strimming where possible to minimise injury to fauna concealed in long grass.
	Excavate and remove 25% of accumulated silt (full depth) using an agreed methodology retaining a fully representative plant assemblage in the SuDS feature by replanting.	4-yearly	National Highways	
	Stack silt within silt storage area and allow to dewater before disposal offsite (48 hours minimum to 1 month maximum). Undertake WAC testing to define suitable waste disposal facility.	4-yearly	National Highways	
	Remove plant remains to wildlife piles on site.	Annually	National Highways	
4.0	**Extended Detention Basin**			
	Check sediment volume is less than 10% of basin volume.	Annually	National Highways	
	When sediment volume reaches 10% of basin volume, implement phased removal of all	As required	National Highways	Expected 10-25 years depending

Ref.	Activity	Frequency	Organisation Responsible	Notes
	sediment to restore original basin volume. Replant with full plant assemblage			on basin drainage ratio.
	An agreed area of wetland vegetation (25% max.) to be cut annually at 100mm above base. Avoid strimming, to reduce chance of injury to sheltering animals/insects).	Annually at end of growing season.	National Highways	
	All cuttings to be raked off and stacked in piles to allow dewatering for 48 hours. Remove cuttings to wildlife or compost piles on site. Work to be undertaken September – October or as this Schedule to avoid injury to protected wildlife.	Annually	National Highways	
	Erect temporary fence protection around sediment forebays only, to prevent access by children to potentially polluted silt if and where necessary during silt removal.	4-yearly	National Highways	
	Excavate and remove 25% of accumulated silt (full depth) to tally with area of removal of wetland vegetation, using an agreed methodology retaining a fully representative plant assemblage in the SuDS feature.	4-yearly	National Highways	
	Stack silt within silt storage area and allow to dewater before disposal offsite (48 hours minimum to 1 month maximum) Undertake WAC testing to define suitable waste disposal facility.	4-yearly	National Highways	
	Remove dead plants to wildlife piles on site.	Annually	National Highways	
5.0	**Planting**			
	Removal of overhanging branches or growth in SuDS features to be identified by arboriculturist and implemented by NH maintenance staff.	Annually	National Highways	
6.0	**Inlets, Outlets and Gratings**		National Highways	
	Inspect inlets and outlets and check for damage, blockages and silt accumulation.	Annually	National Highways	
	Remove all debris and silt from inlet/outlet aprons where present. Strim 1m area around structure where in grass or sweep to ensure unrestricted access.	Annually	National Highways	
	Inspect gratings monthly to check for damage, blockages and silt accumulation.	Annually	National Highways	
	Remove all debris and silt from apron below grating where present. Evaluate requirement to rod or jet pipe run at each inspection and annually after leaf fall. Strim 1m area around structure where in grass.	Annually	National Highways	
7.0	**Inspection and Flow Control Chambers**			

Ref.	Activity	Frequency	Organisation Responsible	Notes
	Inspect for damage and blockages after leaf fall. Remove accumulated debris and silt.	Annually	National Highways	
	Check Hydrobrake controls flow freely. Remove all debris and silt from flow control chamber.	Annually	National Highways	
8.0	**Silt Traps**			
	Inspect surface silt traps and forebays to basins and check for damage and blockages, removing silt at inlet, as required.	Annually	National Highways	
	Inspect below ground silt traps (catchpits) check for damage and blockages, removing silt as required.	Annually	National Highways	
10.0	**Flow Channels/Rills/Cascades (spillway)/Headwalls**			
	Inspect surface low flow channels and check for damage, blockages and silt accumulation removing all debris and silt as required.	Annually	National Highways	
	Inspect pipe routes/headwalls and evaluate requirement to rod any pipe.	Annually	National Highways	
	Rod or jet pipe runs after leaf fall. Remove silt and debris from site.	5 yearly	National Highways	
11.0	**Underground Storage Features**			
	Check inlets, outlets, control structures and overflows	Annually	National Highways	
	Rod or jet pipes through storage structures, including entries, exits, through-pipes, annually after leaf fall.	Annually	National Highways	
12.0	**Underground manholes & pipework**			
	Inspect manhole covers and interiors for damage, blockages and silt accumulation removing all debris and silt as required. Inspect/CCTV pipe routes and evaluate requirement to rod any pipe.	Prior to handover	National Highways	
	Inspect pipe routes and evaluate requirement to rod any pipe.	Annually	National Highways	
	Rod or jet pipe runs after leaf fall. Remove silt and debris from site.	5 yearly	National Highways	

Table 8.1 – Maintenance Schedule

9. References

A full list of cited documents is included in Table 9 below:

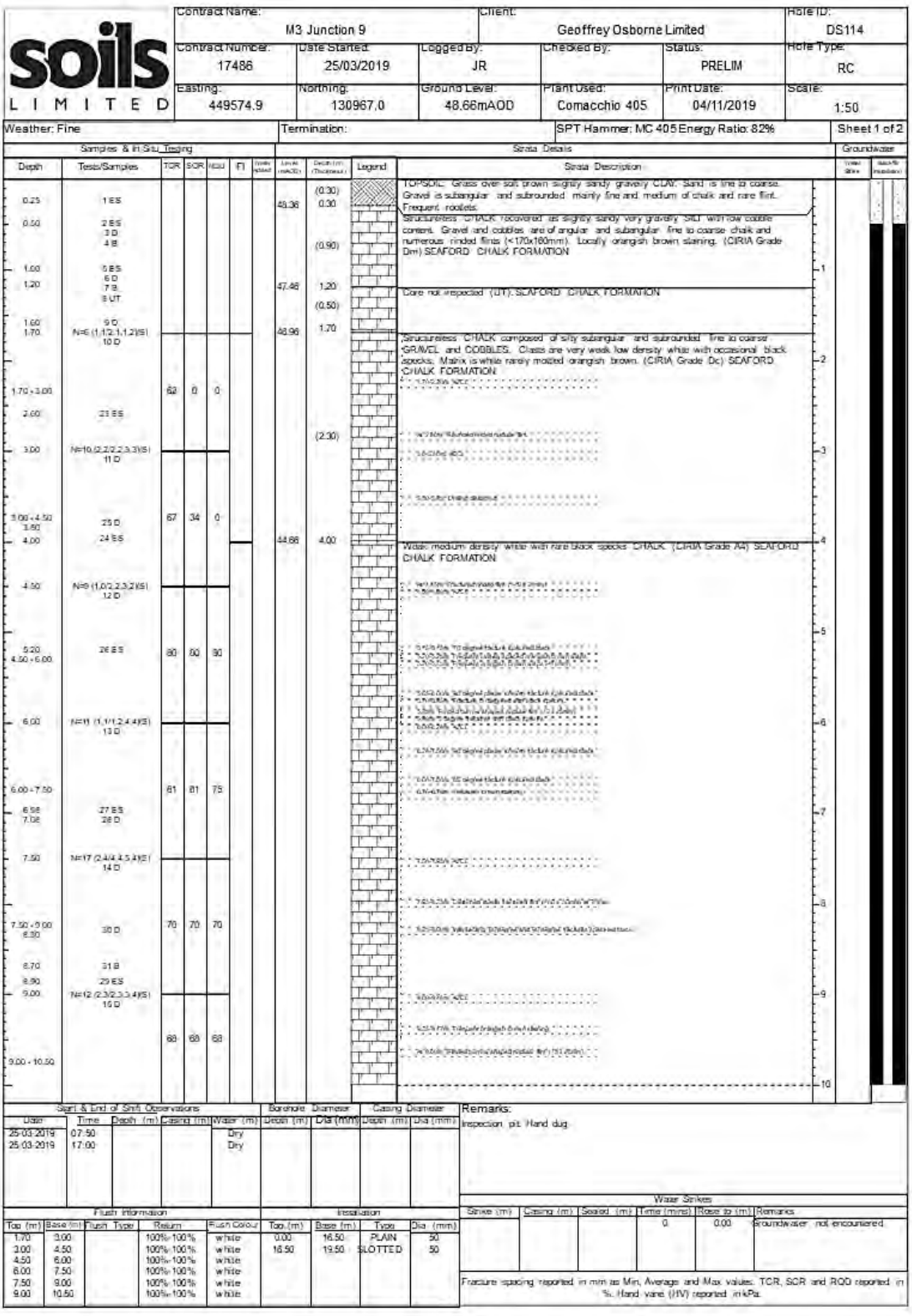
Document	Notes/web address	Citation Ref.
M3 Junction 9 Improvement Scheme: Drainage Strategy Report (2021), Stantec		DSR 2021
CIRIA C753, SUDS Manual		SUDS 2015
Factual Ground Investigation Report at M3 Junction 9 Improvement, for National Highways c/o Geoffrey Osborne Limited, Soils Ltd	HE551511-HEX-EGT-ZZ-RP-CE-0001_Factual Ground Investigation Report P03	GEO 2020
LA 113 - Road drainage and the water environment, DMRB.		LA113
CD 532 - Vegetated drainage systems for highway runoff		CD532
National River Flow Archive (NRFA) (2019). Gauging station No. 42016 – Itchen at Easton.	[redacted]	NRFA 2019
Guidance Manual for Constructed Wetlands R&D Technical Report P2-159/2003, Environment Agency		EA 2003
National Highways Water Risk Assessment Tool, v2.0.4		HEWRAT
DEFRA Report 14784 - Investigating the sources and pathways of synthetic fibre and vehicle tyre wear contamination into the marine environment		DEFRA
Microplastics in urban and highway stormwater retention ponds - Science of the Total Environment 671 (2019) 992–1000		TE 2019
Retention of microplastics in sediments of urban and highway stormwater retention ponds - Environmental Pollution 255 (2019) 113335		EP 2019
Microplastics in a Stormwater Pond - Water 2019, 11, 1466; doi:10.3390/w11071466 (Water 2019		Water 2019
Investigation of 'microplastics' from brake and tyre wear in road runoff – Task 1-902 Final project Report	[redacted]	MPBTW 2020

Table 9 – Full List of References and Citations

TECHNICAL NOTE

Appendix A Geotechnical Logs

Log for DS114



TECHNICAL NOTE

Log for TP11

Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel. 01737 814221 Email: admin@soilslimited.co.uk		Trial Pit Log	Trial Pit No. TP11 Sheet 1 of 1
Project Name: M3 Junction 9	Project No.: 17486	Method: Plant: 8t tracked excavator Support:	Hole Type TP
Location:			Scale 1:25
Client: Geoffrey Osborne Limited	Trial Pit Length: 3.00m	Trial Pit Width: 0.60m	Logged By JT
Dates: 22/03/2019	Level: 53.43m AOD	Co-ords: E449726.56 N130950.40	

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (mAOD)	Legend	Stratum Description
							MADE GROUND: Dark brown gravelly fine to coarse slightly organic clayey SAND with occasional rootlets. Gravel is angular to subrounded fine to coarse of flint and chalk with rare gravel sized brick fragments.
	0.25	D ES		0.25	53.18		Structureless CHALK composed of silty subangular to subrounded GRAVEL. Clasts are very weak to weak medium to high density. Matrix is off white with heavy orange brown staining and brown silty sand. (CIRIA Grade Dc). SEAFORD CHALK FORMATION 0.25-0.45m: Periglacial striping locally with ... infill of light brown fine to medium clayey sand (Head) approximately 300mm wide and 300mm apart. 0.60m: Cobble (100 x 150mm) of subrounded nodular flint.
	0.30	D ES					
	0.50	B D ES					
				0.65	52.78		Structureless CHALK composed of off white slightly sandy very gravelly SILT. Gravel is very weak to weak medium to high density subangular locally stained orange brown off white. Occasional cobbles (100mm x 120mm) of flint. (CIRIA Grade Dm). SEAFORD CHALK FORMATION 0.80-1.50m: Collapse on western and eastern edge of pit.
	1.00	B D D ES					
				1.40	52.03		Structureless CHALK composed of very silty subangular to subrounded GRAVEL. Clasts are very weak to weak medium to high density locally orange brown stained. Matrix is off white with occasional pockets (20mm x 100mm) of chalky clay. With rare cobbles (80mm x 100mm) of nodular flint. (CIRIA Grade Dc). SEAFORD CHALK FORMATION 1.40m: Tubular cobble (160 x 110mm) of flint. 1.50-2.00m: Collapse on western face.
	2.00	B D D ES					
				2.90	50.53		Structureless CHALK composed of off white slightly sandy very gravelly SILT. Gravel is very weak to weak medium to high density subangular. (CIRIA Grade Dm). SEAFORD CHALK FORMATION
	3.00	B D D ES					
	4.00	B B D ES		4.00	49.43		End of Pit at 4.000m

General Remarks: No visible/olfactory evidence of contamination. Between 0.8-1.5m: Collapse on western and eastern edge of pit. Between 1.5-3.0m: Collapse on western face. Trial pit was backfilled with soil arisings and compacted by excavator every 300mm on completion.

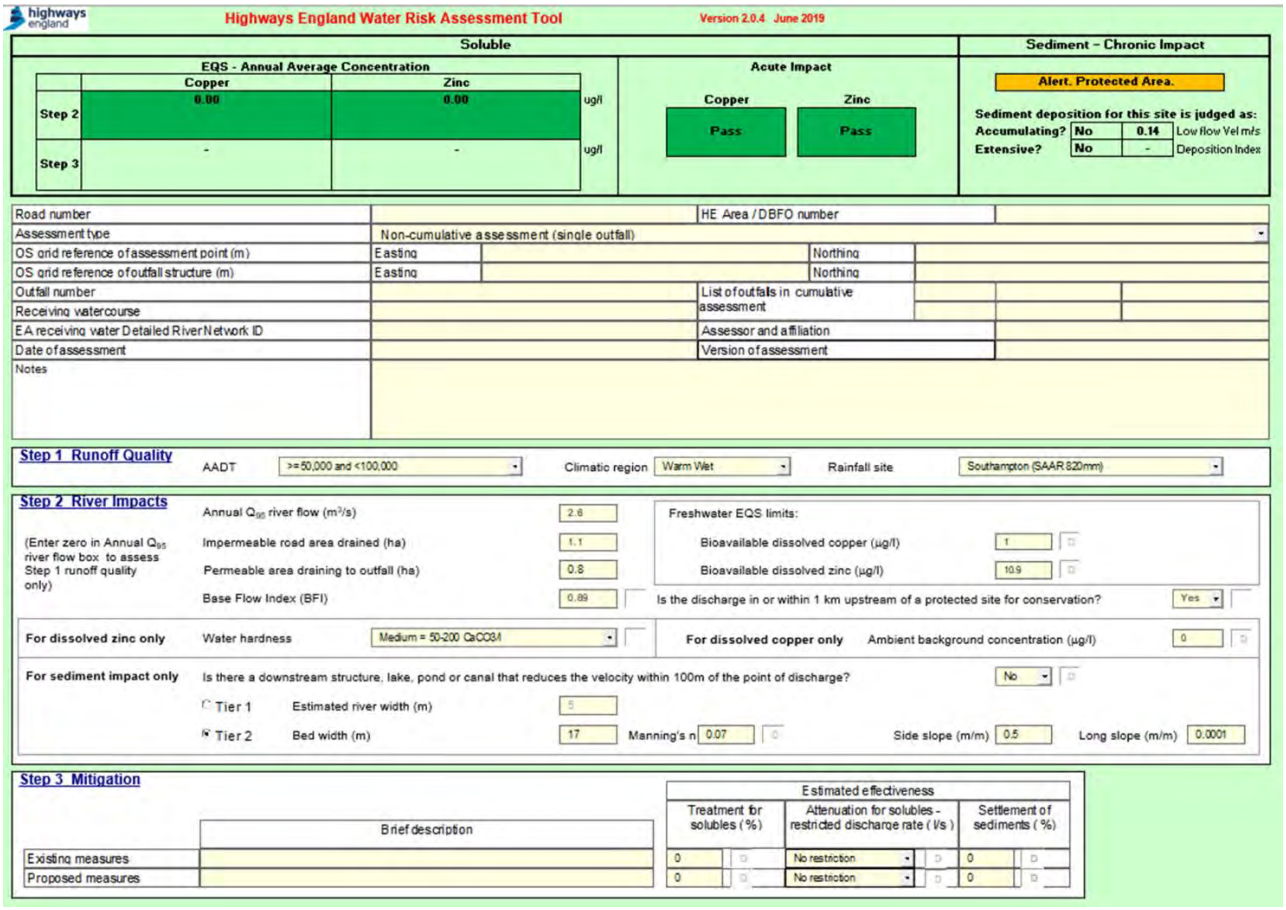
Groundwater Remarks: Groundwater not encountered

Sample Type: D: Disturbed, B: Bulk, J: Jar, W: Water

TECHNICAL NOTE

Appendix B HEWRAT baseline results for existing M3 drainage

Existing A34 SB outfall @ North side of A34 bridge - HEWRAT Watercourse Assessment



highways england — Highways England Water Risk Assessment Tool — Version 2.0.4 June 2019

Soluble				Acute Impact		Sediment – Chronic Impact
EQS - Annual Average Concentration	Copper	Zinc		Copper	Zinc	Alert. Protected Area.
Step 2	0.00	0.00	ug/l	Pass	Pass	Sediment deposition for this site is judged as:
Step 3	-	-	ug/l			Accumulating? No 0.14 Low flow Vel m/s
						Extensive? No - Deposition Index

Road number		HE Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number		List of outfalls in cumulative assessment			
Receiving watercourse					
EA receiving water Detailed River Network ID		Assessor and affiliation			
Date of assessment		Version of assessment			
Notes					

Step 1 Runoff Quality — AADT: >=50,000 and <100,000 — Climatic region: Warm Wet — Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6	Freshwater EQS limits:	
Impermeable road area drained (ha)	1.1	Bioavailable dissolved copper (µg/l)	1
Permeable area draining to outfall (ha)	0.8	Bioavailable dissolved zinc (µg/l)	10.9
Base Flow Index (BFI)	0.89	Is the discharge in or within 1 km upstream of a protected site for conservation?	Yes

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3/l — **For dissolved copper only** — Ambient background concentration (µg/l): 0

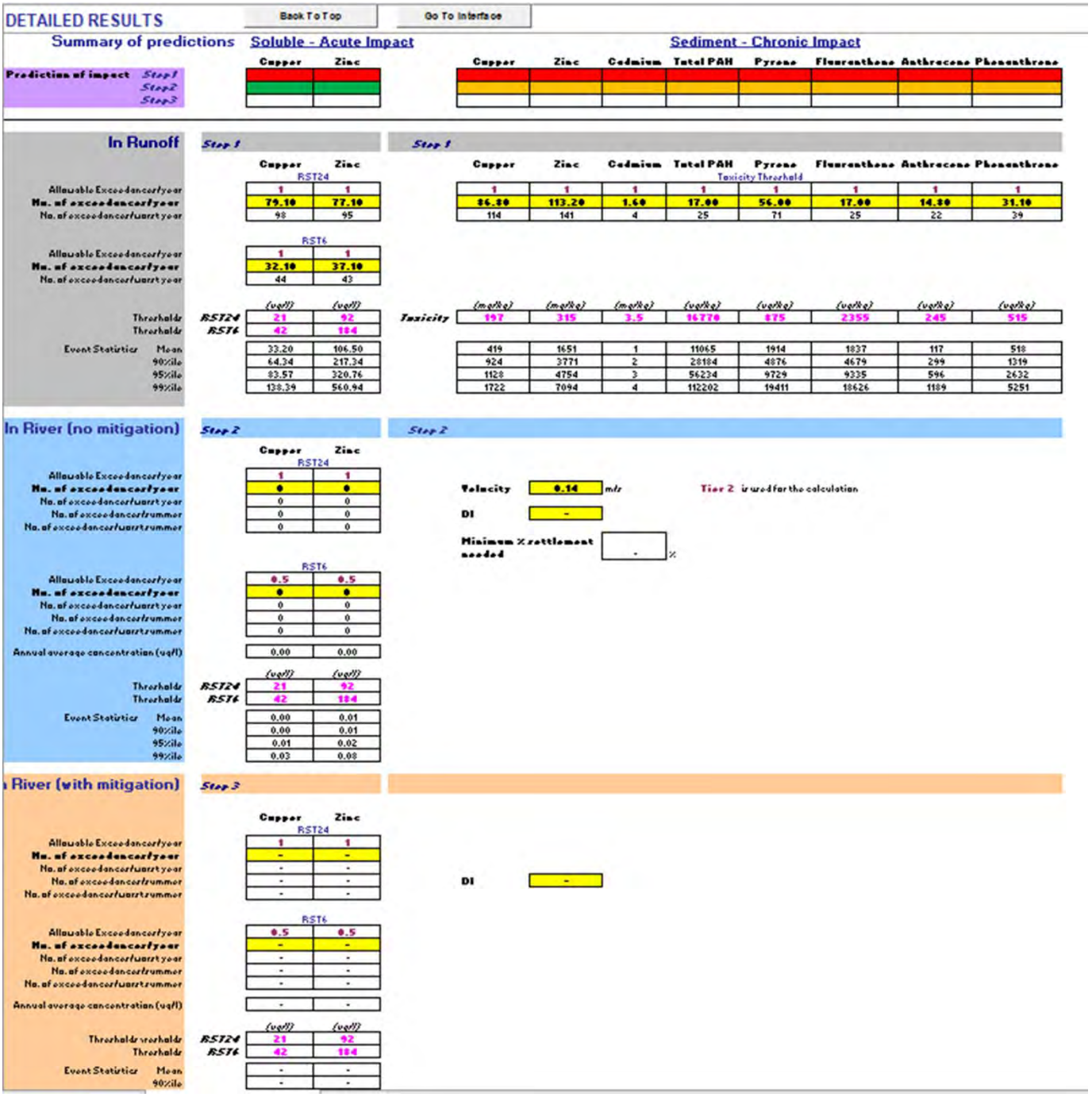
For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 17 — Manning's n: 0.07 — Side slope (m/m): 0.5 — Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	No restriction	0
Proposed measures		0	No restriction	0



DETAILED RESULTS

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Summary of predictions

Soluble - Acute Impact

Prediction of impact	Copper	Zinc
Step1		
Step2		
Step3		

Sediment - Chronic Impact

Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedance/year	1	1
No. of exceedance/year	79.10	77.10
No. of exceedance/summer year	98	95
RST6		
Allowable Exceedance/year	1	1
No. of exceedance/year	32.10	37.10
No. of exceedance/summer year	44	43
	(ug/l)	(ug/l)
Threshold RST24	21	92
Threshold RST6	42	184
Event Statistics Mean	33.20	106.50
90%ile	64.24	217.34
95%ile	83.57	320.76
99%ile	138.39	560.94

Step 1

Toxicity Threshold

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedance/year	1	1	1	1	1	1	1	1
No. of exceedance/year	86.80	113.20	1.60	17.00	56.00	17.00	14.80	31.10
No. of exceedance/summer year	114	141	4	25	71	25	22	39
Toxicity	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
	197	315	3.5	16770	875	2355	245	515
	419	1651	1	11065	1914	1837	117	518
	924	3771	2	28184	4876	4679	299	1319
	1128	4754	3	56224	9729	9335	596	2632
	1722	7094	4	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedance/year	1	1
No. of exceedance/year	0	0
No. of exceedance/summer year	0	0
No. of exceedance/summer	0	0
No. of exceedance/summer summer	0	0
RST6		
Allowable Exceedance/year	0.5	0.5
No. of exceedance/year	0	0
No. of exceedance/summer year	0	0
No. of exceedance/summer	0	0
No. of exceedance/summer summer	0	0
Annual average concentration (ug/l)	0.00	0.00
	(ug/l)	(ug/l)
Threshold RST24	21	92
Threshold RST6	42	184
Event Statistics Mean	0.00	0.01
90%ile	0.00	0.01
95%ile	0.01	0.02
99%ile	0.03	0.08

Step 2

Velocity 0.14 m/s — Tier 2 is used for the calculation

DI -

Minimum % settlement needed - %

River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedance/year	1	1
No. of exceedance/year	-	-
No. of exceedance/summer year	-	-
No. of exceedance/summer	-	-
No. of exceedance/summer summer	-	-
RST6		
Allowable Exceedance/year	0.5	0.5
No. of exceedance/year	-	-
No. of exceedance/summer year	-	-
No. of exceedance/summer	-	-
No. of exceedance/summer summer	-	-
Annual average concentration (ug/l)	-	-
	(ug/l)	(ug/l)
Threshold RST24	21	92
Threshold RST6	42	184
Event Statistics Mean	-	-
90%ile	-	-

DI -

Existing M3 Soakaway Ditch - HEWRAT Groundwater Assessment

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	>50 to <150	2	20
4	PATHWAY	15	Infiltration method	"Continuous", shallow linear (e.g. unlined ditch, swale, grassed channel)	1	15
5		20	Unsaturated zone	Depth to water table <=5 m	3	60
6		20	Flow type (Incorporates flow type an effective grain size)	Flow dominated by fractures/ fissures (e.g. well consolidated sedimentary deposits, igneous and metamorphic rocks or unconsolidated deposits of very coarse sand and coarser)	3	60
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	245
RISK SCREENING LEVEL	Medium

Existing M3 Soakaway Ditch - HEWRAT Spillage Assessment

highways england

View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F		
D1	Water body type	Groundwater							
D2	Length of road draining to outfall *(m)*	1,600							
D3	Road Type *(A-road or Motorway)*	M							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Slip road							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	149,000							
D8	% HGV	15							
D8	Spillage factor *(no/10⁹ HGVkm/year)*	0.43							
D9	Risk of accidental spillage	0.00561	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60							
D11	Risk of pollution incident	0.00337	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No						Totals	Return Period
D13	Return period without pollution reduction measures	0.00337	0.00000	0.00000	0.00000	0.00000	0.00000	0.0034	297
D14	Existing measures factor	0.6							
D15	Return period with existing pollution reduction	0.00202	0.00000	0.00000	0.00000	0.00000	0.00000	0.0020	495
D16	Proposed measures factor	0.6							
D17	Residual with proposed Pollution reduction measures	0.00121	0.00000	0.00000	0.00000	0.00000	0.00000	0.0012	825

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Existing A34 SB Pollution Control Device - HEWRAT Spillage Assessment

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View Parameters | Reset Spillage Risk | Go To Interface

D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	No junction							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	87,000							
D8	% HGV	15							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29							
D9	Risk of accidental spillage	0.00069	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60							
D11	Risk of pollution incident	0.00041	0.00000	0.00000	0.00000	0.00000	0.00000	Totals	Return Period (years)
D12	Is risk greater than 0.01?	**No**							
D13	Return period without pollution reduction measures	0.00041	0.00000	0.00000	0.00000	0.00000	0.00000	0.0004	2413
D14	Existing measures factor	0.5							
D15	Return period with existing pollution reduction	0.00021	0.00000	0.00000	0.00000	0.00000	0.00000	0.0002	4826
D16	Proposed measures factor	0.7							
D17	Residual with proposed Pollution reduction measures	0.00015	0.00000	0.00000	0.00000	0.00000	0.00000	0.0001	6895

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

TECHNICAL NOTE

Appendix C HEWRAT Proposed Drainage Results - Summary Table and Individual Basin results

HEWRAT Inputs/Outputs Summary Table (Proposed M3J9 basins)

M3J9 - Water Quality Assessment - Summary Table 2021 07 30

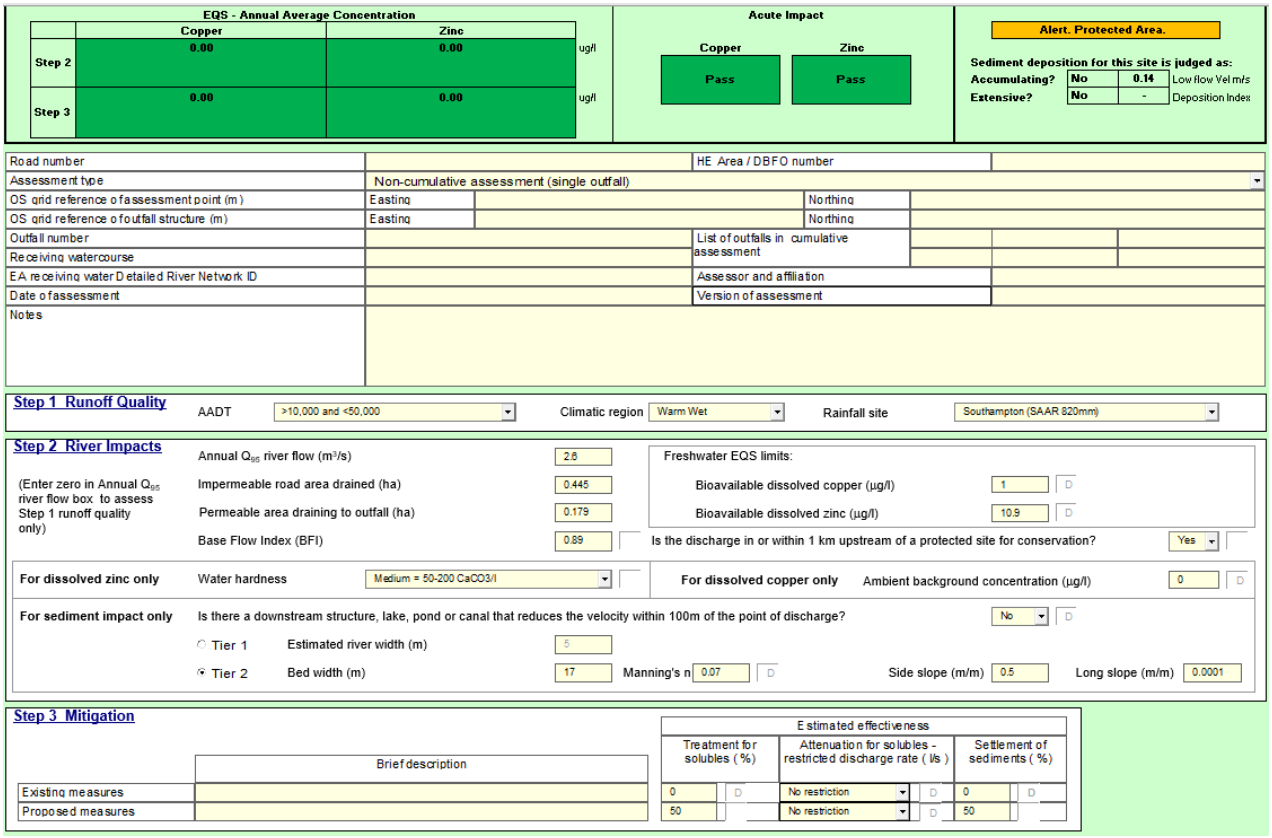
Basin/ Soakaway	SUDS type	Drained Highway Area	Drained Basin area	Total Drained area	Basin Base Area	Drainage Area Ratio	Hydraulic Loading Rate	Basin volume	100m3/ha indicative primary treatment vol.	200m3/ha indicative secondary treatment vol.
ref		ha (sum)	ha (sum)	ha (sum)	ha	ha	mm/day	m3	m3	m3
1	Infiltration Basin	0.612	2.170	2.812	0.018	19	80	1,290	61	
2	IDB	1.258	0.555	1.617	0.188	10	21	5,500		
3A	Detention Basin	7.631	0.410	8.129	0.056	146	293	4,865	763	
3B	Infiltration Basin	8.180	0.685	8.973	0.148	57	122	3,020	818	
3C	IDB	9.550	1.072	10.631	0.255	37	81	7,650		1,910
4	Detention Basin	5.784	0.128	6.213	0.035	165	356	2,000	578	
5	Infiltration Basin	1.681	76.000	77.7	0.300	6	12	5,500		
6	Infiltration Basin	0.000	14.000	14.0	0.146	0	0	29,900		
7	Geocell (blue bridges)	0.427	0.000	0.481	0.020	n/a		228		
Exg A38/A38 outfall to [illegible]	Outfall	1.100	0.800	1.900	n/a	n/a		n/a		
Exg M3 Mainline Soakaway Ditch	Infiltration Ditch	5.630	0.000	5.670	0.07	80		87	563	1,126
Totals										

Notes:

1. HEWRAT flags up 'Alert Protected Area' for all SW discharges to protected conservation sites - EA approval required to satisfy HEWRAT alert.
2. HEWRAT detailed parameters and results are included in separate tabs for all storage/disposal features.
3. *Medium Risk* screening results for discharge to groundwater - Requirement for further quantitative modelling to be confirmed with EA.
4. [illegible]

Individual Basin HEWRAT Results

Basin 1 – Watercourse Assessment



EQS - Annual Average Concentration	Copper	Zinc	
Step 2	0.00	0.00	ug/l
Step 3	0.00	0.00	ug/l

Acute Impact	Copper	Zinc
	Pass	Pass

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Road number			HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number			List of outfalls in cumulative assessment		
Receiving watercourse					
EA receiving water Detailed River Network ID			Assessor and affiliation		
Date of assessment			Version of assessment		
Notes					

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6
Impermeable road area drained (ha)	0.445
Permeable area draining to outfall (ha)	0.179
Base Flow Index (BFI)	0.89

Freshwater EQS limits:

Bioavailable dissolved copper (µg/l)	1
Bioavailable dissolved zinc (µg/l)	10.9

Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3/l

For dissolved copper only — Ambient background concentration (µg/l): 0

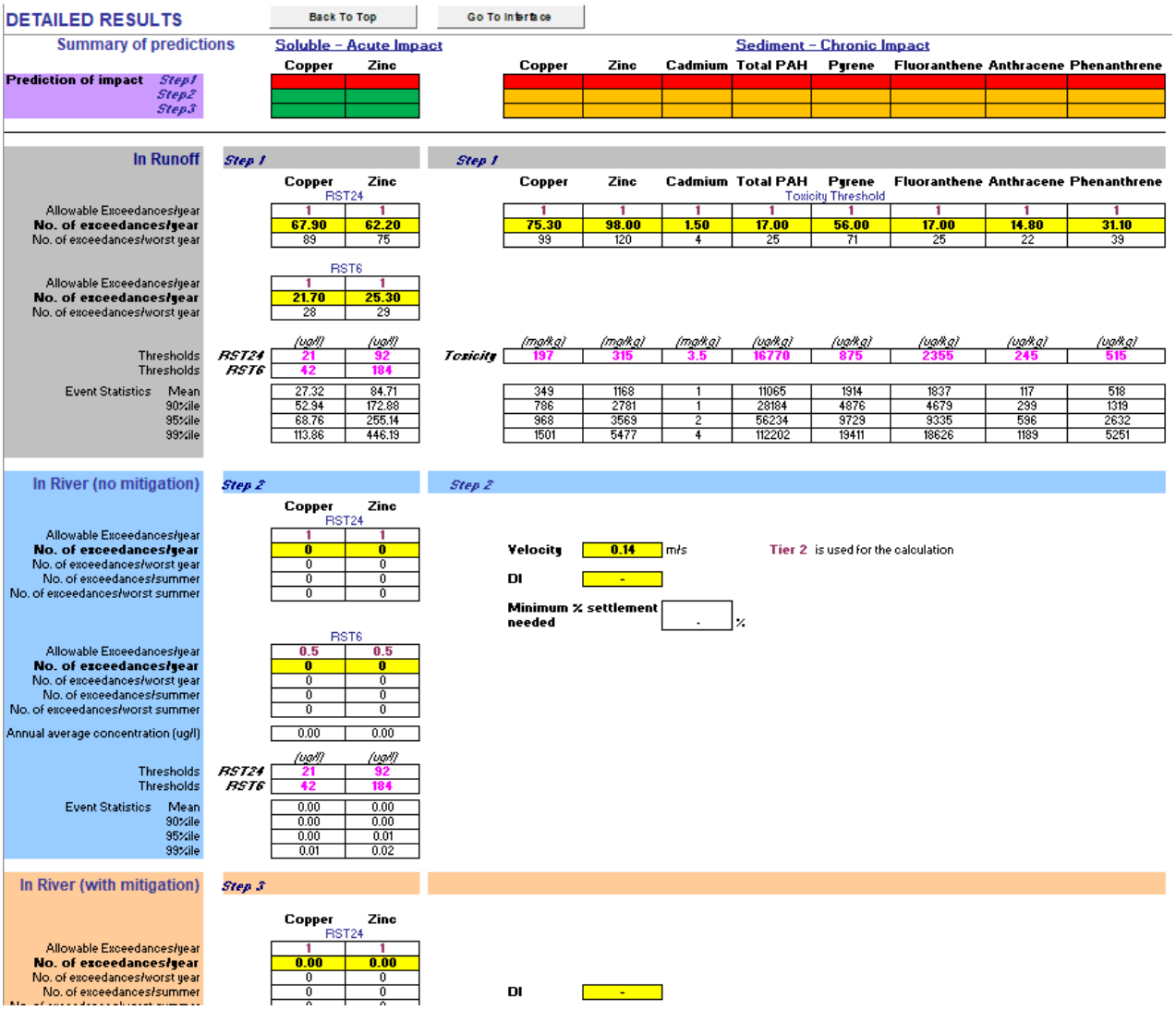
For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 17 | Manning's n: 0.07 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	No restriction	0
Proposed measures		50	No restriction	50



DETAILED RESULTS

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Summary of predictions

Soluble – Acute Impact

Sediment – Chronic Impact

Prediction of impact	Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**67.90**	**62.20**
No. of exceedances/worst year	89	75
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**21.70**	**25.30**
No. of exceedances/worst year	28	29
	(ug/l)	(ug/l)
Thresholds RST24	21	92
Thresholds RST6	42	184
Event Statistics Mean	27.32	84.71
90%ile	52.94	172.88
95%ile	68.76	255.14
99%ile	113.86	446.19

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold								
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**75.30**	**98.00**	**1.50**	**17.00**	**56.00**	**17.00**	**14.80**	**31.10**
No. of exceedances/worst year	99	120	4	25	71	25	22	39
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	349	1168	1	11065	1914	1837	117	518
90%ile	786	2781	1	28184	4876	4679	299	1319
95%ile	968	3569	2	56234	9729	9335	596	2632
99%ile	1501	5477	4	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.00
	(ug/l)	(ug/l)
Thresholds RST24	21	92
Thresholds RST6	42	184
Event Statistics Mean	0.00	0.00
90%ile	0.00	0.00
95%ile	0.00	0.01
99%ile	0.01	0.02

Step 2

Velocity 0.14 m/s — Tier 2 is used for the calculation

DI -

Minimum % settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0

DI -

Basin 1 - HEWRAT Groundwater Assessment

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	<=50,000 AADT	1	10
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <15 m to >5 m	2	40
6		20	Flow type (Incorporates flow type an effective grain size)	Flow dominated by fractures/ fissures (e.g. well consolidated sedimentary deposits, igneous and metamorphic rocks or unconsolidated deposits of very coarse sand and coarser)	3	60
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	210
RISK SCREENING LEVEL	Medium

Basin 1 - HEWRAT Spillage Assessment

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View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F	Totals	Return Period
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	1,000							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Roundabout							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	16,731							
D8	% HGV	15							
D8	Spillage factor *(no/10^9 HGVkm/year)*	3.09							
D9	Risk of accidental spillage	0.00283	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60							
D11	Risk of pollution incident	0.00170	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No						Totals	Return Period
D13	Return period without pollution reduction measures	0.00170	0.00000	0.00000	0.00000	0.00000	0.00000	0.0017	589
D14	Existing measures factor	0.7							
D15	Return period with existing pollution reduction	0.00119	0.00000	0.00000	0.00000	0.00000	0.00000	0.0012	841
D16	Proposed measures factor	0.6							
D17	Residual with proposed Pollution reduction measures	0.00071	0.00000	0.00000	0.00000	0.00000	0.00000	0.0007	1402

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

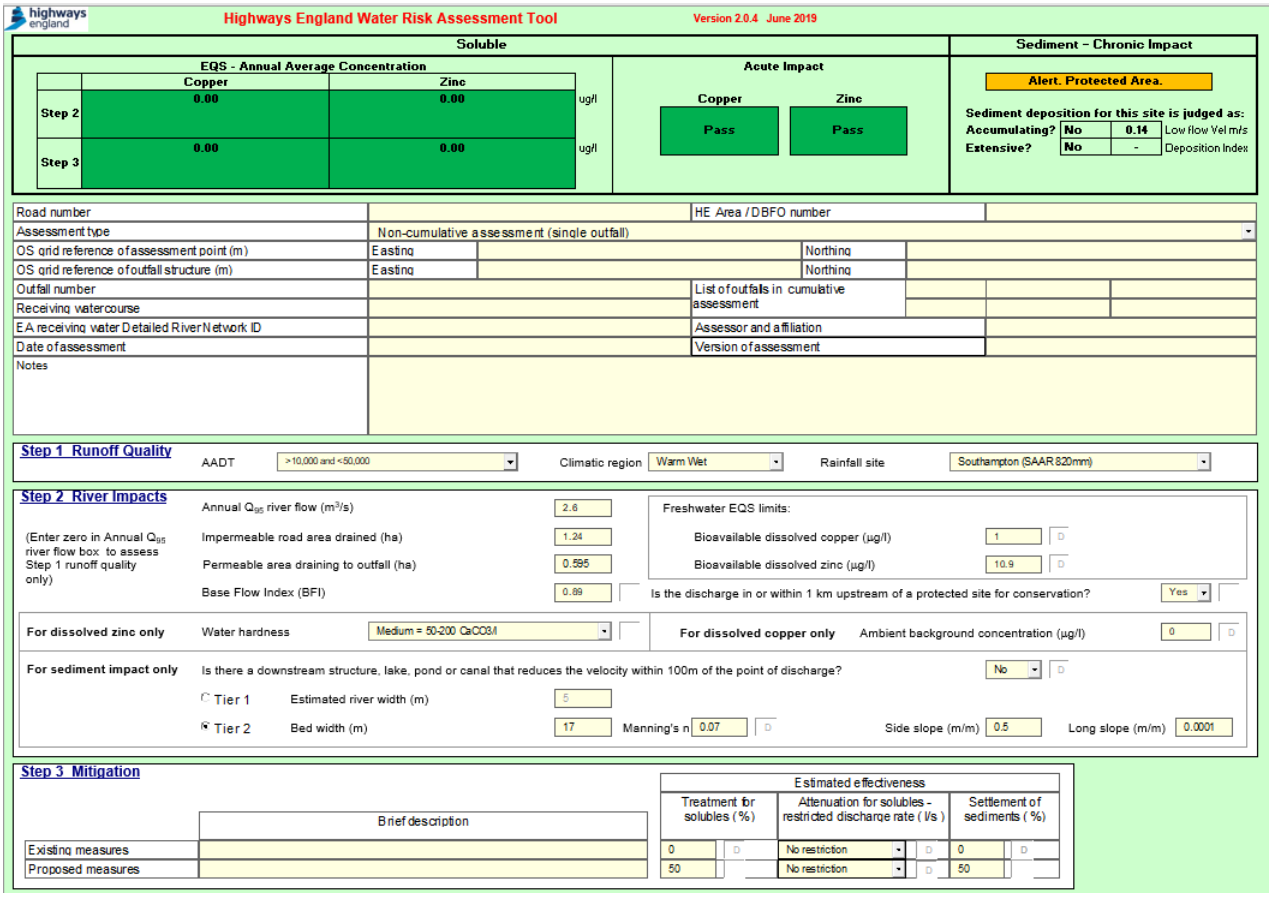
Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Basin 2 – Watercourse Assessment



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Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble				Sediment – Chronic Impact
EQS - Annual Average Concentration			Acute Impact	
	Copper	Zinc	Copper / Zinc	Alert. Protected Area.
Step 2	0.00	0.00 ug/l	Pass / Pass	Sediment deposition for this site is judged as:
Step 3	0.00	0.00 ug/l		Accumulating? No 0.14 Low flow Vel m/s
				Extensive? No - Deposition Index

Road number			HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number			List of outfalls in cumulative assessment		
Receiving watercourse					
EA receiving water Detailed River Network ID			Assessor and affiliation		
Date of assessment			Version of assessment		
Notes					

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

		Freshwater EQS limits:	
Annual Q_{95} river flow (m^3/s)	2.6		
Impermeable road area drained (ha)	1.24	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	0.595	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.89	Is the discharge in or within 1 km upstream of a protected site for conservation?	Yes

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3/l

For dissolved copper only — Ambient background concentration (µg/l): 0 D

For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 17 | Manning's n: 0.07 D | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures		50	No restriction D	50

DETAILED RESULTS

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In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**67.90**	**62.20**
No. of exceedances/worst year	89	75
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**21.70**	**25.30**
No. of exceedances/worst year	28	29
Thresholds RST24 [ug/l]	21	92
Thresholds RST6 [ug/l]	42	184
Event Statistics Mean	27.32	84.71
90%ile	52.94	172.88
95%ile	68.76	255.14
99%ile	113.86	446.19

Step 1

Toxicity	Copper [mg/kg]	Zinc [mg/kg]	Cadmium [mg/kg]	Total PAH [ug/kg]	Pyrene [ug/kg]	Fluoranthene [ug/kg]	Anthracene [ug/kg]	Phenanthrene [ug/kg]
Toxicity Threshold	197	315	3.5	16770	875	2355	245	515
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**75.30**	**98.00**	**1.50**	**17.00**	**56.00**	**17.00**	**14.80**	**31.10**
No. of exceedances/worst year	99	120	4	25	71	25	22	39
Event Statistics Mean	349	1168	1	11065	1914	1837	117	518
90%ile	786	2781	1	28184	4876	4679	239	1319
95%ile	968	3569	2	56234	9729	9335	596	2632
99%ile	1501	5477	4	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.00
Thresholds RST24 [ug/l]	21	92
Thresholds RST6 [ug/l]	42	184
Event Statistics Mean	0.00	0.00
90%ile	0.00	0.01
95%ile	0.01	0.02
99%ile	0.02	0.07

Step 2

Velocity 0.14 m/s — **Tier 2** is used for the calculation

DI -

Minimum % settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.00
Thresholds RST24 [ug/l]	21	92
Thresholds RST6 [ug/l]	42	184

DI -

Basin 2 - HEWRAT Groundwater Assessment

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	<=50,000 AADT	1	10
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <=5 m	3	60
6		20	Flow type (Incorporates flow type an effective grain size)	Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer)	1	20
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	190
RISK SCREENING LEVEL	Medium

Basin 2 - HEWRAT Spillage Assessment

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View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F		
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	1,000							
D3	Road Type *(A-road or Motorway)*	M							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Roundabout							
D6	Location (response time for emergency services)	> 1 hour							
D7	Traffic flow (AADT two way)	50,000							
D8	% HGV	15							
D8	Spillage factor *(no/10⁹ HGVkm/year)*	3.09							
D9	Risk of accidental spillage	0.00846	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.75							
D11	Risk of pollution incident	0.00634	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No						Totals	Return Period
D13	Return period without pollution reduction measures	0.00634	0.00000	0.00000	0.00000	0.00000	0.00000	0.0063	158
D14	Existing measures factor	0.7							
D15	Return period with existing pollution reduction	0.00444	0.00000	0.00000	0.00000	0.00000	0.00000	0.0044	225
D16	Proposed measures factor	0.6							
D17	Residual with proposed Pollution reduction measures	0.00266	0.00000	0.00000	0.00000	0.00000	0.00000	0.0027	375

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

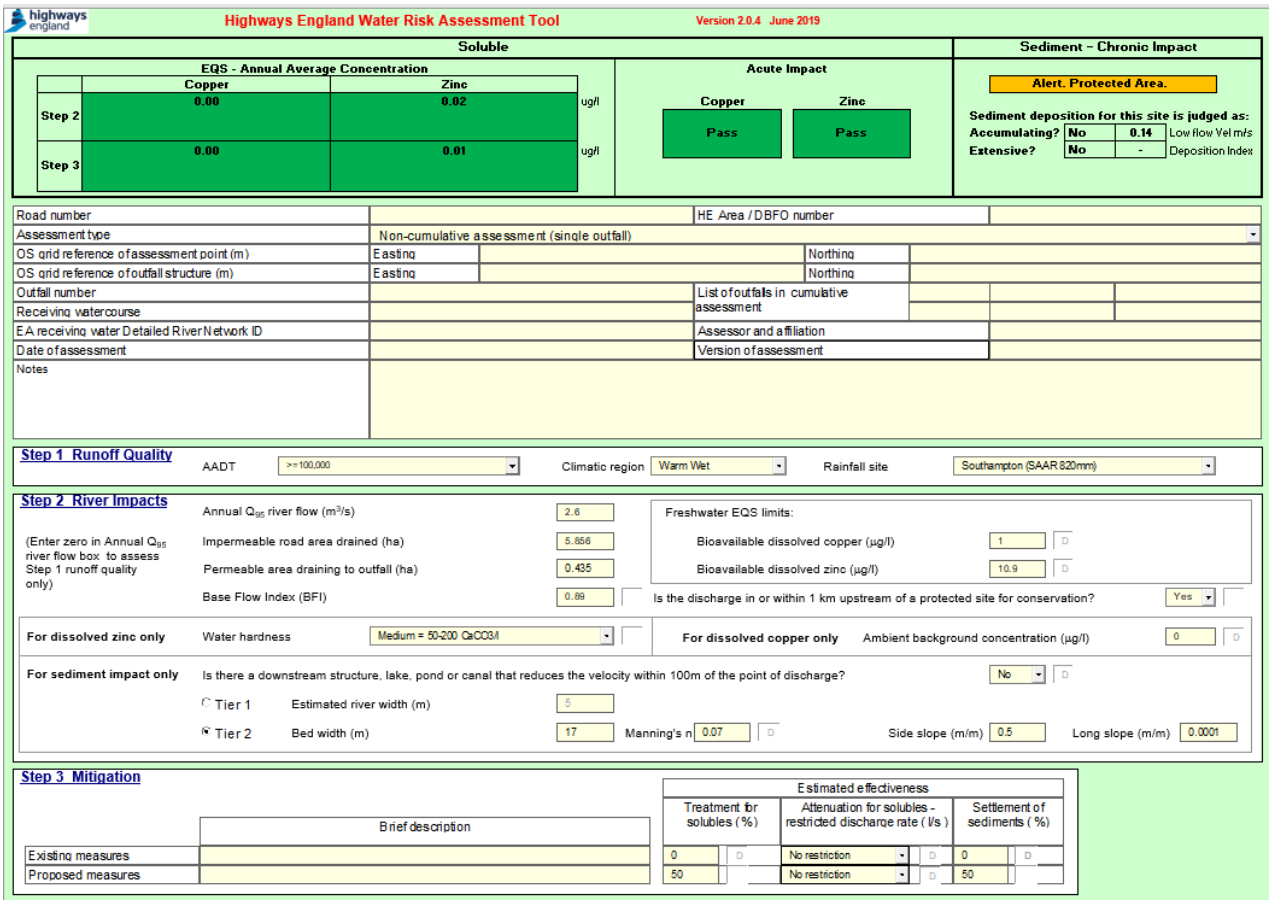
Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Basin 3A – Watercourse Assessment



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Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble				Sediment – Chronic Impact
EQS - Annual Average Concentration			Acute Impact	
	Copper	Zinc		Alert. Protected Area.
Step 2	0.00	0.02 ug/l	Copper: Pass	Sediment deposition for this site is judged as:
Step 3	0.00	0.01 ug/l	Zinc: Pass	Accumulating? No 0.14 Low flow Vel m/s
				Extensive? No - Deposition Index

Road number			HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number			List of outfalls in cumulative assessment		
Receiving watercourse					
EA receiving water Detailed River Network ID			Assessor and affiliation		
Date of assessment			Version of assessment		
Notes					

Step 1 Runoff Quality

AADT: >=100,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6	
Impermeable road area drained (ha)	5.856	
Permeable area draining to outfall (ha)	0.435	
Base Flow Index (BFI)	0.89	

Freshwater EQS limits:

Bioavailable dissolved copper (µg/l)	1	D
Bioavailable dissolved zinc (µg/l)	10.9	D

Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3/l

For dissolved copper only — Ambient background concentration (µg/l): 0 D

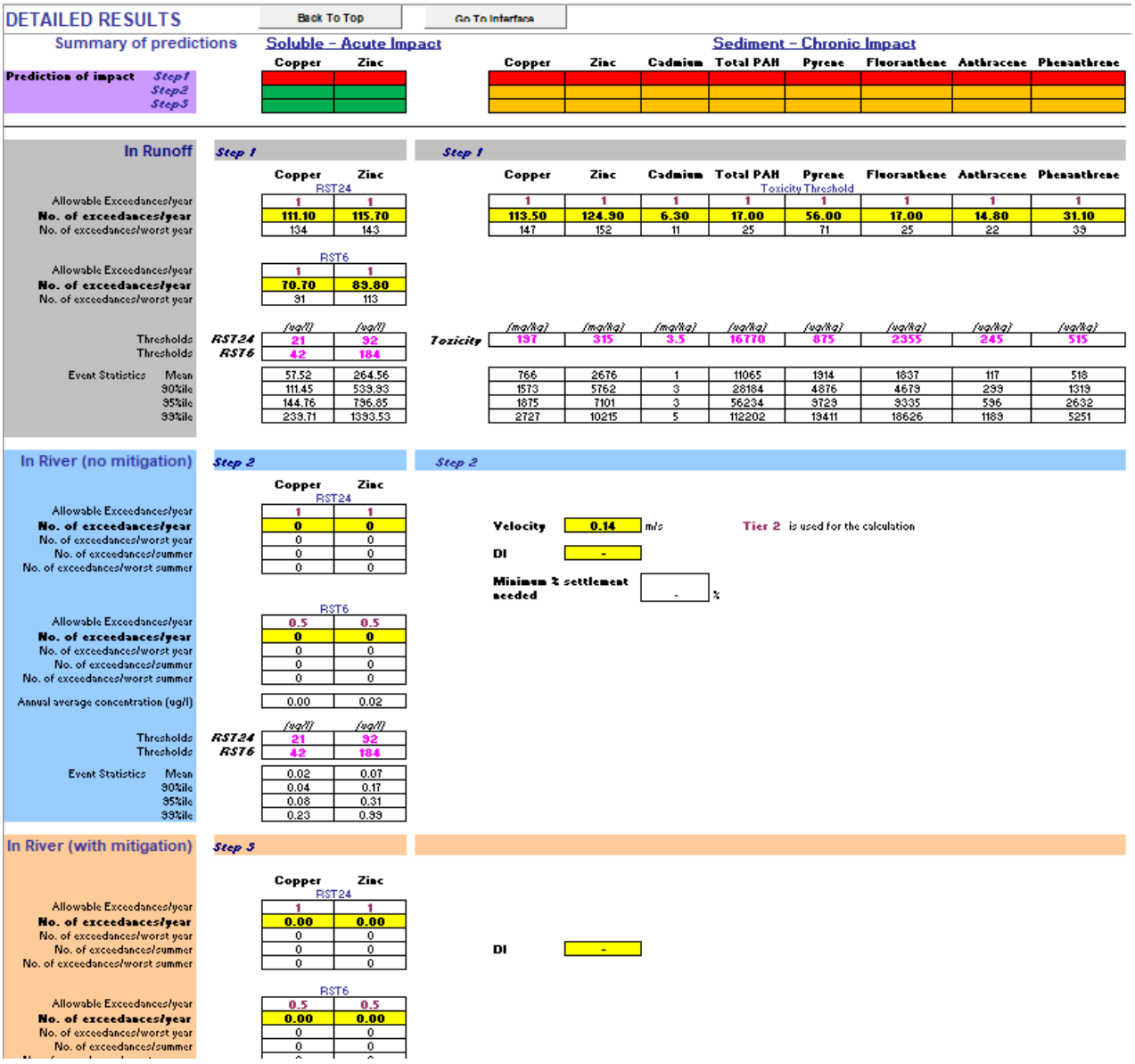
For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 17 | Manning's n: 0.07 D | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures		50	No restriction D	50



DETAILED RESULTS

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Summary of predictions

Soluble – Acute Impact

Sediment – Chronic Impact

Prediction of impact	Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	111.10	115.70
No. of exceedances/worst year	134	143
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	70.70	89.80
No. of exceedances/worst year	91	113
Thresholds RST24	21	92
Thresholds RST6	42	184
Event Statistics Mean	57.52	264.56
90%ile	111.45	539.93
95%ile	144.76	796.85
99%ile	239.71	1393.53

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold								
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	113.50	124.90	6.30	17.00	56.00	17.00	14.80	31.10
No. of exceedances/worst year	147	152	11	25	71	25	22	39
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	766	2676	1	11065	1314	1837	117	518
90%ile	1573	5762	3	28184	4876	4679	299	1319
95%ile	1875	7101	3	56234	3729	9335	596	2632
99%ile	2727	10215	5	112202	13411	18626	1189	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	0	0
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	0	0
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.02
Thresholds RST24	21	92
Thresholds RST6	42	184
Event Statistics Mean	0.02	0.07
90%ile	0.04	0.17
95%ile	0.08	0.31
99%ile	0.23	0.99

Step 2

Velocity 0.14 m/s — Tier 2 is used for the calculation

DI -

Minimum % settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	0.00	0.00
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	0.00	0.00
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0

DI -

Basin 3A - HEWRAT Groundwater Assessment

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	>50 to <150	2	20
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <=5 m	3	60
6		20	Flow type (Incorporates flow type an effective grain size)	Flow dominated by fractures/ fissures (e.g. well consolidated sedimentary deposits, igneous and metamorphic rocks or unconsolidated deposits of very coarse sand and coarser)	3	60
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	260
RISK SCREENING LEVEL	High

Basin 3A - HEWRAT Spillage Assessment

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View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F		
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	2,250							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Roundabout							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	28,000							
D8	% HGV	15							
D8	Spillage factor *(no/10^9 HGVkm/year)*	3.09							
D9	Risk of accidental spillage	0.01066	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60							
D11	Risk of pollution incident	0.00639	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**						**Totals**	**Return Period**
D13	Return period without pollution reduction measures	0.00639	0.00000	0.00000	0.00000	0.00000	0.00000	0.0064	156
D14	Existing measures factor	0.6							
D15	Return period with existing pollution reduction	0.00384	0.00000	0.00000	0.00000	0.00000	0.00000	0.0038	261
D16	Proposed measures factor	0.4							
D17	Residual with proposed Pollution reduction measures	0.00153	0.00000	0.00000	0.00000	0.00000	0.00000	0.0015	652

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

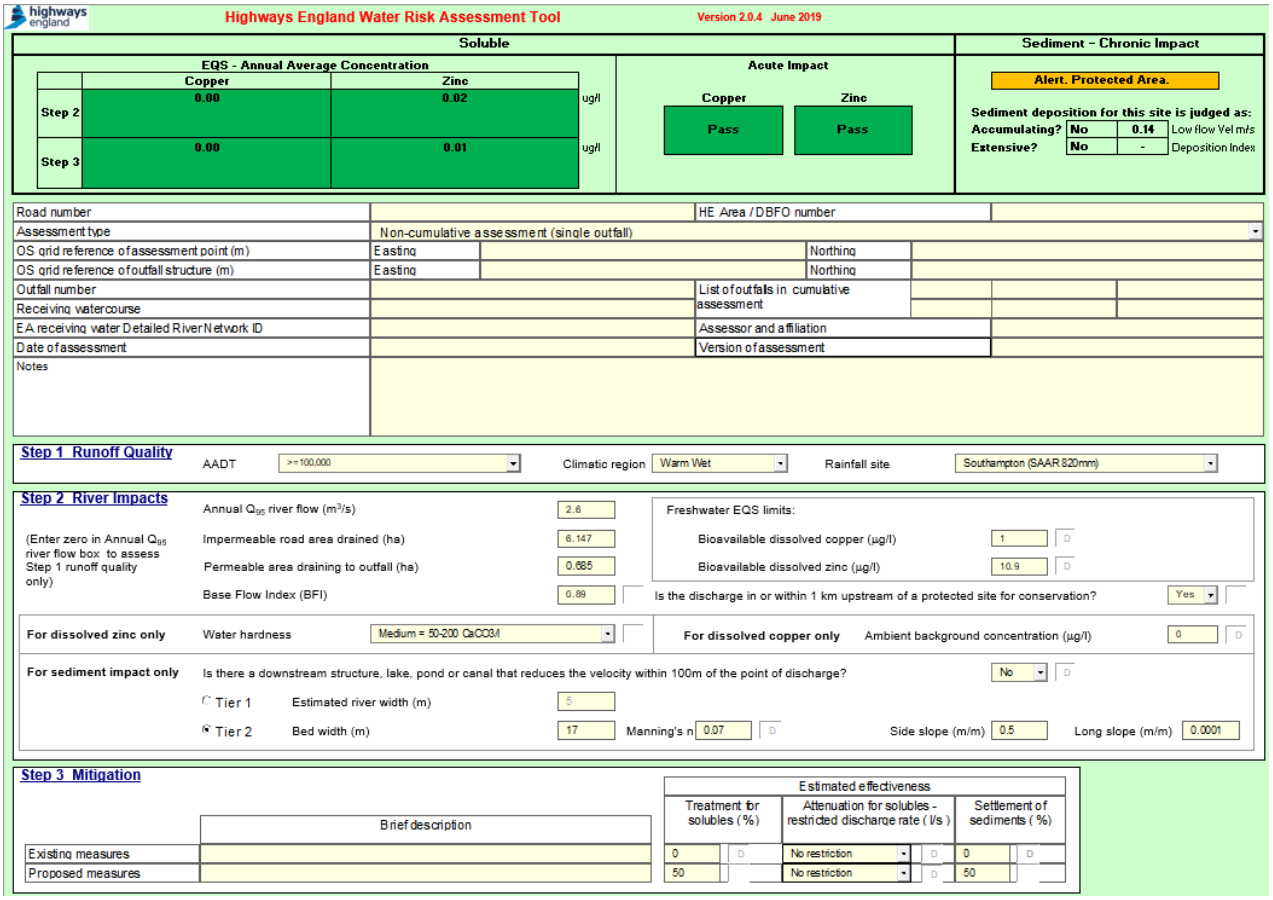
Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Basin 3B – Watercourse Assessment



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Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble				Sediment – Chronic Impact
EQS - Annual Average Concentration			Acute Impact	
	Copper	Zinc	Copper / Zinc	Alert. Protected Area.
Step 2	0.00	0.02 ug/l	Pass / Pass	Sediment deposition for this site is judged as:
Step 3	0.00	0.01 ug/l		Accumulating? No 0.14 Low flow Vel m/s
				Extensive? No - Deposition Index

Road number			HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number			List of outfalls in cumulative assessment		
Receiving watercourse					
EA receiving water Detailed River Network ID			Assessor and affiliation		
Date of assessment			Version of assessment		
Notes					

Step 1 Runoff Quality

AADT >=100,000 | Climatic region Warm Wet | Rainfall site Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6	Freshwater EQS limits:		
Impermeable road area drained (ha)	6.147	Bioavailable dissolved copper (µg/l)	1	D
Permeable area draining to outfall (ha)	0.685	Bioavailable dissolved zinc (µg/l)	10.9	D
Base Flow Index (BFI)	0.89	Is the discharge in or within 1 km upstream of a protected site for conservation?	Yes	

For dissolved zinc only Water hardness: Medium = 50-200 CaCO3/l

For dissolved copper only Ambient background concentration (µg/l): 0 D

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1	Estimated river width (m)	5				
Tier 2	Bed width (m)	17	Manning's n 0.07 D	Side slope (m/m) 0.5	Long slope (m/m) 0.0001	

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures		50	No restriction D	50

DETAILED RESULTS

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Summary of predictions

Soluble – Acute Impact

Sediment – Chronic Impact

Prediction of impact	Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**111.10**	**115.70**
No. of exceedances/worst year	134	143
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	**70.70**	**89.80**
No. of exceedances/worst year	91	113
	(ug/l)	(ug/l)
Thresholds RST24	21	92
Thresholds RST6	42	184
Event Statistics Mean	57.52	264.56
90%ile	111.45	539.33
95%ile	144.76	736.85
99%ile	239.71	1393.53

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold								
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**113.50**	**124.90**	**6.30**	**17.00**	**56.00**	**17.00**	**14.80**	**31.10**
No. of exceedances/worst year	147	152	11	25	71	25	22	39
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	766	2676	1	11065	1914	1837	117	518
90%ile	1573	5762	3	28184	4876	4679	299	1319
95%ile	1875	7101	3	56234	3729	9335	536	2632
99%ile	2727	10215	5	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.02
	(ug/l)	(ug/l)
Thresholds RST24	21	92
Thresholds RST6	42	184
Event Statistics Mean	0.02	0.08
90%ile	0.04	0.18
95%ile	0.08	0.32
99%ile	0.25	1.04

Step 2

Velocity 0.14 m/s — Tier 2 is used for the calculation

DI -

Minimum % settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0

DI -

Basin 3B - HEWRAT Groundwater Assessment

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <=5 m	3	60
6		20	Flow type (Incorporates flow type an effective grain size)	Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer)	1	20
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	210
RISK SCREENING LEVEL	Medium

Basin 3B - HEWRAT Spillage Assessment

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View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F	Totals	Return Period
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	2,600							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Roundabout							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	28,000							
D8	% HGV	15							
D8	Spillage factor *(no/10^9 HGVkm/year)*	3.09							
D9	Risk of accidental spillage	0.01232	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60							
D11	Risk of pollution incident	0.00739	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No							
D13	Return period without pollution reduction measures	0.00739	0.00000	0.00000	0.00000	0.00000	0.00000	0.0074	135
D14	Existing measures factor	0.6							
D15	Return period with existing pollution reduction	0.00443	0.00000	0.00000	0.00000	0.00000	0.00000	0.0044	226
D16	Proposed measures factor	0.4							
D17	Residual with proposed Pollution reduction measures	0.00177	0.00000	0.00000	0.00000	0.00000	0.00000	0.0018	564

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Basin 3C – Watercourse Assessment

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Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble				Sediment – Chronic Impact
EQS - Annual Average Concentration			Acute Impact	
	Copper	Zinc	Copper / Zinc	Alert. Protected Area.
Step 2	0.00	0.02 ug/l	Pass / Pass	Sediment deposition for this site is judged as:
Step 3	0.00	0.01 ug/l		Accumulating? No 0.14 Low flow Vel m/s
				Extensive? No - Deposition Index

Road number			HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number			List of outfalls in cumulative assessment		
Receiving watercourse					
EA receiving water Detailed River Network ID			Assessor and affiliation		
Date of assessment			Version of assessment		
Notes					

Step 1 Runoff Quality

AADT: >=100,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6		Freshwater EQS limits:	
Impermeable road area drained (ha)	7.107		Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	1.072		Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.89		Is the discharge in or within 1 km upstream of a protected site for conservation?	Yes

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3/l

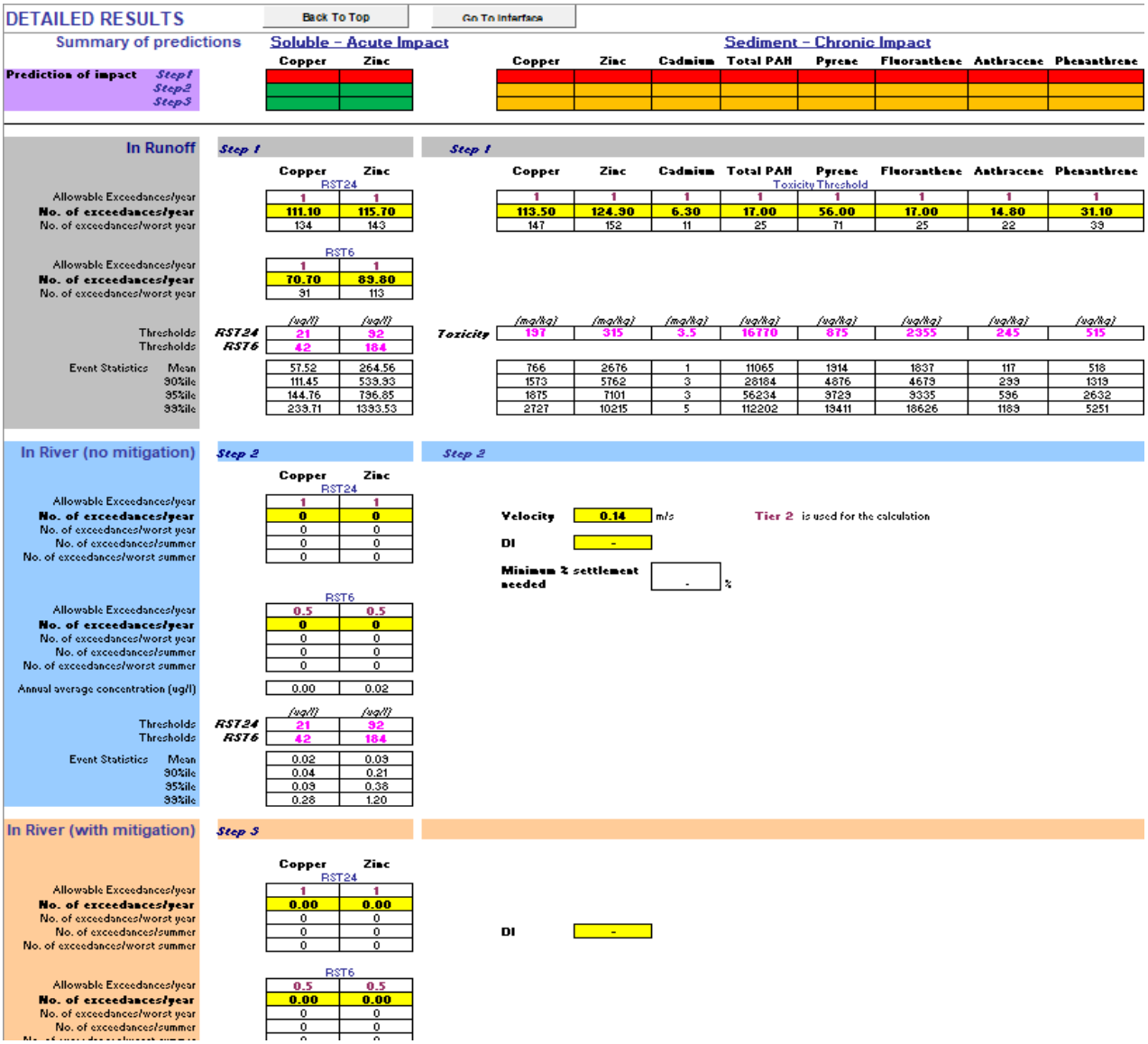
For dissolved copper only — Ambient background concentration (µg/l): 0 D

For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

- Tier 1 — Estimated river width (m): 5
- Tier 2 — Bed width (m): 17 — Manning's n: 0.07 D — Side slope (m/m): 0.5 — Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures		50	No restriction D	50



DETAILED RESULTS | Back To Top | Go To Interface

Summary of predictions | Soluble – Acute Impact | Sediment – Chronic Impact

Prediction of impact	Copper	Zinc	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	111.10	115.70
No. of exceedances/worst year	134	143
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	70.70	89.80
No. of exceedances/worst year	91	113
Thresholds RST24 (ug/l)	21	32
Thresholds RST6 (ug/l)	42	184
Event Statistics Mean	57.52	264.56
90%ile	111.45	539.93
95%ile	144.76	736.85
99%ile	233.71	1333.53

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold								
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	113.50	124.90	6.30	17.00	56.00	17.00	14.80	31.10
No. of exceedances/worst year	147	152	11	25	71	25	22	39
Toxicity Thresholds (mg/kg)	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	766	2676	1	11065	1914	1837	117	518
90%ile	1573	5762	3	28184	4876	4673	293	1319
95%ile	1875	7101	3	56234	3723	3335	586	2632
99%ile	2727	10215	5	112202	13411	18626	1183	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	0	0
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	0	0
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.02
Thresholds RST24 (ug/l)	21	32
Thresholds RST6 (ug/l)	42	184
Event Statistics Mean	0.02	0.09
90%ile	0.04	0.21
95%ile	0.09	0.38
99%ile	0.28	1.20

Step 2

Velocity 0.14 m/s — Tier 2 is used for the calculation

DI -

Minimum % settlement needed - %

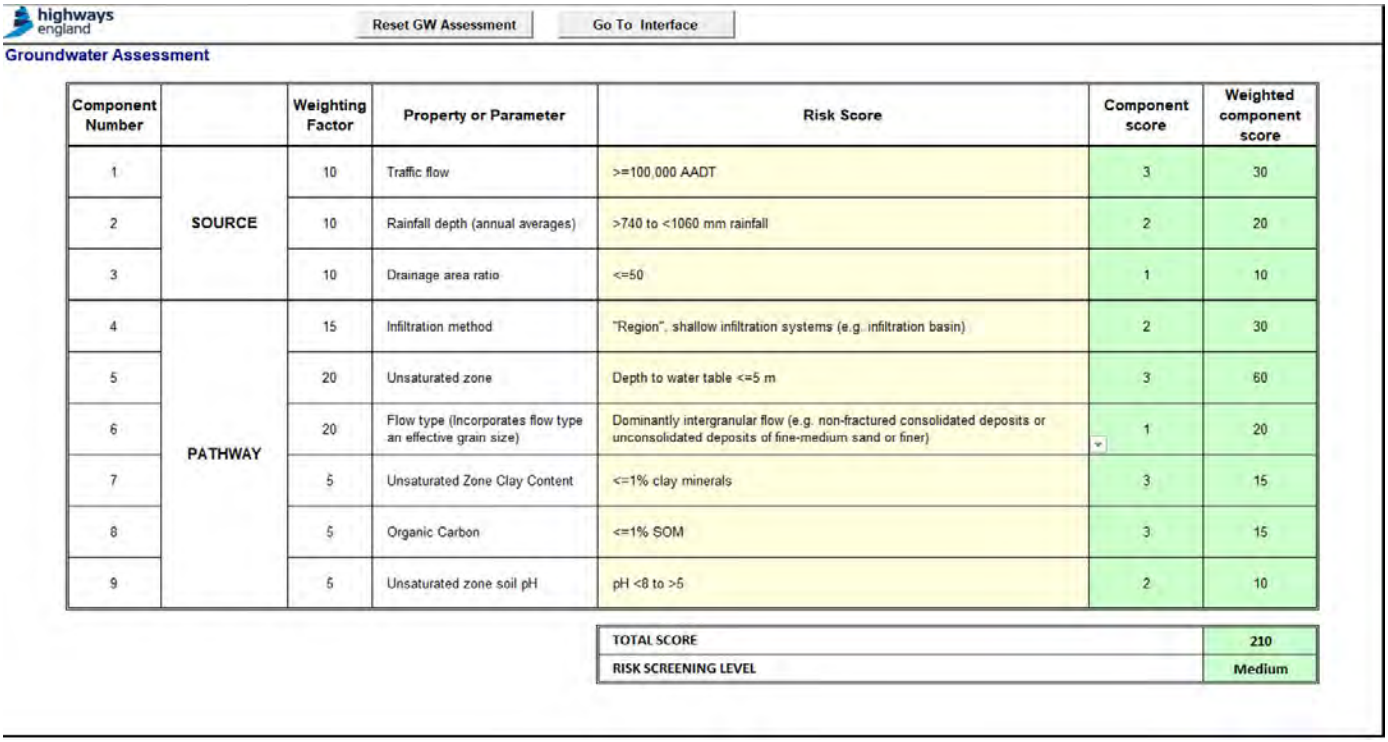
In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	0.00	0.00
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	0.00	0.00
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0

DI -

Basin 3C - HEWRAT Groundwater Assessment



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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <=5 m	3	60
6		20	Flow type (Incorporates flow type an effective grain size)	Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer)	1	20
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	210
RISK SCREENING LEVEL	Medium

Basin 3C - HEWRAT Spillage Assessment

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View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F		
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	3,250							
D3	Road Type *(A-road or Motorway)*	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Roundabout							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	149,961							
D8	% HGV	11							
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.83							
D9	Risk of accidental spillage	0.01624	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60							
D11	Risk of pollution incident	0.00974	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No						Totals	Return Period
D13	Return period without pollution reduction measures	0.00974	0.00000	0.00000	0.00000	0.00000	0.00000	0.0097	103
D14	Existing measures factor	0.6							
D15	Return period with existing pollution reduction	0.00585	0.00000	0.00000	0.00000	0.00000	0.00000	0.0058	171
D16	Proposed measures factor	0.4							
D17	Residual with proposed Pollution reduction measures	0.00234	0.00000	0.00000	0.00000	0.00000	0.00000	0.0023	428

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

Location	Serious Accidental Spillages (Billion HGV km/ year)	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Basin 4 – Watercourse Assessment

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Highways England Water Risk Assessment Tool Version 2.0.4 June 2019

Soluble				Sediment – Chronic Impact
EQS - Annual Average Concentration			Acute Impact	
	Copper	Zinc	Copper / Zinc	Alert. Protected Area.
Step 2	0.00	0.01 ug/l	Pass / Pass	Sediment deposition for this site is judged as:
Step 3	0.00	0.01 ug/l		Accumulating? No 0.14 Low flow Vel m/s
				Extensive? No - Deposition Index

Road number			HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number			List of outfalls in cumulative assessment		
Receiving watercourse					
EA receiving water Detailed River Network ID			Assessor and affiliation		
Date of assessment			Version of assessment		
Notes					

Step 1 Runoff Quality

AADT: >=100,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

		Freshwater EQS limits:	
Annual Q_{95} river flow (m^3/s)	2.6		
Impermeable road area drained (ha)	4.389	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	0.128	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.89	Is the discharge in or within 1 km upstream of a protected site for conservation?	Yes

For dissolved zinc only Water hardness: Medium = 50-200 CaCO3/l — **For dissolved copper only** Ambient background concentration (µg/l): 0 D

For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1	Estimated river width (m)	5				
Tier 2	Bed width (m)	17	Manning's n 0.07 D	Side slope (m/m) 0.5	Long slope (m/m) 0.0001	

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures		50	No restriction D	50

DETAILED RESULTS

Back To Top | Go To Interface

Summary of predictions

Soluble – Acute Impact

Prediction of impact	Copper	Zinc
Step 1		
Step 2		
Step 3		

Sediment – Chronic Impact

Prediction of impact	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step 1								
Step 2								
Step 3								

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	111.10	115.70
No. of exceedances/worst year	134	143
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	70.70	89.80
No. of exceedances/worst year	91	113
	(ug/l)	(ug/l)
Thresholds RST24	21	92
Thresholds RST6	42	184
Event Statistics Mean	57.52	264.56
90%ile	111.45	539.33
95%ile	144.76	736.85
99%ile	233.71	1333.53

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold								
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	113.50	124.90	6.30	17.00	56.00	17.00	14.80	31.10
No. of exceedances/worst year	147	152	11	25	71	25	22	39
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	766	2676	1	11065	1914	1837	117	518
90%ile	1573	5762	3	28184	4876	4673	299	1319
95%ile	1875	7101	3	56234	9729	9335	596	2632
99%ile	2727	10215	5	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	0	0
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	0	0
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.01
	(ug/l)	(ug/l)
Thresholds RST24	21	92
Thresholds RST6	42	184
Event Statistics Mean	0.01	0.05
90%ile	0.03	0.13
95%ile	0.06	0.23
99%ile	0.18	0.75

Step 2

Velocity 0.14 m/s Tier 2 is used for the calculation

DI -

Minimum % settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	0.00	0.00
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6		
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	0.00	0.00
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0

DI -

Basin 4 - HEWRAT Groundwater Assessment

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	>50 to <150	2	20
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <15 m to >5 m	2	40
6		20	Flow type (Incorporates flow type an effective grain size)	Flow dominated by fractures/ fissures (e.g. well consolidated sedimentary deposits, igneous and metamorphic rocks or unconsolidated deposits of very coarse sand and coarser)	3	60
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	240
RISK SCREENING LEVEL	Medium

Basin 4 - HEWRAT Spillage Assessment

highways england

View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F	Totals	Return Period
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	1,600							
D3	Road Type *(A-road or Motorway)*	M							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Roundabout							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	149,961							
D8	% HGV	10							
D8	Spillage factor *(no/10⁸ HGVkm/year)*	0.43							
D9	Risk of accidental spillage	0.00377	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60							
D11	Risk of pollution incident	0.00226	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No							
D13	Return period without pollution reduction measures	0.00226	0.00000	0.00000	0.00000	0.00000	0.00000	0.0023	443
D14	Existing measures factor	0.6							
D15	Return period with existing pollution reduction	0.00136	0.00000	0.00000	0.00000	0.00000	0.00000	0.0014	738
D16	Proposed measures factor	0.4							
D17	Residual with proposed Pollution reduction measures	0.00054			0.00000	0.00000	0.00000	0.0005	1844

Pollution reduction factor
Use the Indicative Pollution Risk Reduction Factor table below to estimate the factor.

Provide justification for the decision in the appropriate comments box below.

A default value of 1 is used if no measures are considered or if no value is entered.

Justification for choice of existing measures factors

hoice of proposed measures factors

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Basin 5 – Watercourse Assessment

N/A

Basin 5 - HEWRAT Groundwater Assessment

highways england

Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <15 m to >5 m	2	40
6		20	Flow type (Incorporates flow type an effective grain size)	Mixed fracture and intergranular flow (e.g. consolidated deposits or unconsolidated deposits of medium – coarse sand)	2	40
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	210
RISK SCREENING LEVEL	Medium

Basin 5 - HEWRAT Spillage Assessment

highways england

View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F		
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	500							
D3	Road Type *(A-road or Motorway)*	M							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Slip road							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	149,961							
D8	% HGV	11							
D8	Spillage factor *(no/10^8 HGVkm/year)*	0.43							
D9	Risk of accidental spillage	0.00129	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60							
D11	Risk of pollution incident	0.00078	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No						Totals	Return Period
D13	Return period without pollution reduction measures	0.00078	0.00000	0.00000	0.00000	0.00000	0.00000	0.0008	1287
D14	Existing measures factor	0.6							
D15	Return period with existing pollution reduction	0.00047	0.00000	0.00000	0.00000	0.00000	0.00000	0.0005	2146
D16	Proposed measures factor	0.6							
D17	Residual with proposed Pollution reduction measures	0.00028	0.00000	0.00000	0.00000	0.00000	0.00000	0.0003	3576

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Basin 6 – Watercourse Assessment

N/A

Basin 6 - HEWRAT Groundwater Assessment

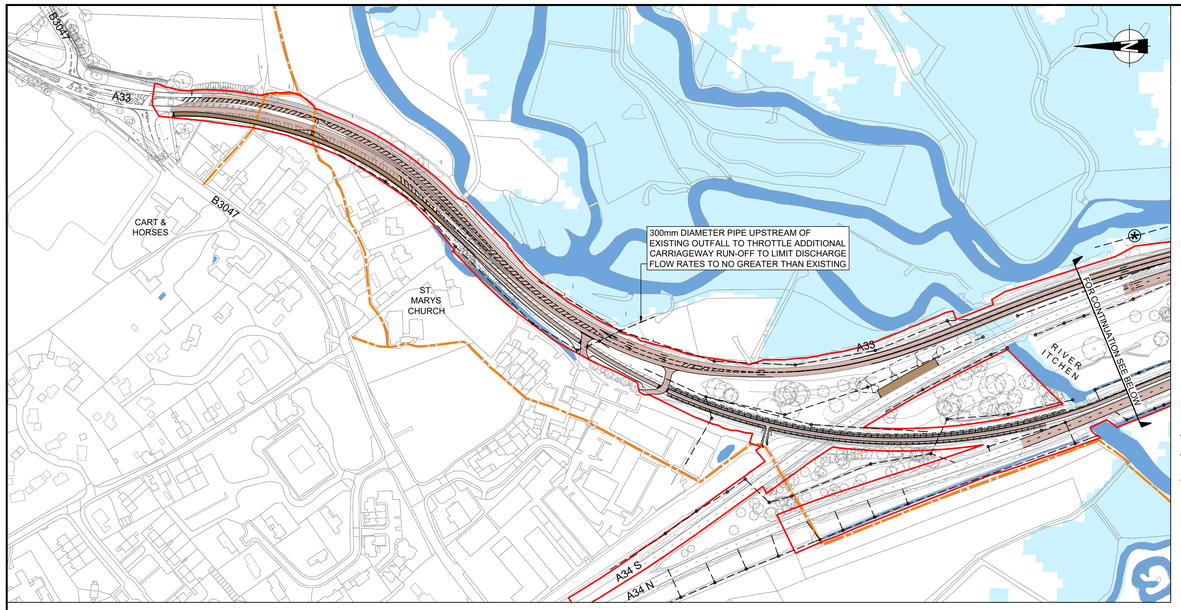
N/A

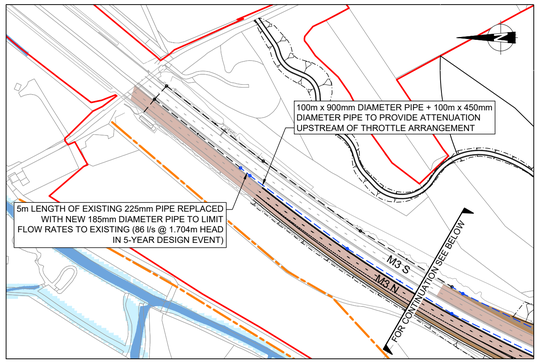
Basin 6 - HEWRAT Spillage Assessment

N/A

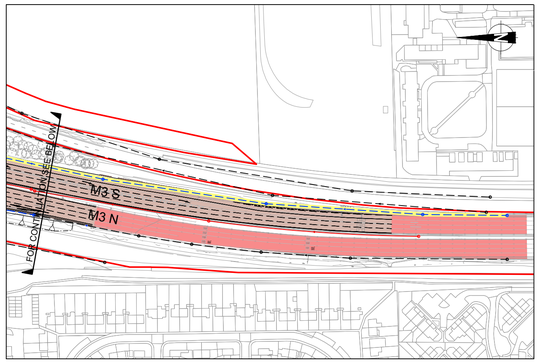
Appendix D Proposed M3J9 Drainage Schematic Plan

HE551511-VFK-HDG-X_XXXX_XX-DR-CD-0512 Drainage Schematic Plan





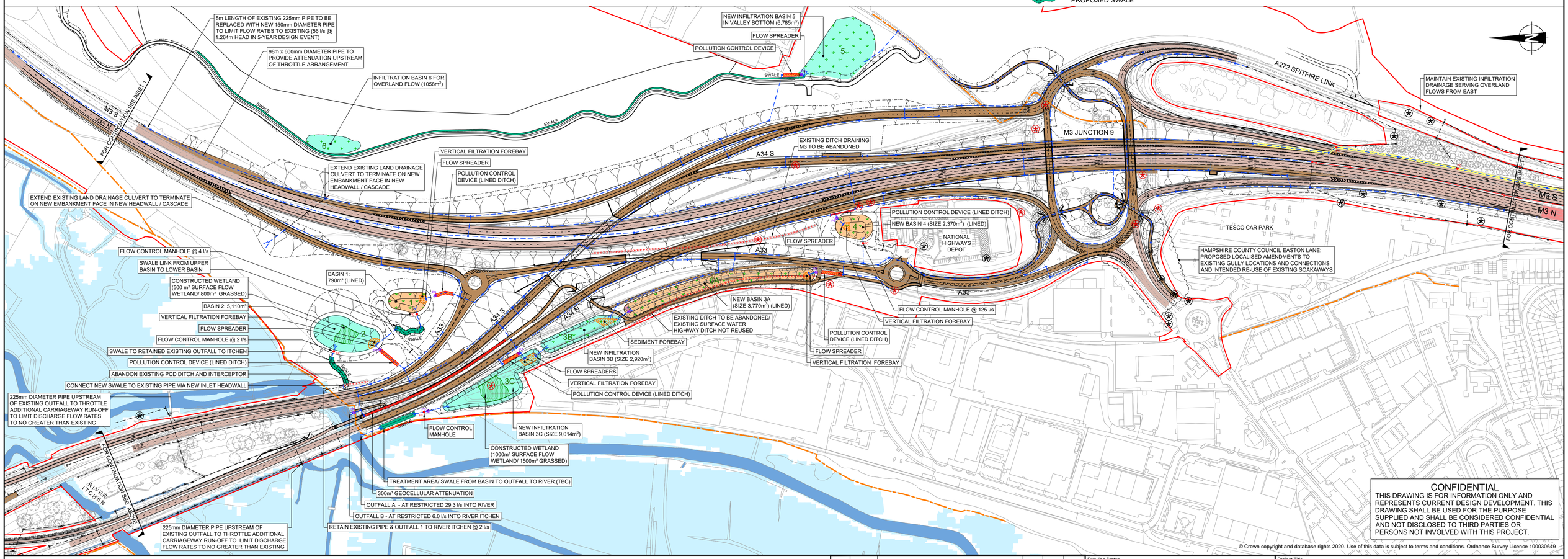
INSET 1: M3 NORTHBOUND CONTINUATION EXTRACT



INSET 2: M3 SOUTHBOUND CONTINUATION EXTRACT

KEY:

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING FOOTPATH / PUBLIC RIGHT OF WAY
- PROPOSED HIGHWAY DRAINAGE NETWORK
- PROPOSED HIGHWAY DRAINAGE (INSTALLED AS PART OF M3 JUNCTION 9 TO 14 SAFETY BARRIER IMPROVEMENT SCHEME WORKS)
- PROPOSED ADDITIONAL DRAINAGE TO BE INSTALLED AS PART OF THE M3 JUNCTION 9 IMPROVEMENT SCHEME (FOLLOWING THE MANAGED MOTORWAY GOVERNMENT PAUSE)
- RETAINED EXISTING HIGHWAY DRAINAGE
- RIVER ITCHEN
- ENVIRONMENT AGENCY FLOOD ZONE 3 EXTENT
- PROPOSED GEOCELLULAR ATTENUATION
- 1 PROPOSED INFILTRATION BASIN AND REFERENCE NUMBER
- 4 PROPOSED LINED BASIN AND REFERENCE NUMBER
- PROPOSED GRASSED BASIN (ALL GRASSED EXCEPT BASIN 2 AND 3C)
- PROPOSED SWALE
- EXISTING CARRIAGEWAY AND DRAINAGE FEATURES TO BE RETAINED
- PROPOSED NEW CARRIAGEWAY / FOOTWAY / CYCLEWAY AREAS
- PS PROPOSED PENSTOCK
- PROPOSED SEDIMENT FOREBAY
- FC PROPOSED FLOW CONTROL MANHOLE
- EXISTING SOAKAWAY FEATURE REFURBISHED AND REUSED



NOTES:

1. THIS DRAWING SHOULD BE PRINTED IN COLOUR.
2. DO NOT SCALE FROM THIS DRAWING.
3. THE LAYOUT SHOWN IS PRELIMINARY AND SUBJECT TO DETAILED DESIGN.
4. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER SGAR 3 SUBMISSION DRAWINGS AND DOCUMENTS.
5. FOR PROPOSED AND EXISTING HIGHWAY CATCHMENTS REFER TO DRAWING NUMBERS HE551511-VFK-HDG-X_XXXX_XX-DR-CD-0513 AND 0515 AND STANDARD NOTES.
6. FOR DETAIL OF M3 JUNCTION 9-14 MOTORWAY UPGRADE DRAINAGE DESIGN REFER TO MOTORWAY UPGRADE SCHEME DRAWING NUMBERS HE549338-JAC-HDG-S1-DN-MAINL-DR-CD-0002 TO 003.
7. PROPOSED DRAINAGE SCHEMATIC SHOWN IS SUBJECT TO REVIEW BY THE RESPECTIVE HIGHWAY AUTHORITIES, LEAD LOCAL FLOOD AUTHORITY AND THE ENVIRONMENT AGENCY.
8. PROPOSED RE-USE OF EXISTING DRAINAGE ASSETS IS SUBJECT TO REVIEW OF SURVEY DATA, ASSET RECORDS AND SITE VERIFICATION. THIS IS TO BE UNDERTAKEN DURING SGAR 5 (DETAILED DESIGN).
9. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH:
   - DRAINAGE STRATEGY REPORT REF: HE551511-VFK-HDG-X_XXXX_XX-RP-CD-0001
   - POLLUTION PREVENTION TECHNICAL NOTE REF: HE551511-VFK-HGN-X_XXXX_XX-TN-CH-0003
10. FIN DRAINS ARE NOT SHOWN ON THIS DRAWING. THESE SHALL BE DETAILED DURING SGAR 5 (DETAILED DESIGN).
11. CONTROL OF RUN-OFF AND SEDIMENT DURING CONSTRUCTION IS TO BE STRICTLY IN ACCORDANCE WITH THE CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN, WHICH MAY INCLUDE PIPES, SWALES AND BASINS NOT SHOWN ON THIS DRAWING. THIS IS TO BE DEVELOPED DURING SGAR 5 (DETAILED DESIGN).
12. PROPOSED FORM OF DRAINAGE SYSTEM REQUIRED TO COLLECT THE SURFACE WATER RUN-OFF FROM THE CARRIAGEWAY SURFACE (eg. GULLIES, FILTER DRAINS ETC.) IS TO BE DETERMINED DURING SGAR 5 (DETAILED DESIGN).

SEDIMENT FOREBAY AREA SCHEDULE

BASIN	FOREBAY AREA (m^2)	FOREBAY DEPTH OF FREEBOARD (mm)
1	10	150
2	40	300
3A	40	300
3B	40	300
3C	135	300
4	36	300
5	36	300

0 50 100 150 200 250m

SCALE 1:2500

Rev.	Date	Description	Drawn	Chk'd	App'd
P04	28.06.22	UPDATED TO SUIT OMISSION OF MANAGED MOTORWAY SCHEME	JH	LC	TRA
P03	24.11.21	ISSUED FOR S3 SUBMISSION	ljj	AC	TRA
P02	15.10.21	UPDATES TO SUIT DESIGN DEVELOPMENT	RG	AC	TRA
P01	28.05.21	FIRST ISSUE	ME	AC	TRA

Drawing Status: S3 - FOR REVIEW & COMMENT

VolkerFitzpatrick

Client: national highways

Project Title: M3 JUNCTION 9 IMPROVEMENT

Drawing Title: SGAR 3 PRELIMINARY DESIGN PROPOSED SURFACE WATER DRAINAGE SCHEMATIC PLAN

Scale	Designed	Drawn	Checked	Approved
1:2500	PR	ME	AC	TRA
Original Size: Size	Date: 28.05.21	Date: 28.05.21	Date: 28.05.21	Date: 28.05.21

Drawing Number: HE PIN HE551511 - Originator VFK - Volume HDG - Location X_XXXX_XX - Type DR - Role CD - Number 0512

Project Ref. No.: 48176

Revision: P04

TECHNICAL NOTE

Appendix E Hydrogeological Risk Assessment (HgRA)

Document ref: 330610074R1 M3 Junction 9 DQRA

M3 junction 9 improvement: Hydrogeological Risk Assessment

T1.02

M3 junction 9 improvement: Hydrogeological Risk Assessment

Prepared for

National Highways

Report reference:

330610074R1, October 2021

Report status:

Final

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M3 junction 9 improvement: Hydrogeological Risk Assessment

This report has been prepared by Stantec UK Ltd (Stantec) in its professional capacity as environmental specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by Stantec solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to Stantec at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, Stantec may, by prior written agreement, agree to such release, provided that it is acknowledged that Stantec accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. Stantec accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against Stantec except as expressly agreed with Stantec in writing.

	Name	Signature
Author	Richard Holtham Robert Sears	[redacted]
Checked by	Robert Sears, Francis Crozier	[redacted]
Reviewed by	Francis Crozier	[redacted]

Revision record:

Issue	Date	Status	Comment	Author	Checker	Reviewer
1	21/09/21	Draft	Issued for comment	RAH, RCS	RCS, FKC	FKC
2	08/10/21	Final		RAH, RCS	RCS, FKC	FKC

Contents

FIGURES

TABLES

APPENDICES

1 Introduction

1.1 Background

The M3 Junction 9 Improvement Scheme (the Scheme) is located at Junction 9 of the M3 to the east of Winchester, running north to south, centred in the Winnall area and extending north to Headbourne Worthy (Figure 1.1). The Scheme includes proposed motorway modifications including the introduction of a new on/off slip road to both northbound and southbound sides of the M3, new link roads between the A33, A34, A272 and M3 roads and a new overhead gyratory above the M3 corridor.

Parts of the Scheme are located in a low spot of the M3, towards which a total of approximately 1.6 km of the existing M3 corridor drains. A separate Motorway Upgrade is currently being constructed immediately to the south of the Scheme, which also drains towards the Land within the Scheme's Application Boundary (hereafter referred to as the "Application Area").

West of the Application Area are commercial and light industrial land uses associated with the Wykeham Trade Park and Winnall Industrial Estate. Most of the surrounding non-highway land is used for agricultural purposes, with arable grassland to the north, and a number of fisheries located to the west.

The Application Area is located in a sensitive hydrogeological environmental setting, located adjacent to the River Itchen, which underlies the M3 and A34 in the north. The River is a designated Main River, with the associated floodplain designated as a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI). The Application Area is underlain by bedrock deposits of the White Chalk Subgroup, which are classified by the Environment Agency (EA) as a Principal Aquifer. Surrounding abstractions include thirty-one public abstractions, alongside nine abstractions for private water supplies within 2 km of the Scheme.

A ground investigation (GI) was previously undertaken, and additional works have been proposed by Stantec to provide supplementary information. Interpretation of the GI data is provided in the **Geotechnical Interpretation Report** **(Document Reference 7.11)**.

The Drainage Strategy Report which forms **Appendix 13.1: Chapter 13: Road Drainage and the Water Environment** **(Document Reference 6.1)** prepared for the planning application included a Highways England Water Risk Assessment Tool (HEWRAT) screening assessment. The results of the screening assessment are that all but one of the currently proposed Extended Detention Basins (EDT) present a 'medium risk' to groundwater and one has a high risk. LA113 (Road drainage and the water environment) (Highways England, 2020) states that where [HEWRAT] indicates a groundwater risk assessment is medium or high, a detailed assessment should be completed by a competent expert with the degree of detail being appropriate to the medium or high result.

A large area requires to be built up in the east of the Application Area (as shown in yellow on Drawing HE551511-VFK-HGN-X_XXXX_XX-SK-CH-0004_P03). It is expected that much of the material excavated from elsewhere in the Scheme will be used to fill this eastern area.

Piling will be undertaken as part of the works, and a piling risk assessment will be carried out prior to works commencing, in accordance with EA methodology. This risk assessment will consider impacts on the water environment.

1.2 Objectives

In its 'M3 Junction 9 Improvement – Environmental Impact Assessment (EIA) Scoping Notification and Consultation Reg 11' response to the Scoping Report the EA indicated concern, given the sensitivity of the groundwater environment beneath the Application Area.

Further comments were received from the EA in response to the Preliminary Environmental Information Report (PEIR). The EA states that its primary concern regarding the Scheme relates to the protection of groundwater, and protection / enhancement of the ecological balance and species within the River Itchen and surrounding areas.

This document has been prepared by Stantec UK Ltd (Stantec) on behalf of National Highways to provide the appropriate assessment for potential impacts to groundwater from the Scheme and, in particular, to address the concerns raised by the EA in its consultation responses.

1.3 Scope of Work

This report presents a Hydrogeological Risk Assessment (HgRA) to identify the significance of risks to the Chalk Aquifer and River Itchen. This HgRA is based on government guidelines appropriate to the geological and hydrogeological environment, which promote the protection of water bodies and related receptors from potential impact of development activities. Specific guidance referenced when undertaking the assessment include:

- Design Manual for Roads and Bridges (DMRB) LA 113 Road drainage and the water environment (Highways England, 2020).
- The EA's approach to groundwater protection (Environment Agency, 2018);
- Remedial Targets Methodology for contaminated land (Environment Agency, 2006);
- Contaminated Land Risk Assessment, A Guide to Good Practice (CIRIA, 2021); and
- Guidance on land contamination risk management (Environment Agency, 2021).

The scope of work undertaken for this HgRA includes the following:

- Review of the baseline geology and hydrogeology for the Application Area and surrounding area;
- Identification of receptors and assessment of potential impacts;
- Recommendations for appropriate monitoring and mitigation measures; and
- Preparation of a Detailed Quantitative Risk Assessment (DQRA) for risks that are qualitatively assessed as significant.

1.4 Competent expert

This report has been prepared by Stantec's Robert Sears, who is a hydrogeologist of over 30 years' experience. Robert is a Fellow of the Geological Society and is a Chartered Geologist.

Figure 1.1 Site location and points of interest

2 Drainage strategy and HEWRAT assessment

The Scheme's drainage strategy is described in the Drainage Strategy Report **Appendix 13.1: Drainage Strategy and Water Environment** **(Document Reference Appendix 6.1)**. The design approach is to install new gravity drainage for all new carriageway, or to replace existing highway drainage that is being built over by new impermeable highway, such as hardening of the central reserve and lane widenings.

In areas where existing carriageway is being overlaid only, then existing highway drainage is retained.

Areas of local, minor lane widenings proposed remote from the main works, are drained to existing highway drainage, which is modified, where required, to maintain existing discharge rates and no-flooding capacity.

All new drainage conveys run-off to extended detention basins (EDBs), which infiltrate to ground where the HEWRAT assessment of risk to groundwater, allows. These new EDBs are shown in Figure 2.1.

Runoff volumes are attenuated in the EDBs as far as space and acceptable draw-down times allow. Runoff volumes that are unable to drain to ground within a practical time period are discharged to the River Itchen.

Treatment of run-off before discharge is proposed as follows:

- Over-the-edge drainage of run-off from carriageways on embankments to filter strips and to infiltration ditches;
- Collection of run-off at carriageway edges in linear drains, gullies or filter drains, which is piped to the following:
    - Attenuation and Primary Settlement treatment in filtration forebays and unplanted, lined EDBs;
    - Attenuation, Secondary Settlement and Filtration treatment in vegetated EDBs, containing both wet and dry habitats; and
    - Tertiary treatment in a grassed swale prior to discharge to the River Itchen.

The only areas where existing linear infiltration drainage, or sealed drainage, is retained (and enhanced where necessary to limit flooding), will be the A33/A34 carriageway to the north of the River Itchen (above northing 131500) and M3 carriageway (above northing 131500). Both these retained areas are proposed to discharge to the River Itchen via existing open ditches or filter trenches.

The proposed drainage design is shown on Drawing HE551511-VFK-HDG-X_XXXX_XX-DR-CD-0512 which is included here as Appendix A. A summary of the EDBs is included in Table 2.1 and they are also labelled and shown on Figure 2.1.

Table 2.1 Summary of attenuation structures

Basin ref.	Type	Source	Inflows	Outfalls
1	EDB (lined)	Highway	From highway	To EDB 2
2	EDB (unlined)	Highway	From highway and EDB 1	To ground and river
3A	EDB (lined)	Highway	From highway	To EDB3B
3B	EDB (unlined)	Highway	From highway and EDB3A	To ground and EDB 3C
3C	EDB (unlined)	Highway	From highway and EDB3B	To ground and river via swale
4	EDB (lined)	Highway	From highway	To EDB 3A
5	EDB (unlined)	Rural overland flow and Highway runoff	From highway and rural land to east	To ground
6	EDB (unlined)	Rural overland flow	From rural land to east	To ground

Each EDB has been assessed using the HEWRAT. As detailed in the HEWRAT Help Guide (Highways England, 2015), the tool considers the following potential pollutants:

- acute pollution impacts associated with copper and zinc; and
- chronic pollution impacts associated with the following determinands in sediments: total copper, zinc, cadmium and total polycyclic aromatic hydrocarbons (PAH), including specific PAH's: pyrene, fluoranthene, anthracene, and phenanthrene.

For groundwater risk, HEWRAT uses an empirical approach taking into account the following factors:

- Traffic flow rate;
- Rainfall rate;
- Ratio of drainage area of road to active surface area of infiltration device;
- Infiltration method;
- Unsaturated zone thickness;
- Flow Type;

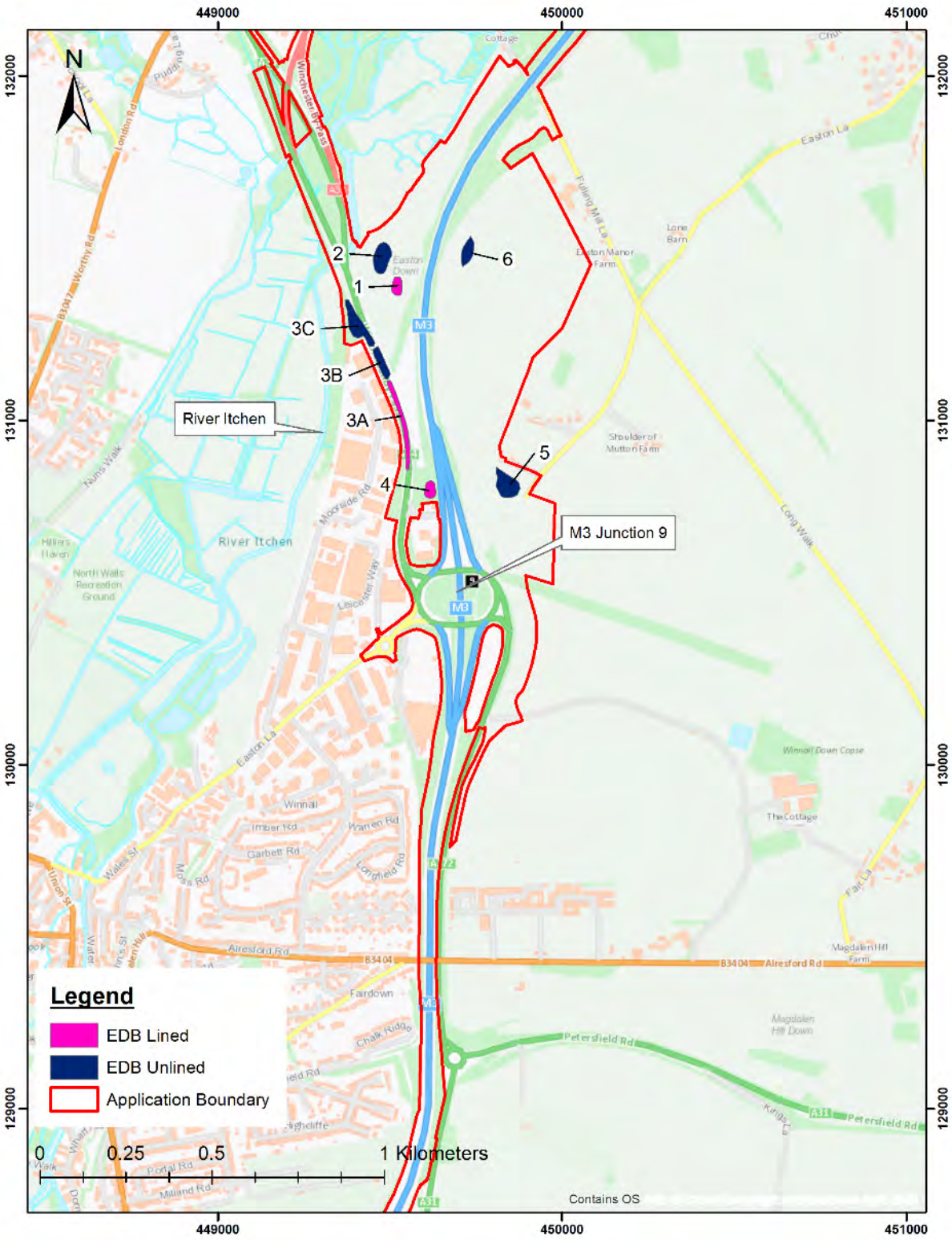
- Unsaturated zone clay content;
- Fraction of organic carbon; and
- Unsaturated zone soil pH.

For each of these parameters, a component score between 1 and 3 is assigned and this is then multiplied by a weighting factor for that parameter to provide a score. This process is repeated for all parameters and the scores are then summed to provide an overall risk score.

The HEWRAT screening assessments for each of the EDBs are presented in Appendix B. For the EDBs that discharge to ground, the highest scores (high risk) are derived where the unsaturated zone is thin (<5 m) and the flow type is dominated by fractures & fissures. The basins that get medium risk scores are those which either:

a) have a thicker unsaturated zone over fractures & fissures; or
b) have intergranular flow through superficial deposits & / or the unsaturated zone is thicker.

Figure 2.1 Application boundary and locations of EDBs



3 Baseline Conditions

3.1 Site setting

The Application Area is located in the River Itchen valley. The elevation in the west of the Applications Area is approximately 40 metres above ordnance datum (mAOD) and the land rises to the east up to a maximum of approximately 75 mAOD.

3.2 Geology

3.2.1 Regional geology

3.2.1.1 Bedrock

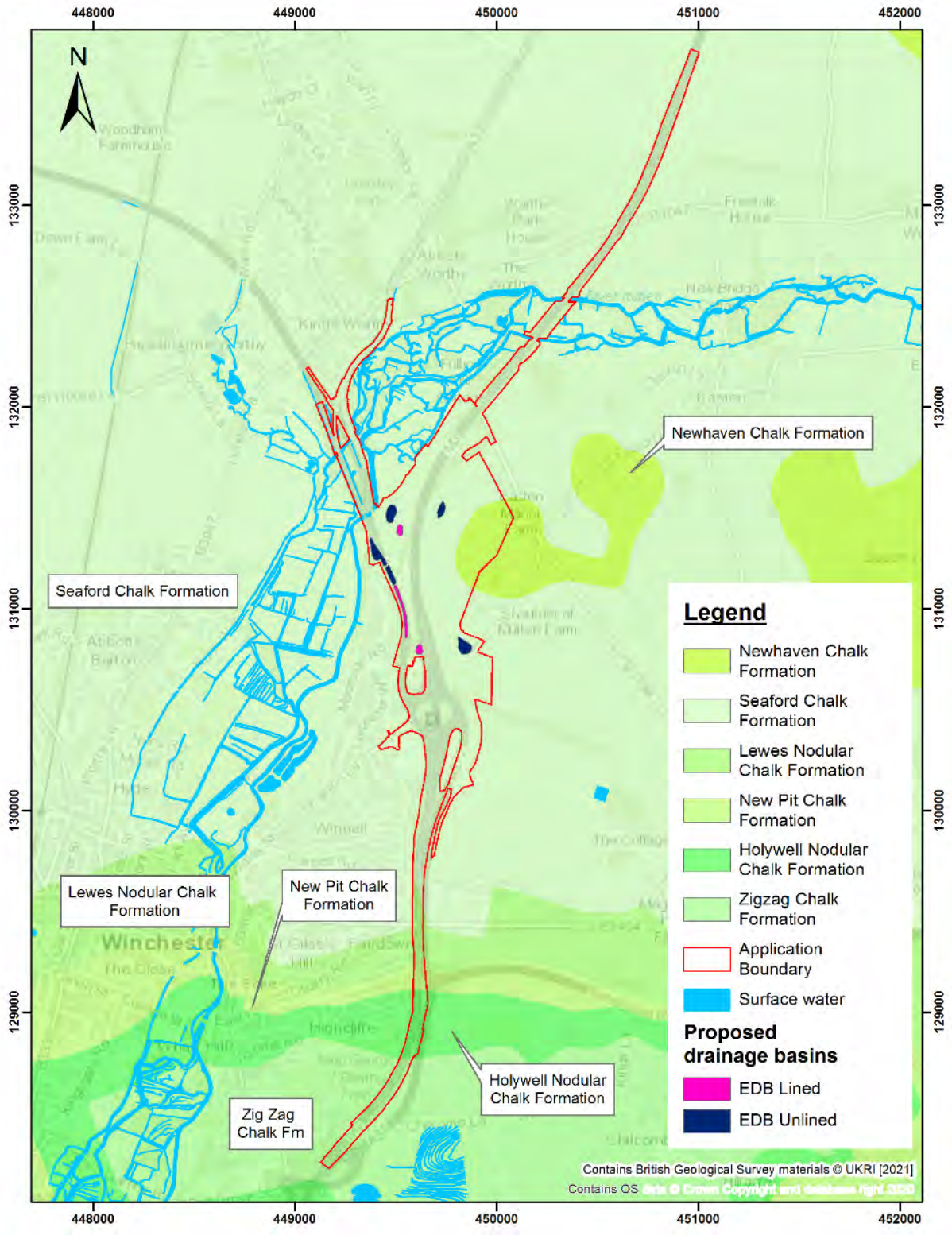
The British Geological Survey (BGS) indicates that the bedrock geology underlying the Application Area comprises the White Chalk Subgroup and the upper part of the Grey Chalk Formation of the Late Cretaceous era (Figure 3.1). The stratigraphy of the rock units in the Application Area and surrounding area are summarised in Table 3.1. In the Application Area, the five lower formations of the White Chalk outcrop, with the Seaford Chalk Formation outcropping across the majority of the Application Area, including the central area around Junction 9 itself and the River Itchen. The Seaford Chalk Formation typically consists of firm white chalk, with nodular and tabular flint seams. Underlying the Seaford Chalk are the Lewes Nodular Chalk Formation, New Pit Chalk Formation, Holywell Nodular Chalk Formation (all of the White Chalk) and Zig Zag Chalk Formation (Grey Chalk Subgroup). These units crop out to the south of the Spitfire Roundabout (A31 and A272). Above the Seaford Chalk Formation is the Newhaven Chalk Formation, which outcrops in small areas in the north of the Application Area.

The Application Area lies on the Winchester-East Meon Anticline, an east to west trending fold. In the main central area of the Application Area, the strata dip 5-10 degrees to the north. In the south of the Application Area, south of the Spitfire Roundabout, the strata dip 4 degrees to the south.

Table 3.1 Stratigraphy of the bedrock geology in the Winchester (based on the BGS Sheet 299 (British Geological Survey, 2002) and BGS memoir (Booth et al., 2008)

	Name	Thickness	Description	Present at surface at Application Area?
White Chalk Sub-group	Portsdown Chalk Formation	5	White chalk with marl beds and a few flint bands	No
	Culver Chalk Formation	50-70	White chalk with flints and many thin marl beds. Comprises the Tarrant Chalk Member and the Spetisbury Chalk Member.	No
	Newhaven Chalk Formation	40-70	Soft to medium hard, white chalk with flints and many thin marl beds (20-70 mm thick).	Yes – small areas in the north
	Seaford Chalk Formation	40-65	Soft white chalk with seams of large nodular and semi-tabular flint. Commonly blocky.	Yes – majority of central area
	Lewes Nodular Chalk Formation	55-65	White, interbedded hard, nodular chalks with soft-medium chalks and marls. Contains persistent seams of flints near the base. Conjugate fractures. Contains karstic features in the Twyford Down Cutting (approx. 500 m south of Application area – See Figure 1.1) including a partially sediment-filled paleaocave system and calcreted karst.	Yes
	New Pit Chalk Formation	40-45	White chalk with many regularly spaced marl beds. Massive and medium hard. Flint beds in the upper half of the succession. Conjugate fractures.	Yes
	Holywell Nodular Chalk Formation	25-30	Hard, nodular chalk with some shelly beds. Characterised by shell debris. Includes Melbourn Rock (c. 5 m) and Plenus Marls (1-3 m) at base.	Yes
Grey Chalk Sub-group	Zig Zag Chalk Formation			Yes

Figure 3.1 Bedrock geology



3.2.1.2 Superficial deposits

Superficial deposits are shown on Figure 3.2 and Figure 3.3. The majority of the Application Area is not underlain by superficial deposits; however, in the north of the Application Area, the M3 and A34 is underlain by alluvium and head deposits. Alluvium deposits of the River Itchen

form a band that is crossed by the M3 and A34, within the Application Area, and also is located to the west of the Application Area. Alluvium is typically formed of unconsolidated detrital material deposited by a river or stream and comprises sorted or semi-sorted sediment within the riverbed or floodplain. This can have a variable lithology depending on the river environment and may comprise clay, silt, sand, peat or gravel. Borehole data available from the British Geological Survey (BGS) indicate that the Alluvium comprises 1 to 1.5 m of peaty silts and clays above 4.5 to 5.5 m of dense gravels (Booth, et al., 2008).

Head deposits are located beneath the north-eastern part of the Application Area beneath the M3 and in smaller lateral bands located north and south of the of the M3 Junction 9 roundabout (see Figure 3.2). To the northeast an area of the M3 crosses through superficial deposits of Head 1; this comprises clay, silt, sand and gravel, often poorly sorted and poorly stratified, formed mostly by solifluction and / or hillwash and soil creep. The smaller bands of Head are composed of clay, silt, sand and gravel that is poorly sorted and poorly stratified containing angular rock debris and clayey hillwash and soil creep that is mantling a hillslope and deposited by solifluction and gelifluction processes.

Except for a small area of Basin 3A (lined) and approximately half of Basin 5 (unlined), none of the other drainage features are shown by the BGS mapping to be underlain by superficial deposits (see Figure 3.3).

Figure 3.2 Superficial geology and artificial ground

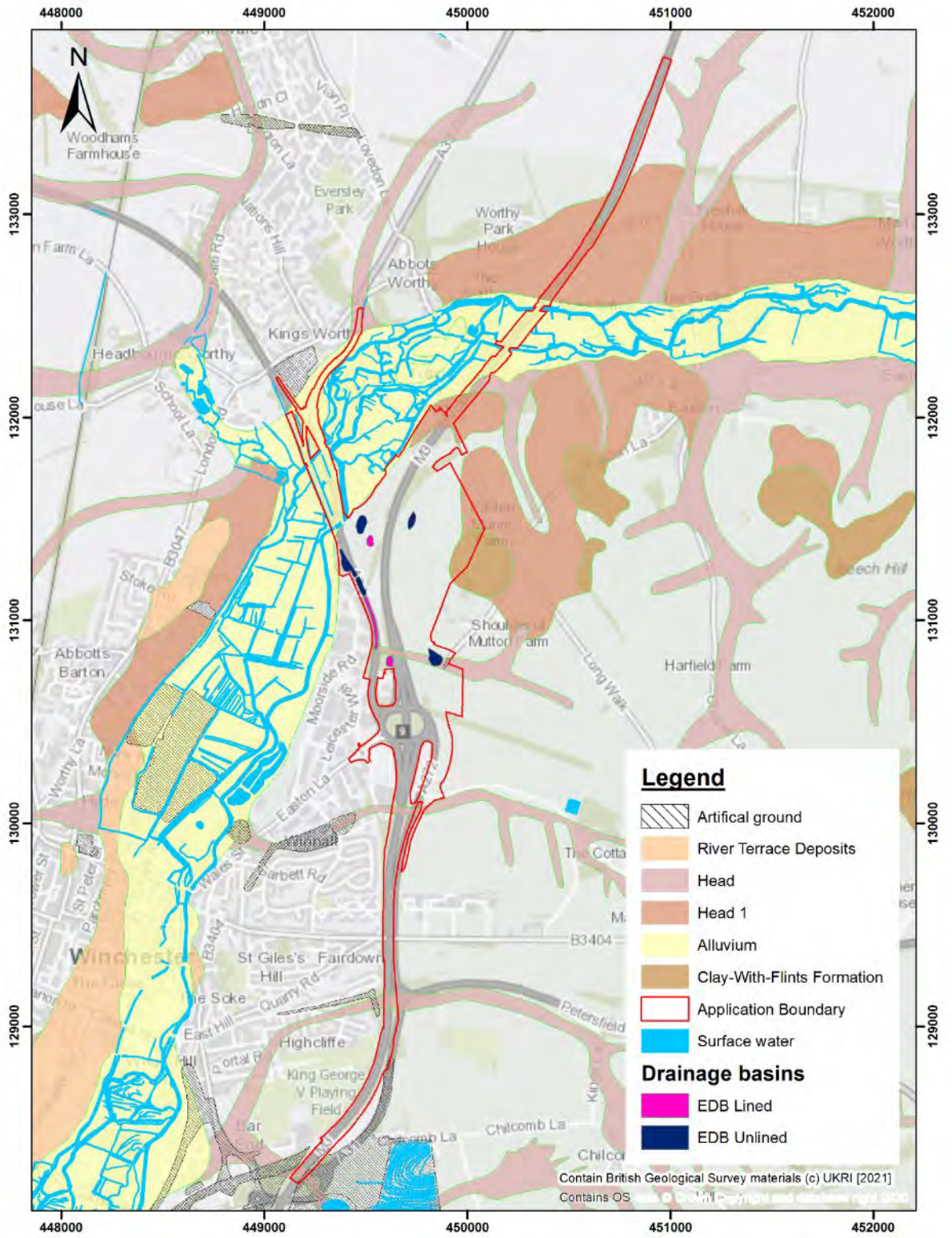
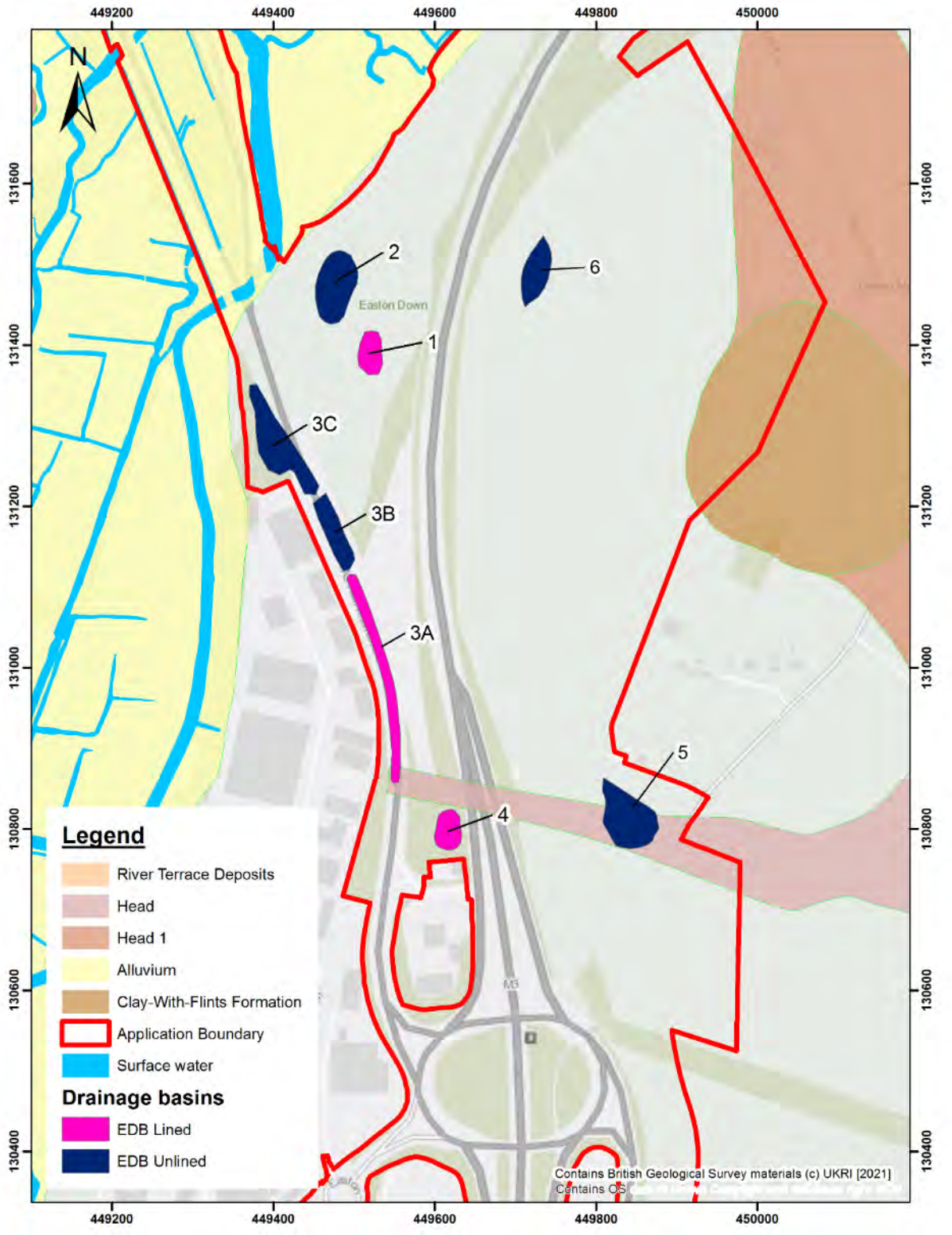


Figure 3.3 Superficial geology - central area



3.2.2 Local Geology

Soils

Soilscapes classifies the majority of the soils within the Application Area as being freely draining, shallow lime-rich soils over chalk limestone. The agricultural land classification and

soil resources report prepared for the Scheme by Reading Agricultural Consultants identifies these as being soils of the Andover 1 association (Reading Agricultural Consultants, 2021). Towards the northeast of the Application Area the soils become fen peat soils, classified as being Charity 2 association, which drain to local groundwater.

Underground cavities

A Cavities Risk Assessment has been undertaken as part of the **Geotechnical Interpretation Report (Document Reference 7.11)**. There was one natural cavity record within 500 m of the Application Area, which was 10 solution pipes on the course of the River Itchen.

A summary of the Hazard ratings for each basin is given in Table 3.2 below. The Hazard rating represents the likelihood for cavities to be present. Most basins are located in an area of Moderate-Low hazard for both natural and mining cavities which means they may occur but are unlikely. A Moderate hazard rating means that they may occur, but probably at a single location.

Table 3.2 Summary of cavities hazard for each basin (from Appendix A of the Geotechnical Interpretation Report (Document Reference 7.11))

Basin	Natural cavity hazard	Mining cavity hazard
1	Moderate-Low	Moderate-Low
2	Moderate-Low	Moderate-Low
3A	Moderate-Low and Moderate	Moderate-Low
3B	Moderate-Low	Moderate-Low
3C	Moderate-Low	Low and Moderate-Low
4	Moderate-Low and Moderate (small area)	Moderate-Low
5	Moderate and Moderate-Low (small area)	Moderate-Low
6	Moderate-Low	Moderate-Low

Encountered geology

The GI information is presented and reviewed in the **Geotechnical Interpretation Report (Document Reference 7.11)**. A summary of the factual report of this investigation is given in Table 3.3. The borehole locations are shown on Drawing HE551551-VFK-HGT-X_XXXX_XX-DR-GE-004 which is included here as Appendix C.

The local superficial geology is shown on Drawing HE551551-VFK-HGT-X_XXXX_XX-DR-GE-0020 which is included here as Appendix D and overlain onto Figure 3.4.

In the central area around the drainage features, the Application Area is typically underlain by topsoil, Made Ground / Engineered Fill and Seaford Chalk Formation. This is in broad agreement with the publicly available BGS data.

In the central area of the Application Area where the EDBs are proposed, the superficial deposits extend further eastwards than indicated by BGS mapping. A summary is given below

of the likely superficial geology at each of the EDBs, although it is noted that there is insufficient borehole coverage to make a detailed assessment.

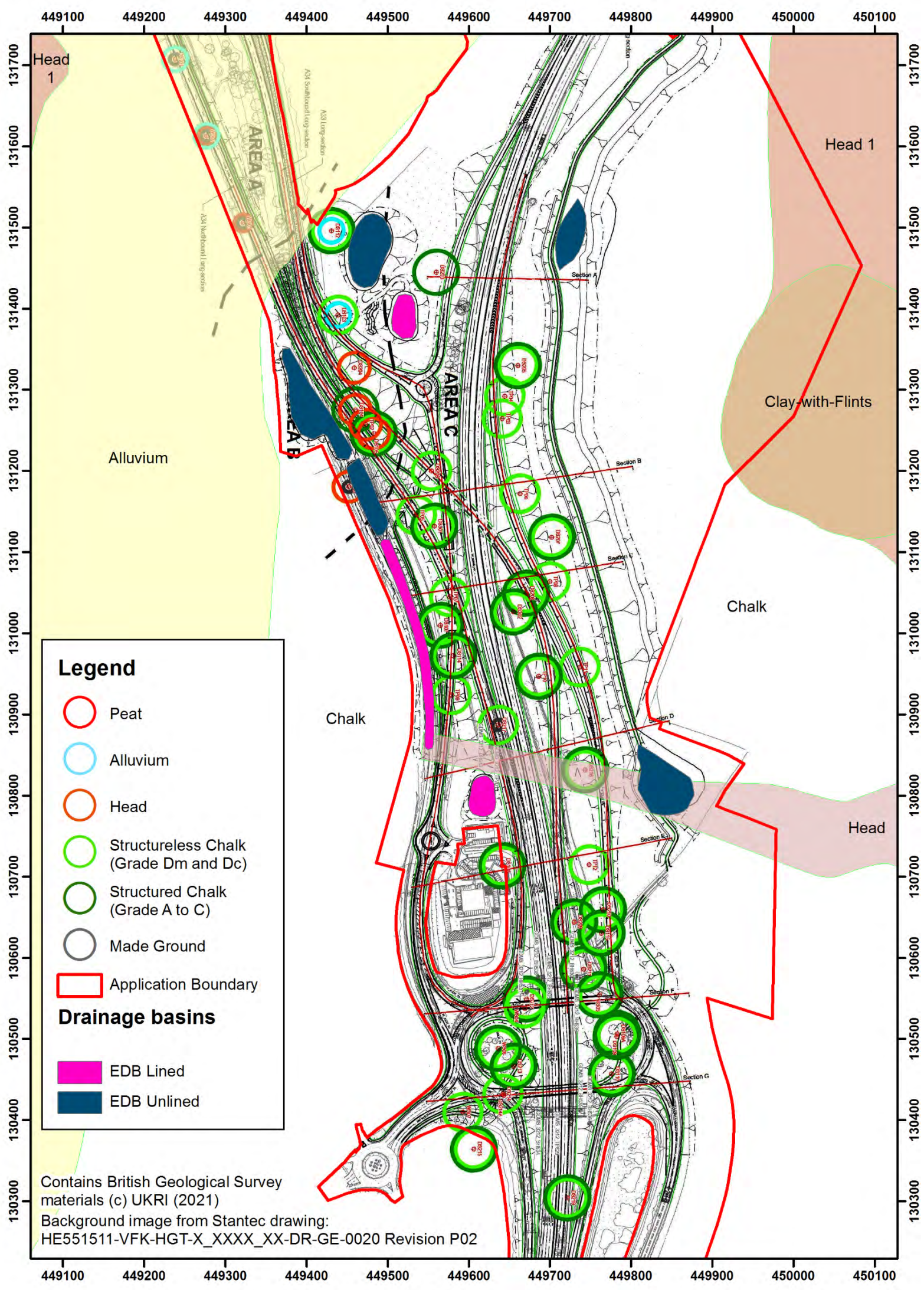
- EDB1. Borehole DS203 shows that there is no superficial geology present close to this location. The EDB drains directly onto structured chalk.
- EDB2. Borehole DS112 suggests that alluvial deposits may be present under this EDB to a depth of 5 m, which is in turn underlain by structureless chalk to a depth of 6.23 m followed by structured chalk.
- EDB3A. Boreholes DS107 and DS114 and trial pits TP07 and TP09 are located to the east of this EDB. The trial pits show structureless chalk whilst the boreholes show structureless chalk to a depth of 1.2 m underlain by structured chalk.
- EDB3B. Borehole WS08 is located immediately west of the northern end of this EDB. This borehole recorded Made Ground to a depth of 5.11 m comprising predominantly white chalk recovered as silty clay with fractured flint. This is underlain by 1.89 m of head comprising a sandy, gravelly, silty clay. The base of the head deposits was not penetrated.
- EDB3C. Boreholes DS104 and DS105 and trial pit TP02 are located east of the southern end of this EDB. TP02 recorded 0.3 m of made ground comprising clayey sand. This is underlain by 3.7 m of alluvium to the base of the pit. The alluvium predominantly comprised a silty or sandy, gravelly clay. Borehole DS104 encountered made ground to 0.3 m, comprising clayey sand. This is underlain by 8.2 m of alluvium to the base of the borehole. The alluvium comprised a sandy gravelly clay with interbedded gravel. Borehole DS105 encountered made ground to 0.35 m, comprising clayey gravelly sand. This is underlain by 5.65 m of head which comprised a gravelly, silty clay. This is underlain by 2 m of structureless chalk followed by structured chalk.
- EDB4. There are no GI boreholes adjacent to this EDB. The nearest boreholes are DS217 and DS108. Both of these record structureless chalk overlying structured chalk. Given this EDBs location further to the east, it is likely that it is underlain by chalk.
- EDB5 and EDB6. No GI data in the vicinity of these EDBs, but underlying geology is likely to be chalk.

Table 3.3 Summary of lithologies encountered from Geotechnical Interpretation Report (Document Reference 7.11)

Layer	Range of depths encountered (m)	Location and brief description
Topsoil	0.0 - 0.45	Encountered in 16 out of 53 boreholes. Grass over light- to dark- brown slightly gravelly clayey sand or sandy gravelly clay.
Made ground / Engineered fill	0.0 - 11.35	Varied across the Application Area, but typically comprised tarmac, sub-base, reworked chalk, gravelly sandy clay with flint cobbles, varying concrete and brick gravel content. It is noted in the Geotechnical Interpretation Report **(Document Reference 7.11)** that in some areas the strata identified by Soils Limited as Made Ground may also be Engineered Fill. Engineered Fill is typically structureless chalk recovered as slightly clayey silty sandy gravel. The Engineered Fill is likely to originate from the construction of the M3, A33 and A34.
Alluvium / Head	0.0m – 9.15,	Located in the north of the investigation area along the A34. Comprising clayey, sandy gravel with low flint cobble content, clayey gravelly sand or silty, sandy, gravelly clay. In places deposits comprised solely sands, gravels and cobbles, with the fines assumed to have been washed away. Peat was encountered as part of the alluvial deposits; this comprised firm brown mottled grey silty slightly sandy gravelly fibrous peat, with fragments of black organic material or plastic dark brown pseudofibrous peat. The Geotechnical Interpretation Report **(Document Reference 7.11)** has reclassified the Alluvium identified by Soils Limited as Head at some locations.

Layer	Range of depths encountered (m)	Location and brief description
Head	0.0 and 7.0	Located in the north of the Scheme and comprising dark brown slightly clayey gravelly sand and firm to stiff silty sandy gravelly clay. Often interbedded cohesive and granular horizons.
Seaford Chalk	0.0 and 30.45 (base of borehole)	Consists primarily of very weak, low density white chalk recovered as gravelly silty clay; structureless silty gravel and cobbles (CIRIA Grade Dm or Dc); structureless chalk composed of slightly sandy silty gravel or clay; weak low density white chalk (CIRIA Grade A3 to C5) or very weak to weak low to medium density speckled chalk (CIRIA Grades A to C). Rare cobbles and gravel comprised of angular flints were also present. It is noted in the **Geotechnical Interpretation Report (Document Reference 7.11)** that the classification of these chalks as structured or unstructured may not be consistent.

Figure 3.4 Local superficial geology superimposed on proposed drainage



3.2.3 Soil contamination

Geoenvironmental testing was carried out during the GI as detailed in the **Geotechnical Interpretation Report (Document Reference 7.11)** to determine the concentrations of contaminants of selected soil and groundwater samples. The testing suite comprised a range of heavy metals, inorganic and organic compounds, and for soils an asbestos screen.

The Geotechnical Interpretation Report states that the vast majority of the soil results are below the selected assessment criteria. The exception to this is one sample out of the 126 samples tested which indicated a marginal exceedance of the Public Open Space assessment criteria for Beryllium (2.3mg/kg compared to an assessment criteria of 2.2 mg/kg). The **Geotechnical Interpretation Report (Document Reference 7.11)** does not consider this significant when compared to the Generic Assessment Criteria.

In addition, waste acceptance criteria (WAC) testing of 10 samples of near surface material was undertaken to allow a preliminary determination of the waste characterisation of any material to be disposed of to landfill. The results of the WAC tests analysis classify the near surface material tested as appropriate for disposal at an Inert Waste Landfill.

3.2.4 Infilled ground/landfilling and historical land use

Infilled ground, landfilling and other historical land uses may be sources of contamination to the water environment.

There are 13 historical landfill areas shown on EA mapping data in the vicinity of the Application Area. The information is summarised in Table 3.4 and the locations are shown on Figure 3.5. These data show there are four historical landfills within or directly adjacent to the Application Area:

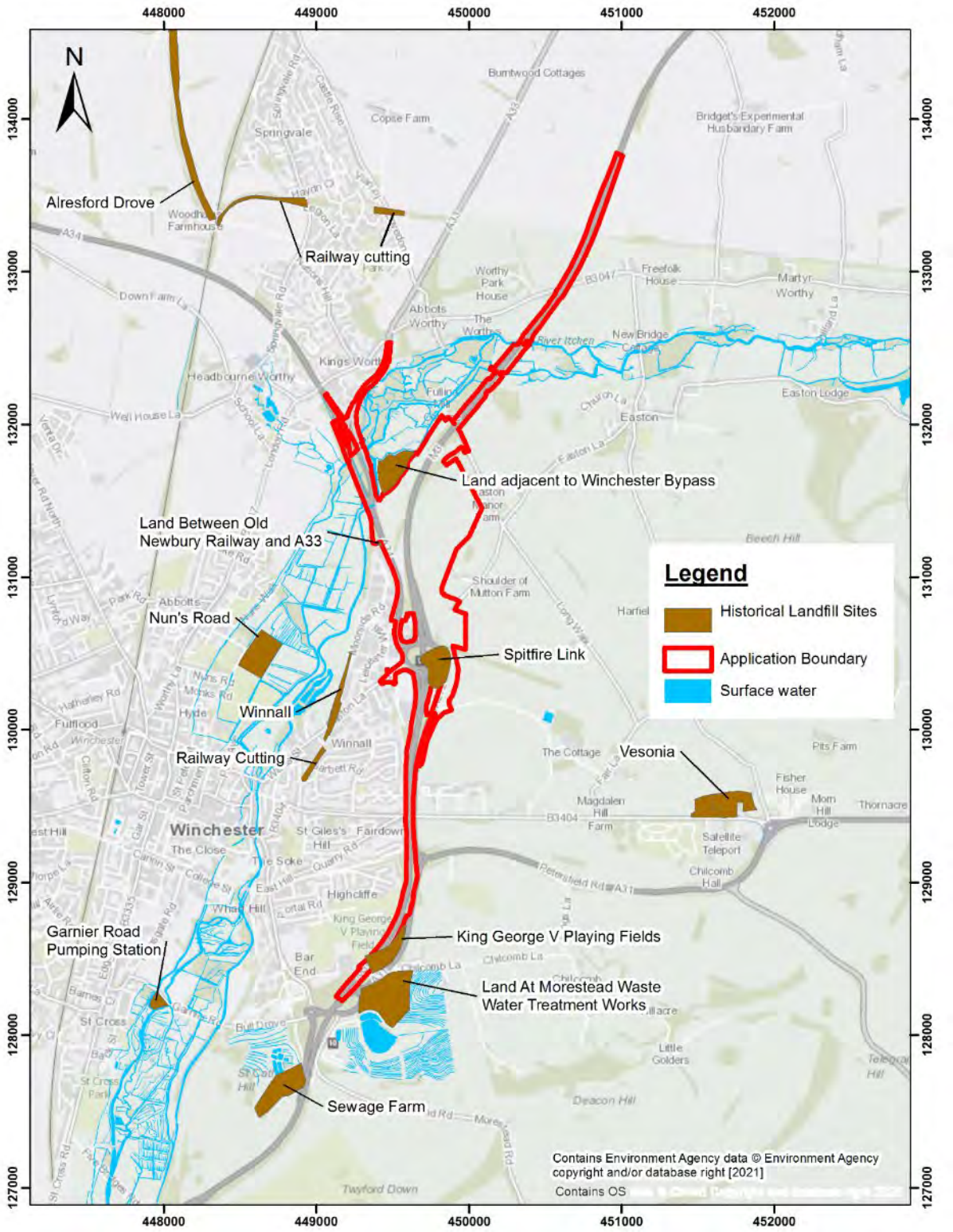
Table 3.4 Historical landfill areas

Name	Waste type	Dates active	Distance from site	Comments
Spitfire Link	No further information		On site	Soil Limited (2020) drilled six exploratory boreholes within or adjacent to the mapped boundary. No records of waste are indicated on borehole logs.
King George V Playing Fields	No further information		On site and adjacent to east	
Land adjacent to Winchester Bypass	Inert	1967-1968	Adjacent to north	Timings suggest related to Winchester Bypass widening. Controlled Waters Risk Assessment in **Chapter 9: Geology and Soils (Document Reference 6.1)**

Name	Waste type	Dates active	Distance from site	Comments
Land Between Old Newbury Railway and A33	No further information		Adjacent to west	Very small so likely to have been a commercial operation. Controlled Waters Risk Assessment **Chapter 9: Geology and Soils (Document Reference 6.1)**
Land At Morestead Wastewater Treatment Works	Inert	1993-2001	30 m southeast	-
Winnall	Commercial and household	1969-	220 m to west	-
Sewage Farm	Commercial and household	Not provided	490 m to south	-
Railway Cutting (near to Winnall landfill)	Inert and commercial	1978-	530 m west	-
Nun's Road	Inert and Industrial	1963-	730 m to west	-
Railway cutting (two parts)	No further information		850 m to north	-
Alresford Drove	Commercial and household	Not provided	1 km northwest	-
Vesonia	Inert and commercial	1979-	1 km east	-
Garnier Road Pumping Station	Commercial and household	1910-	1.1 km west	-

A Controlled Waters risk assessment in **Chapter 9: Geology and Soils (Document Reference 6.1)** has identified a number of other potential sources of contamination that are relevant to this study. These comprise a former gas works and iron works, railways, and land of mixed industrial use within or close to the Application Area that may also be a source of contaminants in soils.

Figure 3.5 Historical landfill areas



3.3 Hydrology

3.3.1 Rainfall

The Standard Average Annual Rainfall (SAAR) for the area around the Itchen at Easton river monitoring point (42016) is 848 mm (NRFA, 2021).

3.3.2 Surface water features

Surface water features in the vicinity of the Application Area are shown on Figure 3.6.

Watercourses

The River Itchen flows east to west across the northern part of the Application Area and then flows south to the west of the Application Area approximately parallel with the M3. The River Itchen is a chalk stream comprising a number of anabranches in the area around Winchester and the Application Area. There is also a network of ditches that are connected with the Itchen that follow the boundaries of the former water meadows within the Itchen floodplain. The Itchen is a designated Main River, with the associated floodplain designated as a SAC and SSSI. Much of the floodplain to the west of the central part of the Application Area is managed as the Winnall Moors Local Nature Reserve.

According to the National River Flow Archive the mean flow data of the River Itchen upstream of the Application Area (location 42016 - Itchen at Easton) is 4.239 m^3/s. Downstream of the Application Area (location 42010 - Itchen at Highbridge & Allbrook Total) mean flow is 5.539 m^3/s, implying that the River gains within the Application Area. Both locations show evidence of substantial surface and groundwater abstraction and the presence of cress beds and fish farms. The baseflow index (BFIHOST) at the River Itchen at Easton is 0.95, indicating that it almost entirely groundwater fed.

To the west of the River Itchen is Nun's Walk Stream, which flows parallel to the track/road of the same name and the Itchen. This is also a designated Main River. Ordnance Survey mapping indicates that Nun's Walk Stream starts around springs at Headbourne Worthy in the north and flows southwest parallel with the Itchen on a straight course and joins with an Itchen anabranch at the north end of Park Road, Winchester, south of the River Park Leisure Centre, approximately 2.5 km to the south.

In the surrounding area, there are very few water courses or water features other than the River Itchen that lie on the Chalk, and this is generally due to the high secondary porosity and permeability of the Chalk allowing rainfall to infiltrate and recharge the aquifer directly.

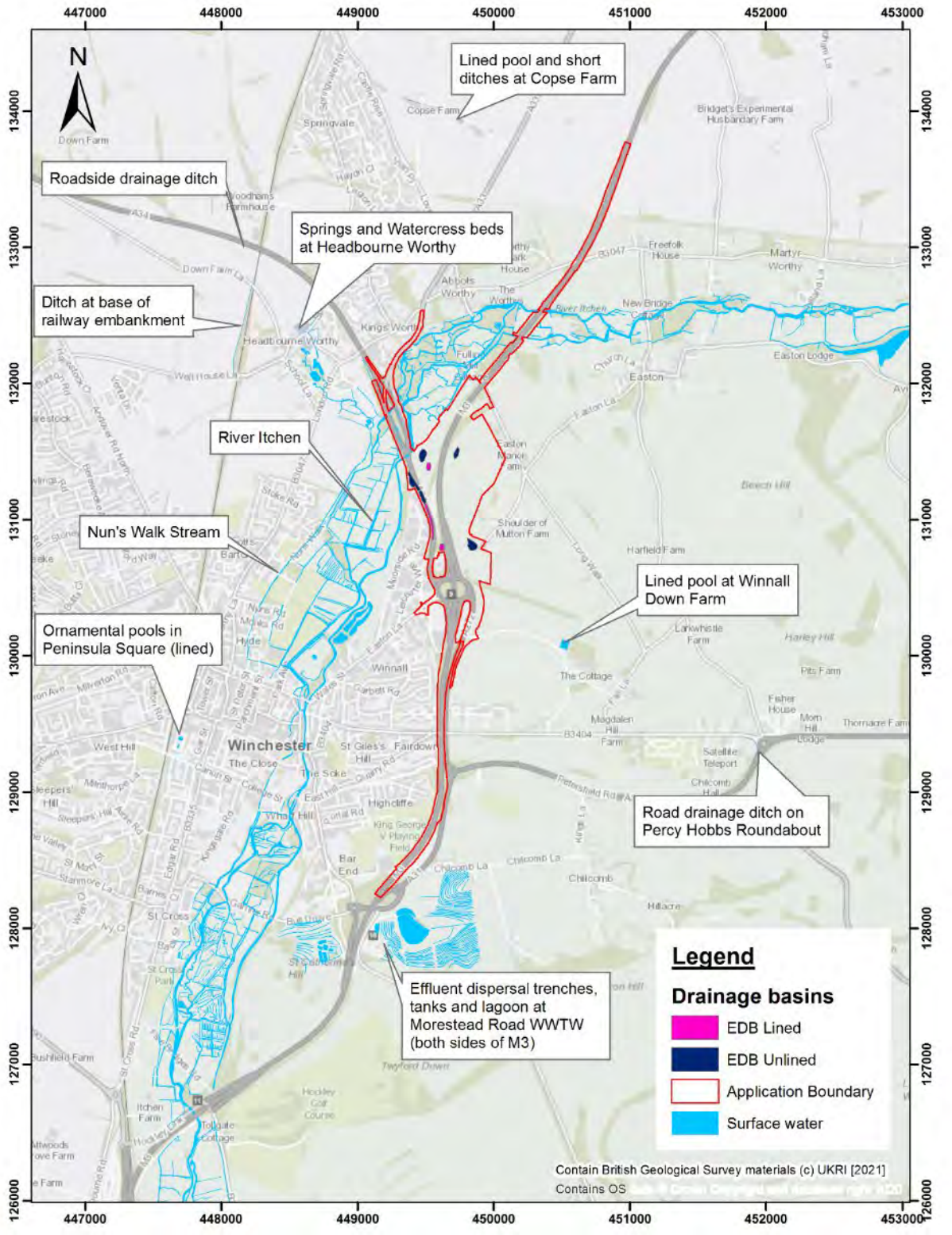
Waterbodies

There are a number of water bodies that fall within the course of the River Itchen. There are three waterbodies located on the eastern side of the Itchen south of the Junction 9 roundabout. There is also a square pond at Winnall Down Farm (125 m from the Application Area, that given its shape is very likely to be manmade, and it appears from satellite imagery that it is lined.

To the south around St Catherine's Hill and Chilcomb there are many effluent dispersal trenches, tanks and a lagoon forming part of the Morestead Road Wastewaster Treatment Works. These features are both to the west and east of the M3.

There are number of fisheries and water cress ponds in the surrounding area that rely on chalk-fed water features, such as those in Headbourne Worthy, 480 m to the west of the Application Area. These ponds are fed by springs from the chalk. There are also watercress ponds around New Alresford, 8 km to the east of the Application Area and upstream on the River Itchen.

Figure 3.6 Surface water features



3.3.3 Surface water quality

No surface water samples were taken as part of the site investigation undertaken by Soils Limited in 2019.

3.4 Hydrogeology

3.4.1 Groundwater classifications and systems

The Alluvium underlying the north of the Application Area is classified by the EA as a Secondary A aquifer, meaning it is a formed of permeable layers capable of supporting water supplies at a local rather than strategic scale, and can provide an important source of base flow to rivers.

The Head deposits are classified as Secondary Undifferentiated aquifer. These are layers for which it has not been possible to determine a permeability due to the variable characteristics of the rock type.

The Chalk Subgroup is classified by the EA as a Principal Aquifer, due to its high fracture permeability, and as such it supports water supply and river base flow on a strategic scale. The Chalk is a dual porosity aquifer with rapid flow occurring through fracture networks and slower flow through the porous matrix.

The top of the Chalk is logged as structureless chalk. Structureless chalk tends to have fewer fissures and fractures and the clayey matrix is often a barrier to groundwater flow.

The Groundwater Vulnerability maps from the EA indicates that the groundwater is of High vulnerability to pollutant discharge at the surface in areas without superficial cover and Moderate-High vulnerability in areas with superficial cover.

3.4.2 Groundwater Source Protection Zones (SPZs)

The Application Area lies within two overlapping groundwater Source Protection Zones (SPZ); which relate to groundwater sources that are used for public drinking water supply. The definitions of each zone are described in Table 3.5 below. There is also another SPZ to the northwest and one to the south. The SPZs are shown on Figure 3.14.

Table 3.5 Outline definitions of Source Protection Zones

Zone	Outline definition (from Environment Agency website – (Environment Agency, 2019)
Zone 1 (Inner Zone)	Defined by a 50-day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres.
Zone 2 (Outer Zone)	Defined by a 400-day travel time from a point below the water table. This zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction. Older SPZs may have used a different methodology.
Zone 3 (Total Catchment)	Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

The SPZ in the northeast of the Application Area is for two Southern Water public water supply boreholes near Easton and lies mostly along the M3 north of the Application Area[1]. Where the Application area is within the SPZ it is mostly in Zone 1, with the northernmost area in Zone 2 (c. 860 m of M3).

[1] Note that co-ordinates are not available for the Itchen Valley PWS's near Easton.

There is also an SPZ approximately 450 m to the northwest of the Application Area associated with the Headbourne Worthy Watercress Beds. These beds are fed by springs. The area closest to the Application Area is in Zone 1 with the 'tail' of Zone 2 and 3 spreading to the northwest away from the Application Area.

There is another SPZ 1 km southeast of the Application Area which is related to further Southern Water public water supply boreholes.

The Drinking Water Groundwater Safeguard Zone (DWGSZ) for the River Itchen Chalk covers Zone 1 and 2 of the SPZ.

3.4.3 Aquifer properties

The Chalk exhibits both matrix flow and fracture flow and the Seaford Chalk Formation has regular orthogonal joint sets (Allen, et al., 1997). The Seaford Chalk usually has high storage although not always high permeability due to the narrow apertures of the fractures (Allen, et al., 1997). Numerous fractures are identified in the chalk in borehole logs.

It is common for there to be higher permeability in chalk river valleys. Palaeogene sediments in river valleys tend to be quite acidic, enhancing dissolution (Allen, et al., 1997). Transmissivities in the Hampshire Basin area are reported in Allen *et al.,* (1997) from 0.55 to 29,000 m^2/d with a geometric mean of 1,600 m^2/d. Allen *et al.* (1997) note that these values are high due to higher number of tests near to rivers. Transmissivity values of 1,000 m^2/d are common in the valley areas. The Candover valley, a tributary of the Itchen to the east, has transmissivities of 1,000 - 3,000 m^2/d and a storage coefficient of 0.01-0.03. Folding tends to enhance fracturing of rocks. However, it also notes that in the axes of anticlines, such as is found here, aquifer properties are thought to be less well developed, with groundwater mounds and lower transmissivities of 100 m^2/d. (Entec, 2002) within (WPK, 2007) suggest transmissivities in the Winchester Anticline are 100-600 m^2/d.

At the Itchen Valley (Easton) Public Water Supply (PWS) to the north of the Application Area, transmissivities of 2,400 and 4,700 m^2/d have been calculated from pumping tests (Environment Agency, 1997 within WPK, 2007).

If we assume that the transmissivity is concentrated in the top 50 m of the Chalk, then a transmissivity of 1,000 m^2/d equates to a hydraulic conductivity of 20 m/d. Below 50 m, chalk fissures tend to be closed due to the mass of rock above them and yields decrease.

Variable head permeability tests were undertaken during the site investigation by Soils Limited. However, it is understood that these tests were undertaken above the watertable and thus may not reflect the hydraulic conductivity of the strata tested. In the **Geotechnical Interpretation Report (Document Reference 7.11)** calculated soil infiltration rates to use as an indication for preliminary designs. Table 9.5 from the **Geotechnical Interpretation Report (Document Reference 7.11)** is reproduced here as Table 3.6. Based on these calculations a soil infiltration rate of 1 x 10^{-6} m/s was adopted for Alluvium, Head and Structured Chalk within 2 mbgl (metres below ground level), and 1 x 10^{-5} m/s for Structured Chalk below 2 mbgl.

Table 3.6 Calculated soil infiltration rates (from Table 9.5 in Geotechnical Interpretation Report (Document Reference 7.11))

Location	Test depth range (mbgl)	Geology as per borehole record logs (mbgl)	Soil infiltration – calculated (m/s)	Soil infiltration(m/hr)
DS104	0 - 4	0.3 - 3.0 Sandy gravelly clay [Alluvium] 3.0 - 4.0 No description [Alluvium]	9.5×10^{-6}	3.4×10^{-2}
DS107	0 - 4	0.4 - 1.2 Structureless chalk 1.7 - 4.0 Chalk Grade B2	1.4×10^{-5}	5.2×10^{-2}
DS109	0 - 3	0.5 - 1.2 Structureless chalk 1.2 - 3.0 Chalk Grade B2	2.8×10^{-5}	1.0×10^{-1}
DS210	0 - 4	0 - 1.7 Structureless chalk (Grade Dc) 1.7 - 4.0 Chalk Grade B2	4.2×10^{-6}	1.5×10^{-2}
DS301	5.7 - 10.15	5.7 - 7.0 Chalk Grade A3-A4 7.0 - 10.15Chalk Grade A3	1.1×10^{-4}	4.1×10^{-1}

Yields in the Lewes to Portsdown Formations are typically 10.5 l/s in boreholes in the Winchester District (Booth, et al., 2008). Booth *et al.* also note that "*rapid groundwater flows are sometimes found in the unconfined chalk aquifer where karstic-type development has taken place. This is commonly associated with the proximity of thin cover, such as the Palaeogene deposits or clay-with-flints".*

3.4.4 Groundwater levels and flow

Available data

Limited groundwater monitoring data are available. Monitoring wells were installed by Soils Limited during March and April 2019 at 23 locations and dips were taken at 13 from the installation until 15th April 2019. Four locations (DS104, DS114, DS301, DS302) were then monitored hourly using pressure transmitters and loggers for the period June 2019 to July 2020.

Groundwater levels

Dip data

Fourteen boreholes were dipped once installed and typically each day during the site investigation works by Soils Limited. The dips and levels on the final day (15th April 2019) are plotted on Figure 3.7 and Figure 3.8 respectively, which also shows the locations. The dip data is provided in Table 3.7 for the whole GI period (where available). These data are taken from the Soils Limited (2020) Factual Report and converted to metres above ordnance datum based on the groundwater elevations provided in the report. A number of boreholes were dry throughout the works period. These data indicate that the groundwater level across the central part of the Application Area is approximately 37.5 mAOD. Groundwater levels at DS208 are noticeably higher at 52.04 mAOD, which is because this borehole is screened in the Seaford Chalk at a higher elevation of 51.91-54.91 mAOD, whereas the other boreholes are screened below 30 mAOD. There is therefore a locally perched groundwater table at DS208.

Groundwater seepage was encountered during the Jacobs Application Area investigation at a depth of 3.10 mbgl in WS02 and 4.50 mbgl in WS03, and 7 mbgl in WS08.

Figure 3.7 Groundwater dip data from final day of installation works in mbgl

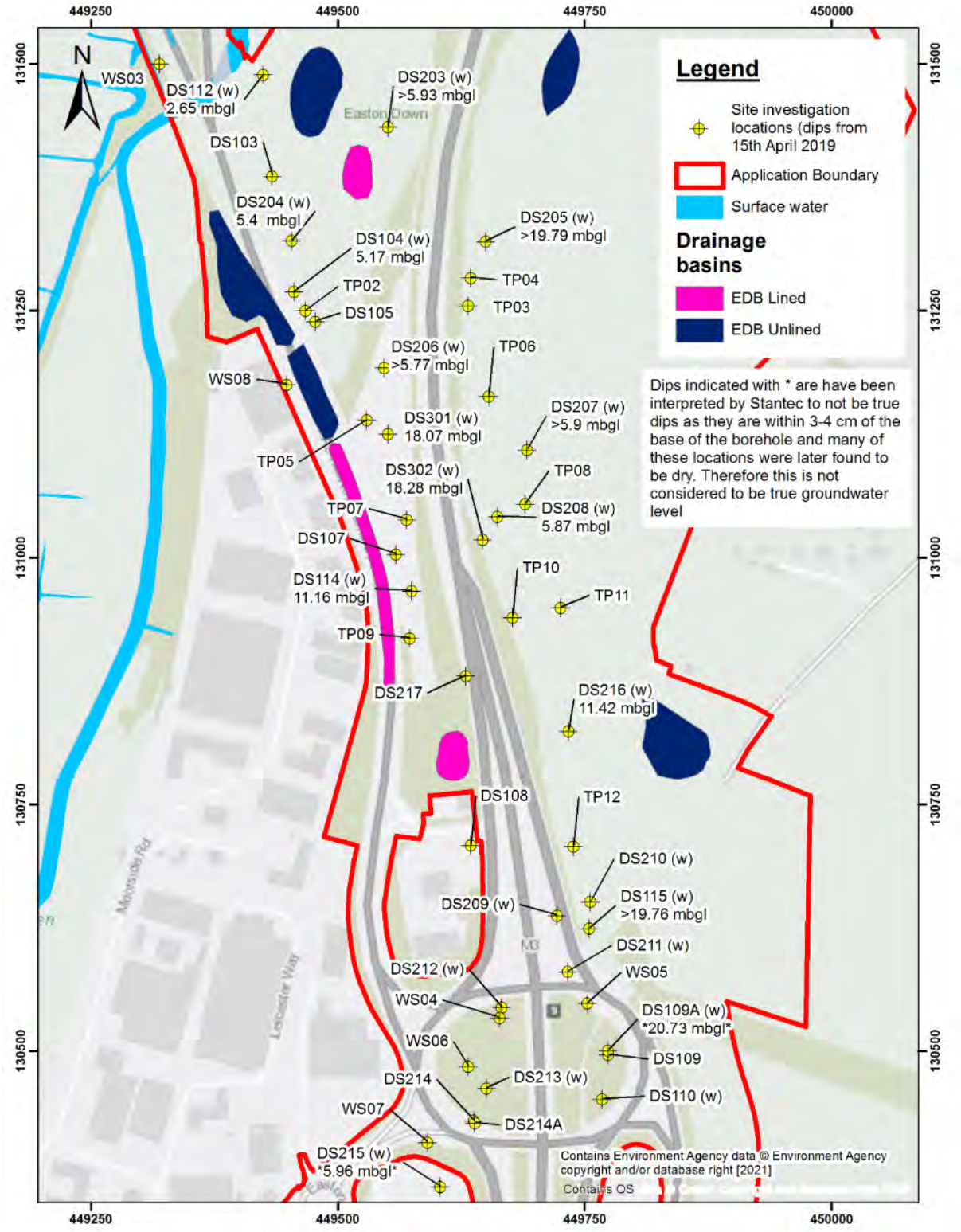


Figure 3.8 Groundwater levels data from final day of installation works in mAOD

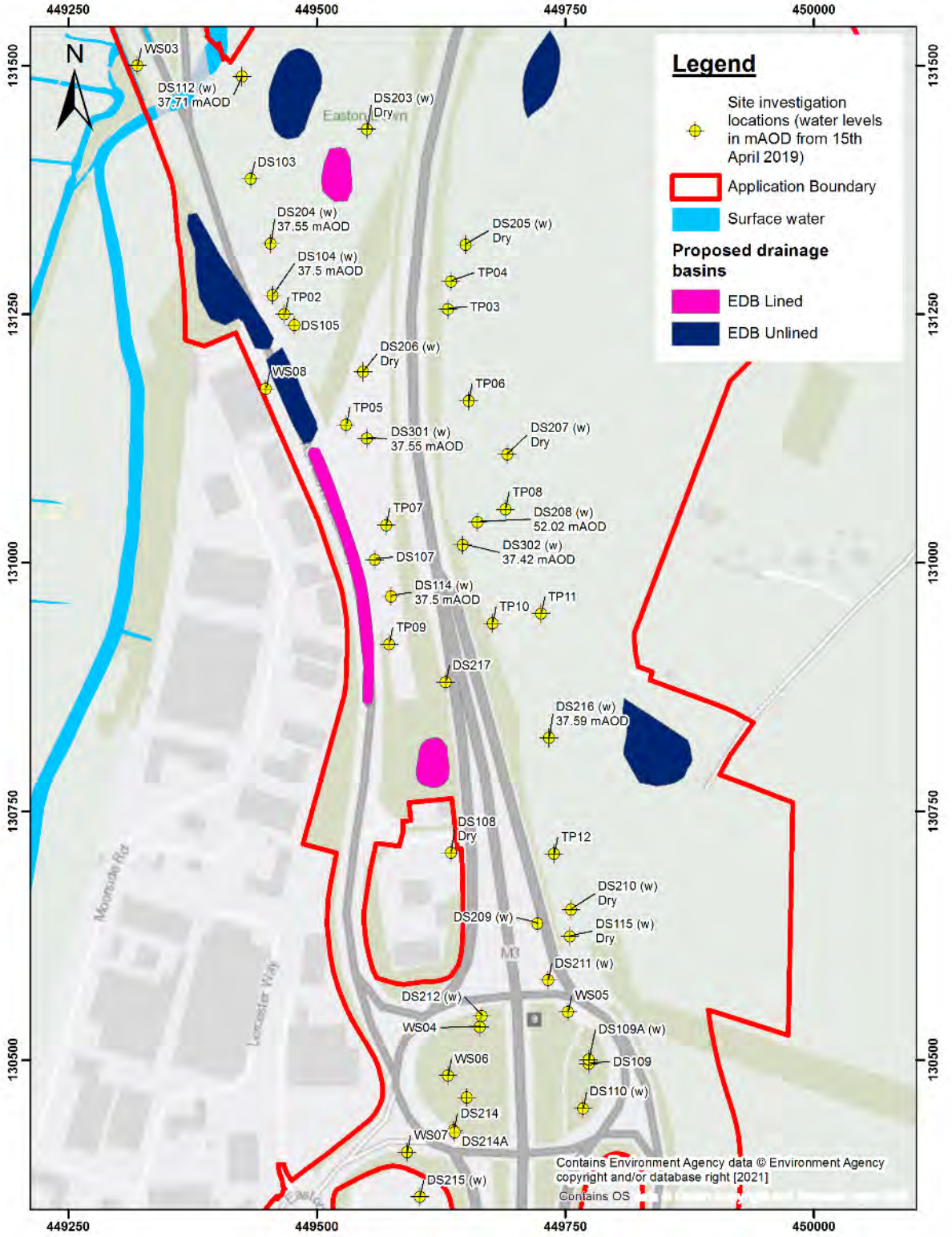


Table 3.7 Groundwater level dip data during site investigation works in mAOD

Date		18/03/2019		19/03/2019		20/03/2019		22/03/2019		25/03/2019		26/03/2019		27/03/2019		28/03/2019		01/04/2019	
Trial Hole	**Ground level (mAOD)**	Water level	Base	Water level	Base	Water level	Base	Water level	Base	Water level	Base	Water level	Base	Water level	Base	Water level	Base	Water level	Base
DS104	42.67																		
DS112	40.36																	37.72	20.93
DS114	48.66													37.56	29.10	37.55	29.10	37.56	29.10
DS115	62.23					Installed		42.82	42.43			Dry	42.47	Dry	42.47	Dry	42.47	Dry	42.46
DS203	57.43																		
DS204	42.95																	37.59	36.85
DS205	69.16	Dry	49.39	Dry	49.39	Dry	49.39	Dry	49.39	Dry	49.44	Dry	49.39	Dry	49.44	Dry	49.39	Dry	49.44
DS206	56.88															Installed		Dry	51.11
DS207	64.65	Dry	58.45	Dry	58.77	Dry	58.71	Dry	58.77	Dry	58.78	Dry	58.75	Dry	58.73	Dry	58.78	Dry	58.78
DS208	57.91	Dry	51.74	Dry	51.92	52.02	51.98	Dry	51.89	52.01	51.97	52.05	52.01	52.00	51.98	52.05	52.01	52.04	52.02
DS210	61.41							Dry	55.63	Dry	55.63	Dry	55.62	Dry	55.62	Dry	55.62	Dry	55.63
DS216	49.01							Installed				37.64	34.28	37.47	33.96	37.65	34.29	37.48	33.98
DS301	55.62													Installed				37.60	<25.62
DS302	55.7			Installed		37.66	<25.7	37.65	<25.7	37.76	<25.7	37.67	<25.7	37.61	<25.7	37.62	<25.7	37.63	<25.7

(Continued on next page)

	Date	02/04/2019		03/04/2019		05/04/2019		09/04/2019		10/04/2019		11/04/2019		12/04/2019		15/04/2019	
Trial Hole	Ground level	Water level	Base	Water level	Base	Water level	Base	Water level	Base	Water level	Base	Water level	Base	Water level	Base	Water level	Base
DS104	42.67	Installed		37.54	27.96	37.75	28.04	37.55	27.94	37.53	27.95	37.66	28.05	37.54	27.95	37.50	27.95
DS112	40.36	37.70	20.95	37.74	21.08	37.87	20.95	37.80	20.95	37.73	21.00	37.71	21.00	37.70	20.89	37.71	21.02
DS114	48.66	37.56	29.10	37.54	29.38	37.64	29.22	37.56	29.10	48.66	48.66	37.61	29.09	37.52	29.51	37.50	29.42
DS115	62.23	Dry	42.68	Dry	42.68	Dry	42.82	Dry	42.68	Dry	42.82	Dry	42.46	Dry	42.46	Dry	42.47
DS203	57.43			Installed				Dry	51.48	Dry	51.48	Dry	51.48	Dry	51.53	Dry	51.50
DS204	42.95	37.58	36.87	37.58	36.87	37.77	36.91	37.78	36.87	37.60	36.89	37.69	36.89	37.56	36.90	37.55	36.89
DS205	69.16	Dry	49.44	Dry	49.44	Dry	49.44	Dry	49.44	Dry	49.44	Dry	49.67	Dry	49.69	Dry	49.37
DS206	56.88	Dry	51.11	Dry	51.10	Dry	51.10	Dry	51.01	56.88	56.88	Dry	51.01	Dry	51.10	Dry	51.11
DS207	64.65	Dry	58.78	Dry	58.78	Dry	58.78	Dry	58.76	Dry	58.74	Dry	58.73	Dry	58.74	Dry	58.75
DS208	57.91	52.04	52.03	52.03	52.01	Dry	52.03	Dry	63.79	52.04	52.03	Dry	52.02	Dry	52.02	52.04	52.02
DS210	61.41	Dry	55.62	Dry	55.63	Dry	55.63	Dry	55.63	Dry	55.52	Dry	55.51	Dry	55.51	Dry	55.52
DS216	49.01	37.48	34.14	37.47	34.23	37.74	34.14	37.19	34.14	37.45	34.16	37.61	34.26	37.60	34.26	37.59	34.26
DS301	55.62	37.59	<25.62	44.54	<25.62	37.59	<25.62	37.60	<25.62			37.69	<25.62	37.61	<25.62	37.55	<25.62
DS302	55.7	37.78	<25.7	37.62	<25.7	37.28	<25.7	37.49	<25.7	37.64	<25.7	37.46	<25.7	37.44	<25.7	37.42	<25.7

Red text indicates that the base of the borehole extended beyond the reach of the 30 m dip tape used.
Yellow highlighting indicates water levels that may be errors.

Logger data

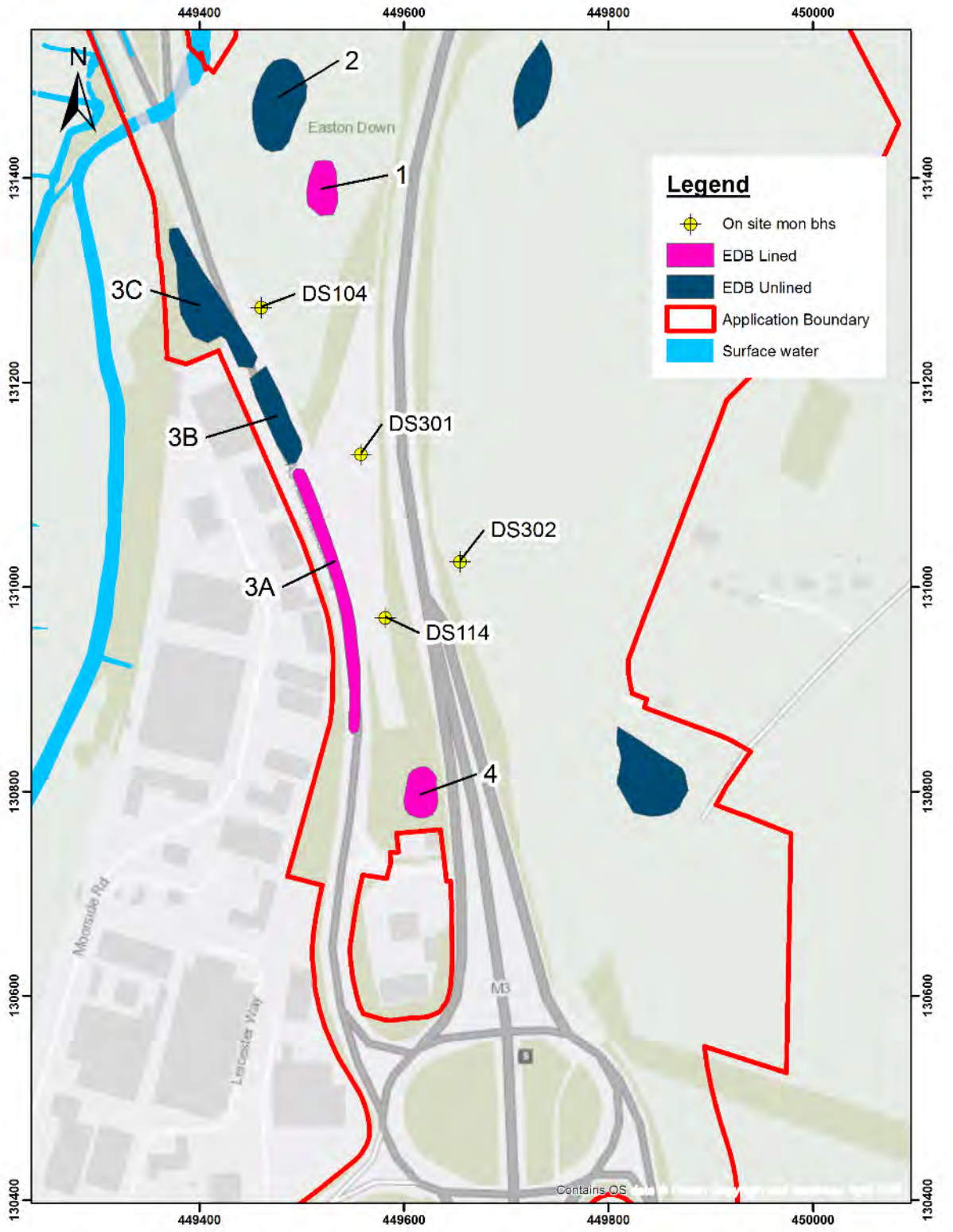
Groundwater monitoring points DS104, DS114, DS301 and DS302 are located close to the proposed drainage basins 2, 3A, 3B and 3C, as shown on Figure 3.9, and monitor the Seaford Chalk Formation. These boreholes are between 15 and 30.5 m in depth and are screened at their base within the Seaford Chalk Formation. A summary of the depths and horizons at the boreholes is given in Table 3.8.

These boreholes were monitored using loggers for one year from June 2019 to July 2020. The water level (in mbgl) is plotted in Figure 3.11. The barometrically adjusted groundwater level (in mAOD)) is plotted in Figure 3.10. A summary of the groundwater level is given in Table 3.9.

Table 3.8 Groundwater monitoring locations

Borehole	Ground level (mAOD)	Depth (mbgl)	Elevation of base (mAOD)	Screened interval (mAOD)	Geology summary
DS104	42.67	15.00	27.67	27.67-32.60 (Seaford Chalk)	Topsoil/Made Ground 0 to 0.3 mbgl Head 0.3 to 8.5 mbgl (some core not recovered). Typically sandy gravelly clay down to 3 mbgl and variable sand, gravels, and sandy gravelly clays at depth. No recovery 8.5 to 10.00 mbgl Seaford Chalk Formation 10.00-15.00 mbgl
DS114	48.66	19.95	28.71	29.16-32.16 (Seaford Chalk Formation)	Topsoil 0 to 0.3 mbgl Seaford Chalk Formation from 0.3 to 19.95
DS301	55.62	30.25	25.27	25.62-30.62 (Seaford Chalk Formation)	Topsoil to 0.4 mbgl. Seaford Chalk from 0.4 to 30.25 mbgl
DS302	55.70	30.45	25.25	25.70-30.70 (Seaford Chalk Formation)	Head from 0 to 0.27 mbgl. Head is composed of light brown slightly gravelly sandy clay. Seaford Chalk from 0.27 to 30.45 mbgl

Figure 3.9 Boreholes monitored for groundwater level



During the monitoring period the groundwater levels vary by approximately 2 m, with all locations showing almost identical trends. Groundwater level generally increase gradually from June 2019 to December 2019, then rise more quickly from mid-December to February 2020 and decline from February to June 2020. Groundwater levels in DS301 and DS302 are approximately 0.3 m higher than those at DS104 and DS114. The groundwater levels range

between 37.19 to 39.38 mAOD. This is the same elevation as the River Itchen and surrounding area to the west. We note that the Chalk groundwater level flow direction is likely to be towards the River Itchen (i.e. from east to west). These wells are located along an approximate north to south line (perpendicular to groundwater flow), making it difficult to assess flow directions or hydraulic gradients directly from these data.

Table 3.9 Summary of groundwater levels (June 2019 to July 2020)

Borehole	Groundwater level (mbgl)			Groundwater level (mAOD)		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
DS104	3.83	4.97	5.43	37.24	37.70	38.84
DS114	9.67	10.98	11.49	37.17	37.68	38.99
DS301	16.41	17.68	29.21	37.43	37.94	39.21
DS302	16.32	17.73	28.90	37.42	37.98	39.38

Figure 3.10 Groundwater level in Application Area SI boreholes in the Application Area (mAOD)

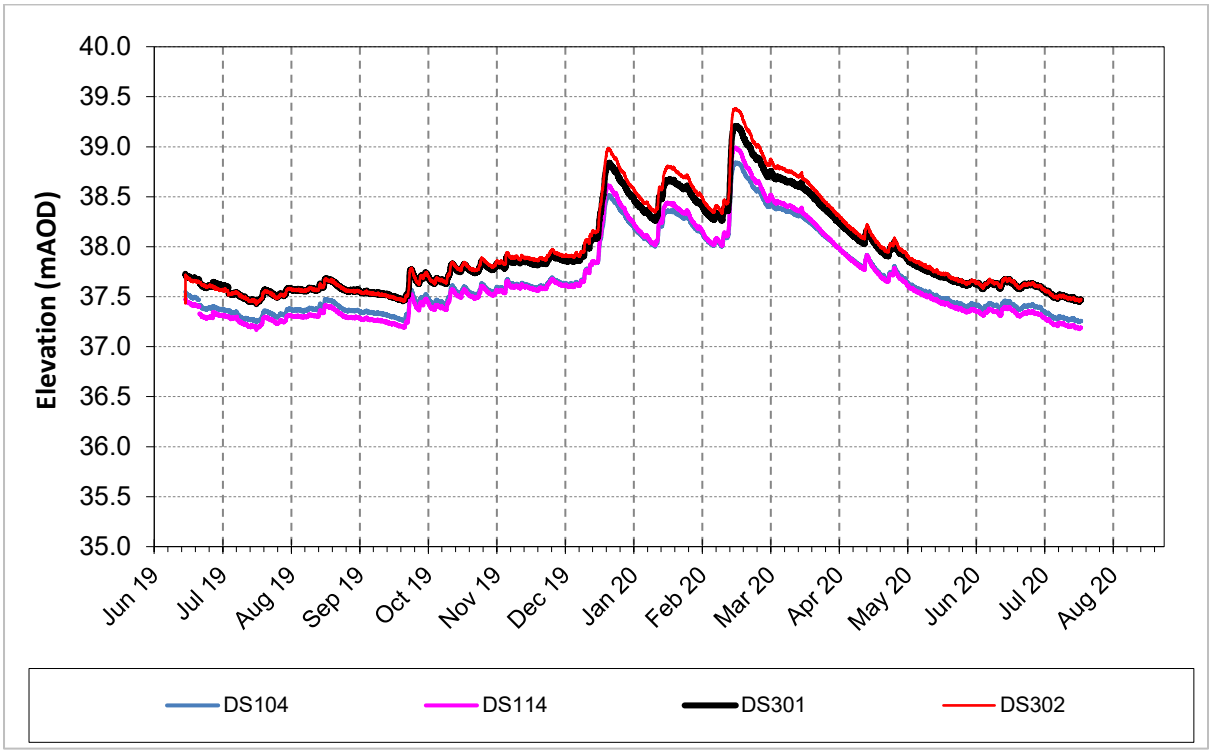
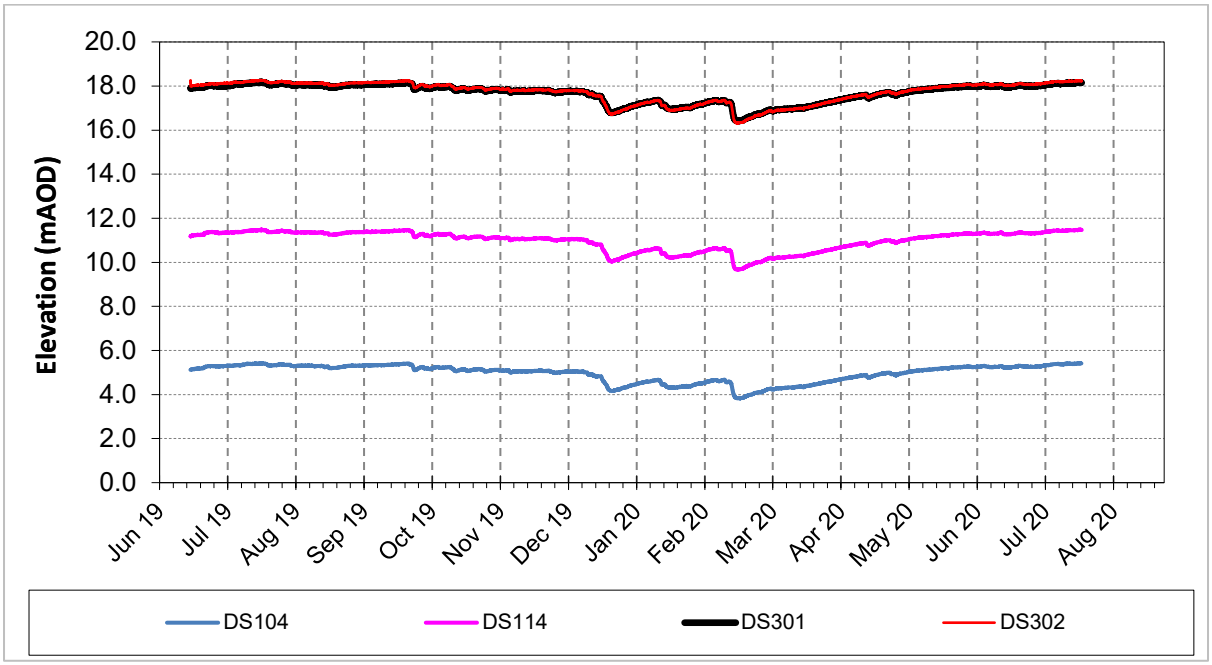


Figure 3.11 Groundwater level in Application Area SI boreholes in metres below ground level



Unsaturated zone thickness

Based on the available groundwater level data, the groundwater depth (unsaturated zone thickness) at each of the proposed EDBs can be estimated. These estimates are summarised in Table 3.10. Unsaturated zone thickness is based on the average groundwater level in the closest borehole to where the EDB is proposed. The logger data at four boreholes indicates that the average groundwater level over the year was 0.2 m higher than the water level recorded in April 2019 during the installation. Therefore, it has been assumed that variability is the same across all boreholes and so the average unsaturated thickness is taken to be 0.2 m smaller than was measured in April 2019.

Table 3.10 Approximate depth to groundwater at unlined EDBs

EDB	Approximate average elevation of EDB (mAOD)	Approximate average unsaturated thickness to nearest 0.1 m	Nearest borehole
1	45	7.1	DS112
2	51	13.1	DS203 DS112
3B	43.5	5.8	DS104
3C	41.5	3.8	DS104

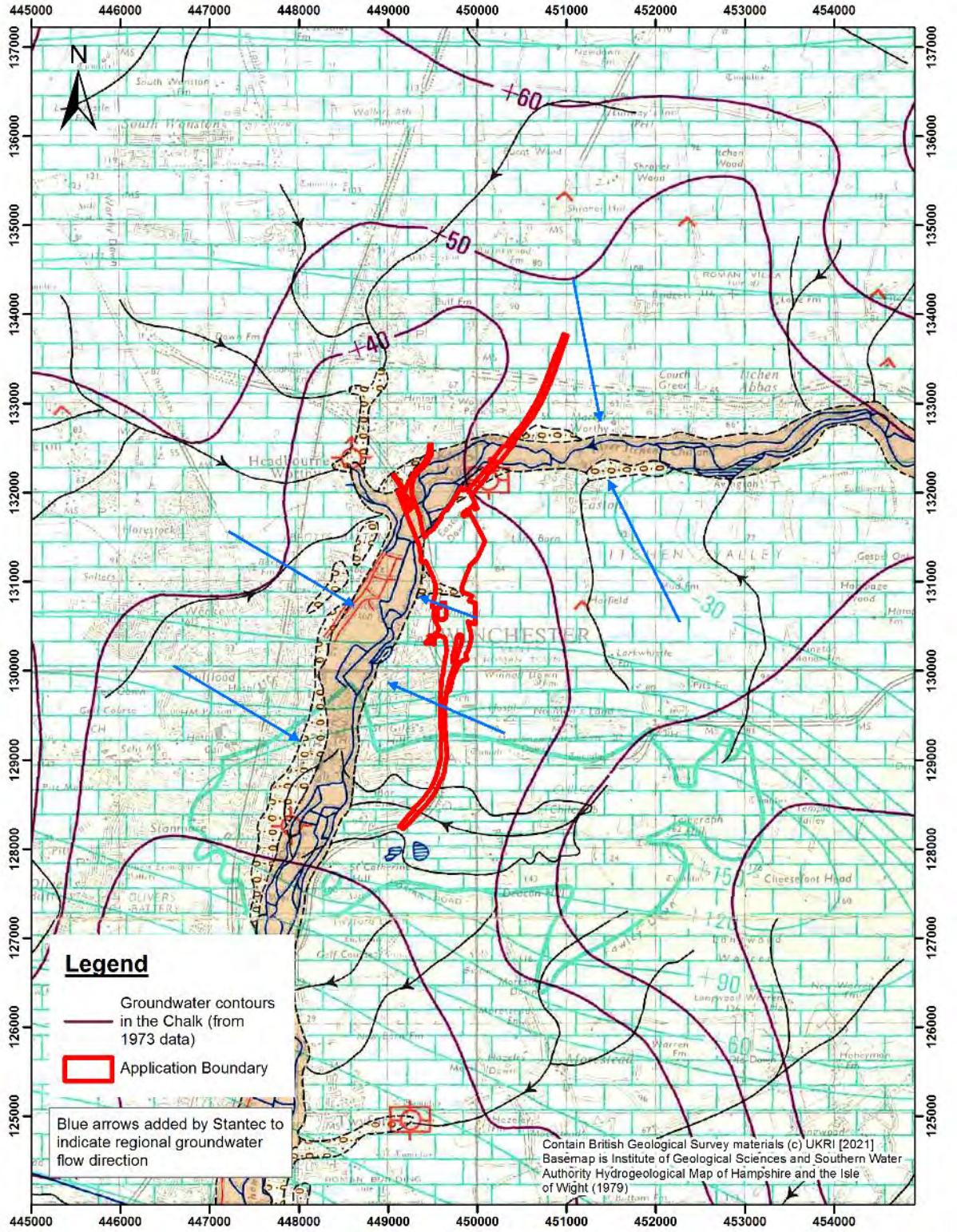
Groundwater flow

The Hydrogeology map of Hampshire and the Isle of Wight (Institute of Geological Sciences and Southern Water Authority, 1979) shows the groundwater contours in the Upper Chalk around the Application Area to be generally mirroring the topography and indicates

groundwater flow towards the River Itchen (Figure 3.12). In the area of the drainage features within the Application Area, groundwater flows to the southwest are indicated, towards the River. These contours suggest that groundwater discharges to the River.

The shape of the SPZs indicate a southeasterly flow at Headbourne Worthy which lies on the western side of the River Itchen. The Itchen Valley abstractions near Easton draw in water from the north of the River and also from the southeast.

Figure 3.12 Application Area overlaid on the Hydrogeological map (Institute of Hydrological Sciences, 1979)



3.4.5 Contaminated land and pollution events

An Envirocheck report was obtained to inform the Preliminary Sources Study Report (WSP, 2017). Envirocheck notes there are two petrol filling stations on Easton Lane, one 7 m (Shell)

from the Application Area and one 66 m (Tesco) away. Stantec has also been made aware by Winchester City Council that there also is a former petrol station located within the Application Area along the A33 (letter reference 21/01483/NSIP, dated 7th July 2021).

Pollution incidents up to 2 km away from the Application area are summarised in Table 3.11 (Envirocheck, 2016). These pollution incidents occurred between 1992 and 1999.

Table 3.11 Pollution incidents within 2 km (from Envirocheck, 2016)

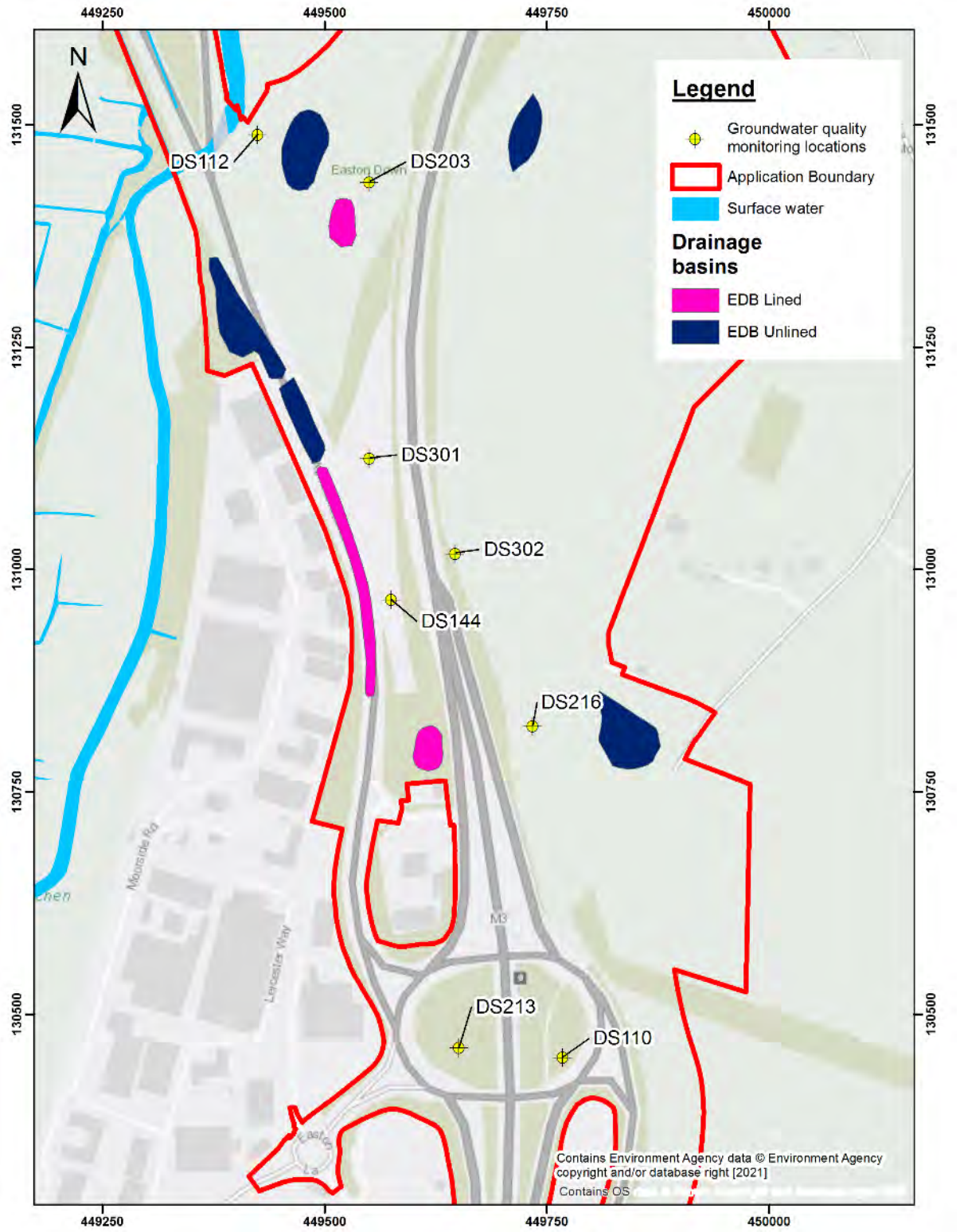
Distance	Number of recorded incidents	Summary of incidents
On site	1	Poultry manure
0-250 m	4	Petrol poured onto ground
		LPG tanker overturned
		Mineral and synthetic oil
		Inert suspended solids from cress beds
251-500 m	2	Slurry discharge
		Inert suspended solids from farm
501-2000 m	12	Slurry discharge
		Milky white discharge from construction
		Suspended solids from construction
		Industrial chemicals
		Waste oil
		River has turned black – inert solids

3.4.6 Groundwater quality

Groundwater samples were taken from eight boreholes on two occasions during the GI in 2019. The locations tested were DS110, DS112, DS114, DS203, DS213, DS216, DS301 and DS302, which are shown on Figure 3.13

On each monitoring occasion, two samples were taken from DS110 at 12 mbgl and 29.5 mbgl, and one sample was taken at the other seven boreholes. Only results from one occasion are available for review by Stantec.

Figure 3.13 Groundwater quality monitoring locations



The Tier 2 Controlled Waters Risk Assessment in **ES Chapter 9: Geology and Soils (Document Reference 6.1)** identified one exceedance of copper, two exceedances of mercury, one exceedance of nickel and one exceedance of zinc against the Environmental Quality Standards (EQS). Furthermore, the limit of detections (LOD) for cadmium, hexavalent chromium, copper, lead and cyanide are above the EQS. It also identified one exceedance of

mercury, one exceedance of nickel and two exceedances of nitrate compared to the UK DWS (Drinking Water Standards). The nitrate exceedances were from wells sampling from the rural catchment to the east of the Scheme and the metal exceedances were from wells sampling close to historical landfills.

Table 3.12 Summary of groundwater quality data (based on data in Controlled Waters Risk Assessment in ES Chapter 9: Geology and Soils (Document Reference 6.1))

Analyte	Units	LOD	Fresh Water (EQS)	No. of Tests	Min	Max	No. > Limit	Locations with exceedances
Arsenic	µg/l	5	50	9	5	5		
Boron	µg/l	5	-	9	14	28		
Cadmium	µg/l	0.4	0.08	9	0.4	0.4	**9**	All
Chromuim (Total)	µg/l	5	-	9	5	10		
Chromium Hexavalant	µg/l	20	3.4	9	20	20	**9**	All
Copper	µg/l	5	1	9	5	9	**9**	All. Detected at DS103 only
Lead	µg/l	5	1.2	9	5	5	**9**	All
Mercury	µg/l	0.05	0.07	9	0.05	18.3	**2**	DS110 (0.24) and DS203 (18.3)
Nickel	µg/l	5	4	9	5	68	**9**	All. Detected at DS203 only
Selenium	µg/l	5	-	9	5	5		
Zinc	µg/l	2	10.9	9	2	27	**1**	DS203
Ammoniacal Nitrogen as NH4	µg/l	50	260	9	50	107		
Cyanide	µg/l	5	1	9	5	5	**9**	All
Nitrate as NO3	µg/l	500	-	9	14300	56000		
Sulphate	µg/l	1000	-	9	6000	31000		
pH	pH Units	1	-	9	7.7	7.8		
>C5 to C6 Aliphatic	µg/l	10	-	9	10	10		
>C6 to C8 Aliphatic	µg/l	10	-	9	10	10		
>C8 to C10 Aliphatic	µg/l	10	-	9	10	10		
>C10 to C12 Aliphatic	µg/l	10	-	9	10	10		
>C12 to C16 Aliphatic	µg/l	10	-	9	10	10		
>C16 to C21 Aliphatic	µg/l	10	-	9	10	10		
>C21 to C35 Aliphatic	µg/l	10	-	9	10	18		
Total Aliphatic C5-35	µg/l	70	-	9	70	70		
>C7 to C8 Aromatic	µg/l	10	-	9	10	10		
>C8 to C10 Aromatic	µg/l	10	-	9	10	10		
>C10 to C12 Aromatic	µg/l	10	-	9	10	10		

Analyte	Units	LOD	Fresh Water (EQS)	No. of Tests	Min	Max	No. > Limit	Locations with exceedances
>C12 to C16 Aromatic	µg/l	10	-	9	10	10		
>C16 to C21 Aromatic	µg/l	10	-	9	10	10		
>C21 to C35 Aromatic	µg/l	10	-	9	10	10		
Benzene	µg/l	1	10	9	1	1		
Ethylbenzene	µg/l	5	-	9	5	5		
Toluene	µg/l	5	74	9	5	5		
M- & P-Xylene	µg/l	10	-	9	10	10		
O-Xylene	µg/l	5	-	9	5	5		
Total Xylene (M, P & O)	µg/l	15	-	9	15	15		
MTBE	µg/l	10	-	9	10	10		
naphthalene	µg/l	0.01	2	9	0.01	0.04		
Acenaphthylene	µg/l	0.01	-	9	0.01	0.01		
Acenaphthene	µg/l	0.01	-	9	0.01	0.01		
Fluorene	µg/l	0.01	-	9	0.01	0.01		
Phenanthrene	µg/l	0.01	-	9	0.01	0.01		
Anthracene	µg/l	0.01	0.1	9	0.01	0.01		
Fluoranthene	µg/l	0.01	0.0063	9	0.01	0.01	**9**	All
Pyrene	µg/l	0.01	-	9	0.01	0.01		
Benzo(a)anthracene	µg/l	0.01	-	9	0.01	0.01		
Chrysene	µg/l	0.01	-	9	0.01	0.01		
Benzo(b)fluoranthene	µg/l	0.01	0.017	9	0.01	0.01		
Benzo(k)fluoranthene	µg/l	0.01	0.017	9	0.01	0.01		
Benzo(a)pyrene	µg/l	0.01	0.00017	9	0.01	0.01	**9**	All
Benzo(g,h,i)perylene	µg/l	0.01	0.0082	9	0.01	0.01	**9**	All
Dibenzo(ah)anthracene	µg/l	0.01	-	9	0.01	0.01		
Indeno(1,2,3-c,d)pyrene	µg/l	0.01	-	9	0.008	0.008		
Sum (benzo b, k, ghi & indeno123cd)	µg/l	0.04	-	9	0.038	0.038		

Orange highlight means LOD > EQS
Red highlight means result > EQS

3.5 Other potential receptors

3.5.1 Licenced water abstractions and discharges

There are multiple public groundwater abstractions to the north and south of the Application Boundary. The majority of groundwater abstractions to the north are for potable water supply, with the abstractions to the south and west primarily used for water cress production and other agricultural purposes, see Table 3.15 and Figure 3.14.

Given the groundwater divide at the River Itchen, the impact from the EDBs on the boreholes to the west and north of the Itchen will be negligible and are not considered further here.

3.5.2 Private water supplies

Winchester City Council have previously provided information on private water supply abstractions and discharges, located within a 2 km radius of the Application Boundary. It is understood that the current Application Boundary has been revised and as a result some of these supplies now fall more than 2 km from the Application Boundary.

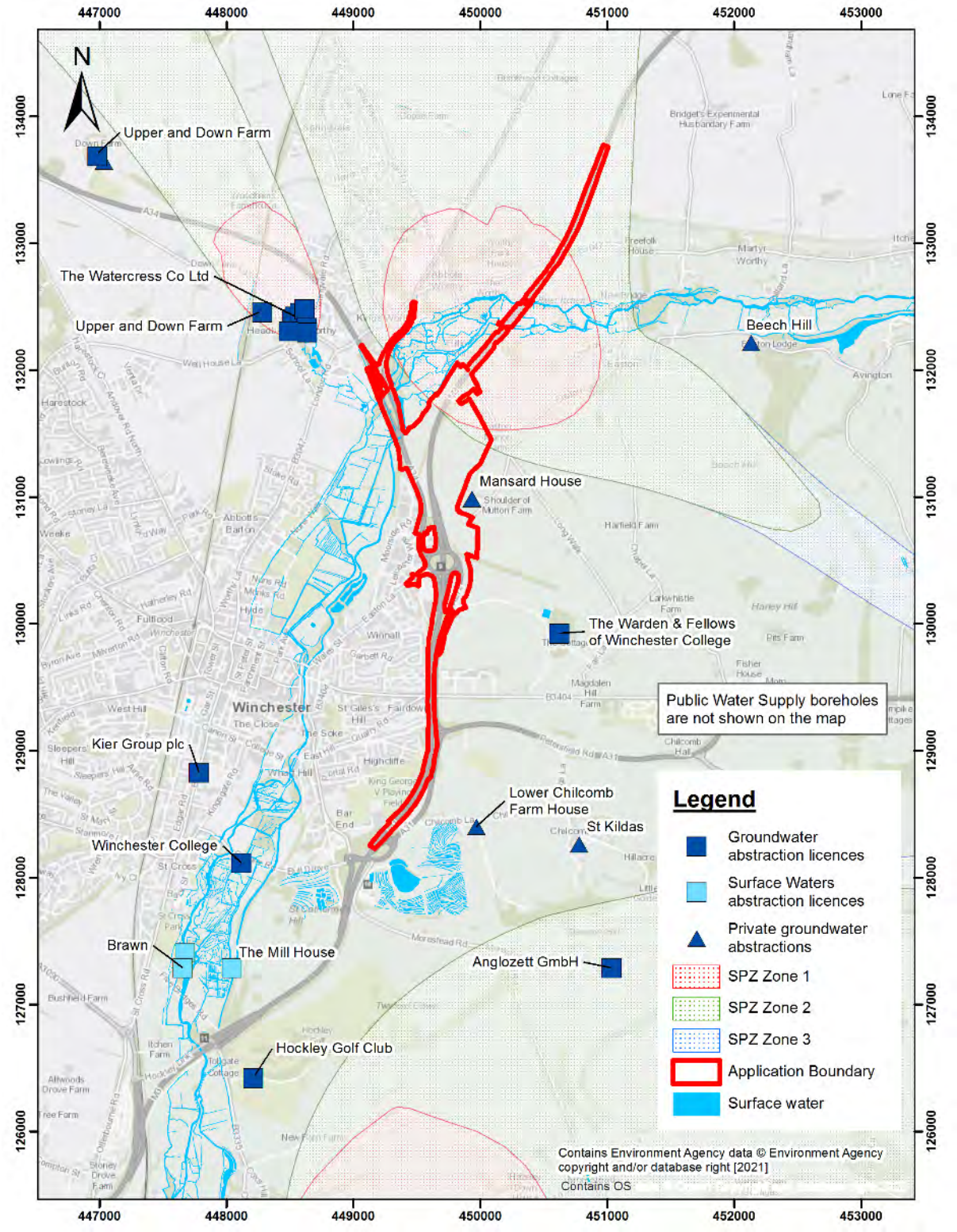
There are nine boreholes used for private water supplies, all of which are currently active and abstract from the underlying chalk aquifer; details of these can be seen in Table 3.13. The locations of private water supply boreholes are shown on Figure 3.14. Some abstractions to the north are beyond the extent of the map and are therefore not shown.

Since all of the private water supplies are on the western and northern side of the River Itchen, up hydraulic gradient, or across hydraulic gradient at a sufficient distance of the EDBs, the Scheme will have a negligible impact upon them, and they are not considered further here.

Table 3.13 Private water abstractions (within 2 km of initial scheme boundary)

FID	Supply Name	Supply Number	Source Type	Source Eastings	Source Northings	Distance from Application Area
Within Application Boundary						
	None					-
Identified outside of the Application Boundary						
19	Shroner Wood	PW000123	Borehole	451582	135626	2 km north
32	Burntwood Farm	PW000118	Borehole	450500	134760	1 km to north
35	Downs Farm Cottages	PW000195	Borehole	447032	133651	2.5 km to north west
51	Mansard House	PW000120	Well	449931	130990	90 m to east
58	Shroner Hill Farmhouse	PW000122	Borehole	450989	135290	1.5 km north
77	Beech Hill	PW000117	Borehole	452132	132220	1.6 km to east
112	Lower Chilcomb FarmHouse	PW000186	Borehole	449967	128403	500 m to east
133	St Kildas	PW000107	Borehole	450776	128265	560 m to south east
136	The Beacon	PW000066	Borehole	450992	135448	1.65 km north

Figure 3.14 Licenced and private abstractions and Source Protection Zones (SPZs)



3.5.3 Designated environmental sites

There are three designated sites within 2 km of the Application Boundary, two of which are within the Application Area itself.

The River Itchen is a SSSI and a SAC along all of its length. The SSSI extends to the surrounding water dependent habitats and environments. Part of the River Itchen SSSI is managed as the Winnall Moors Nature Reserve to the west of the Application Area. The River Itchen flows south to the Solent and Dorset Coast Special Protection Area (SPA) and the Solent and Southampton Water SPA / Ramsar Site.

The South Downs National Park forms part of the eastern side of the Application Area and extends to the east.

Only the River Itchen SSSI is groundwater dependent.

Table 3.14 Designated Sites within 2 km of the Application Area

Name	Designation	Description	Groundwater dependent?	Closest distance from Application Area
River Itchen (multiple parts)	SSSI SAC	River Itchen and surrounding land. Multiple habitats and environments. Close to site: - Fen, marsh swamp, lowland - Broadleaved mixed and yew woodland - Neutral grassland - Rivers and streams	Yes	On site
South Downs	National Park	Chalk Hills and wooded sandstone and clay hills and vales.	Not generally. None within 5 km other than River Itchen (see above).	On site
St Catherine's Hill	SSSI (Biological)	Chalk grassland scrub	No	1.4 km south
Cheesefoot Head	SSSI (Biological)	Chalk downland with horseshoe shaped dry valley, with species rich grasslands.	No	1.8 km east

Figure 3.15 Designated sites within 2 km

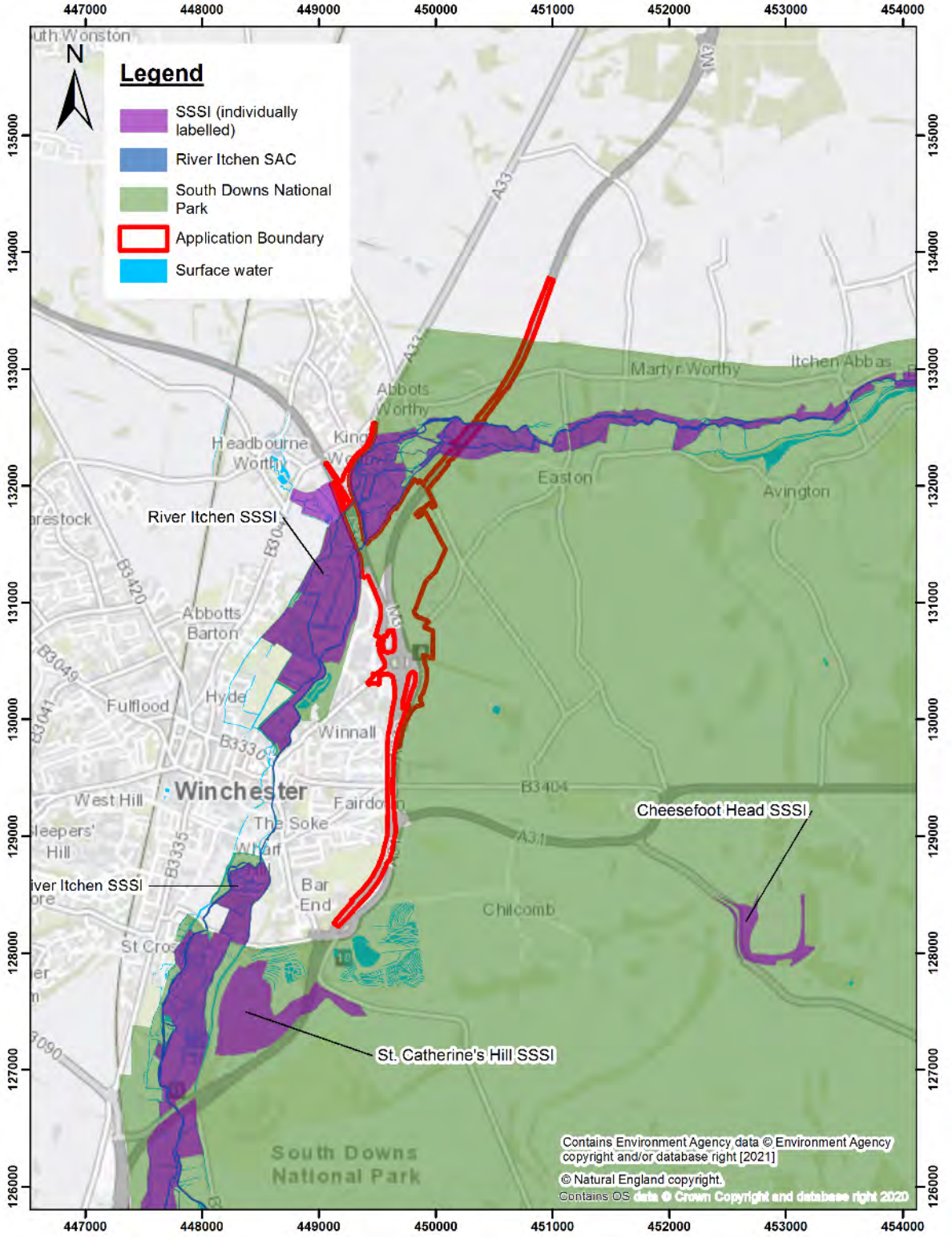


Table 3.15 Licenced groundwater and surface water abstractions

Supply Name	Licence number	Effective date	Purpose	Use	Source	Aquifer type	National Grid Reference
St Cross (Itchen)	31/086	23/04/1992	Aquaculture Fish	Fish Farm/Cress Pond Throughflow	Southern Region Surface Waters	-	SU47672741
Point A, Borehole At Garnier Road	SO/042/00 31/019	17/02/2012	Aquaculture Fish	Fish Farm/Cress Pond Throughflow	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4811328115
Burntwood Farm, Martyr Worthy	11/42/22.5/ 76	23/12/1965	General Agriculture	General Farming & Domestic	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU50333501
Hazeley Estate, Twyford	11/42/22.6/ 89	23/12/1965	General Agriculture	General Farming & Domestic	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU51032729
Watercress Beds At Headbourne Worthy Point A	11/42/22.5/ 1	22/02/1966	Aquaculture Plant	Fish Farm/Cress Pond Throughflow	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4851732410
Watercress Beds At Headbourne Worthy Point B	11/42/22.5/ 1	22/02/1966	Aquaculture Plant	Fish Farm/Cress Pond Throughflow	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4853832428
Watercress Beds At Headbourne Worthy Point C	11/42/22.5/ 1	22/02/1966	Aquaculture Plant	Fish Farm/Cress Pond Throughflow	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4857832456
Watercress Beds At Headbourne Worthy Point D	11/42/22.5/ 1	22/02/1966	Aquaculture Plant	Fish Farm/Cress Pond Throughflow	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4861432487
Watercress Beds At Headbourne Worthy Point E	11/42/22.5/ 1	22/02/1966	Aquaculture Plant	Fish Farm/Cress Pond Throughflow	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4862732339
Watercress Beds At Headbourne Worthy Point F	11/42/22.5/ 1	22/02/1966	Aquaculture Plant	Fish Farm/Cress Pond Throughflow	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4863532303

Supply Name	Licence number	Effective date	Purpose	Use	Source	Aquifer type	National Grid Reference
Upper & Down Farms Point A, Headbourne Worthy	11/42/22.5/73	23/12/1965	General Agriculture	General Farming & Domestic	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU46983369
Upper & Down Farms Point B, Headbourne Worthy	11/42/22.5/73	23/12/1965	General Agriculture	General Farming & Domestic	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU48283246
Upper & Down Farms Point C, Headbourne Worthy	11/42/22.5/73	23/12/1965	General Agriculture	General Farming & Domestic	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU48493231
Point A Down Farm Hursley	31/108	22/07/2008	General Agriculture	General Farming & Domestic	Southern Region Groundwater	H5 Chalk	SU44402660
St Cross, Winchester (Itchen)	SO/042/00 31/035	02/05/2014	Private Water Supply	Heat Pump	Southern Region Surface Waters	-	SU4765327288
Shawford Mill Headrace (Itchen Navigation)	SO/042/00 31/018/R01	21/07/2020	Electricity	Hydroelectric Power Generation	Southern Region Surface Waters	-	SU4739724981
Carrier Channel (Itchen)	SO/042/00 31/002	29/01/2010	Electricity	Hydroelectric Power Generation	Southern Region Surface Waters	-	SU5365232564
Twyford Ps Point D	11/42/22.6/92	26/11/1965	Public Water Supply	Potable Water Supply - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4824
Twyford Ps Point A	11/42/22.6/92	26/11/1965	Public Water Supply	Potable Water Supply - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4825
Twyford Ps Point C	11/42/22.6/92	26/11/1965	Public Water Supply	Potable Water Supply - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4924
Twyford Ps Point B	11/42/22.6/92	26/11/1965	Public Water Supply	Potable Water Supply - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4924
Itchen Valley Point D	11/42/22.4/80	26/11/1965	Public Water Supply	Potable Water Supply - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4932
Itchen Valley Point A	11/42/22.4/80	26/11/1965	Public Water Supply	Potable Water Supply - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU5032

Supply Name	Licence number	Effective date	Purpose	Use	Source	Aquifer type	National Grid Reference
Itchen Valley Point C	11/42/22.4/80	26/11/1965	Public Water Supply	Potable Water Supply - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU5032
Winnall Down Farm, Winchester	11/42/22.4/146	20/06/1977	General Agriculture	Spray Irrigation - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU5061929927
Hockley Golf Club	11/42/22.6/95	23/12/1965	Golf Courses	Spray Irrigation - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU48212642
Hockley Golf Club	11/42/22.6/95	23/12/1965	Golf Courses	Spray Irrigation - Direct	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU48212642
River Itchen At Shawford Park	SO/042/00 31/003	09/10/2009	Remedial River/Wetland Support	Transfer Between Sources (Post Water Act 2003)	Southern Region Surface Waters	-	SU4740724753
Water Meadow Channel Off R Itchen	SO/042/00 31/010	18/10/2010	Remedial River/Wetland Support	Transfer Between Sources (Post Water Act 2003)	Southern Region Surface Waters	-	SU4804127290
Lower Itchen Navigation At Shawford	SO/042/00 31/020	27/03/2012	Non-Remedial River/Wetland Support	Transfer Between Sources (Pre Water Act 2003)	Southern Region Surface Waters	-	SU4711323809
Wellpoints At Winchester College	SO/042/00 32/012	22/07/2020	Construction	Dewatering	Southern Region Groundwater	H5IT Itchen Chalk / UGS	SU4777928830

4 Conceptual site model

4.1 Sources

4.1.1 Carriageway drainage

Rainwater on the carriageway will wash any contaminants present into the drainage system. Contaminants may be in solution which are considered to provide an acute risk or sorbed onto solids which may present a chronic risk. The following pollutants have been identified by the HEWRAT (Highways England, 2015) as potential contaminants to receptors from road drainage schemes:

- Microplastics and other particulate matter (from brake and tyre wear);
- Soluble metals (copper and zinc) and;
- Sediment related pollutants associated with chronic pollution impacts (total copper, zinc, cadmium, PAH - including species pyrene, fluoranthene, anthracene and phenanthrene).

The drainage system discharges into the EDBs. Prior to entry into the EDBs large items are screened out within the lined Pollution Control Device (PCD) ditches and vertical separation forebays. Within the EDBs, finer suspended sediment will settle out as flow velocities diminish. EDBs 1, 3A and 4 are sealed and will not discharge to ground. There will also be an element of attenuation as soluble heavy metals and hydrocarbons will sorb onto sediment present within the EDBs.

Discharge from the lined EDBs is to the unlined EDBs 2, 3B, 3C, 5 and 6. Within these EDBs there will be secondary attenuation, settlement and filtration within vegetated EDBs which will contain both wet and dry habitats.

We note that un-lined EDB2 and EDB3C receive direct runoff from the carriageway via lined PCD ditches and forebays.

Sediment will not infiltrate through the superficial deposits or structureless chalk. Unless, the EDBs are constructed directly over transmissive fissures, we can expect there will be no infiltration of solids, even to structured chalk. Sediment (and any entrained contaminants) will remain trapped within the forebays or EDBs and be subject to periodic removal during maintenance events. Thus, it is contaminants that are directly soluble or that leach from the sediments within the EDBs that form the potential source of contamination for groundwater.

4.1.2 Placement of potentially contaminated materials via cut and fill operations

It is expected that much of the material excavated under the Scheme will be re-used as fill material to bring areas up to required levels. It is noted that a significant volume of material is required to raise levels in the eastern part of the Scheme.

As detailed in Section 3.2.2 this material may contain a proportion of Made Ground from previous road schemes.

4.1.3 Other sources of contamination

There are a number of potential sources of contamination within and adjacent to the Application Boundary. These include landfills, a former gasworks and ironworks, petrol stations, railways and land with mixed industrial use. Rainwater passing through these sources has the potential to leach contaminants into the groundwater.

4.2 Pathways

4.2.1 Unsaturated zone

Where the EDBs and retained highway soakaways are un-lined, they have the potential to discharge to ground. Site specific soil infiltration rates are presented in Section 3.4.3. On the basis of these limited data a maximum soil infiltration rate of 1 x 10^{-6} m/s was adopted for Alluvium, Head and Structured Chalk within 2 mbgl, and 1 x 10^{-5} m/s for Structured Chalk below 2 mbgl.

The other sources of contamination, including re-used material, may be located on superficial deposits or directly on the Chalk. Either way, contaminants will have to pass through the unsaturated zone to the watertable.

Rainfall is estimated as 806 mm/a which represents a long-term average infiltration rate to the EDBs. So long as the unsaturated zone hydraulic conductivity is higher than this, recharge to the watertable will occur. During storm events, when the EDBs become saturated, the infiltration rate could rise to a maximum rate that will be limited by the hydraulic conductivity of the underlying strata. However, such high infiltration rates will be relatively short lived as excess water within the EDBs will drain to surface water and it is expected that the EDBs will be dry for most of the time.

Within the unsaturated zone contaminant attenuation may occur. Attenuation comprises retardation and degradation processes. Heavy metals may be retarded via sorption. There are a number of mechanisms that control metal sorption which is often influenced by soil pH and redox conditions. Where sorption occurs due to cation exchange, the degree of sorption is influenced by the concentration gradient between the soluble contaminant and the solid matrix. If a more dilute flux subsequently passes through the unsaturated zone, contaminants may de-sorb back into solution. Organic compounds, such as PAHs, adsorb onto clay particles and the sorption rate is largely controlled by the fraction of organic carbon present. Whilst this may be significant in alluvial material, chalk tends to have very low organic carbon contents and as such retardation may be limited. Organic compounds may also bio-degrade within the unsaturated zone.

4.2.2 Saturated zone

Once the contaminants reach the watertable, they will migrate within the receiving groundwater, down the hydraulic gradient. Whilst the superficial deposits and structureless chalk may be saturated and act as contaminant transport pathways, contaminant transport will be greatest within fissures and fractures within the structured chalk.

Whilst it is possible that attenuation processes may occur during transport within fissured chalk, they tend to be relatively insignificant. The most likely process is diffusion from the fissure into the chalk matrix, which effectively retards contaminant migration within the Chalk. Given the difficulties in parameterising this process, it has conservatively been ignored for this assessment.

Estimating the volumetric flux in fissured chalk is difficult. Transmissivity data provides a weighted average of hydraulic conductivity in fissures and matrix and applying this across the entire chalk body provides a reasonable dilution estimate. However, in order to determine realistic travel times, it is often necessary to utilise very low effective porosity values. This latter parameter effectively determines the proportion of the chalk that is present as fissures where travel times can be very fast.

Based on the published chalk groundwater contours, the flow direction within the chalk is assessed as follows.

- Areas occupied by the EDBs and retained highway soakaways is to the southwest, towards the River Itchen; and
- Areas within the Itchen Valley (near Easton) PWS SPZ is to the northwest towards the PWS.

4.3 Receptors

For the purposes of this assessment, the following receptors have been assessed.

- The watertable is the receptor for Hazardous substances and
- A distance of 50 m from the Application Boundary is taken to be the receptor for non-hazardous pollutants.

5 Groundwater Impact Assessment

The impact to groundwater from the developments in the Application Area has been assessed using the methodology outlined in Section 9.4 of the Preliminary Environmental Information Report (PEIR) (Stantec, 2021) and is detailed in Table 5.1. The receptor for all potential sources of contamination is groundwater.

5.1 Road drainage

The impact assessment has determined that, without mitigation, the road drainage has the potential to cause a significant impact (Moderate, Large or Very Large) on the groundwater receptor. To mitigate against the potential impacts, a DQRA will be undertaken to investigate the impact of the EBDs on the groundwater quality. This involves modelling of the EDBs following the EA Remedial Targets Methodology (RTM) approach. The findings of this modelling are provided in Section 6.3.

5.2 Filled areas

Soil samples from the Application Area were subject to geoenvironmental testing as detailed in the **Geotechnical Interpretation Report** **(Document Reference 7.11)**. A comparison was made of the results to Generic Assessment Criteria which showed that the soils would not pose a hazard to human health. Water samples were also subject to testing. The water samples would contain any contaminants that have leached from the soils and are detailed in Section 3.4.6. These results were compared to EQS and DWS limits as part of a controlled waters risk assessment in **Chapter 9: Geology and Soils** **(Document Reference 6.1)** which concluded that the risk to controlled waters was low.

Table 5.1 Summary of impacts

Source of Impact	Receptor	Pathways	Magnitude of impact	Value (sensitivity) of receptor/ resource	Potential degree of impact	Potential degree of impact following further assessment
Unlined EDBs 2, 3B & 3C	Groundwater	Unsaturated zone / saturated zone	Moderate (HEWRAT assessment is medium / high)	High	Moderate or Large	Yes – EBDs (the embedded mitigation) will prevent infiltration of solids and will sorb some contaminants. Further sorption and attenuation will occur in the unsaturated zone. It is demonstrated in the DQRA detailed in the next section that impacts are minor.
Unlined EDBs 5 & 6	Groundwater	Unsaturated zone / saturated zone	Predominantly receive runoff from rural catchments to east of Application Area. – Negligible	High	Slight	N/A
Fill areas	Groundwater	Unsaturated zone / saturated zone	Soil and water testing on samples has shown no risk to human health or controlled waters. Negligible	High	Slight	N/A
Old petrol station	Groundwater	Unsaturated zone / saturated zone	Negligible	High	Slight	Investigation to determine if any tanks or residual contaminants in the ground
Operational petrol stations	Groundwater	Unsaturated zone / saturated zone	Negligible as any issues would be rapidly identified and remediated by petrol station operator	High	Slight	N/A

Source of Impact	Receptor	Pathways	Magnitude of impact	Value (sensitivity) of receptor/ resource	Potential degree of impact	Potential degree of impact following further assessment
Historical land contamination	Groundwater	Unsaturated zone / saturated zone	Negligible as assessed by Controlled Waters Risk Assessment in **Chapter 9: Geology and Soils (Document Reference 6.1)**	High	Slight	N/A
Historical pollution events	Groundwater	Unsaturated zone / saturated zone	Negligible as short-lived events unlikely to cause gross contamination of groundwater	High	Slight	N/A

6 Detailed Quantitative Risk Assessment for EDBs

6.1 Introduction

Section 5 has identified a potential impact from the un-lined EDBs No's 2, 3B and 3C. The EDBs have been subject to a HEWRAT screening assessment. The results of the screening assessment are that all but one of the currently proposed EDBs have a 'medium risk' to groundwater and one has a high risk.

In accordance with the National Highways methodology these have been taken forward to a DQRA in order to provide a more robust assessment of the risk to the Chalk groundwater from these potential sources of contamination.

The DQRA follows the Remedial Targets Methodology (RTM) (Environment Agency, 2006). A Level 1 and Level 2 Assessment has been undertaken.

A Level 1 Assessment considers processes within the source term. For the acute source term, there is no process operating within the source term and the predicted concentrations will equal the source term concentrations. For the chronic source term, partitioning of the contaminants between soil and aqueous phase within the source term is taken into account and the estimated aqueous concentration is limited by the contaminants pure phase solubility.

A Level 2 Assessment considers attenuation processes within the unsaturated zone and dilution within the saturated zone. The input to the RTM is source concentrations for acute and chronic risk based on HEWRAT Step 2 output (i.e. representative concentrations within the EDBs). The output from the model is predicted concentrations at the identified groundwater receptors. These predicted concentrations are compared to receptor Target Concentrations. If the predicted concentration is lower than the Target Concentration, we conclude that the EDBs do not pose a risk to groundwater. Conversely, if they are higher, we conclude that they may pose a risk.

Modelling is undertaken using Stantec's (formally ESI) Risk Assessment Model (RAM) software (ESI, 2008). Electronic copies of the models are given in Appendix E.

The RAM software package, together with a number of groundwater risk assessment tools, has been benchmarked by ESI for the EA (ESI, 2001). Additionally, the equations used in RAM have been verified by comparison between direct evaluation of an analytical solution and the semi-analytic transform approach applied for more complex pathways, and by comparison with published solutions used for verification as part of the nuclear waste industry code comparison exercise INTRACOIN (Robinson & Hodgkinson, 1996).

6.2 Model Parameterisation

In the model, it is conservatively assumed that the EDBs are saturated for 50% of the year i.e. that the EDBs contain water for 6 months in each year and are dry of 6 months. During periods when the EDBs are saturated, the infiltration rate is limited to the maximum infiltration rate of the receiving strata. For the remaining 6 months of the year, it is assumed that there is no infiltration. The maximum infiltration rates are presented in Table 6.1 and these rates are

multiplied by 0.5 in the model to derive a conservatively appropriate annual average infiltration rate.

Table 6.1 Infiltration rates

Basin	Underlying geology	Infiltration rate into top of unsaturated zone (m/s)	Justification for infiltration rate
2	Alluvium, structured chalk,	1×10^{-6}	Calculated infiltration rate from **Geotechnical Interpretation Report (Document Reference 7.11)** for sediments
3B	Made Ground and head (base not penetrated)	1×10^{-6}	
3C	Made Ground, alluvium, structureless chalk and structured chalk.	1×10^{-6}	

The source geometry for each of the EDBs is given in Table 6.2. The area and width perpendicular to groundwater flow has been measured from GIS. The length is then obtained by dividing the width into the area. A sediment thickness of 1 m is assigned in order to estimate a volume.

Table 6.2 Source geometry

EDB	Parameter	Values	Units	Justification
All	Thickness	1	m	Parameter not used in model as a constant source (rather than declining source) assumed
2	Area	1351	m^2	Measured from GIS
	Width	55	m	Indicative measured width perpendicular to groundwater flow from plans (assumed to be rectangular in model)
	Length	24.6	m	Calculated from area divided by the width
3B	Area	2,046	m^2	Measured from GIS
	Width	93	m	Indicative measured width perpendicular to groundwater flow from plans (assumed to be rectangular in model)
	Length	22	m	Calculated from area divided by the width
3C	Area	4,205	m^2	Measured from GIS

EDB	Parameter	Values	Units	Justification
	Width	150	m	Indicative measured width perpendicular to groundwater flow from plans (assumed to be rectangular in model)
	Length	28	m	Calculated from area divided by the width

Chronic source term concentrations are taken from the HEWRAT Step 2 output (i.e. representative concentrations within the EDBs) (Table 6.3). These represent soil concentrations within the sediments at the base of the EDBs. Following the RTM methodology, these are converted into aqueous concentrations on the basis of partitioning coefficients for solid and aqueous phases (Table 6.5) and the resulting aqueous concentration is limited by the contaminant solubility (Table 6.6). Acute source term concentrations are taken directly from HEWRAT Step 2 output (Table 6.4).

The attenuation parameters (Table 6.5) are also assigned for sorption within the unsaturated zone.

Table 6.3 Chronic Source terms (from HEWRAT)

	Sediment concentrations from HEWRAT assessment – 95th percentile (mg/kg)						
EDB	Copper	Zinc	Cadmium	Pyrene	Fluoranthene	Anthracene	Phenanthrene
2	968	3569	2	9.729	9.335	0.596	2.632
3B	1875	7101	3	9.729	9.335	0.596	2.632
3C	1875	7101	3	9.729	9.335	0.596	2.632

Table 6.4 Acute source term concentrations (from HEWRAT – 95th percentile (mg/l))

EDB	Copper	Zinc
2	0.069	0.255
3B	0.145	0.797
3C	0.145	0.797

Table 6.5 Attenuation parameters

Determinand	Parameter	Value	Units	Justification
Copper	Partition coefficient (Kd)	13,770	l/Kg	Mid-point of LandSim help
	Half life	No decay		-
Zinc	Partition coefficient (Kd)	301	l/Kg	Mid-point of LandSim help
	Half life	No decay		-
Cadmium	Partition coefficient (Kd)	751	l/Kg	Mid-point of LandSim help

Determinand	Parameter	Value	Units	Justification
	Half life	No decay		-
Pyrene	Partition coefficient (Koc)	6.8×10^4	l/Kg	USEPA (1999)
	Half life	1,925	days	Longest half life in Dallas et al (1999)
Fluoranthene	Partition coefficient (Koc)	4.91×10^4	l/Kg	USEPA (1999)
	Half life	462	days	Longest half life in Dallas et al (1999)
Anthracene	Partition coefficient (Koc)	2.35×10^4	l/Kg	USEPA (1999)
	Half life	365	days	Abiotic degradation rate Verschueren (2001)
Phenanthrene	Partition coefficient (Koc)	2.09×10^4	l/Kg	USEPA (1999)
	Half life	730	days	Abiotic degradation rate Verschueren (2001)

Table 6.6 Solubility parameters

Determinand	Solubility (mg/l)	Unit	Justification
Copper	2.93×10^5	mg/l	ConSim
Zinc	6.06×10^5	mg/l	ConSim
Cadmium	6.51×10^5	mg/l	ConSim
Pyrene	0.137	mg/l	USEPA (1999)
Fluoranthene	0.232	mg/l	USEPA (1999)
Anthracene	0.0537	mg/l	USEPA (1999)
Phenanthrene	1.28	mg/l	USEPA (1999)

The Target Concentrations are defined as follows (Table 6.7):

- Hazardous substances: UKTAG Concentrations in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided (UKTAG, 2016).
- Non-hazardous pollutants: UK DWS taken from the 2016 Regulations, or 1989 Regulations as detailed in Table 6.7.

Table 6.7 Target concentrations

Parameter	Value	Units	Justification
Copper	2	mg/l	Non-hazardous pollutant. The Water Supply (Water Quality) Regulations 2016
Zinc	5	mg/l	Non-hazardous pollutant. Water Supply (Water Quality Regulations) 1989
Cadmium	5×10^{-3}	mg/l	Non-hazardous pollutant. The Water Supply (Water Quality) Regulations 2016
Pyrene	5×10^{-6}	mg/l	Hazardous substance. UKTAG Concentrations in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided for benzo(a)pyrene.
Fluoranthene	5×10^{-5}	mg/l	Hazardous substance. UKTAG Concentrations in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided for benzo(a)pyrene.
Anthracene	5×10^{-5}	mg/l	Hazardous substance. UKTAG Concentrations in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided.
Phenanthrene	5×10^{-8}	mg/l	Hazardous substance. UKTAG Concentrations in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided for benzo(a)pyrene.

Hydrogeological parameters are presented in Table 6.8. The Structured Chalk hydraulic conductivity and hydraulic gradient are used, along with the cross-sectional area, to calculate the groundwater flux. The groundwater flux is used to dilute non-hazardous pollutants.

The hydraulic conductivity of the fissured Chalk is likely to be significantly higher than the value of 1×10^{-5} m/s assigned in Table 6.8 and, based on the data presented in Section 3.4.3, a value of between 1×10^{-5} m/s and 1×10^{-3} m/s may be more plausible. However, by using the value at the lower end of the plausible range, a conservative estimate for dilution is derived.

The effective porosity of the saturated zone is used to estimate travel times. For a Level 2 assessment only dilution is considered in the saturated zone, not attenuation, and so the travel time is for information only.

Table 6.8 Hydrogeology parameters

Parameter		Value	Unit	Justification
Hydraulic conductivity of Structured Chalk (saturated zone)		1 x 10^{-5}	m/s	Calculated infiltration rate from **Geotechnical Interpretation Report (Document Reference 7.11)**.
Hydraulic gradient		0.0076	-	Based on topography in the area around the EDBs. From Lidar data
Effective porosity of aquifer	Unsaturated zone	0.1		Conservative assumption
	Saturated zone	0.01		Conservative assumption to ensure rapid travel time within fissured strata.
Unsaturated zone thickness	EDB 1	7.1	m	Based on average groundwater levels (see Table 3.10) and average elevation of EDB location
	EDB 2	13.1	m	Based on average groundwater levels (see Table 3.10) and average elevation of EDB location
	EDB 3B	5.8	m	Based on average groundwater levels (see Table 3.10) and average elevation of EDB location
	EDB 3C	3.8	m	Based on average groundwater levels (see Table 3.10) and average elevation of EDB location
Fraction of organic carbon – alluvial deposits		0.01	-	Assumption of 1%
Fraction of organic carbon – structureless Chalk deposits		0.001	-	Chalk has little organic carbon, so assigned 0.1%.
Unsaturated zone bulk density		2,385	kg/m^3	Estimated based on particle density of 2,650 and porosity of 0.1 (Freeze & Cherry, 1979)
Mixing depth		5	m	10 % of the travel distance (50 m)

6.3 Model Results

6.3.1 Level 1 Assessment

As detailed in Section 6.1, a Level 1 assessment considers processes operating within the source term.

6.3.1.1 Acute pollution from soluble contaminants

There are no processes operating in the source term for the acute source term. In this case an aqueous source term is considered, and these concentrations are compared directly with the Target Concentrations. The model has been run for EDBs 3B and 3C which have the highest source term concentrations. The predicted concentrations given in Table 6.9 are the same as the source term concentrations given in Table 6.4. These concentrations are lower than the target concentrations given in Table 6.7. Thus, we conclude that the risk to groundwater from acute pollution within the EDBs is not significant.

Table 6.9 EDB2 Predicted concentrations (mg/l)

Copper	Zinc
1.450E-01	7.970E-01

Note blue cells below Target concentration, red cells above target concentration

6.3.1.2 Chronic pollution from sediments

For the chronic source term, following partitioning between the solid and aqueous phases within the EDB sediment, and limited by the pure phase solubility, Table 6.10 shows that there is a predicted impact from zinc and all four PAH compounds. These determinands are therefore taken forward to the Level 2 assessment.

Table 6.10 EDB2 Predicted concentrations (mg/l)

Copper	Zinc	Cadmium	Pyrene	Fluoranthene	Anthracene	Phenanthrene
1.362E-01	2.359E+01	3.994E-03	1.431E-02	1.901E-02	2.536E-03	1.259E-02

Note blue cells below Target concentration, red cells above target concentration

6.3.2 Level 2 Assessment – chronic pollution

6.3.2.1 EDB 2

EDB 2 is located on alluvium overlying structured Chalk and it is estimated that the unsaturated zone thickness at this location is 13.1 m. The model predicts that no hazardous substances would be predicted to reach the watertable at concentrations in excess of the Target Concentration and that there is no pollution by non-hazardous pollutants within 100 years (Table 6.11).

Table 6.11 EDB2 Predicted concentrations (mg/l)

Time(years)	Zinc	Pyrene	Fluoranthene	Anthracene	Phenanthrene
0.1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
100	2.134E-03	1.202E-21	4.616E-32	6.259E-26	4.661E-17

Note blue cells below Target concentration, red cells above target concentration

6.3.2.2 EDB 3B

EDB 3B is located on Made Ground and Head deposits and it is estimated that the unsaturated zone thickness at this location is 5.8 m. The model predicts that no hazardous substances would be predicted to reach the watertable at concentrations in excess of the Target Concentration and that there is no pollution by non-hazardous pollutants within 100 years (Table 6.12).

Table 6.12 EDB3B Predicted concentrations (mg/l)

Time(years)	Zinc	Pyrene	Fluoranthene	Anthracene	Phenanthrene
0.1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	4.616E-27	0.000E+00	0.000E+00	1.187E-27	5.555E-23
100	4.206E-01	4.070E-13	1.730E-21	1.019E-17	1.276E-11

Note blue cells below Target concentration, red cells above target concentration

6.3.2.3 EDB 3C

EDB 3C is located on Made Ground, Alluvium and Structureless Chalk deposits and it is estimated that the unsaturated zone thickness at this location is 3.8 m. The model predicts that no hazardous substances would be predicted to reach the watertable at concentrations in excess of the Target Concentration and that there is no pollution by non-hazardous pollutants within 100 years (Table 6.13).

Table 6.13 EDB3C Predicted concentrations (mg/l)

Time(years)	Zinc	Pyrene	Fluoranthene	Anthracene	Phenanthrene
0.1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
10	4.103E-17	0.000E+00	1.766E-34	7.760E-20	4.866E-16
100	3.338E+00	1.448E-10	1.711E-17	1.274E-14	1.393E-09

Note blue cells below Target concentration, red cells above target concentration

6.3.3 Sensitivity analysis

In order to demonstrate model sensitivity to key parameters, the EDB 3B base case model has been selected. We note that similar relative changes in predicted concentrations would be found for all the models and thus it is only necessary to run sensitivity analysis on one of the EDB models.

6.3.3.1 Fraction of organic carbon

The fraction of organic carbon is decreased by an order of magnitude from 0.01 to 0.001. The effect of this is to decrease retardation of organic compounds in the unsaturated zone by an order of magnitude, which allows less time for degradation to occur. Model results (Table 6.14) show that decreasing the fraction of organic carbon results in predicted concentrations rising by many orders of magnitude which demonstrates that the model is sensitive to this parameter. Pyrene and phenanthrene concentrations are predicted to be higher than the Target Concentration. Note that metals are not assessed as the model does not use fraction of organic carbon to estimate metal retardation rates.

Table 6.14 Sensitivity run 1: fraction of organic carbon (mg/l) at 100 years

	Target concentration	0.01 (base case)	0.001 (sens run 1)
Pyrene	5.000E-06	4.070E-13	**8.102E-05**
Fluoranthene	5.000E-05	1.730E-21	2.697E-07
Anthracene	5.000E-05	1.019E-17	8.754E-07
Phenanthrene	5.000E-06	1.276E-11	**1.517E-04**

Concentrations given in bold exceed the Target Concentration

6.3.3.2 Infiltration rate

In the base case model, the superficial strata hydraulic conductivity is assumed to be limiting the infiltration rate when the EDBs are full of water, and it is further considered that the EDBs are full of water for 50% of each year. For this sensitivity run, it is assumed that the EDBs are full of water for 100% of the year i.e. the infiltration rate is solely limited by the unsaturated zone hydraulic conductivity.

Model results (Table 6.15) shows that increasing the infiltration rate increases predicted concentrations. The reason for this is twofold. Firstly, for hazardous substances, the contaminants spend a shorter period within the unsaturated zone where they degrade. The retarded travel time non-hazardous pollutants through the unsaturated zone is decreased.

Secondly, for non-hazardous pollutants, the greater flux through the unsaturated zone results in a decrease in dilution applied at the watertable.

The results show that the PAH compounds remain well below the Target Concentrations, but zinc is predicted to slightly exceed it.

Table 6.15 Sensitivity run 2a: infiltration rate and unsaturated zone hydraulic conductivity (mg/l) at 100 years

	Target concentration	50% (base case)	100% (sens run 2a)
Zinc	5.000E+00	4.206E-01	**7.894E+00**
Pyrene	5.000E-06	4.070E-13	2.678E-09
Fluoranthene	5.000E-05	1.730E-21	2.359E-15
Anthracene	5.000E-05	1.019E-17	5.761E-13
Phenanthrene	5.000E-06	1.276E-11	1.691E-08

Concentrations given in bold exceed the Target Concentration

6.3.3.3 Unsaturated zone thickness

For EDB 3B, the unsaturated zone has been estimated at 5.8 m thick. For this sensitivity run, the unsaturated zone thickness has been increased by 5 m to 10.8 m.

Model results (Table 6.16) show a decrease in concentrations for all contaminants. This is due to the longer travel time within the unsaturated zone pathway segment resulting in longer breakthrough times. We note that the maximum concentration (at any time) for the PAH compounds is reduced as the longer time spent in the unsaturated zone provides more time for degradation. For zinc, however, which does not degrade, breakthrough would eventually occur to the same concentrations as in the base case model.

Table 6.16 Sensitivity run 3: unsaturated zone thickness (mg/l) at 100 years

	Target concentration	5.8 m (base case)	10.8 m (sens run 3)
Zinc	5.000E+00	4.206E-01	1.535E-03
Pyrene	5.000E-06	4.070E-13	5.244E-19
Fluoranthene	5.000E-05	1.730E-21	3.758E-29
Anthracene	5.000E-05	1.019E-17	1.144E-23
Phenanthrene	5.000E-06	1.276E-11	1.475E-15

7 Conclusions and recommendations

7.1 Conclusions

There are a number of potential sources of contamination within and adjacent to the Application Area. These include landfills, a former gasworks and ironworks, petrol stations, railways and land with mixed industrial uses. On the basis of the soil and water quality data obtained to date by the Scheme, these potential sources have been assessed as detailed in a Controlled Waters Risk Assessment in **Chapter 9: Geology and Soils** **(Document Reference 6.1)** and it was concluded that the potential for significant contamination to groundwater from these sources is low.

Some material will need to be excavated as part of the Scheme. It is envisaged that all this material will be used to raise levels along the eastern side of the Application Area and that there will be no surplus material from the Scheme.

GI has shown that there is a significant quantity of Made Ground within the Application Area, which is probably associated with previous road scheme construction.

On the basis of the soil and water quality data obtained to date by the Scheme, it is considered unlikely that placement of excavated material to raise levels will result in significant mobilisation of contamination. Thus, whilst no significant risk to human health or controlled waters is currently assessed for the in-situ materials, it is also considered that there will be no significant risk following excavation and placement.

The most significant risk to groundwater from the Scheme is considered to be the road drainage. Considerable thought has been put into designing an upgraded road drainage system, with as much drainage as possible captured and discharged to the EDBs. Where levels permit, discharge is routed first to a lined EDB for initial settlement and attenuation of contaminants, followed by discharge to un-lined and vegetated EDBs for further attenuation. Whilst the un-lined EDBs are designed to drain to ground, it is expected that a significant proportion of the discharge following storm events will be routed to the River Itchen.

A HEWRAT assessment has been undertaken for each of the EDBs. The results of the screening assessment show that all but one of the currently proposed Extended Detention Basins (EDT) have a ‘medium risk’ to groundwater and one has a high risk. In order to mitigate against the high risk EDB, it is proposed that this EDB will be lined, thus preventing discharge to groundwater. On this basis a DQRA has been undertaken to further assess the risk from the un-lined EDBs.

Acute risk from soluble contaminants present in the EDBs has been assessed as low. The contaminant concentrations in the EDBs, as derived from the HEWRAT assessment are below the UK DWS and thus pose no significant risk to groundwater.

The models demonstrate that none of the EDBs are likely to result in an impact on groundwater from determinands present within the sediment lining the base of the EDBs (chronic risk).

For the hazardous PAH compounds, the aqueous source term concentration leached from the EDB sediments is limited by the determinand pure phase solubility and the fact that these determinands are highly sorbed onto the sediment matrix. Thus, concentrations leaching from the sediment are modest. The model shows that there is likely to be a sufficient thickness of

unsaturated zone, comprising material containing sufficient organic carbon, to provide sufficient attenuation and ensure that there is no discharge to the watertable.

Copper and cadmium also sorb highly to the EDB sediment such that aqueous concentrations in the EDBs are unlikely to reach concentrations that would cause pollution of groundwater. Predicted aqueous source term zinc concentrations are higher, but attenuation within the unsaturated zone, combined with dilution in the receiving groundwater is sufficient to ensure there is no pollution by this determinand.

Sensitivity analysis has been undertaken of the DQRA models. These show that the models are sensitive to the faction of organic carbon (for organic compounds), infiltration rate and unsaturated zone thickness. Further data on these parameters should be collected as detailed in the next section.

7.2 Recommendations

Stantec has proposed additional GI at each of the EDBs. Geological data obtained from this GI will provide a better understanding of the superficial strata likely to underlie each of these structures. Once these data are available, the HgRA should be reviewed and updated based on the complete dataset.

A number of the boreholes will be completed as groundwater monitoring wells. Timeseries monitoring data will provide more confidence on the unsaturated zone thickness at each of these structures.

It is proposed to undertake soakaway tests at the proposed EDB locations. This will inform the understanding of the unsaturated zone hydraulic conductivity.

It is recommended that soil samples are taken from each of the strata encountered and subject to laboratory testing for fraction of organic carbon. These data can then be used to refine the DQRA model and inform predictions of the risk to groundwater from the Scheme's drainage design.

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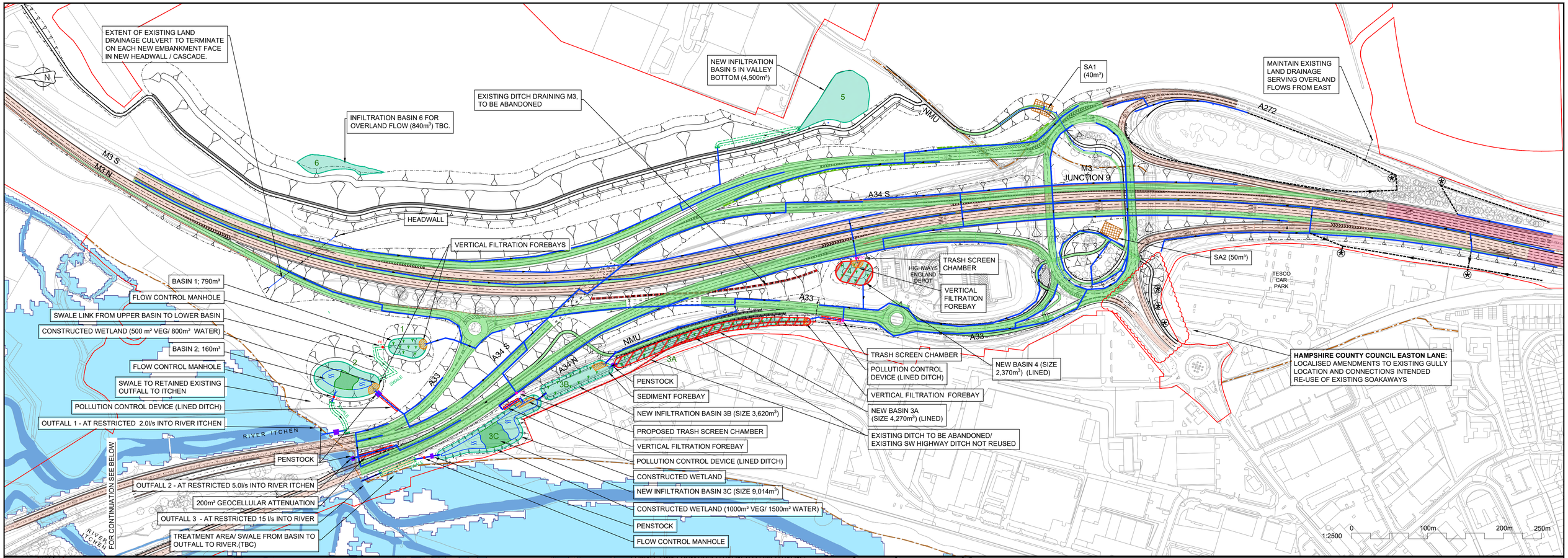
APPENDICES

Appendix A

HE551511-VFK-HDG-X_XXXX_XX-DR-CD-0512_Drainage Schematic Plan



KEY:

- INDICATIVE APPLICATION BOUNDARY
- EXISTING FOOTPATH
- PROPOSED HIGHWAY DRAINAGE NETWORK
- RETAINED EXISTING DRAINAGE
- RIVER ITCHEN
- EA FLOOD ZONE 3 EXTENT
- GEOCELLULAR ATTENUATION
- SA1 - GEOCELLULAR SOAKAWAY
- 1 INFILTRATION BASIN AND REFERENCE
- NEW CARRIAGEWAY
- RETAINED EXISTING CARRIAGEWAY AND DRAINAGE FEATURES
- PROPOSED SMART MOTORWAYS SCHEME TO BE CONSTRUCTED PRIOR TO JUNCTION 9 IMPROVEMENTS SCHEME
- PROPOSED PENSTOCK
- PROPOSED SEDIMENT FOREBAY
- EXISTING SOAKAWAY FEATURE REFURBISHED AND REUSED
- TSC TRASH SCREEN CHAMBER
- FC FLOW CONTROL MANHOLE
- GRASSED BASINS (ALL GRASSED EXCEPT BASIN 2 AND 3C)

Notes:

1. Scheme is subject to Preliminary Design at stage 3 and subject to change pending design development.
2. For existing drainage network refer to drawings HE551511-VFK-HDG-X_XXXX_XX-DR-CD-0507 to 0511
3. For detail of Smart Motorway drainage design refer to SMP drawings HE549338-MMSJV-HDG-000-DR-CD-31001 TO 31007
4. Proposed scheme shown is subject to reviews with the respective Highway Authorities, Lead Local Flood Authority and the Environment Agency.
5. Suitability of re-use of existing drainage assets is subject to review of survey, asset records and site verification.
6. Drawing to be read in conjunction with Pollution Prevention Technical Note ref: HE551511-VFK-HGN-X_XXXX_XX-TN-CH-0003.

Rev.	Date	Description	Drawn	Chk'd	App'd
P01		FIRST ISSUE	ME	AC	TRA

Drawing Status: S2 - FOR INFORMATION

VolkerFitzpatrick

Client: highways england

Project Title: M3 JUNCTION 9 IMPROVEMENTS

Drawing Title: DRAINAGE SCHEMATIC PLAN

DRAFT

Scale	Designed	Drawn	Checked	Approved
1:2500	PR	ME	AC	TRA
Original Size	**Date**	**Date**	**Date**	**Date**
A1	05.02.21	05.02.21	05.02.21	05.02.21

Drawing Number: HE PIN HE551511 - Originator VFK - Volume HDG - Location X-XXXX-XX - Type DR - Role CD - Number 0512

Project Ref. No.: 48176

Revision: P01

Appendix B

HEWRAT screening assessments

EQS - Annual Average Concentration	Copper	Zinc	
Step 2	0.00	0.00	ug/l
Step 3	0.00	0.00	ug/l

Acute Impact	Copper	Zinc
	Pass	Pass

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Road number		HE Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number		List of outfalls in cumulative assessment			
Receiving watercourse					
EA receiving water Detailed River Network ID		Assessor and affiliation			
Date of assessment		Version of assessment			
Notes					

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.8			
Impermeable road area drained (ha)	0.445	Freshwater EQS limits: Bioavailable dissolved copper (µg/l)	1	D
Permeable area draining to outfall (ha)	0.179	Bioavailable dissolved zinc (µg/l)	10.9	D
Base Flow Index (BFI)	0.89	Is the discharge in or within 1 km upstream of a protected site for conservation?	Yes	
For dissolved zinc only Water hardness	Medium = 50-200 CaCO3/l	**For dissolved copper only** Ambient background concentration (µg/l)	0	D
For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?			No	D
Tier 1 Estimated river width (m)	5			
Tier 2 Bed width (m)	17	Manning's n 0.07 D	Side slope (m/m) 0.5	Long slope (m/m) 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures		50	No restriction D	50

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	<=50,000 AADT	1	10
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <15 m to >5 m	2	40
6		20	Flow type (Incorporates flow type an effective grain size)	Flow dominated by fractures/ fissures (e.g. well consolidated sedimentary deposits, igneous and metamorphic rocks or unconsolidated deposits of very coarse sand and coarser)	3	60
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	210
RISK SCREENING LEVEL	Medium

DETAILED RESULTS

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Summary of predictions

Prediction of impact	Soluble – Acute Impact: Copper	Zinc	Sediment – Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

In Runoff

Step 1

	Copper	Zinc
RST24 Allowable Exceedances/year	1	1
No. of exceedances/year	**67.90**	**62.20**
No. of exceedances/worst year	89	75
RST6 Allowable Exceedances/year	1	1
No. of exceedances/year	**21.70**	**25.30**
No. of exceedances/worst year	28	29
Thresholds RST24 (ug/l)	21	92
Thresholds RST6 (ug/l)	42	184
Event Statistics Mean	27.32	84.71
90%ile	52.94	172.88
95%ile	68.76	255.14
99%ile	113.86	446.19

Step 1 — Toxicity Threshold

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**75.30**	**98.00**	**1.50**	**17.00**	**56.00**	**17.00**	**14.80**	**31.10**
No. of exceedances/worst year	99	120	4	25	71	25	22	39
Toxicity Thresholds (mg/kg)	197	315	3.5	16770	875	2355	245	515
Mean	349	1168	1	11065	1914	1837	117	518
90%ile	786	2781	1	28184	4876	4679	299	1319
95%ile	968	3569	2	56234	9729	9335	596	2632
99%ile	1501	5477	4	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24 Allowable Exceedances/year	1	1
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
RST6 Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.00
Thresholds RST24 (ug/l)	21	92
Thresholds RST6 (ug/l)	42	184
Event Statistics Mean	0.00	0.00
90%ile	0.00	0.00
95%ile	0.00	0.01
99%ile	0.01	0.02

Step 2

Velocity 0.14 m/s — Tier 2 is used for the calculation

DI -

Minimum % settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24 Allowable Exceedances/year	1	1
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0

DI -

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View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F
D1	Water body type	Surface watercourse					
D2	Length of road draining to outfall *(m)*	1,000					
D3	Road Type *(A-road or Motorway)*	A					
D4	If A road, is site urban or rural?	Rural					
D5	Junction type	Roundabout					
D6	Location (response time for emergency services)	< 1 hour					
D7	Traffic flow (AADT two way)	16,731					
D8	% HGV	15					
D8	Spillage factor *(no/10^9 HGVkm/year)*	3.09					
D9	Risk of accidental spillage	0.00283	0.00000	0.00000	0.00000	0.00000	0.00000
D10	Probability factor	0.60					
D11	Risk of pollution incident	0.00170	0.00000	0.00000	0.00000	0.00000	0.00000
D12	Is risk greater than 0.01?	**No**					
D13	Return period without pollution reduction measures	0.00170	0.00000	0.00000	0.00000	0.00000	0.00000
D14	Existing measures factor	0.7					
D15	Return period with existing pollution reduction	0.00119	0.00000	0.00000	0.00000	0.00000	0.00000
D16	Proposed measures factor	0.6					
D17	Residual with proposed Pollution reduction measures	0.00071	0.00000	0.00000	0.00000	0.00000	0.00000

Totals	Return Period
0.0017	589
0.0012	841
0.0007	1402

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

Location	Serious Accidental Spillages (Billion HGV km/year)	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Runoff to Watercourses

Basin 2 HEWRAT

Infiltration to Groundwater

Basin 2 HEWRAT

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Highways England Water Risk Assessment Tool

Version 2.0.4 June 2019

Soluble

EQS - Annual Average Concentration

	Copper	Zinc	
Step 2	0.00	0.00	ug/l
Step 3	0.00	0.00	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment – Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Road number		HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting	Northing	
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number		List of outfalls in cumulative assessment	
Receiving watercourse			
EA receiving water Detailed River Network ID		Assessor and affiliation	
Date of assessment		Version of assessment	
Notes			

Step 1 Runoff Quality

AADT: >10,000 and <50,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6
Impermeable road area drained (ha)	1.24
Permeable area draining to outfall (ha)	0.595
Base Flow Index (BFI)	0.89

Freshwater EQS limits:

Bioavailable dissolved copper (µg/l)	1
Bioavailable dissolved zinc (µg/l)	10.9

Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3 mg/l

For dissolved copper only — Ambient background concentration (µg/l): 0

For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No

- ○ Tier 1 — Estimated river width (m): 5
- ◉ Tier 2 — Bed width (m): 17; Manning's n: 0.07; Side slope (m/m): 0.5; Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	No restriction	0
Proposed measures		50	No restriction	50

Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	<=50,000 AADT	1	10
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <=5 m	3	60
6		20	Flow type (Incorporates flow type an effective grain size)	Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer)	1	20
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	190
RISK SCREENING LEVEL	Medium

Runoff to Watercourses

Basin 2 HEWRAT

Spillage Risks

Basin 2 HEWRAT

DETAILED RESULTS

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In Runoff

Step 1

	Copper	Zinc
RST24 Allowable Exceedances/year	1	1
RST24 No. of exceedances/year	67.90	62.20
RST24 No. of exceedances/worst year	83	75
RST6 Allowable Exceedances/year	1	1
RST6 No. of exceedances/year	21.70	25.30
RST6 No. of exceedances/worst year	28	23
Thresholds RST24 (ug/l)	21	32
Thresholds RST6 (ug/l)	42	184
Event Statistics Mean	27.32	84.71
90%ile	52.94	172.88
95%ile	68.76	255.14
99%ile	113.86	446.19

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold	1	1	1	1	1	1	1	1
	75.30	38.00	1.50	17.00	56.00	17.00	14.80	31.10
	33	120	4	25	71	25	22	33
Toxicity (mg/kg)	197	315	3.5	16770	875	2355	245	515
	349	1168	1	11065	1314	1837	117	518
	786	2761	1	28184	4876	4673	233	1319
	968	3569	2	56234	3729	3335	536	2632
	1501	5477	4	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24 Allowable Exceedances/year	1	1
RST24 No. of exceedances/year	0	0
RST24 No. of exceedances/worst year	0	0
RST24 No. of exceedances/summer	0	0
RST24 No. of exceedances/worst summer	0	0
RST6 Allowable Exceedances/year	0.5	0.5
RST6 No. of exceedances/year	0	0
RST6 No. of exceedances/worst year	0	0
RST6 No. of exceedances/summer	0	0
RST6 No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.00
Thresholds RST24 (ug/l)	21	32
Thresholds RST6 (ug/l)	42	184
Event Statistics Mean	0.00	0.00
90%ile	0.00	0.01
95%ile	0.01	0.02
99%ile	0.02	0.07

Step 2

Velocity: 0.14 m/s — Tier 2 is used for the calculation

DI: -

Minimum % settlement needed: - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24 Allowable Exceedances/year	1	1
RST24 No. of exceedances/year	0.00	0.00
RST24 No. of exceedances/worst year	0	0
RST24 No. of exceedances/summer	0	0
RST24 No. of exceedances/worst summer	0	0
RST6 Allowable Exceedances/year	0.5	0.5
RST6 No. of exceedances/year	0.00	0.00
RST6 No. of exceedances/worst year	0	0
RST6 No. of exceedances/summer	0	0
RST6 No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.00
Thresholds reshold RST24 (ug/l)	21	32
Thresholds RST6 (ug/l)	42	184

DI: -

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		A (main road)	B	C	D	E	F	Totals	Return Period
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall *(m)*	1,000							
D3	Road Type *(A-road or Motorway)*	M							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Roundabout							
D6	Location (response time for emergency services)	> 1 hour							
D7	Traffic flow (AADT two way)	50,000							
D8	% HGV	15							
D8	Spillage factor *(no/10^3 HGVkm/year)*	3.09							
D9	Risk of accidental spillage	0.00846	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.75							
D11	Risk of pollution incident	0.00634	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No							
D13	Return period without pollution reduction measures	0.00634	0.00000	0.00000	0.00000	0.00000	0.00000	0.0063	158
D14	Existing measures factor	0.7							
D15	Return period with existing pollution reduction	0.00444	0.00000	0.00000	0.00000	0.00000	0.00000	0.0044	225
D16	Proposed measures factor	0.6							
D17	Residual with proposed Pollution reduction measures	0.00266	0.00000	0.00000	0.00000	0.00000	0.00000	0.0027	375

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

Location	Serious Accidental Spillages (Billion HGV km/year)	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Runoff to Watercourses

Basin 3A HEWRAT

Highways England Water Risk Assessment Tool

Version 2.0.4 June 2019

Soluble

EQS - Annual Average Concentration

	Copper	Zinc	
Step 2	0.00	0.02	ug/l
Step 3	0.00	0.01	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment – Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Road number		HE Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number		List of outfalls in cumulative assessment			
Receiving watercourse					
EA receiving water Detailed River Network ID		Assessor and affiliation			
Date of assessment		Version of assessment			
Notes					

Step 1 Runoff Quality

AADT: >=100,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6	Freshwater EQS limits:	
Impermeable road area drained (ha)	5.856	Bioavailable dissolved copper (µg/l)	1 D
Permeable area draining to outfall (ha)	0.435	Bioavailable dissolved zinc (µg/l)	10.9 D
Base Flow Index (BFI)	0.89	Is the discharge in or within 1 km upstream of a protected site for conservation?	Yes
For dissolved zinc only Water hardness	Medium = 50-200 CaCO3/l	**For dissolved copper only** Ambient background concentration (µg/l)	0 D
For sediment impact only Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?			No D
Tier 1 Estimated river width (m)	5		
Tier 2 Bed width (m)	17	Manning's n: 0.07 D; Side slope (m/m): 0.5; Long slope (m/m): 0.0001	

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures		50	No restriction D	50

Basin 3A HEWRAT Infiltration to Groundwater

Basin 3A HEWRAT

Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	>50 to <150	2	20
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <=5 m	3	60
6		20	Flow type (Incorporates flow type an effective grain size)	Flow dominated by fractures/ fissures (e.g. well consolidated sedimentary deposits, igneous and metamorphic rocks or unconsolidated deposits of very coarse sand and coarser)	3	60
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	260
RISK SCREENING LEVEL	High

Runoff to Watercourses

Basin 3A HEWRAT Spillage Risks

Basin 3A HEWRAT

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Summary of predictions

Soluble – Acute Impact: Copper, Zinc

Sediment – Chronic Impact: Copper, Zinc, Cadmium, Total PAH, Pyrene, Fluoranthene, Anthracene, Phenanthrene

Prediction of impact: Step1, Step2, Step3

In Runoff

Step 1

RST24

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**111.10**	**115.70**
No. of exceedances/worst year	134	143

RST6

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**70.70**	**89.80**
No. of exceedances/worst year	91	113

		Copper [ug/l]	Zinc [ug/l]
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	57.52	264.56
	90%ile	111.45	539.33
	95%ile	144.76	736.85
	99%ile	233.71	1393.53

Step 1

Toxicity Threshold

	Copper [mg/kg]	Zinc [mg/kg]	Cadmium [mg/kg]	Total PAH [ug/kg]	Pyrene [ug/kg]	Fluoranthene [ug/kg]	Anthracene [ug/kg]	Phenanthrene [ug/kg]
Toxicity	1	1	1	1	1	1	1	1
	113.50	124.90	6.30	17.00	56.00	17.00	14.80	31.10
	147	152	11	25	71	25	22	33
	766	2676	1	11065	1914	1837	117	518
	1573	5762	3	28184	4876	4679	299	1319
	1875	7101	3	56234	9729	9335	596	2632
	2727	10215	5	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

RST24

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0

RST6

	Copper	Zinc
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.02

		Copper [ug/l]	Zinc [ug/l]
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	0.02	0.07
	90%ile	0.04	0.17
	95%ile	0.08	0.31
	99%ile	0.23	0.93

Step 2

Velocity: 0.14 m/s — Tier 2 is used for the calculation

DI: -

Minimum % settlement needed: - %

In River (with mitigation)

Step 3

RST24

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0

DI: -

RST6

	Copper	Zinc
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0

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		A (main road)	B	C	D	E	F
D1	Water body type	Surface watercourse					
D2	Length of road draining to outfall (m)	2,250					
D3	Road Type (A-road or Motorway)	A					
D4	If A road, is site urban or rural?	Rural					
D5	Junction type	Roundabout					
D6	Location (response time for emergency services)	< 1 hour					
D7	Traffic flow (AADT two way)	28,000					
D8	% HGV	15					
D8	Spillage factor ($no/10^9$ HGVkm/year)	3.09					
D9	Risk of accidental spillage	0.01066	0.00000	0.00000	0.00000	0.00000	0.00000
D10	Probability factor	0.60					
D11	Risk of pollution incident	0.00639	0.00000	0.00000	0.00000	0.00000	0.00000
D12	Is risk greater than 0.01?	No					
D13	Return period without pollution reduction measures	0.00639	0.00000	0.00000	0.00000	0.00000	0.00000
D14	Existing measures factor	0.6					
D15	Return period with existing pollution reduction	0.00384	0.00000	0.00000	0.00000	0.00000	0.00000
D16	Proposed measures factor	0.4					
D17	Residual with proposed Pollution reduction measures	0.00153	0.00000	0.00000	0.00000	0.00000	0.00000

Totals	Return Period
0.0064	156
0.0038	261
0.0015	652

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

Location	Serious Accidental Spillages (Billion HGV km/ year)	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

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Highways England Water Risk Assessment Tool

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Soluble – EQS - Annual Average Concentration	Copper	Zinc		Soluble – Acute Impact	Copper	Zinc	Sediment – Chronic Impact
Step 2	0.00	0.02	ug/l		Pass	Pass	Alert, Protected Area.
Step 3	0.00	0.01	ug/l				Sediment deposition for this site is judged as:
							Accumulating? No 0.14 Low flow Vel m/s
							Extensive? No - Deposition Index

Road number		HE Area / DBFO number	
Assessment type	Non-cumulative assessment (single outfall)		
OS grid reference of assessment point (m)	Easting	Northing	
OS grid reference of outfall structure (m)	Easting	Northing	
Outfall number		List of outfalls in cumulative assessment	
Receiving watercourse			
EA receiving water Detailed River Network ID		Assessor and affiliation	
Date of assessment		Version of assessment	
Notes			

Step 1 Runoff Quality

AADT: >=100,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6	
Impermeable road area drained (ha)	6.147	
Permeable area draining to outfall (ha)	0.685	
Base Flow Index (BFI)	0.89	

Freshwater EQS limits:

Bioavailable dissolved copper (µg/l)	1
Bioavailable dissolved zinc (µg/l)	10.9

Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3/l

For dissolved copper only — Ambient background concentration (µg/l): 0

For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 17 | Manning's n: 0.07 | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0	No restriction	0
Proposed measures		50	No restriction	50

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Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <=5 m	3	60
6		20	Flow type (Incorporates flow type an effective grain size)	Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer)	1	20
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	210
RISK SCREENING LEVEL	Medium

DETAILED RESULTS

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Summary of predictions

Soluble – Acute Impact: Copper | Zinc

Sediment – Chronic Impact: Copper | Zinc | Cadmium | Total PAH | Pyrene | Fluoranthene | Anthracene | Phenanthrene

Prediction of impact: Step 1 / Step 2 / Step 3

In Runoff

Step 1

RST24

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	111.10	115.70
No. of exceedances/worst year	134	143

RST6

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	70.70	89.80
No. of exceedances/worst year	91	113

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	57.52	264.56
	90%ile	111.45	533.93
	95%ile	144.76	796.85
	99%ile	239.71	1393.53

Step 1

Toxicity Threshold

	Copper (mg/kg)	Zinc (mg/kg)	Cadmium (mg/kg)	Total PAH (ug/kg)	Pyrene (ug/kg)	Fluoranthene (ug/kg)	Anthracene (ug/kg)	Phenanthrene (ug/kg)
	1	1	1	1	1	1	1	1
	113.50	124.90	6.30	17.00	56.00	17.00	14.80	31.10
	147	152	11	25	71	25	22	33
Toxicity	137	315	3.5	16770	875	2355	245	515
	766	2676	1	11065	1914	1837	117	518
	1573	5762	3	28184	4876	4673	299	1319
	1875	7101	3	56234	3723	3335	536	2632
	2727	10215	5	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

RST24

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	0	0
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0

RST6

	Copper	Zinc
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	0	0
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.02

		Copper (ug/l)	Zinc (ug/l)
Thresholds	RST24	21	92
Thresholds	RST6	42	184
Event Statistics	Mean	0.02	0.08
	90%ile	0.04	0.18
	95%ile	0.08	0.32
	99%ile	0.25	1.04

Step 2

Velocity: 0.14 m/s — Tier 2 is used for the calculation

DI: -

Minimum % settlement needed: - %

In River (with mitigation)

Step 3

RST24

	Copper	Zinc
Allowable Exceedances/year	1	1
No. of exceedances/year	0.00	0.00
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0

DI: -

RST6

	Copper	Zinc
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	0.00	0.00
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0

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		A (main road)	B	C	D	E	F
D1	Water body type	Surface watercourse					
D2	Length of road draining to outfall *(m)*	2,600					
D3	Road Type *(A-road or Motorway)*	A					
D4	If A road, is site urban or rural?	Rural					
D5	Junction type	Roundabout					
D6	Location (response time for emergency services)	< 1 hour					
D7	Traffic flow (AADT two way)	28,000					
D8	% HGV	15					
D8	Spillage factor *(no/10^8 HGVkm/year)*	3.09					
D9	Risk of accidental spillage	0.01232	0.00000	0.00000	0.00000	0.00000	0.00000
D10	Probability factor	0.60					
D11	Risk of pollution incident	0.00739	0.00000	0.00000	0.00000	0.00000	0.00000
D12	Is risk greater than 0.01?	No					
D13	Return period without pollution reduction measures	0.00739	0.00000	0.00000	0.00000	0.00000	0.00000
D14	Existing measures factor	0.6					
D15	Return period with existing pollution reduction	0.00443	0.00000	0.00000	0.00000	0.00000	0.00000
D16	Proposed measures factor	0.4					
D17	Residual with proposed Pollution reduction measures	0.00177	0.00000	0.00000	0.00000	0.00000	0.00000

	Totals	Return Period
	0.0074	135
	0.0044	226
	0.0018	564

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Runoff to Watercourses

Basin 3C HEWRAT

Highways England Water Risk Assessment Tool

Version 2.0.4 June 2019

Soluble

EQS - Annual Average Concentration

	Copper	Zinc	
Step 2	0.00	0.02	ug/l
Step 3	0.00	0.01	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Road number		HE Area / DBFO number			
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number		List of outfalls in cumulative assessment			
Receiving watercourse					
EA receiving water Detailed River Network ID		Assessor and affiliation			
Date of assessment		Version of assessment			
Notes					

Step 1 Runoff Quality

AADT: >=100,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6	
Impermeable road area drained (ha)	7.107	
Permeable area draining to outfall (ha)	1.072	
Base Flow Index (BFI)	0.89	

Freshwater EQS limits:

Bioavailable dissolved copper (µg/l)	1	D
Bioavailable dissolved zinc (µg/l)	10.9	D

Is the discharge in or within 1 km upstream of a protected site for conservation? Yes

For dissolved zinc only — Water hardness: Medium = 50-200 CaCO3/l

For dissolved copper only — Ambient background concentration (µg/l): 0 D

For sediment impact only — Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge? No D

Tier 1 — Estimated river width (m): 5

Tier 2 — Bed width (m): 17 | Manning's n: 0.07 D | Side slope (m/m): 0.5 | Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for solubles (%)	Attenuation for solubles - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures		50	No restriction D	D 50

Runoff to Watercourses

Basin 3C HEWRAT Infiltration to Groundwater

Basin 3C HEWRAT

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <=5 m	3	60
6		20	Flow type (Incorporates flow type an effective grain size)	Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer)	1	20
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	210
RISK SCREENING LEVEL	Medium

Runoff to Watercourses

Basin 3C HEWRAT Spillage Risks

Basin 3C HEWRAT

DETAILED RESULTS | Back To Top | Go To Interface

Summary of predictions

Prediction of impact	Soluble - Acute Impact: Copper	Zinc	Sediment - Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

In Runoff

Step 1

	Copper	Zinc
RST24 Allowable Exceedances/year	1	1
RST24 No. of exceedances/year	111.10	115.70
RST24 No. of exceedances/worst year	134	143
RST6 Allowable Exceedances/year	1	1
RST6 No. of exceedances/year	70.70	89.80
RST6 No. of exceedances/worst year	91	113
Thresholds RST24	21	32
Thresholds RST6	42	184
Event Statistics Mean	57.52	264.56
90%ile	111.45	533.33
95%ile	144.76	796.85
99%ile	233.71	1393.53

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Toxicity Threshold	1	1	1	1	1	1	1	1
No. of exceedances/year	113.50	124.90	6.30	17.00	56.00	17.00	14.80	31.10
No. of exceedances/worst year	147	152	11	25	71	25	22	39
Toxicity	197	315	3.5	16770	675	2355	245	515
Mean	766	2676	1	11065	1914	1837	117	518
90%ile	1573	5762	3	28184	4876	4679	299	1319
95%ile	1875	7101	3	56234	3729	3335	596	2632
99%ile	2727	10215	5	112202	13411	19626	1189	5251

In River (no mitigation)

Step 2

	Copper	Zinc
RST24 Allowable Exceedances/year	1	1
RST24 No. of exceedances/year	0	0
RST24 No. of exceedances/worst year	0	0
RST24 No. of exceedances/summer	0	0
RST24 No. of exceedances/worst summer	0	0
RST6 Allowable Exceedances/year	0.5	0.5
RST6 No. of exceedances/year	0	0
RST6 No. of exceedances/worst year	0	0
RST6 No. of exceedances/summer	0	0
RST6 No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.02
Thresholds RST24	21	32
Thresholds RST6	42	184
Event Statistics Mean	0.02	0.09
90%ile	0.04	0.21
95%ile	0.09	0.38
99%ile	0.28	1.20

Step 2

Velocity: 0.14 m/s — Tier 2 is used for the calculation

DI: -

Minimum % settlement needed: - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24 Allowable Exceedances/year	1	1
RST24 No. of exceedances/year	0.00	0.00
RST24 No. of exceedances/worst year	0	0
RST24 No. of exceedances/summer	0	0
RST24 No. of exceedances/worst summer	0	0
RST6 Allowable Exceedances/year	0.5	0.5
RST6 No. of exceedances/year	0.00	0.00
RST6 No. of exceedances/worst year	0	0
RST6 No. of exceedances/summer	0	0

DI: -

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		A (main road)	B	C	D	E	F	Totals	Return Period
D1	Water body type	Surface watercourse							
D2	Length of road draining to outfall (m)	3,250							
D3	Road Type (A-road or Motorway)	A							
D4	If A road, is site urban or rural?	Rural							
D5	Junction type	Roundabout							
D6	Location (response time for emergency services)	< 1 hour							
D7	Traffic flow (AADT two way)	149,961							
D8	% HGV	11							
D8	Spillage factor (no/10^2 HGVkm/year)	0.83							
D9	Risk of accidental spillage	0.01624	0.00000	0.00000	0.00000	0.00000	0.00000		
D10	Probability factor	0.60							
D11	Risk of pollution incident	0.00974	0.00000	0.00000	0.00000	0.00000	0.00000		
D12	Is risk greater than 0.01?	No							
D13	Return period without pollution reduction measures	0.00974	0.00000	0.00000	0.00000	0.00000	0.00000	0.0097	103
D14	Existing measures factor	0.6							
D15	Return period with existing pollution reduction	0.00585	0.00000	0.00000	0.00000	0.00000	0.00000	0.0058	171
D16	Proposed measures factor	0.4							
D17	Residual with proposed Pollution reduction measures	0.00234	0.00000	0.00000	0.00000	0.00000	0.00000	0.0023	428

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

Location	Serious Accidental Spillages (Billion HGV km/ year)	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

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Highways England Water Risk Assessment Tool

Version 2.0.4 June 2019

Soluble

EQS - Annual Average Concentration

	Copper	Zinc	
Step 2	0.00	0.01	ug/l
Step 3	0.00	0.01	ug/l

Acute Impact

Copper	Zinc
Pass	Pass

Sediment - Chronic Impact

Alert. Protected Area.

Sediment deposition for this site is judged as:

Accumulating?	No	0.14	Low flow Vel m/s
Extensive?	No	-	Deposition Index

Road number			HE Area / DBFO number		
Assessment type	Non-cumulative assessment (single outfall)				
OS grid reference of assessment point (m)	Easting		Northing		
OS grid reference of outfall structure (m)	Easting		Northing		
Outfall number			List of outfalls in cumulative assessment		
Receiving watercourse					
EA receiving water Detailed River Network ID			Assessor and affiliation		
Date of assessment			Version of assessment		
Notes					

Step 1 Runoff Quality

AADT: >=100,000 | Climatic region: Warm Wet | Rainfall site: Southampton (SAAR 820mm)

Step 2 River Impacts

(Enter zero in Annual Q_{95} river flow box to assess Step 1 runoff quality only)

Annual Q_{95} river flow (m^3/s)	2.6	Freshwater EQS limits:		
Impermeable road area drained (ha)	4.369	Bioavailable dissolved copper (µg/l)	1	D
Permeable area draining to outfall (ha)	0.128	Bioavailable dissolved zinc (µg/l)	10.9	D
Base Flow Index (BFI)	0.89	Is the discharge in or within 1 km upstream of a protected site for conservation?	Yes	
For dissolved zinc only: Water hardness	Medium = 50-200 CaCO3/l	For dissolved copper only: Ambient background concentration (µg/l)	0	D
For sediment impact only: Is there a downstream structure, lake, pond or canal that reduces the velocity within 100m of the point of discharge?			No	D
Tier 1 / Tier 2: Estimated river width (m)	5			
Bed width (m)	17	Manning's n: 0.07 D	Side slope (m/m): 0.5	Long slope (m/m): 0.0001

Step 3 Mitigation

	Brief description	Estimated effectiveness: Treatment for soluble (%)	Attenuation for soluble - restricted discharge rate (l/s)	Settlement of sediments (%)
Existing measures		0 D	No restriction D	0 D
Proposed measures		50	No restriction D	50 D

DETAILED RESULTS

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Summary of predictions

Prediction of impact	Soluble - Acute Impact: Copper	Soluble - Acute Impact: Zinc	Sediment - Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Step1										
Step2										
Step3										

In Runoff

Step 1

	Copper RST24	Zinc RST24	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
						Toxicity Threshold				
Allowable Exceedances/year	1	1	1	1	1	1	1	1	1	1
No. of exceedances/year	**111.10**	**115.70**	**113.50**	**124.30**	**6.30**	**17.00**	**56.00**	**17.00**	**14.80**	**31.10**
No. of exceedances/worst year	134	143	147	152	11	25	71	25	22	39
	RST6									
Allowable Exceedances/year	1	1								
No. of exceedances/year	**70.70**	**89.80**								
No. of exceedances/worst year	91	113								
	(ug/l)	(ug/l)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Thresholds RST24	21	32	Toxicity 191	315	3.5	16170	875	2355	245	515
Thresholds RST6	42	184								
Event Statistics Mean	57.52	264.56	766	2676	1	11065	1314	1837	117	518
90%ile	111.45	539.93	1573	5762	3	28184	4876	4673	299	1319
95%ile	144.76	796.85	1875	7101	3	56234	9729	9335	596	2632
99%ile	239.71	1393.53	2727	10215	5	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

	Copper RST24	Zinc RST24
Allowable Exceedances/year	1	1
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
	RST6	
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0**	**0**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
Annual average concentration (ug/l)	0.00	0.01
	(ug/l)	(ug/l)
Thresholds RST24	21	32
Thresholds RST6	42	184
Event Statistics Mean	0.01	0.05
90%ile	0.03	0.13
95%ile	0.06	0.23
99%ile	0.18	0.75

Step 2

Velocity: 0.14 m/s — Tier 2 is used for the calculation

DI: -

Minimum % settlement needed: - %

In River (with mitigation)

Step 3

	Copper RST24	Zinc RST24
Allowable Exceedances/year	1	1
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0
No. of exceedances/worst summer	0	0
	RST6	
Allowable Exceedances/year	0.5	0.5
No. of exceedances/year	**0.00**	**0.00**
No. of exceedances/worst year	0	0
No. of exceedances/summer	0	0

DI: -

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	>50 to <150	2	20
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <15 m to >5 m	2	40
6		20	Flow type (Incorporates flow type an effective grain size)	Flow dominated by fractures/ fissures (e.g. well consolidated sedimentary deposits, igneous and metamorphic rocks or unconsolidated deposits of very coarse sand and coarser)	3	60
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	240
RISK SCREENING LEVEL	Medium

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View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F
D1	Water body type	Surface watercourse					
D2	Length of road draining to outfall *(m)*	1,600					
D3	Road Type *(A-road or Motorway)*	M					
D4	If A road, is site urban or rural?	Rural					
D5	Junction type	Roundabout					
D6	Location (response time for emergency services)	< 1 hour					
D7	Traffic flow (AADT two way)	149,961					
D8	% HGV	10					
D8	Spillage factor *(no/10^3 HGVkm/year)*	0.43					
D9	Risk of accidental spillage	0.00377	0.00000	0.00000	0.00000	0.00000	0.00000
D10	Probability factor	0.60					
D11	Risk of pollution incident	0.00226	0.00000	0.00000	0.00000	0.00000	0.00000
D12	Is risk greater than 0.01?	No					
D13	Return period without pollution reduction measures	0.00226	0.00000	0.00000	0.00000	0.00000	0.00000
D14	Existing measures factor	0.6					
D15	Return period with existing pollution reduction	0.00136	0.00000	0.00000	0.00000	0.00000	0.00000
D16	Proposed measures factor	0.4					
D17	Residual with proposed Pollution reduction measures	0.00054			0.00000	0.00000	0.00000

Totals	Return Period
0.0023	443
0.0014	738
0.0005	1844

Pollution reduction factor

Use the Indicative Pollution Risk Reduction Factor table below to estimate the factor.

Provide justification for the decision in the appropriate comments box below.

A default value of 1 is used if no measures are considered or if no value is entered.

Justification for choice of existing measures factors:

Justification for choice of proposed measures factors:

Spillage Factor

Location	Serious Accidental Spillages (Billion HGV km/ year)	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

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Reset GW Assessment | Go To Interface

Groundwater Assessment

Component Number		Weighting Factor	Property or Parameter	Risk Score	Component score	Weighted component score
1	SOURCE	10	Traffic flow	>=100,000 AADT	3	30
2		10	Rainfall depth (annual averages)	>740 to <1060 mm rainfall	2	20
3		10	Drainage area ratio	<=50	1	10
4	PATHWAY	15	Infiltration method	"Region", shallow infiltration systems (e.g. infiltration basin)	2	30
5		20	Unsaturated zone	Depth to water table <15 m to >5 m	2	40
6		20	Flow type (Incorporates flow type an effective grain size)	Mixed fracture and intergranular flow (e.g. consolidated deposits or unconsolidated deposits of medium – coarse sand)	2	40
7		5	Unsaturated Zone Clay Content	<=1% clay minerals	3	15
8		5	Organic Carbon	<=1% SOM	3	15
9		5	Unsaturated zone soil pH	pH <8 to >5	2	10

TOTAL SCORE	210
RISK SCREENING LEVEL	Medium

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View Parameters | Reset Spillage Risk | Go To Interface

		A (main road)	B	C	D	E	F
D1	Water body type	Surface watercourse					
D2	Length of road draining to outfall *(m)*	500					
D3	Road Type *(A-road or Motorway)*	M					
D4	If A road, is site urban or rural?	Rural					
D5	Junction type	Slip road					
D6	Location (response time for emergency services)	< 1 hour					
D7	Traffic flow (AADT two way)	149,961					
D8	% HGV	11					
D8	Spillage factor *(no/10^8 HGVkm/year)*	0.43					
D9	Risk of accidental spillage	0.00129	0.00000	0.00000	0.00000	0.00000	0.00000
D10	Probability factor	0.60					
D11	Risk of pollution incident	0.00078	0.00000	0.00000	0.00000	0.00000	0.00000
D12	Is risk greater than 0.01?	No					
D13	Return period without pollution reduction measures	0.00078	0.00000	0.00000	0.00000	0.00000	0.00000
D14	Existing measures factor	0.6					
D15	Return period with existing pollution reduction	0.00047	0.00000	0.00000	0.00000	0.00000	0.00000
D16	Proposed measures factor	0.6					
D17	Residual with proposed Pollution reduction measures	0.00028	0.00000	0.00000	0.00000	0.00000	0.00000

Totals	Return Period
0.0008	1287
0.0005	2146
0.0003	3576

Justification for choice of existing measures factors

Justification for choice of proposed measures factors

Spillage Factor

Location	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

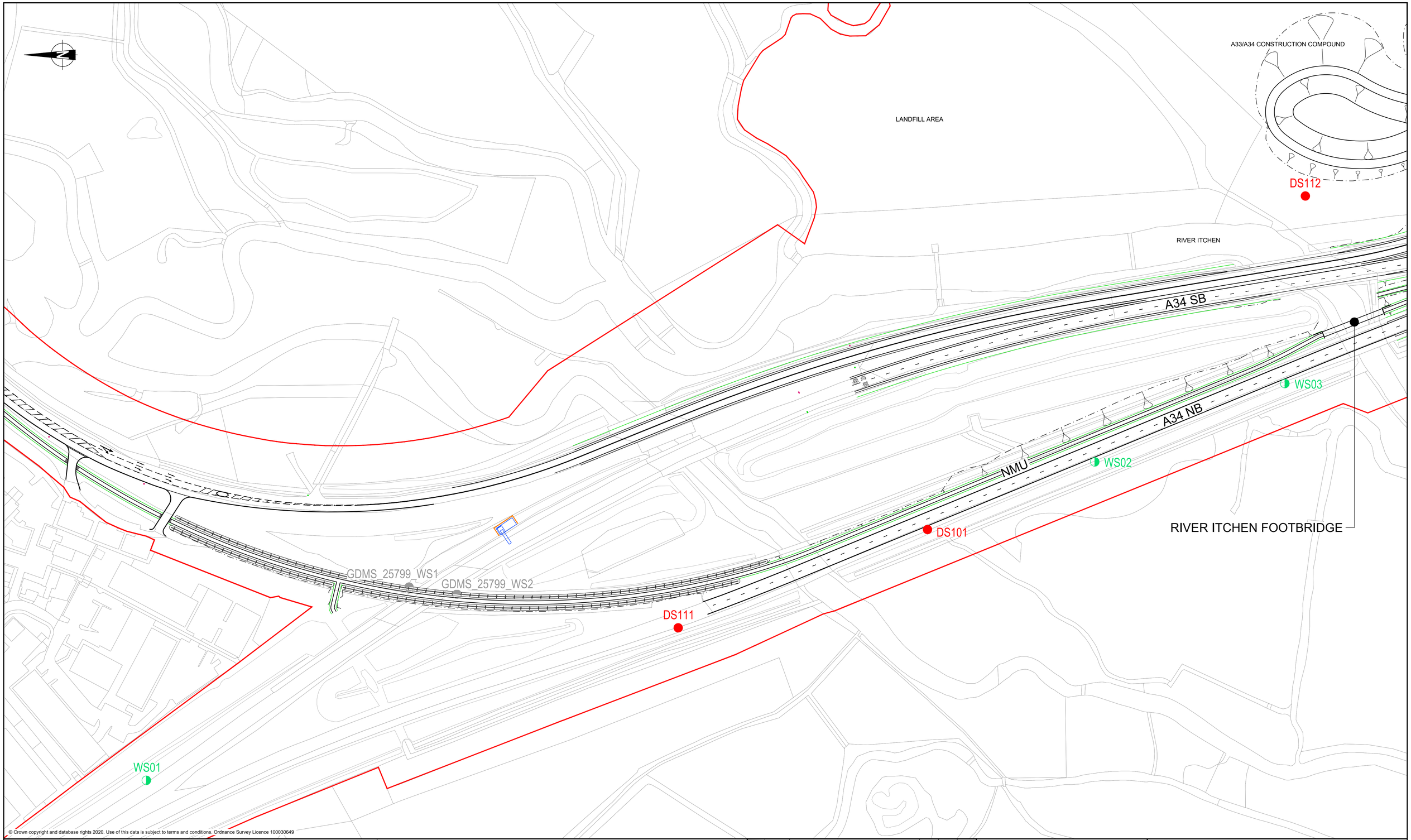
Indicative Pollution Risk Reduction Factors for Spillages

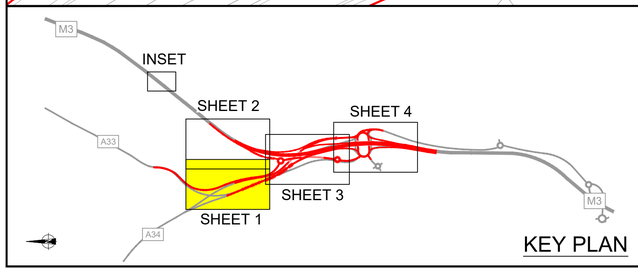
System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Appendix C

HE551551-VFK-HGT-X_XXXX_XX-DR-GE-004 Exploratory hole location plan





KEY PLAN

GDMS HISTORICAL EXPLORATORY HOLES

- TRIAL PIT
- CABLE PERCUSSION BOREHOLE
- WINDOWLESS SAMPLING BOREHOLE

SOILS LIMITED 2019 EXPLORATORY HOLES

- TRIAL PIT
- DYNAMIC SAMPLING WITH ROTARY CORE FOLLOW ON
- WINDOWLESS SAMPLING BOREHOLE

Rev.	Date	Description	Drawn	Chk'd	App'd

Drawing Status: FOR SGAR 3B

VolkerFitzpatrick

Client: highways england

Project Title: M3 JUNCTION 9 IMPROVEMENTS

Drawing Title: EXPLORATORY HOLE LOCATION PLAN

SHEET 1 OF 4

Scale	Designed	Drawn	Checked	Approved
1:1000	AD	davco	AD	RHT
Original Size	**Date**	**Date**	**Date**	**Date**
A1	05.05.21	05.05.21	05.05.21	06.05.21

Drawing Number: HE PIN | Originator | Volume
HE551511 - VFK - HGT - X_XXXX_XX - DR - GE - 0001
Location | Type | Role | Number

Project Ref. No.: 48176

Revision: P01

BH543

GDMS_3212_BH541

DS218

DS220

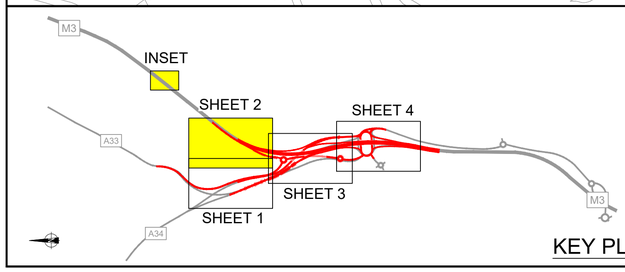
DS203

M3

M3

A33/A34 CONSTRUCTION COMPOUND

LANDFILL AREA



KEY PLAN

GDMS HISTORICAL EXPLORATORY HOLES

- TRIAL PIT
- CABLE PERCUSSION BOREHOLE
- WINDOWLESS SAMPLING BOREHOLE

SOILS LIMITED 2019 EXPLORATORY HOLES

- TRIAL PIT
- DYNAMIC SAMPLING WITH ROTARY CORE FOLLOW ON
- WINDOWLESS SAMPLING BOREHOLE

Rev.	Date	Description	Drawn	Chk'd	App'd

Drawing Status: FOR SGAR 3B

VolkerFitzpatrick

Client: highways england

Project Title: M3 JUNCTION 9 IMPROVEMENTS

Drawing Title: EXPLORATORY HOLE LOCATION PLAN

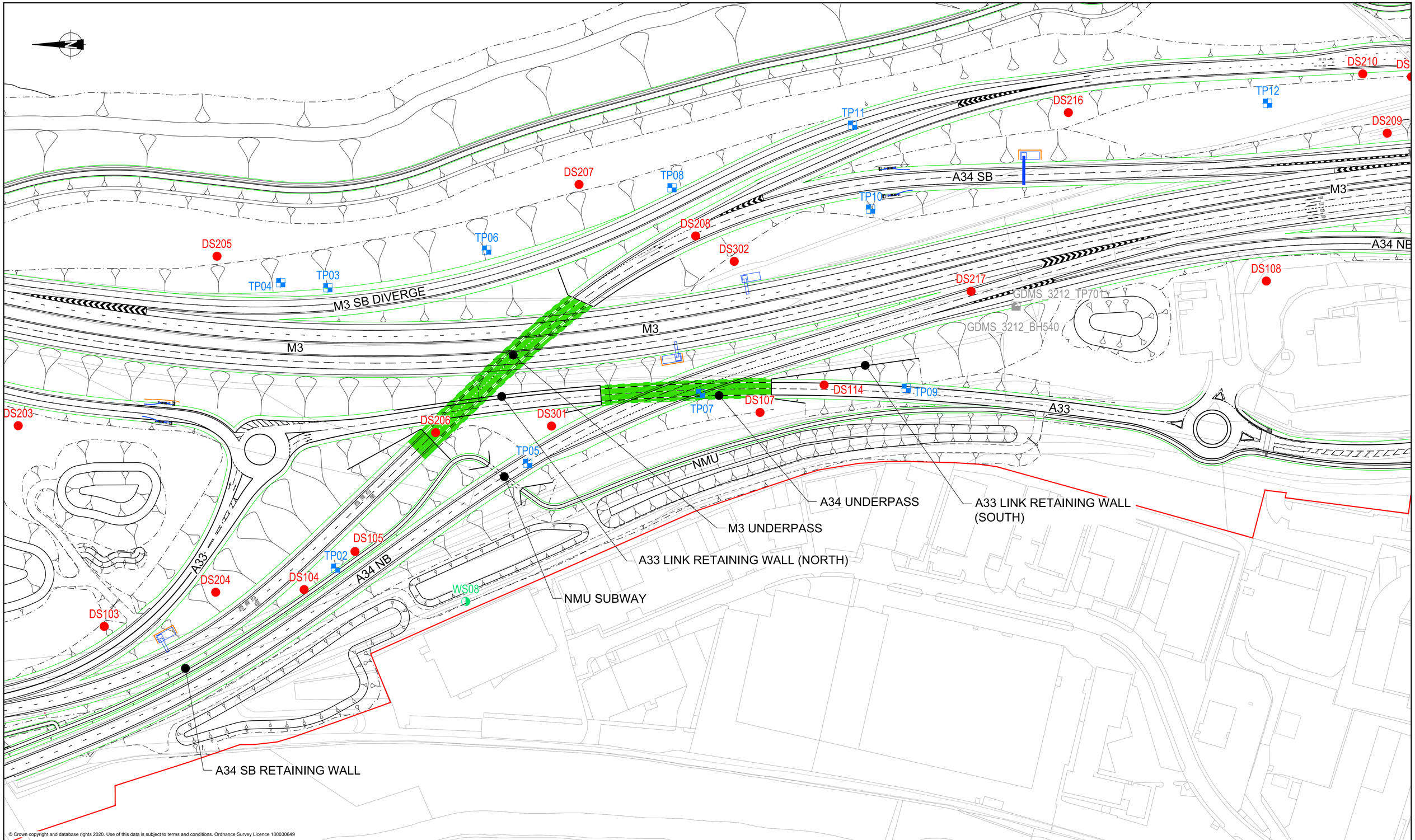
SHEET 2 OF 4

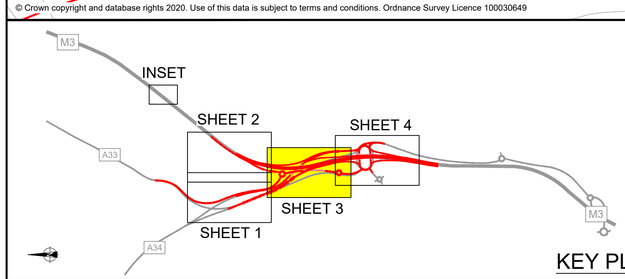
Scale	Designed	Drawn	Checked	Approved
1:1000	AD	davco	AD	RHT
Original Size	**Date**	**Date**	**Date**	**Date**
A1	05.05.21	05.05.21	05.05.21	06.05.21

Drawing Number: HE PIN | Originator | Volume
HE551511 - VFK - HGT - X_XXXX_XX - DR - GE - 0002
Location | Type | Role | Number

Project Ref. No.: 48176

Revision: P01





KEY PLAN

GDMS HISTORICAL EXPLORATORY HOLES

- TRIAL PIT
- CABLE PERCUSSION BOREHOLE
- WINDOWLESS SAMPLING BOREHOLE

SOILS LIMITED 2019 EXPLORATORY HOLES

- TRIAL PIT
- DYNAMIC SAMPLING WITH ROTARY CORE FOLLOW ON
- WINDOWLESS SAMPLING BOREHOLE

Rev.	Date	Description	Drawn	Chk'd	App'd

Drawing Status: FOR SGAR 3B

VolkerFitzpatrick

Client: highways england

Project Title: M3 JUNCTION 9 IMPROVEMENTS

Drawing Title: EXPLORATORY HOLE LOCATION PLAN

SHEET 3 OF 4

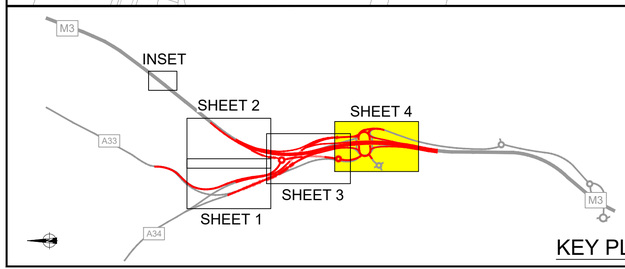
Scale	Designed	Drawn	Checked	Approved
1:1000	AD	davco	AD	RHT
Original Size	**Date**	**Date**	**Date**	**Date**
A1	05.05.21	05.05.21	05.05.21	06.05.21

Drawing Number: HE PIN | Originator | Volume | Location | Type | Role | Number
HE551511 - VFK - HGT - X_XXXX_XX - DR - GE - 0003

Project Ref. No.: 48176

Revision: P01

NMU SUBWAY
NMU
A272 SPITFIRE LINK
SPITFIRE LINK
RETAINING WALL
DS109A
DS109
DS110
DS210
DS115
WS05
TP12
DS211
GDMS_3212_BH536
GDMS_3212_BH535
DS209
GDMS_3212_BH539
GDMS_3212_BH630
DS219
M3
GDMS_3212_TP629
M3
M3
GDMS_3212_BH805
GDMS_3212_TP628
GDMS_3212_BH538
GDMS_3212_BH534
DS212
WS04
A34 NB
GDMS_3212_BH537
DS213
DS214
DS214A
DS108
WS06
DS215
M3 J9 SOUTHERN BRIDGE
WS07
NMU SUBWAY
NMU
EASTON LANE
NMU SUBWAY
M3 J9 NORTHERN BRIDGE



KEY PLAN

GDMS HISTORICAL EXPLORATORY HOLES

- TRIAL PIT
- CABLE PERCUSSION BOREHOLE
- WINDOWLESS SAMPLING BOREHOLE

SOILS LIMITED 2019 EXPLORATORY HOLES

- TRIAL PIT
- DYNAMIC SAMPLING WITH ROTARY CORE FOLLOW ON
- WINDOWLESS SAMPLING BOREHOLE

Rev.	Date	Description	Drawn	Chk'd	App'd

Drawing Status: FOR SGAR 3B

VolkerFitzpatrick

Client: highways england

Project Title: M3 JUNCTION 9 IMPROVEMENTS

Drawing Title: EXPLORATORY HOLE LOCATION PLAN

SHEET 4 OF 4

Scale	Designed	Drawn	Checked	Approved
1:1000	AD	davco	AD	RHT
Original Size: A1	Date: 05.05.21	Date: 05.05.21	Date: 05.05.21	Date: 06.05.21

Drawing Number: HE551511 - VFK - HGT - X_XXXX_XX - DR - GE - 0004
(Originator | Volume | Location | Type | Role | Number)

Project Ref. No.: 48176

Revision: P01

Appendix D

HE551551-VFK-HGT-X_XXXX_XX-DR-GE-0020 Geological plan

Key

- Made Ground
- Peat
- Alluvium
- Head
- Structureless Chalk (Grade Dm and Dc)
- Structured Chalk (Grade A to C)

Rev.	Date	Description	Drawn	Chk'd	App'd
P02	05.05.21	INCORPORATING HE COMMENTS	davco	AD	RHT

Drawing Status: FOR SGAR 3B

VolkerFitzpatrick

Client: highways england

Project Title: M3 JUNCTION 9 IMPROVEMENTS

Drawing Title: GEOLOGICAL PLAN

Scale	Designed	Drawn	Checked	Approved
1:2500	AD	davco	AD	RHT
Original Size	**Date**	**Date**	**Date**	**Date**
A1	01.12.20	01.12.20	04.12.20	08.12.20

Drawing Number: HE551511 - VFK - HGT - X_XXXX_XX - DR - GE - 0020 (HE PIN | Originator | Volume | Location | Type | Role | Number)

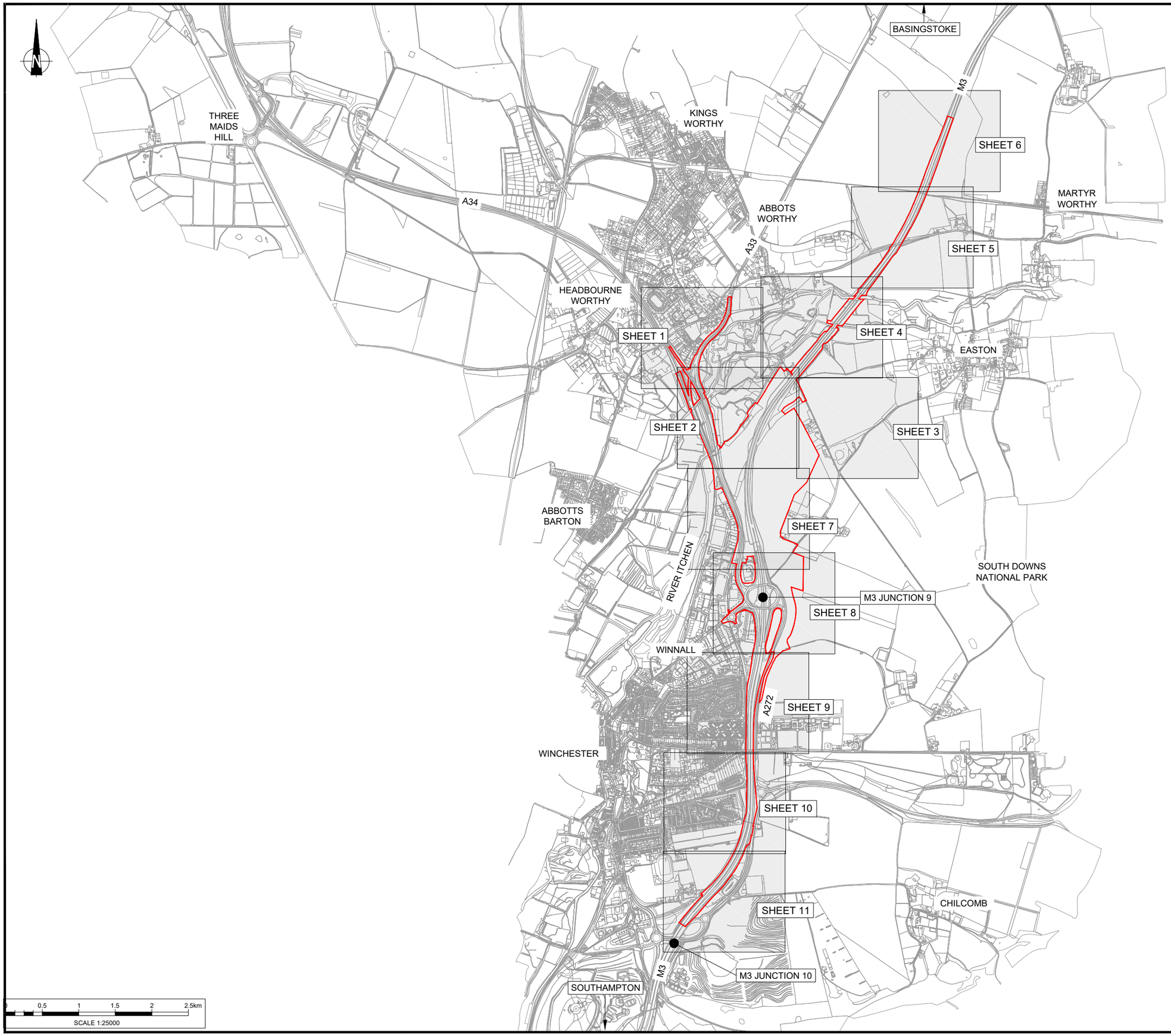
Project Ref. No.: 48176

Revision: P02

Appendix E

RAM model files (electronic appendix)

Appendix E Environmental Mitigation Design Plan



NOTES

Purpose of use

FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

1. This drawing has been produced using CAD software, therefore all dimensions are shown in metres unless shown otherwise.
2. Do not scale from this drawing. Use only printed dimensions.
3. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018

KEY:

APPLICATION BOUNDARY

REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN
APFP REGULATIONS 5(2)(a)
(DOCUMENT REFERENCE 6.2)

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:25000	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0016

Existing Features:

General Features

National Cycle Network (NCN Route 23)

Existing Hampshire County Council Footpath

Existing Environmental Features

Retained Woodland Trees and Hedges predominantly located within the Application Boundary

Existing Woodland Trees and Hedges predominantly located outside the Application Boundary

Watercourses - River Itchen and its tributaries

Existing Landform (Contours)

Primary Planning and Policy Considerations

South Downs National Park

Proposed Project Features:

Application Boundary

Permanent Acquisition of Land

General Project Features

Proposed Footway, Cycleway and Horse-Riding Route

Proposed Footpath Link

Proposed Footway and Cycling Route

Proposed New Carriageway

Proposed 1.35m high post and wire fence

Proposed 1.3m high post and 4 rail fence

Proposed Bridge Parapet

Proposed Retaining Wall

Proposed Cutting

Proposed Embankment

70 Proposed Modified Landform (Contours) Metres Above Ordnance Datum

Proposed Variable Message Sign (VMS) Sign

Relocated VMS Sign

Proposed Sign Gantries

Proposed Landscape Elements:

Grassland (LE 1)

LE1.1 Amenity Grass (EFK)

LE1.3 Chalk Grassland

LE1.3 Species Rich Grassland

Planting (LE 2)

LE2.1 Woodland (Broadleaf)

LE2.4 Linear Belts of Shrubs and Trees

LE2.8 Native Scrub Planting

Hedgerows (LE 4)

LE4.3: Native Species Hedgerow

Trees (LE 5)

LE5.1: Individual Trees

Wetland Habitats (LE 6)

LE6.1 Waterbodies and Associated Plants

LE6.2 Banks and Ditches

LE6.4 Marsh and Wet Grassland

Proposed Environmental Elements:

Ecological (E3)

E3.2: Ecology Protection Measures (EPM)

E3.2 Ecological Protection Measure - Ecological Fencing (1.3m high post and 4 rail fence)

E3.2 EPM - Bat box

E3.2 EPM - Dormice nest box

E3.2 EPM - Reptile hibernacula

E3.2 EPM - Bird box

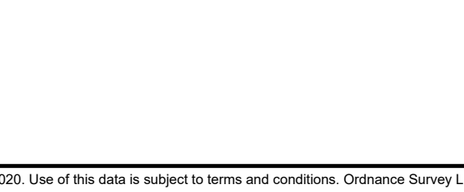
Reference

An Environmental Feature Reference Symbol is provided for each environmental / landscape element. This provides a unique reference ID, environmental function and the specific landscape / environmental element. For ease of interpretation and to reduce the duplication of data, where single elements span multiple sheets only the full symbol is provided on the sheet it first appears on, with each subsequent symbol for that element referencing back to the original symbol location.

Environmental Functions (EF)

EFA	Visual Screening
EFB	Landscape Integration
EFC	Enhancing the Built Environment
EFD	Nature Conservation and Biodiversity
EFE	Visual Amenity
EFF	Heritage
EFG	Auditory Amenity
EFH	Water Quality
EFJ	Agricultural/Highway Boundary
EFK	Access

Reference



NOTES

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Development Consent Order Number / Document

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3. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018

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0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (LEGEND) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

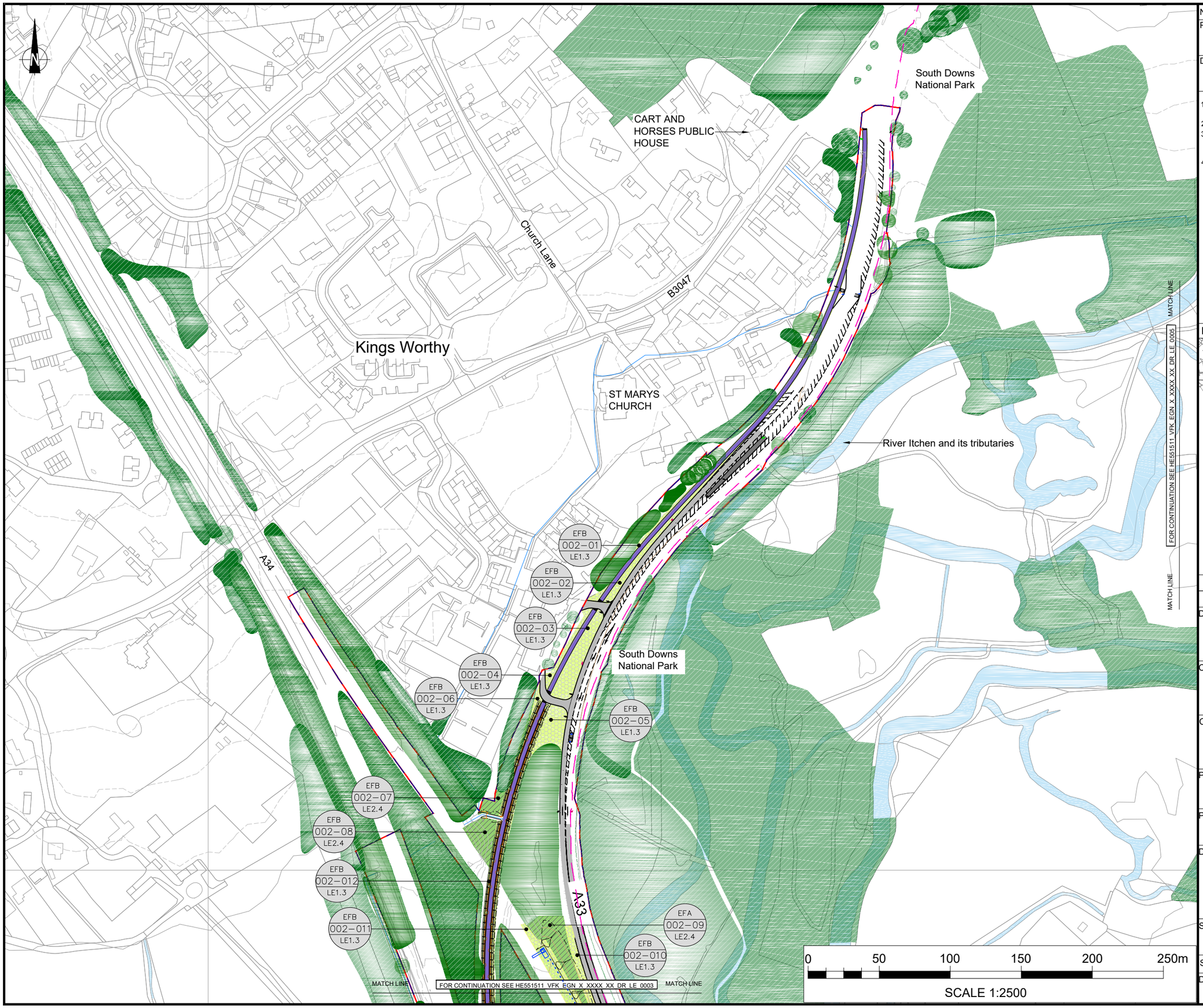
SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015



NOTES

Purpose of use

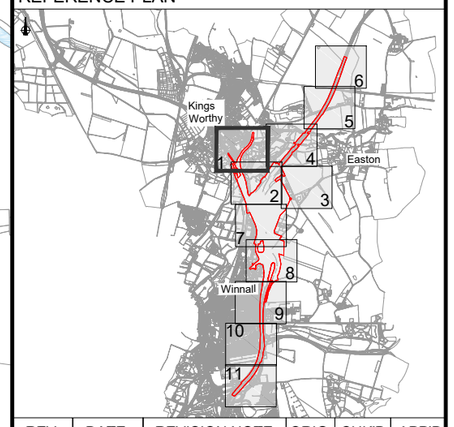
FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

1. This drawing has been produced using CAD software, therefore all dimensions are shown in metres unless shown otherwise.
2. Do not scale from this drawing. Use only printed dimensions.
3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018

REFERENCE PLAN



REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 1 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0002

Refer to 002–07
Refer to 002–09
Refer to 002–08
Refer to 002–11
Refer to 002–12
Refer to 002–010
Refer to 002–05
A33
A34 Northbound
A34 Southbound
MATCH LINE
FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0002
MATCH LINE
River enhancement to align with Environment Agency's River Itchen Restoration Strategy, likely to include riparian planting and / or channel narrowing by marginal planting.
River Itchen and its tributaries
River enhancement to align with Environment Agency's River Itchen Restoration Strategy, likely to include riparian planting and / or channel narrowing by marginal planting.
EFD 003–01 LE1.3
MATCH LINE
FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0005
MATCH LINE
EFD 003–02 LE2.8
M3 Northbound
M3 Southbound
EFD 003–03 LE2.8
EFD 003–04 LE2.8
EFB 003–05 LE2.8
EFB 003–10 LE1.3
EFD 003–07 LE1.3
EFA 003–06 LE2.1
EFH 003–18 LE6.1
EFA 003–16 LE2.8
EFH 003–17 LE6.2
EFK 003–32 LE1.1
EFA 003–08 LE2.1
EFA 003–11 LE2.4
EFD 003–09 LE2.8
EFB 003–12 LE1.3
EFB 003–13 LE1.3
EFA 003–14 LE2.4
EFB 003–26 LE2.8
EFH 003–27 LE6.2
EFB 003–24 LE1.3
EFA 003–25 LE2.8
EFB 003–23 LE1.3
EFA 003–29 LE2.4
EFB 003–33 LE4.3
EFB 003–31 LE1.3
EFA 003–19 LE2.4
EFH 003–28 LE6.2
EFH 003–21 LE6.1
EFH 003–20 LE6.2
EFA 003–15 LE2.1
EFB 003–22 LE1.3
Areas of chalk grassland acting as an infiltration feature
SHEN 0065
SHEN 0068
MATCH LINE
FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0004
MATCH LINE
FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0008
0 50 100 150 200 250m
SCALE 1:2500

NOTES

Purpose of use

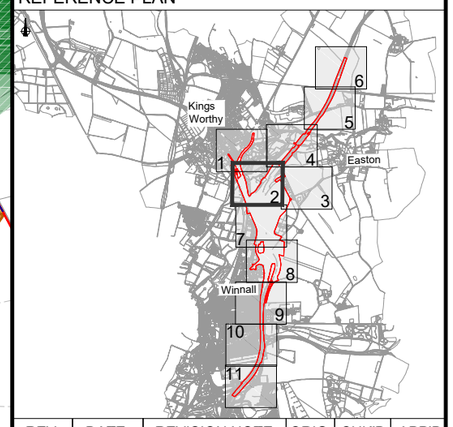
FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

1. This drawing has been produced using CAD software, therefore all dimensions are shown in metres unless shown otherwise.
2. Do not scale from this drawing. Use only printed dimensions.
3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018
5. Plot reference 003-02, 003-04 and 003-16 have opportunity for advanced planting
6. Plot references 003-05, 003-06, and 003-11, to be specified with reference to adjacent water main and Southern Water's *"A Guide to Tree Planting near Southern Water Mains and Sewers"* guide. Only small shrubs / hedgerows on top of water main and within 6m easement. Small trees and shrubs within 6-10m offset zone.Woodland and large trees to be planted outside of 10m zone.

REFERENCE PLAN



REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 2 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

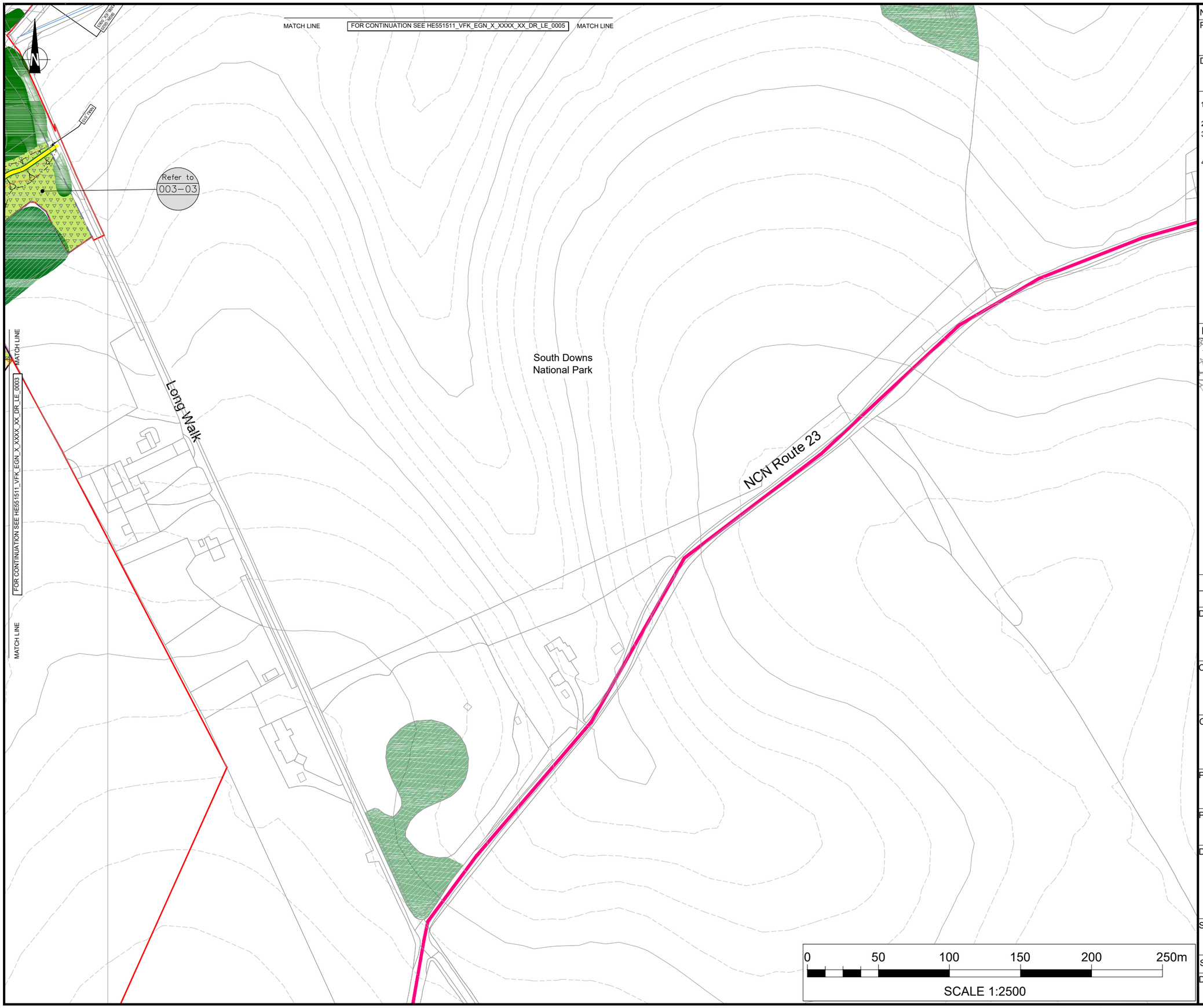
DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0003

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0005

MATCH LINE



MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0003

MATCH LINE

NOTES

Purpose of use

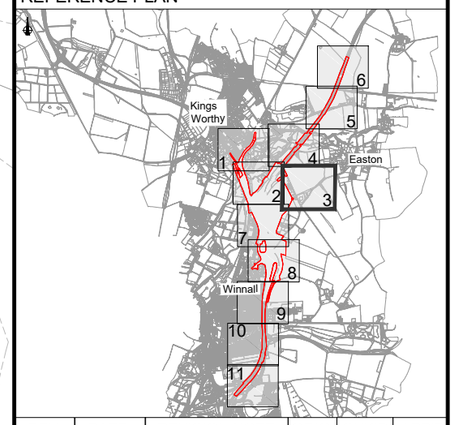
FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

1. This drawing has been produced using CAD software, therefore all dimensions are shown in metres unless shown otherwise.
2. Do not scale from this drawing. Use only printed dimensions.
3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018

REFERENCE PLAN



REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 3 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0004

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0006

MATCH LINE

No environmental works within this area of the Application Boundary

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0002

MATCH LINE

River Itchen and its tributaries

M3 Northbound

M3 Southbound

Refer to 003–02

Refer to 003–01

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0003

MATCH LINE

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0004

MATCH LINE

0 50 100 150 200 250m

SCALE 1:2500

NOTES

Purpose of use

FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

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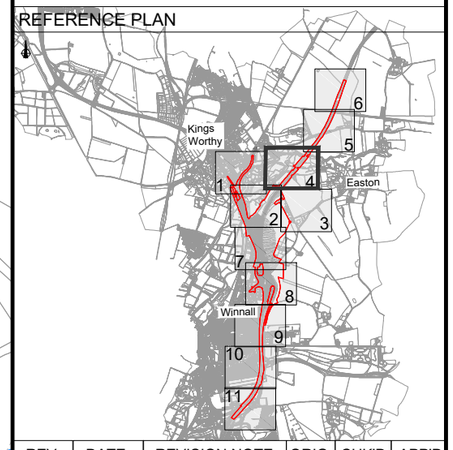
2. Do not scale from this drawing. Use only printed dimensions.
3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018
4. Plot reference 003-02 has opportunity for advanced planting

REFERENCE PLAN



REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 4 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0005

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0007

MATCH LINE

No environmental works within this area of the Application Boundary

B3047

M3 Northbound

M3 Southbound

1

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0005

MATCH LINE

0 50 100 150 200 250m

SCALE 1:2500

NOTES

Purpose of use

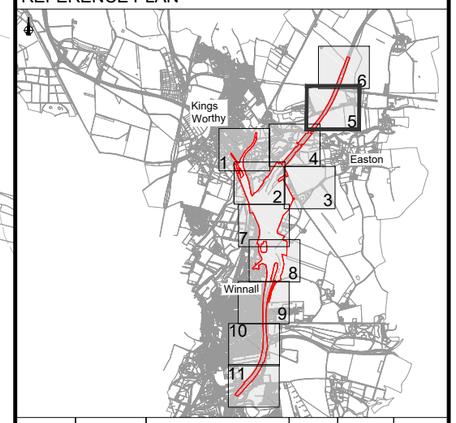
FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

1. This drawing has been produced using CAD software, therefore all dimensions are shown in metres unless shown otherwise.
2. Do not scale from this drawing. Use only printed dimensions.
3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018

REFERENCE PLAN



REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

DESIGNER

Stantec

CONTRACTOR

VolkerFitzpatrick

CLIENT

national highways

PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 5 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

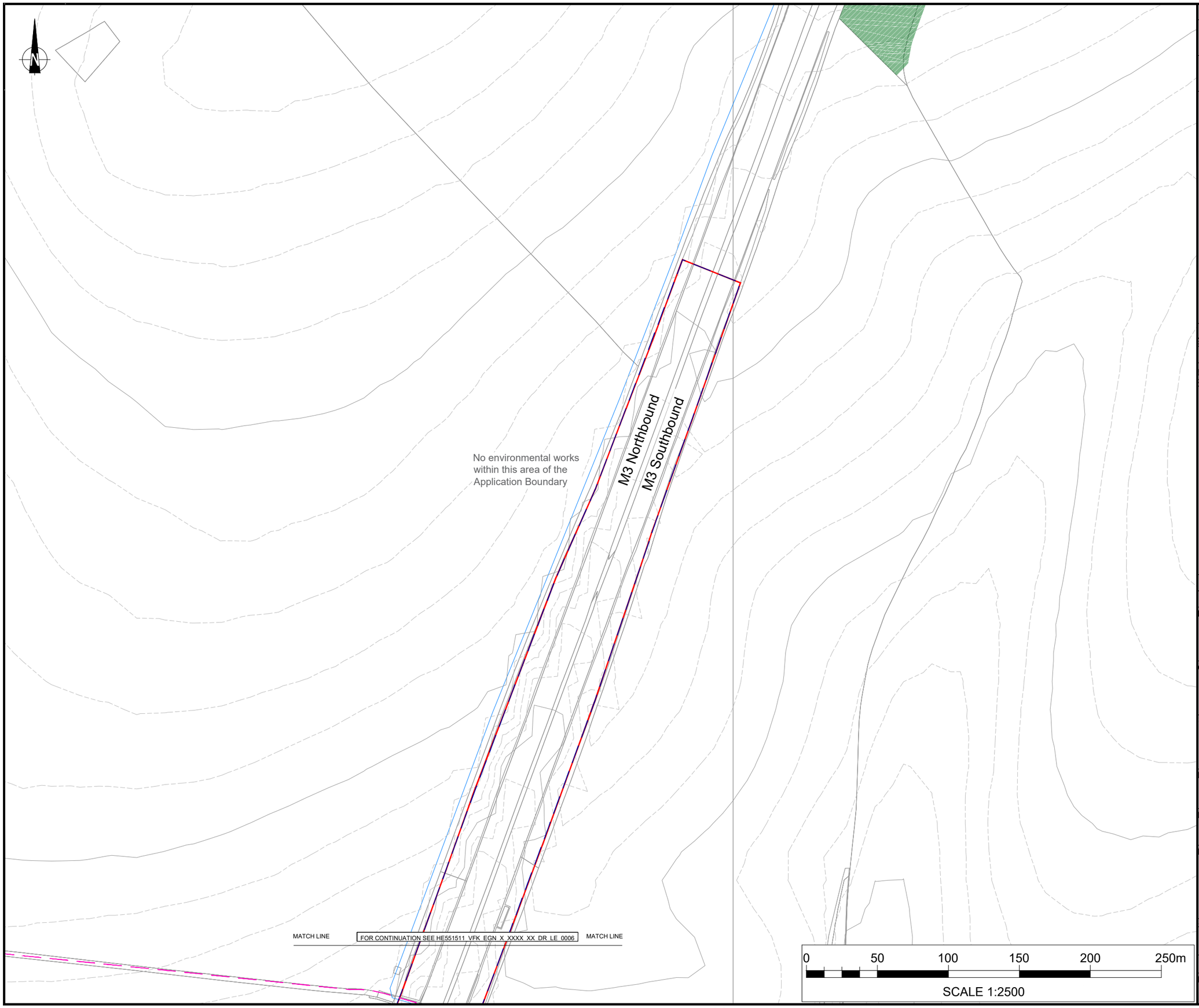
SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0006



NOTES

Purpose of use

FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

1. This drawing has been produced using CAD software, therefore all dimensions are shown in metres unless shown otherwise.
2. Do not scale from this drawing. Use only printed dimensions.
3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018

REFERENCE PLAN

REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
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DESIGNER

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M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 6 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

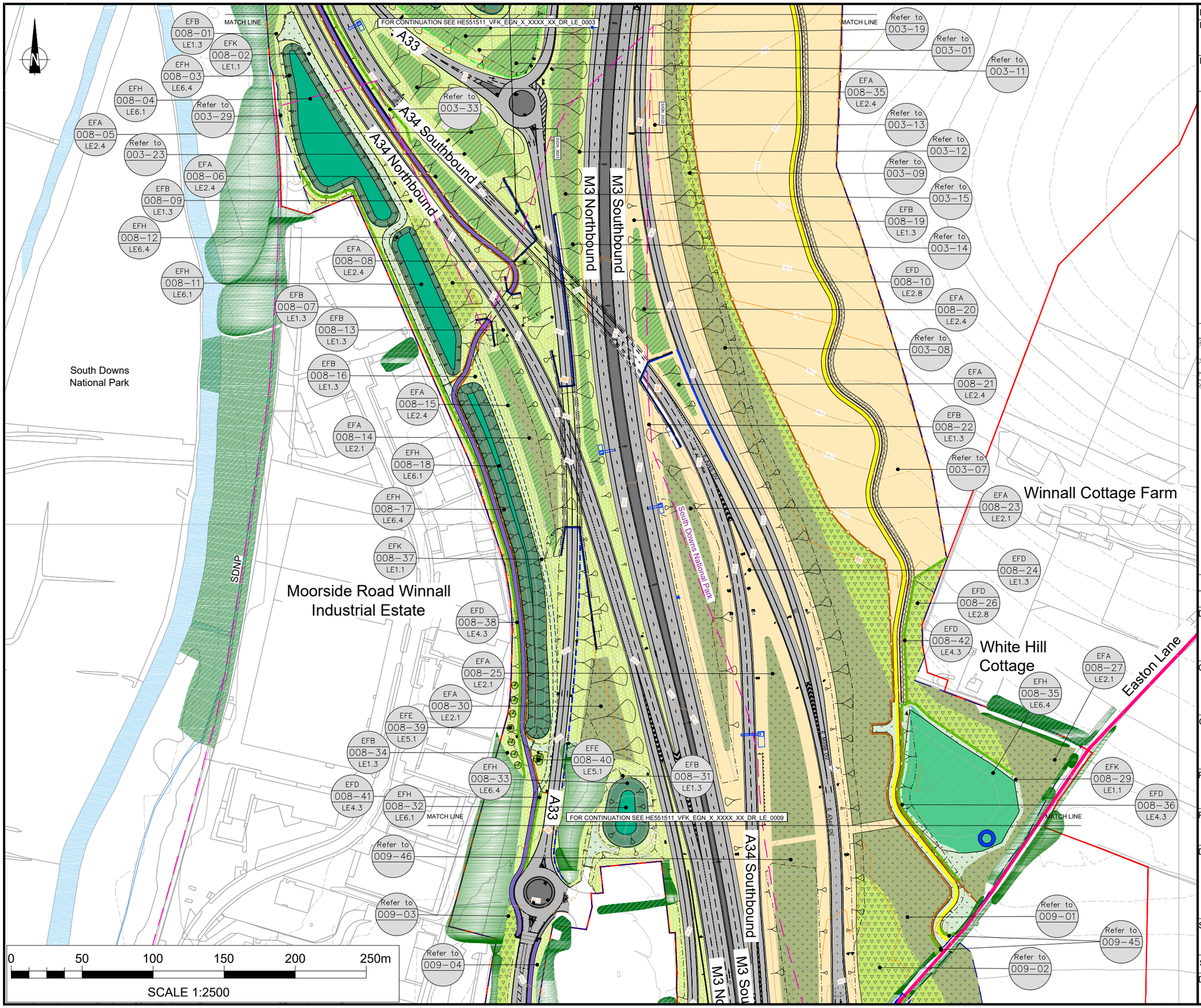
SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0007



NOTES

Purpose of use

FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

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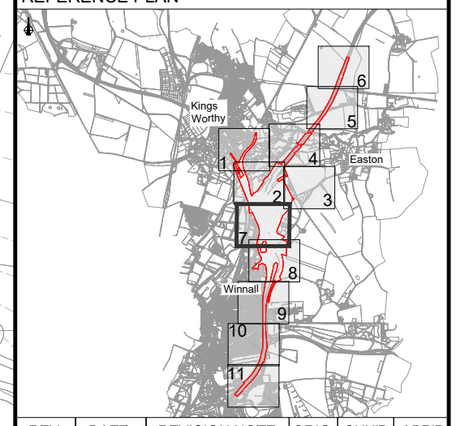
3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018
5. Plot reference 008-26, 008-27 have opportunity for advanced planting
6. Plot references 008-05, 008-06, 008-08, 008-10 and 008-35, to be specified with reference to adjacent water main and Southern Water document *"A Guide to Tree Planting near Southern Water Mains and Sewers"*. Typically, only small shrubs / hedgerows on top of water main and within 6m easement. Small trees and shrubs within 6-10m offset zone.Woodland and large trees to be planted outside of 10m zone.

REFERENCE PLAN



REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
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PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 7 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

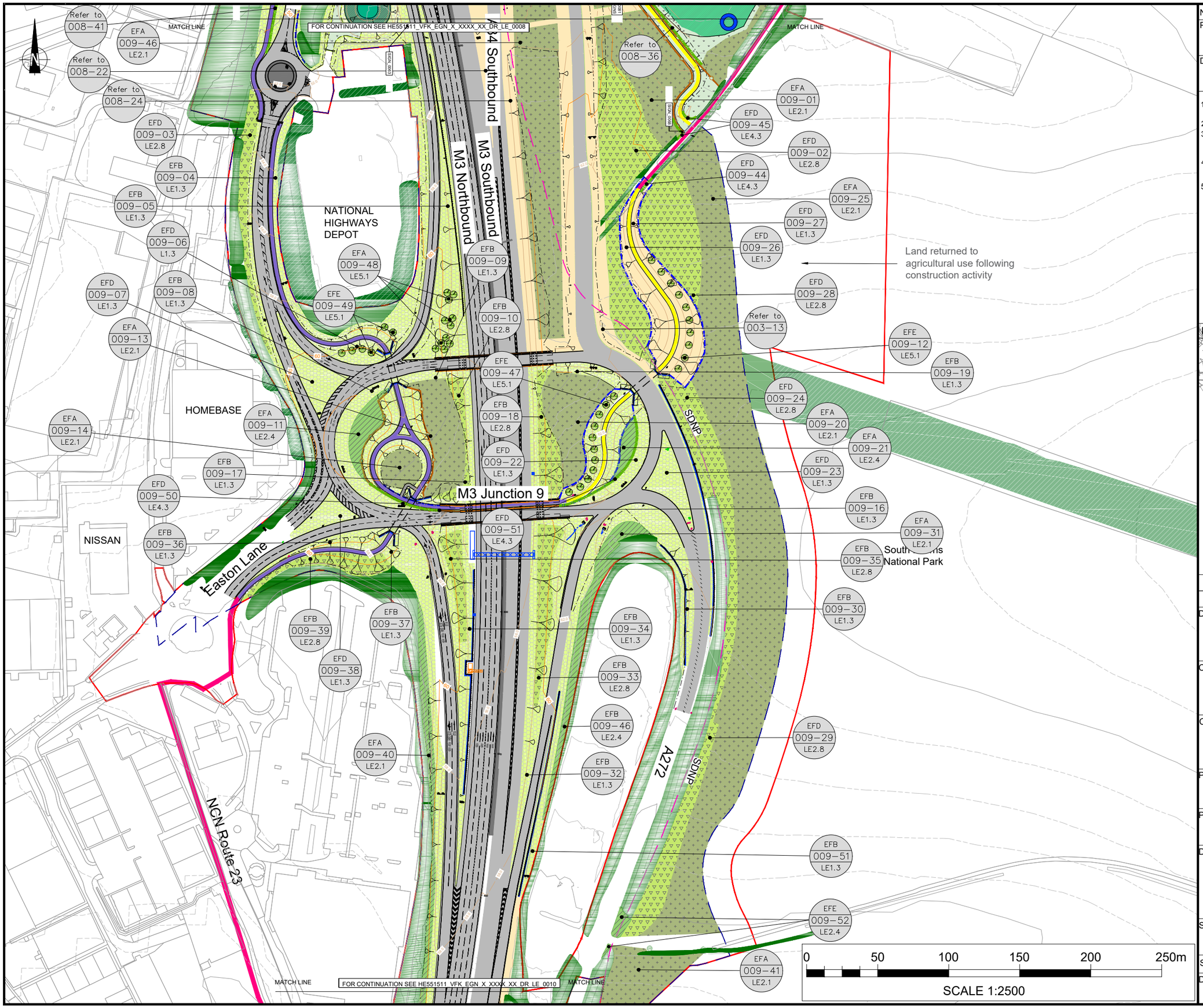
SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3 | SCALE: 1:2500 | STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0008



NOTES

Purpose of use

FOR DCO SUBMISSION

Development Consent Order Number / Document

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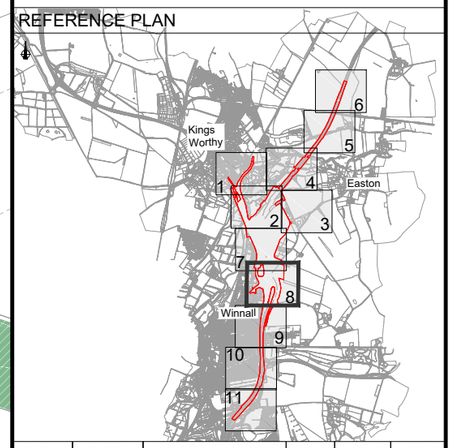
3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018
5. Plot reference 009-25 and 009-41 have opportunity for advanced planting

REFERENCE PLAN



REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

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PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 8 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

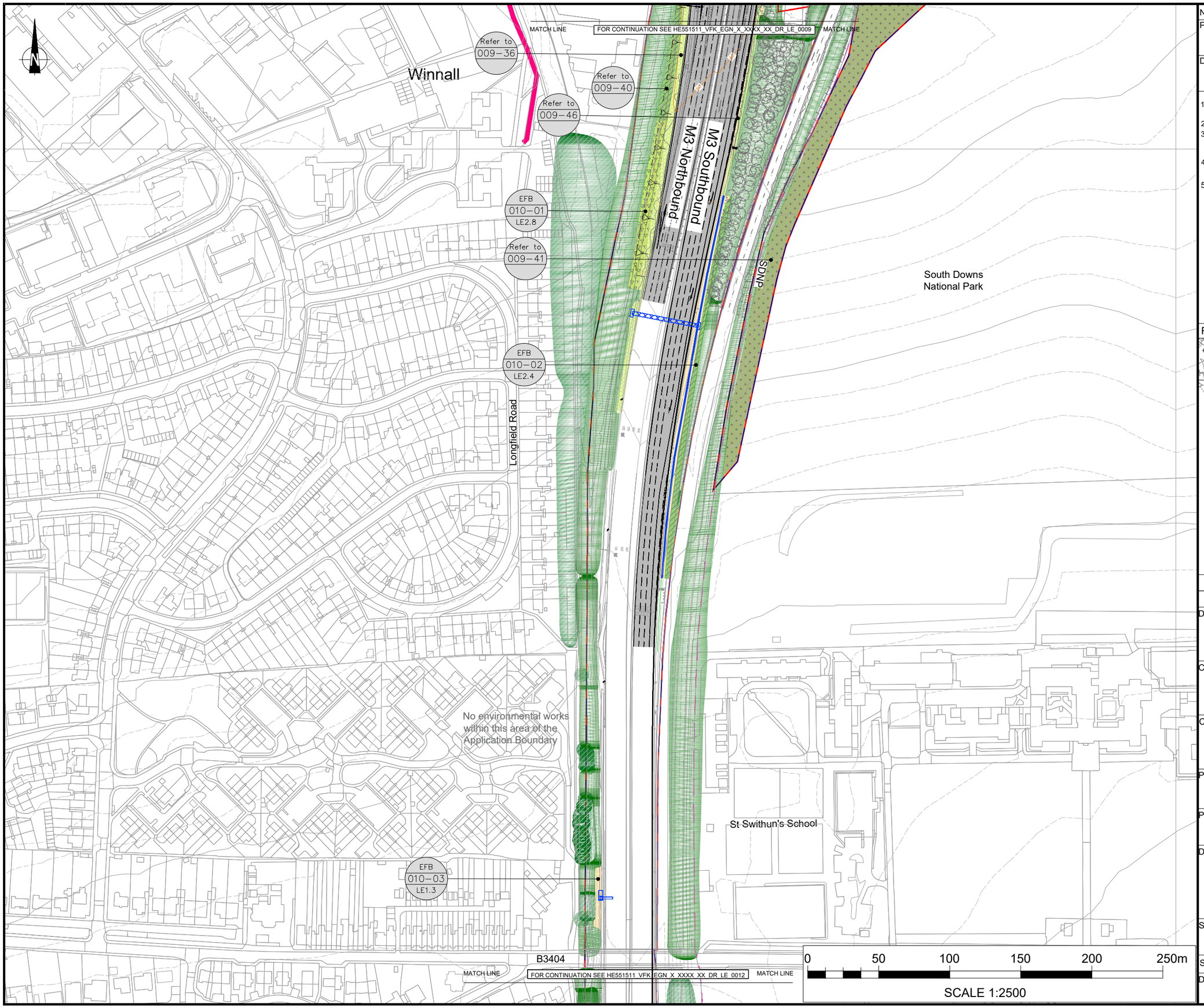
SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0009



NOTES

Purpose of use

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Development Consent Order Number / Document

TR010055/APP/6.2

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3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018
5. Plot reference 009-41 has opportunity for advanced planting

REFERENCE PLAN

REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

DESIGNER

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PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 9 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0010

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0010

MATCH LINE

Quarry Road

Chalk Ridge

Fivefields Road

Gordon Avenue

SDNP

South Downs National Park

A31 Petersfield Road

M3 Northbound

M3 Southbound

EFB 011–01 LE2.4

EFB 011–02 LE1.3

0 50 100 150 200 250m

SCALE 1:2500

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0013

MATCH LINE

NOTES

Purpose of use

FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

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3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018

REFERENCE PLAN

REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
0	NOV22	APPLICATION SUBMISSION	IM	AC	AS

DESIGNER

Stantec

CONTRACTOR

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CLIENT

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PROJECT TITLE

M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 10 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0012

MATCH LINE

FOR CONTINUATION SEE HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0012

MATCH LINE

M3 Northbound

M3 Southbound

SDNP

South Downs National Park

EFB 012–01 LE2.4

EFB 012–02 LE1.3

A31

0 50 100 150 200 250m

SCALE 1:2500

NOTES

Purpose of use

FOR DCO SUBMISSION

Development Consent Order Number / Document

TR010055/APP/6.2

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3. For legend refer to drawing HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0015 Environmental Masterplan Legend
4. Vegetation outside of Application Boundary sourced from National Forest Inventory Woodland England 2018

REFERENCE PLAN

REV	DATE	REVISION NOTE	ORIG	CHK'D	APP'D
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M3 JUNCTION 9 IMPROVEMENT

PROJECT STAGE

PCF STAGE 3

DRAWING TITLE

FIGURE 2.3 - ENVIRONMENTAL MASTERPLAN (SHEET 11 OF 11) APFP REGULATIONS 5(2)(a) (DOCUMENT REFERENCE 6.2)

SUITABILITY

APPLICATION SUBMISSION

SHEET SIZE: A3	SCALE: 1:2500	STATUS: REV 0

DOCUMENT REFERENCE

HE551511_VFK_EGN_X_XXXX_XX_DR_LE_0013