M2 Junction 5 Improvements Environmental Statement Volume 2 - Appendix E.4 Drainage Strategy June 2019

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1. Introduction

1.1 Scope of this Technical Note

1.1.1 This Technical Note (TN) is intended to provide a summary of the overall Drainage Design Strategy for the RIP schemes as it relates to the M2 Junction 5 project, outlining a comprehensive and systematic approach for road drainage design aspects of the above scheme to contribute to the requirements of the PCF Stage 3 Assessment. This TN does not encompass land drainage aspects including inter alia, culvert proposals, watercourse alterations, geomorphology, floodplain storage matters, or associated flood risk relating to land drainage proposals. Notwithstanding, close collaboration will be undertaken with the land drainage team to provide appropriate solutions, contribute to risk mitigation, and rigorously challenge imposed constraints and opportunities of all elements of the design solution. Proposed road drainage designs and estimates will be carried out to current best practice guidance and based on the available information for the existing situation.

2. Existing Situation and Upgrade

2.1 Roads and Drainage

2.1.1 The M2 Junction 5 (A249) Stockbury Roundabout forms part of the strategically important corridor linking Dover with London. Junction 5 is a grade separated junction, including a roundabout that provides an interchange between the northwest-southeast oriented M2 and southwest-northeast oriented A249. The below identified scope refers to selected option 4H1 (Option 4H1).

2.1.2 Three scheme options were considered before commencing the Stage 3 works, i.e. Option 4, Option 10 and option 12. Out of these, option 4H1 was considered final. This option will involve:

- Construction of 2 bridges crossing the roundabout;
- Construction of elevated section over the roundabout;
- 4no. free flow links around the roundabout connecting M2, A249 and nearby areas;
- Construction of New Maidstone road link; and
- Minor and major earthworks strengthening the existing.

2.1.3 The existing drainage from the Highways Agency Drainage Data Management System (HADDMS) comprises of surface and sub-surface water collection systems such as carrier and filter drain pipe networks, kerb and gully drainage, pre-earthwork drainage, soakaways and ponds.

2.1.4 No drainage plans are available for Maidstone Road, Oad Street, or other affected minor roads from the Technical Appraisal Report (November 2016). No information is available from HADDMS or as-built drawings regarding any nearby watercourses, outfalls to watercourses or culverts.

2.1.5 Information on the existing highway drainage is limited. A gap analysis of the data available from the HADDMS database shows that the information is incomplete.

2.1.6 As per the Technical Appraisal Report (November 2016) parts of the existing drainage network must be replaced or alternatively defect rectification carried out to ensure pipes have sufficient residual life. The proposed drainage will mimic the existing drainage and will utilise existing assets, where possible.

2.1.7 The existing drainage arrangement will need to be proved by drainage and topographic surveys. For drainage survey requirements and extent plans refer to the Drainage Survey Specification (HE551521-ATK-HDG-XX-DR-CD-000001).

2.2 Environment and Flooding

2.2.1 Full extents of constraints are shown on the Environmental Constraints Plan Figure 2.1 in Volume 3.

2.2.2 The Environment Agency (2015) Flood Map for Planning indicates that the existing alignment of the A249 Sittingbourne Road, the M2/A249 roundabout junction, Maidstone Road and junction with the M2 motorway are in a high-risk Flood Zone 3. However, this has been confirmed by the EA to be incorrect and the site falls within a low risk zone. The floodplain is associated with a ditch system that flows parallel to the A249 and, further north, Maidstone Road and Chestnut Street.

2.2.3 The ditch system is likely to be classified as an 'ordinary watercourse' and is therefore under the jurisdiction of Kent County Council which acts as the Lead Local Flood Authority (LLFA) for this area. The alignment of the watercourse is not illustrated on Ordnance Survey mapping and will need further identification during survey work.

2.2.4 The EA Surface Water Flood Risk map highlights the 'ordinary watercourse' route as a zone at high risk from surface water flooding, described as having a 3.33% (1 in 30) or greater annual probability of flooding in any year.

2.2.5 An attenuation pond has been identified adjacent to the eastern slip road (from the A249 to join the westbound M2 carriageway) and is believed to form part of the surface water management system for the highway network. Another pond exists adjacent to property known as The Gate House. It is unclear at this stage whether it receives flows from the highway network. This will be clarified during survey work.

2.2.6 There is a history of surface water flooding at the location of The Gate House pond, described by residents during a site visit, as well as on land to the north of the M2 viaduct, between the A249 and Maidstone Road. This flooding is not represented in HADDMS.

2.2.7 HADDMS contains a record of highway flood events in the area, typically occurring in autumn/winter (August to November) and vary in severity from 0 to 7 (where 10 is the maximum flood severity). The A249 within the study area has been classified with a 'very high' flood hotspot status. The historical flood events on the highway are likely to be due to an inadequate existing drainage system, or poor asset condition and maintenance resulting in reduced hydraulic capacity.

2.3 Aquifers and Groundwater (Source Protection Zones)

2.3.1 The site falls within and near several Source Protection Zones (See drawing HE551521-ATK-EAC-XX-M2-LL-000001). These are namely Inner Zone (zone 1), Outer Zone (zone 2) and Total Catchment (zone 3). The SPZs reflect the risk of contamination from activities that might cause pollution in the area; the closer the

activity the greater the risk. A 2km overview of the scheme area shows the majority of the scheme to be within the Outer Zone (Zone 2).Section of the A249 Road (Ch. 1950 To Ch 2450), New Maidstone Link road J5_L2 (Ch .480 to Ch. 550) are within the Inner Zone (Zone 1) and a small portion of alignment J5_L3 (Ch. 150 to Ch. 250 and Ch. 350 to Ch. 497), J5_RA Stockbury Roundabout (Ch 0 to Ch 50 and Ch 350 to Ch 471), A249 mainline (Ch 1350 to Ch. 1450), A249_L2 (Ch 80 to Ch 150) and a small portion of alignment A249_L1 (Ch 550 to Ch581) are within the Total Catchment Zone 3.

2.3.2 Requirements for development of the drainage within and nearby these areas have been discussed with the Environment Agency, and are as follows:

2.3.3 It is not acceptable for any highway runoff to be discharged to ground within SPZ1. Discharge to ground in SPZ2 and SPZ3 is allowed, subject to appropriate assessment of anticipated pollutant levels, proposed treatment and resultant water quality.

2.3.4 Mapped SPZs are a planning guide and not to be taken as exact boundary lines. Therefore, effort must be made not to discharge to ground for some distance from the SPZ1 boundary.

3. PCF Stage 3 Road Drainage Design Strategy

3.1 Road Drainage Design Strategy

3.1.1 The drainage design for the upgraded and new carriageway sections will consist of gravity drainage networks, which will convey flows to suitable outfalls.

3.1.2 The road drainage design has been developed to sufficient detail to contribute to the preparation of the PCF Stage 3 Assessment. One of the items in the PCF Stage 3 is the Scheme Assessment report. The stages of the Scheme Assessment Report are detailed in TD37/93 of the Design Manual for Roads and Bridges (DMRB).

3.1.3 It was the original intention to re-use as much as possible of the existing drainage however, the modelling of the existing drainage relied on the availability of surveys. The drainage surveys are planned after the DF3 milestone and as such, the preliminary design will be based on the following assumptions:

The pipe carrier systems will be full depth new replacement design.

The outfalls for the pipe carrier systems will be closest to the low points of the catchment areas created by the proposed vertical alignment, unless intermediate outfalls to soakaways are required.

Soakaways or infiltration basins will be proposed at low points, or along the length of the highway verge as trenches where space is limited. At these locations permeability testing will be scheduled to confirm suitability. For soakaway test locations refer to the GI specification document (HE551521-ATK-GEN-XX-SP-CE-000001) and drawings (HE551521-ATK-HDG-XX-DR-CD-000003 and HE551521-ATK-HDG-XX-DR-CD-000004).

3.2 Constraints

3.2.1 Key constraints identified include:

- Works within Source Protection Zones;

- Atkins GI will need to check for contamination within existing soakaways. EA require following standard procedure: test, remediate and backfill (particularly important in SPZ1);
- Current proposed drainage strategy: grass channels (lined with impermeable liner as per section 3.4 of HA119/06), will discharge to soakaways in various forms at intervals. Flyover and roundabout to have combined kerb drains. Where space is limited grass channels will be replaced with other forms of collection system;
- As no drainage can discharge to ground in the vicinity of SPZ1, discharge from the northern part of the works may need to be discharged to the existing highway drainage system. Although not confirmed, it is thought the existing highway drainage may discharge to swales to the north east of the mapped SPZ1;
- Proposed soakaways require a pollution control valve in upstream manholes with appropriate access to enable the systems to be closed off in the event of a spillage;
- Infiltration basins & soakaways have been sized using assumed suitable infiltration rates (defined at DF1). Actual dimensions of soakaways required are to be confirmed after infiltration tests and associated calculations have been carried out;
- In the absence of information about existing drainage, the pipe carrier systems for the preliminary design are assumed to be full depth new replacement design;
- Gullies/CKDU/BDK dimensions and locations are indicative only. CKDU may be replaced with gullies at detail design if required;
- All ditches at the top of cutting slopes are assumed to be lined and are to discharge flows at low points to the unlined ditches / filter drains at the toe of slopes. Slope stability calculations have been undertaken by the geotechnical team, which have confirmed unlined ditches at the top of cutting slopes are likely to cause instability;
- Ditches at the toe of slopes are assumed to be unlined and are to function as soakaways;
- Infiltration pond access tracks and turning heads have been defined via a vehicular track analysis and are shown indicatively;
- Additional suitable pollution control measures to be confirmed at detailed design;
- Geocellular soakaway units have been proposed for soakaway trenches and soakaway chambers;
- A shallow pipe network has been proposed on the elevated road;
- Cross pipes have been proposed through the existing road;
- Where new drainage connects into existing drainage, attenuation shall be in the form of a larger diameter pipe which discharges through an orifice flow

control device into the existing drainage pipe. The maximum diameter for the attenuation pipe shall be 900mm;

- For some ponds, the required storage volume safety factor of 2 is marginally reduced to fit the pond within the scheme boundary. The balance storage volume is accomplished by proposing attenuation pipes at the upstream of the ponds;
- Embankment / cutting slope ditches have been combined with highway drainage (soakaways) in some locations due to space constraints;
- Check dams on grass channels at regular intervals will be provided to prevent rapid runoff by increasing capacity of the system, where steep slopes exist, particularly on the Maidstone Road link;
- Outlets from grass channels will be as per Figure C.4 and Figure C.5 of HA119/06;
- Works are potentially near deep water (infiltration basins);
- Works to be undertaken within confined spaces (catchpits and soakaways);
- Construction of structures (cross-pipes/culverts) are required under live carriageway;
- Other relevant constraints shall be identified and included on the drawings as they become known; and
- Refer to risk register for risks and assumptions.

3.3 Allowable Discharge

3.3.1 Control of allowable discharge is required to contribute to the flood management objectives of neutral or better effect on the overall flood risk at the site. In the case of the M2 J5, soakaways will be sized to control runoff rates up to the 1 in 100-year return period. Allowable discharge rates are driven by outflow from the proposed soakaways.

3.3.2 In those locations highway drainage is proposed to discharge to the existing systems, allowable discharge rates will be calculated using the modified rational method. Greenfield runoff rates will be established based on the ICP SuDS method using MicroDrainage and additional volume due to widening works will be estimated using the Quick Storage Estimate method using the same software.

3.3.3 Peak outflows from these increased widened catchments will be controlled to match existing highway peak runoff rates for 1 in 1, 1 in 5 and 1 in 100-year return periods. The increase in new impermeable area for these catchments shall be controlled to equivalent greenfield runoff rates.

Minimum Limit of Discharge Rate

3.3.4 A practical minimum limit on the discharge rate from a flow attenuation device is a compromise between attenuating to a satisfactory low flow rate while keeping the risk of blockage to an acceptable level. The Sustainable Drainage Systems (SUDS) Manual acknowledges that the minimum size flow control is typically between 75mm to 150mm. The sizing of the flow control device will comply with

this requirement from the SUDS manual with an absolute minimum diameter of 75mm of the flow control aperture to prevent blockage.

3.4 Pipe and Chamber Networks

3.4.1 For the purposes of feasibility assessment for PCF Stage 3, outline conveyance pipework will generally be developed in accordance with HD33/16 'Surface and Subsurface Drainage Systems for Highways', section 6. Pipes shall be designed for the 1 in 1-year return period without surcharge and the 1 in 5 year return period with no flooding. Review of design return periods may be carried out on critical sections of carriageway during PCF Stage 3 assessment. Due to lack of existing drainage information, preliminary design assumes that the pipe carrier systems would be full depth new replacement design.

3.4.2 Where new drainage connects into existing drainage, attenuation shall be in the form of a larger diameter pipe which discharges through an orifice flow control into the existing drainage pipe. The maximum diameter for the attenuation pipe shall be 900mm.

Hydraulic Design Parameters

3.4.3 For this project the Flood Studies Report (FSR) rainfall data will be used. Inflow hyetograph rainfall intensities used to calculate the design storms shall include increase as an allowance for the effects of climate change. There may be a requirement for higher percentage value for climate change to comply with recent sustainability objectives. However, a decision was taken at Drainage Management level for all the RIP schemes to use climate change allowance in the design. Inflow hyetograph rainfall intensities used to calculate the design storms shall include an additional 20% allowance for the effects of climate change, with a sensitivity test to be undertaken with a 40% allowance.

3.4.4 Percentage Runoff estimates have been used in the calculations of contributing areas as per HA37.

3.5 Surface Water Collection System

3.5.1 Surface water collection shall be provided by lined grass channels where verge width allows on mainline sections. Outlets for grass water channels will be as per figure C.4 and figure C.5 of HA 119/06. Where there are width restraints for the use of grassed channels, alternative linear drainage systems shall be used such as combined kerb and drain or slot drains. The roundabout and slip roads will generally have a combined kerb and drain arrangement and will be designed fully at detail design stage.

Drainage on Over Bridges and Under Bridges

3.5.2 The over bridges within the site extents will be drained by suitable bridge deck units where required and the approaches to the bridge by CDKU. Under bridge areas will drain via suitable linear drainage systems that fit within available verge width.

3.6 Attenuation

3.6.1 The DIS requires a safety factor of 2 to be applied to Infiltration pond sizes to cover unknown issues at preliminary design stage. However, where space constraints

are an issue, a reduction of the required betterment to the ponds has been proposed with the addition of online storage.

3.6.2 The attenuation ponds will be designed according to the SUDS Manual CIRIA C753. In accordance with good practice and CDM designer duties, early consideration was given in consultation with highway designers to accessibility for inspection and maintenance. Online attenuation will be in the form of larger diameter pipes with orifice flow controls where discharge points are into existing pipe networks. Ponds and soakaways have been sized using assumed infiltration rates stated in the TAR (November 2016) compiled by WSP. Actual infiltration rates will be confirmed after tests have been carried out as part of the GI.

3.6.3 Summary of pond volumes considered are given in the catchment calculation spreadsheet (HE551521-ATK-HDG-XX-CA-CD-000003). Refer to Appendix A for catchment area details for all ponds.

3.7 Earthworks Drainage

3.7.1 It will generally be necessary to provide pre-earthworks cut-off drains, located at the top of cuttings or at the toe of embankments, to intercept runoff flowing towards the road from adjoining land. This is anticipated to be by means of a ditch where space permits and where insufficient space is available filter drains will be used. For preliminary design the following corridors have been considered:

6.5m for cut off/ toe ditches (2m maintenance strip to boundary, 2.5m for 0.5m deep 1 in 2 side slopes, 2m to earthworks interface slope). This is a relaxed specification of the original 13m width proposed in the overarching design input statement for all RIP schemes, due to space constraints throughout the site.

Due to space constraints, several filter drains have been proposed at the toe of highway embankment.

Ditches at the top of cutting slopes are assumed to be lined and are to discharge flows at low points to the unlined ditches / filter drains at the toe of slopes.

Pre-earthworks drainage shall generally be kept separate from the road drainage network unless there is a specific benefit in connecting them. Depending on the catchment and ground characteristics and topography, a suitable flow assessment method shall be selected from DMRB HA106/04 'Drainage of Runoff from Natural Catchments' Section 5 or CIRIA C697 'SUDS Manual' Table 4. 2.

3.8 Soakaways

3.8.1 Soakaways will be designed to collect and store storm water run-off from impermeable areas and to allow its efficient infiltration to the ground. The effective functioning of soakaways depends on soakaway shape, size and soil properties. Soakaways are designed to HA118/06, HA103/06 and the methodology described in BRE Digest 365 and CIRIA Report 156.

3.8.2 New Soakaways have been sized based on assumptions. The following are the assumptions considered in the design:

- Outflow from the soakaways has been based on assumed infiltration rates stated in the TAR (November 2016) compiled by WSP. Actual infiltration rates will be confirmed after tests have been carried out as part of the GI; and

- The inflow is calculated based on the rainfall duration rather than the run-off duration. The latter may be considerably longer, depending on the length of drains.

3.9 Interaction with Existing Drainage

3.9.1 This aspect relates to the re-use, replacement and/or connection into existing drainage. Since this project relates to the upgrade of an existing junction it is very important to understand the interaction with the existing drainage. The lack of drainage surveys during Stage 3 is explained in the above Section 2. It was therefore not possible to investigate.

3.10 Surface Water Treatment

3.10.1 Highways Agency Water Risk Assessment Tool (HAWRAT) (DMRB Section 3 Part 10, HD45/09 'Road Drainage and the Water Environment' Section 5), shall be used to assess the impacts of road drainage on receiving surface watercourses where it has potential to affect the water quality. An assessment of the potential impacts of routine runoff on surface waters is required to determine whether there is an environmental risk and if pollution mitigation measures are needed. This assessment will be undertaken by the Environment Team. The results from the assessment may have an impact on the preliminary drainage design and this is risk is covered in the risk register.

3.10.2 Early feedback from the Environment Team suggests that there may be some benefit in the infiltration ponds functioning as bio-retention systems, with dense vegetation and specific types of filtration media. This should be considered at the next stage of design once further details such as infiltration rates have been confirmed.

Appendices

Appendix A.

Table A.1: Catchment area for ponds

Catchment Ref	Outfall to Pond	Catchment area (Ha)		
		Impermeable Area (Ha)	Verge Area (Ha)	Natural catchment
1	Infiltration Pond 1	3.227	1.168	-
2	Infiltration Pond 2	0.732	0.246	0.438
3	Infiltration Pond 3	0.993	0.390	0.438
4	Infiltration Pond 4	0.587	0.476	1.150
5	Infiltration Pond 5	2.418	0.790	-
6	Infiltration Pond 6	0.690	0.350	3.230

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